ELECTRONICS WORLD

SEPTEMBER, 1960

50 CENTS

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FM AUTO RADIO PROBLEMS

WHAT MICROPHONE WOULD YOU USE?

(See Page 35)

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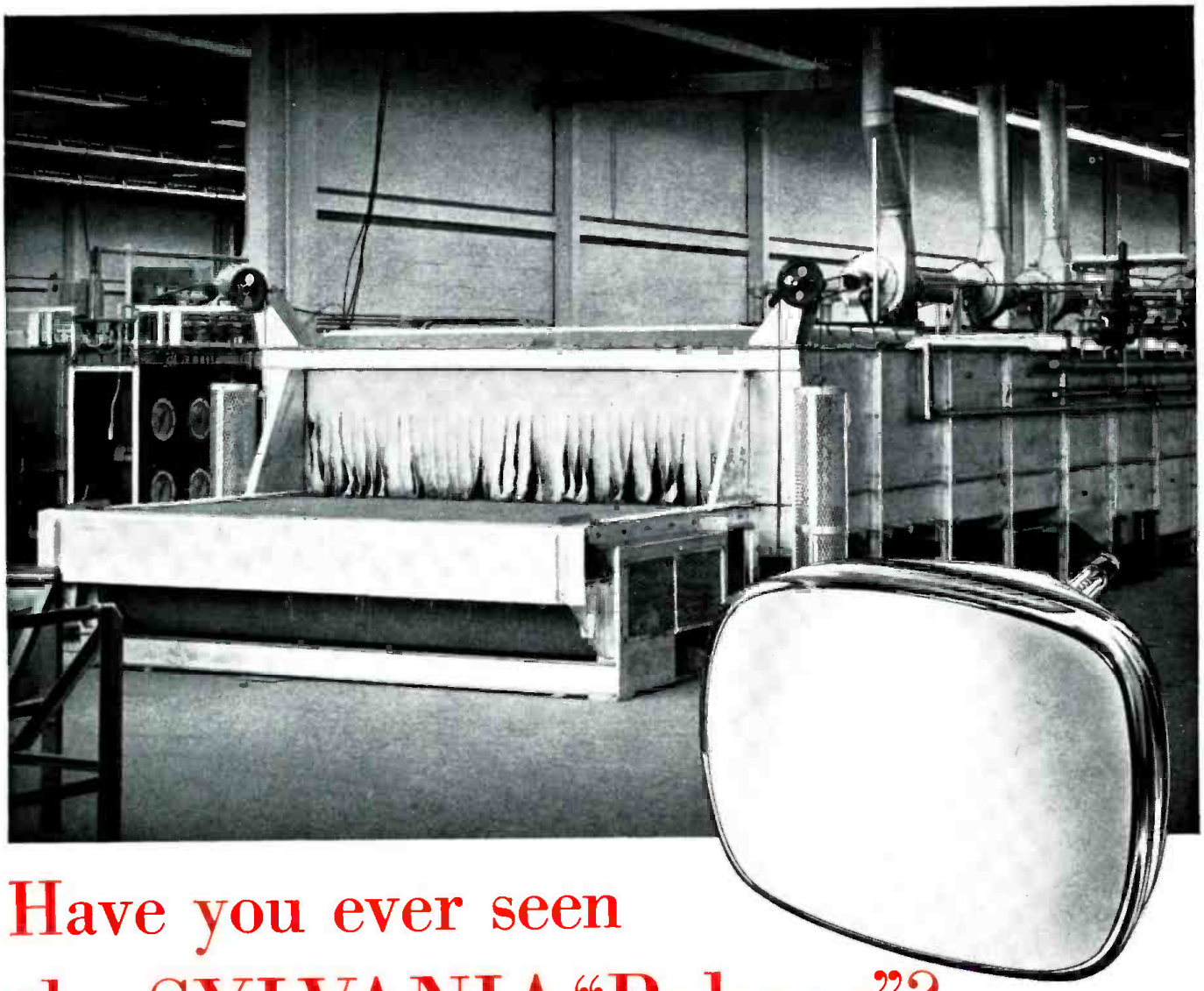

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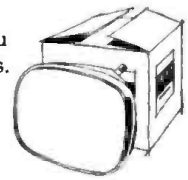

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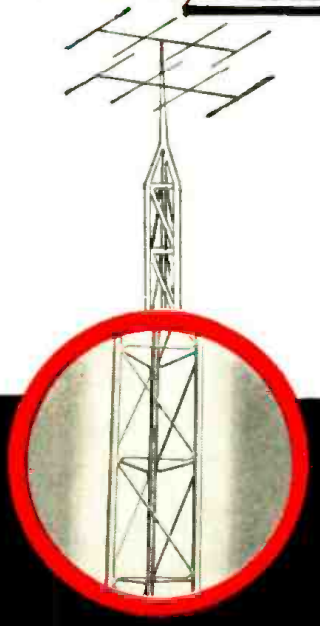

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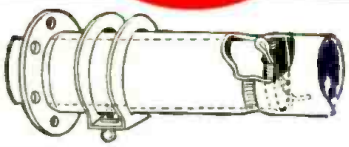

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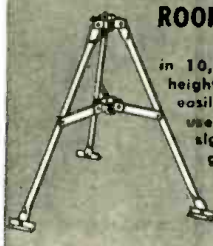

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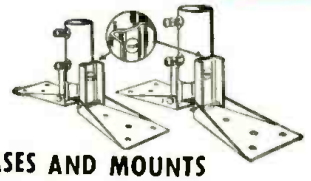

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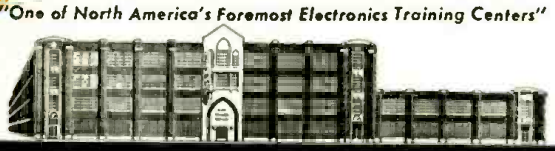

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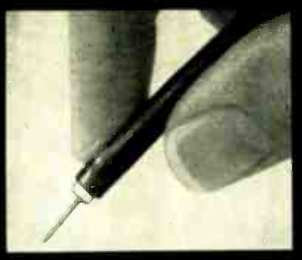

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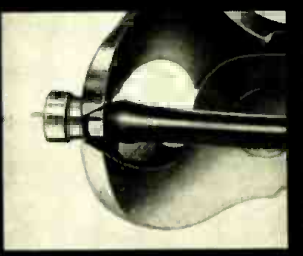

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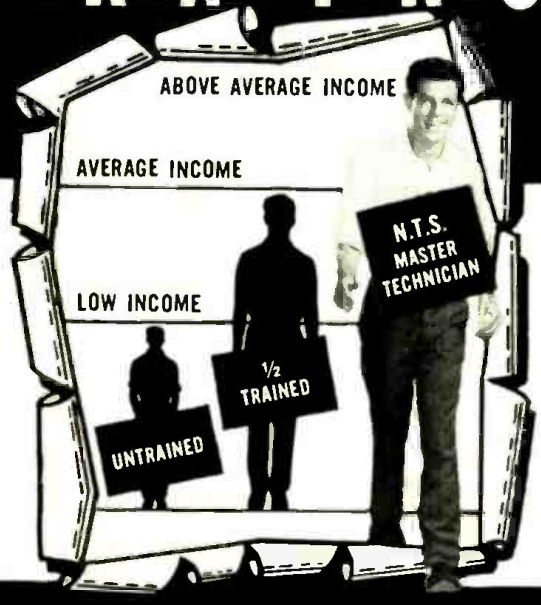

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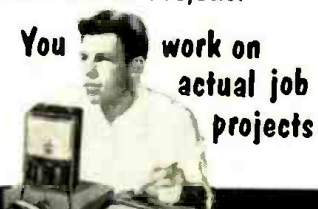

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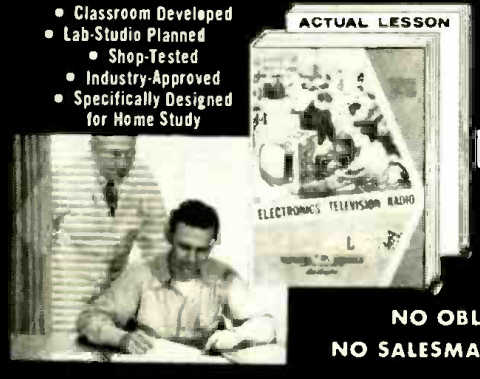

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...for the Record

By W. A. STOCKLIN
Editor

A Friend & Associate

IT is with deepest emotion that we announce that Dr. Oliver Read, Publisher of ELECTRONICS WORLD, has retired from the *Ziff-Davis Publishing Company*. He was the guiding light for this publication for the last 22 years and, more recently, he was both Editor and Publisher of our sister publication, POPULAR ELECTRONICS, as well as being Publisher of HIFI/STEREO REVIEW.

Although we are all sorry to see Ollie leave us, his retirement will give him more time to devote to writing and to electronics product engineering and development, especially in the marine electronics field. It will also give him some time to enjoy his many hobbies. He will not be lost to us completely though, since he will continue to serve as advisor to the *Ziff-Davis Electronics Division*.

Dr. Oliver Read

Many old-timers, who are still readers of ELECTRONICS WORLD, will remember him prior to his days with *Ziff-Davis* when he was working at *Utah Radio* developing a completely new line of amateur-radio kits, and writing many articles for this publication. He started as Technical Editor of RADIO NEWS (one of our former names) in November, 1938, and then progressed rapidly to be named Managing Editor in October, 1941, Editor in October, 1945, and then Publisher in July, 1956.

When he first started with this publication, with its staff of only two other people, it was far from being a profitable enterprise. But by 1944, conditions had changed and we found ourselves the leading publication in our field. Many of our readers, both in and out of the Armed Forces, during the Second World War will remember our famous U. S. Army Signal Corps issue in 1944 as a milestone in the field of publishing.

We know that we will never forget his reports of the Bikini A-Bomb test in 1946. This was the fourth atomic explosion, and Ollie was one of those privileged to attend and witness this history-making event.

Amateur radio is another field in which he obtained recognition. Many present-day hams will remember Ollie's call, W9ETI, from Chicago and, more recently, W1ETI, from Connecticut. In addition, he was trustee for WA2GNH, POPULAR ELECTRONICS' Amateur Radio Station, which is located right in our New York office.

There are those who will remember him for his books. He was author of "The Recording and Reproduction of Sound" and, more recently, co-author of "From Tin Foil to Stereo—Evolution of the Phonograph." Both of these books represented fields in which he was greatly interested in the last few years. Many have seen and enjoyed his collection of old-time phonographs, which he restored as a labor of love.

Those of us who are close to him will always remember his kindness, gentleness, and consideration. There is no doubt that we will all miss him since we will not see him each day as we have for many years, but we do know that his future activities will be less hectic than publishing inevitably must be. We are sure that we can speak for his many friends in wishing him good luck in everything that he will be doing. —30—

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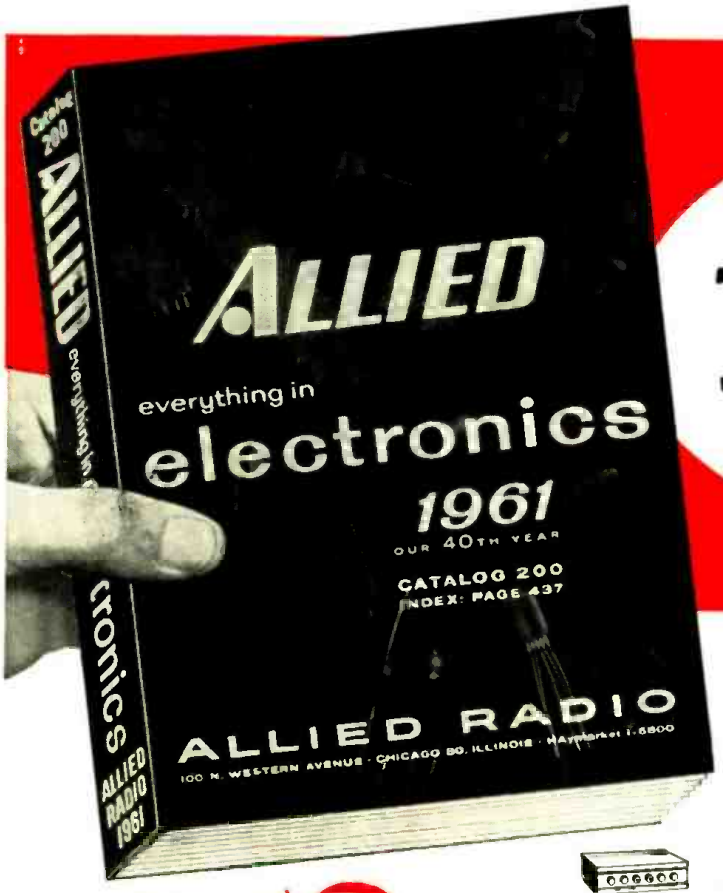

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Cleaning After Rubbing For 90 Sec.	GOOD	Good	Good	Good	Good	Fair	Poor	Good	Fair	Poor
Protection After 30 Sec. Exposure to H_2S Gas	GOOD	Fair	Fair	Good	Good	Fair	Very Poor	Good	Very Poor	Good
Protection After 2 Hours Exposure to H_2S Gas	BEST	—*	—*	2nd Best	5th Best	—*	—*	3rd Best	—*	4th Best
Flash Characteristics	None at 200°F.	—*	—*	Greatest tendency	Boils at 70°F. Tendency to ignite	—*	—*	Tendency to ignite	—*	Slight tendency to ignite
Attack On Plastic Material	NO	—*	—*	Yes**	Yes**	—*	—*	Yes**	—*	Yes**

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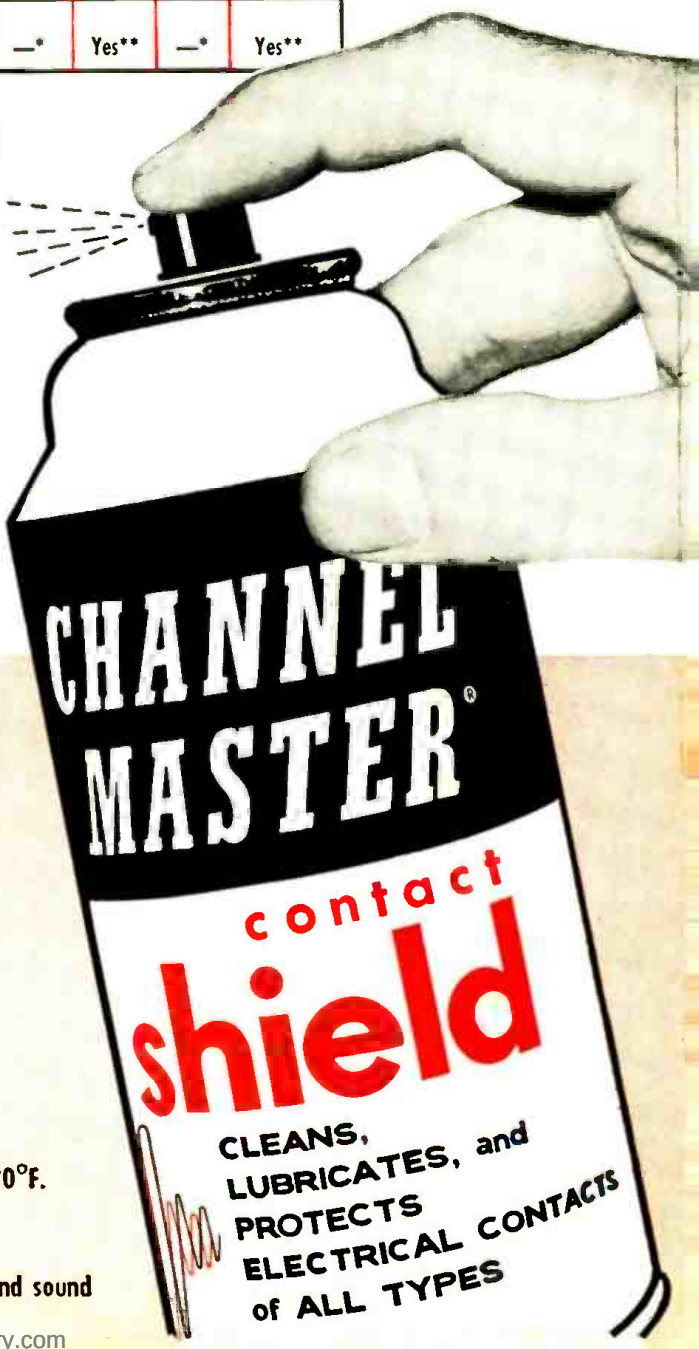

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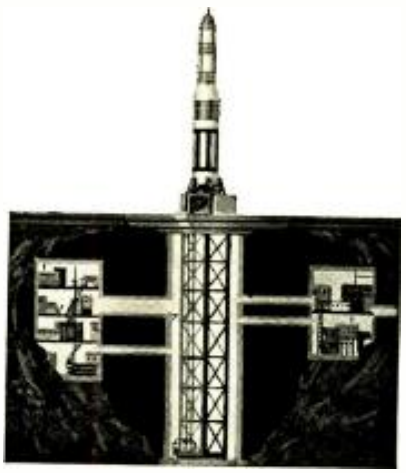

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AUSTRALIAN TELEVISION

To the Editors:

Since you left us out of your "Spot News" (May, 1960 issue) under "Big Gains in Overseas TV," you might be good enough to publish this letter.

Australia is, in area, almost the same size as the United States, but in population we are only about 10,000,000 strong. Our first TV station, TCN Channel 9, opened in Sydney late in 1956, and we now have 16 stations operating with many more to open soon. But the important matter relative to your article is that we have almost one million licensed TV receivers now operating, practically all of them manufactured in this country in the short space of about 3½ years.

We have commercial stations as in the U. S., and we view your popular programs through them. In addition, government-owned stations operate too, and every viewer must buy an annual license costing $12.00 for which he may own any number of TV sets. Two-set homes are already common and, in addition, quite a number of motor cruisers, caravans, and the like are fitted with TV receivers in addition to multiple installations in motels, hotels, etc. Human nature being what it is the world over, there are probably a number of "freeriders" (or is it "freeloaders" you call them). Consequently, the over-all total of TV sets is well in excess of the known license figures.

Now, Sir, since you give honorable mention to a country with a mere 100,000 sets, I think a bleat from down under is justified in view of the rapid development of TV in Australia, which *pro rata, per capita*, or what have you, might be a world record.

W. M. FERRIS, Director
Channel Master Pty, Ltd.
Brookvale, N.S.W.
Australia

We know our readers are always interested to learn about the status of TV overseas. Incidentally, no offense was meant in leaving out Australia from the countries listed.—Editors.

* * *

MUSIC-POWER RATING

To the Editors:

I have recently read your editorial in the June issue on music-power ratings. There were a number of points raised which I think misled rather than clarified readers on the various amplifier power ratings. First, I would like to point out that the music-power ratings were included in the IHFM standards before they were adopted by the EIA.

Concerning the value of music-power *versus* steady-state sine-wave ratings, I would like to point out that even though two amplifiers do not have the same steady-state power ratings, the results when *playing music* will be the same for both amplifiers, if all other factors are equal and each amplifier has the same *music*-power rating. This is because the waveform of music has a high peak-to-average value, and the biases and voltages do not shift nearly as much as with a high amplitude steady-state sine-wave signal.

Why has this music-power rating become popular? Certainly, it often gives a higher rating than the steady-state rating, but that is not the fundamental reason. The fundamental reason is that it gives a more realistic rating so that the customer can tell from the rating how his amplifier is going to reproduce *music*. I am sure you will realize there are many important characteristics in an amplifier aside from power output and frequency response. To name a few, there are ability to recover quickly from overload, clean clipping, freedom from parasitic oscillation and instability during overload, stability regardless of load conditions, heating, etc.

The same factors which determine the power output, namely the various voltages and impedances with which the output tubes are associated, and also the feedback circuits and networks, influence all of these other characteristics. In many amplifiers in the past everything has been sacrificed for maximum steady-state sine-wave output power, a condition never encountered in reproducing music. Many such amplifiers have been unstable, have distorted horribly when overloaded even slightly, etc.

We have been building high-fidelity amplifiers for many years—in fact, to the best of my knowledge, our 210-A, first announced in 1946, was the first one. We are fully convinced that music power is the proper way to rate an amplifier for reproducing music. In order to give the customer the best reproduction for his music, the amplifier should be designed for maximum music-power output. Steady-state sine-wave output is of secondary importance in the reproduction of music. The leading advantage of steady-state sine-wave measurements is that they are about the easiest of all measurements to make.

H. H. SCOTT
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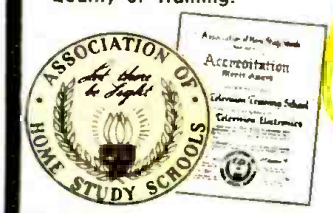

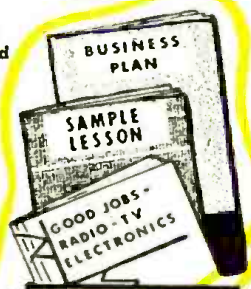

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in the music-power concept. We are glad to give him the opportunity to express some of his views on this important subject about which there is still much difference of opinion.

For an article that discusses many of these points, we suggest that our readers watch for "Music-Power Rating—Help or Hindrance?" scheduled for next month's issue.—Editors.

* * *

FLASHLIGHT-CELL VOLTAGES

To the Editors:

I wonder if it is possible to use ordinary D-size flashlight cells for meter-calibration purposes? Just what voltages do these cells produce under conditions of very light loading, such as would occur when measurements are made with a v.t.v.m. or sensitive v.o.m.?

MARC SAUL
Floral Park, New York

About the freshest D-size flashlight cells that are available, whose age is not over six months, should have open-circuit voltages averaging 1.57 volts. After about a year's storage, this voltage falls to about 1.56 volts. At ages of around 1½ to 3 years, the open-circuit voltage should be 1.55 volts. These voltages are for well-sealed, leakproof-type cells that have been stored and measured at 70°F.

You might also try using a mercury cell for calibration purposes. For example, a new Mallory *RM-1 cell has an initial voltage of close to 1.358 volts. This value drops to 1.352 volts after a year's storage at 70°F.*

Still another suggestion is to measure the open-circuit voltage of a fully charged lead-acid storage battery. This should measure 2.12 volts exactly. If the battery is partly discharged so that its specific gravity is around 1240, then an open-circuit voltage of 2.08 volts should be measured.—Editors.

* * *

MEASURING TAPE SPEED

To the Editors:

Mr. Burstein's article "Measuring Tape Speed," page 39 in the June, 1960 issue, did a very thorough job of discussing this parameter and promoting devices for its measurement.

Of what practical value is such an article. There is absolutely nothing that the average tape recorder enthusiast can do to correct long term, cumulative time errors. Even the factory can seldom help him.

Flutter and wow are of far greater importance to the user, and the devices described will do nothing at all to pinpoint these problems.

You have a splendid publication and Mr. Burstein is a very able man. However, please don't waste your space on such non-constructive material.

J. H. MCCONNELL
Murray Hill, New Jersey

We cannot quite agree with Reader McConnell here. We believe the very first step in correcting an error or trying to get someone to do something about that correction is to know that

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William H. Patchin, 3865 Westview Ave., NW, Canton, Ohio	1st	12
V. Dean DeVore, 309 Bess Street, Washington, Ill.	1st	16
Edward T. Wall, Box 184, Kenly, N.C.	1st	12
James W. Wranich, 4236 Michigan Street, Kansas City, Mo.	1st	20
Robert E. Sullivan, 2475 E. Douglas, Des Moines, Iowa	1st	12
Nelson S. Kibler, 1413 Patrick Henry Dr., Falls Church, Va.	1st	18
Barry L. Ulrich, 1110 Chestnut Ave., Barnesboro, Pa.	1st	14
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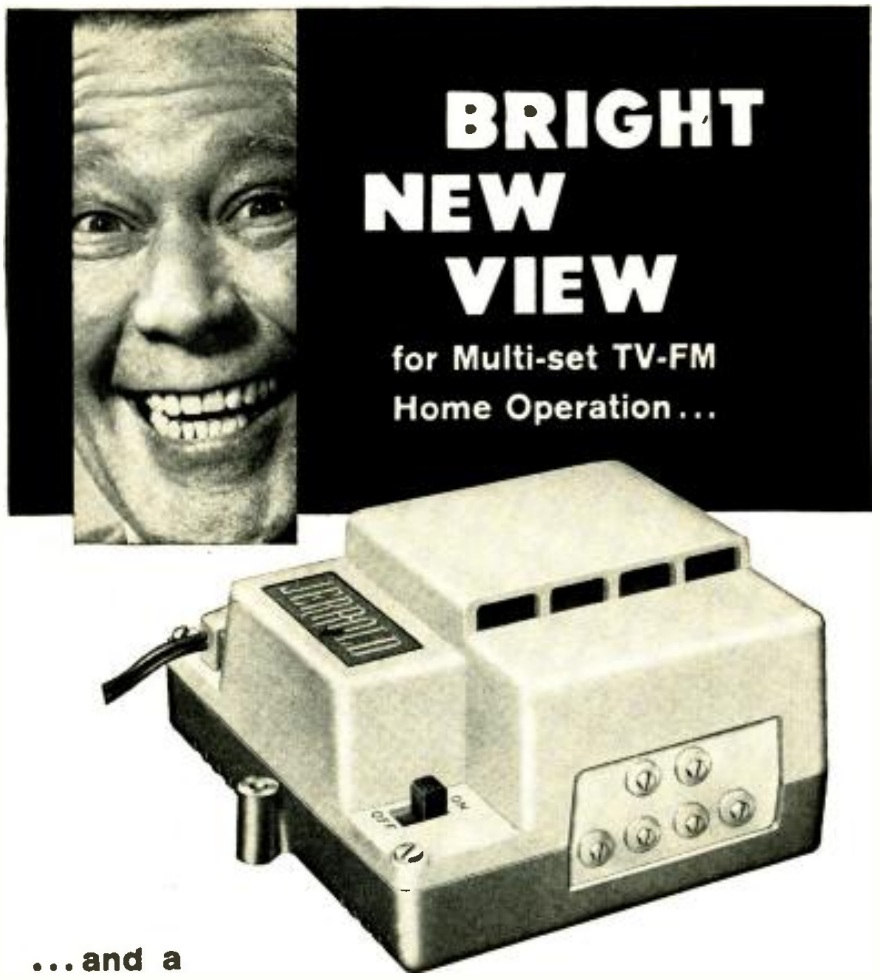

it exists. Our article attempted to show simple means of determining whether or not speed errors do occur in tape measurements and what their extent is.

We would like to point out that although most of our material is "practical" an occasional "think piece" or theory article is useful.—Editors.

* * *

FM BOOSTER

To the Editors:

I live in the fringe area of an FM station which I would like to receive, so the article on a simple FM booster in your April, 1960 issue caught my attention.

Since I am interested in boosting the signal of one particular station, is it reasonable to attempt a modification of the design to obtain higher gain with narrower bandwidth? If, for example, the gain could be increased from 20 db to 26 or 27 db, this would give me a voltage gain of 20 instead of 10, which might make full limiting possible.

I am a little uncertain about the actual dimensions of the ½-inch coil form to be used in winding the input and output coils. At first I assumed that this meant ½ inch in diameter, but if the inductance is to be .3 microhenry for 4½ turns in one inch, the ½ inch must refer to the *radius* of the coil form. I may have miscalculated, and would very much appreciate getting this definitely settled, since I would like to try building the booster.

FRANK EVANS
Los Alamos, New Mexico

It is possible to increase gain by narrowing bandwidth. However, there always exists the problem of oscillation, if this is carried to an extreme. Since the amplifier is not neutralized in our circuit, we would not recommend attempting to increase the gain much further because of the fairly good chance of causing the booster to oscillate.

According to Author Gicca, Reader Evans is correct about the dimensions of coils L_1 and L_2. The inductance indicated in the parts list will be obtained with ½-inch radius coil forms. Using ½-inch diameter forms, the inductance actually amounts to .1 microhenry. Fortunately, the tuning capacitors C_1 and C_3 are sufficient to resonate either inductance into the FM booster so that either coil size may be used. The author actually employed the ½-inch diameter forms.

In addition, some of our readers have been having problems with the two radio-frequency chokes shown in our parts list. The National Company *part number shown for RFC_1 is actually a 1-millihenry choke while the* National Company *part number shown for RFC_2 is a 1.3-microhenry choke. Neither of these two chokes is particularly critical, and the circuit should operate properly with chokes having either the values shown in the parts list or those designated by the part numbers.—Editors.* —30—

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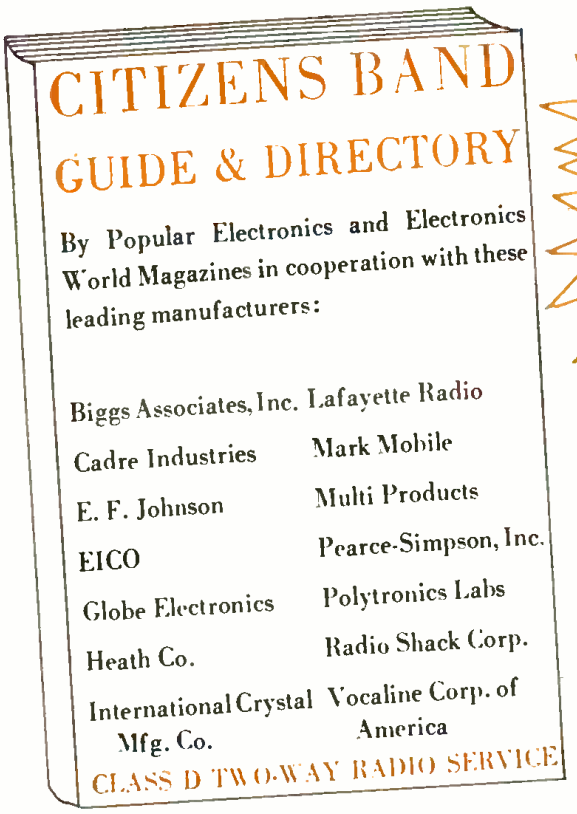

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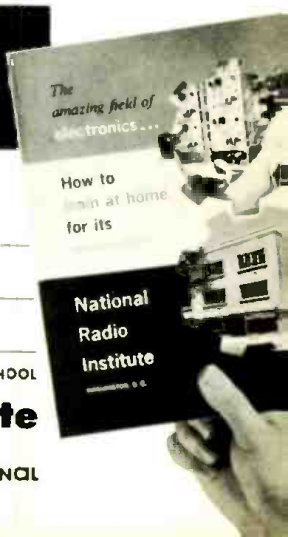

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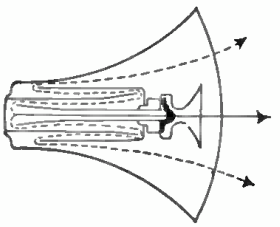
The Sounding Board

FINE DYNAMIC MICROPHONES YOU CAN DEPEND ON — Always

"How stable?" is the question asked most often about a microphone. Once the type of installation is determined, it is essential that frequency response and directional sensitivity characteristics remain unaffected. This is *stability* — and should remain constant. It is a clue to the wide acceptance and universal use of the Electro-Voice family of dynamic microphones — a family comprising 35 different models, each designed for a specific application. Highly developed precision tooling, extensive research, and functional design have created instruments of outstanding ruggedness and durability. All internal parts nest or interlock to prevent any movement of the reproducing mechanism even when the case is subjected to severe shock. In addition, the exclusive Acoustalloy diaphragm assures smooth response and reliability far surpassing ordinary demands. This vital moving element has no equal in withstanding high humidity, temperature extremes, corrosion and mechanical impact. Laboratory tests reveal only two ways to damage Acoustalloy: heat the microphone so hot it can't be handled, or actually puncture or tear the diaphragm. Each microphone type is field-tested prior to acceptance for manufacture and, when in production, every model is evaluated for exact frequency response, level and possible distortion, or mechanical imperfections prior to shipment. Such care in manufacturing and testing assures maximum reliability, all-important stability, and remarkable uniformity within dynamic types.



MORE SOUND FROM FEWER SPEAKERS WITH ELECTRO-VOICE C D P

The Compound Diffraction Horn was created initially by Electro-Voice to handle the extremely difficult sound dispersion problems encountered by the U. S. Navy on flight decks of aircraft carriers. Maximum dispersion was achieved by designing a compact horn which would provide optimum diffraction of sound waves — and replace the inefficient, bulky horns formerly used for this application.

Lower frequencies disperse easily. High frequencies, because their wave lengths are usually smaller than the radiator dimensions, are directional. In the Compound Diffraction Projector, Electro-Voice has narrowed the horizontal dimension to less than the wave length of the most important frequencies to be reproduced and extended the vertical dimension to preserve the area necessary for loading efficiency. This results in wide lateral dispersion and reduction of unneeded vertical dispersion.

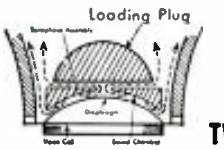
Electro-Voice Compound Diffraction Projectors assure wide frequency range without "dead spots". This is achieved by acoustically loading both sides of the diaphragm with respective horns for the high and low frequencies. Diffraction Horns insure intelligibility and excellent quality at all points within the area they cover. Thus, the inherent limitations of conventional reentrant or multi-cellular horns are overcome.

There are E-V Compound Diffraction Projectors designed specifically for hard-to-handle public address situations whatever they might be. Greater audio range makes them the ideal PA speakers for music as well as speech (as much as 2½ octaves wider response). Because each speaker is capable of delivering uniform spread at all frequencies, intensity and intelligibility are assured without the expense of adding speakers.

NEW HAM RECEIVER PASSES THE TOUGHEST TEST OF ALL

An interesting story lies behind the recent performance testing of the first RME 6900 Communications Receiver. After final inspection of the first unit, one of the RME executives (W9IOP), decided to use this new receiver in the 1960 Radio Amateur Sweepstakes. This contest, sponsored each year by the Amateur Radio Relay League, determines which amateur operator can establish the most radio contacts in a given 40 hour period.

The receiver was delivered to W9IOP only three hours before the contest began. In spite of his lack of familiarity with the receiver, W9IOP not only won the contest, but logged a record-breaking 1,369 contacts to establish a new national Sweepstakes record.



HORN-LOADED TWEETERS PROVIDE CLARITY WITHOUT DISTORTION

Electro-Voice Tweeters are noted for clarity and low distortion. But obtaining that clarity was a critical problem until E-V's development of the Avedon Sonophase Throat Design.

VHF tweeters handle the widest range of response — from 3500 to 20,000 cps. E-V tweeters function as a true piston in the lower range, but at the critical point (about 12 kc) sound must be taken from the center of the diaphragm and from the periphery at the same time. Without some way to prevent it, sound cancellation occurs because of diaphragm deformation at and above this critical frequency. This deformation causes phase shift to occur between the center and periphery of the diaphragm. Increasingly higher frequencies cause the phase shift to be more pronounced because of an ever increasing deformation of the diaphragm. The Avedon Sonophase Throat Design accomplishes the vital restoration of phase relationship and level by incorporating a compression driver with unique loading plugs which properly phase upper frequencies while leaving lower frequencies unaffected. The loading plugs force the sound to travel a circuitous path, producing in-phase sound regardless of the frequency of the signal.

Coupled to the Avedon Sonophase Throat Design is the Hoodwin Diffraction Horn, designed to insure sound dispersion throughout the listening area. This is especially important in stereo application to prevent the "beamed" or directional nature of most high frequencies.

Want more information on any of the items mentioned in the Sounding Board? Simply check the appropriate boxes below and mail the coupon to Dept. 90N, Electro-Voice, Inc., Buchanan, Michigan.

- ☐ Microphones
- ☐ RME 6900
- ☐ Horn-loaded Tweeters
- ☐ C D P

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SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER

★ Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Subminiatures, Novals, Subminars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

★ Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES: Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a handsome, portable Saddle-Stitched Texon Case. Only..... **$47.50**

Model TW-11—TUBE TESTER . . . Total Price $47.50—Terms: $11.50 after 10 day trial, then $6.00 per month for 6 months if satisfactory. Otherwise return, no explanation necessary!

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

THE *ONLY* 20,000 OHMS PER VOLT V.O.M. SELLING FOR LESS THAN $50 WHICH PROVIDES *ALL* THE FOLLOWING FEATURES:

✓ **6 INCH FULL-VIEW METER** provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.

✓ **MIRRORED SCALE** permits fine accurate measurements where fractional readings are important.

✓ **CAPACITY RANGES** permit you to accurately measure *all* condensers from .00025 MFD to 30 MFD in addition to the standard volt, current, resistance and decibel ranges.

✓ **HANDSOME SADDLE-STITCHED CARRYING CASE** included with Model 80 Allmeter at no extra charge enables you to use this fine instrument on outside calls as well as on the bench in your shop.

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

• A built-in Isolation Transformer automatically isolates the Model 80 from the power line when capacity service is in use.
• Selected, 1% zero temperature coefficient metalized resistors are used as multipliers to assure unchanging accurate readings on all ranges.

SPECIFICATIONS:

7 **D.C. VOLTAGE RANGES:** (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.
6 **A.C. VOLTAGE RANGES:** (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500 Volts.
3 **RESISTANCE RANGES:** 0 to 2,000/200,000 Ohms. 0-20 Megohms.
2 **CAPACITY RANGES:** .00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.
5 **D.C. CURRENT RANGES:** 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 18 Amperes.
3 **DECIBEL RANGES:** — 6 db to + 18 db, + 14 db to + 38 db, + 34 db to + 58 db

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. Only ..... **$42.50 NET**

Model 80 — ALLMETER . . . Total Price $42.50—Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary!

GENOMETER

7 Signal Generators in One!

✓ *R.F. Signal Generator for A.M.*
✓ *R.F. Signal Generator for F.M.*
✓ *Audio Frequency Generator*
✓ *Bar Generator*
✓ *Cross Hatch Generator*
✓ *Color Dot Pattern Generator*
✓ *Marker Generator*

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peak wave audio signal.

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency)

CROSS HATCH GENERATOR: The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV): Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

THE MODEL TV-50A comes absolutely complete with shielded leads and operating instructions.

$47.50 NET

Model TV-50A—Genometer
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

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The Model 88.... A New Combination
TRANSISTOR RADIO TESTER and DYNAMIC TRANSISTOR TESTER

The Model 88 is perhaps as important a development as was the invention of the transistor itself, for during the past 5 years, millions of transistor radios and other transistor operated devices have been imported and produced in this country with no adequate provision for servicing this ever increasing output.

The Model 88 was designed specifically to test all transistors, transistor radios, transistor recorders, and other transistor devices under dynamic conditions.

AS A TRANSISTOR RADIO TESTER

We feel sure all servicemen will agree that the instruments and methods previously employed for servicing conventional tube radios and TV have proven to be impractical and time consuming when used for transistor radio servicing. The Model 88 provides a *new simplified rapid* procedure — a technique developed *specifically* for radio's and other transistor devices.

An R.F. Signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble whether it be a transistor, some other component or even a break in the printed circuit is located and pinpointed. The injected signal is heard on the front panel speaker as it is followed through the various stages. Provision has also been made on the front panel for plugging in a V.O.M. for quantitative measurement of signal strength.

The Signal Tracing section may also be used less the signal injector for listening to the "quality" of the broadcast signal in the various stages.

AS A TRANSISTOR TESTER

The Model 88 will test all transistors incuding NPN and PNP, silicon, germanium and the new gallium arsinide types, without referring to characteristic data sheets. The time-saving advantage of this technique is self-evident. A further benefit of this service is that it will enable you to test new transistors *as they are released!*

SPECIFICATIONS:

✔ Model 88 operates on a self-contained 4½ volt battery and is always ready for instant use on the bench or in the field.

✔ ***Signal Injector:***

The signal injector used in the Model 88 is a new departure in signal source design. Previously, signal sources were provided by signal generators operating on a single frequency and requiring retuning. The Signal Injector of the Model 88 employs a transistor in a grounded emitter self-modulating blocking oscillator generating a low R.F. frequency providing stable harmonics to 30 megacycles. A power output of over 2.5 volts peak to peak is provided. An attenuator prevents overload of the receiver or the amplifier under test

✔ ***Signal Tracer:***

Two high-gain grounded emitter transistors are utilized in a high gain amplifier with sufficient output to operate the built-in 4½" Alnico V Speaker. A diode is used as a "clamp" to prevent overloading of the output stage. A volume control permits attenuation of strong signals. Provision is also made on the front panel for the addition of a meter or an oscilloscope for quantitative evaluation of the signal strength.

✔ ***Transistor Tester:***

The transistor tester used in the Model 88 measures the two most important transistor characteristics needed for transistor servicing; leakage and gain (beta).

The leakage test measures the collector-emitter current with the base connection open circuited. A range from 50 ohms to 100,000 ohms covers all the leakage values usually found in both high and low power transistor types.

The gain test (beta) translates the change in collector current divided by the base current. Inasmuch as the base current is held to a fixed value of 50 microamperes, the collector current calibrated in relative gain (beta), is read directly on the meter scale.

The Model 88 will test *all* transistor types, including NPN or PNP, germanium, silicon, gallium arsenide and the newer diffused junction and mesa types.

Model 88 comes housed in a handsome portable case. Complete with a set of Clip-On Cables for Transistor Testing, an R.F. Diode Probe for R.F. and I.F. Tracing; an Audio Probe for Amplifier Tracing and a Signal Injector Cable. Complete—nothing else to buy! Only

$38.50

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☐ Model TV-50A....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model TW-11.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model 80.....Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months

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AIWA INTRODUCES A NEW SMALL-SIZE BI-DIRECTIONAL RIBBON MICROPHONE MODEL VM-16

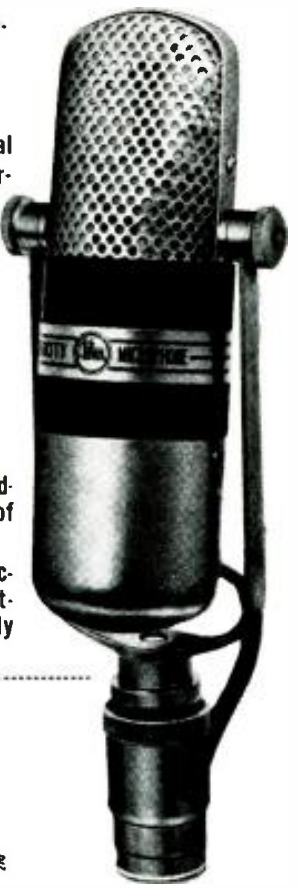
UNI-DIRECTIONAL RIBBON MICROPHONE MODEL VM-18

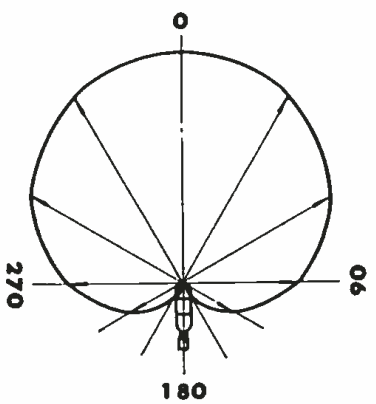
Features:

* Small size and slim shape facilitate handling.
* Comparatively high sensitivity and fine response characteristics.
* Sturdy construction with short ribbon diaphragm.
* Humming minimized
* Equipped with a low frequency attenuation circuit.

Features:

* Superlative high quality response characteristics.
* Engineered in collaboration with the Technical Research Laboratory of the Japan Broadcasting Corporation (NHK).
* Outstanding results when used for FM broadcasting and high fidelity recording because of its exacting quality of tone reproduction.
* Because of the above superior characteristics, small size and non-reflecting satin-chrome finish is ideally suited for TV broadcasting.

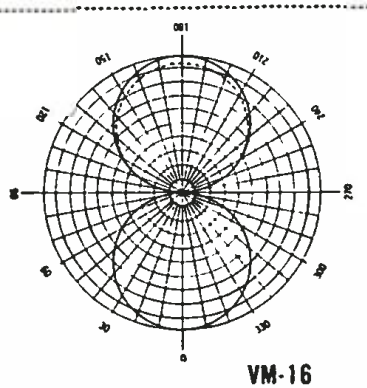




VM-18

Specifications:

* Type: Ribbon Microphone
* Impedance: 600 ohm ± 20% (At 1000 c/s at 0 point of the switch)
* Sensitivity: 75 db (0db = 1V/m bar 1000 c/s)
* Directionality: Uni-directional
* Noise Level: Below 30 db
* Dimensions: 9 5/8" (length) 1 1/2" (dia.) Weight 2.2 lbs. (9 feet-cord & plug included)



VM-16

Directional Characteristic
— 500 c/s, 1000 c/s, ··· 8000 c/s

Specifications:

* Frequency Response: 50-15,000 c/s ± 3 db
* Output Level: 80 db (150 ohms/1,000 c/s)
* Impedance: 150 ohms, 250 ohms or 600 ohms
* Directional Characteristics: Bi-directional
* S/N 20 db or below (in parallel field at 1 m gauss)

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Spot News

Latest Information on the Electronic Industry

By ELECTRONICS WORLD'S WASHINGTON EDITOR

LUNAR MAPPING STUDY TO FEATURE USE OF RADAR AND TV--A lunar analysis and mapping program--coded "Project Lamp"--has been scheduled by the Corps of Engineers of the Department of the Army. It will revolve about the use of radar and TV techniques for making a rapid and accurate dimensional survey of the entire lunar surface, including the back of the moon. Commenting on this remote-type visual-direction application in a Congressional report, prepared for the Committee on Science and Astronautics, Army engineers said that the radar system, which is quite light (on the order of 1000 pounds payload) will employ a radar altimeter, multiple-frequency surface interrogator, and passive distance-measuring devices. As the space vehicle with this system flies around the moon, radar will record the profile of the surface directly beneath the flight path. After a number of such flights, a record of the moon's surface would be built up and stored in a computer. By plotting many profiles, a map could be produced if it were found desirable. Television will be used to obtain stereoscopic coverage of the moon's surface, as well as for obtaining star and earth positional data to preserve the geometric relationship necessary for stereo-photo mapping. Basically, the TV system will take pictures of the moon and transmit them to earth. To orient these pictures, another TV camera in the satellite will take and transmit a picture of the stars at the same time to determine proper orientation.

TROUBLE-FREE SCATTER COMMUNICATION NETWORK OPENED IN PACIFIC--A 6500-mile communications system, said to be virtually trouble-free, is now in operation in the Pacific area. Called the "Pacific Scatter Communication System", the network employs a technique in which signals are sent upward to a layer of the atmosphere--the ionosphere-- and then bounced back in scatter fashion to earth. Oddly enough, the signals themselves are not broken up; they are merely scattered. One receiver picks up the clearest signal and should this one fade, another operational receiver picks up another signal without a lapse. This assures a constant stream of trouble-free signals. One of the largest of its kind in the world, featuring eight inter-connected stations, the network extends from Oahu, Hawaii to Luzon in the Philippines. Between all adjacent sections there are high-capacity communication channels which can handle separate teletypewriter messages up to 100 words a minute.

DREAM-ANALYZING ELECTRONIC UNIT UNDER STUDY--A subvocal interpreter--described as a "dream analyzer"--which can codify speech that cannot be heard from a sleeping person is now under study by Bell Telephone Labs at the request of University of Chicago doctors. The unique device will measure lip movements and vocal cord vibrations, then translate them into symbols for interpretation.

ELECTRONIC COMPUTER FOUND TO AID METALLURGICAL RESEARCH--Automatic electronic digital computers can be used economically for both routine and complex calculations required in metallurgical research, according to the Bureau of Mines. Three years' experience with computers has disclosed that they can perform key calculations basic to the production of iron, steel, and other metals. Government experts in charge of these studies said that the speed and accuracy advantages offered by these computers make them extremely practical tools for research labs.

SUPER-HIGH BANDS SOUGHT FOR VITAL REMOTE CONTROL--The FCC has been asked to allocate 100 mc., in one block or in segments, within the 13,000 to 35,000 mc. band, for the control by radio of highly specialized equipment designed to perform complex tasks under conditions that would be dangerous to humans.

OVERSEAS TV STATIONS UP ABOUT 14 PER-CENT SINCE FIRST OF YEAR--Overseas television stations of all types have increased by nearly 14 per-cent since the beginning of the year; from 1088 to 1237. Altogether 109 new stations went into operation in the Free World, 98 of which were in Western Europe, 40 new ones went on the air in the Sino-Soviet bloc. Television sets in use abroad now number 34,500,000, with the Free World accounting for 28,950,000, an increase of about 2,150,000. The Soviet countries have about 5,600,000, up nearly 300,000. -30-

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Here are some of the world's greatest electronics books... chosen carefully by Ziff-Davis Electronics Book Service as among the best in their fields. You'll find top-notch texts and manuals on theory and instruction...important volumes covering radio and TV servicing, transistors and tubes...reference books to help you understand such fields as computers, citizens band, communications, and electronics experimentation.

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For those with little or no technical knowledge who wish to know the fundamentals of radio theory and servicing. $7.95

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Two antenna experts tell you their secrets of antenna choice and installation for best reception in any area. Loaded with useful tips on improving reception in fringe and difficult areas. $5.25

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A practical guide to FM V.H.F. receivers, their design, construction, alignment and repair. $5.00

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Explains in easy-to-understand manner the use of simple and advanced test instruments, opening a radio servicing business, pitfalls, and successful procedures for a full-grown business. $5.95

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Over 60 instruments described, their uses fully explained, and valuable work-saving short-cuts outlined. $4.95

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Keep abreast of the latest designs and concepts in both transistors and tubes by using the charts diagrams, and photographs in these practical books!

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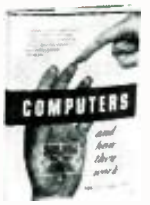

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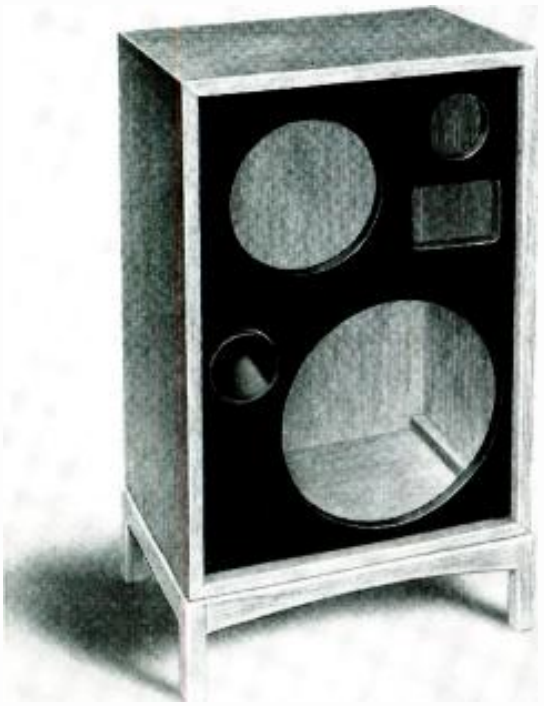
Another exciting development by University

New Medallion XII Enclosure Kit Features Five Decor-Matching 'Snap-On' Grille Styles



THE MEDALLION XII: *Here's everything you've ever wanted in an enclosure kit. A complete choice of styling. Compact dimensions for stereo . . . (the Medallion is only 24" x 17" x 12½" deep). And versatility of placement as a highboy or lowboy, on the floor, on its matching base . . . or even as a built-in. Net prices: Enclosure kit—$49.95. (Prices on grille and base kits to be announced.)*

WORLD'S WIDEST CHOICE OF SPEAKERS AVAILABLE FOR PLANNING YOUR SYSTEM

University's new award-winning Series 200 wide-range speakers offer today's most advanced design features that produce the finest high fidelity performance from a wide variety of compact enclosures. The Medallion is a perfect example. All Series 200 woofer cones have *two* highly compliant cloth suspensions—inner and outer—that achieve lowest bass reproduction with complete clarity and accuracy.

Their one-piece die-cast baskets provide life-long rigidity and reliability for the entire speaker structure. And for maximum ease of installation, each Series 200 speaker mounts from the front or the rear of the baffleboard.

NEW MODEL 312 12" 3-Way Diffaxial with Diffusicone midrange and Sphericon Super Tweeter. Response: 28-40,000 cps. $73.00 net.

NEW MODEL 6201 12" Coaxial. Improved version of the most popular speaker ever made. Response: 28-18,500 cps. $57.75 net.

Advantages of Radiation Resistance Loading Now Yours in Kit Form

Radiation Resistance Leading has become widely recognized as a significant advance in the art of compact speaker enclosure design over the older, fully-sealed high compliance systems. With RRL, you realize greater efficiency and cleaner response from any woofer.

This results from the precisely matched acoustic coupler which enables the woofer to develop ample output with only a small portion of its excursion potential. There is fully 75% less bass distortion at higher output levels . . . and perfect reproduction from amplifiers with as little as 10 clean watts.

University's Unique "Select-a-Style" Concept Opens Up Many New Possibilities for Kits

Now, for the first time ever in high fidelity cabinetry, you have a complete choice of styles in kit form . . . Contemporary, Colonial, Swedish Modern, French Provincial and Italian Provincial. This is the important difference of Medallion cabinetry . . . "Select-a-Style" snap-on grilles that let you match your decor *exactly*.

Each grille is authentic in period and crafted with meticulous care. Choose the style you prefer, assemble it, finish it and snap it on. It's that easy! What if you ever change your decor? Just change the grille. It's that economical! *Doubly* economical when you consider its modest price.

Putting it Together Was a Snap! Sounds Great, Too!

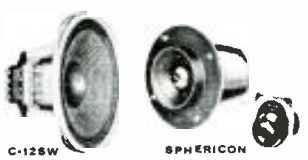
That's what *you'll* say after assembling *your* Medallion enclosure. Every piece is machined to the closest tolerances . . . pre-cut and pre-drilled for quick and precise assembly. Smooth-grained birch veneers assure you a professional furniture finish.

Tools you need for assembly? Just enthusiasm and a screwdriver . . . everything else is included . . . screws, glue, sandpaper, grille fabric and complete, easy-to-follow instructions. In just a few pleasure-packed hours, you'll be enjoying the superb performance that only the Medallion XII can give you.

Versatile Baffleboard Takes 12" Woofer, Wide Variety of Mid & High Range Speakers

For building multi-speaker systems, University offers a complete line of woofers, both high compliance and high efficiency. They feature the built-in flexibility and advantages of adjustable response, dual impedance and the patented dual voice coil for single-woofer stereo use.

There are also many mid-range speakers and wide-angle horn loaded tweeters to complete any 2-way or 3-way system . . . plus the sensational new Sphericon, described below.



MODEL C-12SW 12" Dual Voice Coil Woofer. High end response adjustable to 700, 2500, 5000 cps. Overall response, 40-6000 cps. $39.50 net.

MODEL T202 SPHERICON Super Tweeter. Major breakthrough in high frequency engineering. Response: 3000-40,000 cps (±2db to 22,000 cps). $24.95 net.

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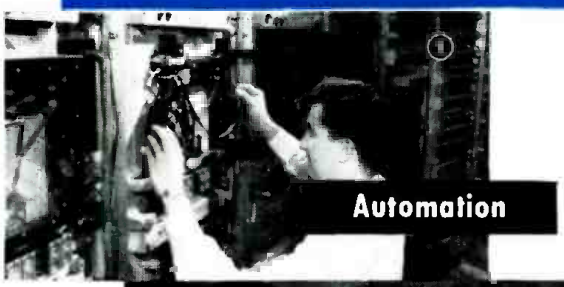

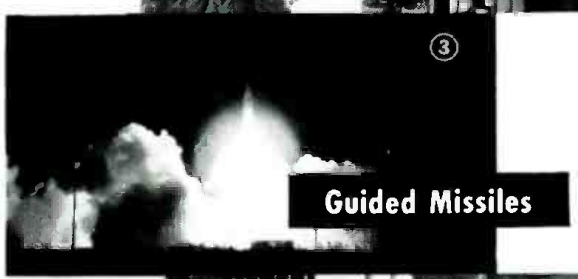

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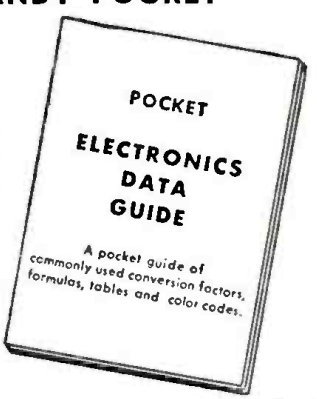

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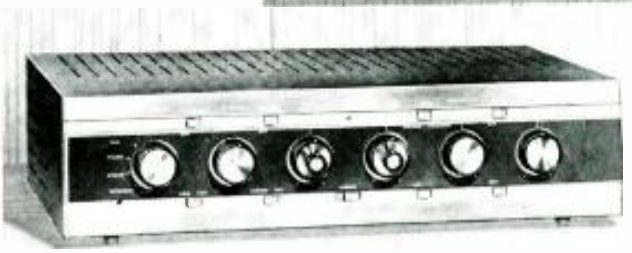

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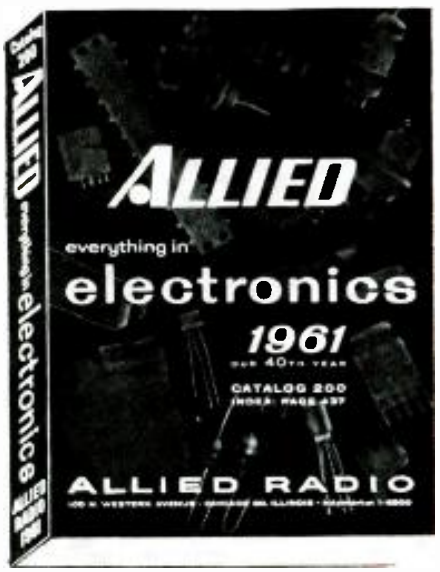

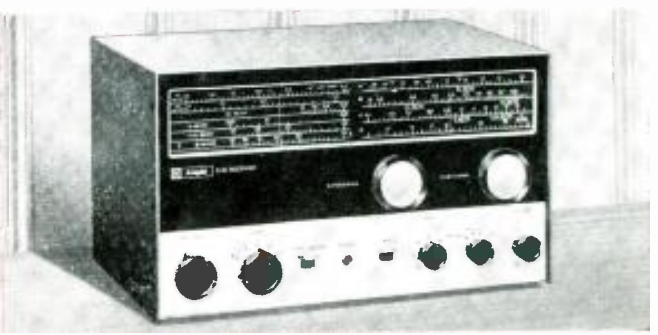

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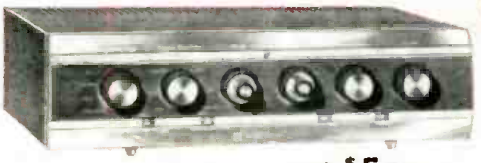

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Only $39.95 For Full 20 Watts Stereo!

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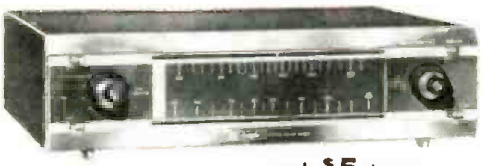
Y-927 Super-value 20-Watt Stereo Hi-Fi Amplifier, with special clutch-type dual-concentric level control; biggest bargain in Stereo hi-fi.. **$39.95**

Y-731 Deluxe FM-AM Stereo Hi-Fi Tuner, with Dynamic Sideband Regulation, variable AFC, "Magic Eye" slide-pointer tuning; includes multiplex add-in feature..... **$87.50**



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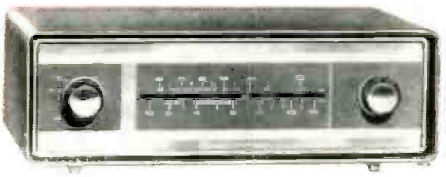

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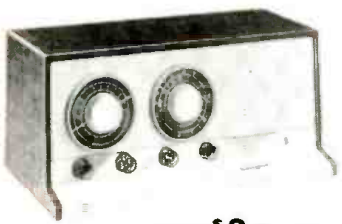

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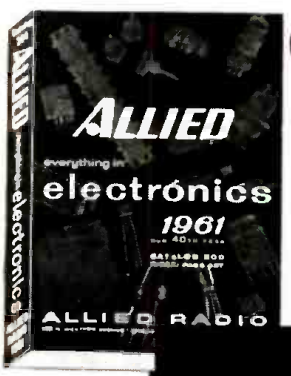

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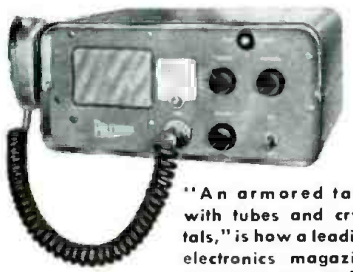

"An armored tank with tubes and crystals," is how a leading electronics magazine described the **Poly-Comm II,** known as the "Workhorse of Industry." The **Poly-Comm II** is most rugged and reliable citizens band transceiver made. Designed for continuous duty and featuring a super-sensitive dual conversion superhet receiver . . . optimum selectivity through dual conversion with 16 tuned circuits and three 455 Kc IF stages, (If you hear him he's on your channel) . . . completely weather and rust proofed . . . teflon wiring . . . solid steel cabinet and chassis for rugged use under any conditions.

Additional Features: 3 watts power output. Super-sensitive squelch circuit. Delayed automatic volume control. 100% modulation capability. Push to talk without relays. Flooting series gate-type noise limiter. Comes with universal mounting bracket and professional microphone.

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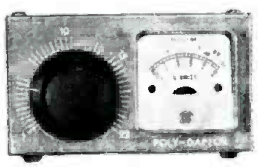

The Poly-Daptor is a remote control variable tuner and S-meter covering 26.965 Mc (channel 1) to 27.225 Mc (channel 22). Retains use of 4 transmit channels with instant switching of crystal control or variable tuner. The S-meter operates at all times with either variable or crystal controlled receiver.

$29.50 user net Complete

The Poly-Comm 6-2 operates on 6 and 2 meters, V.F.O. or crystal control and triple conversion superhet receiver with squelch and ANL, S-meter and instant band switching.

$299.50 amateur net Complete

Within the Industry

ALBERT COUMONT has been appointed sales manager of *Sprague Products Co.*, the distributors' supply subsidiary of the *Sprague Electric Co.*

In his new post Mr. Coumont will be responsible for the management of field sales of components and transistors to a nationwide network of distributors, succeeding Harry Kalker who has held the dual posts of president and sales manager of the subsidiary.

Mr. Coumont first joined the division in 1956 as assistant to the president, after serving as service coordinator of the RETMA (now EIA). Prior to that post he was manager of sales for electronic products of the *International General Electric Company* in New York. He has been in the electronic field since 1936.

* * *

H. E. McCALLICK, former associate dean of the College of Technology, University of Houston, has been named executive vice-president of *Capitol Radio Engineering Institute* of Washington, D. C. . . . **A. B. BUCHANAN**, assistant communication engineer of the *Detroit Edison Company*, has retired after 38 years of radio and electronic work to establish a consulting engineering practice in the mobile radio systems field . . . **F. P. RICE**, director of operations for *International Resistance Co.* since 1958, died recently at the age of 49 . . . **DR. WILLIAM L. FIRESTONE** is the new director of engineering for *Motorola's* Communications Division . . . **WILLIAM B. VOORHIS** has joined the staff of *National Electronics, Inc.* as production manager of the new thyratron and rectifier division. He was formerly with *Tung-Sol* . . . **ALLEN W. DAWSON** has been named manager of the television bulb sales department of the Electrical Products Division of *Corning Glass Works* . . . **CLYDE W. KAERICHER**, former executive of *Minneapolis-Honeywell*, has joined *Telex, Inc.* as vice-president in charge of corporate affairs . . . *ansformer Corporation* **UEL L. BARAF** president **SSELL** vice-president of **OHN R. WELTY** is the anager for diodes and *otorola's* Semiconductor ion . . . **ROBERT SACK-** elected executive vice-hief operating officer of *tion* . . . The Solid State ment of *CBS Laborato-* **ALFRED F. KASPAUL** to the post of manager. He has been with the *Laboratories* since 1957 . . . **JOSEPH N. BENHAMIN**, president of the *Bogen-Presto Division*, has resigned his post. No immediate announcement of his future plans was forthcoming . . . **HOWARD P. MUNDAY** has been named training and communications coordinator for the *CBS Electronics Division* . . . **GEORGE L. MALLORY** has been appointed to the newly created post of vice-president, operations, for *Gates Radio Company* . . . Appointment of **LUIS H. URDANG** to the post of manager for quality control at the Mountaintop, Pa. plant, has been announced by *Radio Corporation of America* . . . *Amperex Electronic Corporation* has promoted four senior applications engineers to positions as section heads in the applications engineering department. Those promoted include **BERTRAM GREEN, WALLACE HICKMAN, ALBERT H. KATZ,** and **KEVIN REDMOND.**

* * *

DR. PEI WANG has been named to the newly created post of engineering manager in charge of device services for the Semiconductor Division of *Sylvania Electric Products Inc.*

In his new position, Dr. Wang is responsible for material engineering, chemistry, device techniques, and service. He will continue to maintain offices at the division's headquarters laboratory in Woburn, Mass. where he has been a senior engineering specialist since 1958.

Dr. Wang joined the company in 1953 as a material and chemistry engineer. Prior to that he was a research associate at the University of Wisconsin.

* * *

WESTON INSTRUMENTS DIVISION has opened new district sales offices and service facilities at 1125 Marshall St. in Redwood City, California . . . **WESTREX CORPORATION** has moved its eastern operations into a six-story building at 540 W. 58th St., New York City . . . Construction of a new 10,000-square-foot plant for **CONDENSER PRODUCTS COMPANY** has begun in Brooksville, Florida. Occupancy is scheduled for September 1st and will complete the shift of the firm's operations from New Haven, Conn. . . . The San Carlos plant of **EITEL-McCULLOUGH, INC.** is being expanded by the addition of two new buildings which are being built at a cost of over one-million dollars. Scheduled for completion in November, the new buildings will cover 63,000 square

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... informative shop talks

by AL MERRIAM

Sylvania National Service Manager

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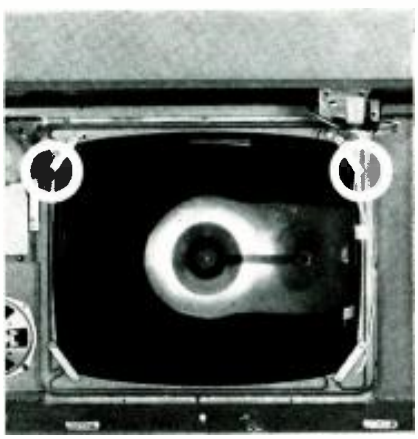
And that's Sylvania Bonded Shield 23". Mounting or removing a Bonded Shield picture tube is easier and faster simply because there are no old-fashioned straps. The mounting "ears" are a strong part of the shield, and the door-latch mounting clips are easy as pie. How easy is that? Look...



Take out one screw on the two top clips...loosen the rest of the screws.

That's all there is to it . . . the tube is removed that easily!

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feet . . . **RAYTHEON COMPANY's** new Airborne Equipment Center has been dedicated at Sudbury, Mass., the firm's seventh major facility to be completed and become operational within the past year . . . **GENERAL ELECTRIC COMPANY** will add another 260,000 square feet of office, engineering, and manufacturing space to its transistor and tunnel diode facilities at Electronics Park, Syracuse . . . **RADIO CORPORATION OF AMERICA** will open a new research laboratory in Japan to conduct fundamental studies in the physics and chemistry of solids. The facility will be located in a new building now under construction in Tokyo.

* * *

R. R. FORBES has been appointed manager of the Semiconductor Department of *P. R. Mallory & Co. Inc.'s* Elkon Division at Du Quoin, Illinois.

In his new capacity, Mr. Forbes will have charge of all of the department's activities including research and development, production, quality control, and sales. He also assumes the duties of Dr. C. H. Moore who has resigned to take a position with another company.

Mr. Forbes joined the organization as president of *Mallory Plastics Company*, Chicago. Before that he was manager of the radio and television division of *Sylvania Electric Canada Limited*.

* * *

CHARLES D. BROWN has been appointed manager of marketing at *General Electric Company's* Instrument Department in West Lynn, Mass. . . . **DR. ROBERT A. NOTTENBURG** has been appointed director of education for the *Cleveland Institute of Electronics*. He was formerly dean of the faculty for *International Correspondence Schools* . . . **RUSSELL W. SWIGART** has been named credit manager of *World Radio Laboratories* . . . **C. T. KIERULFF** has been named president and chief executive officer of *Kierulff & Company* while **C. R. KIERULFF** moves up to the post of chairman of the board . . . *General Instrument Company* has announced the election of **MOSES SHAPIRO** as president and **MONTE COHEN** as vice-chairman of the board . . . **RAY D. BARR** has been appointed vice-president and controller of *Globe Electronics* . . . **F. D. MEADOWS** has been named manager of video products administration for *Ampex Professional Products Company* . . . *Sangamo Electric Co.* has appointed **ROGER R. MILLER** to the new post of sales manager of electronic components . . . **WILLIAM D. HOGAN** has been named manager of field engineering, a newly created post within the Semiconductor Division of *Sylvania Electric Products Inc.* He was formerly with *Raytheon* at Waltham . . . **LT. COL. JOHN F. RIDER** (U.S.A., Ret.) was honored at a testimonial dinner held by the Lt. Harold G. Blumberg Post of the American Legion. He was honored for his "contribution to the American Way of life." —30—

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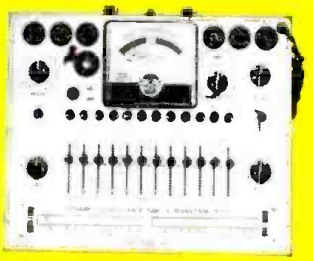

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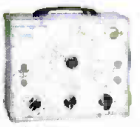

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†Shown in optional Furniture Wood Cabinet **WE71:** Unfinished Birch, **$9.95;** Walnut or Mahogany, **$13.95.**

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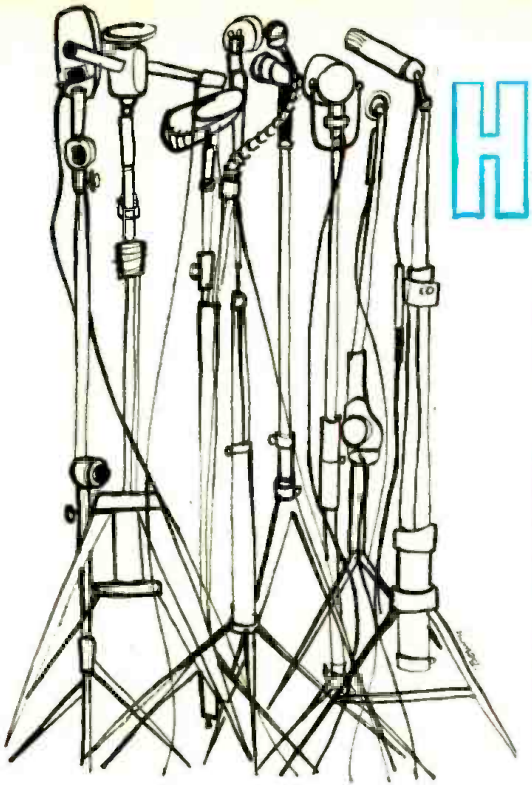


HOW TO CHOOSE THE PROPER MICROPHONE

By **GEORGE RILEY**
Electro-Voice, Inc.

Picking the right mike for your particular application will certainly pay dividends in price and performance.

PICKING the wrong microphone for your sound installation can be much like putting the wrong carburetor on your automobile. While it might work, you won't get top performance unless you've chosen the right one by mere coincidence. The odds are that you will end up with mediocre performance, without realizing it could be much improved.

Complex as it may be, the field of sound equipment is one where a small amount of accurate information can go a long way. It can be built upon to form a firm foundation for choosing, using, and getting the most out of the equipment you buy. The results show up in dollars saved and in performance far above that obtainable by guesswork or casual advice. Quite often, proper application of an inexpensive microphone will produce superior performance over a much more expensive microphone wrongly applied, in the same installation. Broadcast stations, for example, have actually gone on the air using $30 microphones throughout, with acceptable results. This, however, is the extreme—like using a box camera to record sporting events. But it can be done, and the point is that application "know-how" pays long dividends.

Actually, only three points must be considered when picking the proper microphone for any application, whether it be home recording, professional broadcasting, or a communications system in the roaring noise of a steel plant. These are: (1) the type of generating element best suited to the conditions, (2) the most desirable microphone pickup pattern, and (3) the final quality desired. To obtain optimum results in most applications, the first two factors must be carefully considered. On the other hand, if low-cost equipment is being used in the balance of the system and price is a controlling factor, or on special applications such as radio communications equipment, the third factor may be compromised to some extent.

In a microphone, the energy of sound

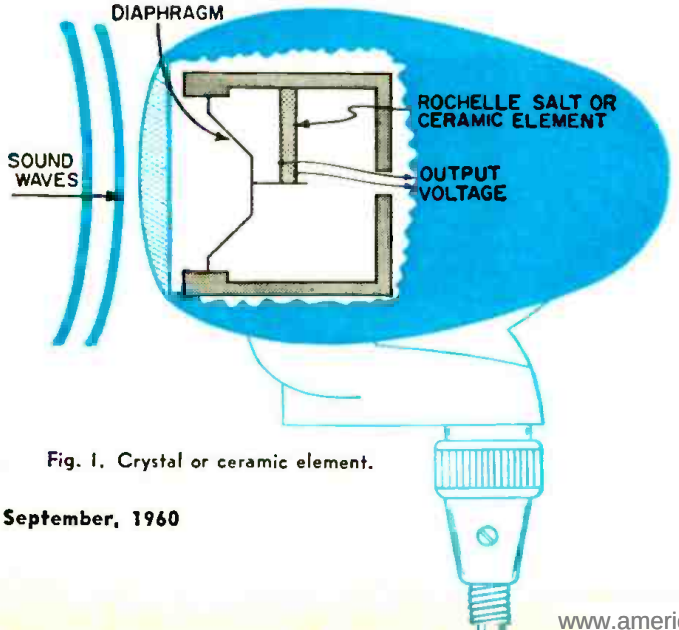


Fig. 1. Crystal or ceramic element.

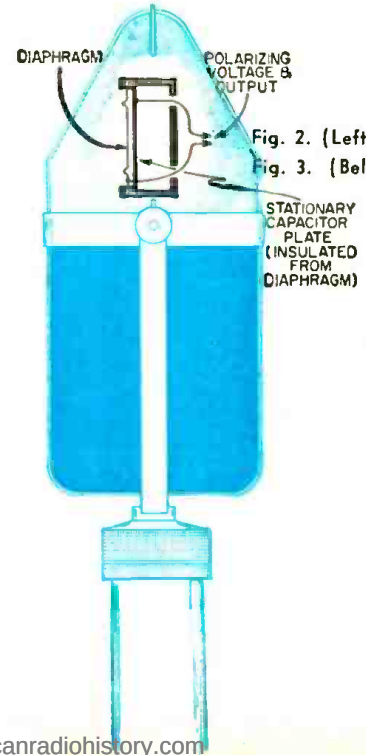
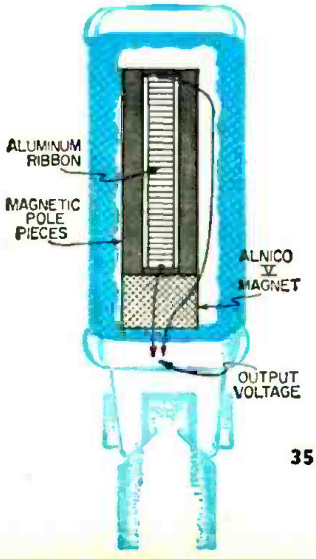


Fig. 2. (Left) Capacitor microphone element.
Fig. 3. (Below) Ribbon microphone element.



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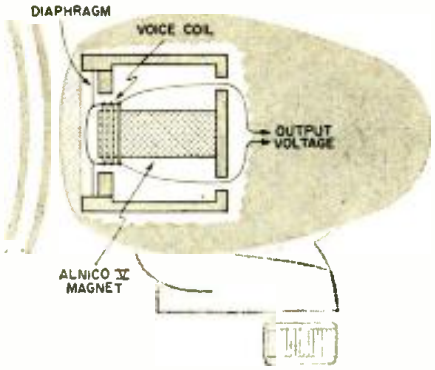

Fig. 4. Dynamic generating element.

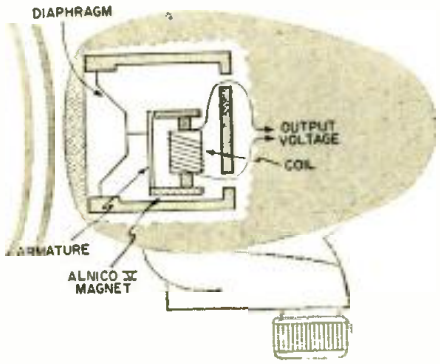

Fig. 5. Magnetic generating element.

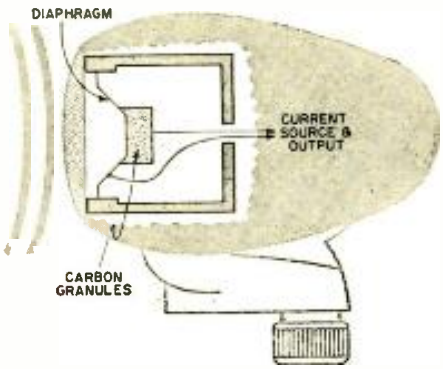

Fig. 6. Carbon microphone element.

waves is used to actuate a diaphragm —to make it vibrate at the identical rate of the sound source. How closely it does this depends on the skill of the engineers who design microphones. In most microphones, the energy of the vibrating diaphragm is then used to generate an electrical voltage. It is very difficult to amplify sound itself, but in the form of an electrical voltage which varies in frequency as the sound varies in pitch, it can be easily amplified to perform almost any job we desire, from driving a loudspeaker or making a tape recording to vibration-testing a full-sized ship!

Not all microphones generate a voltage directly. Some types change a direct current to one which varies and is controlled by the movement of the microphone diaphragn. This allows us to obtain an output voltage across a resistor in series with the microphone.

Microphones which fall into the class of true voltage generators are the crystal, ceramic, dynamic, ribbon, and magnetic. All generate a voltage which is an electrical facsimile of the sound waves actuating the microphone diaphragm. In the remaining class are the carbon and capacitor microphones which modify the direct current supplied to them into one which varies in an identical manner according to the movement of the microphone diaphragm.

Next, consider the problem of pickup pattern. We may not always wish to pick up sounds coming to the microphone from *all* directions. For example, in recording a wedding, the words of the participants must be picked up distinctly, but a cough in the crowd or even the footsteps of the ushers would be distracting in the final recording. In directing his men at the scene of a large conflagration, it might be impossible for the fire chief to make himself heard above the noise unless a microphone which cancels *all* sound except that of his own voice is used.

The fact that the human brain has the ability to sort out undesirable sounds and ignore them has led many an amateur recordist into a dilemma. It is not difficult for two persons to converse in a noisy bus, but try to record that conversation and one suddenly discovers that the microphone is truly an ear without a brain. Proper use of directional microphones, however, can usually provide satisfactory results even under the most difficult conditions.

Characteristics of a microphone which determine its quality will be discussed in detail later. No reasonable person would expect top performance using a $5 microphone with a $500 tape recorder. The more costly the microphone, the greater is the need to make the proper choice if good value is to be obtained.

With these fundamentals in mind, we can return to the three basic requirements for proper choice of a microphone and discuss them in greater detail.

Crystal and Ceramic Elements

Some crystalline materials have the property of generating an electrical voltage when a thin slab of the crystal is bent or twisted. Rochelle salt (potassium sodium tartrate) is one of the most suitable substances since it can be grown synthetically and at a comparatively low cost. It can be cut into small slabs for use in low-cost microphones. Physically, it is sufficiently compliant so that a microphone diaphragm, with a diameter of around 2 inches, coupled to it mechanically will produce high output level. Fig. 1 shows how sound waves moving the diaphragm of this type of microphone transmit a force which bends the crystal element to produce the electrical signal we require. Many low-cost microphones use Rochelle salt crystal elements from which they derive their general identification as "crystal" microphones.

CONDITION OR CHARACTERISTIC	CRYSTAL	CERAMIC	DYNAMIC	RIBBON	MAG-NETIC	CAPAC-ITOR	CARBON
High Temperature (112°F. or above)		•	•	•	•	•	•
Low Temperature	•	•	•	•	•	•	•
High Humidity		•	•	•	•		•
Rough Handling			•		•		•
Very High Output							•
High Output	•	•			•		
Wide Frequency Range			•	•		•	
Low Cost	•	•	Some		•		•
Long Mike Line[1]			•	•	•	•	
Low Distortion			•	•		•	

[1]Choose low-impedance models where hum or long lines (over 20 feet) may be encountered.

Table 1. Choose type of element best suited to use and with desired characteristics.

ACOUSTIC CONDITION	OMNI-DIRECTIONAL	BIDIRECTIONAL (Ribbon Only)	UNIDIRECTIONAL (CARDIOID, LINE)	DIFFERENTIAL (CLOSE-TALKING)
Low Reverberation	•	•	•	
High Reverberation		•	•	
Low Random Noise	•	•	•	
Very High Noise				•
Source Far From Mike			•	
Source Close	•	•	•	Less than 3"

Table 2. Select the pickup pattern that is best suited to the acoustic conditions.

Table 3. The final choice will be determined by the quality desired and application.

APPLICATION	APPROX. PRICE RANGE	TYPICAL EXAMPLES			
		OMNI-DIRECTIONAL	BI-DIRECTIONAL	UNI-DIRECTIONAL	DIFFERENTIAL
Low-cost home record-ing, P.A.	$5 - $30	Crystal Ceramic Dynamic Magnetic		Crystal Ceramic	
High-quality home record-ing, P.A.	$30 - $70	Dynamic	Ribbon	Dynamic Ribbon	
High noise level and Mobile	$15 - $35	Crystal Ceramic Carbon Dynamic Magnetic			Carbon Dynamic
Professional recording, Broadcast	$50 - over $300	Dynamic Capacitor	Ribbon	Dynamic Ribbon Capacitor	

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While Rochelle salt crystals permit the construction of quite low-cost and high-level microphones, this material has some disadvantages. Its composition is two molecules of water of crystallization to every molecule of Rochelle salt. Additional moisture from high humidity or evaporation of the water of crystallization from high heat causes a breakdown of the crystal structure and a useless microphone. Given reasonable care in the cool climates of the northern hemisphere, crystal microphones usually last for a good many years. What is more, special protective coatings are sometimes applied to the crystalline element to help it resist the effects of moisture and humidity. But in tropical or semi-tropical countries, where heat and humidity are common, the same type microphone may last only a few weeks or perhaps even only a few days. Leaving a crystal microphone in an automobile in the summer with the windows closed may cause damage.

Because of this problem, most microphone manufacturers have recently begun substituting barium titanate ceramic elements for Rochelle salt. Unlike the early crystal elements, the ceramic material is not affected by extremes of temperature and humidity. In addition, its cost is low, permitting its use in inexpensive microphones. Construction of ceramic microphones is identical to that of the crystal microphone shown in Fig. 1. While the output level is slightly lower than the crystal, it is sufficiently high to operate most standard audio equipment.

Dynamic Generating Elements

The construction of the dynamic element shown in Fig. 4 will be familiar to anyone who has examined a cross-sectional diagram of a dynamic loudspeaker. When sound strikes the diaphragm, the voice coil attached to the diaphragm moves forward and back through a strong magnetic field formed by the magnet structure. The signal thus generated is taken off through the voice-coil leads and fed into an amplifier.

Use of Alnico V magnets produce output levels almost on a par with those obtained with average crystal microphones. Development of non-metallic diaphragm materials has made possible greatly extended frequency response and extremely rugged construction. A well-designed dynamic microphone, for example, can be soaked by rain and dried out with no ill effects. It can even be used to drive nails without damage to anything but the finish of the microphone case.

Since the generating elements themselves can be built compactly, dynamic microphones may take the form of tiny lavalier microphones worn on a neck cord as well as the larger, high-quality slim studio microphones. Cost is reasonably low although it does exceed that of crystal microphones.

Ribbon Microphones

Ribbon generating elements made possible the first high-quality microphones in the early thirties. These early microphones have been drastically improved since that time and today's small, attractive ribbon microphones have little resemblance to their heavy, bulky predecessors.

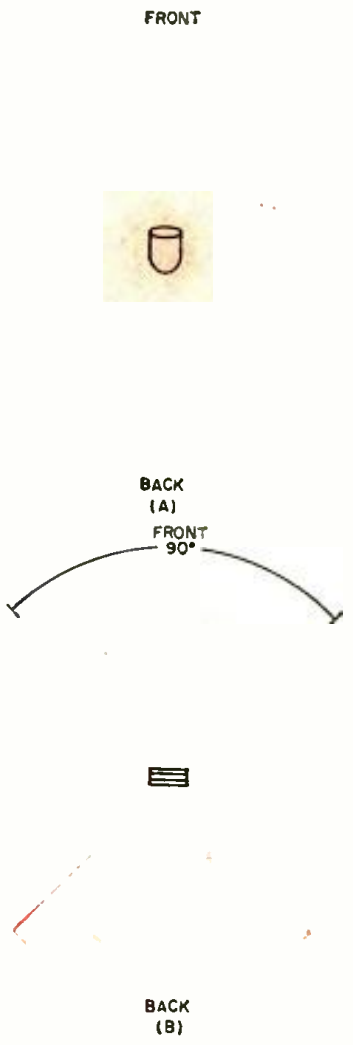


Fig. 7. (A) Omnidirectional and (B) bi-directional microphone pickup patterns.

While wide-range response can be achieved with ribbon elements, use of this type microphone is somewhat restricted. As Fig. 3 shows, the generating element consists of an extremely thin, corrugated aluminum ribbon suspended in a magnetic field. Electrically, this ribbon can be considered as a single turn of a straightened-out voice coil which also acts as the diaphragm. The ribbon must be extremely compliant since its area is small, yet it must respond to very small sound pressures. This high compliance becomes a problem when the ribbon microphone is used outdoors since wind will cause the ribbon to flutter, resulting in high-level, undesirable noise. This limits the use of the ribbon microphone to indoor applications where good results can be obtained.

In operation, sound waves actuate the ribbon just as they do the diaphragm in a dynamic microphone. Since the ribbon is suspended in a strong magnetic field, it passes through magnetic lines of force as it moves forward and backward. The voltage thus generated is taken off the ends of the ribbon which are, of course, insulated from the magnetic structure.

Magnetic Generating Elements

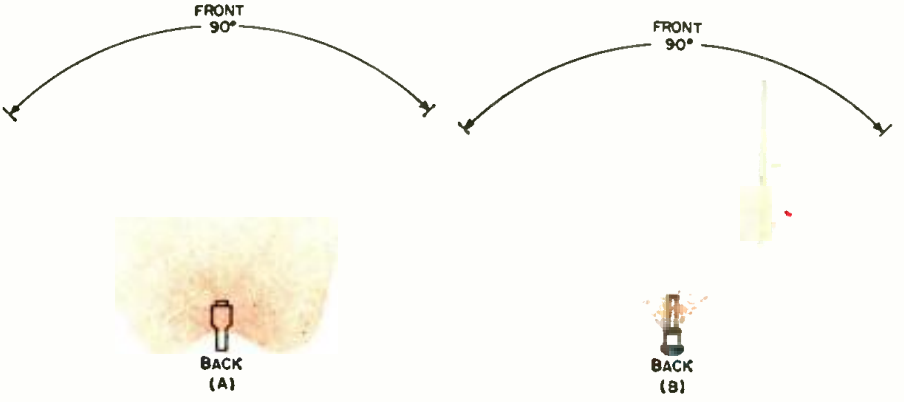
Fig. 5 shows the structure of the magnetic generating element, sometimes called the variable- or controlled-reluctance element. Here the diaphragm drives an armature which is a part of a magnetic circuit. As the armature moves, it varies the magnetic field passing through the coil. The fluctuating voltage generated in the coil is taken off at its output leads.

The magnetic microphone enjoys several advantages. First, its output is relatively high—comparable to that of a crystal type. It is rugged, inexpensive, and will usually withstand rough handling. Balanced against these advantages is the disadvantage of limited range response which makes this type element most useful in low-cost applications.

Carbon Types

Probably the most common of all microphone types is the simple carbon microphone (Fig. 6) as this is the mike used in conventional telephone handsets. In this type, a moving diaphragm exerts more or less pressure on a small "button" or container of carbon granules. When a low-voltage d.c. source is connected to the button through a series resistor, the current is made to vary in accordance with the changes of resistance of the carbon granules. This variation is in step with the sound pressure changes exerted on the diaphragm, thus we have converted the

Fig. 8. (A) Cardioid and (B) line-type unidirectional mike pickup patterns.



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sound waves into an electrical signal.

Because of the limited frequency response and noise generated by this type of element, its use is restricted to voice communications and then only when intelligibility of speech rather than high-quality reproduction is required. This type of microphone has a very high output level so that it does not need the preamplification required for most other types. In addition, the carbon microphone is extremely rugged.

Capacitor Microphones

The development of the capacitor microphone in the late twenties was the first improvement over early carbon microphone designs and provided much better quality. This element (Fig. 2) does not generate a voltage directly but merely converts a direct current fed to it into one which alternates or varies in accordance with sound-pressure waves impressed on the diaphragm. This means that each capacitor microphone must have its own power supply, adding cost to an already expensive assembly and increasing chances for equipment failure.

An advantage, however, is the fact that this unit can be built to furnish very wide frequency response, particularly in the miniaturized types. The inherently rising response (increasing output level as frequency increases) of some of these types gives a "presence" which has made it popular for professional recording applications. Its popularity, however, has been limited by its high cost and the development of high-quality dynamic types.

Pickup Patterns

The second step in choosing a micro-

(*Continued on page* 76)

Cover Story

MANY of our readers have used or are acquainted with some of the microphones shown on our cover this month. True, the mikes are usually protectively housed so that their "innards" are not visible, but we thought it would be interesting to partially disassemble some examples of the various types to see what they look like. We have chosen mikes that are used for mobile communications, home recording, professional recording, broadcasting, and public-address system applications. Included are examples of capacitor, ceramic (or crystal), dynamic, carbon, and ribbon types.

At the extreme left (A) is a capacitor microphone of professional quality, the Sony C-37A. This mike, which sells for just under $300, may be adjusted for either a unidirectional (cardioid) response or an omnidirectional response. According to the manufacturer, the frequency response is within ± 2 db from 20 to 18,000 cps. The mike's diaphragm is a special plastic film, one side of which is coated with a thin film of gold that forms the movable plate of the capacitor that generates the audio signal. A fixed electrode behind the diaphragm is the capacitor's fixed plate. Our photo shows the movable gold plate clearly, along with the wire that connects the fixed plate to the mike's cathode-follower preamp directly below it. The built-in preamp is required to convert the very high impedance of the capacitor mike into a much lower impedance (200 ohms) so that long lengths of output cable can be used without a loss of highs. Also, since the capacitance of the mike is so low, it must be operated into a very high impedance for good low-frequency response. The cathode-follower, a 6AU6 tube, obtains its power from a separate power supply which also supplies polarizing voltage to the microphone. When one speaks into this mike, the moving-plate diaphragm vibrates in accordance with the sound. This varies the capacitance, and therefore the charging current, in the grid resistor of the cathode-follower. A replica of the audio signal at the grid, but at a slightly lower level, is obtained at the cathode. This signal is fed through RC networks (in the power supply unit) for various low-frequency roll-offs, if desired, then to a microphone transformer that connects the audio signal to the output cable.

Second from the left (B) is an example of a hand-held ceramic microphone, the Astatic 333. This mike is an inexpensive (about $11) unit suitable for home recording and p.a. systems. The manufacturer rates the frequency response from 30 to 12,000 cps. Another model, the 331, using the same housing but a differently shaped diaphragm, is limited to voice frequencies from 300 to 5000 cps. This latter model is useful for communications, Citizens Band applications, and paging. In our cover photo, the grille and upper part of the housing have been removed to show the metal diaphragm. Cemented to the center of the back surface is a small linkage that engages one end of a 1/2" long x 1/16" wide ceramic bar, fixed in position at its other end. When sound waves strike the diaphragm, it vibrates. This bends the ceramic bar and, because of its piezoelectric properties, an audio voltage is generated. The voltage is now ready to be applied to a microphone preamp for amplification. The ceramic microphone, like the capacitor mike, is a high-impedance device. Mikes of this type are also made with Rochelle salt crystalline material (crystal mikes) instead of the ceramic element (barium titanite) employed in this unit. The slide switch is spring-loaded in the Model 331 and has an extra set of contacts in order to provide push-to-talk operation as well as a power-switching function.

The third microphone from the left (C), the Electro-Voice Model 664, is a dynamic (moving-coil) type with a cardioid directivity pattern. This mike, designed mainly for high-quality public-address system installations, sells for about $50. The manufacturer specifies a frequency response from 40 to 15,000 cps. In order to show the special ribbed diaphragm and moving coil, we have removed the grille screen, retainer grille, filter, and magnetic shield screen that normally enclose the front of the microphone. The moving coil fits in the circular air gap of a permanent-magnet structure, in principle much like an ordinary PM speaker. When sound causes the diaphragm to vibrate, it moves the coil that is immersed in the intense magnetic field. As a result, an audio voltage is generated which is applied to the primary of a built-in microphone transformer. This transformer steps up the normally very low impedance of the moving coil to either 150 ohms for low-impedance circuits or to a much higher value for high-impedance circuits. Openings in the mike's case serve to admit sound through three internal passages to the rear of the diaphragm. These are to provide a uniform cardioid pattern at all frequencies.

The microphone that is third from the right (D) is a hand-held carbon mike. This unit, the Turner SR-90R, is designed mainly for portable communications equipment. The mike is suitable for voice frequencies only, having a frequency response from 200 to 4000 cps. The diaphragm, backed by a small container of carbon granules, and the external contact assembly are all built as a single self-contained cartridge. This cartridge, incidentally, appears to be identical with the microphone cartridge used in the ordinary telephone. When the diaphragm is vibrated by speech, it changes the resistance of the carbon granules as they are alternately compressed and released. When a low-voltage d.c. source is connected through a load to the mike, the resultant current then varies in accordance with the speech. The microphone is a low-impedance device with an impedance value of about 80 ohms. A spring-loaded, push-to-talk switch is included in the metal housing. Price of the mike is around $16.

Second from the right (E) is the Norelco Model EL3752/01 dual-dynamic stereo microphone. This mike, designed mainly for home stereo tape recording, consists of two separate moving-coil elements that are mounted at right angles to each other in a single lightweight plastic housing. The directivity of each element is a cardioid, and because of the mounting, one element responds mainly to sounds originating at the left and the other responds to sounds at the right. The movement of the diaphragm-mounted coils in the fixed magnetic fields generates audio signal voltages as previously described. Directly at the centers of the front housings of the two microphone elements are mounted two small transformers. These step up the low impedance of the moving coils to about 25,000 ohms for use in high-impedance circuits. The stereo mike retails at about $40.

At the extreme right (F) is a ribbon microphone with the outer grille removed. This mike, the Shure Model 300, is a unidirectional type suitable for broadcast, recording, and high-quality p.a. system installations. Its cost is around $70. The manufacturer quotes a frequency response of ± 2 1/2 db from 30 to 15,000 cps. The black rubber horn at the front of the mike directs the sound energy toward a sensitive metal ribbon suspended vertically between the poles of a magnetic structure. When this ribbon is caused to vibrate in the intense magnetic field, a voltage is generated across the ribbon terminals. Openings covered with a blue cloth material near the back of the structure terminate the backside of the ribbon and maintain proper response and directivity of the microphone. Because of the extremely low impedance of the ribbon, a built-in step-up transformer at the base of the mike is used to provide an output impedance of 50, 150, or 250 ohms, depending on the position of the built-in switch. (Cover Photo: Bob Loeb) —30—

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The Laser

Dr. Theodore H. Maiman of Hughes Research Laboratories studies the laser's main parts. These include a light source (a special photoflash-like spiral tube) which surrounds synthetic ruby crystal rod through which excited atoms are stimulated to produce an intense beam of coherent, single-frequency light.

A Light Amplifier

An optical maser which amplifies light by means of stimulating atomic radiation within ruby crystal.

EDITOR'S NOTE: *The principles of operation of this new experimental, laboratory device are similar to those employed in the maser except that the laser operates at frequencies that are in the visible light part of the electromagnetic spectrum instead of the microwave region. In the case of the maser, the ruby crystal is supercooled to just a few degrees above absolute zero, and a microwave oscillator supplies the pumping signal needed for operation. The laser operates at room temperature and the pumping signal is supplied by a photoflash-like tube high-intensity light source. For complete details on the operation of the maser, which has now progressed to practical use outside of the laboratory, see our lead article on this subject in a forthcoming issue.*

AT A RECENT press demonstration, *Hughes Research Laboratory* scientists showed for inspection a new solid-state electronic device that can be used to amplify light. The device, smaller than a water tumbler and containing a rod of synthetic ruby, is an optical maser or "laser" (from *L*ight *A*mplification by *S*timulated *E*mission of *R*adiation). Some possible future applications of the light amplifier include its use as a scientific tool for investigating properties of matter and for performing basic experiments of physics. The device will also permit focusing of light into high-intensity beams for space communications and for industrial, chemical, and medical purposes. By communicating on the frequencies of visible light, there would be a large number of channels available that are not currently in use for communications.

Most of the applications of the laser stem from the fact that the device is able to generate "coherent" light. The smaller the portion of the electromagnetic spectrum over which any particular source generates energy, the more coherent is the source. Previous sources of light energy, such as incandescent lamps, are "incoherent" sources since they simultaneously generate energy over a relatively large part of the spectrum. R.f. sources, on the other hand, are very coherent. The laser then is used to generate single-frequency light, much like an r.f. carrier, but in the visible-light portion of the spectrum.

In operation, a light source, in the form of a powerful flash-tube lamp, irradiates a synthetic ruby crystal which absorbs energy over a broad band of frequencies. This optical energy excites the atoms to a higher energy state from which the energy is reradiated in a very narrow band of frequencies. The excited atoms are coupled to an optical resonator and stimulated to emit the radiation together, rather than individually and in random, as in ordinary light sources. Small mirrored surfaces at both ends of the long, thin ruby crystal keep the light energy bouncing back and forth long enough for the proper interaction to occur. Small pinhole openings in the mirrored surfaces permit entry of the light that is to be amplified and emission of the amplified light at the other end.

Because of the coherence of the generated light, perfectly parallel, needle-sharp beams could be generated less than one-hundredth of a degree wide. What is more, this beam would not spread or scatter as does ordinary light. As a result of such concentration, extreme brightness and intense local heat would be produced. —30—

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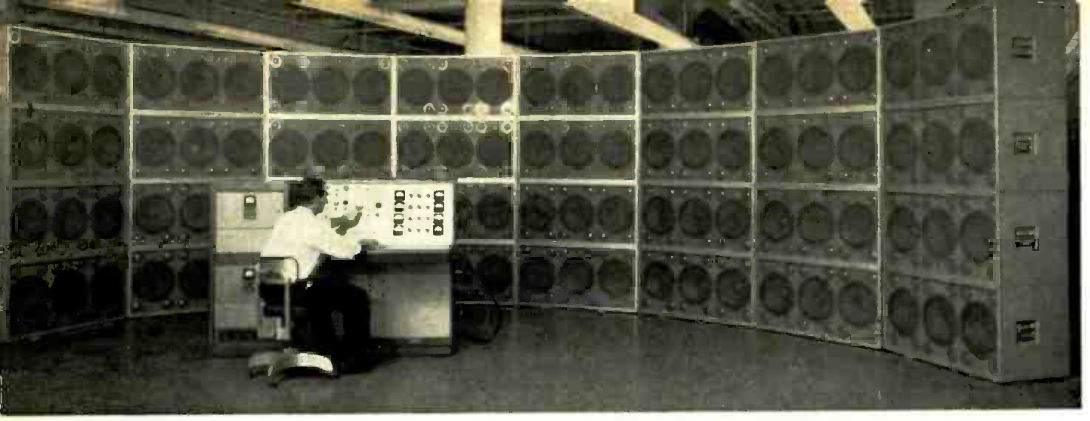
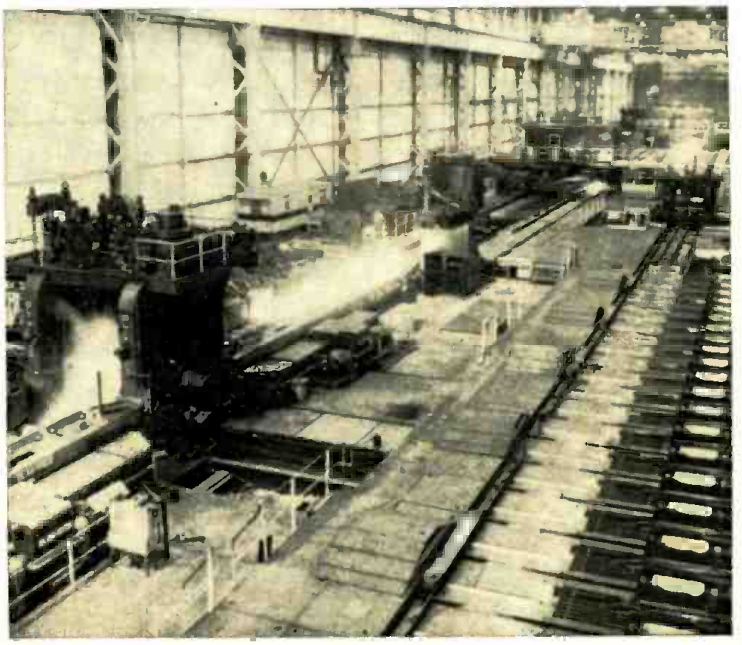
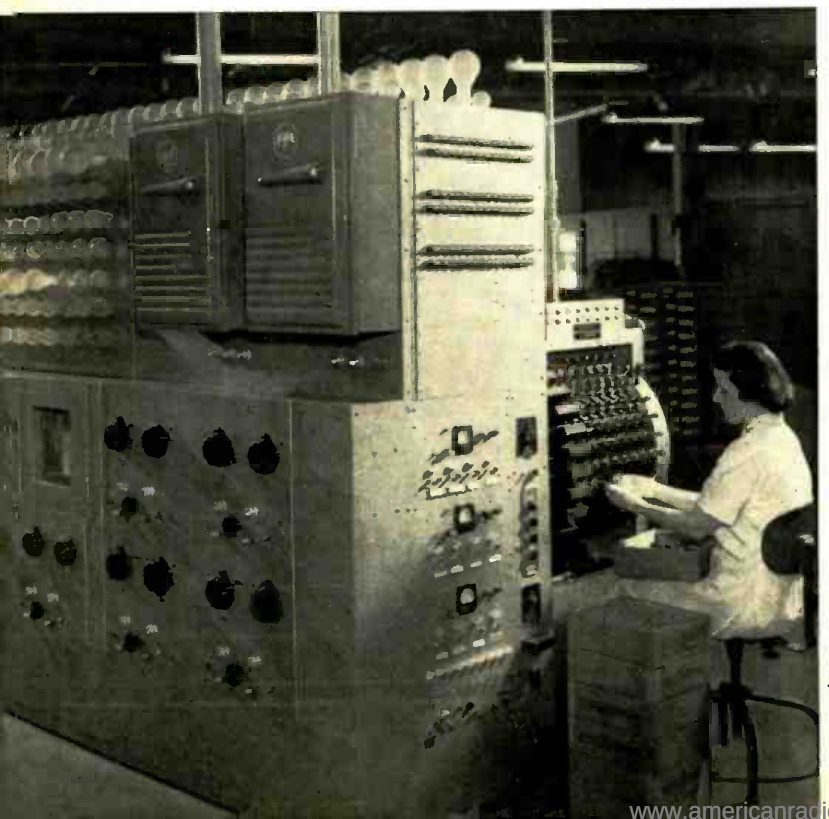


▲ High-Intensity Sound System

Acoustical engineer at *Stromberg-Carlson* makes preliminary test—at low power—of big array of loudspeakers destined for Wright Air Development, Ohio. There they will be a key part of a large high-intensity sound system being used in studies of the physiological effects of high-intensity sound. Each of a pair of high-power amplifiers feeding the speakers has an output of 7000 watts, over the entire audio range. Every one of the 32 separate speaker baffles mounts 3 woofers and 12 tweeters.

Recent Developments in Electronics





▲ Punch-Card-Controlled Rolling Mill

Over-all view of the rolling area in *U. S. Steel's* new Chicago structural mill which is capable of turning out 250-foot beams and bars at the rate of one every 19 seconds. To achieve this production rate, a *G-E* drive and control system speeds 5-ton slabs of hot, raw steel through the mill at rates approaching 20 m.p.h. The specially engineered control system uses punched-card data to automatically direct all operations in the mill. A total of 43 operations are automatically controlled and sequenced by preselected data stored on punched cards and fed into the control system by static logic elements.

New Tube-Aging Machine

Operator loads miniature tubes for radio and TV sets into this new aging machine developed by *RCA* Electron Tube Div. This device, capable of aging 2000 tubes per hour, has been placed in operation in the company's manufacturing plant in Cincinnati. Aging is a process of operating tubes for a short time under controlled conditions to improve stability and performance. This assures greater uniformity and quality. The operator inserts tubes into sockets which are conveyed through the complete aging schedule and automatically removed from the machine. ◀

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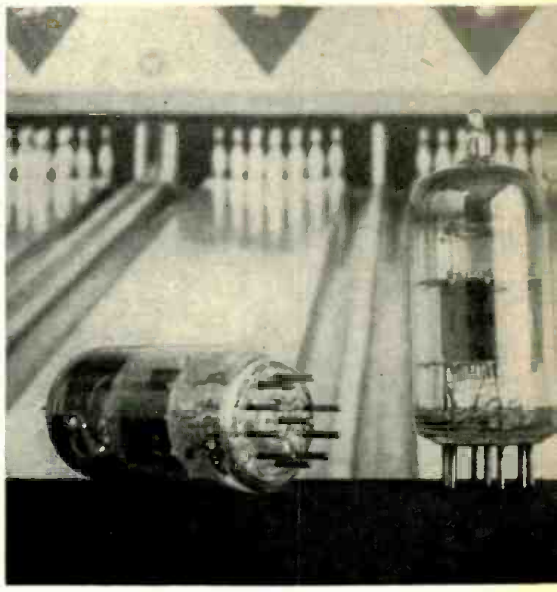
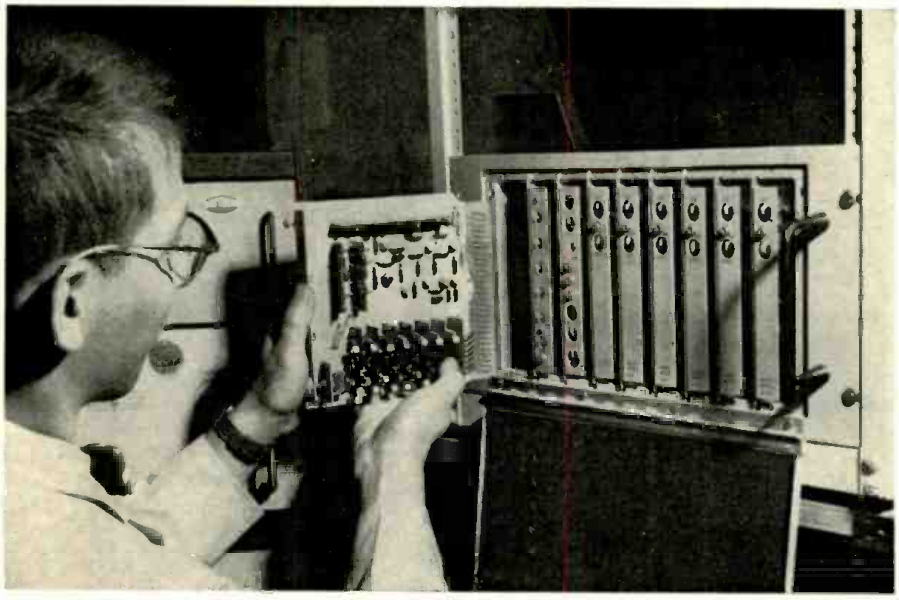
Fast Computer-Converter

The engineer shown below is inspecting electronic, component-loaded cartridge of *Raytheon's* new compact analogue-to-digital converter. Said to be about 50 times faster than any similar unit now on the market, the new converter pours out two and one-half million samples of information per second. It is less than a cubic foot in size. In spite of the high speed, accuracy remains high—one-half per-cent of full scale. Among other tasks, the converter-computer combination can measure stress or strain of an airplane wing. As the wing stretches, an analogue signal is produced that is then converted into more usable digital form. Converters can also ride inside missiles to convert environmental data to digital form for easier transmission to monitor stations. ▼

"Ten-Pin" Tubes ▶

Samples of *Sylvania's* new "Ten-Pin" tube are shown at the right. This is a new construction in miniature receiving tubes which combines multiple circuit function in a single bulb or envelope. The new design should substantially reduce chassis designing costs by simplifying circuitry and wiring. The "Ten-Pin" utilizes the regular 9-pin base arrangement of the conventional miniature envelope with an additional pin centered in the pin circle. First tubes to incorporate the new design are a double-tetrode for use as an r.f. amplifier and oscillator-mixer in FM tuners and receivers; and a triple-triode for use as an r.f. amplifier, oscillator-mixer, and a.f.c. control. The new tube design is intended for use in both entertainment as well as industrial applications.



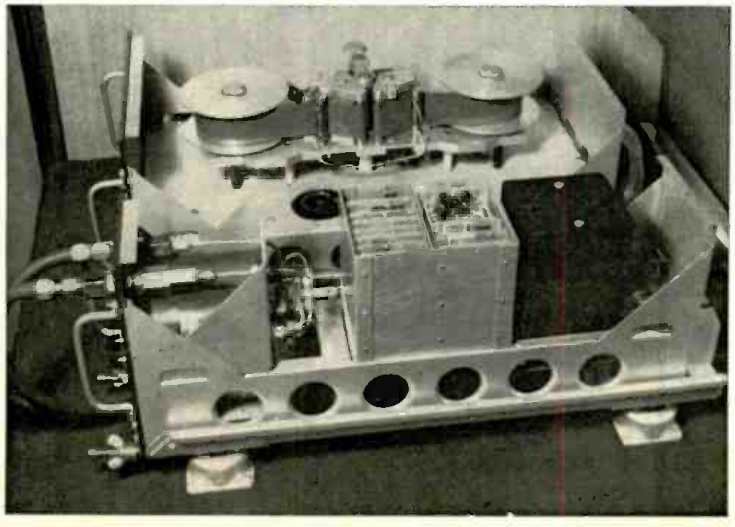


All-Transistorized Computer

IBM engineers make final performance checks on a new all-transistorized data-processing system prior to its formal acceptance by *Texas Instruments*. The computer, installed in a special glass-enclosed, environment-controlled area of 1300 sq. ft., consists of 22 units with a total weight exceeding 17 tons. It is the first fully transistorized data-processing system delivered to private industry. The computer will add or subtract 17,000 five-digit numbers per second; can "remember" instructions stored in half a million ferrite memory cores and put this information to work in 6 microseconds. It can also read magnetic tape at a rate of up to 62,500 characters per second. ▼

Transistorized Flight-Performance Recorder

A transistorized, lightweight flight-performance tape recorder developed by *Minneapolis-Honeywell* is shown here installed aboard a company plane for demonstration to the FAA. Data obtained can be used to determine when maintenance is required and the type of maintenance needed. ▼



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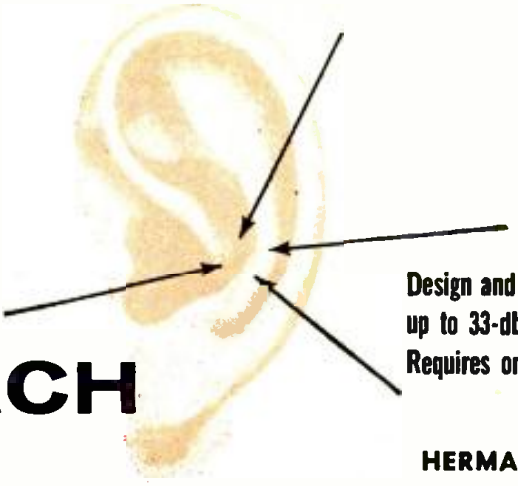

A NEW APPROACH TO LOUDNESS COMPENSATION

Design and installation of variable bass control to supply up to 33-db boost at 40 cps for very low-level listening. Requires only one additional pot, resistor, and capacitor.

By
HERMAN BURSTEIN/HENRY C. POLLAK

IT IS generally agreed that the Fletcher-Munson effect—the ear's decreasing sensitivity to low frequencies when volume is reduced— necessitates bass boost when the listening level is below that of the original performance. But there is no agreement as to the best method of supplying such boost.

An article by one of the authors[1] pointed out the difficulties of the loudness control, which is often employed to automatically supply increasing bass boost as volume is lowered. In brief, they are: (1) complex operation, involving constant resetting of the level control (sometimes accessible only from the back of the control amplifier) so that the loudness control will operate in the correct range for program sources of different volume levels; and (2) departure of *individual* hearing characteristics from the Fletcher-Munson curves, which represent a group *average* and usually are the basis for the frequency characteristics of the loudness control.

The same article pointed out that the bass control can generally provide sufficient bass boost to cope with the Fletcher-Munson effect in most situations. That is, volume is seldom reduced more than 30 db below the original performance level and, in the case of a 40-cycle note—about the lowest frequency commonly encountered in music—this would require about 19-db boost, which most bass controls can provide within a few db. Moreover, the bass control as an instrument for achieving loudness compensation has the advantages of simpler operation and being able to tailor the bass boost to the individual's specific hearing characteristics.

On the other hand, the bass control may fall down in two respects. (1) If volume is reduced more than 30 db, as may occasionally happen, the control ordinarily can no longer provide enough bass boost to overcome the Fletcher-Munson effect. (2) If some bass boost is used for other purposes—for example, to compensate for room characteristics, speaker characteristics, bass deficiency in the program sources, the listener's preference as to bass-treble balance, etc.—there may not be enough boost left to also take care of the Fletcher-Munson effect at very low listening levels.

The occasional inadequacy of the bass control could be overcome if it provided something like 30 db or more bass boost at the extreme low end rather than the conventional 15 to 18 db of emphasis. But this raises other problems. For one thing, additional bass boost is achieved by attenuating the rest of the audio range, which means loss of gain. To restore the original gain of the control amplifier might well require another amplifier stage, entailing more cost, more bulk, and perhaps more distortion and noise, which tend to increase with each additional stage. Another problem is that the availability of as much as 30 db or more bass boost might overload the following stage, particularly at high volume levels. Moreover, if so much bass boost were applied at high volume level, either intentionally or accidentally, this might blow out the speaker.

Variable Bass Control

What we really want, therefore, is more available bass boost only at low levels, that is, when the gain control is turned down. This can be termed a *variable bass control.* And we want this extra bass boost without substantially increasing cost and with no increase in noise and distortion. We would like to eat our cake and have it.

Fortunately, all these desiderata can be had through a very simple and economical circuit, shown in Fig. 1A. As stated in the previous paragraph, it can be called a variable bass control, because at any setting *above mid-position* it provides an increasing amount of bass boost as the gain control is turned down. The circuit operates at no expense in gain, so that an additional stage is not required. The *extra* bass boost is derived directly from the gain sacrificed by the volume control. In other words, some of the gain given up through the gain control is retrieved at low frequencies, thereby achieving bass boost.

The circuit can be incorporated in new or existing equipment. In the case of existing equipment, it would be necessary to replace the pot in the bass control circuit with a pot of the same value and taper but permitting the ad-

[1] Burstein, Herman: "Is a Loudness Control Necessary?" RADIO & TV NEWS, July, 1958.

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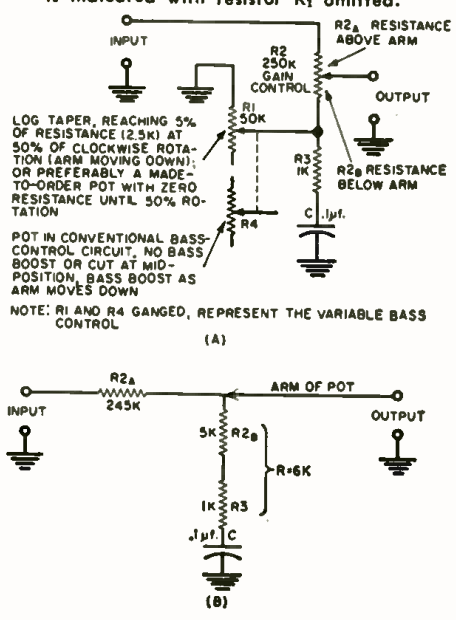
dition of a ganged control, namely R_1 in Fig. 1, so that both will be operated by a single shaft.

To help explain the circuit, Fig. 1B shows it in slightly different form and with R_1 omitted. For simplicity, the series combination of R_{2B} and R_3 is termed R. The arm of R_2 is assumed to be positioned so that R_{2A} is 245,000 ohms and R_{2B} is 5000 ohms. R_{2A} and R form a voltage divider. At high frequencies, C is a virtual short-circuit to ground, so that the output voltage is determined by the ratio of R to $R + R_{2A}$. At the lower frequencies, however, C is not a short-circuit to ground. As frequency decreases, the increasing reactance of C causes a larger portion of the input voltage to appear across the output terminals. The upper turnover frequency, where the reactance of C equals R, is 260 cycles, and there is a 3-db rise in output at this point. Output continues to rise with decreasing frequency owing to the rising impedance of the output leg of the voltage divider. However, when the reactance of C equals $R_{2A} + R$, the bass boost approaches an end. At this lower turnover frequency, bass boost is within 3 db of the maximum attained; the maximum boost of course is equal to the input voltage. The greater the ratio of R_{2A} to R, the greater is the total bass boost; also, the higher is the frequency at which boost commences.

It can be seen that bass boost is due to the role played by C. If C were to be shorted, then no bass boost would occur; instead there would be the same attenuation for all frequencies. Returning to Fig. 1A, we can now understand the role played by R_1. When the bass control is at mid-position or below (counterclockwise), R_1, which is ganged with the bass control, is at a minimum and effectively bypasses C. Hence there is no *extra* bass boost due to C. As the bass control is turned *above mid-setting* (clockwise), C is no longer bypassed, so that it can introduce extra bass boost. The amount of extra bass boost produced by C depends upon the extent to which it is bypassed by R_1. The more the bass control is above mid-setting, the greater is the resistance of R_1, the smaller is its bypassing action, and therefore the greater is the extra bass boost due to C.

Fig. 1. Variable bass control circuit is shown at (A). (B) Equivalent circuit is indicated with resistor R_1 omitted.



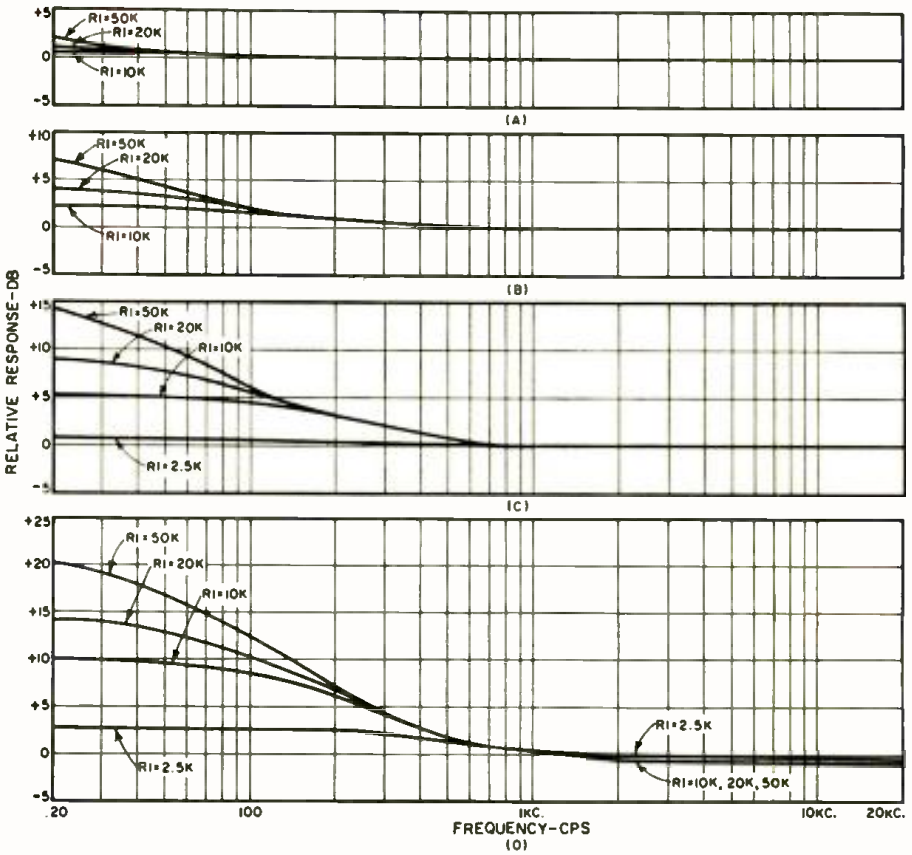


Fig. 2. Effect of R_1 upon response when the gain control is set for various degrees of attenuation at 1000 cps as follows: (A) −10 db, (B) −20 db, (C) −30 db, (D) −40 db.

At the same time, the amount of extra bass boost depends upon the position of the arm of R_2. The lower the setting of the arm, the greater is the ratio of R_{2A} to R (see Fig. 1B), and therefore the greater is the *potential* extra bass boost. However, this potential can be realized only if the bass control is clockwise of mid-position, so that R_1 does not effectively bypass C.

The purpose of R_3 is to limit the frequency at which bass boost commences (3 db rise) at very low settings of the gain control. R_3 in conjunction with R_{2B} and C keeps the upper turnover frequency below 1000 cycles until the gain control is turned practically all the way down. The value of the gain control, R_2, is chosen so that it will be suitable in most control amplifiers, that is, low enough not to produce a significant high frequency loss in conjunction with the input capacitance of a high-mu triode (typically a 12AX7) following the control. On the other hand, the 250,000-ohm value of R_2 is high enough not to load down the typical preceding stage apt to be encountered.

Effects of Control

Figs. 2A, 2B, 2C, and 2D show the effect of various values of R_1, these values depending upon the extent to which the bass control is turned clockwise of mid-position. Each figure shows the effect of R_1 for a given setting of the gain control. These settings represent volume reductions of 10, 20, 30, and 40 db at 1000 cycles.

Fig. 2A shows that when volume is reduced 10 db, very little *extra* bass boost is produced, even when the bass control is all the way up and therefore R_1 is at maximum resistance, permitting maximum extra boost. At 40 cycles, only about 1 db extra boost is obtained. In such a situation, namely with volume reduced only 10 db, it is to be expected that the conventional bass control will be perfectly able to cope with the various factors requiring bass boost.

When volume is reduced 20 db, more than 5 db extra boost can be had at 40 cycles. When volume is decreased more than 20 db—which is when the conventional bass control may become inadequate to the tasks it faces—copious amounts of extra bass boost become available. When volume is reduced 30 db at 1000 cycles, 40 cycles can be boosted an *extra* 11.5 db; assuming that the conventional bass control can supply 15 db boost, this makes 26.5 db boost in all. When volume is reduced 40 db, 40 cycles can be boosted an *extra* 18 db, or a likely 33 db in all.

If still greater amounts of extra bass boost are desired than indicated by the graphs of Fig. 2, this can be achieved by simply decreasing the value of C, causing boost to commence at a higher frequency. Values between .025 μf. and .1 μf. appear to be practical, serving to

(*Continued on page* 104)

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Electronic pH Measurement

By TOM JASKI

This widely used processing technique involves many electronic technicians in industrial work.

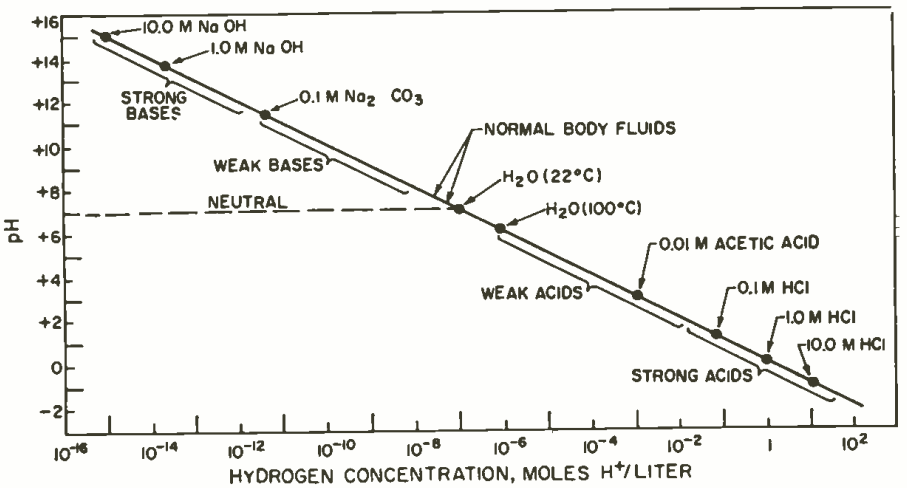


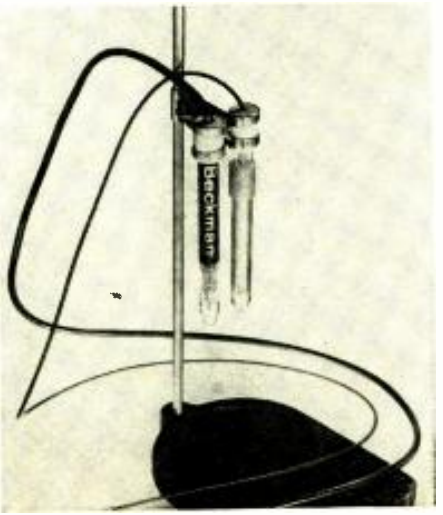
Fig. 1. The pH factor is a logarithmic function of hydrogen-ion concentration.

IF YOU ARE an electronic technician who has moved over into industrial work, you may encounter a mysterious instrument called a *p*H meter. This encounter may take place if you are in the food industry, the oil industry, the paper and textile industry, a chemical or cosmetic plant, a medical laboratory, or a biological research center. What is it, why do we use it, and how does it work?

The *p*H factor is the yardstick for measuring acidity or alkalinity, particularly of liquids. This happens to be an extremely important measurement, because human and animal life is possible only within a very narrow range of *p*H for the body fluids. Excess acidity leads to coma and death. Excess alkalinity can cause convulsions and, eventually, death.

We can protect ourselves against such extreme forces of nature as heat and cold. We can withstand other unusual environmental conditions or compensate for them (such as using supplementary oxygen at very high altitudes). However, there is little that can be done rapidly to counteract a *p*H that has gone awry. If our *p*H goes up from its normal, slightly base (alkaline) point, we've had it.

Fig. 2. Glass (left) and calomel reference (right) electrodes by Beckman.



Small wonder then that *p*H measurements are used in any industry dealing with articles that human beings consume, wash in, smear on themselves, or feed to their pets. We find it used anywhere from water-supply systems, to sewage-treatment plants, to bakeries.

Only electronic techniques are sensitive enough to measure *p*H—at least where any sort of convenience or reasonable speed is required. Chemical titration (adding one drop at a time of a neutralizing solution to a liquid being tested) is a long, slow process, although it may actually be somewhat more accurate.

The term *p*H is actually a ratio for the concentration of hydrogen ions in a solution. Specifically, $pH = log \frac{1}{H \text{ ion concentration, in moles/liter.}}$ The liter, metric unit of capacity, is equal to approximately one quart. The "mole" is a popular abbreviation for the gram molecule. A gram molecule is that quantity of any element or compound which has a weight (in grams) equal numerically to its molecular weight. The molecular weight of a substance is the number of times its molecule is heavier than a molecule of hydrogen, whose molecular weight is 1.

To take a specific example, the molecular weight of oxygen is 32. Thus a molal (gram-molecular) solution of

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oxygen would be one in which every liter of liquid would have 32 grams of oxygen dissolved in it.

The reason the mole is used is that it *always* contains the same number of molecules, whatever substance is involved. If a substance is heavy (has molecules that weigh more), we use a proportionately greater number of grams. When a substance is light (has "lighter" molecules), we use fewer grams, keeping the number of molecules the same. A mole always contains 6.06×10^{23} molecules, as a matter of fact. This makes the formula for defining *p*H pretty sensible, for all it says is that we want to know how many hydrogen (H^+) ions are floating about in a given quantity of solution.

The *p*H chart of Fig. 1 shows that this factor is a logarithmic function of hydrogen ion concentration (horizontal axis). Actual *p*H numbers were established arbitrarily, with the value of 7 being assigned to absolutely neutral water (which is not practical to achieve). Above this number we have a base, or alkaline solution; below this number we are dealing with an acid. The lower the number, the stronger the acid; the higher the number, the stronger the base. A strong (10-molal) solution of hydrochloric acid (HCl) is shown at one extreme of the scale, with a strong solution of lye (sodium hydroxide, NaOH, *p*H of 15) at the other extreme.

Note that the range of *p*H in which life can exist is extremely small, slightly base. Note also that we may have to measure, for strong bases, a very small number of ions. We must measure down to about 10^{-15} mole, or only about 10,000,000 ions in the solution. Now if you consider that we could not put enough zeros on this page to write out the total number of molecules in a liter of water, you can see that this must indeed be a sensitive measurement.

Our means to this end is a very good electrode, called a glass electrode, which is sensitive to the number of H^+ ions in a solution. We compare the measurement we get from this glass electrode with a standard, which we call the calomel (mercurous chloride) electrode. The latter electrode is completely insensitive to H^+ ions in a solution. The two electrodes are shown diagrammatically in Fig. 5, and the actual electrodes are shown in Fig. 2.

Now the glass electrode is such a complicated device that whole books have been devoted to its theory of operations; so we will not try to explain it here. Just remember that between the outside solution, which is the solution to be measured, and the inside "buffer solution" (usually hydrochloric acid) a potential is created proportional to the number of H^+ ions in the former. Also note that the calomel electrode is so saturated with ions that it is completely insensitive to outside ion changes, but that it always produces a potential of .282 volt at 22 degrees C. The temperature is important, because the potential changes with temperature and we must always either compensate or correct for this when reading *p*H.

Now if we use some sensitive instrument to measure the potential between the glass electrode and the reference calomel-potassium chloride (KCl) electrode, when both are dipped into a solution whose *p*H we want to know, we will read a voltage proportional to the H^+ ions less the voltage of the reference electrode. The glass electrode has extremely high internal resistance, on the order of 100 megohms or more. We cannot measure the potential with an ordinary instrument, for we would virtually short the electrode, even with a good v.t.v.m. This would, in fact, actually damage the electrode. It would "polarize" in the same way as a battery does under heavy discharge, and would become useless for days until it recovered.

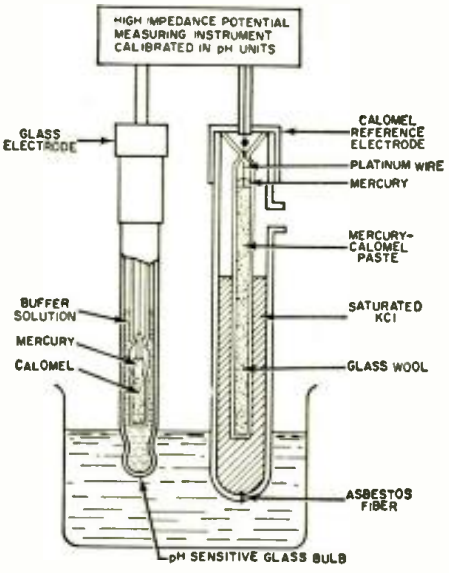

Fig. 5. Cut-away shows details of the glass and reference electrodes.

We must use an instrument with very high input resistance, as well as a sensitive one. Such an instrument is called an electrometer. It is a specially designed v.t.v.m. with no resistance from grid to cathode, except leakage over the very special vacuum tube used, something that can be measured in the thousands of megohms.

Fig. 4 shows a special *p*H measuring instrument designed by *Beckman*. Fig. 3 is the schematic diagram. But, since this is a bit cluttered, let's look at Fig. 8, which is a simplified diagram showing the basic action with all the refinements left out. Here you can see a bridge type of circuit to provide a precise voltage for the tube. This voltage is connected in opposition to the input voltage from the electrodes. Thus when the bridge voltage is adjusted to

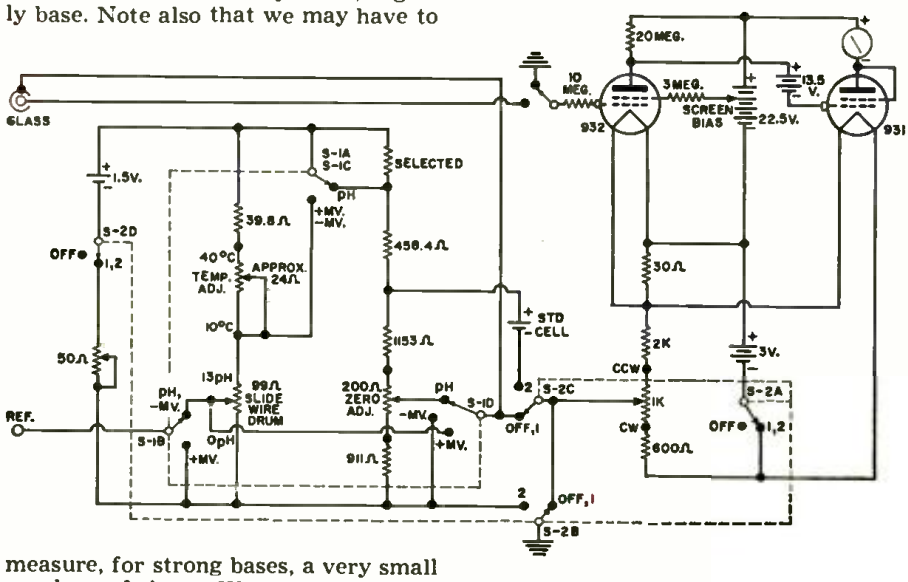

Fig. 3. This circuit measures voltage difference between electrodes with an electrometer. Latter is a sensitive v.t.v.m. with very high input R.

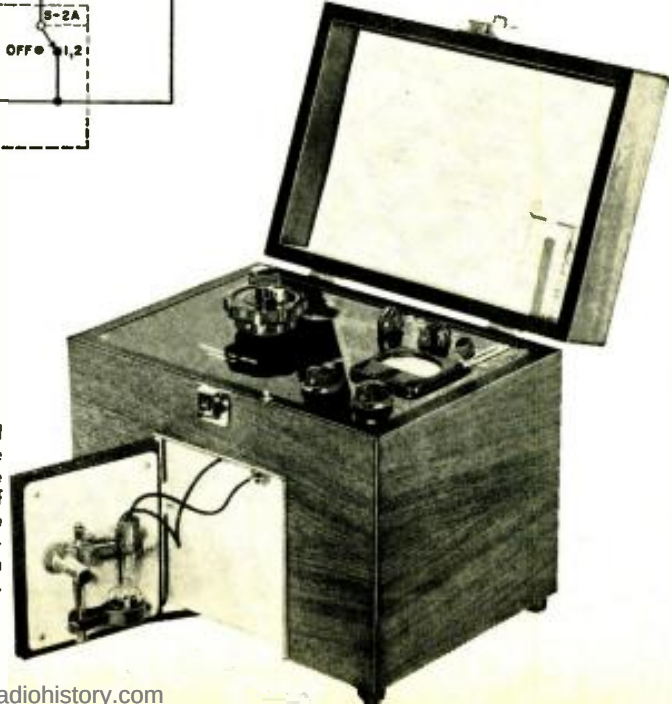

Fig. 4. This Beckman pH meter includes a voltage bridge and a sensitive electrometer (circuit of Fig. 3) in addition to the two external, test electrodes shown mounted on the door's inside panel.

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exactly the same voltage provided by the external electrodes, not even grid current for the small vacuum tube can flow, the meter will show null (plate current is kept down by the applied bias), and so the glass electrode has no load on it. This is important for accurate measurement.

Now, looking back at Fig. 3, you can quickly distinguish some refinements to this basic circuit. There we see temperature compensation (the 24-ohm control), and a variable resistance (50 ohms) to compensate for battery voltage drop (which is of course important to accuracy). We also see a standard cell which is used to check the battery voltage. In the *MV* position of switch S_1, the instrument is set up to compare battery voltage. The temperature adjustment control is graduated in degrees; it is set after the temperature is read separately on a thermometer. Note that in the *MV* position the instrument is also usable for the measurement of very small voltages.

The slide-wire scale (99 ohms) is graduated in small *p*H units. Thus when we have balanced the bridge perfectly for battery voltage and temperature, we then connect our two electrodes and null balance for these with the slide-wire drum. Now we can read *p*H directly on the calibrated slide-wire scale. The meter is connected to the electrometer tube through an added cathode-follower stage, instead of being shunted across the electrometer stage, since otherwise the low meter resistance would shunt the vacuum-tube plate load resistor. Note that the bias is obtained from the 3-volt filament battery, and adjusted by means of the 1000-ohm potentiometer.

Accurate as this measuring instrument is, it is not very convenient for a processing situation. In the latter, we will very likely prefer to have a means of continuously recording the changes in *p*H which may occur during a process. For this we would add some sort of continuous recorder, like the instrument shown in Fig. 7. The diagram for this type of unit is given in Fig. 6. This is a sensitive recorder by virtue of an integral, high-gain a.c. amplifier.

Fig. 7. This General Electric continuous recorder charts pH level changes.

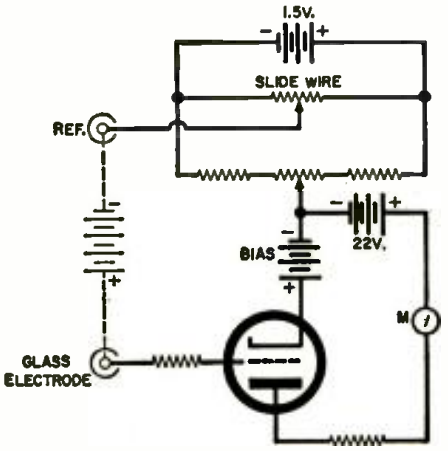


Fig. 8. Basic electrometer circuit to read voltage with negligible loading.

Although the small voltage we wish to measure is a d.c. potential, we can use an a.c. amplifier because the input circuit of the instrument is provided with a chopper. The latter may be described as a precision vibrator or d.c.-to-a.c. inverter. Because of its accuracy, the a.c. output is reliably proportional to the direct current input.

The change on the glass electrode is approximately 59 millivolts per unit of *p*H. Thus to measure *p*H within the range of the values suitable to human life, which is .2 unit of *p*H (7.3 to 7.5), we need measurements covering little more than 10 millivolts full scale.

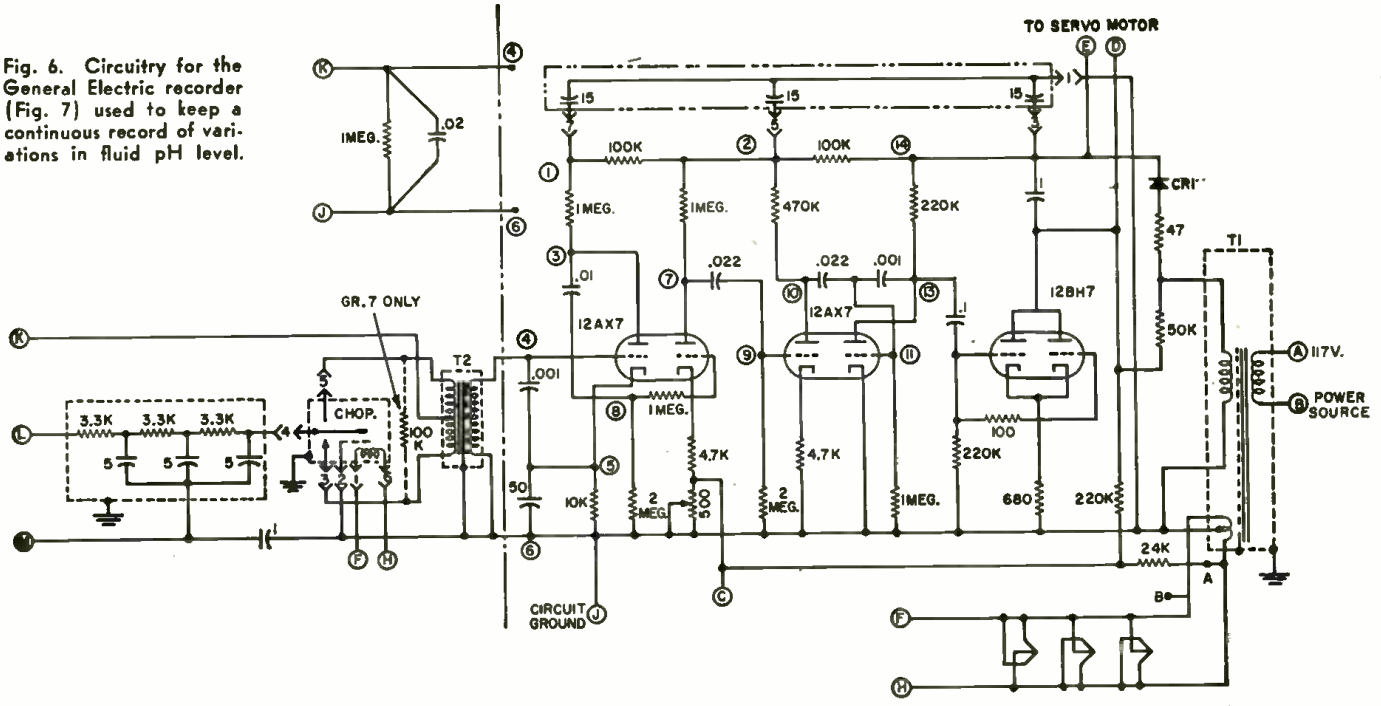
This is well within the range of the instrument shown. Temperature compensation is still needed, and we will use the same type of bridge circuit to obtain the "bucking" voltage for the electrodes. However, in the continuous kind of measurement we would use a more rugged voltage source, such as a well regulated power supply, and for temperature compensation a separate temperature bulb (Fig. 9) is also immersed in the liquid being tested. The bulb then would automatically perform the function of the manual temperature-adjusting potentiometer in Fig. 5. Output from the amplifier drives the recording assembly through a servomotor.

Accuracy of the continuous kind of recording would, in all probability, be less than with the electrometer instrument, but it would have the advantage that at least we would detect *changes* in *p*H readily, and we could trace back in time to see when such changes occur. This would give us a clue as to what part of the process caused the changes, and allow adjustments or corrections to be made.

Service on *p*H instrumentation will seldom concern the electrodes. Cracked electrodes cannot be mended, and must be replaced; indication of cracked electrodes is given when the electrode fails to respond to a known "test" *p*H change. The manufacturer usually recommends that new electrodes, which are made from extremely thin glass, be soaked in water for some time before being placed in service. This has to do with initial changes in the electrode,

(*Continued on page* 130)

Fig. 6. Circuitry for the General Electric recorder (Fig. 7) used to keep a continuous record of variations in fluid pH level.



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Making Your Career in Electronics

By NORMAN EISENBERG

THOMAS EDISON, trying to improve his incandescent lamp in 1883, noted that electrical energy seemed capable of crossing a gap between two conductors—a hot filament and a positively charged plate—in a vacuum. Why this "Edison effect" occurred or how it could be used was not understood. Some 13 years later, Sir J. J. Thomson provided clues, involving the flow of electrons, in his investigations and conclusions concerning the electron theory. Then, in 1907, Lee de Forest found a way of controlling this electron flow in a vacuum tube by introducing a grid.

The last event triggered a series of developments which, as history views such things, rapidly projected the world into a new era, the age of electronics. From Edison's modest observation, electronics has become, in little more than two generations, a complex and pervasive area of science and technology, comprising many fields, "subfields," and combined fields that cut across, up, and down through virtually all fields of endeavor in all parts of the world. It has furnished us with products our grandparents could only have dreamed about (or could not even have dreamed about) from miniature hearing aids to space ships. It has involved large numbers of people in many ways.

There was a time—within the memory of most of us—when the "man in electronics" was a fellow down the street who fixed radios. Today a "man in electronics" may be testing critical metals, or using a 200,000-power microscope, or measuring miniscule voltages from a living brain, or listening to signals from outer space, or designing an industrial control system—or still doing well at repairing home radios plus a host of other appliances including TV sets, auto radios, hi-fi equipment, and Citizens Band gear. Still growing, this gigantic industry has already become the fifth largest in the U.S.A., with an estimated annual revenue approaching $15-billion and employing more than 1,700,000 men and women.

Are There Openings?

Impressive as the size of this "task force" is, we are often told it is inadequate for present assignments and anticipated expansion—*not* always in terms of available numbers but (perhaps more important) in terms of *specific skills and training*. Thus, while electronics undeniably offers a vast job market, it often is a *selective* market, particularly with respect to advancement and the better paying jobs. For the same reason, of course, it is somewhat competitive—although, at the top job levels, the jobs themselves often compete for the man.

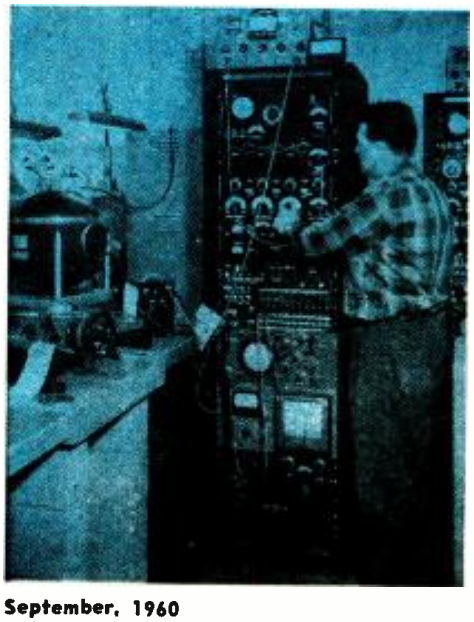
In any case, electronics is one of the best career-potential fields today. According to a recent study made by David L. Golan, a leading employment consultant and head of *Stevens Associates*, N.Y.C., its horizons are constantly changing to present new vistas. One of the results, for example, of a recent Supreme Court decision involving patents and design development was to place a number of designs into public domain. As a result, companies with sufficient capital could move ahead into diverse areas that were not before practical, opening new opportunities. Since mid-1959, for example, *RCA* has made a commitment of some $800-million to be invested in the next five years in computers. Others, such as *Philco, Burroughs, National Cash Register* have also entered this area or are about to do so. According to Golan, this is just one example of how "the field suddenly explodes into new facets, with newly created job openings for qualified personnel," even where the supply of trained people seemed adequate a short time before.

Throughout the field and its many ramifications—of which computers, ultrasonics, nucleonics, automation, and so on are only a few—there is, of course, difference as to what constitutes "qualified personnel," how much they can earn, and how far they can go. Different types of operations, different products and services, sometimes different parts of the country all add up to create exceptional dips and peaks in any "average" or "normal" line of development. Nonetheless, and keeping the possibility of exceptions in mind, it is feasible to describe something of a pattern as regards training, jobs, salary levels, and advancement.

Details and specifics are listed in the accompanying tables, based largely on the recent Golan-*Stevens* study and other industry sources. As indicated, the entire field of electronics, from a job standpoint, can be classified in terms of positions requiring relatively little technical training; those that re-

1

Photo 1: Technician stands behind azimuth alignment theodolite (made by Perkin-Elmer) at base of Jupiter missile. Photo 2: Technician for Picker X-Ray Corp. radiographically checks a stainless-steel coating. Photo 3: A Kearfott technician uses a test console to check a gyroscope.



3

2

Competence in electronics does not automatically guarantee you a brilliant future; but, with wise judgement, you can find one of the good positions to be had on most levels of technical qualification.

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quire technical training of a specific nature below the college level; some with college training, although not necessarily a degree; and those which definitely demand a college degree. Note that the indicated requirements are for *entering* a specific job; advancement almost always involves additional training and study.

Bottom of the Ladder

To begin with, let's take the person with little or no specific technical training or job experience, but with interest and proven or indicated aptitude—a budding radio ham, for example, or a man who has tinkered with small electronic construction projects at home. At the very least, such a person could start as a trainee or "junior electronic technician." An example of the kind of job he could get might be, perhaps, simple wiring and testing under supervision, at a salary of $55 to $70 a week. Actually, such a job would constitute an apprenticeship.

Under conditions of normal industrial growth, that man could expect to earn between $85 and $100 a week after one or one-and-a-half years. With suitable training (either at an outside school or through in-plant training), he could rise steadily. It is not uncommon to find, after a three-year period, that such a man is designated as "senior electronic technician" at pay up to $130 a week, or as "junior foreman" at $100 to $105 a week, or even "senior foreman" at $125 to $150 a week.

Work such as testing or mock-up wiring, at a higher-than-beginner level, would require that a man have the ability to visualize things spatially. Higher positions in this area would require some knowledge of mathematics as well. On the other hand, another major area of work primarily involves manual dexterity. This would be in parts and components assembly. Interestingly enough, many of the jobs requiring so-called manual skills are being filled—and quite well, too—by women, although in supervisory posts it is generally the men who take over.

Promotion in this area may lead to line foreman, or assistant foreman, or into quality control. With solid mathematical training, plus specialized courses and proven administrative ability, one could eventually work into statistical quality control, a fairly high-paying type of work. At the quality-control level, you generally move out of the "hourly rate" class into the "yearly salary" range, specifically $6000 to $8000. Statistical quality control pays up to $10,000-$11,000 a year.

Sales and Service

Yet another major area for the untrained, but talented, beginner would be in sales and service. A newcomer might start as an apprentice at the bench, under supervision, earning $50 to $65 a week. After two years, if all went well, he should have learned enough to warrant a salary of $90 to $100 a week. In time, he could be earning about $125 a week; as a field service technician he might get $150 weekly.

An entry into sales work could be made, perhaps, after two years with the company. Naturally, the company's needs and the man's own abilities would have to agree for this to happen. The sales field, generally, is tricky and difficult to generalize about. Admittedly, in sales, you will find some of the highest paying positions in any industry. Industrial sales generally offer higher average earnings than consumer-product sales, although individuals in consumer-goods sales do, at times, earn more than industrial sales personnel.

In any case, sales work, despite its well-known returns, can be unstable. Take, for example, the steady decline in the sales of specific types of home entertainment equipment—notably AM radios—which, according to EIA figures, went downward after 1948. Also consider the slow fall in TV set sales after 1956. Often as not, such declines are not so much a matter of "bad times" as a result of periodic fluctuations or intra-industry undercurrents that are tricky to assess. On the other hand, they can be compensated for. For example, when AM sales went down, FM sales began to go up. Hi-fi components cut into package sets, and so on. Somewhat less obvious would be periodic changes in car radio sales. Here, the number of sets sold relates directly to the number of new cars sold; and the latter number follows an apparent three-to-four year cycle. Thus, a man who did very well in 1955 selling car radios might find his earnings down in 1956 and 1957, but picking up again in 1958. The sales work field takes, among other qualifications, a "head" for this sort of anticipatory reckoning as well as the ability and wherewithal to "ride it out" at times.

Engineers and technicians, in hearing-aid development for Sonotone Research Laboratories, are making acoustic tests.

Neither chief of electronic design dept. (left) nor engineering assistant (right) for M. Ten Bosch has a degree.

Technical Training

For the technically trained, non-college, non-sales-minded person there are other well paying areas. The specific form of training could be that obtained through a technical school, either residence, or correspondence, or a combination of both; a military-service technical school; a company-sponsored school such as those conducted by *RCA, IBM, AMF*, and others; or through in-plant or on-the-job training. And it could be obtained before or during actual employment.

The most typical electronic schooling would give a man a solid grounding in basic electronic theory and circuits, plus laboratory or workbench practice. He would become familiar with test equipment as well as some of the maintenance and operation of practical equipment. The more math he can absorb during this training, the better off he is likely to be in the long run. While math may not be essential to filling a good many jobs successfully at the outset, it may be a requisite for advancement later on. It would be a "must" in certain fields such as design work or advanced jobs involving computers.

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GROUP I

All positions in this group, beyond the beginning level, can be attained by progression within the individual job categories indicated.

JOB TITLE	FIELDS	LEVEL	TRAINING & EXPERIENCE	SALARY RANGE (Annual)
Assembler	Manufacturing and production, electronic components and equipment	Trainee	High school	$ 2600-3200
		Junior	H.S. + 6 mos. job experience	2800-3900
		Senior	H.S. + 2 yrs. job experience	3600-5200
		Inspector	Same, or experience as sr. assembler, or tech. school grad. + 2 yrs. job experience	4400-6500
		Foreman		4400-6900
Electronic Technician	All phases of the industry	Trainee	H.S.	2500-3300
		Junior	H.S. + 1 yr. exp., or some technical schooling	3100-4200
	(See Group II for further information and higher job levels.)			
Laboratory Technician	Research and development, private industry as well as gov't. and military (See Group II for further information and higher job levels.)	Trainee	H.S. + indicated or demonstrated aptitudes	2800-3900
Sales	Electronics distributors; retail sales; sales divisions of mfrs., etc. (See Group II for further information and higher job levels.)	Trainee	H.S. + indicated or demonstrated aptitudes; science or math interest preferred	3100-5200
Service Technician	Components and equipment mfrs.; service organizations; gov't. and military	Trainee	H.S. for computer trainee, math, aptitude, and some training preferred	3100-3600 (up to 3900 for computer service trainees)
		Junior	Technical school graduate, or on-the-job training	3600-5200 (plus per diem in some cases)
	(See Group II for further information and higher job levels.)			

GROUP II

All positions in this group require technical school training, or specialized company courses, or some college training.

JOB TITLE	FIELDS	LEVEL	TRAINING & EXPERIENCE	SALARY RANGE (Annual)
Assistant Engineer	Electronic equip. mfrs.	Junior	Graduate of technical school, service school, or on-the-job training. Could be upgraded from technician, service trainee, or sr. draftsman	$ 3000-4200
		Intermediate		4200-6000
		Senior		6000-8000
Cameraman	TV studio	Junior	Technical School or other special training	7500-9000
		Senior		9000-12,000
		Supervisor		10,000-14,000 +
Civil Service Specialties	Government and airways services, military electronics	Classified by Government index system; for details, consult Civil Service Commission	H.S. + technical training. Various combinations of job experience and schooling possible to qualify for different positions	4600-13,500
Computer Technician, Wiring	Various phases of civilian and military production, service, and maintenance	Levels not specified	Technical school, or appropriate military school, or H.S. + on-the-job training	3600-6800
Computer Technician, TAB Operator	As above, plus various business applications	Junior	As above	3300-4200
		Intermediate		3900-5200
		Senior (Supervisor)		4500-7800
Computer Technician, Programmer	All phases of business and industry, banking, commerce, consulting work, research and development, etc.	Trainee	Tech school or 2 yrs. college; college grad	4200-5200
		Junior	As above	5200-7000
		Intermediate	As above, plus math. aptitude	6500-9000
		Senior	College grad with major in math, physics, engineering, or accounting	8000-12,500
Designer	Manufacturing; research and development; some distributors; all production of parts and equipment; specialized areas, e.g.—nucleonics, instrumentation, communications, radar, etc.	Junior	Technical school; appropriate military school; also may be upgraded from draftsman	4000-6000
		Intermediate		5200-8000
		Senior	Engineering degree, or equivalent in college-level trng. + experience	7800-12,500
Draftsman	Same as above	Trainee	H.S. + mech. aptitude	3200-4200
		Junior	Technical or military school; or from training as above	3900-4500
		Intermediate	As above	4400-7000
		Senior	As above	6500-10,000

(Continued on next page)

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GROUP II—(CONTINUED)

JOB TITLE	FIELDS	LEVEL	TRAINING & EXPERIENCE	SALARY RANGE (Annual)
Electronic Technician	All phases of manufacturing, service, research	Intermediate	Technical school or equivalent, or upgraded from jr. technician	4500-6000
		Senior		5500-7500
Field Engineer	Liaison, maintenance for manufacturer, or distributor, or military	Junior	Technical school or equivalent; also may be recruited from technicians, draftsmen, others	5000-6000
		Intermediate		5600-8000
		Senior		7500-9600
Field Maintenance and Repair	Equipment mfrs.; military airways; utilities; computers and business machines	Junior	Technical school or selected from technicians	4250-6000
		Senior		5500-7500 plus per diem
Foreman, plant	Manufacturing	(Not applicable)	Technical school and generally specialization in experience	4400-7800
Inspector, parts and quality control	Manufacturing; research and development	Junior	Technical school or recruited from assembler	4400-5600
		Senior		6000-7500
		Supervisor	Some college	6500-8000
Instrument Technician	Missiles; Airlines; CAA	Junior	Technical school	4400-6600
		Senior		6000-8000
Laboratory Technician	Test equipment; research and development	Intermediate	High school and technical school, and with experience at lower level in category	4500-6000
		Senior		5500-7500
		Note: can progress to Prototype and Model Maker		to 10,000
Radio Operator	Airlines; ships; other communications	Varies with situation	Technical or company school; FCC ticket	6000-7500 +
Radio/TV Transmitter Engineer	Various governmental posts as well as commercial broadcasting	As above	Appropriate schooling; FCC ticket	6000-14,500
Sales Engineer	Technical sales at various business and industry levels	As above	Technical school with special product training preferred	6000-22,000 + (too varied to specify exactly)
Sound Specialist	Recording, radio, TV broadcasting		Technical school	6000-10,000
Technician	Communications; utilities; airlines; telephone	Varies	Technical school, sometimes plus company school	6000-8400
Technical Writer	Manufacturers; military; communications; many others	Junior	Some college, degree preferred	4500-6000
		Intermediate		5500-7500
		Senior		7200-9600
		Editor		8500-12,500
				(Per diem sometimes added in top 3 categories)
Test Engineer	Manufacturing	Junior	Technical school or some college plus experience at lower level in category	4600-6600
		Intermediate		6000-8000

All positions in Groups I and II, appearing above and on the preceding page, are open to personnel without college degrees.

A broad academic base in electronics often saves a man years of job apprenticeship. It also permits him to start at a higher level than he could without schooling. A spokesman for *Reeves Instrument Corp.* has said that a man with only six months of real electronic schooling is likely to be more valuable to the company than a man with 18 months of job experience and no equivalent schooling.

Not only can the trained man start at a higher level (what might be for the untrained man an intermediate level), but he can move up faster and higher, and into more interesting and diverse fields. Research and development, industrial controls, broadcast engineering, and instrumentation are only a few. A beginning laboratory technician, for example, in instrumentation, might start at $65 to $85 a week. After a three- to five-year period, he'd be earning up to $125 a week. If, in the course of his work, he became a specialist at, say, wiring prototype models, he'd earn $8500 a year. Once in this area, he could take advanced study and eventually find his way into design work, with a salary in the five-figure bracket.

An "intermediate technician" could also use his background and experience to qualify for such fields as airways communications, government monitoring, or general broadcasting.

The man "moving up" is invariably a man "brushing up." Sometimes when a company finds "its man," it will sponsor his schooling at a reputable institute, which may or may not lead to a degree, depending on the courses chosen and the needs of the particular study program. Recently, for example, a relatively small company in Brooklyn, N. Y., which specializes in microwave research and development, was looking for a senior electronic technician. The salary offered was $125 to $130 a week, plus fringe benefits. Among the latter were a medical plan and other conventional advantages—plus sponsorship through a college degree in engineering or physics, all expenses paid.

Military Training

What about military service schools? These provide training similar to that

(*Continued on page* 94)

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Teleprinter Sets Speed Record

By
JORDAN McQUAY

Technical details on world's fastest message printer that operates at speeds up to 12,000 words per minute. New electrostatic printing techniques are utilized.

Fig. 1. Components of the high-speed teleprinter along with copy prepared by unit.

FASTEST message printer in communications history is a high-speed teleprinter that operates at rates up to 1000 characters *per second* — or about 12,000 words per minute!

This is 200 times faster than an ordinary teletypewriter, 150 times faster than an average typist, and 75 times faster than the average person talks.

Developed for the Army Signal Corps by the *Burroughs Corporation*, the teleprinter (Fig. 1) has no type bars or faces like conventional teletypewriters. It uses a new method of electrostatic recording to form letters and figures on dielectric-coated paper, without the use of chemicals. The only mechanical motion is the paper-drive mechanism, and even this movement is controlled electronically.

The system is also equipped with a standard keyboard for low-speed manual operation, or for preparing tapes which later may be fed back into the system at much higher operating speeds. But its principal feature is its ability to receive and record messages at high speed using a new technique of page printing with electronic control.

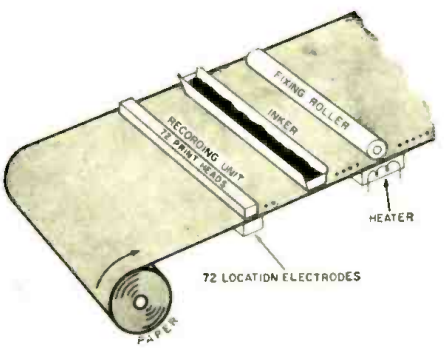
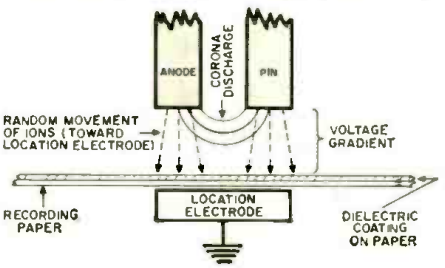


Fig. 2. Electrostatic recording system used.

Fig. 3. Electrostatic action between the anode and the pin of a single print head.



The electrostatic recording system produces visible marks on paper in accordance with applied electrical signal intelligence. Alphanumeric characters are formed almost instantly, and in any font or format.

The recording system (Fig. 2) consists essentially of a complex recording unit, an inker, and a fixing roller.

The recording unit is composed of a single row of 72 small *printing heads*. Opposite each head is a *location electrode*. Paper passing between the row of printing heads and the row of location electrodes is acted upon by one or more of the printing heads, each of which can produce any letter, figure, line, or symbol on the paper by electrostatic action.

To illustrate this action, refer to Fig. 3.

Each printing head is composed of an array of *pairs* of anodes and pins. The pairs are arranged in a 7 x 5 matrix. Each *anode* has its respective *pin*.

The anode—known as the *column selector*—is pulsed by 800 volts. At the same time, the pin is pulsed by about

(*Continued on page* 102)

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Don't Underrate Transistors

By JAMES R. SPENCER

Explanation of maximum ratings of junction transistors and how to determine maximum operating capabilities.

Storage Temperature, t_s	−40 to +65°C
Collector-to-Emitter Voltage, V_{CE}	−20 volts
Collector Current, I_C	−150 ma.
Collector Dissipation at 25°C Ambient Temperature, P_C	200 mw.
Junction Temperature Rise (without heat sink), k	0.2°C/mw.
Junction Temperature Rise (with heat sink), k	0.065°C/mw.

Table 1. Absolute maximum ratings of typical junction transistor used as example.

NORMALLY transistors are not operated at their maximum ratings; however, there are many times when it may be desirable to operate a transistor very close to these maximum ratings. An understanding of the interrelationship among the various maxima is necessary if the demise of many a good transistor is to be prevented.

Manufacturers of transistors supply specification sheets which provide information comparable to that found in a tube manual. Usually after a brief description of the transistor and its mechanical specifications, the absolute maximum ratings are listed. A typical list of such ratings for a germanium *p-n-p* junction transistor is shown in Table 1. The transistor is a medium-power unit intended for audio-output applications.

Storage Temperature

The storage temperatures are the two temperature extremes, low and high, to which the entire transistor—case, leads, whiskers, and semiconductor blank—can be subjected without permanent damage. The low-temperature extreme is usually determined by cold-induced mechanical stresses which may cause the germanium blank to crack. The effects which determine the high-temperature extreme are not as simple. For example, I_{co}, the a.c. parameters, and the life expectancy of the transistor may all deteriorate with extended storage at elevated temperatures. The results of transistor life tests, however, indicate that life expectancy is an exponential function of the ambient storage temperature and, therefore, the maximum storage temperature is usually chosen to yield a reasonably high life expectancy.

The storage temperatures also have the following influence on transistor operation. The transistor case temperature cannot be below the low-temperature extreme during operation and the transistor junction cannot exceed the high extreme.

Maximum Ratings

The absolute maximum collector-to-emitter voltage is the maximum reverse voltage which may be impressed between the emitter and collector without permanently damaging the transistor. The value of this maximum voltage is usually determined by what is known as punch-through. Punch-through occurs when the electric field generated by the collector voltage extends completely across the base region. When this point is reached, transistor action ceases and an extremely large current flows between the emitter and collector.

The common-emitter output characteristic curves for the transistor given in Table 1 are shown in Fig. 1. The diagonally hatched area indicates the region on the curves where operation is not possible without exceeding the absolute maximum voltage rating of the transistor.

The absolute maximum collector current is the maximum current which can flow through the base-collector junction without irreversibly damaging the transistor. This value is determined by the maximum current density the base-collector junction can tolerate. It is a function of base-collector junction area, semiconductor material resistivity, and is different for each type of semiconductor.

Fig. 2 shows the limitations placed on the output curves by both the absolute maximum collector voltage and the absolute maximum collector current.

Fig. 1. Collector curves showing limits due to voltage rating.

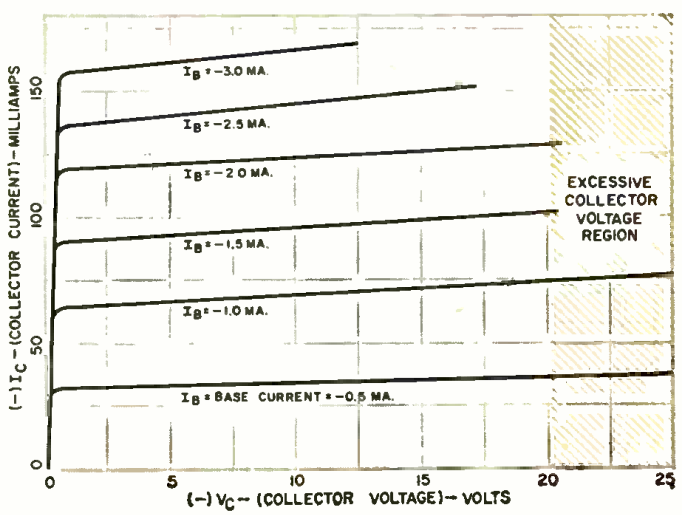
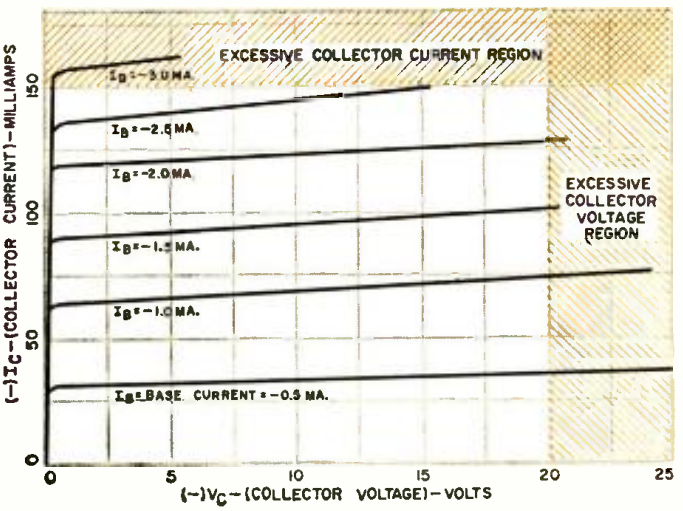


Fig. 2. Limits imposed by collector voltage and current maxima.



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The product of the two maxima in Fig. 2 gives a power rating of 3 watts. The manufacturer, however, has specified in Table 1 an absolute maximum collector dissipation of 200 milliwatts at an ambient temperature of 25°C (77°F. See Table 2 for converting centigrade to Fahrenheit.) The power dissipated within the transistor and termed collector dissipation is the familiar I^2R loss of electrical power which is converted into heat. The maximum allowable collector dissipation is a function of the thermal resistance of the junction and is limited by the maximum allowable junction temperature. The maximum junction temperature is the same as the high temperature limit of the storage temperature ratings discussed earlier. The temperature of the junction is elevated above the ambient, or case, temperature when the transistor is operating, due to collector dissipation. The junction temperature may be calculated for any transistor using the equation:

$$t_j = t_a + kP_c \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where t_j is the junction temperature, t_a is the ambient temperature, k is the thermal drop of the transistor, and P_c is the collector dissipation. Here k is a function of the mechanical design and heat dissipating mechanism of the transistor. Two values for k are given in Table 1; one for when the transistor is used without a heat sink and the other for when an infinite heat sink is used. The junction temperature of this transistor, when operated at the absolute maximum collector dissipation specified by the manufacturer, can be obtained by substituting values in equation (1):

$t_j = 25 + 0.2 \times 200$

$t_j = 65°C$

CENTIGRADE (DEG.)	FAHRENHEIT
−40	− 40
−35	− 31
−30	− 22
−25	− 13
−20	− 4
−15	+ 5
−10	+ 14
− 5	+ 23
0	+ 32
+ 5	+ 41
+10	+ 50
+15	+ 59
+20	+ 68
+25	+ 77
+30	+ 86
+35	+ 95
+40	+104
+45	+114
+50	+122
+55	+131
+60	+140
+65	+149

Table 2. Temperature conversion table.

Collector Dissipation

It can be seen from the above that the manufacturer has stipulated a maximum collector dissipation rating that will provide safe junction temperature when the transistor is operated at normal room temperatures. To illustrate the limitations imposed by the maximum collector dissipation rating, a maximum power dissipation area is shown on the collector characteristic curves in Fig. 3. The cross-hatched area indicates the region on the curves where operation at an ambient temperature of 25°C is not possible without exceeding the absolute maximum collector dissipation rating.

If the transistor is operated at an ambient temperature that is higher than 25°C, the collector dissipation must be derated. For example, if the transistor is operated in a sealed equipment case that also contains operating vacuum tubes, the ambient temperature may be as high as 122°F. The maximum collector dissipation allowable for operation without a heat sink at this ambient temperature can be determined by a restatement of equation (1).

$$P_c = \frac{t_j - t_a}{k} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$P_c = \frac{65 - 50}{0.2}$$

$P_c = 75$ mw.

Thus it is possible to operate the transistor in an ambient temperature of 122°F provided precautions are taken to limit the maximum collector dissipation to 75 milliwatts. The limitation imposed on transistor operation at 122°F ambient is illustrated in Fig. 4.

The relationship between collector dissipation and ambient temperature shown in equation (2) indicates the possibility of safely operating the transistor beyond the manufacturer's absolute maximum collector dissipa-

(*Continued on page* 135)

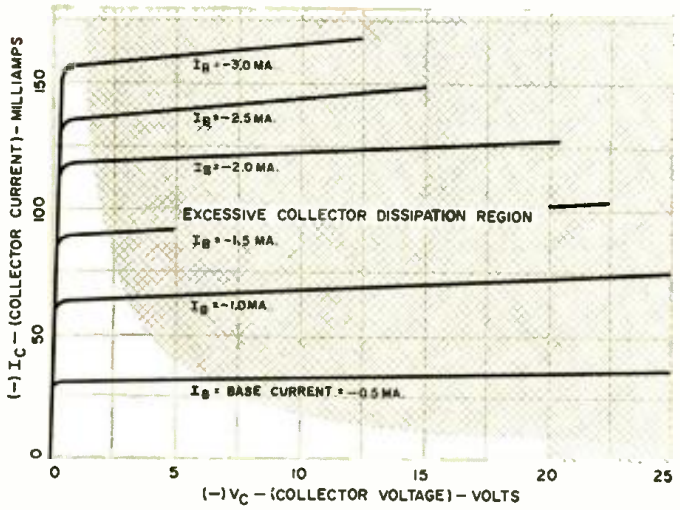


Fig. 3. Limitation imposed by maximum collector dissipation when transistor is operated at 25° C without using heat sink.

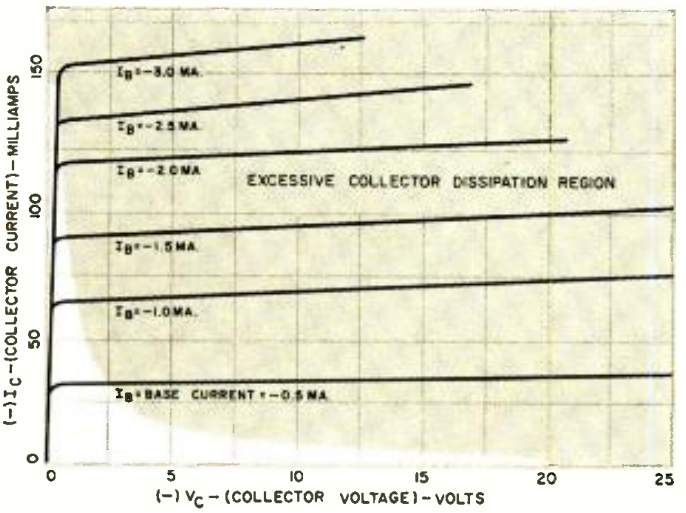
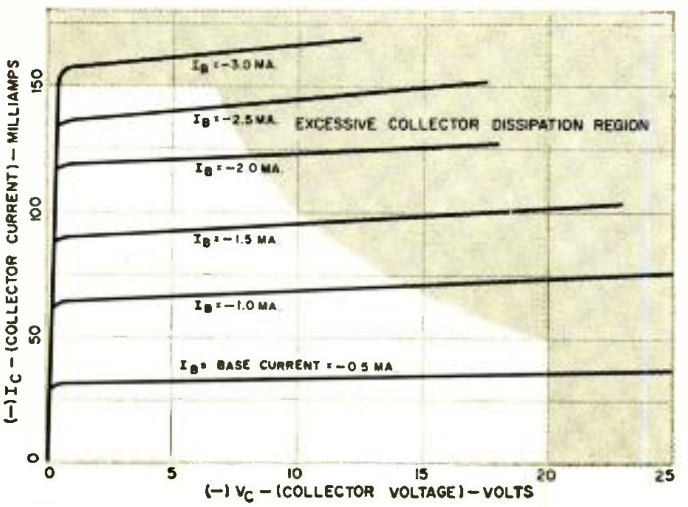


Fig. 4. Limitation imposed by maximum collector dissipation when transistor is operated at 50° C without using heat sink.

Fig. 5. Collector dissipation limitations for operation at an ambient temperature of 0° centigrade with a heat sink employed. Compare the region of excessive collector dissipation shown here with that obtained under operating conditions shown in the previous figure.



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THE CITIZENS BAND & ITS USES

More efficient and economical business operations—more pleasurable uses of our leisure hours—these and more are offered by Citizens Radio equipment.

THE growth of the public communications network in the United States is one of the major reasons for our country's economic strength. We are able to communicate rapidly by means of telephones and to bring the public up-to-the-minute through broadcast radio and television. Another means of communication, personal mobile communications, is now enjoying tremendous popularity.

We have long had two-way mobile radio services for use by police and fire departments, and businesses able to show a real need. But the technical requirements have been stringent, resulting in relatively high-cost equipment. Then, in 1947, the Citizens Radio Service was authorized.

Three classes of stations were set up. These are:

Class A (460-470 mc., 50-watts maximum power) This service is used by groups not eligible for a license in other services but, because of technical requirements, equipment is quite expensive, around $700 and up.

Class B (465 mc., 5-watts maximum power) Any citizen over 18 years old can get a license; relatively loose technical requirements allowed low-cost sets (around $100), but because of the power limits and the line-of-sight propagation characteristics of radio signals at this frequency, only very short range is possible.

Class C (27 mc., 5-watts maximum power or 30 watts under certain conditions) This is allocated exclusively for remote control of objects (model planes and boats, garage doors, etc.).

Even with the range limitations of the Class B service, two companies,

Vocaline Company of America, Inc. and *Stewart Warner Corporation*, marketed low-cost equipment. An estimated 12,000 to 15,000 licenses were issued with some 35,000 radios in service.

Because of the interest generated by use of the Class B Citizens Band and other considerations, the FCC re-evaluated the allocations of certain frequency bands and came up with two major changes. One of these was the establishment of the Business Band, with its less strict eligibility requirements for a station license. The other was the setting up of an additional class of station in the Citizens Band, the Class D. Such stations operate on some 23 voice channels in the 27-mc. band with a maximum power of 5 watts (plate power input).

When the Class D Band was first opened up, some irresponsible manufacturers advertised that their equipment could be used as a license-free amateur band, just to gab or to see at what distances one could reach another station, and fill up the airwaves with

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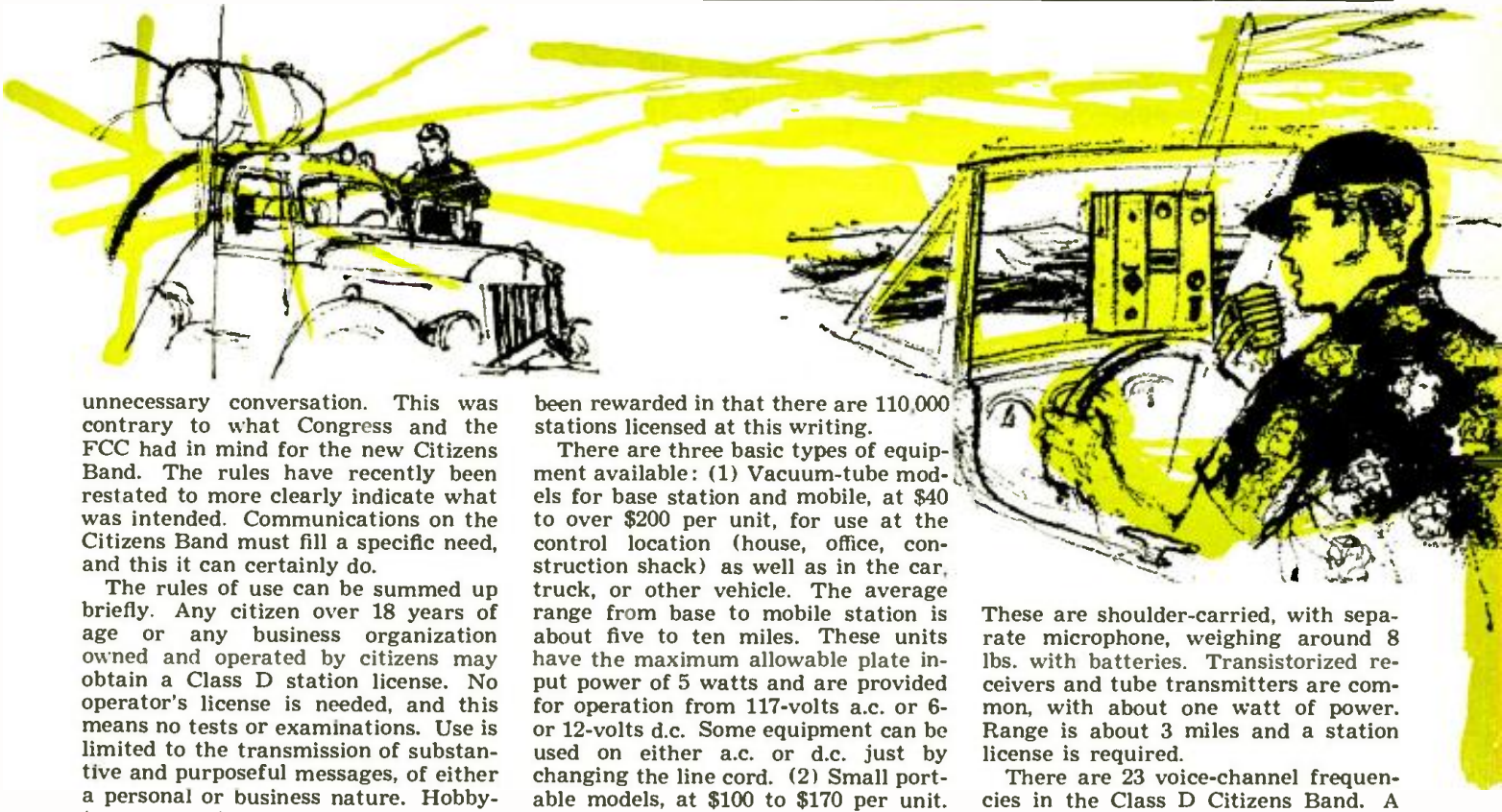
A National Travel Service Frequency for Citizens Banders

IT WASN'T too long ago, in fact in our February, 1960, issue (page 8) that ELECTRONICS WORLD suggested the desirability of having specific channels assigned for use by those interested in marine applications of Class D Citizens Band equipment. It would be rather foolish if every boat owner were left on his own to choose a channel out of the 23 available. Chaos would result, and communication between boats and marinas would be utter confusion. Partly as a result of our editorial, but more likely because of the wholehearted cooperation of everyone concerned with the operation of CB equipment, channels 9 and 13 were chosen for marine applications. The use of these frequencies, of course, is not compulsory, but it is the hope of everyone in the industry that these channels will be accepted on a voluntary basis so that a more efficient use of this new band will result.

Because of the enthusiastic support from the marine field, it became obvious that a similar arrangement should be set up for use by tourists, when traveling on our highways, to call motels, service stations, or to call for any form of help under emergency conditions. Channel 15 (27.135 mc.) was thought most desirable, and it is to be referred to as the "National Travel Service Frequency." The thought did come up that there might be a possibility of violating section 19.61 (g) of the FCC rules and regulations for Class D operation. This rule prohibits "any transmission designed to elicit a response from random or unknown stations," and requires that the transmissions from a Class D station "be addressed to specific persons or stations" except in an emergency situation.

The FCC, in a letter to Vocaline Company of America, Inc., clarifies the regulations as they would apply in this case as follows: "Section 19.61 does not mean it is necessary to address the persons or stations by call sign or by name in a situation of this type. Accordingly, it is permissible for a licensee of a Class D station to direct a transmission to any motel, gas station, or garage within a particular limited area, as long as the privilege is not abused. It is emphasized that the procedure most clearly indicates that it is not a general call to any or all stations hearing that transmission, and the transmission must be adequately specific to indicate the station or stations desired even though the names and call signs of the stations involved are not known." The transmission should be made in the following form: "This is 1W0000 calling any motel in the (specified) area. I am located at ..... and require accommodations for the night. Can you advise if you have an opening and, if so, the best route to follow."

Since no further obstacles remain, Channel 15 is now to be used as a "National Travel Service Frequency." Plans are being formulated to bring this to the attention of all motor clubs, motels, service stations, and emergency services. Once again, the industry has shown leadership in trying to make the Class D Citizens Band an effective and useful means of communication. As in the marine field, the use of this channel is not compulsory. —30—



unnecessary conversation. This was contrary to what Congress and the FCC had in mind for the new Citizens Band. The rules have recently been restated to more clearly indicate what was intended. Communications on the Citizens Band must fill a specific need, and this it can certainly do.

The rules of use can be summed up briefly. Any citizen over 18 years of age or any business organization owned and operated by citizens may obtain a Class D station license. No operator's license is needed, and this means no tests or examinations. Use is limited to the transmission of substantive and purposeful messages, of either a personal or business nature. Hobby-type or radio-amateur type of communications are prohibited.

In the two years since September, 1958, when the Class D Band became a reality, and the present, over fifty manufacturers have put Citizens Band transceivers on the market, indicating a knowledge, at least on the part of manufacturers, that a tremendous potential market exists. Their faith has been rewarded in that there are 110,000 stations licensed at this writing.

There are three basic types of equipment available: (1) Vacuum-tube models for base station and mobile, at $40 to over $200 per unit, for use at the control location (house, office, construction shack) as well as in the car, truck, or other vehicle. The average range from base to mobile station is about five to ten miles. These units have the maximum allowable plate input power of 5 watts and are provided for operation from 117-volts a.c. or 6- or 12-volts d.c. Some equipment can be used on either a.c. or d.c. just by changing the line cord. (2) Small portable models, at $100 to $170 per unit. These are completely transistorized, hand-held sets with built-in microphone, weighing from 8 oz. to 4 lbs. Power is less than one-tenth watt and the range is very limited, up to perhaps one mile. Not even a station license is required if these little portables are used with one another and not with a bigger licensed set. (3) Larger portable models, at $200 to $300 per unit. These are shoulder-carried, with separate microphone, weighing around 8 lbs. with batteries. Transistorized receivers and tube transmitters are common, with about one watt of power. Range is about 3 miles and a station license is required.

There are 23 voice-channel frequencies in the Class D Citizens Band. A station license does not limit the operation to one or a limited number of frequencies as is the case in some other radio services. This is of distinct advantage if a given area becomes crowded with many systems on the same frequency because it is only necessary for the owner to change his channel of operation to a less congested frequency.

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Use of two-way radio has required, and always will require, patience on the part of the user. There are only so many frequencies available for communication and this results in a "party-line" situation. Users of any radio service are bound to have other stations operating on the same frequency. This will result in interference. This should not pose too serious a problem since most messages should take less than a minute and the great majority are only five to ten seconds long.

Applications

It is not necessary to have a business or commercial reason for using the Citizens Band. For example, one of the largest uses is in pleasure boating. The range over open water is from 5 to 40 miles depending on the quality of the set, the noise suppression of the engine, and the antenna installation. If you have a cottage on or near the shore of a body of water, you can use the Citizens Band to let your wife know that the fishing is good and you're going to stay out another hour, or you ran into Charlie and you're on your way over to his house for a beer, or you ran out of gas and want her to send someone out. You can talk to others who have sets in their boats to find out where the fish are biting, where to rendezvous, what sea conditions are, and so on.

It has been suggested that Channel 13 (27.115 mc.) be used as the non-commercial marine frequency. All clever marina operators will probably monitor this so that boat owners will always be able to call for their facilities or other information. Because many boats and marinas are presently equipped with sets and many thousands more will be by next season, a certain degree of safety is afforded. However, the Coast Guard does not monitor the Citizens Band and any boat operating in coastal or Great Lakes waters should be equipped with a regular marine radiotelephone so that the Coast Guard may be summoned should help be necessary.

If your car and house are equipped with Class D radios, you can let your wife know you are stuck in traffic and will be late, or you can ask her if she wants you to stop at the store. Families travelling together on a vacation can pass road information back and forth between cars.

Although the above indicates some legal pleasure uses for the Citizens Band, its prime function is in aiding the operation of a wide variety of commercial enterprises. All businesses that use trucks, cars, tractors—any vehicle—can put the Citizens Band to good use.

How many times has the driver of a service vehicle arrived back at the shop only to find that he had another call he could have made a mile from where he was and 10 miles from the shop. All types of services are in this category, oil delivery and furnace maintenance, radio and TV service, refrigeration and other appliance services, rural sewage maintenance, and so on. Then there are laundry and dry cleaning pick-up and delivery trucks, ready-mix concrete, sand and gravel trucks, and other similar services.

In addition, CB equipment can be used in the control of construction equipment, cranes, bulldozers, and trucks; tractors, trucks, and combines on large farms; lift trucks and other yard machinery at industrial plants; real-estate salesmen's cars; maintenance equipment on golf courses, cemeteries, and parks; and crop dusting, exterminating, small town taxis, and local trucking.

Professional use of CB gear is also suggested for doctors in rural communities and veterinarians with a large-animal practice. School buses have been equipped with Citizens Band radios in rural areas for safety and convenience during snow storms or if breakdown occurs.

Auxiliary police and volunteer fire departments use Class D equipment for primary or supplementary communications; county road maintenance crews use it to speed up operations and help re-route traffic.

But why the Citizens Band? Why not the Business Band? Most commercial enterprises are eligible for a Business Band license but many thousands cannot afford the higher priced equipment. Most do not need the few extra advantages of a somewhat greater range and partial protection from interference that the Business Band offers.

No discussion of this type would be complete unless the liabilities are also mentioned. There are two major disadvantages to use of the Class D Citizens Band, or any other service for that matter that operates on frequencies up to 50 mc. The first is "skip," in which radio signals are reflected back to earth by the ionosphere. These signals are received a thousand miles or more away by someone who couldn't care less. This effect is sporadic and should not seriously hamper the use of the band. Patience is required at times, but users will usually find some other people on their channel locally.

The other disadvantage is the electro-mechanical and atmospheric noise that is created between 20 and 30 mc. This is overcome in several ways and brings us to receiver design considerations and eventually to relative equipment cost. Although differences in transmitter efficiency and type of modulation account for variations of up to perhaps 40 per-cent in transmitter output (the FCC limits the power *input* to 5 watts), the major dissimilarities in performance between one manufacturer's unit and another are the result of receiver design.

Receiver Design

Many Class D channels are spaced only 10 kc. apart. If a receiver does not have a high degree of selectivity (ability to receive only what it is supposed to), the user will hear stations transmitting on adjacent channels. This can be extremely disconcerting. Further, the ever-present noise generated in this frequency will appear along with the signal to a degree that requires a relatively strong signal to override the noise.

The degree of sensitivity (ability to respond to a weak signal) now becomes a factor. As you get farther away from the station you want to reach, your transmitted signal becomes weaker. The better the receiver's sensitivity, the farther you will be able to go before losing the other station.

If the inherent noise suppression built into the receiver is inadequate, good selectivity and sensitivity are of little value. Fortunately, good noise suppression usually goes hand-in-glove with a highly selective and sensitive circuit, but not always.

When a receiver is turned on, everything that is picked up by the antenna is applied to the receiver, noise as well as signal. The various tuned circuits begin eliminating the unwanted noise and signal as they amplify the desired signal. But there is always some residual noise and, unless there is something to quiet the noise, an operator can find it annoying. "Squelch" is the name given to the circuit that keeps the receiver completely quiet until a wanted signal arrives. To be of real value, the squelch must "open" to a signal as weak as the receiver can use. It is also helpful to have the squelch variable so it can be adjusted to the desired level of signal strength to be received.

(*Continued on page* 90)

Table of the channels and corresponding frequencies that may be used in Citizens Band.

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
1	26.965 mc.	12	27.105 mc.
2	26.975 mc.	13	27.115 mc.
3	26.985 mc.	14	27.125 mc.
4	27.005 mc.	15	27.135 mc.
5	27.015 mc.	16	27.155 mc.
6	27.025 mc.	17	27.165 mc.
7	27.035 mc.	18	27.175 mc.
8	27.055 mc.	19	27.185 mc.
9	27.065 mc.	20	27.205 mc.
10	27.075 mc.	21	27.215 mc.
11	27.085 mc.	22	27.225 mc.
		23*	27.255 mc.

* Shared with Class C radio-control and not recommended for use in Class D Band.

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Radio Aids to Aircraft Navigation

By **FRANCIS A. GICCA**
Senior Engineer, Raytheon Co.

Description of two widely used electronic systems that will allow a pilot to perform a safe instrument landing.

IN THE previous articles of this series we discussed the three systems of long-range aircraft navigation which allow a pilot to guide his airplane between distant cities. These three systems: radio ranges, direction finding, and VOR, can make long-range navigation almost automatic. As a matter of fact, there are several aircraft autopilot systems which operate with ADF or VOR bearings and actually keep a plane on course automatically. However, the most exact enroute navigation is of no avail unless a landing can be successfully completed at the destination. This final article will describe the two widely used systems of terminal navigation which allow a pilot to perform a safe instrument landing.

Before an instrument approach and landing can be performed, it is obvious that an airplane must first be guided away from its long-range enroute course and on a course which leads the airplane to the vicinity of the terminal airport. Most low-frequency radio-range stations have been so located that one of the four courses lies directly over the instrument runway of a nearby major airport. An airplane flying along this on-course radial will thus fly right over the airport and can receive terminal navigation signals to perform an instrument landing.

Likewise, ADF beacon and VOR stations are located so that airplanes flying along a specified radial will be guided over a major airport. In high density areas where several major airports exist it would be impractical to locate long-range navigation stations so that all airports are covered. In this case, each airport maintains its own short-range navigation station designed to guide airplanes to its vicinity. ADF beacons are widely used by airports for this purpose. Such beacons will guide airplanes to the airport area but not necessarily along a radial which lies along the instrument runway, due to wind-drift effects. Since VOR inherently eliminates the wind-drift problem, VOR is also used to navigate airplanes to the instrument runway. Such terminal short-range VOR is known as "TVOR." All short-range navigation aids are designed to guide airplanes within about 25 miles of the airport where terminal navigation can begin.

Instrument landings should be called instrument approaches since terminal navigation does not actually *land* an airplane. Rather, terminal navigation allows an aircraft to make a low instrument approach to the end of the runway and, *if* the runway comes into sight without exceeding specified minimum conditions of ceiling and visibility, a normal landing can be executed. In general, these instrument landing minima are: ceiling 1000 feet, visibility 3 miles. If the weather causes airport conditions to be below these minima then a landing is not legally possible, even with radio aids, and an alternate airport with acceptable weather must be used.

Two systems of terminal navigation are in widespread use in the United States today. These are ILS and GCA. ILS allows an instrument approach by reference to cockpit instruments alone. GCA, on the other hand, requires no cockpit instrumentation since all navigation equipment is on the ground. The airplane needs only a functioning v.h.f. transmitter and receiver in order to maintain contact with the GCA controller.

ILS

The ILS (*I*nstrument *L*anding *S*ystem) of terminal navigation was developed during World War II in order to enable properly equipped aircraft to make a safe instrument approach and landing during poor weather conditions without visual reference to the ground. ILS also helps reduce the length of time aircraft must be held aloft during periods of traffic congestion by speeding up instrument approaches.

The standard ILS navigation system consists of three separate navigational aids combined to provide a sharply defined radio path to the end of the instrument runway. These three aids, the "Localizer," "Glide Slope," and "Marker Beacon," combine to provide lateral and vertical guidance to the runway as well as positive radio fixes along this approach. The transmission and reception of each separate element of the ILS navigational system will be discussed individually and then combined in order to study the over-all operation of this unique system of terminal navigation.

The "Localizer" portion of ILS provides a beam course for horizontal, left-right, guidance. It is similar to the low-frequency radio ranges in that it provides a horizontal radio range course oriented along the direction of approach. Fig. 10A shows a simplified block diagram of a typical ILS Localizer transmitter. A 200-watt v.h.f. transmitter operating in the 108-112 mc. band broadcasts the range signal. In the low-frequency radio-range system, position away from the on-course signal is marked by an off-course Morse Code signal which is audibly noted. Obviously, such a system would not be suitable for marking the Localizer course since aircraft position should not depend upon a pilot's ability to hear deviations from on-course when his airplane is so close to the ground. Small deviations from the Localizer course at low altitudes could cause a disaster. The on-course signal, therefore, must be coded in a manner that allows deviations to be electronically detected by an aircraft receiver and displayed on an appropriate cockpit meter.

Fig. 10A shows how the on-course signal is coded. The v.h.f. carrier power is fed to two independent amplitude

PART 3

Terminal Instrument Navigation (ILS & GCA)

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ILS localizer transmitter shack. The localizer array inside the building is an 8-antenna linear array. Two antennas, which are placed close together in the center, radiate the modulated carrier signal, and the other six loops are placed symmetrically on either side to form the necessary horizontal localizer course.

modulators where the carrier is 20% amplitude modulated by 90- and 150-cycle signals. The modulated Localizer signal is then applied to a broad horizontal antenna array which transmits the Localizer signal. The 150-cycle modulated signal is beamed to the right of the runway centerline while the 90-cycle modulated signal is beamed to the left of the runway centerline. As in the low-frequency radio ranges, these two signals overlap in a narrow beam along the centerline of the runway. Along this beam both signals will be received with equal intensity. To the right of the runway the 150-cycle modulated signal will be stronger while to the left of the runway the 90-cycle modulated signal predominates. Because of the extremely directional characteristics of the v.h.f. antenna array used, the horizontal beam—where both signals are equal in intensity—is extremely narrow. Thus, position from the Localizer centerline can be simply determined by measuring the relative intensity difference between the 90- and 150-cycle signals detected by a v.h.f. receiver.

Fig. 11A shows the simple receiver used to detect and display Localizer signals. The v.h.f. receiver is generally the same receiver that is used for v.h.f. communication and reception of VOR signals since these also lie within the 108-127 mc. receiver band. Following detection of the 90- and 150-cycle on-course coding signals by the receiver's audio detector, these signals are separated by tuned filters. The separated signals are then diode detected in order to produce two d.c. voltages proportional to the received strength of the 90- and 150-cycle coding signals. A left-right meter is connected between these two d.c. voltages so that it indicates the difference between them. Thus, if the 90-cycle signal is stronger than the 150-cycle signal, its d.c. voltage will be larger—which will cause the left-right meter to deflect to the right. This indicates that the airplane is to the left of the runway centerline and a corrective turn to the right should be executed until the meter is centered. The indicator is so sensitive that an angular position error of less than two degrees will deflect the meter off-scale. In most aircraft installations, the left-right meter used for Localizer indications is the same meter used by the VOR converter.

The "Glide Slope" portion of ILS provides a second beam for vertical, up-down, guidance. Operation of the Glide Slope is almost identical to that of the Localizer, that is, position from a vertically inclined beam which intersects the end of the runway is determined by measuring the relative amplitude of 90- and 150-cycle coding signals.

Glide Slope transmitters broadcast in the u.h.f. band of 328.6 to 335.4 mc. and radiate a maximum power of 20 watts. Fig. 10B shows a simplified block diagram of a Glide Slope transmitter. As in the Localizer, the u.h.f. Glide Slope carrier is amplitude modulated to about 48% in two modulators by 90- and 150-cycle coding signals. Two simple horizontal dipole antennas mounted on a mast are used to transmit the Glide Slope signal. The upper dipole beams the 90-cycle modulated signal upwards and the lower dipole beams the 150-cycle modulated signal downwards. The beam formed by the overlapping of these two signals is inclined at between 2¼ and 3 degrees to the end of the instrument runway and thus forms a vertical glide path that will lead aircraft down to the end of the runway. The actual angle chosen depends upon the nature of the terrain beyond the runway.

Glide-slope transmitter shack and antenna system. Note the two dipole radiators on pole. These are placed at different heights and are moderately directive horizontally. The lobing of the two antennas in the vertical plane differs because of different heights, and the glide-slope course is formed by the junction of the lower lobe of the lower antenna and the two lower lobes of the upper antenna. The angle of the resultant course is controlled by antenna heights. Signals above glide slope have mainly 90-cps modulation, while those below glide slope have mainly 150-cps modulation. A third (modifier) antenna array maintains the glide slope perfectly straight to the touch-down point.

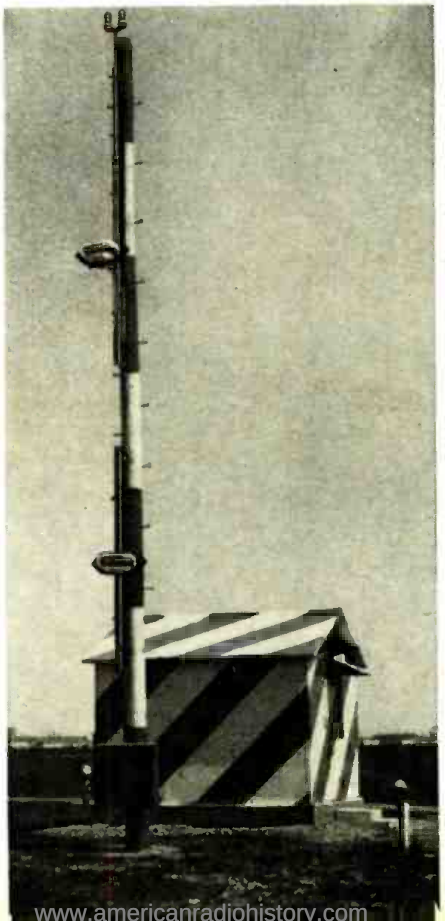

Fig. 11B shows that the typical Glide Slope receiver is also similar to that used for receiving Localizer signals. However, the Glide Slope receiver is used only for reception of u.h.f. Glide Slope signals whereas the Localizer v.h.f. receiver is also used for communications and VOR navigation. Detected Glide Slope coding signals are separated by two 90- and 150-cycle tuned filters. The signals are then rectified and used to deflect an up-down meter. If the 150-cycle signal is stronger than the 90-cycle signal, the up-down meter will deflect upwards indicating that the aircraft is below the glide path and the pilot must execute a climb until the meter is centered.

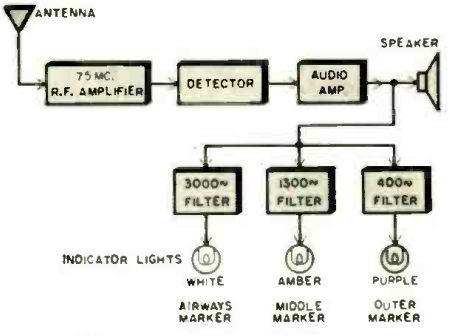

Fig. 9. Marker-beacon receiver.

Since the glide path angle can be as small as 2¼ degrees from the horizontal, the Glide Slope indication must be extremely sensitive to small angular position errors since an error of only a couple of degrees could cause a serious crash. For this reason, an angular error of less than half a degree will cause full-scale deflection of the Glide Slope up-down meter.

Localizer and Glide Slope indications are often combined in a single cockpit panel meter which may also include a VOR course selector thereby centralizing most navigation functions in a single indicator. The *Lear* Model 4087 indicator, used in the NAVCOM 100 navigating system, is typical of such a multiple indicator.

By following the lateral and vertical guidance provided by the Localizer and Glide Slope transmitters, a pilot can perform an accurate instrument letdown to the end of a runway. However, horizontal and vertical guidance alone is not sufficient for a *safe* instrument landing for it is vital that a pilot also know his relative position along the approach path. Unless this additional information is provided, it is en-

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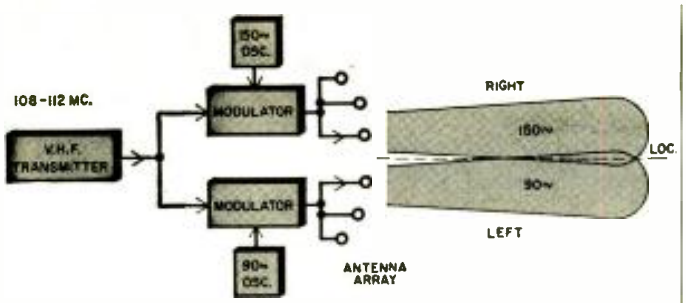
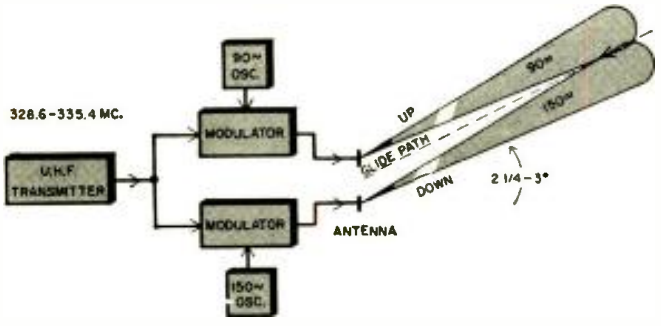
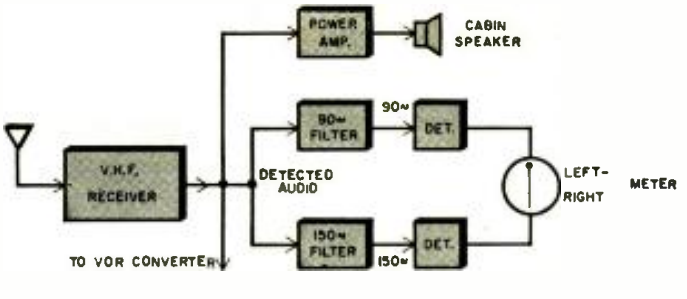


A

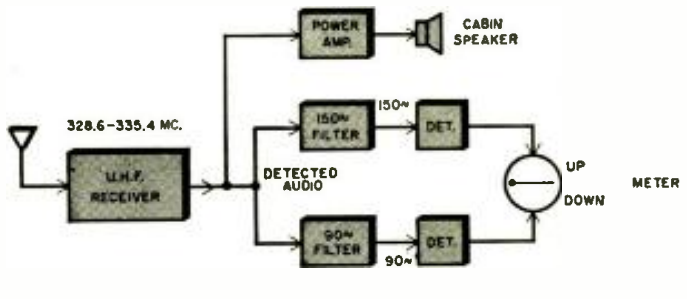


B

Fig. 10. (A) Localizer and (B) glide-slope transmitters.



A



B

Fig. 11. (A) Localizer and (B) glide-slope receivers.

tirely possible for an airplane to run into the ground at the end of the runway because the pilot did not know he was so close to the ground and could not see the runway. True, the aircraft carries an altimeter, but unfortunately an altimeter is not sufficiently accurate since it is sensitive to barometric pressure weather changes and furthermore tends to lag true altitude during a descent. Therefore, a more accurate, or "positive," fix must be provided. The "Marker Beacon" portion of the ILS system provides this position fix.

A "Marker Beacon" is simply a low-powered v.h.f. transmitter whose radiation is sharply beamed upwards to form a flat cone-shaped vertical beam above the station. When an aircraft passes over a Marker Beacon station the signal is received and the pilot then knows he is directly over the station. Thus, appropriately placed Marker Beacons along the approach path indicate an aircraft's position on the path.

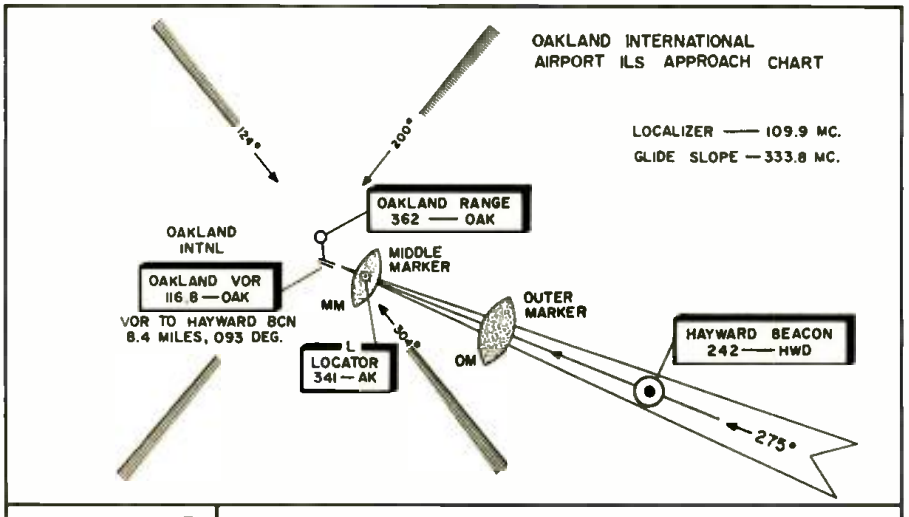
There are three different types of Marker Beacons. All operate on a frequency of 75 mc. and all radiate about two watts of power. The first type of beacon, known as an Airways Marker Beacon, is used to provide long-range navigation fixes. These airways beacons are located along airlanes and provide positive location on long flights. Airways markers are identifiable because they are amplitude modulated with a 3000-cycle continuous tone and are keyed continuously with 6 dots per second. At some airports, the airways marker is also used as a runway boundary marker and is located about 250 feet from the approach end of the instrument runway.

The two remaining types of Marker Beacons are used exclusively for ILS approaches. The "Outer Marker" (OM) Marker Beacon, as its name implies, is located farthest from the runway and generally serves to mark the point at which a descent should begin. Outer Markers are amplitude modulated with a 400-cycle continuous tone and keyed continuously with 2 dashes per second. The Outer Marker is located between 4 and 7 miles from the end of the runway.

The "Middle Marker" (MM) Marker Beacon generally marks the point at which descent should cease if the runway is not in sight. Middle Markers are amplitude modulated with a 1300-cycle continuous tone and keyed continuously with alternating dots and dashes. Middle Markers are located about 3500 feet from the end of the runway.

A Marker Beacon receiver may consist of a 75-mc. r.f. amplifier and audio detector feeding a cockpit loudspeaker, or it may incorporate circuitry which automatically separates the identifying modulations and indicates type of beacon on a cockpit indicator. Most Marker Beacon receivers used by light aircraft rely upon the pilot to audibly identify the Marker Beacon Morse Code identification. That is, if the pilot hears a succession of dots and dashes

Fig. 12. Simplified ILS approach chart for San Francisco's Oakland Airport.



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Traffic controllers at GCA radar scopes. Scopes at right are for the Airport Surveillance Radar (ASR), while those at left are for the Precision Approach Radar (PAR).

from his loudspeaker, he knows he is passing over a middle marker. If, instead, he hears a series of dashes he is over an outer marker, or an airways marker if he hears a series of dots.

Fig. 9 shows a type of Marker Beacon receiver which automatically indicates the type of Marker Beacon. A 75 mc. r.f. amplifier, detector, and audio amplifier extract the coding information from the Marker Beacon signal. Three filters tuned to 400, 1300 and 3000 cycles separate the coding signals and apply them to three colored indicator lights. A blue (sometimes purple) light is connected to the output of the 400-cycle filter and flashes when passing over an outer marker. An amber light flashes when 1300 cycles is present indicating the middle marker, and a white light flashes when passing over a 3000-cycle coded airways or boundary marker.

Most middle and many outer Marker Beacon transmitter sites also transmit a low-frequency "compass locator" signal. This consists of a 25-watt nondirectional signal in the 200 to 415 kc. low-frequency band. The compass locator provides a signal for direction finders aboard the aircraft and thus furnishes a means for determining the heading of the aircraft with respect to the desired approach course. In congested areas, low-frequency Marker Beacons are also used to indicate the point at which descent should be started.

A unique ILS indicator is used by *Bendix* in its complete v.h.f. navigational system. A single 3-inch indicator provides Marker Beacon three-light indication as well as left-right, up-down Localizer and Glide Slope metering. A VOR course selector is also included.

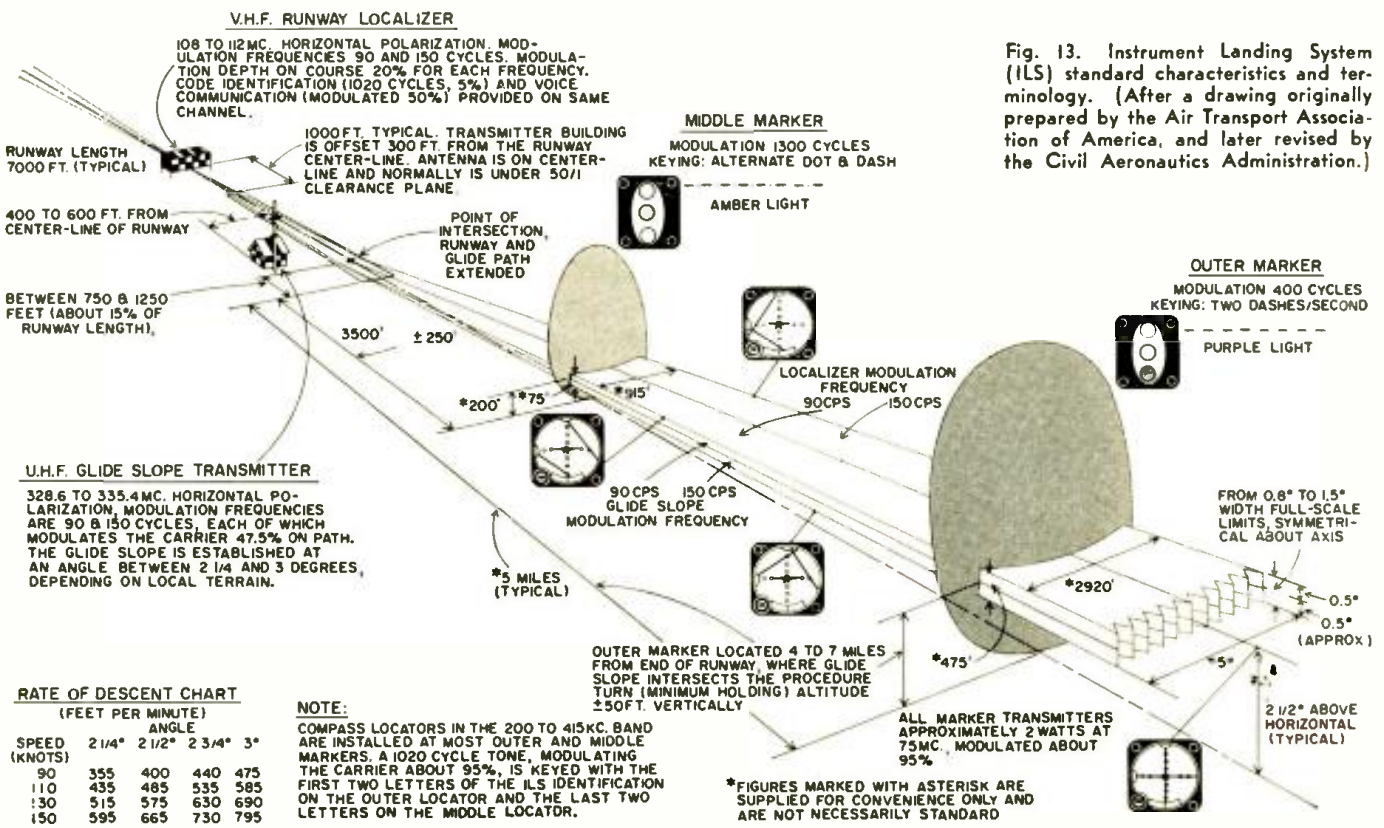
Terminal Navigation with ILS

Fig. 13 shows a complete ILS installation that can be found at most large airports and summarizes the operation of the complete ILS system. Light airplanes generally do not use the complete ILS system because most small plane owners cannot afford the luxury of a separate Glide Slope receiver. As was previously pointed out, the Localizer signal is generally recovered from a v.h.f. receiver which is also used for communication and VOR navigation. The additional cost of a Localizer converter and simple Marker Beacon receiver is small in comparison to the added cost of an additional u.h.f. Glide Slope receiver and converter. *National Aeronautical Company's* inexpensive Mark II VOR receiver, described in Part 2, also includes a Localizer converter and aural Marker Beacon receiver thereby allowing simple ILS navigation. The lack of a Glide Slope receiver deprives the light airplane of vertical glide-path guidance so the pilot must accomplish his descent with reference to a Rate of Descent meter. ILS navigation charts specify a recommended rate of descent from a fixed altitude over the Outer Marker for various speed aircraft.

In the earlier articles we examined how an aircraft can navigate to the San Francisco area using long-range navigation aids. We shall now examine how an instrument approach and landing can be completed at San Francisco's Oakland International Airport using ILS.

Fig. 12 shows a simplified ILS approach chart for Oakland Airport. Notice that this particular ILS approach pattern uses a low-frequency radio

(*Continued on page* 112)



RATE OF DESCENT CHART
(FEET PER MINUTE)

SPEED (KNOTS)	ANGLE 2 1/4°	2 1/2°	2 3/4°	3°
90	355	400	440	475
110	435	485	535	585
130	515	575	630	690
150	595	665	730	795

NOTE:
COMPASS LOCATORS IN THE 200 TO 415 KC. BAND ARE INSTALLED AT MOST OUTER AND MIDDLE MARKERS. A 1020 CYCLE TONE, MODULATING THE CARRIER ABOUT 95%, IS KEYED WITH THE FIRST TWO LETTERS OF THE ILS IDENTIFICATION ON THE OUTER LOCATOR AND THE LAST TWO LETTERS ON THE MIDDLE LOCATOR.

Fig. 13. Instrument Landing System (ILS) standard characteristics and terminology. (After a drawing originally prepared by the Air Transport Association of America, and later revised by the Civil Aeronautics Administration.)

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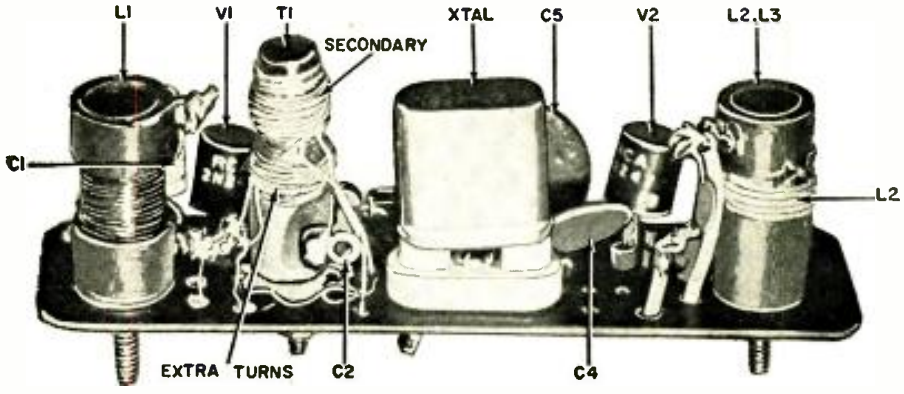
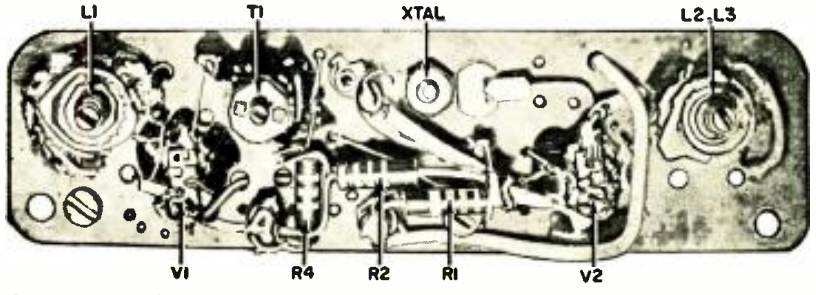


View showing components that are mounted on top of plastic board used as chassis.

Citizens-Band Converter



Bottom view of plastic chassis board showing resistors and coil-slug adjustments.

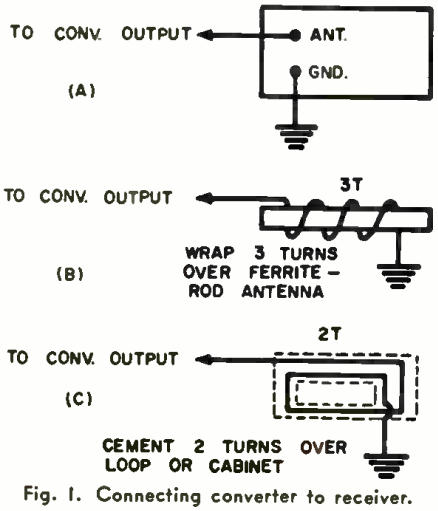


Fig. 1. Connecting converter to receiver.

Construction of a single-channel transistorized converter unit that works with a broadcast set.

By **J. H. THOMAS**

ALTHOUGH the transistorized Citizens-Band converter to be described was specifically designed to be used with transistor receivers of the pocket variety, it can, of course, be used with any other radio provided the proper supply is available. This is not a difficult requirement since the converter will work at almost any voltage from 3 to 12 volts negative. It is somewhat more expensive than a tube-type converter but, of course, much more versatile and, because of the crystal-control, quite stable.

The Circuit

As can be seen from the schematic diagram of Fig. 2, the circuit is quite conventional in that it consists of a well-known transistorized crystal oscillator and a mixer. The output of the oscillator is fed to the base of the mixer stage, where it is mixed with the incoming signal.

The converter, as shown, is designed for fixed-frequency operation but of course you can listen to other channels with slightly less efficiency by tuning the broadcast receiver into which the 1000 to 1600 kc. i.f. signal is fed.

The two *RCA* 2N247's are used because both transistors must be capable of operating up to 30 mc. If you have a 2N384 on hand, this can be substituted for either of the 2N247's.

Construction

The entire unit is built on a narrow strip of plastic. In the author's unit this shape was required so that the converter could be fitted into the cabinet of the portable receiver, but any other layout will do as well provided the oscillator coil is a reasonable distance from the antenna coil or at right angles to it, to prevent radiation of the oscillator frequency.

The coils were wound on forms from a piece of surplus gear. They were ⅜" o.d. and have a copper slug, ¼" diameter and ¼" long, for tuning. A similar commercial coil is the *CTC* Type LS-3 coil with 2013-C brass slug.

The output transformer was made by adding turns to a *Crest* #200-6 variable inductance which is tunable from 70 to 225 μhy. To get the tapped primary, 30 turns of #34 s.c.e. are wound on the end in the same direction as the original coil and then cemented into place. The secondary consists of 20 turns on top of the original coil and wound at the other end of the form. This makes very close coupling but since the oscillator is crystal-controlled, no "pulling" of the separate oscillator need be anticipated. With the capacitor specified, the primary of this home-made transformer will tune down to about 1000 kc. With more capacitance you can reach any spot on the broadcast band.

A miniature transistor i.f. transformer, using external capacitance only, can be used by making the capacitance much lower than shown in the transformer diagram. How much lower will depend on the transformer. Another alternative would be to use a standard i.f. transformer with reduced capacitance, although it may be necessary to first remove some turns and then add a few to achieve a tapped primary.

(*Continued on page 88*)

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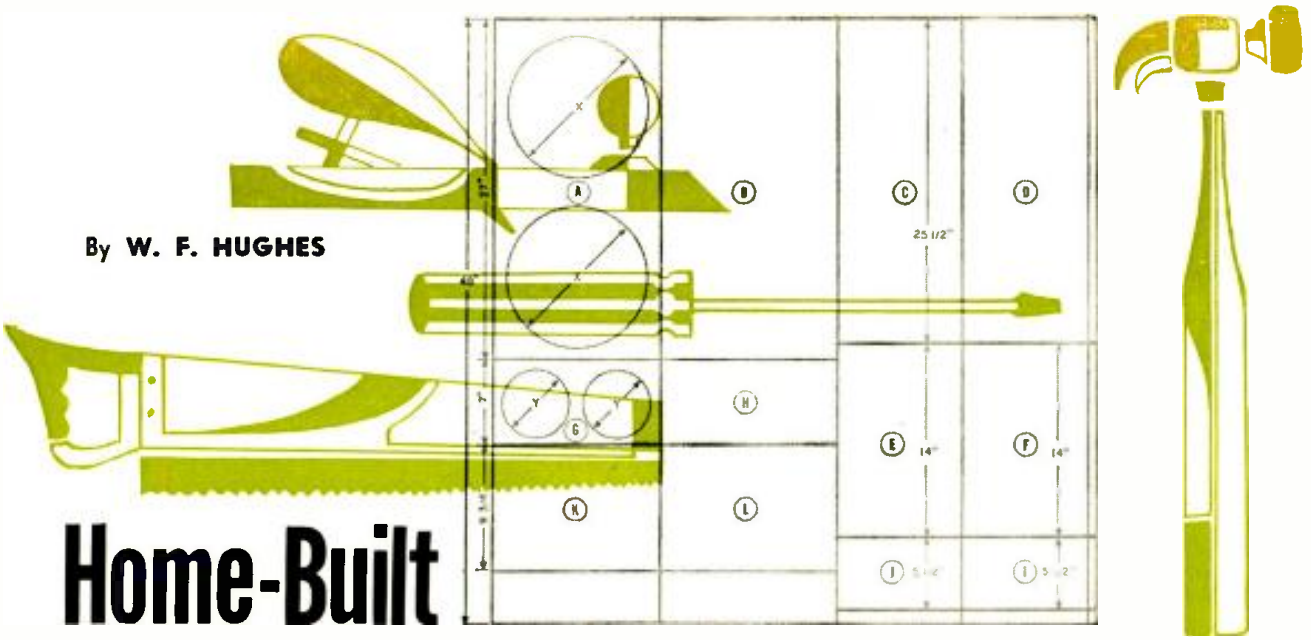


By W. F. HUGHES

Home-Built Acoustic-Suspension-Type Speaker System

Construction of simple hi-fi system that can be built for under $30. When used with suitable tweeter, result is a good, wide-range unit

EDITOR'S NOTE: The performance of this home-built, acoustic-suspension-type speaker system should not be expected to be as good as commercially available units whose loudspeakers are especially made to match their enclosures. Because of the low cost and ease of construction, however, the project is definitely worthwhile for the audio enthusiast who wants good performance and compact size.

DURING the past few years considerable advance has been made in the commercial production of speaker systems using the acoustic-suspension principle. The cost of such systems is substantially below the cost of the best systems available prior to their development and their proponents consider that no compromises have been made in performance. Quality acoustic-suspension speakers produced commercially, when coupled with a suitable tweeter, provide very good results indeed at moderate cost.

Even so, the budget-minded hi-fi enthusiast may not be able to afford an acceptable commercial unit of this type. This article describes a simple home-made system, using inexpensive speakers, which will perform surprisingly well in comparison with ready made units.

The system is built around two 12" woofers and two optional 5" mid-range speakers. The two woofers are housed in one bookcase-sized enclosure and, if the mid-range speakers are used, they can be housed in a small enclosure which can be fastened to the woofer cabinet to form one compact unit. The mid-range speakers are not at all essential and, if the recommended woofers are used, they alone will result in an adequate system which can be built for a total cost of under thirty dollars.

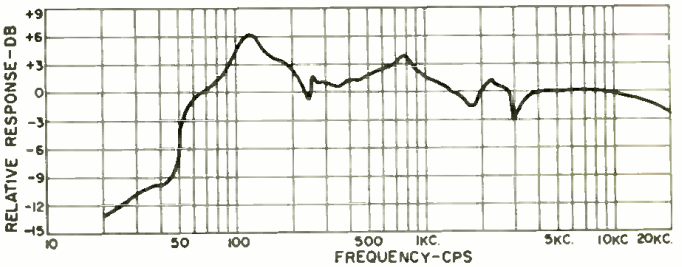
One of the small, inexpensive electrostatic tweeters can be added to give better performance above 5000 cps and, when used with the woofers alone, will result in acceptable sound at a minimum cost. The mid-range speakers can be added at a later date to provide a slight improvement in the range from 3000 to 5000 cps. However, even without the mid-range speakers the over-all result is comparable, even in the mid-range, to the moderately priced commercial units.

The Loudspeakers

The speakers used were "Shield Crest" types purchased from *Olson Radio Corp.* for about eleven dollars per woofer and about six dollars per mid-range, but any similar quality speakers may be used. Since the performance of the speakers depends on the cones being fairly compliant, the cones must be treated if the outer edges are stiff. The "Shield Crest" speakers were fairly good in this respect, one of the reasons why they were selected, so no treatment was necessary. Other speakers, if not fairly compliant, can be treated by coating the outer edge of the cone with *Kodak* "Photo Flo" diluted about one part to 100 in water. After drying, the edge is then painted with a saturated solution of silica gel (calcium chloride) in water. Commercial softening kits are also available from some radio suppliers. This wet-

◀ Fig. 1. Completed woofer section before covering. Speakers are mounted from front with sealing compound and machine screws.

Fig. 2. Steady-state acoustic frequency-response measurements taken with the woofers and inexpensive electrostatic tweeter.



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ting treatment loosens the cone, lowering its resonant frequency, and allowing it to act more freely against the air spring of the air trapped in the enclosure. This acoustic spring controls the speaker movement rather than the mechanical stiffness of the cone itself. It is vital, then, not to puncture the cone accidentally or to allow an air passage into the sealed enclosure.

The Enclosure

The two woofers are mounted in a box made of ¾" plywood which is completely screwed and glued together before the speakers are mounted. Fig. 5 gives the general layout for the box and shows how the entire system can be fabricated from a piece of 4-foot x 4-foot plywood. Care should be taken to mate the joints carefully and a liberal amount of glue should be used, along with closely spaced #8 or #6 wood screws, in order to insure tightness. The box must be absolutely air tight.

Before assembling the box, the speaker holes should be cut just large enough to allow the speakers to fit in from the front after the box is put together. Fig. 3 shows a cross-section of the speaker mounting.

Four wires, about four-feet long, should be cut and fed through a small hole in the rear panel. The wires can be stapled or fastened to the inside and outside of the rear panel near the hole so that they will not move in the hole and break the seal—which is made by filling the hole with plastic wood or glue. A terminal strip may be fastened later to the rear panel, forming a convenient junction for the speaker leads from the amplifier or crossover network.

After assembly and installation of the lead wires, but before installing the

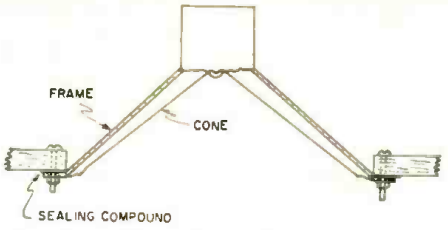
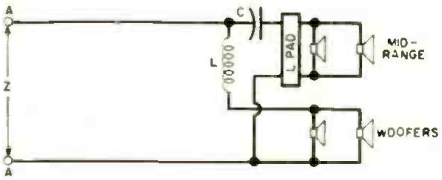


Fig. 3. Sealing and mounting of speakers.



Z-ohms	L-mhy	C-μf	
4	0.8	50	SPEAKERS IN PARALLEL AS SHOWN
16	3.0	12	SPEAKERS IN SERIES

Fig. 4. Crossover network used for 700-cps crossover. L-pad allows proper balancing. If electrostatic tweeter is used, the 16-ohm arrangement is employed and the low-frequency signals from the tweeter crossover network are applied to points A-A.

speakers, the entire box must be filled (through the speaker holes) with fiber glass acoustic padding. The inside walls should first be lined and then layers laid in the box until it is completely filled except for space left for the speakers. A light dripping of glue on the padding will keep it in place.

When the box is filled, the speakers can be wired and put into place. The leads should be clearly marked before sealing the cabinet. A thin covering of cloth can be used on the back of the speakers to insure that the fiber glass does not get into the mechanism.

Special precautions must be taken not to puncture the cone while mounting it from the front. Machine screws, #8 or #6, about 1½-inch long should be fed from inside the box and allowed to protrude. The speaker is then placed over these bolts and washers and nuts put into place.

In order to effect a good seal, some sort of sealing compound can be used between the speaker rim and the wooden front panel. "Duxseal" (*Johns Manville*), "Tub Tight," or even "Permagasket" can be used. "Duxseal" seems preferable since it remains plastic and will not shrink or crack. The photograph of Fig. 1 shows the completed woofer section with the speakers in place and sealed.

After the woofer section is completed, a mid-range section can be built in the same way. After completion, the two boxes can be mounted together and covered with grille cloth and veneered if desired.

Wiring

Depending on the impedance of the amplifier and speaker used, the speakers can be wired in a variety of ways. Fig. 4 shows an arrangement for 8-ohm speakers (the impedance of the speakers used) being fed by a 4- or 16-ohm amplifier. The woofers and mid-range speakers are wired in series for 16-ohm operation and in parallel for 4-ohm operation. If the woofers are used alone, a tweeter can be added to give good high-frequency response and to smooth out the mid-range. A suitable crossover network must be used with the tweeter. This can be made fairly easily or purchased as an accessory unit with the tweeter. The woofers can then be wired in series and a 16-ohm crossover network used.

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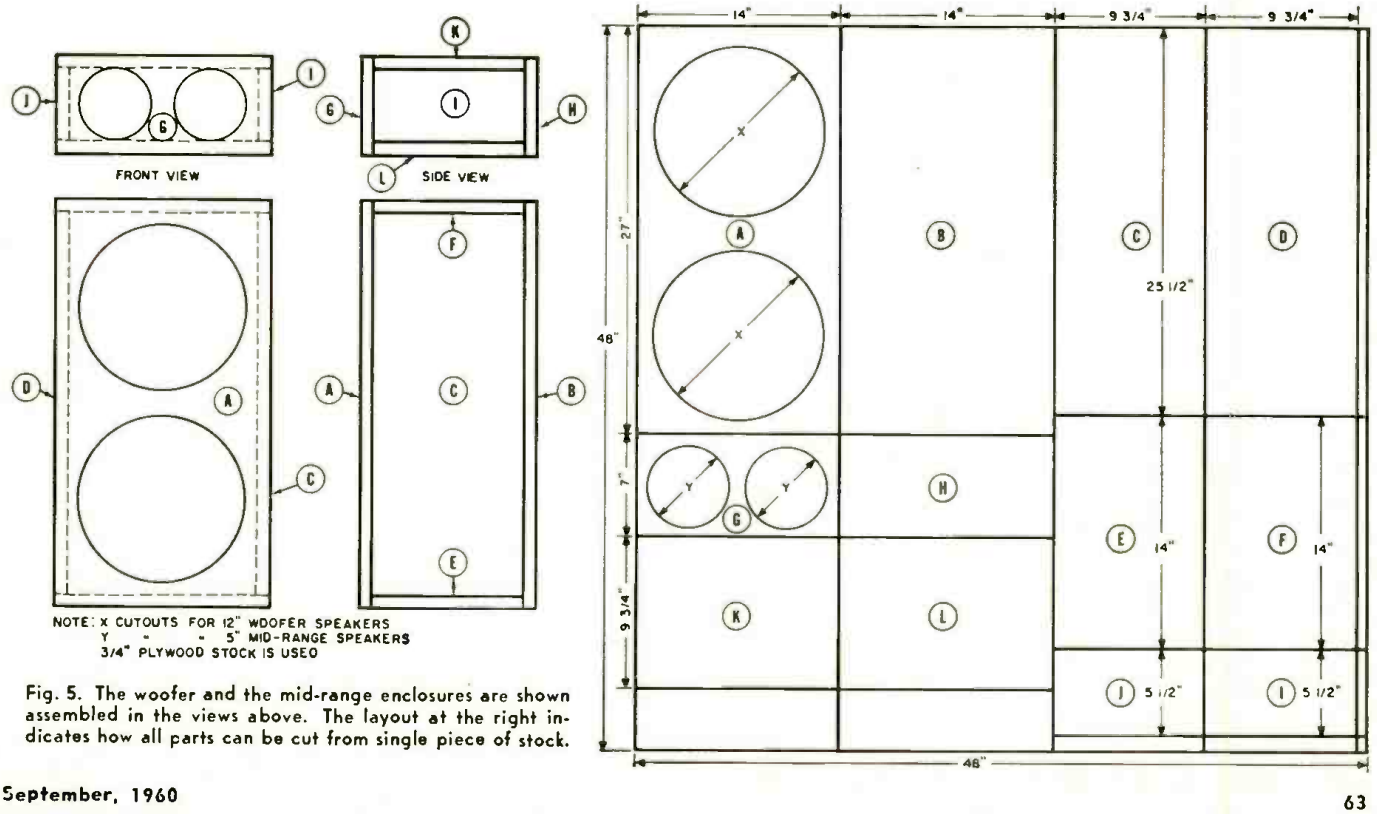

Fig. 5. The woofer and the mid-range enclosures are shown assembled in the views above. The layout at the right indicates how all parts can be cut from single piece of stock.

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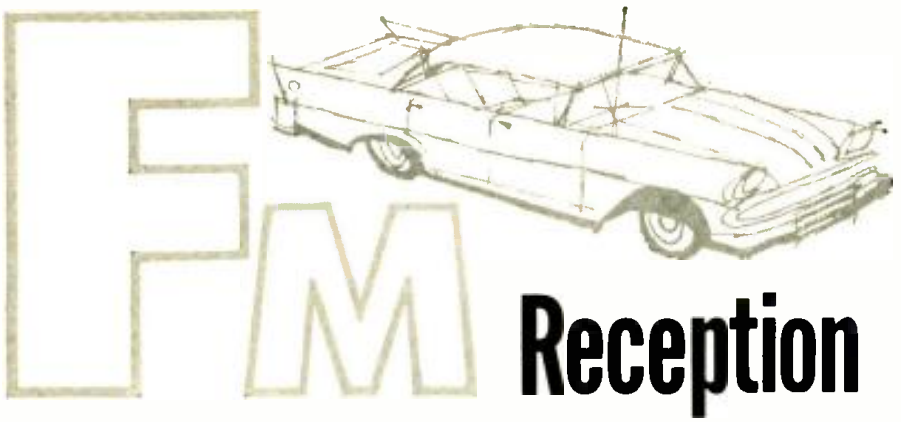


FM Reception on Wheels

It isn't easy, but understanding the special problems helps. The Motorola FM-900 includes many solutions.

SINCE FM reception in the home has enjoyed widespread acceptance for many years, one may wonder why receivers of this type have not been marketed for use in automobiles until quite recently. Today one has hardly finished looking over the last FM car radio offered to the public when another is announced. The potential purchaser (and the reader interest, over the years, on information for converting standard FM tuners and receivers for vehicular use indicates that there are such potential purchasers) may ask, "What took them so long?"

The fact is things are not as simple as they seem. Take the matter of noise and interference, where FM is particularly considered to outshine AM. Due to the specific vehicular environment, an axiom involving the relative merits of these two types of modulation is reversed. Unless given its due consideration, noise can actually be a greater problem on FM. Furthermore, this is just one of the problems involved.

The result is that a suitable FM auto receiver must be something quite different from just another FM set for home use, even with modest changes. The *Motorola* FM-900 shows a recognition of the difficulties involved and indicates conscientious design efforts to overcome them. Accordingly, it makes a good starting point for our discussion on several grounds. It will serve as a guide to anyone wishing to adapt any FM receiver to his vehicle. Also, where such conversion is not practical, it will help the prospective listener to select and properly install an alternate tuner or receiver.

As to the matter of noise, any owner of a v.h.f. receiver (TV or FM) must have some idea that reception in this spectrum is peculiarly responsive to interference generated by automotive ignition systems. When a car or truck rolls by, the TV owner knows about it without having to look out of his window. The black, horizontal streaks marring his picture are a sure giveaway. His TV sound (or the usually whisper-quiet background when he is listening to his FM set) is interrupted by annoying, crackling noises.

Not only is the ignition system of the average vehicle a superior generator of this type of noise; the ignition wiring used generally adds insult to injury by acting as a highly efficient antenna system for propagating this undesired r.f. It happens that the ignition-wire lengths used tend to be resonant at or near the FM band.

When this interference occurs during home reception, the irritated listener has the consolation of knowing that the noise will pass soon, with the passage of the offending vehicle. Inside a moving automobile, the listener is in the position of carrying the noise source with him wherever he goes. Furthermore, it is never more than a few feet away from his receiver's antenna and antenna input, where it can easily compete with signal. Thus ignition-suppression measures considerably more effective than those required for reasonable AM reception become necessary. More will be said concerning these measures later.

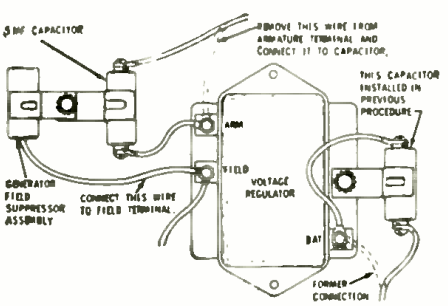


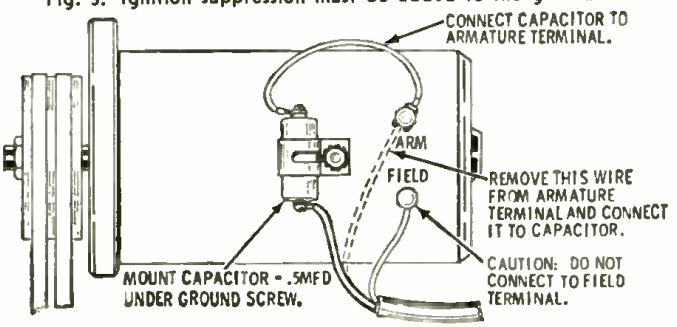
Fig. 2. Extra suppressor capacitors at the voltage regulator may be needed.

Another problem involves the receiving antenna. The sizable, roof-top unit that may cap a home installation is simply not practical on a moving vehicle. A simpler, more modest entity is needed, and it should preferably be the same whip used for the AM receiver that is likely to be in the auto already. Such a signal interceptor will provide considerably less input for the FM receiver for two reasons: regarded only as an antenna, it will not have the same gain that a more sophisticated device would provide; also, it will suffer in line-of-sight pickup because it is necessarily low to the ground instead of being high on a roof-mounted mast. In addition, it will be much closer to the noise source than would a home-use antenna.

Already we can see how the separate problems of auto reception begin to run into each other. The closely coupled ignition system makes high sensitivity and superior noise rejection

◀ Fig. 1. The compact radio is made for under-dash mounting.

Fig. 3. Ignition suppression must be added to the generator.



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mandatory. Limitations on the antenna installation cut down available signal.

Since v.h.f. reception, whether on TV or FM, is largely limited by the horizon, the service area from the station over which the moving vehicle can obtain good reception is more restricted than with AM. This would seem to inhibit reception too far away from a city—but also cut it down in the streets of a metropolis itself, where tall buildings block direct transmission. Fortunately, the latter is not necessarily true. Such v.h.f. signals bounce and ricochet off nearby structures. Thus multi-path reception of a reasonably strong signal down on the city's streets is quite feasible. One of TV's great metropolitan hazards, "ghosting," becomes a boon in the new context. In fact, this ability of FM transmissions to "bounce" assists in many situations where AM usability disappears, as when the vehicle is moving through a tunnel or underpass.

Although signal may still be available in what would ordinarily be "dead spots," it is certainly attenuated. Thus we are still left with a potentially serious impairment of listening enjoyment: fading. These fluctuations must be ironed out.

Problems enough? Don't go away; there are more. Due to the relatively small ratio between the bandwidth of a single FM station and the full extent of the assigned band, and also due to the problems of frequency stability in this spectrum, tuning is quite critical, as it often is on home instruments. At home, you can take your time. In a car, according to a widespread belief, the driver is supposed to keep his eye on the road and his hand on the wheel. Safety demands that he be able to tune quickly, easily, and with the least possible visual distraction.

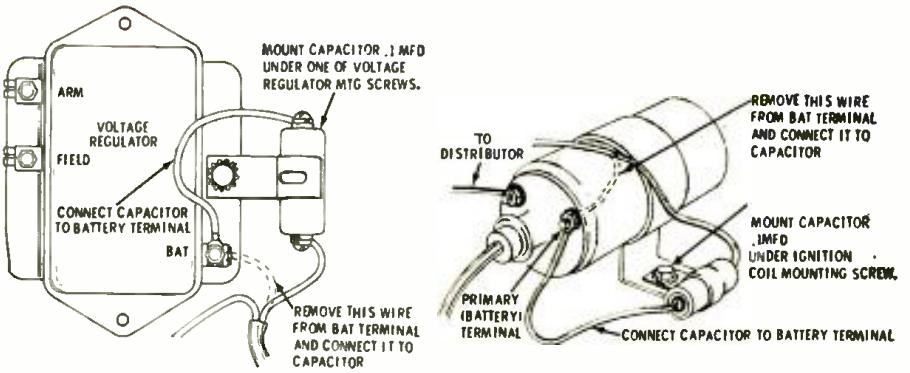

Fig. 5. Suppressor location for the voltage regulator (A) and ignition coil (B).

The normal requirement of frequency stability is aggravated by the fact that it can be affected by changing supply voltages—and the auto's battery-generator system is not famous for constant output. Voltage fluctuation can also produce variations in sensitivity and audio-output level.

How can these problems be met? Let's examine Fig. 4. The signal circuits, which appear to be most conventional, get first consideration. The antenna-input system does not seem to be startling, but it does have one important difference from its home-receiver counterpart. Since a match to conventional antennas is useless here, input impedance is in the vicinity of 50 ohms instead of 300. The ordinary, telescoping antenna used on an auto, when manually adjusted for peak reception with this circuit, will be a quarter-wavelength affair, which matches the lower impedance.

The entire front end consists of a single twin triode, V_1. This may seem like cutting corners in the wrong place, but it isn't. The circuit used is that of the grounded-grid r.f. amplifier followed by an autodyne converter. This type of circuit (see "Don't Dodge the One-Tube FM Front End," ELECTRONICS WORLD, August, 1959) has many virtues. It can provide commendable

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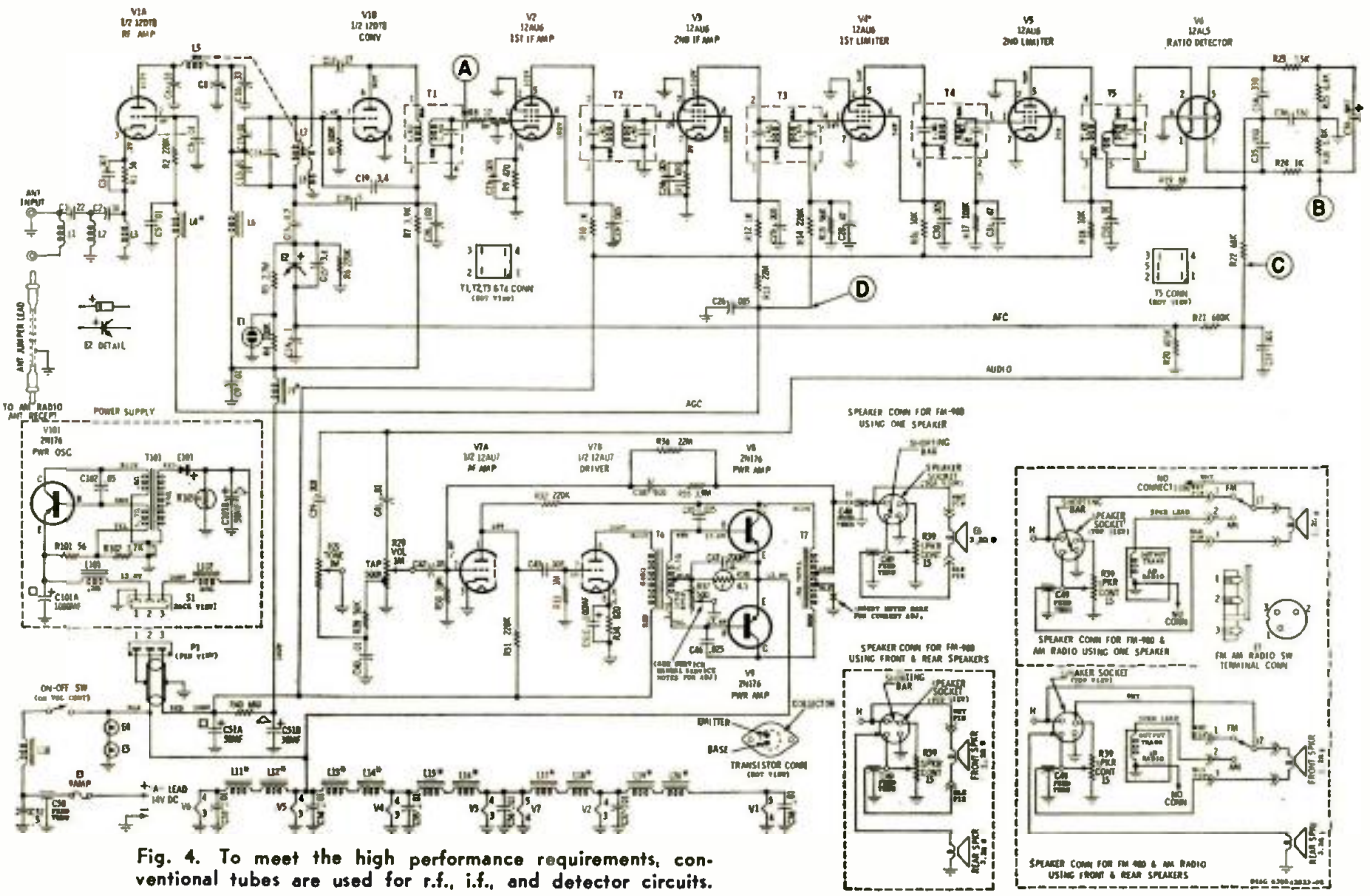

Fig. 4. To meet the high performance requirements, conventional tubes are used for r.f., i.f., and detector circuits.

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Cascode Circuits: How and Why

By JIM KYLE

Study of a circuit widely used in TV tuners and other applications. Variations and service considerations.

BORN of a war-time need for long-range radar and brought to maturity in the TV-booming mid-1950's, the cascode amplifier circuit today can be found in almost any application where a low-noise, high-gain amplifier is required. Nevertheless, although the circuit itself is a relatively simple and straightforward means of obtaining radio-frequency amplification, many technicians, in and out of the service field, show occasional bewilderment about it.

Some of that aura of mystery can be removed. Along the way, commonly encountered, practical problems can be pointed out, as well as methods for handling such problems and improving the operation of cascode circuits in general.

A good starting point is an understanding of what we mean by "a cascode circuit." In the past, the term "cascode" has been applied to a number of amplifier circuits. On top of this, there are several variations of the basic Wallman amplifier that have been given the name. Stripped of non-essential detail, the cascode circuit consists of a conventional grounded-cathode amplifier stage coupled to a grounded-grid stage. Each stage normally employs a triode tube or tube section. Both stages together provide about as much gain as a single pentode —with a much lower noise contribution from the tubes.

The circuit came into its own with the introduction of the famed "cascode tuner" for television. In fact, the TV tuner is still the most likely place to find this type of amplifier. However, as the possibilities of this amplifier configuration became more evident, its use broadened out. Today one may find a cascode circuit in an FM tuner, a communications receiver, commercial two-way equipment—and in portions of the TV receiver aside from the tuner itself, as in the i.f. amplifier.

Essential features of the basic series cascode circuit are shown in Fig. 1. An incoming signal from the antenna goes to the grid of the first stage. Amplified signal voltage at the plate is then fed directly to the second-stage cathode through L_6. The grid of stage two is grounded for r.f. energy by capacitor C_5. The signal, amplified still more by this triode, goes from the second-stage plate to T_9, and so to the next portion of the set. (Typical values for this schematic and others discussed later are consolidated in Table 1.)

In this circuit, R_2 is the a.g.c. isolation resistor; R_1 is the cathode bias resistor for the first stage, and R_7 provides a d.c. return from the grid of the second stage to its cathode. Capacitors C_3 and C_5 are for bypass purposes.

No Oscillation?

At this point, some of the confusion associated with the circuit begins to crop up. For example, why doesn't the cascode circuit oscillate? Many technicians, including those familiar with the ancient triode-t.r.f. days, will recall that, when input and output circuits of a triode amplifier are tuned to the same frequency, the circuit quickly turns itself from an amplifier into an oscillator unless it is properly neutralized. In fact, a circuit familiar to many amateurs, the TNT (tuned-not tuned) oscillator, makes use of this fact.

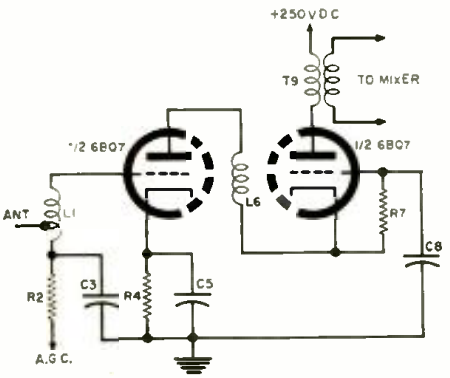

Fig. 1. A basic series cascode circuit, showing the essential elements.

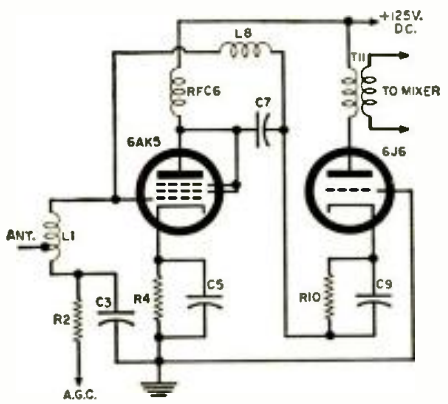

Fig. 2. The original Wallman cascode circuit used a triode-connected pentode.

Table 1. Components used in Figs. 1-5.

COMPONENT	VALUE AND COMMENTS
R_2	100,000 ohms
R_4	82 to 100 ohms
R_6	0 to 47 ohms
R_7, R_8	470,000 ohms
R_{10}	100 ohms
C_3 to C_9	.001 μf. disc ceramic
L_1, L_6, L_8	Resonant with circuit capacitance at signal frequency
RFC_6	1 millihenry
T_9, T_{10}, T_{11}	R.f. transformers

The cascode is a tuned triode amplifier, yet it does not oscillate. True, coil L_6 of the typical circuit is often called a neutralizing coil, yet satisfactory operation may be obtained without it. Strangely enough, the reason for the circuit's stability lies, not in the first stage (which would seem to be ripe for oscillation), but in the second —the grounded-grid amplifier. The input impedance of a grounded-grid amplifier is extremely low. About 700 ohms is typical in most cascode applications. This is the load resistance for the first stage, and it is low enough to damp out oscillation.

Another way of saying this is that the low load resistance *reduces amplification* of the first stage below the minimum necessary to sustain oscillation, since amplification is a function of a tube's load (R_L) as well as of its amplification factor (mu).

Where's the Gain?

The last statement makes sense when considered all by itself. However, it leads directly to the next sequence of head-scratching when we consider it in the light of the claim that the complete circuit exhibits about as much gain as an efficient pentode circuit, and far more than a single triode. How is this seeming contradiction resolved? One way of explaining what happens is to resort to a column of mathematical calculations involving tube characteristics and circuit relationships. However, a general picture can be given without doing so.

Although amplification of the first stage considered alone is quite low, its output signal actually passes through the second, grounded-grid stage before reaching the working "load" for the entire amplifier, T_9 of Fig. 1, across which the amplified signal is developed. (In this connection, note that the output signal of the first stage, which is also the input signal for the second stage, is in series with the output signal of the second stage. This is not the case with a conventional grid-input amplifier, where input and output

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signal voltages are in opposite phase.) The second stage may thus be considered as a network between the first stage and the load.

With the amplification factor of the first stage unchanged and its effective load thus increased, amplification goes up, as the formulas in any tube-characteristic manual show. However, oscillation is still prevented. The second stage has already been likened to a network between the first stage and the load. Actually, this network provides isolation in one direction. Although it passes signal on to the load, the grounded-grid configuration makes the grid act as a shield between the cathode (input) and plate (output), drastically reducing the cathode-to-plate capacitance. This capacitance, in a triode amplifier, is normally the coupling path that feeds back the signal which produces oscillation.

Cascode Variations

As with most other basic circuits, there are countless possible variations on the cascode theme, some of which we will consider. Actually, the popular versions vary from the original Wallman circuit of Fig. 2. Making use of tube types then available, the latter employed a triode-connected 6AK5 pentode for the first stage and one section of a 6J6 for the second. Also, as far as supply voltages are concerned, the two stages were in parallel, but the signals were in series. In modern applications, the two stages are in series with each other across the supply voltage, as shown in Fig. 1 and the other circuit variations with this article.

The latter arrangement simplifies the coupling between the two stages, eliminating two components, RFC_6 and C_7 (Fig. 2). The simplification is the reason that the TV industry developed the version, now almost universally used, in which the two triodes are in series or stacked across "B+".

An important variation of the series cascode circuit is shown in Fig. 3, where the voltage divider composed of resistors R_7 and R_8 replaces the second-stage grid return resistor (R_7 of Fig. 1). This change converts the circuit from semi-remote cut-off operation to nearly full remote cut-off condition. Here's how it works:

Applying a.g.c. voltage to the input grid increases bias of the first stage, which reduces current through this triode. The voltage drop across the tube itself is increased, which means that voltage at the plate goes up. Since the two tubes are in series across the fixed supply voltage (with the first-stage plate connected to the second-stage cathode through neutralizing coil L_6 in Figs. 1 and 3), an increase in the drop across the first stage reduces the voltage available for the second stage. This reduces gain of the latter. The over-all effect provides semi-remote cut-off operation in any series cascode circuit, with gain for both stages being influenced by a control voltage at the first grid.

However, in Fig. 3, second-stage grid voltage is clamped to the design value by the voltage divider, R_7 and R_8. Normally, this is chosen so that the second-stage grid is about one volt less positive than the second-stage cathode in the absence of a.g.c. voltage.

Now when a.g.c. voltage is applied to the first stage (causing its plate voltage to rise), the change in voltage also increases the grid bias of the second stage by increasing the potential difference between cathode and grid. This lowers over-all gain for the circuit even more smoothly than is the case with the circuit of Fig. 1, resulting in extension of the cut-off characteristic. By manipulating values of R_7 and R_8, the design engineer can choose from a wide range of gain characteristics.

In addition to the clamped-grid refinement and other features already mentioned, the circuit used in the cascode TV tuner has other modifications. Since these tuner circuits are widely available in service data and other sources, a complete circuit has not been included here. In general, the modifications in typical TV tuner applications involve the addition of components to make operation more reliable over the wide range of conditions and frequencies found in such applications. They have little or no effect on the theory of operation and, once the basic circuit and its elements are understood, the additions can be recognized and understood more readily.

Additions will include the coil-switching at the antenna input and at the plate load of the second triode, trimmer capacitors for tuning and bandpass adjustment at such points as the first-triode grid and second-triode plate, feedthrough capacitors mounted on the tuner subchassis to replace more conventional types, and filament bypassing.

Another important variation of the basic circuit (most often encountered in communications receivers but seldom in TV or FM tuners) is shown in Fig. 4. By replacing neutralizing coil L_6 with resistor R_6, one adjustment is eliminated at almost no sacrifice in efficiency. As explained earlier, coil L_6 is not necessary to prevent oscillation. Its chief purpose is to improve gain at higher frequencies by "tuning out" the second-stage input capacity. The gain improvement shows up in the set as increased sensitivity or less snow on the screen of a TV set.

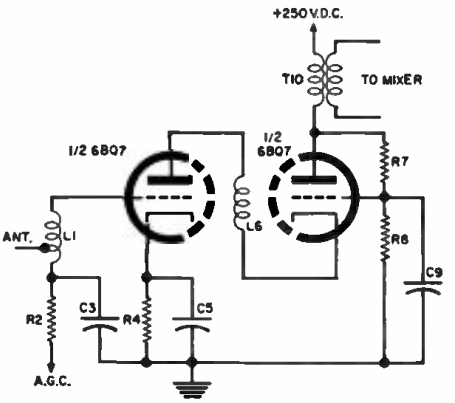

Fig. 3. Clamping grid of second triode improves over-all a.g.c. action.

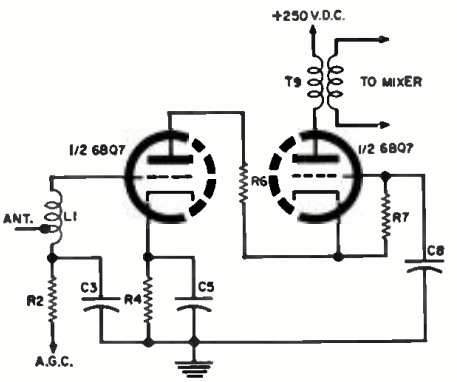

Fig. 4. At some frequencies, L_6 may be replaced by R_6 with no impairment.

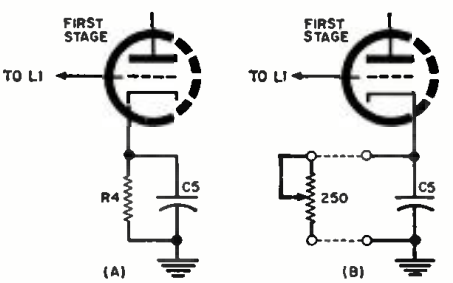

Fig. 5. The cathode bias resistor may be individually adjusted for more gain.

Table 2. Twin triodes used in cascode r.f. designs, with their special features.

TYPE	HEATER CURRENT (amps.)	RELATIVE GAIN	SPECIAL CHARACTERISTICS
6BC8	.400	97	Low cross-modulation
6BK7B	.450	147	Very high gain to 300 mc.
6BQ7A	.400	100	Low noise
6BS8	.400	113	High cascode transconductance
6BX8	.400	105	Low plate voltage (65 v.)
6BZ7	.400	107	Low noise
6BZ8	.400	125	Low cross-modulation
6DJ8	.365	196	Very high gain, low plate voltage
6ES8	.365	196	Same as 6DJ8 (90 v.)

However, at frequencies below 52 megacycles, the circuit provides plenty of gain without coil L_6. In such a case, the coil can be replaced either by a piece of wire or a resistor (R_6 in Fig.4) with no loss of efficiency.

Other variations of the circuit which may be encountered include changes in input and output connections (from parallel-resonant to series-tuned circuits) and use of lower and higher sup-

(*Continued on page* 126)

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Tv

Remote-Control Aligner-Tester

By **FRANK HADRICK,** Simpson Electric Co.

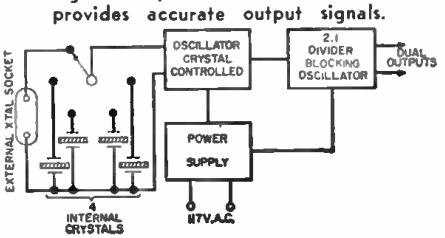
A new test instrument designed for checking and aligning ultrasonic TV remote-control equipment.

NEARLY all manufacturers of TV receivers now offer remote-control features of one type or another with their sets. The steady increase in the number of models so equipped is one indication of increasing public acceptance. It follows that the service technician is steadily encountering more of these sets in his work and that the occasions on which he must service them are also increasing.

Although there are various. basic types of remote-control systems, the wireless, supersonic type appears to be the most popular (see "Ultrasonic TV Remote Controls," August 1960, page 54). In this system. when the hand-held transmission unit is operated, an acoustic, ultrasonic signal is produced by either mechanical or electronic means. This signal is picked up by a concealed transducer (microphone) at the TV receiver, where it is converted to an electrical signal, amplified to a usable level, then detected and used to operate a relay controlling a particular function. From this point, complexity of the system depends mainly on the number of functions, such as "on-off," volume control, and channel selection, that are remotely controlled. The frequencies at which these systems operate are usually in the range from about 37 to 43 kc., with an accuracy of about plus or minus 15 to 20 cps.

Since the average service shop is not likely to have the facilities for checking performance in the course of troubleshooting, the *Simpson* Model 407 Remote Aligner (Fig. 2) has been designed for the purpose. The compact instrument includes a crystal-controlled generator that will produce any of a group of four fixed frequencies that may be chosen between 35 and 45 kc.

Fig. 1. A crystal-controlled oscillator provides accurate output signals.



The modified, crystal-controlled Pierce oscillator (Fig. 1) produces sine-wave output signals at twice the desired frequency, which are coupled to the 2:1 divider (blocking oscillator) stage. For example, if the selected crystal will oscillate at 80 kc., output of the divider will be 40 kc. This occurs because the free-running range of the blocking oscillator is 35 to 45 kc. Therefore, when crystal-oscillator signal is applied to the blocking oscillator, it acts to synchronize the latter at exactly half the crystal frequency with great accuracy. A tunable wave-shaping network in the plate of the pentode (Fig. 3), pre-set at the factory, is adjusted so that output over the operating range is sinusoidal.

The crystal selector switch on the front panel permits a choice of any of

Fig. 2. The Simpson Model 407, shown with its attenuator probe, has dual outputs, one of which is used for monitoring level.

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four internal frequencies, which may be specified by the purchaser. These may be chosen to accommodate the remote-control systems the owner is most likely to encounter in his work. An external crystal socket provides for the insertion of crystals to produce other frequencies within the operating range should they become necessary. The typical crystal and output frequencies shown in Fig. 3 are not necessarily those of any particular manufacturer.

Output level is continuously variable from approximately 100 microvolts to 1 volt r.m.s. A low-output range from 0 to about 10 microvolts is obtained with the 100,000:1 accessory probe, shown schematically in Fig. 4, which is a capacitive voltage divider. If the low range is desired, the probe can be connected directly to one of two pairs of output terminals provided, and a v.t.v.m. can be connected to the remaining output for monitoring. With the v.t.v.m. on its lowest a.c. range, scale readings are multiplied by 10 for the probe output in microvolts. (On some units a phono jack replaces the output terminal shown in Fig. 1 at the upper right.)

This method of output calibration is extremely valuable for sensitivity checks and measurements. It is sometimes necessary to determine the sensitivity of a particular remote-controlled function at the receiver (the input-signal level required to energize the relay involved). In this check, the acoustic output is not involved, so the transducers at the transmitter and receiver are not used. Voltage output from the probe is connected directly to the remote-control amplifier input at the TV set, as shown in Fig. 5A. The output control of the Model 407 is advanced from minimum until the relay in question is energized. Sensitivity is determined by observing the monitored v.t.v.m. reading at this point. These remote-control amplifiers usually have very high sensitivity, on the order of only a few microvolts.

The procedure recommended not only can determine whether one function's sensitivity is adequate, it can also be used to make certain that all functions of the same remote-control system have approximately the same sensitivity, which provides additional information about possible defects. For example, if sensitivity on one function only is low, alignment on that function only or adjustment of the relay involved may be all that is required.

An alternate method of checking relative sensitivity of all functions, shown in Fig. 5B, also includes the receiver microphone in the over-all check. Instead of the output probe, a microphone assembly is connected to the instrument's output, and the receiver microphone is left in place. With the two microphones separated by some specific, constant distance, all receiver functions are checked for relative sensitivity.

Where alignment is necessary at the receiver-amplifier, any of several methods can be used. Probe output from the Model 407 can be introduced at the amplifier input or some other point in the circuit, and adjustment of amplifier and/or discriminator circuits can be made. Alignment can also be achieved using the coupling method shown in Fig. 5B. In addition to these two ways of injecting signal, for alignment or troubleshooting, others are possible. The best one to use is that recommended by the manufacturer of the television receiver in his service data.

With many remote systems, the technician is content to use the transmitting unit as his standard for accuracy and align the receiver to track with the former. This has drawbacks in all cases, but particularly in the case where the transmitter output is mechanically produced by a tuning-fork system rather than electronically. Tuning-fork output is a short burst of several sine-wave cycles, rather than a continuous wave. Accurate alignment against this elusive signal is extremely difficult, if not impossible. With the Remote Aligner, a c.w. signal of known, adjustable amplitude and accurate frequency is used instead.

In addition, even where electronic transmitters are used, some other standard reference is needed, as the former unit may itself be giving trouble. Frequency accuracy of the Remote Aligner, against which transmitters may be checked, is within .01 per-cent, and accuracy of output-amplitude measurement depends on accuracy of the v.t.v.m. used for monitoring.

While it may be desirable to check the frequency accuracy of the instrument itself at times, this function is performed with the internal crystals. To calibrate it, an oscilloscope is connected between the left jack on the external-crystal socket and instrument ground. The scope is adjusted to display several cycles of a stable pattern. The output should be a *steady* sine-wave pattern, with a pulse appearing on every other cycle, for each of the four positions of the crystal-selector switch. If not, the frequency-lock adjustment on the front panel is manipulated until such a pattern is achieved on all four switch positions with the *same* frequency lock setting. After the instrument has been thus calibrated, output amplitude from one selector position to another should be constant within 1 db. —30—

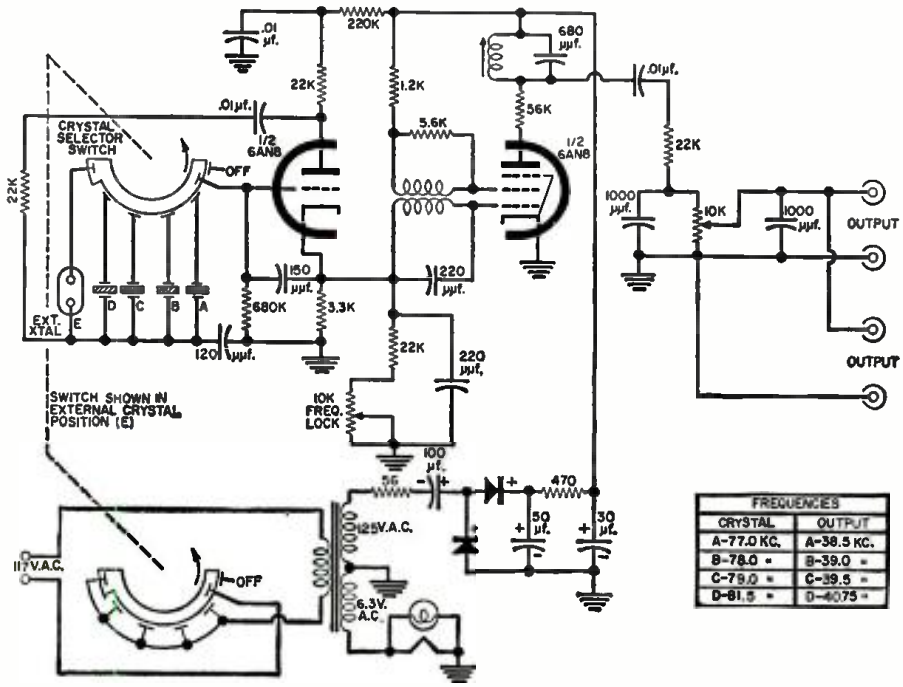


Fig. 3. Output oscillator works at half the frequency of the selected crystal.

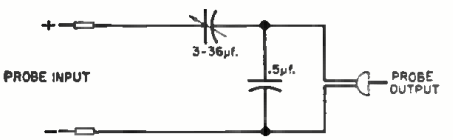
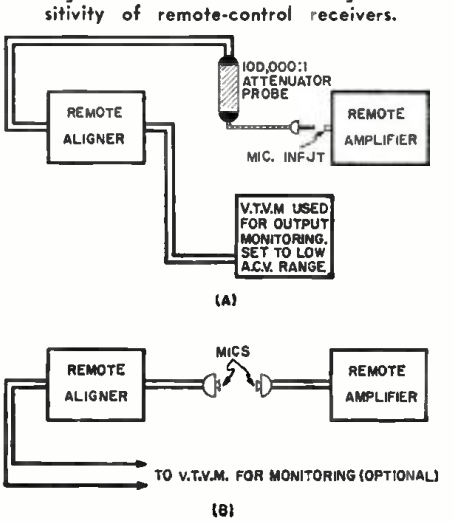


Fig. 4. The 100,000-to-1 attenuator probe is a capacitive voltage divider.

Fig. 5. Two methods for checking sensitivity of remote-control receivers.



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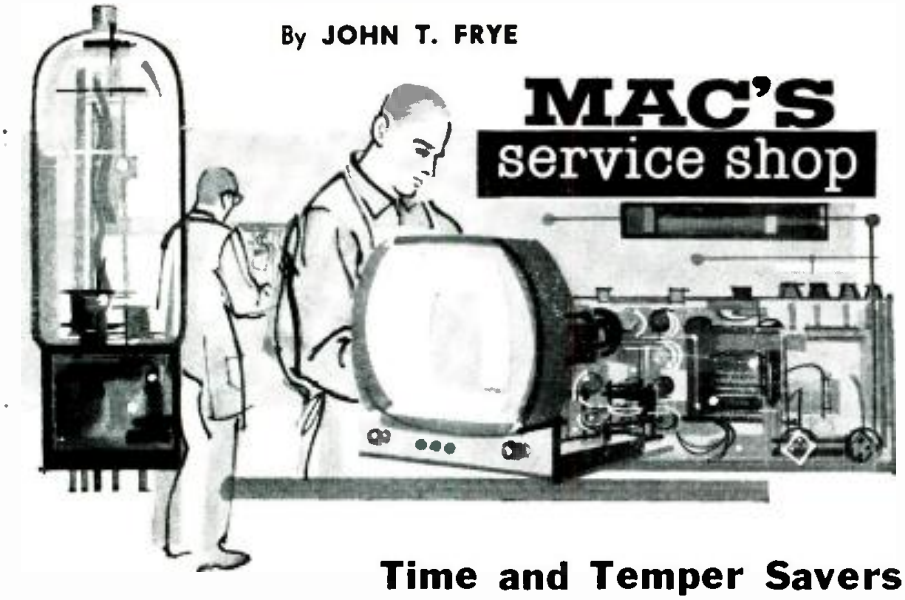
By JOHN T. FRYE



Time and Temper Savers

"OK, OK!" Barney was saying as he came through the door of the service department Monday morning; "what were you doing here last night? Marge and I saw a light on at ten o'clock as we drove past, and your car was parked out front."

Mac, Barney's employer, heaved an exaggerated sigh of resignation. "A man can't get away with a thing, can he? You won't rest, though, until you know. Actually it all started when I went to Doc Briney for my regular physical checkup Saturday."

"Nothing's wrong with you, is there?" Barney asked with quick concern.

"Not really. My blood pressure was up a trifle, and he asked if there was anything 'irritating or exasperating' about my work. The more I thought about that the more I grinned; for you'll agree, I'm sure, there are several things about radio and TV servicing that might aptly be termed irritating or exasperating—even excluding the customers."

"And how!" Barney soulfully agreed.

"Sunday the wife went to a class reunion and left me sort of at loose ends. I got to thinking about some of the petty little goat-getters here at the bench; so I decided to come down and see what I could do about a few of them. The project became so interesting I didn't quit until after eleven last night."

"These are new," Barney observed as he pointed to a row of lidless transparent plastic boxes fastened up behind the bench.

"Yeah. They are to receive the knobs, back-cover trimounts, and chassis screws and washers you remove and either scatter around over the bench or place carefully in a box on the bench and promptly upset. You know: the same little parts that gradually dribble off the bench during the heat of your tussle with the set and hide on the floor where they can't be found when you're ready to put the chassis back in the cabinet. You can see at a glance what each one of the plastic boxes contains, and notice they are tilted out so that even a tiny lockwasher can be slid up over the side with a forefinger."

"A couple of the boxes have stuff in them now."

"Those are extra trimounts, dial-cord springs, and knob springs to replace those that still will manage to get away in accordance with Murphy's Law. We're through spending dollars-an-hour time hunting fraction-of-a-cent hardware. Along the same line, I want you to observe and *use* this little red plastic nut-starter. It is a real time and temper saver. When I think of all the time I've wasted trying to start a nut on an i.f. can spade lug buried down under a nest of wires with fingers that suddenly seem as large and clumsy as bananas, or tried to improvise a nut-starter from a length of solder or a holding-type screwdriver—well, I can really appreciate something like this; but if it is to save time it must be used right in the beginning, not as a last resort. As you can see, the recess in one end can be pressed down over a 3/16" nut and that in the other end over a 1/4" nut. Either size nut will be held firmly in the end of the slender tube while it is easily started in the most cramped quarters."

"What's the purpose of the big clipboard mounted behind the bench?"

"It's to hold diagrams, step-by-step alignment instructions, or other service literature where it can be easily seen as you work and where it will not be burned with the soldering iron, torn with a sharp chassis corner, soaked and stained in excess contact cleaner, or otherwise mutilated. Not being able to read the value of a component or the number of a trimmer can waste a lot of time. We have a very substantial investment in our service literature, and it behooves us to take care of it."

"This doohicky that looks like a small piece of plywood hinged to the back of the bench is new. What's it supposed to be?"

"Swing it out and you'll see that a two-turn loop of wire is fastened to the back side. The signal generator output cable connects to those terminals on the top and permits us to radiate a signal from the two-turn coil into the loop antenna of a set on the bench, as is usually specified in the adjustment of r.f. trimmers. In the past we have tried to get by by simply connecting a piece of wire across the output terminals of the signal generator and draping this near the loop antenna of the set. It was always shorting out, falling off, or sagging away from the loop and giving us misleading output indications. It was hard to be sure if the change in output was produced by a trimmer adjustment or by a change in the position or shape of the radiating loop. This coil can be swung so as to give us any degree of coupling to the loop antenna we wish, and it will stay where we put it. What's more, since we'll always be using the same radiating coil, we'll soon learn what constitutes normal receiver response to a given signal generator output and a controlled amount of coupling between the radiating coil and the loop.

"Along that same line," Mac continued, "here's another little item I think will aid in keeping down the blood pressure. It's a simple extension cord for connecting a cabinet-mounted speaker of an a.c.-d.c. receiver to the chassis outside the cabinet. The speaker is mounted in the cabinet in a high percentage of the current printed-circuit sets, and connection to the chassis is usually made through a pair of short, comparatively stiff wires permanently connected to the chassis and fitted with plugs that go into simple jacks mounted on the speaker frame. It is virtually impossible to work on the set out of the cabinet with these wires connected. Even if you do manage to turn on the receiver, you are almost certain to break off one or both wires in moving the chassis about. On the other hand, if you use clip leads to extend the wires, these are forever shorting together or slipping off. As you can see, the 'extension' consists of a couple of lengths of flexible insulated wire soldered to two speaker jacks mounted on a piece of Bakelite. The other ends of the wires terminate in pins to fit the speaker jacks. With this in use, the chassis can be turned every which way, as it often must be in examining, servicing, or aligning, without impairing the connections to the speaker."

"That will come in handy," Barney conceded. "If we like, we can connect those pins to the binding posts of our substitute speaker; but I prefer to use the set speaker when I can. Sometimes it has an intermittent defect that may be overlooked if the substitute speaker is used during the servicing."

"That's my boy!" Mac applauded; "but speaking of 'overlooking,' you missed this new cheater cord coming out of our variable-voltage isolation transformer. It's connected internally across the 'normal' voltage output socket and will carry the voltage

(*Continued on page* 93)

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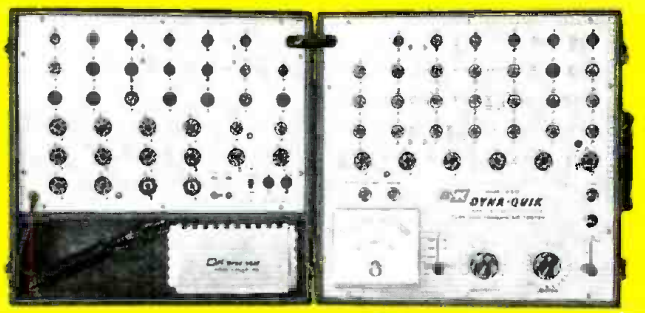

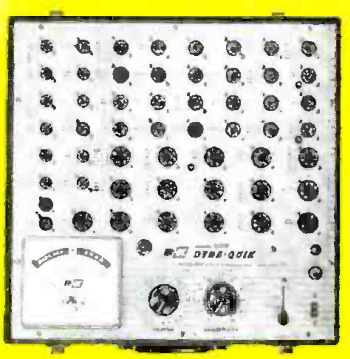

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Response: Plus or minus 1 db 6 cps to 60 KC.
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A-410	15 watts	EL-84, 6V6, 6AQ5	14.95
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Write for complete data on Dynaco transformers including suggested circuits and modernization of Williamsom-type amplifiers to 50 watts output.

DYNACO INC.

3912 Powelton Ave., Philadelphia 4, Pa.

Hi-Fi-Audio Product Review

FOUR-CHANNEL MIXER

Sigma Electric Co., 11 East 16 St., New York 3, N. Y. has introduced its Model SA3761, a four-channel audio mixer for professional use in recording and broadcasting studios as well as in central sound systems.

The mixer contains four separate single-stage amplifiers, each employing a triode-connected type 5879 tube and

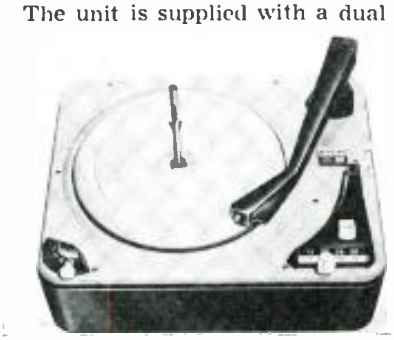
each provided with an individual input transformer. The impedance of each of the four inputs may be adjusted individually to 50, 125, 150, 200, 250, 333, 500, or 600 ohms. The output impedance may be similarly set. The mixer is designed to feed directly into the microphone input of *Ampex* recorder Models 402, 403, and 350, and when used with a special adapter cable, it will work into *Ampex* Models 400, 400A, 401, and 401A.

STEREO CHANGER/PLAYER

Electronic Instrument Co. Inc., 33-00 Northern Blvd., Long Island City 1, N. Y. is now offering a new four-speed automatic record changer/automatic-manual single-record player as the *Eico* Model 1007.

The low-distortion stereo crystal cartridge has been designed integrally with the extra-long tone arm to eliminate mid-range resonances which can sometimes occur when tone arm and cartridge come from different makers.

The unit is supplied with a dual *RC*



magnetic input adapter. The cartridge snaps in and out of the tone arm without tools and features an instantly replaceable twin stylus. The factory adjusted stylus force is 4.5 grams.

The Model 1007 features a special speed-change and power transmission mechanism with four individual intermediate compound idlers, one for each speed. In addition, the changer mechanism is controlled by a central precision cam-wheel which eliminates excess linkages and makes for a jam-proof mechanism.

FIDELITONE TAPE HEAD

Fidelitone, Incorporated, 6415 Ravenswood Ave., Chicago 26, Ill. has added a compact, four-track magnetic recording and playback head to its line of audio components.

One of the smallest four-track heads yet developed, it meets all the dimensional requirements of the EIA Standard. The heart of the unit contains two separate channels with a unique solid core. These tapered cores provide a flat response to 15 kc. (with standard compensations) obtainable at 3.75 ips.

The manufacturer will supply complete specifications on this new head upon request.

FM CAR RADIO/CONVERTER

Kinematrix, Inc., 1616 N. Damen Ave,. Chicago 47, Ill. has developed a versatile FM radio/converter for auto-

mobiles. Called the "Skylark," the new equipment features a modular concept. The basic tuner serves as a converter, ready to be used by car owners who already have an AM radio installed. The addition of the compact "KX Audio Pak" makes a complete 15-watt FM radio, so that if a new car—without an AM radio—is purchased at a later date, the owner can have an FM system.

The "Skylark" is said to be the slimmest FM car radio available, extending only 2¼-inches below the dashboard. It is reported to work efficiently on existing car antennas. The set features one-knob control placed close to the driver, as well as an edge-lighted FM and logging scale.

TRANSISTORIZED RECORDER

The Electronics Division of the *Morse Sewing Machine Company*, 122 W. 26th St., New York, N. Y. has a 4½-pound transistorized tape recorder on the market, the Model 300.

This unit features a single control for record, rewind, and replay. Designed as an office machine or for vari-

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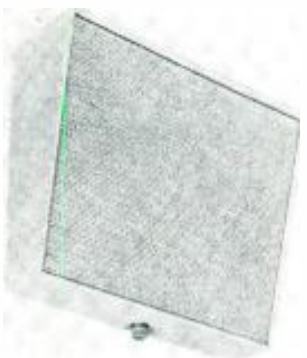
ous portable applications, this 8½" x 7 3/16" x 3⅜" recorder operates at 3.75 ips speed. The circuit is completely transistorized and uses six transistors and a varistor.

Available accessories include a crystal microphone, crystal earphone, recording tape with 3" reels, a 3" take-up reel, and a telephone adapter. Complete performance specs and price information are available from the manufacturer.

SPEAKER-BAFFLE COMBO

Utah Radio & Electronic Corp., 1124 E. Franklin St., Huntington, Indiana is now marketing a ready-to-use speaker and baffle combination which utilizes its new "Magni-Magic" inverted speaker unit.

The dual-diameter design features



an 8-inch, 8-ohm speaker capable of handling 5 watts and screw terminals that eliminate soldering. In four different series, the speaker-baffle combination is available with (a) speaker-baffle, 70-volt transformer and volume control, (b) speaker-baffle and volume control, (c) speaker and baffle only, and (d) speaker-baffle and transformer only. Completely wired and ready for immediate use, the combination measures 12" wide, 9½" high, and 4" deep at the top and 2¼" at the bottom.

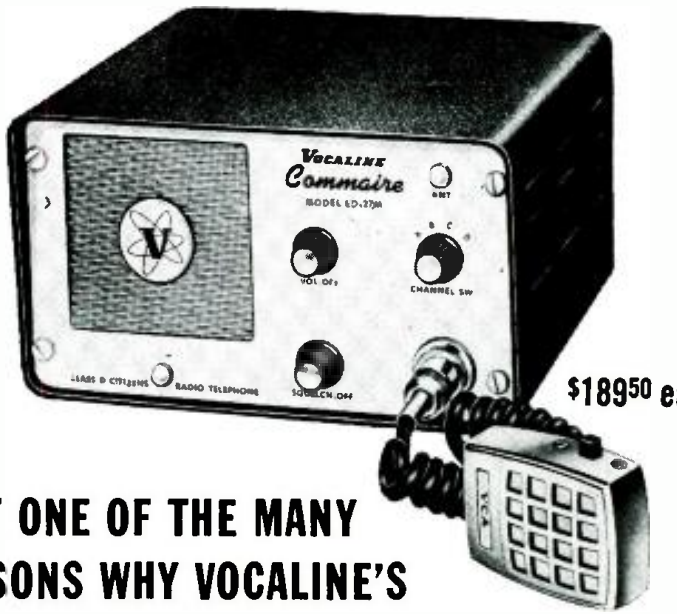
The models are available in mahogany, blonde, and walnut finishes. Complete specifications are available from the manufacturer.

WIDE-RANGE OSCILLATOR

Jackson Electrical Instrument Co., 124 McDonough Street, Dayton, Ohio is now offering a wide-range oscillator that supplies both sine- and square-wave output for checking hi-fi, stereo, and audio amplifier circuits for operation, voltage, gain, and frequency response.

The Model 605 features push-button range selection and continuously variable output power. Frequency range is 20 to 200,000 cps, in four ranges. The square wave is generated by a Schmitt trigger circuit which is actuated by the sine wave.

SELECTIVITY: ±5Kc at points 6db down!



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The Commaire ED-27 Single-Channel Citizens Band Radio... in a class by itself:

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Microphone, transmitter, receiver and carrying case, $250. For information or literature, write: Superscope, Inc., Dept. 6, Sun Valley, California.

SONY

SUPERSCOPE. The Tapeway to Stereo

Accuracy is 3% or 1 cycle, whichever is greater. Output voltage is 0 to 5 volts r.m.s. sine-wave and 20 mv. to 7 plate-to-plate volts square-wave. Output level is ±1 db over the full range.

The unit measures 11" high. 7⅝" wide, and 13" deep. It draws 50 watts and will operate from any 50/60-cycle, 110-120-volt power source.

TWO-SPEED TURNTABLE

Ercona Corp., 16 West 46 St., New York 36, N. Y., has introduced a new "Connoisseur" turntable for operation at 33⅓ and 45 rpm speeds. The turn-

table uses a hysteresis synchronous motor. Speed change is accomplished by a double-stepped cone. ground integrally on the motor shaft to assure concentricity. The motor shaft is suspended in graphite nylon bearings and all revolving shafts are precision ground and lapped to a "mirror finish."

According to published performance figures, the rumble factor is down −50 db when referred to 7 cm./sec. at 1 kc. Wow is stated to be .15%; flutter. 0.1%. Hum level is down to −80 db. The turntable itself is 12 inches in diameter and lathe-turned of anti-magnetic non-ferrous metal.

TRANSISTORIZED MIXER

Westrex Corporation, Recording Equipment Department, 6601 Romaine St., Hollywood, Calif. has introduced a completely transistorized mixer for audio recording.

The Type RA-1627 mixer accepts up to eight inputs at a nominal level of −5

dbm and provides a single channel of equalized output in the range of −20 to +16 dbm. Input and output connections are made through a terminal strip on the front. A jack field is provided to facilitate special circuit configurations.

Modular construction makes possible configurations to meet any need in disc recording, radio, television, p.a., or motion pictures. Response is flat within ±0.5 db from 40 to 12,000 cps.

Built for table mounting, the mixer is housed in a hardwood cabinet which measures 13" x 16½" x 40½". Access to all electronic modules is from the front for easy servicing.

NEW VU METER

Robins Industries Corporation. Flushing, N. Y. has added the Model VU-100 vu meter to its line of audio accessories.

The meter measures 4½ inches and has a two-color scale; modulation calibrations from 0 to 100% are provided with vu calibrations from −20 to +3. The instrument provides dual impedance inputs for use with high- or low-impedance circuits. Sensitivity of the basic movement is 200 μa. The meter mounts in a 2¾" diameter hole and extends to a depth of 1½" inches.

"MUSI-KAR" TUNER

Trans-Pacific Electronics Inc., 4216 Lankershim Blvd., North Hollywood. California has developed and is marketing a new FM tuner for cars which has been tradenamed "Musi-Kar."

The unit is a true tuner, not a converter. and merely uses the audio stage of the car radio, the tuner output being cut into the volume control of the auto set. The tuner provides full 86.5 to 109.5 mc. coverage. Sensitivity is 1.5

μv. (antenna loaded) with quieting sensitivity of 2.5 μv. for 20 db quieting at 98 mc. The standard 50- to 72-ohm car-type antenna is used with the tuner. The circuit employs six tubes and a power transistor.

Dimensions of the tuner are 8¾" x 3½" x 5". Complete details are available from the manufacturer on request.

REMOTE SPEAKER SWITCH

Centralab, 900 E. Keefe Ave., Milwaukee 1, Wis. has added a stereo remote speaker switch to its line of electronic controls.

The Model 1486 enables switching from the "main pair" of stereo speakers to a remote pair of stereo speakers as well as permitting operation of all four speakers simultaneously.

The switch is 1$\frac{1}{32}$" high and 1$\frac{29}{64}$" wide. The ¼" diameter shaft measures 1½" from the bushing with ½" split knurl. It is supplied with a black and chrome push-on knob and complete installation instructions. This new item is now available at all of the company's distributors.

NEW ESL CARTRIDGES

Electro-Sonic Laboratories, Inc., 35-34 36th St., Long Island City 6, N. Y. has introduced two new stereo cartridges. Model ESL-C99 fits any stand-

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ard changer or arm. Model ESL-P99 "Micro/Flex" is designed for use only with the ESL-S310 professional series arm. Both cartridges have otherwise

similar characteristics. Each uses patented d'Arsonval elements, said to be inherently linear. These elements are coupled to the new "micro-flex" frictionless stereo separating system.

Specifications, listed by the manufacturer, are: vertical compliance, 5 x 10^{-6} cm./dyne; lateral compliance, the same; dynamic mass, .0025 gram; output per channel, 1 mv. at 10 cm./sec.; channel separation, 20 to 25 db.; frequency response, with *Elektra* 35 test record, ±2 db, 18 to 20,000 cps.

AUDIO CATALOGUES

DATA FOR AUDIO BUILDERS

Telectrosonic Corporation, 35-18 37th Street, Long Island City, N. Y. has published a colorful and informative brochure showing how hi-fi fans can start modestly and build up a complete sterephonic tape system.

The brochure features the company's Series 900 of "building block" stereo tape decks and related preamplifiers. Through text and diagram, the booklet shows how to start with a "playback only" unit and eventually wind up with an integrated record-play, four-track stereo system.

HI-FI/STEREO EQUIPMENT

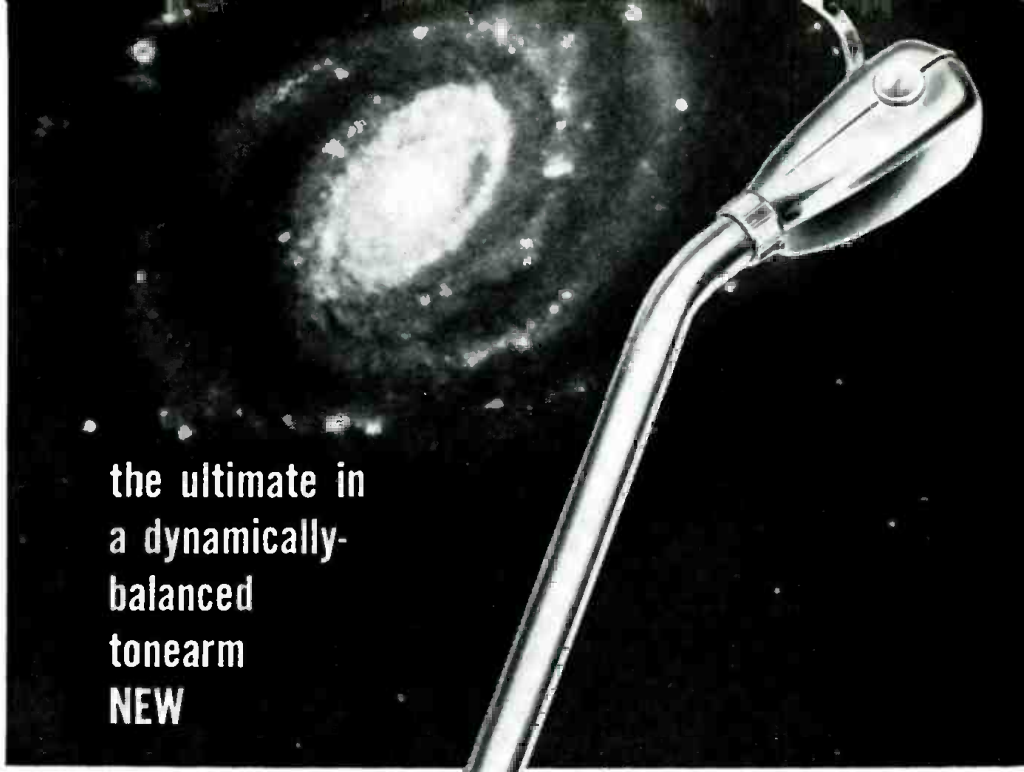
Kierulff Sound Corporation has just published a new catalogue covering high-fidelity and stereo equipment.

The 84-page booklet contains product and price information on a wide variety of audio equipment and accessories. Copies are available from any of the company's six locations in downtown Los Angeles, West Los Angeles, Riverside, Long Beach, Studio City, and Orange, California.

NEEDLE REFERENCE GUIDE

Recoton Corp., 52-35 Barnet Ave., Long Island City 4, N. Y. has announced publication of its 9th annual "Simplified Replacement Needle Reference Guide".

This easy-to-read, all-inclusive guide now includes a phonograph manufacturers' index, both monophonic and stereo, and a convenient cross-reference guide. Also included on the cover page is a spot check listing from needle to cartridge manufacturer and *vice versa*. —30—



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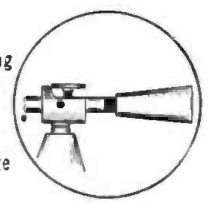
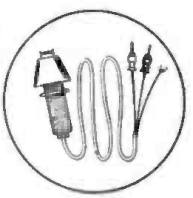
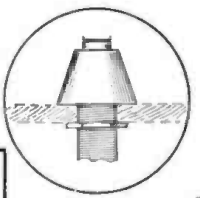
MICROPOISE DYNAMIC BALANCE CONTROL—By dialing the cushioned, spring-tension Microscope Balance Control, the arm is dynamically balanced and set for accurate stylus pressure.



PERMANENTLY ATTACHED PLUG-IN CABLE—fully shielded single-jacket cable is anchored to the arm—includes two color-coded plug-in leads, 2 shields and a ground wire. No soldering! No hum problem! Fast, correct installation assured!



FAST SINGLE-HOLE MOUNTING: Arm base mounts through single hole by tightening of single locknut.



PLUS THESE EXTRA FEATURES...

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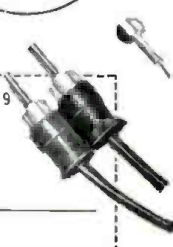

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A conventional needle with a rounded ball tip can't fit the microgroove accurately. Its rounded shape prevents proper contact in the high tonal passages. Result? Distortion and noise.

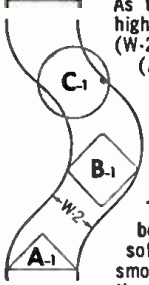
But, Fidelitone's new Pyramid Diamond is shaped like the original cutting stylus to fit the record groove exactly. It maintains proper contact in all frequency areas. This lowers background noise and distortion by as much as 85%, and reproduces only maximum true sound — stereo or monaural.

HERE'S WHY...

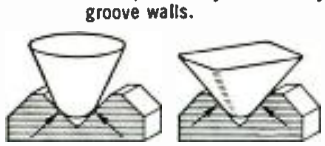
Recording Stylus Ordinary Needle Pyramid Diamond

Fidelitone's new Pyramid Diamond is shaped similar to the stylus that recorded the original sound. It perfectly follows every contour created by the recording stylus.

In an unmodulated, or low frequency groove, the recording stylus (A) cuts a groove (W-1) wide enough to let an ordinary ball point needle (C) and the Fidelitone Pyramid Diamond (B) track the centerline of the groove accurately, and contact all recorded sound impressions.



As the groove is modulated by high tones, the groove width (W-2) cut by the recording stylus (A-1) narrows. This causes the ordinary ball needle (C-1) to rise and "pinch out" of the record groove. It bridges modulation crests, mistracks centerline and distorts sound impressions. The Pyramid Diamond (B-1), because of its new shape, stays solidly in the record groove, smoothly glides along the centerline positively driven by the groove walls.



BALL POINT DIAMOND PYRAMID DIAMOND

And the new shape of the Pyramid Diamond allows more surface contact between needle and record, substantially reducing contact pressure. This greatly increases needle and record life.

See your record dealer or hi-fi specialist today. Demand the Fidelitone Pyramid Point. You owe it to your records and your listening pleasure.

For the complete story on the revolutionary new Pyramid Diamond, or the name of your nearest dealer, write Fidelitone, Chicago 26, Illinois.

Fidelitone

"Newest shape on records"

The Proper Microphone

(Continued from page 38)

phone for your particular application consists of selecting the proper pickup or polar pattern, either omnidirectional or directional. Each type of microphone, irrespective of the generating element, has its own pickup characteristics. In the case of directional microphones, these characteristics are designed for a specific purpose.

It is not always easy to tell from the microphone's appearance what its directivity is. For example, a generating element mounted in a case with an open grille in front but closed in the back may be an omnidirectional (also called non-directional) microphone. Its looks are misleading since it would appear to pick up sound only from the front through the open grille. But sound waves from the back and sides of the case will produce as much output in some microphone types as does sound from the front. There are also microphones available whose directivity pattern can be changed from omnidirectional to directional by simply turning a screw.

Omnidirectional microphones (Fig. 7A) can be built with nearly any type of generating element. These microphones are available from the lowest to the highest price classes. The more expensive types represent the highest quality and most uniform response available in today's microphones.

These pickup characteristics, however, limit the applications in which the omnidirectional type can be used. If used under poor acoustical conditions, these microphones will pick up undesirable noise, echo, and reverberation. These, in public-address applications, will cause feedback or acoustic howl as the microphones pick up, and the speakers reproduce, the same echo over and over again. But for some types of studio use, general nonstereo recording in the home, or under favorable acoustic conditions, omnidirectional microphones, particularly the better quality dynamic types, are unsurpassed.

The ribbon microphone provided the first "control" of sound pickup. Its main pickup areas are from the front and back of the microphone along a line at right angles to the surface of the ribbon itself. It attenuates sounds arriving from either side, or from above or below the microphone. This attenuation helps to eliminate feedback and other undesirable noise by proper positioning of the microphone. Fig. 7B shows the two-way directivity (bidirectional) characteristic of the ribbon microphone. Although this type of response is unique with the ribbon, it is possible to eliminate the back lobe of response entirely and produce a unidirectional pattern.

Unidirectional microphones, with a heart-shaped or cardioid polar pattern, provide greatly improved control of sound pickup and, even for the novice, are quite easy to use. These highly versatile microphones pick up sound across approximately 45° to either side of the front axis and attenuate sounds arriving from the sides and back. The farther off-axis the source of sound is beyond 45°, the greater the attenuation, until at the back of the microphone there is almost no pickup at all, as shown in Fig. 8A. This means that one need merely aim the microphone at the person or group being recorded, keeping the back of the microphone positioned toward any source of echo, crowd, or other interfering noise. Whether the application is public address or recording, the elimination of this unwanted noise is a prime necessity. If the 90° acceptance angle (45° each side of the front axis) across the front of the cardioid microphone is too narrow, the microphone need merely be moved back until the entire group is within that angle. In the case of large choirs or orchestras, an additional microphone or two should be used.

It should be remembered that while an omnidirectional microphone is used only under good acoustical conditions, the cardioid is not limited to just poor conditions but can be used to advantage under either. Professional cardioid models are among the finest directional microphones available, although it is possible to obtain less expensive cardioid types. Practically any of the generating elements previously described can be used in the cardioid microphone.

An even greater control of sound pickup is produced by a new type "line" microphone. With this type, a short length of tubing or transmission line, a foot or more long with openings along its length, is arranged in front of the generating element. This type, as with the cardioid, picks up sound across an angle of about 45° each side of the front axis of the microphone. However, at the sides as well as the back, arriving sounds are virtually cancelled. With this greater control, the microphones can be moved back much farther from the source of sound than even the cardioid and normal pickup maintained. This makes the line microphone especially useful on stage pickups or any application where the microphone cannot be used close to the performer or other source of sound.

The one remaining type is perhaps much more specialized but is highly useful where there is a high level of surrounding noise. Such conditions are found in industrial plants, at sporting events, and on emergency work. Microphones of the differential or noise-cancelling type and built with a carbon or a dynamic element are employed here.

The case of the differential microphone has two openings, one leading to the front and one to the back of the diaphragm. When used very close to the lips, the sound pressure on the front of the diaphragm is much greater than on the back since the sound must travel quite a bit farther to reach the back of the diaphragm. Under these conditions, the microphone operates

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normally. However, sounds originating more than 3 inches from the microphone have about the same distance to travel to the front and back of the diaphragm. As a result, cancellation occurs. Even extremely loud sounds, such as jet engine noise and gunfire, are cancelled. Applications for this microphone are quite obvious.

Quality of Performance

The one remaining choice to be made is the quality of performance desired. This will depend on many things, including the amount that one wants to pay for the microphone. The owner of a low-cost tape recorder may desire professional results. He may never quite achieve them, but the use of a better microphone than that furnished with the recorder, the application of the principles covered above, careful placement, and some patience, will, in many cases, produce substantial improvements.

Quite naturally, the owner of a *Cadillac* will not fuel it with kerosene. Nor should the owner of professional equipment, whether it be a tape recorder or a public-address installation in a cathedral, suddenly become economy minded in choosing microphones for his use. They represent a long-term investment and one of the few variables where great improvement in performance can be obtained.

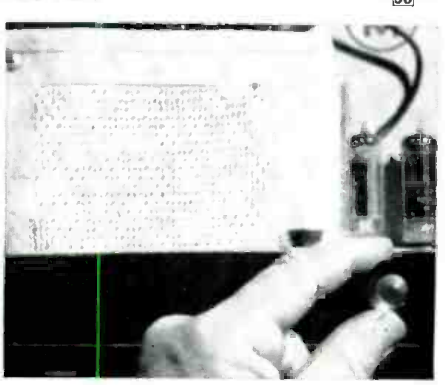
Most medium-priced tape recorders will produce dramatic improvements in recordings when at least a medium-priced microphone, properly chosen, is added. Public-address installations need not be expensive to produce fine quality, but they must include the proper microphone.

The simple principles of choosing the proper generating element, pickup pattern, and desired quality will not only assure the best value but can provide much satisfaction in the final results obtained. —30—

SUBSTITUTE GRILLE CLOTH

By GLEN F. STILLWELL

IF YOU need a small piece of grille cloth and the genuine article is not available, try using a piece of burlap bag. This isn't as silly as it sounds because even the coarsest and cheapest material can be made presentable by spraying it with a coat or two of aluminum or gold paint. If only a very small piece is required, it may be dipped into the paint, then hung out to dry. In this way, soiled grille cloth may be renovated to look like new. —30—



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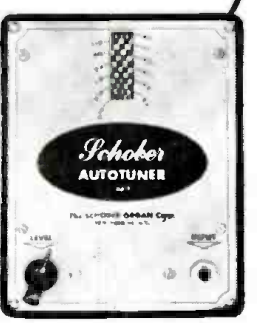

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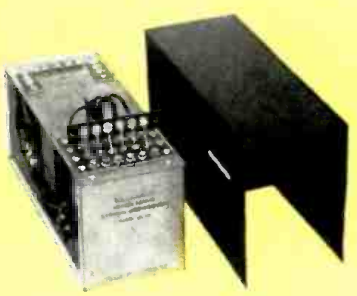

MIXED LOWS STEREO CROSSOVER KIT (AN-10)

Permits using one bass woofer and more economical "wing" speakers for stereo. Delivers non-directional bass of both channels below 250 cps to one woofer; passes higher frequencies to wing speaker. Takes 25 watts per channel; 8, 16 ohm woofers; 8 ohm high freq. speakers. 10 lbs.

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Rubber matted heavy turntable is shock mounted, and idler wheels retract to prevent flat spots. 4-pole motor; 16, 33⅓, 45 and 78 RPM; Sonatone 8TA 4-SD ceramic stereo turnover cartridge with diamond and sapphire styli; preassembled mechanism and base. 10 lbs.

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A low-cost, versatile stereo preamp-control center. Four inputs each channel accept magnetic cartridge, crystal or ceramic cartridge, and tuner, tape, TV, etc. Six position function switch gives flexible stereo or monophonic use. Features cathode follower outputs plus hi-level outputs for tape recorder drive, calibrated Baxandall-type tone controls for each channel, clutch-type volume controls, filament balance controls, and accessory AC sockets. Self-powered. Styled in black and gold. 8 lbs.

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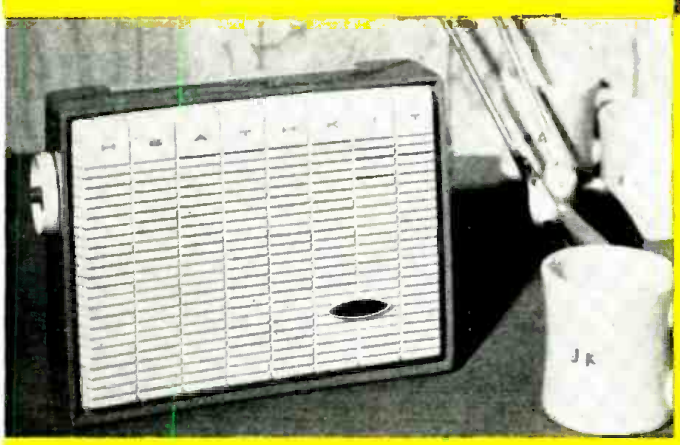
AA-30 **$45.95**



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COMMERCIAL SOUND SYSTEM (CSS-2) same as above except with 2 speakers. 25 lbs. **$99.95**

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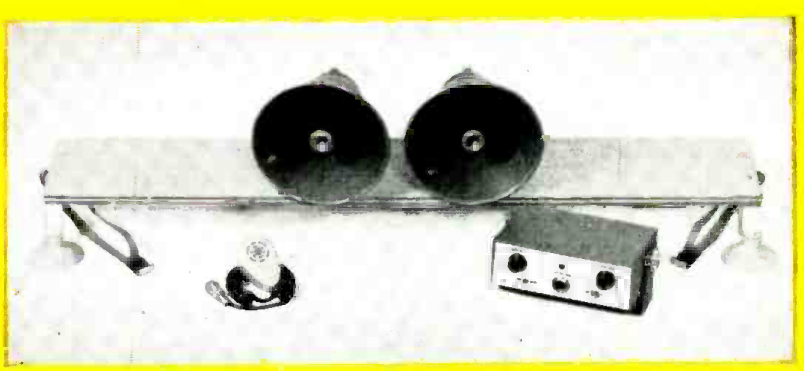

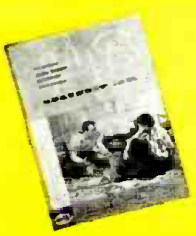

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Fill out the order blank below. Include charges for parcel post according to weights shown. Express orders shipped delivery charges collect. All prices F.O.B. Benton Harbor, Mich. A 20% deposit is required on all C.O.D. orders. Prices subject to change without notice.

HEATH COMPANY, Benton Harbor 15, Michigan

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ITEM	MODEL NO.	PRICE

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( ) SEND MY FREE COPY OF YOUR COMPLETE CATALOG

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Double Power

IN ALL DIRECTIONS . . .

WITH THE hy-gain

Colinear Ground Plane

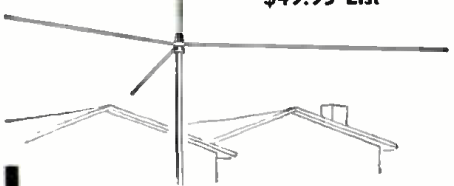
FOR

Citizens Band

3.4 DB

OMNIDIRECTIONAL

Model CLR,
$49.95 List



Unlike multi-element beam antennas which concentrate energy in one or more directions at a sacrifice in power in other directions, the Hy-Gain Colinear Half Wave Length Ground Plane achieves gain through colinear action which concentrates more power at lower angles to the horizon . . . performing equally well receiving or transmitting. Exclusive Hy-Gain design, precision tuned and matched for 52 ohm coax cable, conforms to legal limitations, overall height 18 ft., built to heavy duty commercial specs, radiator 1-1/4" OD to 3/4" OD heavy wall heat treated aluminum tubing, radials 9 ft. long of 5/8" OD aluminum tubing. Cycolac plastic base insulator . . . accepts masts to 1-5/8". Complete with matching stub.

Investigate the hy-gain

COMPLETE CITIZENS BAND LINE

including

BEAMS
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AND ANTENNAS
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1135 No. 22nd St. Lincoln, Nebr.

A Vibrator "Washer"

By

FRANK DE BRA

A handy "conditioner" for service shops handling automotive, two-way mobile, or marine radio work.

SOMETIMES a new vibrator just won't start, as you fellows who do any automobile radio and other mobile work already know. Or, if it does start, it doesn't produce the voltage it should.

The reason for this is that the contact points become oxidized while the vibrator is lying around on the shelf waiting to be put into service. This oxidation does not hurt the vibrator, it just keeps it from operating.

Nearly every technician has, at one time or another, resorted to the use of a lamp in series with the 117 volts a.c. to get a vibrator started. While this "gimmick" works, after a fashion, it is not really satisfactory since it is capable of getting the technician "all shook up" if he is careless and gets himself instead of the vibrator across the 117!

To get a new vibrator to vibrate satisfactorily, it is necessary to burn the oxidation off all the contact points, not just the pull and interrupter. In our shop we built a "vibrator washer." Each new vibrator goes through the washer and gets all its contact points thoroughly "washed" before it goes into service.

The diagram (Fig. 1A) shows how our unit is made. Our business is marine electronics and we handle 6-, 12-, 24-, and 32-volt vibrators, synchronous and non-synchronous. Other versions for other types of service work are shown in Figs. 1B and 1C. Our washer has proved itself capable of handling 95% of our vibrator types. The various vibrator sockets and the lamp socket are mounted in a "Minibox". No fuse is necessary because a short merely lights the lamp.

If this particular model doesn't suit your needs, it is a simple matter to redesign it. See Figs. 1B and 1C.

First, make a list of the various types of vibrators you will want to "wash." Vibrators with the same base are not necessarily the same inside, so refer to a vibrator guide to determine the number of different sockets or differently wired sockets you will need. Then, still referring to the guide, work up a wiring diagram.

In determining the correct wiring, there are two things which must be kept in mind: 1. Be absolutely certain that the lamp is *always* in series with the line. The 117 volts of a.c. directly across the contacts can ruin a good vibrator in nothing flat; and 2. In order to do a thorough job, each pair of contacts must have a.c. across them. If they don't make and break with the a.c. across them, they won't burn clean.

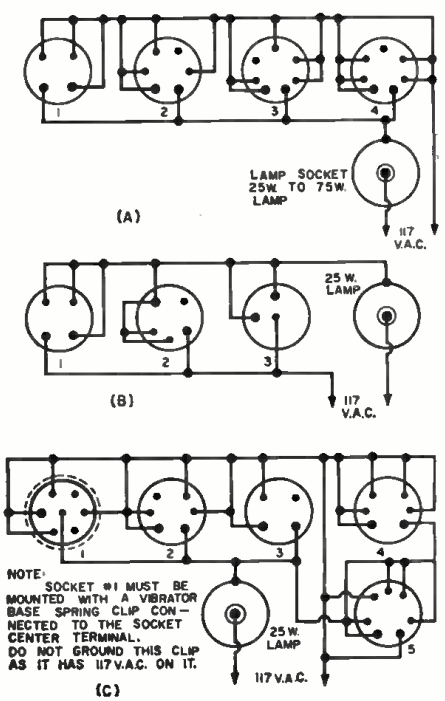
A good idea is to open one of each type of vibrator you use, insert it in the proper socket, and watch to see that each set of points is making and breaking with the voltage across it. Sparking each time the vibrator is started and stopped indicates that the vibrator is being properly "washed". Also this gives you a positive check on whether you wired the socket correctly or not.

The lamp may be any value from 75 watts down. The lower the wattage of the lamp, the lower the current through it and across the vibrator contacts. Twenty-five watts should be about right but 50 watts won't hurt anything.

One word of caution: Don't leave the vibrator operating in the "washer" longer than necessary. A few seconds is usually all that is required to burn off the oxidation. Longer operation can damage the points by too much burning.

The diagrams of Fig. 1 will cover most of your requirements. However, be sure to check a vibrator chart to determine your specific needs. —30—

Fig. 1. Various vibrator socket arrangements for types most often used in (A) marine, (B) automotive, and (C) mobile communications radio equipment.



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a new way to measure amplifier power!

It's no secret that the new Music Power Rating system is now being used by many hi-fi manufacturers in determining amplifier power. How does this new system compare to the conventional sinewave continuous power method? Is it of real value to both manufacturer and consumer? October ELECTRONICS WORLD examines Music Power Rating in depth—answering these questions and many others. It's just one of the many important hi-fi features coming your way in the October issue of ELECTRONICS WORLD.

October ELECTRONICS WORLD also brings you many other features on servicing, construction, test equipment. You'll want to read about:

Pneumatic Devices for Electronic Circuits

The technician who deals with electronic gear that works in conjunction with other non-electronic equipment must have a thorough understanding of the entire picture. Here's a rundown on the role of pneumatic devices that tie in with electronic systems.

Hand Held Citizens Band Transceiver

Complete construction details on a transistorized transceiver that weighs less than two pounds and has a range of one mile Perfect for intercom applications, it may be operated without a license.

Don't miss October ELECTRONICS WORLD—authoritative ...informative...important!

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NEW! LAFAYETTE HE-15A

2-WAY SUPERHET

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Completely Wired - NOT A KIT!

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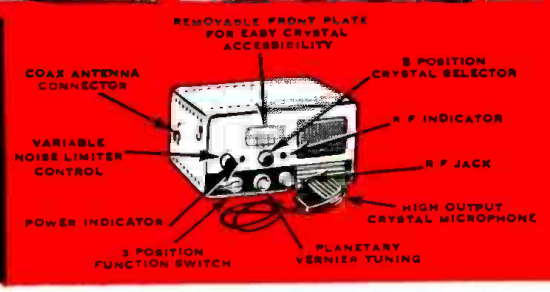

CITIZENS BAND — The New Two-Way Personal Communications Method for Everyone — Fill out the FCC form enclosed with each Lafayette Transceiver. No examination or technical knowledge required — Any citizen 18 years or older is eligible for a license.

THE GREATEST VALUE in the CITIZENS BAND FIELD

Just think . . . now you can have economical, efficient 2-way radio communication from your home, office, store, auto, truck or boat . . . literally hundreds of uses. The Lafayette HE-15A Superheterodyne Transceiver is both a compact precision transmitter and receiver designed to operate on the new class D "Citizens Band." Two or more of these units furnish your own communications system covering up to a 20 mile or more radius depending on antenna height and terrain.

The Lafayette HE-15A meets all FCC requirements and operates in much the same manner as police and other short-wave communications systems. The Transceiver features 5 crystal controlled transmitting channels operating at a maximum legal power input of 5 watts fully modulated, RF stage in both transmitter and receiver. The 5 position crystal selector on the front panel selects any one of 5 transmitting frequencies. These 5 crystals are readily accessible by means of a removable front plate. The superheterodyne receiver is tuneable over the full 23 channel band with 3 watts audo output, AVC, and an amazingly effective Full-Wave Variable Noise Limiter. The noise limiter is continuously variable from the front panel for diminishing ignition and other unwanted noise pickup. A new 5 prong microphone jack makes conversion to a push-to-talk relay a cinch. RF jack on the front panel may be used to monitor the current in the final tube using external meter.

Controls include a 3 position function switch (transmit, receive, and transmit with spring return), planetary vernier tuning plus variable noise limiter. Output impedance matches 52 and 72 ohm antenna with Amphenol type coax connector. Has large 4" PM speaker; input jack for crystal or ceramic microphone; power receptacle in rear for AC line and 6 or 12 volt external power supply. Supplied with single transmitting crystal for channel 9, high output crystal microphone, and brackets for easy mounting of units in auto, boat, etc. Operates on 115 volts AC. Addition of 6 or 12 volt power supply (separately supplied) adapts transceiver, for mobile operation. Size 10¼Wx5½Hx6⅜"D. Tube completement: 2-6U8A/6EA8, 1-6AL5, 16V6, 1-12AX7, 1-6AW8. Shpg. wt., 11 lbs.

HE-15A ..... 5.00 Down ..... Net 64.50

POWER SUPPLY: Adapts HE-15A for mobile operation. Complete with cable, 6 or 12 volt vibrator and mounting flanges. Completely enclosed. Size 4¼Dx6Wx4"H. Shpg wt., 4 lbs.

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Chrome swivel ball mount base designed to be mounted on any surface. Stainless steel spring holds rod in properly adjusted position and prevents rod damage from shocks and blows. Stainless steel whip for maximum resiliency and strength. Shpg. wt., 4 lbs.

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- Mounts Vertically or Right Angle

An outstanding antenna value. This high quality three section telescoping antenna is designed for attachment directly to your citizens band transceiver. Ideal for point to point service over short distances. Molded base loading coil has a threaded stud with a PL-259 plug—connector for vertical or right angle mounting. Shpg. wt.; 1 lb.

HE-19 ..... Net 3.95

NEW! 10,000 OHMS PER VOLT MULTITESTER

Outperforms Instruments Many Times Its Size

9.95

- Extra Large 3½" Meter Face
- Completely Wired and Tested
- All Accessories Included

A convenient, pocket-sized instrument with an unusually sensitive 14,000 ohms-per-volt AC-DC meter, 1% resistors, single range selector switch. First capacity range requires 120V AC, second range requires 6V AC. Durable Bakelite case and panel; probes and flexible leads are plastic coated and color coded. Complete with battery. 4½x3½x1⅛". Shpg. wt., 1½ lbs.

TE-10 ..... Net 9.95
TE-14 Pigskin Carrying Case, shpg. wt., 8 oz. ..... Net 1.95

NEW! LAFAYETTE RADIO FIELD INDICATOR

7.95

- Provides a Continuous Indication of Transmitter Output
- Rugged 200 ua Meter Movement
- Completely Portable —Requires no Electricity, Batteries or Transmitter Connection.

With this rugged, new radio field indicator you can check performance of your marine, mobile or fixed transmitter . . . actually measures the RF field generated by any transmitter between 100KC and 250MC regardless of power. Features a 200 ua meter movement with a variable sensitivity control. Phone jack at rear of indicator accepts earphones thus providing an aural check of transmitter output. Antenna extends from 3¼ to 10¾". Powerful magnet on bottom plate allows easy mounting on car dashboard or metal surfaces. Use anywhere . . . requires no electricity or batteries. Dimensions: (less antenna) 3⅛Wx2¼Hx2"D.

TM-14 ..... Net 7.95

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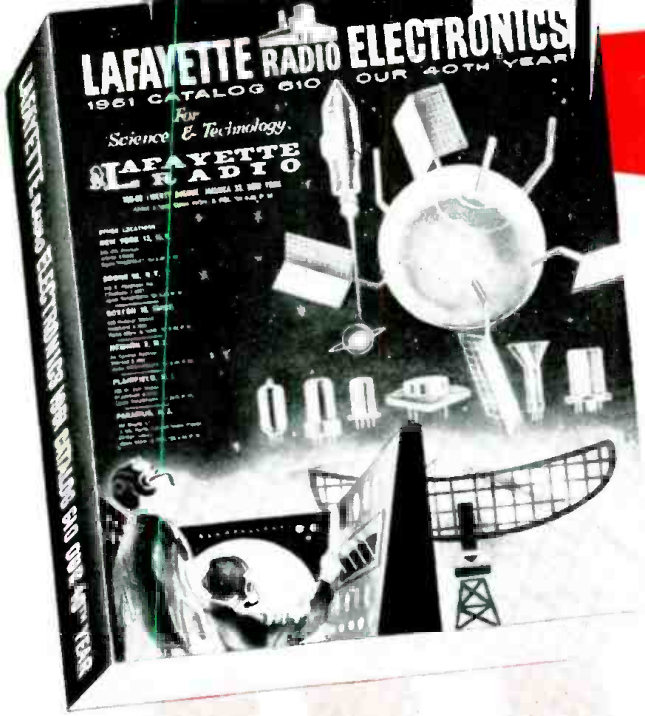

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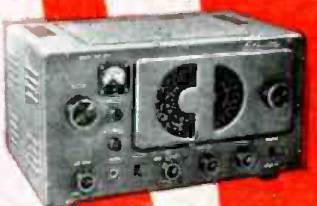

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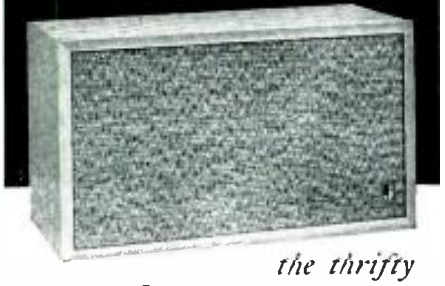
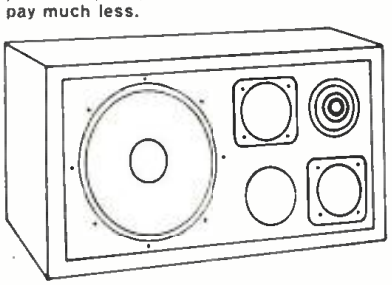


the thrifty 4-speaker TF-3
from **Jensen**

In the "budget" price range, there is no finer speaker system on the market. In fact, careful comparison proves that Jensen's beautifully balanced TF-3 is unquestionably the finest . . . not only the best "buy" . . . but point for point, the best system—and you pay much less.



compare . . .

components: The TF-3 uses a 10" Flexair woofer, effective from 25 cycles, two special midrange units, and the new Jensen Sono-Dome Ultra Tweeter . . . so brilliant a speaker, it does not even begin to operate until 10,000 cycles!

power ratings: The TF-3 drives to full room volume with a good quality 10 watt amplifier. It does not require a 20 watt amplifier for clean performance.

enclosures: In the Jensen TF-3 you get top quality construction ¾" gum hardwood, rigidly built. It stains beautifully—or paint or build-in as you choose. Dimensions: 13½" H., 23⅓" W., 11⅛" D.

compare . . .

price: There is no real comparison. *$79.50*

You are invited to make these comparisons—and any others you wish—between the Jensen TF-3 and any other "rated" speaker system on the market regardless of price. Comparison with the thrilling *sound* of the TF-3 will still further prove that . . .

there is always something better from

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New Tube Tester Data

Recent listings with which owners of Triplett tube checkers can keep roll charts up to date.

TRIPLETT MODEL 3414

FIL.	TYPE	1	2	3	4	5	6	7	8	9	0	CKT.	LOAD
I	5GH8	—	—	—	U*	D*	—	—	D	D	—	3	81
I	5GH8 Test 2	—	D	—	U*	D*	—	D	—	—	—	3	45
J	6EV7	—	D	D	U*	D*	—	—	—	—	—	6	38
J	6EV7 Test 2	—	—	—	U*	D*	—	D	D	—	—	6	38
J	6GC6	—	U*	D	—	D	—	D*	—	—	—	3	23
		4 & 8 show short											
J	6GM6	D	D	U*	D*	—	—	—	—	—	—	3	32
J	6GM8/ECC86	—	D	D	U*	D*	—	—	—	—	—	5	95
J	6GM8 Test 2	—	—	—	U*	D*	—	D	D	—	—	5	95
K	7DJ8/PCC88	—	—	—	U*	D*	—	D	D	—	—	4	58
K	7DJ8 Test 2	—	D	D	U*	D*	—	—	—	—	—	4	58
K	8ET7	—	—	—	U*	D*	D	D	—	—	—	3	59
K	8ET7 Test 2	D	D	—	U*	D*	—	—	—	—	—	3	42
K	8ET7 Test 3	D	—	D	U*	D*	—	—	—	—	—	3	42
N	12FR8	D	D	D	U*	D*	—	—	D	D	—	1	33
N	12FR8 Test 2	D	D	D	U*	D*	D	D	—	D	—	1	70
N	12FR8 Test 3	D	D	D	U*	D*	—	—	—	—	—	1	20
N	12FX8	—	—	—	U*	D*	D	—	—	—	—	1	88
		Pin 7 shows leakage above 1 megohm											
N	12FX8 Test 2	—	D	—	U*	D*	D	D	D	—	—	1	40
N	12FX8 Test 3	D	D	—	U*	D*	—	D	—	D	—	1	10
N	12GA6	D	D	U*	D*	—	—	—	—	—	—	1	77
N	12GA6 Test 2	—	D	U*	D*	—	—	D	—	—	—	1	9
N	12GC6	—	U*	D	—	D	—	D*	—	—	—	3	23
		4 & 8 show short											
O	14GT8	—	—	—	U*	D*	—	D	—	—	—	2	60
O	14GT8 Test 2	D	—	—	U*	D*	—	—	—	—	—	4	22
O	14GT8 Test 3	—	—	D	U*	D*	—	—	—	—	—	4	22
T	35GL6	D	D	U*	D*	—	D*	—	—	—	—	5	63
		Pin 1 shows leakage											
J	7247	—	—	—	D*	D*	—	D	D	U*	—	7	55
J	7247 Test 2	—	D	D	D*	D*	—	—	—	U*	—	6	25
J	7408	—	U*	—	—	D	—	D*	D	—	—	3	52
J	7581	—	U*	—	—	D	—	D*	D	—	—	4	63

*Denotes square around U or D.

TRIPLETT MODEL 3444

TUBE	A	B	ELEMENTS	C	D	REJ/AVG	NOTES
2-01C	5.0	0	1200-0-0000	11	8	Diode	F (6)
2C36	6.3	12	1254-0-0000	2	3	2.2/4.5	F
2C39	6.3	4	1254-0-0000	1	3	3.0/6.0	F
3E29	6.3	5	1563-2-5100	3	4	7.0/14.	(6)
	(Connect two plate terminals with jumper.)						
4-65A	6.3	15	1605-0-6200	2	2	1.2/2.4	(6)
829B	6.3	5	1563-2-5100	3	4	7.0/14.	(6)
	(Connect two plate terminals with jumper.)						
832-A	6.3	8	1563-2-5100	3	3	3.5/7.0	(6)
	(Connect two plate terminals with jumper.)						
5894/AX9003	6.3	7	1563-2-5100	3	4	6.5/13.	(6)
	(Connect two plate terminals with jumper.)						
6263	6.3	40	1235-4-0000	1	3	3.5/7.0	

Note: To test tubes listed above on the Model 3444, use the CG adapter.

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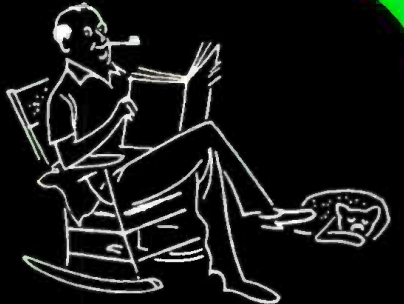

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New portable high styled two-way radio that actually fits into your pocket. Exclusive "power-pak" rechargeable battery lasts a year or more . . . For factory, surveying, construction, department stores, stock-yards, hospitals, firemen, policemen, golf, office, and home. Price $125.00 each.

Can also be used with Globe Electronics' CB100 or CB200 two way citizens band radios, for longer ranges.

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Complete 3-channel, 2-way station for permanent installation or travel. Only 3½x10½x13. Easy to install, operate. Only 3 controls. Range 5-15 miles. Complete with one set crystals, push-to-talk microphone, $129.95 each.

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Especially designed for the commercial user and consumer desiring a more rugged unit. Five crystal controlled channels for transmitting. Four crystal channel receiving plus one tunable position over entire band. Adapted for selective calling system. Dual conversion eliminates interference. Absolutely quiet. Size: 3⅞x12x10⅛ . . . $179.95 each.

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☐ POCKETPHONE ☐ CB-100 ☐ CB-200

Name _____

Address _____

City & State _____

Citizens Band Converter

(Continued from page 61)

The diagram of Fig. 1 shows the methods used to connect the converter to the broadcast receiver. Depending on the type of receiver with which the converter is to be used, the connections can be made direct to the antenna terminals, through a few turns wrapped on the ferrite-rod antenna in the receiver, or by means of a few turns of wire cemented to an existing loop antenna. In the latter two alternatives you have a choice as to how tight the coupling is to be made.

Remember that on a transformerless a.c.-d.c. receiver the chassis is one side of the line, in which case you must not connect the converter direct to the chassis.

If the converter is to be employed with an automobile receiver, it can be used as shown if the auto battery is of the type with positive ground. If the negative of the battery is grounded the converter should be used either with a "floating" ground or grounded only through a .05-μf. capacitor. Another alternative would be to use 2 *n-p-n* transistors in which case the battery's connections should be reversed. The *n-p-n* equivalents of the 2N247 should be chosen to be r.f. amplifier transistors that have a cut-off frequency of at least 30 mc.

Current requirements of the converter are minimal: the transistors draw less than 10 ma. (how much depends on the voltage) and the bias voltage divider passes 2 ma. at 6 volts. Remember to arrange the converter so that the battery is disconnected when the converter is not being used or there will be a continuous drain on the battery.

Frequency drift of the transistor oscillator, because of the crystal, is very low, but remember that the crystal is somewhat affected by temperature so that if you install the converter in an existing receiver, keep it away from heat-producing tubes.

For the converter you will need a crystal which differs from the desired channel frequency by the i.f. frequency. Thus, if you want to use the 27.255 mc. channel and receive the signal on 1000 kc. on your dial, the crystal must be 26.255 or 28.255 mc. Such crystals are readily available, particularly the lower band type, many of which can be obtained surplus as well as new.

The antenna required need only be a short length of wire but if you are transmitting on 27 mc. anyway, you can use the transmitting antenna. A normal automobile whip antenna will do nicely for the receiver.

Building this converter is a little more expensive, because of the transistors, than some of the single-transistor superregenerative versions. There are compensations, however, for you will end up with a very sensitive Citizens Band receiver. —30—

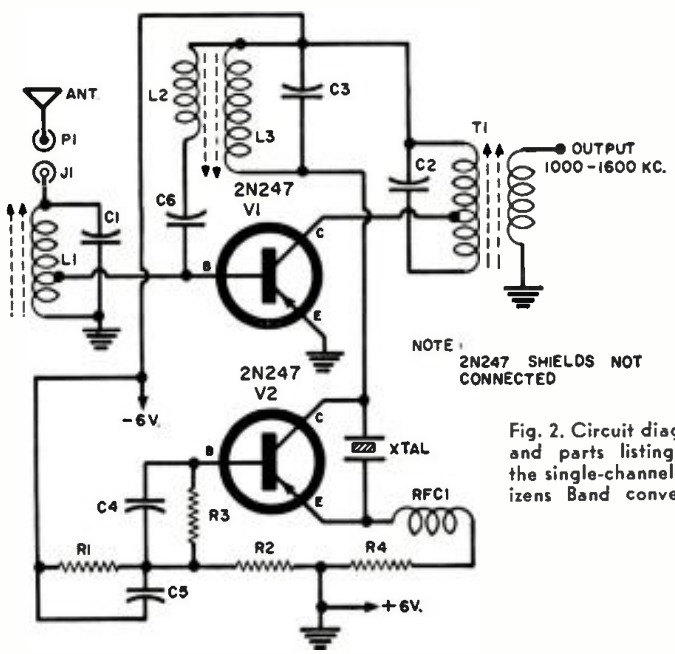

Fig. 2. Circuit diagram and parts listing for the single-channel Citizens Band converter.

R1—2700 ohm, ½ w. res.
R2—1000 ohm, ½ w. res.
R3—22,000 ohm, ½ w. res.
R4—470 ohm, ½ w. res.
C1—20 μμf. tubular ceramic capacitor
C2—80 μμf. tubular ceramic capacitor
C3—6.8 μμf. disc ceramic capacitor
C4, C5—.01 μf. disc ceramic capacitor
C6—10 μμf. disc ceramic capacitor
RFC1—300 μhy. r.f. coil
Xtal.—Receiving crystal for desired Class D band (see text)
P1—Antenna plug
J1—Antenna jack
L1—20 t. #26 en. antenna coil wound on ⅜" form with slug. Tap at 5 t. (see text)
L2—4 t. #26 en. wound over L3 on CTC Type LS-3 ⅜" o.d. coil form with 2013-C brass slug (author used surplus coil form, see text)
L3—20 t. #26 en. wound on same form as L2 (see text)
T1—Output trans. Author modified a Crest #200-6 variable inductor (70-225 μhy.), see text. Also refer to article for alternatives.
V1, V2—"p-n-p" transistor (RCA or Sylvania 2N247)

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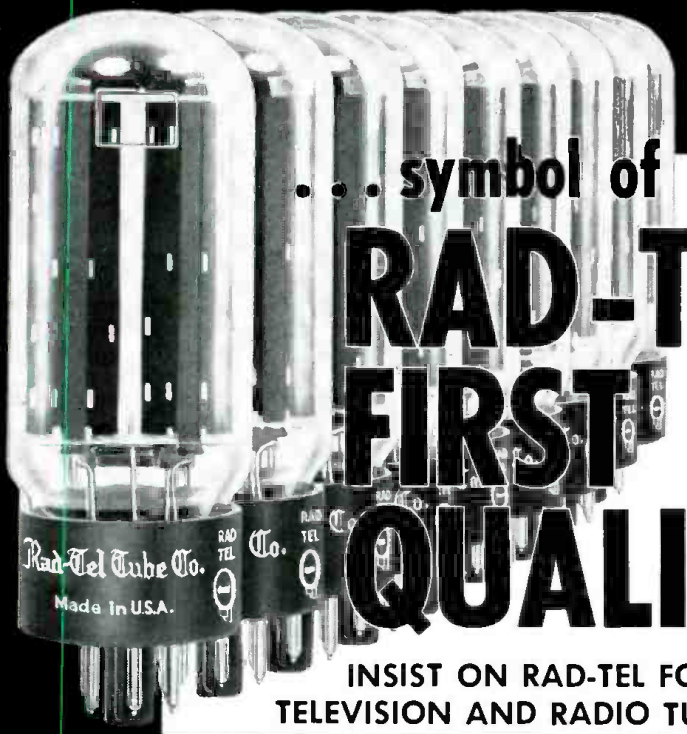

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	0Z4M	.79		3DT6	.50		6AB4	.46		6BJ6	.62		6EU8	.79		12A4	.60		12BD6	.50		12EG6	.54		19BG6	1.39
	1AX2	.62		3Q5	.80		6AC7	.96		6BK7	.85		6EA8	.79		12AB5	.55		12BE6	.53		12EZ6	.53		19T8	.80
	1B3GT	.79		3S4	.61		6AF3	.73		6BL7	1.00		6H6GT	.58		12AC6	.49		12BF6	.44		12F5	.66		21EX6	1.49
	1DN5	.55		3V4	.58		6AF4	.97		6BN4	.57		6J5GT	.51		12AD6	.57		12BH7	.73		12F8	.66		25BQ6	1.11
	1G3	.73		4BC5	.56		6AG5	.65		6BN6	.74		6J6	.67		12AE6	.43		12BL6	.56		12FM6	.45		25C5	.53
	1J3	.73		4BC8	.96		6AH6	.99		6BQ5	.65		6K6	.63		12AF3	.73		12BQ6	1.06		12K5	.65		25CA5	.59
	1K3	.73		4BN6	.75		6AK5	.95		6BQ6GT	1.05		6S4	.48		12AF6	.49		12BY7	.74		12SA7M	.86		25CD6	1.44
	1L6	1.05		4BQ7	.96		6AL5	.47		6BQ7	.95		6SA7GT	.76		12AJ6	.46		12BZ7	.75		12SK7GT	.74		25CU6	1.11
	1LN5	.59		4BS8	.98		6AM8	.78		6BR8	.78		6SK7	.74		12AL5	.45		12C5	.56		12SN7	.67		25DN6	1.42
	1R5	.62		4BU8	.71		6AN4	.95		6BU8	.70		6SL7	.80		12AL8	.95		12CA5	.59		12SQ7M	.73		25EH5	.55
	1S5	.51		4BZ6	.58		6AN8	.85		6BY6	.54		6SN7	.65		12AQ5	.52		12CN5	.56		12U7	.62		25L6	.57
	1T4	.58		4BZ7	.96		6AQ5	.50		6BZ6	.54		6SQ7	.73		12AT6	.43		12CR6	.54		12V6GT	.53		25W4	.68
	1U4	.57		4CS6	.61		6AR5	.55		6BZ7	.97		6T4	.99		12AT7	.76		12CU5	.58		12W6	.69		25Z6	.66
	1U5	.50		4DE6	.62		6AS5	.60		6C4	.43		6U8	.78		12AU6	.50		12CU6	1.06		12X4	.38		35C5	.51
	1X2B	.82		4DK6	.60		6AT6	.43		6CB6	.54		6V6GT	.54		12AU7	.60		12CX6	.54		17AX4	.67		35L6	.57
	2AF4	.96		4DT6	.55		6AT8	.79		6CD6	1.42		6W4	.57		12AV5	.97		12DB5	.69		17BQ6	1.09		35W4	.52
				5AM8	.79		6AU4	.82		6CF6	.64		6W6	.69		12AV6	.41		12DE8	.75		17C5	.58		35Z5GT	.60
	3AL5	.42		5AN8	.86		6AU6	.50		6CG7	.60		6X4	.39		12AV7	.75		12DL8	.85		17CA5	.62		50B5	.60
	3AU6	.51		5AQ5	.52		6AU7	.61		6CG8	.77		6X5GT	.53		12AX4	.67		12DM7	.67		17D4	.69		50C5	.53
	3AV6	.41		5AT8	.80		6AU8	.87		6CM7	.66		6X8	.77		12AX7	.63		12DQ6	1.04		17DQ6	1.06		500C4	.37
	3BA6	.51		5BK7A	.82		6AV6	.40		6CN7	.65		7AU7	.61		12AZ7	.86		12DS7	.79		17L6	.58		5DEH5	.55
	3BC5	.54		5BQ7	.97		6AW8	.89		6CR6	.51		7A8	.68		12B4	.63		12DZ6	.56		17W6	.70		50L6	.61
	3BE6	.52		5BR8	.79		6AX4	.65		6CS6	.57		7B6	.69		12BA6	.50		12EL6	.50		19AU4	.83		117Z3	.61
	3BN6	.76		5CG8	.76		6AX7	.64		6CU5	.58		7Y4	.69												
	3BU8	.78		5CL8	.76		6BA6	.49		6CU6	1.08		8AU8	.83												
	3BY6	.55		5EA8	.80		6BC5	.54		6CY5	.70		8AW8	.93												
	3BZ6	.55		5EU8	.80		6BC7	.94		6CY7	.71		8BQ5	.60												
	3CB6	.54		5J6	.68		6BC8	.97		6DA4	.68		8CG7	.62												
	3CF6	.60		5T8	.81		6BD6	.58		6DB5	.69		8CM7	.68												
	3CS6	.52		5U4	.60		6BE6	.55		6DE6	.58		8CN7	.97												
	3CY5	.71		5U8	.81		6BF6	.44		6DG6	.59		BCX8	.93												
	3DK6	.60		5V6	.56		6BG6	1.66		6DQ6	1.10		8EB8	.94												
				5X8	.78		6BH6	.65		6DT5	.66		10DA7	.71												
				5Y3	.46		6BH8	.87		6DT6	.53		11CY7	.75												

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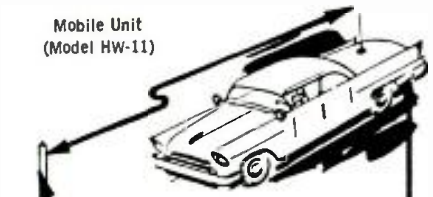

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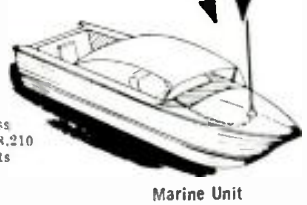

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The Citizens Band

(*Continued from page* 56)

Like most everything else, a good Citizens Band radio must have a combination of good features; in this case selectivity, sensitivity, noise suppression, squelch, and an efficient transmitter. The more of these features included, the higher the cost, in most cases.

Because the Citizens Band is provided primarily for systems communication (a given group communicating among its members, a tunable receiver is not usually necessary, but it is sometimes valuable in determining which channels are the least crowded.

The noise generated by the diathermy equipment found in many hospitals is one of the worst enemies of the Citizens Band user in an urban area. Because of this, and temporary channel crowding, many users have found multi-channel equipment advantageous. Diathermy is liable to appear at any time and anywhere in the Class D band. If it does, or congestion takes place on the normally used channel, you can switch to another frequency with a multi-channel set. Boat owners should also have gear that is equipped with more than one channel because of change of location, or the desirability of having different channels for cottage-to-boat, club-to-boat, and boat-to-boat.

Antennas

A two-way radio station is no better than its antenna installations. A good antenna installation can help a fair piece of equipment work pretty well, but a fair antenna installation and a good piece of equipment are poor economies.

For permanent base-station installations there are five common types of antennas: ground plane, coaxial sleeve, center-fed dipole, end-fed dipole, and various types of directional beams. The first four are for omnidirectional use, that is, they will radiate and receive in all directions more or less equally.

The Federal Communications Commission limits the height of the top of an antenna to 20 feet above any existing man-made or natural structure on which it is mounted. For best performance, the base antenna should be mounted as close to this height as possible.

The ground-plane type is probably the most common base-station antenna. At 27 mc. they measure almost 9 feet high and have either 3 or 4 radials of the same length protruding horizontally or downward at a 45-degree angle from the base of the 9-foot vertical radiating element. An isolating skirt (additional set of ground radials) is sometimes helpful in obtaining maximum performance.

Coaxial-sleeve and dipole antennas are about 18 feet long. These antennas should all be mounted vertically to provide best communication with mobile units which usually employ simple vertical whip antennas.

The most common directional antenna is the three-element yagi. Some of these can be mounted vertically for use with mobile units operating in one general direction from the base station, or horizontally for station-to-station use.

Directional antennas have two distinct advantages: they increase the operational distance and reduce or eliminate interference caused by nearby stations not in the radiation pattern of the antenna.

Mobile & Marine Antennas

The most common mobile antenna is the simple vertical whip, working against ground (which may be a vehicle's body and chassis or a boat's hull). One common antenna for the Class D band is about 9 feet long, made of stainless steel (fiber glass encapsulated ones are also available), and provided with a mount and connecting cable. The vehicle acts as the ground and the antenna location on the vehicle is most important.

The ideal location is in the electrical center of the vehicle, normally the center of an automobile's roof. We know of several *Volkswagon* buses with 9-foot antennas up there that outperform base stations. It is a little impractical to do this in most cases and very often the desired range does not require such an extreme installation.

A good location on an automobile is high up on a rear fender, near the trunk lid; as high as practical on a station wagon, pick-up, or panel truck; and near the top of the cab on bigger trucks.

Bumper-mounted antennas result in two main losses in efficiency. Part of the antenna is shielded by the body of the car and all of the "ground" is on one side, causing a directional signal which is most undesirable for mobile operation.

There is a way of shortening the physical length of antennas while still allowing the antenna to operate properly, although with a decrease in efficiency. A coil, of the proper inductance determined by the desired length of the antenna, can be inserted at the antenna's base, middle, or near the top. These coils cause a reduction in efficiency that is often compensated for by allowing the antenna to be mounted at a more favorable location on the vehicle, because of the antenna's shorter physical length. There is no advantage in shortening, by use of a coil, a base-station antenna other than to reduce its size.

The antennas used with small portable Class D sets are always short, being less than 48 inches long. Most of them are of the telescoping type either with an external coil or a coil built inside the unit. Because the "ground" (the portable unit itself) is poor, performance varies greatly with the relative location of the unit. For instance, resting the unit on the roof of an automobile will greatly increase the effec-

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tive ground area and the performance.

The physical dimensions of full-size ground planes, coaxial sleeves, or dipoles, make their use impractical on boats under thirty feet long. Even with larger boats, a ground plane would be unsightly, and the ground radials might be in the way.

Unless the antenna is mounted on a metal boat, which would provide a ground at the feed point of the antenna, the use of a simple, vertical whip will not result in the best performance. However, these antennas can be used with more success if ground radials are run fore and aft. If a ground wire is run from the equipment to a ground plate or the engine, the radiation pattern will vary from boat to boat. Even without the best ground system, because of capacitive coupling to the water itself, which usually serves as a good "ground," operation over water is usually fairly good with simple antennas.

There are available some antennas made especially for marine use. One is a shortened coaxial-sleeve type, fiber glass encapsulated and 11 feet long. Another is an odd type of ground plane, with only two ground radials and a 5-foot radiating element using loading coils.

Of prime importance with outdoor antennas, particularly for marine use, is that the antenna must be sturdy mechanically and able to withstand corrosion. Another point to check, especially when buying an antenna made by a company other than the one which made the radio unit, is the type of antenna connector used. This must match the connector on the set or it will have to be changed.

Servicing

All electronic equipment needs service for continuing operation and Citizens Band sets are no exception. Although most qualified radio and television service technicians can maintain receivers, an FCC operator's license is required to perform complete service on the transmitters.

There are people in almost every community who hold such licenses, allowing them to work on Citizens Band transmitters. Those who are in the business of maintaining two-way equipment can be found in the classified pages of every telephone book we have seen under the heading "Radio Telephone." Very often, if a radio and television service company is not in a position to maintain the sets, they know who can do the work locally.

Necessary service is normally similar to that needed on a radio or TV set. Parts and tubes need occasional replacement and minor alignment adjustments are sometimes necessary.

The Class D Citizens Band may be considered a tool, which if properly utilized, can provide more economical business operations and more pleasurable use of our leisure hours. Why don't you put the Citizens Band to work for you? —30—

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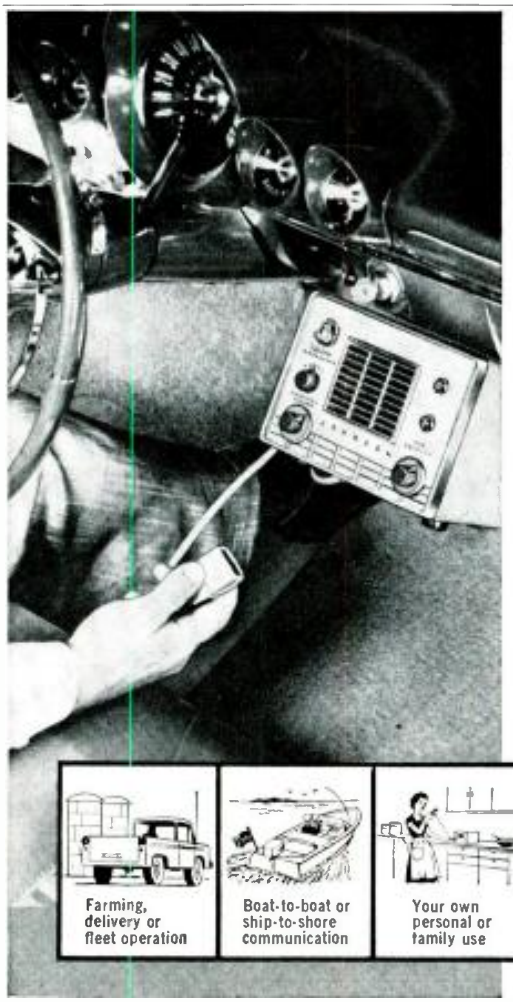

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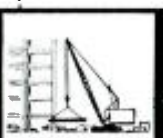
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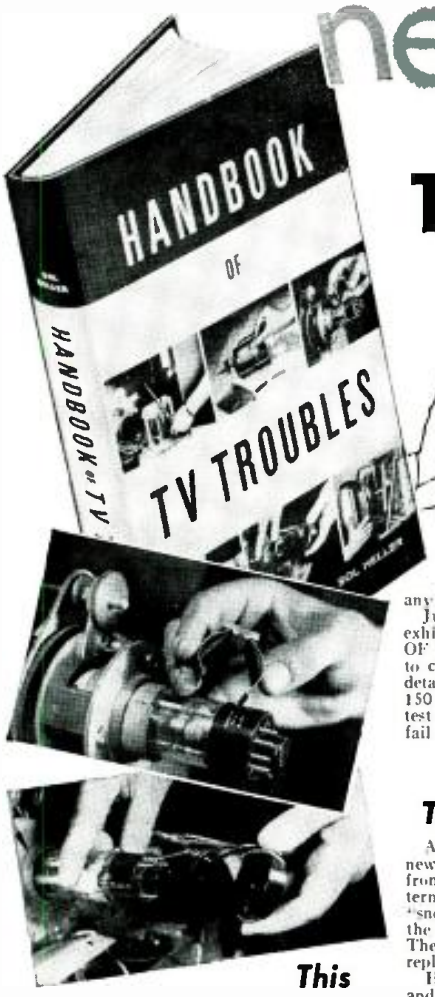

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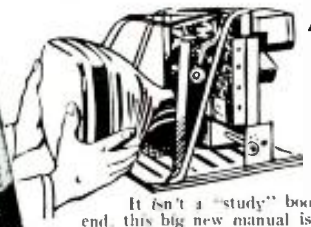

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CB Call Letters Not To Be Assigned By Suppliers

FCC clamps down on call assignments made for the purpose of "demonstration."

EDITOR'S NOTE: *The following information is based on a recent FCC release. It should be of interest to all of our readers who use, buy, sell, or manufacture Citizens Band equipment.*

AN INCREASING number of reports have reached the FCC concerning the practices of some suppliers of Business and Citizens Radio equipment in advising their customers that such equipment may be operated by them prior to the issuance of a radio station license by the Commission. In some instances, sellers have "assigned" radio station call signs to purchasers along with the sale of the radio gear. In a few such cases, these call signs have been the same as those authorized to be used by the manufacturer or seller of the equipment.

Although a radio operator's license is *not* needed to operate a Citizens Band station, a radio station license *is* required. With the exception of certain low-power equipment described in Part 15 of the Commission's Rules, the operation of any radio transmitter by a person other than the one to whom the station license has been issued, or by a person directly under his control or supervision, is illegal and may result in the imposition of severe criminal sanctions.

Under Section 310(b) of the Communications Act, the prior consent of the Commission is required for the transfer or assignment of any radio station license or the rights granted thereunder. One who fails to observe this provision by the transfer of his operating authority subjects himself to possible license revocation and such other enforcement action as the Commission may consider warranted. The designation of such unlawful activities as "equipment demonstrations" does not render them less illicit.

This matter is being brought to the attention of manufacturers, distributors, and retail vendors of Business and Citizens Radio equipment in the belief that they share the Commission's conviction that the development of these services is hampered by the above practices. Anyone who engages in such practices, in addition to the possibility of having drastic enforcement action instituted against him, may be sacrificing the long-range good will of a misadvised customer for the benefit of an immediate sale. All prospective users of CB equipment should therefore be advised that they must await the arrival of their own license in order to operate. —30—

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Mac's Service Shop

(Continued from page 70)

shown in the selector-switch window. It's to be used on any a.c.-d.c. set that employs a safety line-cord connector mounted on the back cover when you want to turn the set on with the back off. In the past, I've seen you use an ordinary cheater cord for this purpose and plug it straight into the light line because you were too lazy to turn on the isolation transformer. Now I'm making it *easier* for you to use the isolation transformer on these sets, and I better not catch you using anything else!"

"Aye, aye, sir!" Barney said with a grin as he tugged at a curly red forelock. "Watch your blood pressure, sir!"

"This goes into your house-call tool kit," Mac said, ignoring him, as he handed over a gleaming little chrome-plated tube. "It's a penlight with a completely adjustable dental mirror mounted at the light bulb end. One way to use it is to adjust the mirror so it reflects light from the bulb around corners and into spots you could never illuminate directly. Another use is to shine the light on a spot and adjust the mirror so you can see, by reflection, the illuminated area. This will come in mighty handy when you have to replace a miniature tube in a hidden socket in a TV set. Nothing makes a technician look more stupid or gets his goat quicker than to have to fumble around five or ten minutes replacing a tube he just removed."

"I'll buy that," Barney interrupted with deep feeling; "it makes you feel like a real schnook."

"Finally," Mac went on, "here are a handful of soft colored crayons to be used to mark the points from which wires are unfastened or unsoldered during testing or replacement of parts. I know paint or fingernail polish would be more durable, but they're also more difficult to apply and to keep ready for instant use. All we need is something to mark the spot from which a wire was removed until we are ready to replace the wire. These will do the job nicely. There are enough colors here to match the colors usually found on wire insulation."

"I'll tell you another place where one of those crayons will come in handy," Barney offered. "It's to mark the position of a miniature i.f. transformer can on the chassis, a speaker in the cabinet, or any other part you intend to remove and later replace in exactly the same position. One swipe with a crayon down the side of the part and onto the adjacent area will do it. Then all you have to do is to match up the ends of the broken crayon line and you know the part is just where it was."

"Good! That winds up the list of actual devices I dreamed up to save time and temper, but I've been thinking there are a few *procedures* that will contribute to the same end. Take, for example, the matter of replacing a slipping dial cord. If the cord has been slipping on the drive shaft for some time, that shaft will be polished as smooth as glass; and even the new properly installed, properly tensioned cord will often slip. To prevent this, all you need to do is to make a few swipes around the drive shaft with a bit of sandpaper to knock off the glaze *before* installing the new cord. Fail to do this and you may have to do the whole job over."

"I read you loud and clear!" Barney exclaimed; "and I can think of another example of how a few seconds spent in proper preparation can save minutes. I'm talking about tinning leads before trying to solder them into a circuit. A properly tinned lead requires a minimum amount of heat to make it join in a good soldered joint; but I've actually destroyed a tube socket by overheating a lug in trying to solder an untinned lead to it. And if you think the tube socket lug was hot when this happened, you should have seen me!"

Mac chuckled sympathetically. "I know. Half the anger we feel about the annoying things in servicing we've been discussing is directed at our own laziness, stupidity, and lack of foresight that permits them to happen. Any time we can remove a source of irritation from our work, we've taken a step toward being a better-balanced, more efficient service technician—and we'll probably live one heck of a lot longer too!" —30—

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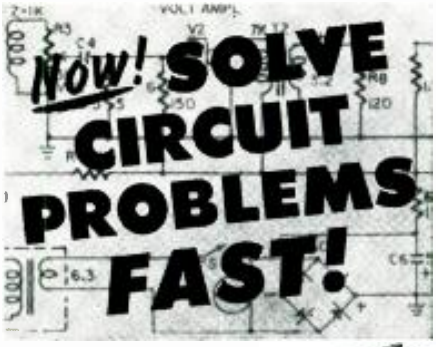

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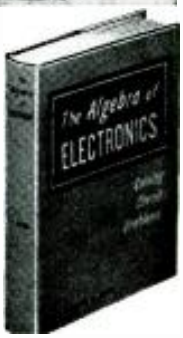

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Careers in Electronics

(*Continued from page* 50)

obtained at other schools. They can, and often do, prepare a man for comparable opportunities in private industry. Some industrial firms, however, may deprecate the value of military technical training to the extent that the applicant's performance level cannot be readily ascertained, due to the inaccessibility of the man's detailed performance record while in service. Nonetheless, completed military technical training, plus in-service performance in the man's indicated specialty, does provide higher-level entry into private industry than any school training with no job experience.

A radio transmitter operator, for example, will have experience considered "directly transferable" for, say, broadcast studio work. Even more "directly transferable" would be men in such specializations as Ground-Control Approach or Instrument-Landing systems. Here, competent men would qualify readily for field service work with equipment manufacturers, or as operators of the equipment directly at airfields.

Advanced Training

A number of well-paying careers may be developed by those who do not have a degree, but do have some (two years or more) college training in a specialized interest group, such as math, physics, design, or engineering. This kind of training, combined with some experience in any specific phase of electronics, could qualify a man for any of several jobs that start at the $6000- to $8000-a-year level. Much would depend, of course, on personal interests and abilities, as well as available openings. Such areas would include: field service engineering; sales engineering; sales promotion (including advertising and public relations); technical writing; product engineering; design engineering; special work with computers; and many more. These jobs cover the range from intermediate to near-top levels throughout the industry.

Men without degrees, who prove themselves, can go high—although there may be specific situations barred to them. One such might be a spot that involved direct supervision of a group of men who had degrees. Another would be a position where one of the requisites actually called for a specific *type* of degree or an advanced (Master's or Doctor's) degree. Outside such instances, experience can often represent the equivalent of a degree in terms of a man's qualifications. From a salary standpoint, two years of experience are roughly the equivalent of one year's education.

As for the college degree itself, it is often, at present, a passkey to a very wide diversification in job opportunities. A man fresh out of college may, indeed, be able to start at $6000 to $7500 a year. With a Master's degree, and still no experience, he may even start at $9000. A doctorate, without job experience, can command $10,000 to $11,000. The "normal top" for a man with a bachelor's degree, after some years of experience, is estimated between $13,000 and $15,000.

At these levels there actually are more job categories than at the lower levels—but each one is more highly specialized. This perhaps requires some explanation. To most people who are not engineers or involved professionally in the electronics field, there seems to be little difference among engineers. "An engineer is an engineer." The most basic differences recognized at all might be among production, design, and research engineers. While this simple view may have been true ten or more years ago, it has lost its validity since then.

Today, job requirements at the higher levels have become so specialized that even the highly competent graduate engineer cannot readily step from one specific type of work into another. Additional training is required; this re-orientation, or preparation for new specialization, may take from three months to two years, depending on the

Unlike the positions in the preceding groups, these require college degrees.

GROUP III

These positions require a college degree, or its educational equivalent, i.e., college plus technical schooling, or company course, etc. In general, these are engineering level positions, implying a degree in Electrical Engineering, Mechanical Engineering, or Physics. In the computer field, a B.S. in E.E., Math, or Physics is desirable. At the higher levels of design and development, more and more a Master's degree is a requisite. In specialized research, a Master's is a minimum, a Ph.D. desirable.

Because of requirements such as these, it is obviously impossible to detail the many engineering categories in the same manner as for Group I and Group II positions. Instead, we list approximate salary ranges covering the most general engineering classifications.

CLASSIFICATION	YEARS EXPERIENCE	SALARY RANGE
Engineer	0-2	$5500-7500
Intermediate Engineer	2-5	7200-10,000
Senior Engineer; Senior in Design and Development	5-8	8500-13,500
Project Engineer; First Level Administrator; Research Head	8 and up	10,000-19,500
Administrator; Section Chief	10 and up	14,000-23,500

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man himself and the job he is to fill.

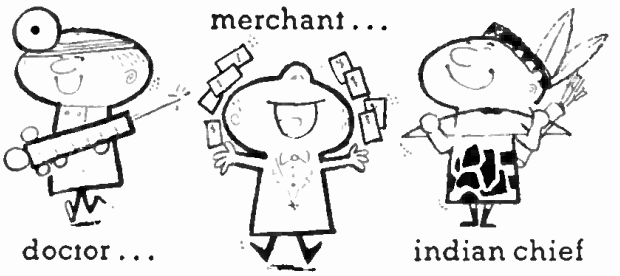
As an example, it is no longer enough for a company to look for a "communications engineer." Now the category must be narrowed to, say, a "microwave specialist." Or, again, take the specialty known as "analogue-computer circuitry designer." *Digital* computer circuitry designers need not apply! And so it goes, into ever-narrowing and more specific types of work. Recruitment consultants and personnel men alike find it difficult to screen applicants for such specializations, which require a kind of pin-pointing referral demanded by many of today's electronic firms. This intra-industry problem, as well as the question of sheer numbers required *versus* those available, contributes to what has been called our "manpower shortage," although the term is often misunderstood. This shortage, actually defined by the need for extreme specialization, puts college graduates—as well as others with less training presently employed or planning to enter the field—in the position of being faced with many choices, of job type, of company, of locality in which to work and live.

Evaluating Job Situations

To these people, a host of factors must be weighed in arriving at a decision. Among them would be the stability of a particular company, its policies regarding personnel development, fringe benefits, educational extension opportunities, and so on. Also to be considered, if information is available, are such factors as the nature of the company's growth. A favorable sign would be continued increases in expenditures for both sales and research, as indicated in stockholders' reports. A relatively small annual turnover in personnel is another favorable sign. The seasonal or non-seasonal nature of its products might also be important.

Finally, there is the matter of the living conditions in the area related to where you'll be employed. Travel distance to and from work might be considered, as well as the residential aspects of the area in terms of cultural, social, religious, and educational factors that may be important to you or your family. In other words, "case the area"— using your own good sense (and senses) to evaluate it in terms of your interests and needs. For specific information, consult the local Chamber of Commerce, talk with real estate agents or other local people. One revealing indication of the "liveability index" of an area would be the published lists of teachers' salaries, generally available from the Board of Education or the Town Clerk.

In sum, for maximum job satisfaction you should do a little "market research" of your own. Less than a generation ago, such an attitude was wellnigh unheard of. But then, so were transistor radios, electronic thinking machines, and a lot of other things that today we take for granted in this growing field. —30—



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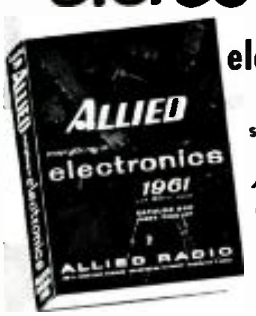

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Mobile Transistor Power Supply

By DONALD C. CHAYET
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Construction of simple unit that converts 12 v. d.c. to 200 v. d.c. at 75 ma. without expensive components.

TRANSISTOR power supplies are the most efficient way of converting low-voltage d.c. to higher voltages for use as "B plus" in mobile converters, tuners, and transceivers.

The present methods of building such supplies utilize toroidal transformers. These range in price from $16 to more than $30. The author decided that it was possible to achieve similar results using inexpensive, on-hand stock parts.

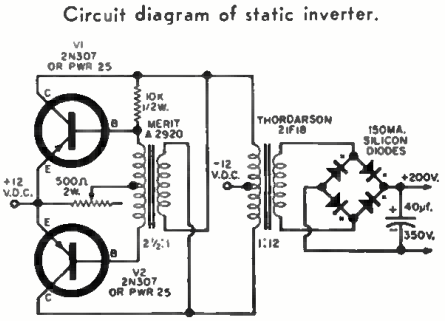
The first consideration in the design of this unit was to supply sufficient feedback current to make the transistors oscillate when full collector current was drawn. It was found that an inexpensive driver transformer of approximately 2.5:1 ratio, with the 2.5 section center-tapped, would supply sufficient bias for power transistors of approximately 25 watts dissipation. The power output is taken through a 10 volt, 5 amp. filament transformer into a full-wave silicon diode bridge.

The largest single item of cost was for the two power transistors; a *Sylvania* 2N307 and a *Workman* "Power 25." Both of these types worked quite well. A *Bud* "Minibox" measuring 7" x 5" x 3" was used as a chassis. The natural aluminum finish was chosen to facilitate heat dissipation. The driver transformer is a *Merit* #A-2920 while the output transformer is a *Thordarson* 21F18. The four silicon diodes were chosen as the least expensive available and were rated at a peak inverse voltage of 400 volts.

The transistors must be insulated from the chassis and each other. *Bendix Radio Division* makes plastic insulators and bushings for use with this type of transistor. The bushings must be trimmed approximately 1/16th inch because they are designed for ⅛-inch panels and the chassis specified is a 1/16th-inch type.

The U-shaped section of the "Minibox" was used for mounting all of the components. The two transistors were mounted, one on each side, with the driver transformer in the middle.

Circuit diagram of static inverter.



The output transformer was mounted on one side and the space between the top of the transformer and the other side was used to mount the pot. The terminal block was mounted on the side opposite the output transformer.

The only possible pitfall in the construction of this unit is if the circuit fails to oscillate. If this occurs, reverse the base leads on the transistors. When this unit is used in temperatures of less than 50 degrees F, it may refuse to start with a load. It is permissible to remove the load so that the oscillator can build up to normal operating frequency. This should take 1 to 3 seconds.

This circuit should be wired with #20 wire or heavier, due to the fact that the current can go as high as 4 amperes. The parts placement and lead lengths are not critical.

The 10,000-ohm resistor from the base to collector can be connected to either transistor and is used only to cause it to break into oscillation under loads. The 500-ohm pot is used to control the output voltage by controlling the oscillating frequency of the circuit. Its exact dissipation and resistance are not critical. Approximately 500 ohms and 2 watts are common values and were found to work quite well.

The bias control is set, using any one of three different methods. All three methods require the use of a 2500-ohm, 10-watt resistor as a load. The input current to the device may be monitored and the bias control set for 3 amps. input under this load. The second method involves monitoring the output voltage and adjusting the bias control to a point where the voltage is down 10 volts from maximum. The third method calls for the insertion of a milliammeter in series with the load and setting the bias control for a current of 75 ma.

All of these methods may be utilized for determining the maximum operating point of the transistors and the minimum resistance setting of the pot. The pot may be turned down further to give less voltage if the output of the device is too high.

This inverter will supply 75 ma. at 200 volts, with a current drain of 3 amperes at 12 volts. The over-all operating efficiency of this type of inverter, as compared to vibrators or dynamotors, is at least twice as high and will, in many cases, exceed this.

Other rectifier systems can be used in place of the bridge in order to obtain other output voltages and currents. —30—

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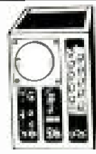
BC-603 FM RECEIVER



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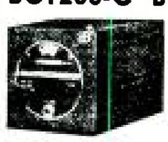

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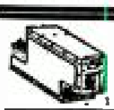

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100-150 Mc Includes 2—832A, 2—1625 Tubes. BRAND NEW................. $21.50

SPECIAL OFFER! Limited quantity ARC-5/T23 xmitters. Excellent Used, less tubes.........$5.95

MD-7 MODULATOR for T-23, complete with 4 tubes. LIKE NEW.................. $9.95

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Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes....... $16.95

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SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES

Type	Description	Used	Like NEW
BC-453	Receiver 190-550 KC......	$12.95	$14.95
BC-454	Receiver 3-6 Mc..........	9.45	12.45
BC-455	Receiver 6-9 Mc..........	11.50	13.95
BC-450	3-Receiver Control Box.....	1.29	1.75

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SPLINED TUNING KNOB for 274-N and ARC-5 RECEIVERS. Fits BC-453, BC-454 and others. Only 49c

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BC-456 Modulator ....USED 3.45 NEW 5.95

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ALL ACCESSORIES AVAILABLE FOR COMMAND EQUIPMENT.

234-258 MC RECEIVER

AN/ARR-2

BRAND NEW 11-tube UHF Tunable Receiver with schematic. Only a few at this low price!

Complete with tubes $8.88

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FAMOUS BC-645 TRANSCEIVER

15 Tubes 435 to 500 MC

BRAND NEW

Can be modified for 2-way communication, voice or code, on ham band 420-450 mc, citizens radio 460-470 mc, fixed and mobile 450-460 mc, television experimental 470-500 mc. 15 tubes (tubes alone worth more than sale price!): 4—7F7, 4—7H7, 2—7E6, 2—6F6, 2—955 and 1—WE 316A. Now covers 460 to 490 mc. Brand new BC-645 with tubes, less power supply in factory carton.

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PE-101C Dynamotor, 12/24V input...........$7.95

UHF Antenna Assembly 2.45

Complete Set of 10 Plugs 5.50

Control Box 2.25

SPECIAL "PACKAGE" OFFER:

BC-645 Transceiver, Dynamotor and all accessories above. COMPLETE, BRAND NEW, While Stocks Last.......................... $29.50

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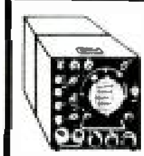

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BRAND NEW $12.95

Conversion instructions for 110V 60 cyc. AC 65c

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Value $1200.00.

Our Price.......... $79.50

Used, less tubes, crystal and visor, but with 3BP1 C.R. tube..............$29.50

12 Volt Inverter Power Supply for above. BRAND NEW $32.50

28 Volt Inverter Power Supply, exc. cond.....$49.50

Shock Mount for above.......................$2.95

Circuit diagram and connecting plugs available.

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MN26C Receiver as above, BRAND NEW...... 27.50

MN20E Rotatable Loop for above........... 4.25

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Flexible Mechanical Cable for Above........ 3.95

MN28C Receiver Control Box............... 4.95

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FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane. Indicator and receiver complete with all tubes and crystal.

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Receiver-Indicator as above, BRAND NEW $88.50

12V Inverter Power Supply. BRAND NEW....$32.50

28V Inverter Power Supply, exc. cond........$49.50

Shock Mount for above......................$2.95

BC-906 FREQ. METER—SPECIAL

Cavity type, 145 to 235 Mc. BRAND NEW, complete with antenna. Manual included.

OUR LOW PRICE.......... $10.88

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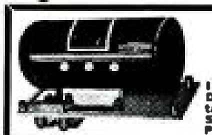

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Input 12V DC. Output: 625 V DC @ 225 Ma, for press-to-talk intermittent operation. Shpg. wt. 14 lbs. OUR LOW PRICE, BRAND NEW...$8.45

OTHER DYNAMOTOR VALUES:

Type	Input	Output	Excellent Used	BRAND NEW
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DA-1A	28V 1.6A	230V .100A		3.25
DM-28	28V	224V .07A	2.75	4.75
DM-32A	28V 1.1A	250V .05A	2.45	4.45
DM-33A	28V 5A 28V 7A	575V .16A 540V .25A	1.95	3.75
DM-34D	12V 2A	220V .080A	4.15	5.50
DM-53A	28V 1.4A	220V .080A	3.75	5.45
DM-64A	12V 5.1A	275V .150A		7.95
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PE-86	28V 1.25A	250V .050A	2.75	3.85

BD-77 DYNAMOTOR Input 14V @ 39A. Output 1000V @ .350A with starting solenoid, Filter Box and Mounting Base ....Like New $14.95

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200-1500 Kc
2 to 18.1 Mc

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24V Dynamotor for ART-13.................. 11.95

Same as above less meter................. 39.50

BC-652A RECEIVER—Hot Special! 2000 to 6000 Kc AM Receiver, 2-band, complete with all tubes, 200 Kc Xtal Calibrators, and 12 V Dynamotor. Fine for 80-meter Ham band, Marine, etc. Provides for CW, MVC, AVC. Speaker Jack and two Headphone Jacks. Shpg. Wt. 50 lbs. Like new, only $22.50

POWER SUPPLY for BC-620, 659, available for 6, 12 or 24 Volts DC. Specify................$8.95

BC-659 TRANSMITTER & RECEIVER

27 to 38.9 Mc. F.M. Two preselected channels crystal controlled. 5 watts. Complete with speaker, tubes. Used $10.95

Less tubes, used...............................$5.95

Antenna for [illegible]. Telescoping 20" to 8 Ft....$2.95

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ARB CRV 46151—190 to 9050 Kc in 4 bands. 6 Tube Superhet communications receiver, with local and remote tuning, band change. Sharp and broad tuning, AVC, CW. Illuminated dial. Complete with tubes and dynamotor. BRAND NEW....$34.50

Like New $26.50

Power Supply 110 V. AC. Wired $8.50

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Consisting of: BC-620 FM TRANSCEIVER, 20-28 Mc., with Power Supply for 6 or 12 Volt DC operation, including all components: Antenna, Mast Base and Sections, Handset, Technical Manual and all other accessories, ready for operation. BRAND NEW, in original packing.

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Terrific buy! VHF Transmitter-receiver, 100-156 Mc. 4 channels. Xtal-controlled. Amplitude modulated voice. They're going fast! Excellent condition.

SCR-522 Transmitter-Receiver, complete with all 18 tubes, top rack and metal case.

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Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike		$5.45
T-30	Carbon Throat Mike	$ .34	.74
T-45	Army and Navy Lip Mike		1.25
TS-9	Handset		3.88
TS-11	Handset		3.95
TS-13	Handset		4.25
RS-38	Navy Type		4.75

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Model	Description	Excellent Used	BRAND NEW
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HS-33	Low Impedance	2.69	4.65
HS-30	Low Imp. (featherwt.)	.90	1.65
H-16 U	High Imp. (2 units)	3.75	7.95

TELEPHONICS—600 ohm Low Impedance HEADSETS, BRAND NEW, PER PAIR $3.25

CO-307A Cords, with PL55 plug and JK26 Jack .99

Earphone Cushions for above—pair.......... .50

TG-34A CODE KEYER

Self-contained automatic unit, reproduces code practice signals recorded on paper tape. By use of built-in speaker, provides code-practice signals to one or more persons at speeds from 5 to 25 WPM.

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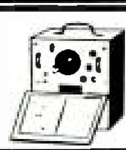
Checked [illegible], exc. used $18.95

Single Reels of Tape, Each.$1.85

BC-221 FREQUENCY METER



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6C4	.25	6SL7	.85	815	2.15
6AL5	.38	12A6	.45	826	.44
6AC7	.55	SPECIAL PURP.		1625	.29
6J6	.32	2C39	3.50	4X-150	5.95
6V6	.85	3E29	4.25	6072	2.50
				1P25A	7.95

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3 Amp. Hour, BRAND NEW. 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte ....Only $2.95

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1—Quart Bottle Electrolyte (for 2 cells) 1.45

ALL BRAND NEW! Combination Price $5.45

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- Built-in 3" x 5" oval PM speaker and detachable ceramic-element microphone.
- 5-W xtal-controlled transmitter—can transmit on any of the 23 Citizens Band channels.
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- ANYONE can build this kit by following the easy simplified "beginner-tested" step-by-step instructions.
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Model 762: 117 VAC & 12 VDC
Including mounting bracket

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Teleprinter Sets Record

(*Continued from page* 51)

−1000 volts (biased at 450 volts), producing a difference between the anode and pin of 1350 volts.

This causes an *arc* between the anode and pin, resulting in a source of ions. Because of the voltage gradient from the arc to the paper (at ground potential), there is a migration of ions to the paper causing a deposit of charged particles on the surface of the paper. The placement of such a "dot" can be controlled by selecting various pairs (of anodes and pins) in each printing head.

The paper then passes through an inker, which contains powdered ink that adheres to any charged areas on the paper. In this way, images on the paper become visible to the human eye.

The paper then passes over a heater and through a fixing roller, where the particles of ink are pressed into the softened polyethylene-coated surface of the paper. This permanently fixes the alphanumeric images on the paper.

Electronic Control

The problem of providing suitable pulses to the particular pairs of anodes and pins contained within any of the 72 printing heads is solved by electronics. A simplified circuit diagram is shown in Fig. 4.

Initially, a conventional "start-stop" teletypewriter signal is converted to a five-bit parallel code by means of a *receiver distributor* using solid-state techniques. This is basically an electronic analogue of a mechanical distributor.

This five-bit parallel code is converted to dot locations produced by the 72 printing heads in two steps: (1) from binary to one-out-of-50 character circuits by means of a *decoding network,* and then (2) from a character circuit to 35 output circuits by means of an *encoding network.*

The decoding network is essentially a diode matrix composed of 176 diodes and 35 resistors. Output of this network consists of 50 signals representing the characters to be printed *plus* eight output signals that are used for control functions—such as line feed, carriage return, spacing, etc.

The encoding network consists of 340 diodes. It has one input circuit for each character to be printed. And it has 35 outputs, one for each "dot" location in the matrix of a printing head.

These 35 outputs are applied to a *pin pulser,* which produces a pulse of about −1000 volts for any desired pin of the matrix of a printing head.

Thus, when a character circuit is selected by the decoding network, the connection of the diodes in the encoding network is such that appropriate output circuits are energized to pulse appropriate pins in the matrix of any of the 72 printing heads.

The exact printing head selected for application of such pulses is determined by the anode pulses, which are selected cyclically by means of 72 separate pulse transformers, synchronized by a control voltage from the decoding network. See Fig. 4.

Commercial types of power supplies are used for all high-voltage pulse requirements. Other power is obtained from solid-state devices.

Operating Speeds

The teleprinter is equipped with six preset operating speeds. One of these —750 words per minute—is the accepted standard for Army communications purposes.

Only factors limiting the present top speed to 1000 characters per second are mechanical considerations of inking and of moving the paper past the printing heads of the recording system.

Development work is continuing toward solving this problem, and the *Burroughs Corporation* now believes it is possible to attain operating speeds of more than 5000 characters per second through mechanical improvements in the basic system design.

All of the transistorized electronic circuits of the system are now fully capable of responding to such future high-speed requirements—making certain the reception and reproduction of future messages at the rate of more than 50,000 words per minute! —30—

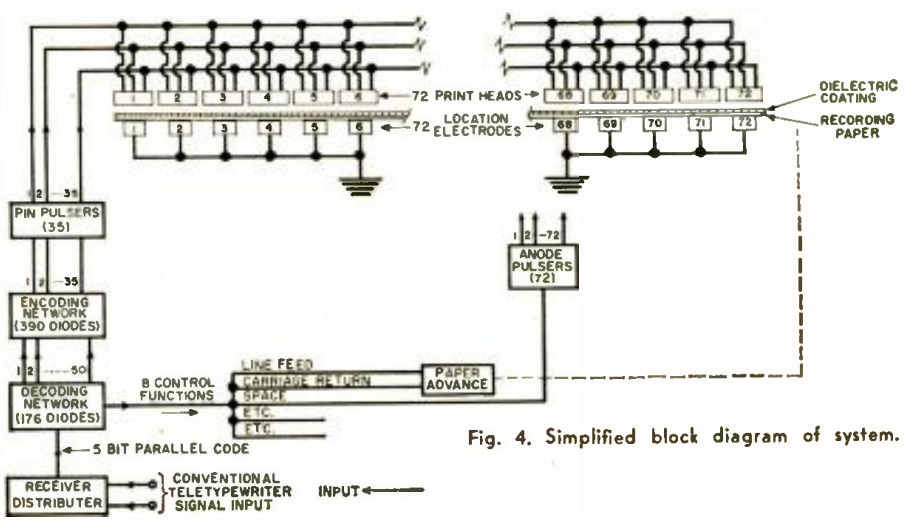

Fig. 4. Simplified block diagram of system.

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Name-the-Scientist Puzzle

By

JOHN A. COMSTOCK

YOUR association with the electronics field should include familiarity with the many famous scientists without whom radio, TV, hi-fi, and electronics would be impossible. Try your hand at working this puzzle. If you can fill in the correct names and words, you have paid small tribute to these outstanding men who have helped make life easier for all of us through electronics.

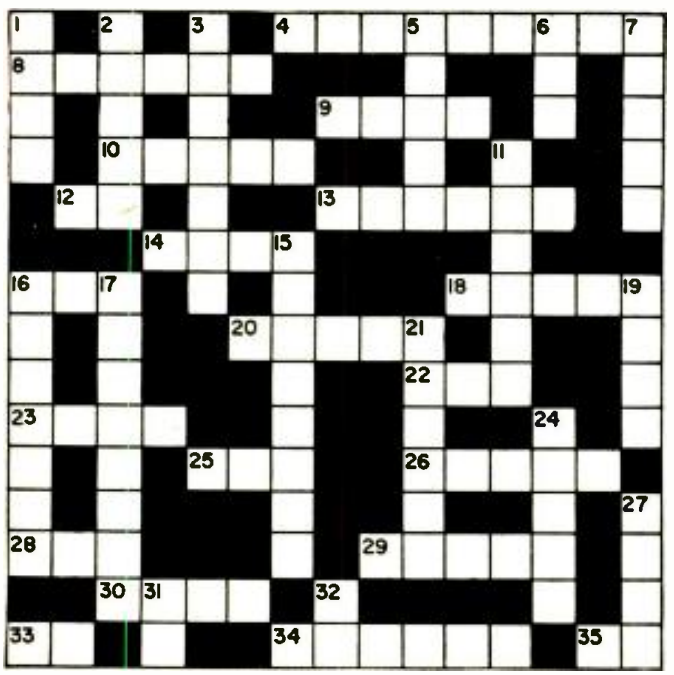
(*Answer on page* 140)

ACROSS

4. Inventor of superhet circuit and FM system of broadcasting.
8. Inventor of the cylinder phonograph.
9. "Gauss" is unit of ——— density.
10. First man to demonstrate electromagnetic radiation phenomenon.
12. An electronic device invented by Fleming (abbr.).
13. De Forest's early triode.
14. The relationship between current flow and magnetic flux was investigated by———.
16. William Gilbert is closely linked with———(abbr.).
18. Unit of inductance bears this U.S. physicist's name.
20. Discoverer of e.m.f.
22. Well-known New England technical school. (colloq.).
23. British engineer after whom unit of power consumption was named.
25. German physicist, Kirchoff's, initials.
26. Armstrong's first name.
28. First name of the "Father of the Vacuum Tube."
29. In 1946 it was proved possible for radar to———the moon and be reflected back to earth.
30. X———were discovered by the German physicist, Wilhelm K. Roentgen.
33. ———Forest invented the triode by adding a grid to Fleming's diode.
34. Man famous for his contributions to sound measurement.
35. "Alva's" first and last initials.

DOWN

1. Inventor of telephone.
2. Angstrom is noted for his contributions in measuring the wavelength of———.
3. The French mathematician, Jean B. J.....whose name is associated with wave analysis.
5. W. C. Sabine developed a well-known formula for——measurement.
6. German physicist after whom the unit of resistance was named.
7. The unit of flux density was named after this German mathematician.
11. He added a third element to the diode.
15. Inventor of the "Iconoscope."
16. The CGS unit of magnetic flux was named after this British physicist.
17. Scientist whose name is associated with sound range because of his investigations into this phenomenon.
19. Japanese inventor of an antenna.
21. French physicist after whom the unit of current flow was named.
24. The hand that is employed for motors.
27. ———analysis was investigated by Fourier.
31. First and last initials of the man who gave us the practical unit of current intensity.
32. Unit for designating length of light waves was named for this physicist (first and last initials).



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TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
0A2	.60	4X150A	8.50	813	8.50	957	.30	5751	.90
0A3	.70	5R4GY	1.00	815	1.70	2050	.90	5763	.80
0A4	.75	C6J	6.50	829B	7.00	2051	.75	5814A	.75
0B2	.45	6D4	1.50	832	3.00	26Z5W	1.15	5879	.90
0B3	.65	6X4W	1.00	832A	5.50	5654	.75	6080	2.75
0C3	.50	6J4WA	1.15	843	.30	5686	1.50	6082	3.75
0D3	.40	218	8.00	866A	1.05	5687	.75	6135	1.00
2C44	.75	304TL	35.00	872A	1.05	5702	1.50	6146	2.45
2D21	.55	313C	1.25	884	.80	5703	1.50	6159	2.75
2E24	1.95	5J29	.50	885	.75	5725	.90	6189	1.00
2E26	1.95	750TL	32.00	954	.20	5726	.40	6201	1.00
3A4	.45	807	1.00	955	.30	5749	.70		

JAN SURPLUS TUBES

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
0Z4	.42	6AG7	.44	6CL6	.59	7C4	.39	14A7/12B7	.48
1A7GT	.45	6AH4GT	.55	6CM6	.59	7C5	.44	14B8	.48
1B3GT	.52	6AH6	.42	6CM7	.40	7C6	.46	14Q7	.48
1H4G	.39	6AK5	.43	6CN7	.40	7C7	.48	19	.48
1H5GT	.45	6AL7	.45	6CS6	.42	7E6	.48	19AU4GT	.49
1L4	.39	6AM8	.49	6DE6	.44	7E7	.44	19BG6G	1.00
1L6	.42	6AN8	.54	6DQ6	.79	7F7	.42	19J6	.48
1N5GT	.52	6AQ5	.44	6F6	.69	7F8	.42	19T8	.58
1Q5GT	.44	6AQ6	.42	6H6	.37	7H7	.40	24A	.48
1R5	.41	6AQ7GT	.48	6J4	1.00	7N7	.48	25AV5	.75
1S5	.39	6AR5	.48	6J5	.44	7Q7	.48	25BQ6	.79
1T4	.41	6AS5	.42	6J7	.59	7X7/XXFM		25DN6	.99
1U4	.41	6AT6	.42	6K6GT	.33		.44	25L6GT	.40
1U5	.42	6AT8	.48	6K7	.48	7Y4	.39	25W4GT	.41
1V2	.49	6AU4GT	.40	6K8	.58	7Z4	.38	25Z5	.44
1X2	.52	6AU5GT	.50	6L7	.49	12A8	.42	25Z6	.44
2A3	.95	6AU6	.40	6N7	.59	12AQ5	.52	26	.40
2AF4	.88	6AU8	.49	6Q7	.59	12AT6	.42	35A5	.45
3BC5	.48	6AV5GT	.49	6S4	.40	12AT7	.61	35B5	.44
3BN6	.80	6AV6	.42	6S8GT	.40	12AU6	.40	35C5	.46
3BZ6	.40	6AW8	.40	6SA7	.40	12AU7	.44	35L6GT	.48
3CB6	.41	6AX4GT	.50	6SC7	.44	12AV6	.42	35W4	.43
3CF6	.42	6AX5GT	.49	6SF5	.49	12AV7	.63	35Y4	.39
3CS6	.42	6B8	.44	6SF7	.55	12AX4GT	.50	35Z5GT	.47
3LF4	.49	6BA6	.46	6SJ7	.55	12AX7	.51	37	.48
3Q4	.44	6BC5	.44	6SK7	.40	12AZ7	.55	39/44	.35
3S4	.44	6BC8	.49	6SL7GT	.50	12B4	.42	42	.45
3V4	.44	6BD6	.40	6SN7GT	.40	12BA6	.44	43	.45
4BQ7A	.65	6BE6	.44	6SQ7	.40	12BA7	.69	45	.47
4BZ7	.65	6BF5	.45	6SS7	.62	12BE6	.44	50A5	.45
5AS8	.52	6BF6	.40	6T4	.62	12BF6	.44	50B5	.48
5AT8	.44	6BG6G	.99	6T8	.61	12BH7	.51	50C5	.48
5AV8	.44	6BH6	.41	6U8	.66	12BQ6	.53	50L6GT	.48
5AW4	.49	6BJ6	.41	6V6	.44	12BR7	.48	50X6	.51
5BK7	.58	6BK5	.65	6W4GT	.39	12BY7	.55	56	.43
5J6	.51	6BK7	.68	6W6GT	.43	12CA5	.48	57	.43
5T8	.49	6BL7GT	.68	6X4	.37	12J5	.45	58	.43
5U4G	.39	6BN6	.70	6X5	.40	12K7	.40	71A	.59
5U8	.49	6BQ6GT	.73	6X8	.65	12L6	.40	75	.60
5V4G	.49	6BQ7	.68	6Y6G	.69	12Q7	.45	76	.45
5V6GT	.45	6BY5	.60	7A4/XXL	.44	12SA7	.44	77	.45
5X8	.45	6BZ6	.42	7A5	.42	12SG7	.48	78	.60
5Y3GT	.42	6BZ7	.68	7A6	.44	12SJ7	.48	80	.52
5Y4G	.55	6C4	.39	7A7	.42	12SK7	.44	84/6Z4	.48
6A7	.60	6C5	.60	7A8	.45	12SN7GT	.46	117Z3	.44
6A8	.60	6C6	.60	7B4	.42	12SQ7	.44	117Z6	.90
6AB4	.40	6CB6	.44	7B5	.41	12V6GT	.40	117L7	1.95
6AC7	.55	6CD6G	.99	7B6	.46	12W6GT	.40	117M7	1.95
6AF4	.82	6CF6	.42	7B7	.48	12X4	.46	117P7	1.95
6AG5	.40	6CG7	.40	7B8	.44	12Z3	.46		

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New Loudness Compensation

(*Continued from page 43*)

keep boost toward the low end of the audio range, where it properly belongs since the Fletcher-Munson effect principally involves frequencies below 400 cycles.

Limitations

The circuit of Fig. 1A does not permit infinite attenuation, as gain controls generally do. Instead, it provides about 45-db maximum attenuation. This does not appear to be a serious limitation. It is difficult to conceive of a situation in the home where 45-db attenuation is insufficient. Bearing in mind that about 30-db attenuation is generally the most that is used, and that the dynamic range of most program sources is no more than 45 to 50 db, it seems that attenuation of 45 db should be enough. In fact, the limited attenuation can be an asset, as in the case of the absent-minded listener who may turn down the volume to answer the telephone and then forget to shut off the set before retiring; the fact that the audio system does continue to put out a minute amount of sound can be a valuable reminder. However, one way of increasing the maximum attenuation is to reduce R_s, at the same time proportionately increasing C and decreasing R_1; the drawback is that the size of C tends to become unwieldy.

A second criticism which might be directed at the circuit of Fig. 1A is that at mid-position of the bass control R_1 is not zero, as it theoretically should be, but is 2500 ohms, thereby causing some extra bass boost to take place. R_1 is a stock item, namely a log-taper pot that attains 5% of its total resistance at 50% of its clockwise rotation. However, when volume is reduced 10 or 20 db at 1000 cycles, a value of 2500 ohms for R_1 produces virtually no extra bass boost. Even when volume is reduced 30 db, a 2500-ohm resistance causes less than 1-db extra bass boost, as shown in Fig. 2C. Only when volume is down 40 db does a 2500-ohm resistance cause significant extra bass boost, and still this is less than 3 db, as shown by Fig. 2D. It is difficult to believe that anyone would wish to listen to music at a level of 40 db below the original performance without using a good deal more than 3-db bass boost.

Both criticisms—incomplete attenuation and residual bass boost—can be avoided altogether by using a special pot for R_1, namely one that has zero resistance in the first 50% of its clockwise rotation. *Mallory* and *IRC* have indicated to the authors that a special pot can be made to order at an extra charge of about $10.

Conclusion

In conclusion, the authors wish to point out that Fig. 1A embodies a truly new approach to the problem of loudness compensation. True, if the bass control is set to the right of mid-posi-

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tion, so that R_1 becomes appreciable in value and enables extra bass boost to take place, the gain control behaves in the manner of a loudness control, providing increasing bass boost as the volume goes down. However, this is not the intended mode of operation, although a number of listeners may find it to be a satisfactory one.

Instead, the authors have in mind not an automatic form of loudness compensation, as in the case of the loudness control, but a manual form of compensation, where the listener adjusts the bass control to give him what his ear indicates is satisfactory balance; no one has yet disputed the fact that the ear should be the final arbiter. The variable bass control can provide as much as 20 db *extra* bass boost above that supplied by the conventional bass control, and it does so only when the extra boost is needed, at low listening levels. Moreover, unlike the case of the loudness control, the user can always return to flat response simply by setting the bass control to mid-position (unless volume has been reduced 40 db or more, which is extremely rare).

Fig. 1A does not necessarily represent the ultimate version of the variable bass control. However, it does incorporate what the authors feel is an important principle: If bass boost is made necessary by the Fletcher-Munson effect, then the bass control should be able to provide all the bass boost needed to compensate this effect, with enough left over for other factors that also require bass emphasis. —30—

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By H. LEEPER

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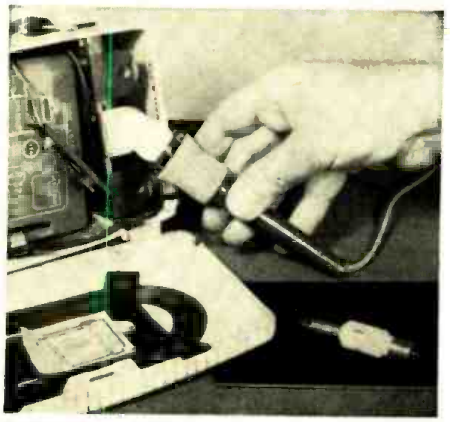

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Service Industry News

WE ALL LIKE to think of ourselves as civilized beings capable of dealing with abstract notions. Indeed we are, but such refined activity still cannot match the forcefulness of our responses when we are confronted with the specific and concrete elements of reality. Thus it is easy to consider broad international problems—or broad service-industry problems—calmly and then forget about them without having generated much heat or without having taken much action. It is only when they hit us in direct, tangible form that we really become excited.

Take the matter of coordinated service-association activity on all levels, local, statewide, regional, and national. Most of us would agree broadly that certain problems, which cut across artificial boundaries, need such activity. But where's the fire?

Out of Monon, Indiana comes a letter from T.P., where there *is* a fire, and Monon's service dealers, including the correspondent, aren't calm. Strictly speaking, the conflagration is raging out of the state, in Chicago, Illinois, but the men of Monon can feel the heat from the flames. They have an area association—but it doesn't reach as far as Chicago.

The problem that T.P. is up against begins with the fact that metropolitan Chicago newspapers are widely circulated in his home town. The Sunday editions carry the usual TV sections, which list the weekly program line-ups for Chicago's five channels, receivable in Monon. These supplements also carry advertising, many of them on TV service, and the latter are larded with handsome claims (sometimes direct, but more often artfully "suggested").

Some of the ads boast of "one-hour" TV service. To Monon residents who are not in a position to find out for themselves (many Chicago residents have learned better), this means any set can be repaired within one hour of the time that the call for service is made. At best, the ads can only be pinned down to mean that a technician will be in the caller's home within one hour (if he can make it).

Other ads sell "guaranteed" picture tubes (up to two years' warranty) at startlingly low prices including installation, if the set owner brings his TV to the CRT vendor. To meet these prices, T.P. says he would have to take a loss on every picture tube he sells. There are other advertised claims, but these are the principal ones. Monon set owners are making their service dealers' lives miserable with demands to know why service and replacement parts are so exorbitant in their town and why service is less speedy. We directed queries to Chicago to find out what was going on.

Our reply came from Frank Moch, executive director for NATESA, on behalf of the national group and its local affiliate, TESA-Chicagoland. The latter group has accumulated much evidence against these advertisers and worked with the state's attorney to bring some of the offenders to justice. There also has been cooperation with the local Better Business Bureau, which has massive complaint files against many of the advertisers but seems powerless to take effective action under existing legislation. It has been possible to get Internal Revenue agents to take some of the questionable operators in tow.

As to the picture tubes, they appear to be rebuilt units although the ads do not usually trouble to mention this (in at least one case they are claimed to be new). Also not generally mentioned is the fact that the "dud" allowance for the old CRT is included in the quoted price. Concerning the two-year warranties, orders to cease and desist have been issued in several cases of these unsupported promises.

Clearly the service people in Chicago have an uphill battle on their hands against this sort of competition. However, they have the advantage that enough set owners in their city have been "taken" to provide them with ammunition for answering their customers' questions. To set owners in Monon, where no one has had a chance to learn the hard truth, it seems that only thornless roses grow in Chicago.

With some of the evidence now in his hands, T.P. should fare better in dealing with his irate clientele. Still better, his letter may be an instrument in eliminating the harmful advertising altogether. It appears that his Chicago colleagues have been trying to involve the Federal Trade Commission in their difficulty for some time, on the grounds that Chicago's metropolitan newspapers are in interstate commerce, but they need evidence to support their contention. With the cooperation of T.P. and other Indiana service dealers, FTC intervention may become a reality.

If it does, it will please this publication to know that it has made some contribution by bringing together people who need each other's help. Nevertheless, it is important that such coordination should always be possible directly within the service industry itself. Occurrences like the mutual Monon-Chicago problem, which are scarcely unusual, provide all the concrete evi-

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dence we need to establish the need for such cooperation.

Tube Call-Back Losses

The "Crusade Against Call-Backs" sponsored by *Raytheon* has reached the point at which the official list of "ten toughest types" is available. These are: 1B3GT, 6AU4GTA, 6AX4GT, 6BQ6GTA/B, 6SN7GTB, 1X2A/B, 6CB6A, 6CG7, 6X8, and 12AT7.

For readers who have not kept up with this campaign, it is based on two premises: the many service dealers who make no service charge for call-back replacement of tubes still in warranty are taking a beating, and the problem seems to be centered about a relatively small number of tube types that are notorious for early breakdown. As a result, *Raytheon* conducted a nation-wide survey among service professionals to determine the ten most (un)popular types.

The "winners" of this contest will constitute the first ten tubes in the manufacturers new "Uniline" series. Others will be added later. Uniline types will be manufactured under special supervision to insure high reliability, with an elaborate system of quality-control checks. To back up this series and to allay some of the call-back loss suffered by service operators, *Raytheon* offers a special guarantee. For any tube in the line that fails during the warranty period, the dealer will not only receive the usual replacement at no charge, but he will also receive one dollar as partial compensation for his no-charge call.

New Monthly Format

Congratulations are in order to the Television Service Association of Northeastern New York on the new format for its monthly "TSA Newsletter." It has always been an informative publication, although run off as a mimeographed affair in the past. The organ is now being printed professionally. The latest issue we have received gives an explanation of provisions of the statewide licensing bill supported by TSA and the broader New York group of which it is a member, ESFETA.

More on Sears

Independent technicians who are called in to work on sets carrying the "Silvertone" brand name of *Sears Roebuck* are running into trouble in more than one part of the country. We recently had occasion to report on an incident in Pennsylvania. Another incident originates in King County, Washington. An independent called in by the set owner found that the picture tube and other tubes, still in warranty, were defective. An attempt to obtain warranty replacements from the local *Sears* service agency proved fruitless. A complaint to the main electronics division in Chicago brought a quick reversal. *Sears* affirms the fact that guaranteed parts remain guaranteed without regard to who works on the receiver.

—30—

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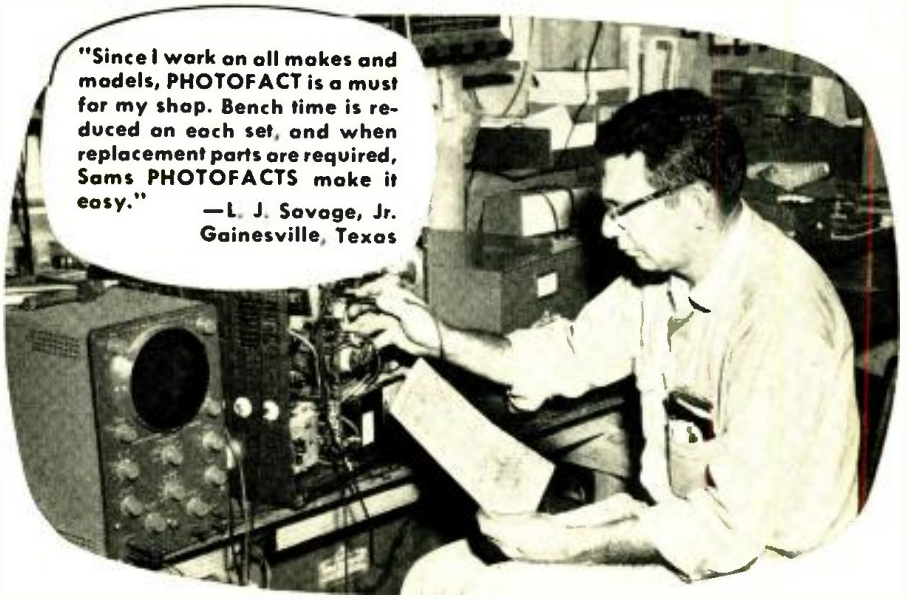

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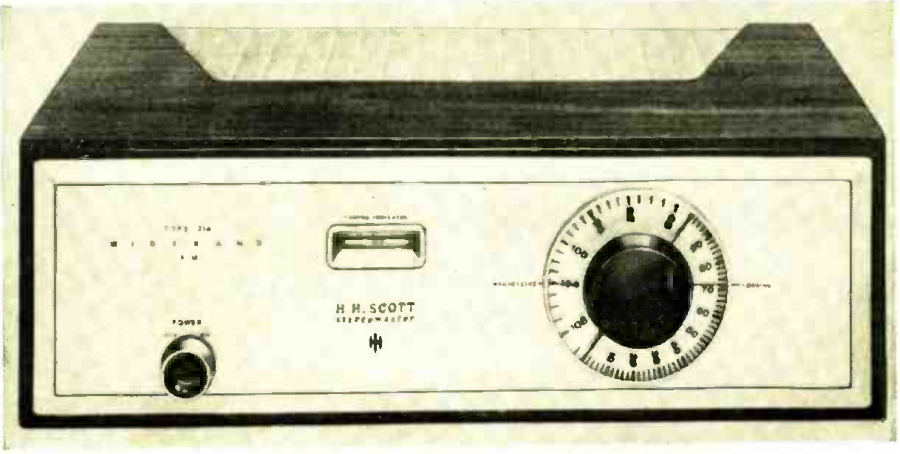
Audax CA-60 Speaker System
Homewood Model 2 Speaker Enclosure Kit



H. H. Scott Model 314 FM Tuner

THE new *H.H. Scott* Model 314 wide-band FM tuner is one of the finest that we have had a chance to check. The tuner is not only extremely sensitive and fully meets all the other specifications quoted for it by its manufacturer, but it shows evidence of considerable "know-how" in the field of tuner design. Because of the wide-band circuitry used, no a.f.c. is required to keep stations in tune. The high sensitivity means that even weak signals will be received and will produce adequate limiting. Complete front-end shielding prevents interference with nearby TV sets and helps eliminate cross-modulation.

Mechanically it also differs from many others on the market in that it does not use printed wiring, but has conventional components on a copper bonded to aluminum chassis. The chassis is large enough to permit the placement of the power supply section at a fair distance from the signal circuits, a feature which probably accounts for the very low inherent hum level. Heater leads are carefully twisted and routed for minimum hum pick-up and a hum balancing potentiometer is included. The "B+" is filtered through a 3-section filter and the audio output stage gets its plate voltage through a fourth filter section. Actual hum measurements indicated that the hum level was well below 60 db below 1 volt, the limit of our test set-up.

The Model 314 tuner has only an "on-off" control and the tuning dial on the front panel. Audio level is adjusted from the rear. In place of a dial cord, the tuning shaft is driven directly from the front control through a planetary friction drive. A tuning eye indicates correct station adjustment. Although no a.f.c. is needed because of the wide-band circuitry, all critical circuits use temperature compensation to minimize oscillator drift.

The r.f. section uses a 6BQ7A in a cascode circuit, followed by a 6U8 which contains the oscillator and mixer. Two stages of i.f. amplification and a third stage as a limiter provide ample gain at broad bandwidth. The second i.f. stage also acts as limiter so that actually two cascaded limiters are in the circuit on very strong signals. A wide-band ratio detector using crystal diodes drives the audio output stage. To provide for FM multiplex reception, a separate audio output is available which does not go through the volume control and the output stage.

A number of measurements on a typical tuner yielded the following results:

Usable sensitivity for 20-db quieting (100% modulation): 90 mc., 1.4 μv.; 98 mc., 1.4 μv.; 106 mc., 1.6 μv.

Usable sensitivity for 30-db quieting (100% modulation): 90 mc., 2.0 μv.; 98 mc., 2.5 μv.; 106 mc., 2.5 μv.

Volume sensitivity for 20-db audio loss (100% modulation): 90 mc., 1.0 μv.; 98 mc., 1.0 μv.; 106 mc., 1.0 μv.

Detector peak separation: 2.1 mc.

Detector linear region: 1.2 mc.

Oscillator drift: after 10 minute warmup ±20 kc., approx.

Audio output: 1.2 volts r.m.s. undistorted.

Audio response: within ±1 db from 30 cps to 15,000 cps except for standard de-emphasis curve.

Actual "on-the-air" tests of this tuner verified the measured data and also indicated a very high interference re-

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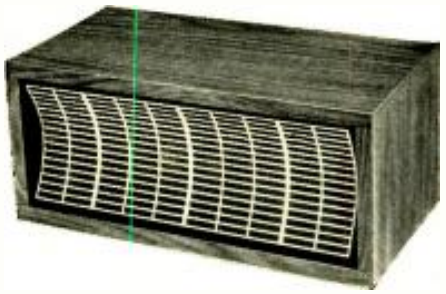
jection ratio. It performed very well in capturing weak stations located adjacent to strong ones, and generally gives the user everything one comes to expect in a high-quality FM tuner. The unit is available for $114.95 and comes complete with one audio cable and a 300-ohm twin-lead antenna. —30—



Audax CA-60 Speaker System

HERE at last is a bookshelf speaker system that really lives up to its name. The *Audax* CA-60 will actually fit comfortably on a normal bookshelf since it measures only 9½" x 10" x 18". What is more, the highly decorative inward-curved satin aluminum grille coupled with the oiled walnut cabinet results in a strikingly attractive over-all appearance.

The speakers used are two 6-inch high-compliance types for low and mid-frequencies along with a 3-inch cone-type tweeter for the highs. The tweeter is mounted between the two woofers along with its built-in high-pass filter, a series-capacitor type. Below the tweeter is a small rectangular ducted port which serves to lower the fairly high resonant frequency of the compact enclosure. Sound-absorbing material is used to line the back cover.

In sweeping the *Audax* unit with an audio oscillator, we found its mid-range and low-frequency performance fairly smooth down to about 70 to 75 cps. The cone tweeter has a gradual roll-off at the very high treble frequencies, so that the over-all effect is one of good balance between highs and lows. The mid-range performance was clean and there was no evidence of spurious resonances or "birdies." Also, there was no exaggerated bass effects nor was there any "barrel-house boom" in the reproduction of the lower tones.

We were impressed with the very high efficiency of the unit which would permit its use with low-powered phonos and amplifiers. As a matter of fact, as little as 5 watts of amplifier power should be adequate to fill the average living room with sound when this speaker system is used. The power-handling ability of the system is about 20 watts of peak program material.

This system should find acceptance among the large number of people who either do not want to pay for or do not require the extremes of the frequency range. Such individuals may have less expensive record players, for example, with which a speaker system with extended low-frequency response would serve to intensify the hum and rumble. In addition, especially for stereo, where

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the use of two speaker systems will enhance the bass, these units should do an entirely suitable job.

In summary, the Model CA-60 is a compact, attractive, general-purpose high-fidelity speaker system with adequate performance at a reasonable price. The unit is available at dealers for $59.95. A vinyl-covered model, with 25 feet of cable, a handle, and a volume control, is also available at the same price. —30—

Homewood Model 2 Speaker Enclosure Kit

FOR those who are in need of a well-designed, inexpensive speaker enclosure, and prefer to construct one from a kit, the *Homewood Industries, Incorporated* Model 2 might be just the answer. It is a book-shelf-type unit, measuring 14" high, 21" wide, and 12¼" deep. The enclosure is constructed of ¾" hardwood plywood, and its design is of the bass-reflex type. It is available in either birch or walnut and, since all four sides are finished surfaces, this model is suitable for either horizontal or vertical placement. The design is for use with either 12" or 8" speakers. The speaker to be used should be of the wide-frequency-range type, such as a coaxial unit. Both 8" and 12" speakers will be suitable but we would, of course, prefer the larger of the two since it would provide better low-frequency response. Since the internal volume of the cabinet is approximately 1⅝ cubic feet and the port area is 17½ square inches, the most desirable speaker for a perfect match should be one having a free-air cone resonance of approximately 80-85 cps.

The construction of the kit is not difficult. All corners are extremely well-mitred, providing a sturdy assembly. A special tape is supplied with the kit that is used to temporarily hold the cabinet corners together while the glue dries. This method, even for the complete novice in wood craftsmanship, results in a fairly good job. We tried one corner using this method, and found no problems. For the balance of the assembly, we used wood clamps to really squeeze the joints together, and the construction turned out perfectly. Very little sanding was required.

As in all bass-reflex cabinets, some form of sound absorption material should be used on at least three of the non-parallel sides of the cabinet to

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eliminate standing waves within the box. We used 1" thick glass wool available from our local parts distributor since this material was not supplied with the kit.

One of the greatest advantages of obtaining an unfinished speaker cabinet is that it gives one the opportunity to finish it to match the decor in the house. In the case of this particular speaker, we stained it to match the wood paneling of the room, and then finished it off with two thin coats of satin-finish varnish. This particular kit is available in birch for $14.50 and in walnut for $19.95. —30—

VR HINT

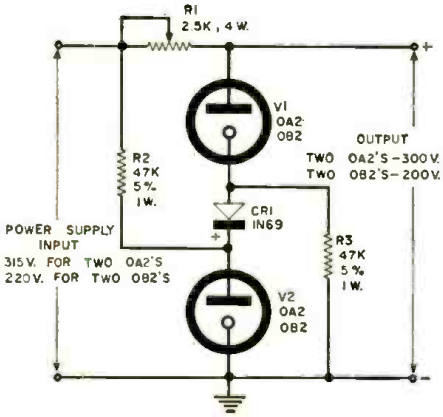
By DAVE STONE

DO YOU want to regulate a power supply with VR tubes but find that the power supply's output voltage is too low to start or "fire" the VR tubes? Voltage regulators such as the 0A2 and 0B2 require an average starting voltage of 25 to 35 volts higher than their nominal regulating voltage. The 0A2 regulates at a nominal 150 volts but requires about 185 volts to fire while the 0B2 regulates at 100 volts but requires about 130 volts for starting.

The problem of too-low starting voltage becomes tougher when two of the same type VR's are added in series across the power supply to regulate a higher voltage, because the starting voltage must then be approximately doubled, i.e., two 0A2's require about 370 volts while two 0B2's take 260 volts.

This problem can be solved if the power supply can furnish at least 10 to 20 volts above the nominal regulating voltage under normal loading conditions. A diode and two resistors added to the series regulating circuit will enable the power supply to fire the VR tubes in parallel and, once fired, the VR tubes will regulate in series.

The two 47,000-ohm resistors pass enough current initially to start the VR's in parallel and also bias the diode so that it does not conduct. When the VR tubes fire, the diode conducts and places both tubes in series across the supply voltage. The same circuit and parts can be used successfully with two 0A2's in series for 300-volt regulation or two 0B2's in series for 200-volt regulation. The 2500-ohm series potentiometer is adjusted to obtain proper regulation when the normal load is connected to the power supply and may be replaced by fixed resistance of equivalent value if desired. —30—



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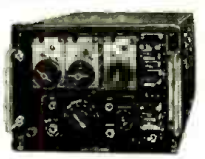

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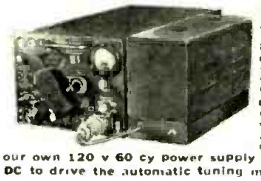

Hallicrafters R-44 ARR-5 AM-FM receiver cost the Air Force $900.00. Tunes 27.8 to 143 mc continuous in 3 bands. Includes Police, Fire, Aircraft, low TV channels, Amateur 10 and 6 meter bands, and the FM Broadcast Band 88-108 mc. With the BROAD switch position, is "hi-fi," with a cathode-follower output at the Video jack to feed your amplifier/speaker setup. It uses Armstrong FM discrimination, has a limiter stage, and the S— meter is also a tuning indicator for FM. The oscillator is voltage regulated for stability. Was a 14-tube superhet with 956 radiation suppressor and 956 RF, but we remove and bypass the first 956, change the circuit slightly, and substitute a 6AK5 for the RF stage. We ship to you aligned, modified, ready to use, with an extra pin jack brought out to the front panel from the last 5.25 mc AM I.F. stage so you can, if you wish, double-superheterodyne into any receiver which tunes to 5.25 mc. We start with BRAND NEW receivers! Includes our own 120 v 60 cy power supply (shown alongside the receiver in the photo) which also furnishes DC to drive the automatic tuning motor in the receiver if you wish to use it. FOB Los Angeles ... **$149.50**
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Radio Aids to Navigation

(*Continued from page 60*)

beacon, Hayward Beacon at 242 kc., to mark the point at which an ILS descent should begin. Therefore, a pilot's first task is to bring his airplane over Hayward Beacon at the proper altitude and heading before an ILS descent can begin.

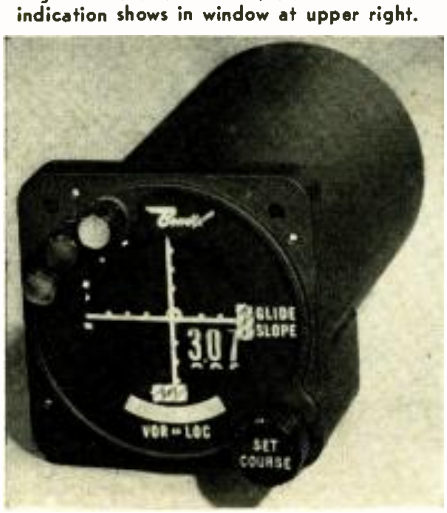
The simplest procedure is to use an ADF receiver to home-in on the beacon itself. Oakland VOR can also be used since the 93-degree radial from Oakland VOR passes directly over Hayward Beacon. The actual procedure to be followed will depend upon the equipment on board the aircraft and specific instructions from the instrument traffic control operator at Oakland.

If an aircraft flies towards Hayward Beacon from the east on a heading of 275 degrees and intercepts the beacon at an altitude of 2600 feet, the plane will intersect the ILS Localizer and Glide Slope signals over the beacon. Note that the Localizer signal, at 109.9 mc., intersects Hayward Beacon at a bearing heading of 275 degrees and that the Glide Slope signal, at 333.8 mc., being directed upwards at an angle of 2 degrees—54 minutes intercepts Hayward Beacon at an altitude of 2600 feet. A compass locator broadcasting at 341 kc. is located at the middle marker to help aircraft in lining up along the proper heading of 275 degrees.

Upon passing over Hayward Beacon, the Localizer and Glide Slope signals can be followed down to the runway. The outer marker is located 4.1 miles from the end of the runway and an aircraft should pass over this marker at an altitude of 1320 feet. The middle marker is located 0.6 mile from the end of the runway and an aircraft should pass over this marker at an altitude of 230 feet. If the runway is not in sight when passing over the middle marker, the airplane must pull up from its descent. If the runway *is* in sight, a normal landing may then be made and the aircraft has successfully completed its flight.

If the aircraft does not possess a Glide Slope receiver, then descent must be made with reference to a Rate of Descent meter. The ILS approach chart for Oakland specifies various rates of descent from Hayward Beacon for various aircraft speeds in knots. Note that the rate is based upon *true* ground speed of the landing aircraft. True ground speed is calculated by correcting true air speed for wind air speed. Thus, the pilot must compute his true ground speed before beginning an ILS descent.

Multipurpose ILS and VOR indicator which shows "Up-Down" glide-slope indications, "Left-Right" VOR or localizer indications. Lights at upper left are marker-beacon indicators. VOR course selector shows radial angle in numeral window, and "To-From" indication shows in window at upper right.



GCA

GCA (*G*round *C*ontrolled *A*pproach) represents the only terminal navigation system that does not require any navigational instruments on board the landing aircraft. GCA consists simply of a ground-based radar which is capable of accurately tracking approaching aircraft in azimuth and elevation. A GCA traffic controller on the ground observing a radar display can guide an airplane to an instrument landing by literally "talking" the pilot down along a glide path to the runway.

GCA was developed originally for the armed forces during World War II and consisted of several independent radar transmitters. Civil GCA today consists of two radar units. An "Airport Surveillance Radar" (ASR) scans an area about 30 miles from the center of the airport and is used for establishing initial contact with aircraft and guiding them along a proper approach course to within about 5 miles from the end of the runway. A second radar, the "Precision Approach Radar" (PAR), then takes over and guides the aircraft down a glide path to the runway.

The Airport Surveillance Radar display consists of a Plan Position Indicator (PPI) type of display which shows azimuthal (left-right) direction of aircraft from the airport. The Precision Approach Radar presents two separate displays. A limited angle PPI (B Scope) display shows azimuthal position along the direction of approach. A Range-Height Indicator (RHI) display shows elevation (up-down) position along this approach path. The photograph of a GCA control center clearly shows the types of displays used.

GCA could be used as a primary terminal navigation aid, but it is not. Its high cost in comparison to ILS is certainly one of the reasons why ILS is found at every large airport and GCA is not. Furthermore, pilots prefer ILS because it gives them a reassuring shipboard visual indication of position which GCA cannot provide. As a result, ILS forms the main radio aid to terminal navigation in this country. GCA is mainly used as an aid in emer-

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gency situations where either ILS equipment fails or an unequipped airplane is caught in poor weather.

During the past three months we have examined the operation of our country's major civil aids to aircraft navigation. These navigational systems are unique in the world and illustrate typical American engineering ingenuity. No other federal government in the world provides a more extensive array of aids to civil aviation than the United States, and this is important. In most other countries, civil aviation is virtually non-existent due to tight federal restrictions. In the United States, however, private aircraft far outnumber commercial airliners. In June 1959, for example, privately registered aircraft accounted for 96.2% of all registered airplanes in comparison to the airlines' 1.8%. This means that radio navigation aids should be simple in principle and inexpensive to receive. All present radio aids are just that.

As the airlines adopt higher speed jet transports, present navigational aids may not be adequate and longer range aids will be needed.

The future will see the development of many new radio aids that will simplify the staggering job of air traffic control and ease air navigation for every pilot, private or commercial. It is certain that these radio aids will strengthen our country's unique belief in the freedom of the airlanes.

In closing, the author would like to thank the Federal Aviation Agency, *Collins Radio Company, Aero Signal Labs,* the *National Aeronautical Company, Lear, Incorporated,* and the *Bendix Aviation Corporation* for their friendly cooperation and assistance which made these articles possible.

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EDITOR'S NOTE: *Readers of these articles will be interested in a series of long-play records released by Aero-Progress, Inc., 1493 Santa Monica Blvd., Los Angeles 25, Calif. dealing with radio aids to aircraft navigation. The first of these, entitled "On Course, On the Glide Path" (priced at $5.98 direct from the company), describes and illustrates by means of actual in-the-air recordings the use and sounds of the radio aids covered by Author Gieca.*

Other records in the series, entitled "Instrument Flight" and "Aircraft Communications," cover an actual instrument flight from take-off to touchdown and illustrate the use of other aircraft radio equipment by actual examples. For further details, we suggest that our readers contact the company at the above address. —30—

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Tubes and Semiconductors

A Forecast of Sales

By **LOUIS MARTIN**
General Marketing Manager, Westinghouse Electric Corp., Electronic Tube Division

An informed estimate of the relative importance of the tube and semiconductor market for the year 1962.

WHEN the semiconductor emerged from the relative seclusion of the laboratory into the bright sunlight of practical application, a wave of fear that the vacuum tube was dying traveled over the engineering grapevine system. Many new equipments in which tubes could outperform semiconductors had the latter designed into them, because the romantic appeal of the new offspring transcended the operating advantages of tubes.

There *are* applications where the superiority of semiconductors is unquestioned. Examples are: hearing aids, portable radios used for entertainment purposes, and simple applications requiring "information diodes." On the other hand, in those applications in which temperature variations are important, in which extremely small size is not too important, in which power consumption is not a major consideration, engineers would be well advised to examine carefully the relative characteristics of tubes before commitments on final design are made. Cost, which is nearly always a consideration, is generally on the side of tubes at this time, although this can change in the future. Some additional factors influencing the choice of tubes or semiconductors are: upper frequency limit, noise figure, high-voltage requirements, nuclear radiation, and reliability. The choice is not always a simple one.

It should be mentioned that tube companies are not asleep at the switch. Almost every, if not all, major manufacturer of receiving tubes is working on basically new designs, which will increase their advantages in some areas and thus make the decision of the equipment design engineer easier.

As far as the distributor is concerned, however, equipment appears in the field with either tubes or semiconductors. His job, therefore, is to furnish replacements for these equipments and to supply laboratories and small OEM (original equipment manufacturer) accounts with either tubes or semiconductors, so that the research man or design engineer can work to his heart's content to freeze his design —with either tubes or semiconductors. And, like an undertaker, the distributor gets the business at the end.

Where will this business be in 1962? Will distributors be selling as many tubes then as they did in 1958? Or will semiconductors sweep the field like molten lava?

The answer is that, because tubes and semiconductors each have relative advantages, both will be with us for a long time to come.

Some Figures

Let us look at some figures.

Industrial and commercial electronic equipment increased from $680 million in sales in 1950 to $2.5 billion in 1958. Of this $2.5 billion, $1.0 billion was derived from factory installation, operation, distribution, and repair. It is estimated that this business will be $3.7 billion in 1962 and that, of this amount, about $1.5 billion will represent factory installation, operation, distribution, and repair.

The home entertainment electronics market is composed of two parts: the factory value of the sets and the value added through distribution. In 1958, this market was about $2.3 billion and it is estimated that it will be $3.2 billion in 1962.

On the average, the value added through distribution is between 35%-40% of the total. It is more difficult to estimate this market than commercial or military markets, because radio, TV, and hi-fi are more susceptible to price changes—a fact well known to those who are radio and TV, as well as parts distributors.

The replacement market is served by two types of electronic distributors: the industrials, who obtain 20%-25% of this market, and the entertainment distributors, who get 75%-80% of this business. A tabulation of this market is as follows (in millions of dollars):

	1950	1958	1962 (est.)
Service & Installation	330	1,140	1,350
Tubes	60	280	350
Other Parts	180	610	760
Distribution Revenue	160	620	740

Service and installation represent the charge to the consumer for time and labor of the technician. Approximately 85%-90% of this is for servicing radio and TV. The growth of this business, four times between 1950 and 1958, is significant, and the total dollars is greater than any of the other major categories.

Tube sales to distributors, $280 million in 1958 and $350 million in 1962, represent about 30% of all distributor purchases, and is undoubtedly the most important single category in the distributor business.

Other parts represent electronic components and devices of all types, exclusive of tubes. This market more than tripled in eight years.

Distributor revenue represents the mark-up charged by the distributor and the technician for the functions they perform.

The Semiconductor Market

The semiconductor market may be broken down into three parts: (1) transistors, (2) diodes and rectifiers (germanium and silicon), (3) others (thermisters, dynisters).

A tabulation of sales of transistors and diodes shows the following (in millions of dollars):

	1955	1958	1962 (est.)
Transistors	15	115	300+
Diodes & Rectifiers	15	100	160
Total	30	215	460+

These figures are estimates of total sales, OEM and distributor. A breakdown is extremely difficult, because the accuracy of the data, especially during the early years, is not too good. The fact remains, however, that the tremendous increase in sales automatically will be felt in the distributor market, although the numerical extent is subject to some debate at this time.

One reason for this is the lack of accurate statistical data on field performance of semiconductors. In the case of tubes, such data are available, simply because they have been in existence for so long. As time goes on and field data are collected, assembled, and analyzed, more accurate predictions can then be made for semiconductors.

There are some who believe that the replacement business of semiconductors should be small, because they have such long life. This statement should not be made at this time. The "long life" reputation of semiconductors, for the most part, is an extrapolation of laboratory-controlled data and is not supported by sufficient field data, as stated previously. Failures of components in equipment other than the semiconductors, sudden large power surges, large increases in temperature, even for short intervals, and mechanical mis-handling all tend to shorten

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semiconductor life. This, of course, requires replacement in the field. A good illustration of this is in the extent of sales of selenium and silicon rectifiers for TV sets. Certainly, industry-wide, they are not negligible. One final, important consideration is manufacturing technique—it is one thing to make nearly theoretically perfect transistors in the laboratory and quite another to mass-produce them for an untold number of applications.

It should also be mentioned that transistors have not yet achieved the state of standardization of tubes.

Tube Market

A comparison of the corresponding total manufacturers' tube sales, OEM and distributor, is as follows (in millions of dollars):

	1955	1958	1962 (est.)
Receiving Tubes	360	340	320
Power Tubes	115	140	180
Total	475	480	500

Note that cathode-ray tubes have not been tabulated or discussed. The reason is simple. As yet, no one has designed a semiconductor to replace a cathode-ray tube.

Comparing these figures with those of semiconductors, it is expected that total tube sales will be about equal to semiconductor sales by about 1962. Because, in general, receiving tubes correspond to transistors and power tubes to semiconductor diodes, a comparison of each of these categories shows that they each will be about equal by 1962.

Several conclusions can be drawn from these figures.

(1) Transistors and semiconductors are an essential part of the market.

(2) Tubes will increase in sales with time, but not nearly as rapidly as semiconductors.

(3) Tubes and semiconductors will have about the same dollar volume of sales by 1962.

(4) Power tube sales show a steady increase with time. —30—

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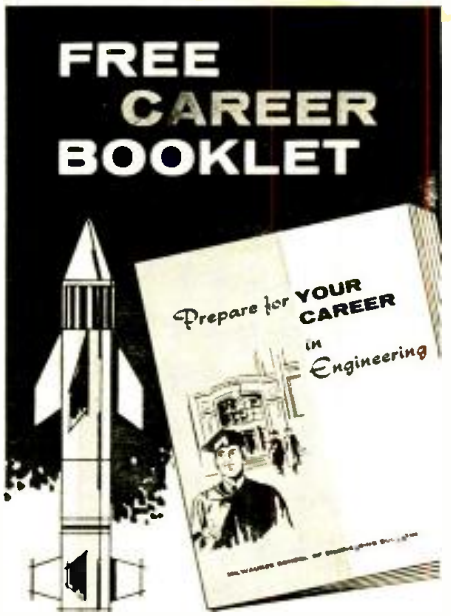

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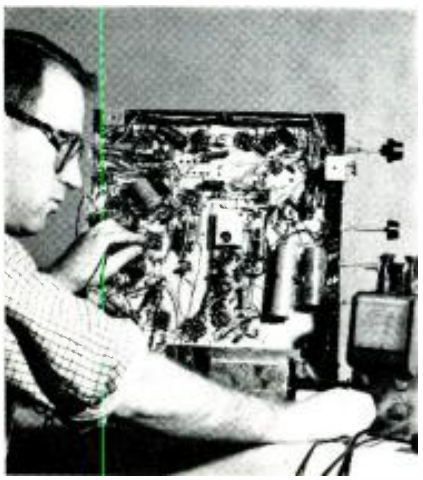

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By
BERT WHYTE

CERTIFIED RECORD REVUE

WITH this column, I begin my eighth year of reviewing for this magazine. No wonder I am getting gray around the temples! All kidding aside, time certainly does fly. It seems only yesterday that I was campaigning in these pages for a thing called pre-recorded tape . . . and it was "monaural" yet!

And then we went to bat for a new-fangled thing called "binaural" sound . . . and then soon came stereo tape and of course the stereo disc. And in between were the Audio Fairs, where every year the technology of hi-fi became ever more precise and more sophisticated.

During those years we have had our great debates . . . the rise of the small speaker and it *versus* the big . . . an argument that still rages and probably will continue for years to come. The hi-fi world expanded and evolved during those years and some cynics think that the period up to 1958 was the "golden years of hi-fi" and something which we will not see again.

Well the hi-fi scene has changed and admittedly some of the changes are less than desirable. There are too many pundits expounding on stereo who actually are babes in the woods on the subject, there are too many fast buck boys climbing on the stereo bandwagon, and the result is far too great a percentage of the public still pretty confused about this stereo business. The general consensus among knowledgeable people in this industry is that it is time for a housecleaning and a more honest presentation of facts to the public. Otherwise the record industry will continue in its present rather chaotic state and this will be reflected in slumping sales figures.

As I write this column it is early July and while a seasonal slump in sales has always been a part of the record business, this year they are really singing the blues. And many feel it is directly traceable to all this hysterical "oversell" on packaged stereo, where the majority of the units give only marginal stereo, if that.

Thus, for a variety of reasons, my expected deluge of new recordings did not happen and it will probably be the November issue before any of the big fall issues begin to show. In the meantime there are still a few choice items to discuss.

STRAUSS, RICHARD
DEATH AND TRANSFIGURATION
DON JUAN

Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury Stereo SR90202. Price $5.95.

Two staples of the symphonic repertoire are here given rather intense, brooding performances by Dorati. He elicits some playing of great precision from the Minneapolis musicians, and if this is one of his best recordings with this orchestra (Dorati retired from this post at the end of the season), he leaves a fitting legacy to his successor.

The sound is sheer magnificence, especially the "Death and Transfiguration." It is really huge, ultra-sonorous with great groaning basses and formidable brass and percussion. Directivity and depth are handled with taste and the reverb is calculated to lend a rich "bloom" to the over-all sound.

This disc again refutes those who say that a stereo disc cannot maintain a sufficiently strong bass response.

FRANCK
SONATA IN A MAJOR FOR VIOLIN AND PIANO
DEBUSSY
SONATA FOR PIANO AND VIOLIN IN G MINOR

Isaac Stern, violinist, and Alexander Zakin, pianist. Columbia Mono ML5470. Price $4.98.

A small-scaled, but nonetheless delectable item for those who favor chamber music. Two of the loveliest sonatas for piano and violin ever written, are given thoughtful, rather cerebral performances, which also have their lyrical moments.

Stern's tone is ravishingly beautiful and no one could help but admire Zakin's estimable playing as well. The recorded sound is moderately close-up but, in my opinion, this type of repertoire calls for less reverb than was used. Very clean and bright sound throughout.

CHOPIN
CONCERTO FOR PIANO AND ORCHESTRA #1 IN E MINOR
KRAKOWIAK (Op. 14)

Stefan Askenase, pianist, with Residentie Orchestra, The Hague, conducted by Willem van Otterloo. Deutsche Grammophon Stereo 138085. Price $5.98.

Here is another of those fabulously quiet-surfaced records pressed by *DGG* in Germany. This is a rousing perusal of the Chopin "Piano Concerto #1" by Chopin specialist Askenase. He brings to the work a remarkable facility of touch coupled with a big tone and brilliantly expressive dynamics.

The same can be said of his traversal of the difficult grand rondo the "Krakowiak." This *DGG* recording is miked quite a bit closer than is usual for them and with the M/S stereo technique. I personally like it, as it gives a more accurate positioning of instruments and affords better detail. As usual, reverb is brilliantly handled and the over-all result is one of the best *DGG* I have heard as yet.

DUPRE AT SAINT-SULPICE

Marcel Dupré, organist. Mercury Stereo SR90228. Price $5.95. Vol. 3.

This is part of a continuing series of recordings *Mercury* has been making with the great organist Marcel Dupré and at his favorite organ in Saint-Sulpice in Paris . . . this time the music of Franck. The church is huge, second only to Notre Dame and the organ is

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one of the largest in Europe. There were some formidable problems of reverb to overcome so as to retain the churchly echoes and yet not obscure the detail in the scores. *Mercury* has succeeded brilliantly and the result is an overwhelming experience in organ sound.

Of stereo effects there is little . . . the main use here is to capture the balances and reverb properly. Dupré plays the grandiose "Grand Piece Symphonique," a "Fantasie" and "Pastorale." Needless to say the performances are superb, with Dupré cleverly maintaining tempi which coincide with the reverb time so as not to blur his lines.

All in all an outstanding find for organ lovers. Thunderous bass for hi-fi, too.

DVORAK
SYMPHONY #2
SLAVONIC DANCES 1, 3, 7, 8
Concertgebouw Orchestra of Amsterdam conducted by Bernard Haitink. Epic Mono LC3668. Price $4.98.

Young Bernard Haitink is one of the most highly regarded of young Dutch conductors and in recognition of his abilities, he has recently been appointed co-conductor of the great Concertgebouw along with Eugen Jochum.

In this unjustly neglected Dvorak symphony Haitink displays a steady beat and authoritative view of the score and an impressive command of conductorial techniques in general. The work itself combines lyrical elements with strong rhythmic accents which appear to be derived from folk dances. Soundwise, this is recorded moderately close-up, with fair detail and with fairly broad acoustics. Frequency range was quite wide and dynamic response was good.

PROKOFIEV
LOVE FOR THREE ORANGES SUITE
SCYTHIAN SUITE
St. Louis Symphony Orchestra conducted by Eduard van Remoortel. Columbia Mono ML5462. Price $4.98.

This is one of the first recordings for *Columbia* of Remoortel and the St. Louis Symphony. As such, one might have felt that they would have given Remoortel rather different repertoire, since the competition here is rather fierce. Our young friend strives mightily, but he is outgunned by Dorati in the "Three Oranges" and by Markevitch in the "Scythian." Each has a more intuitive insight into the score than Remoortel seems able to summon at this stage of his development.

This is mono and is a nice job of recording, although I might quibble with some of the inner balances at times. It is quite clean with good dynamic and frequency range. —30—

CONCERTS SCHEDULED

ACOUSTIC Research and Dynaco are jointly sponsoring a series of "Live vs Recorded" concerts during the 1960 New York High Fidelity Music Show. A pair of AR-3 speakers and Dynakit preamplifier and Mark III amplifiers will vie with the Fine Arts Quartet in direct comparison tests.

The concerts will be open to the public without charge at the New Orleans Room of the Hotel New Yorker, across the street from the Trade Show Building where the Hi-Fi Show will be held.

The concert schedule is as follows: Wed. Sept. 7th, 3, 4, 8, and 9 p.m.; Thurs. Sept. 8th, 6, 7, 8, and 9 p.m.; Fri. Sept. 9th, 6, 7, 8, and 9 p.m.; Sat. Sept. 10th, 6, 7, 8, and 9 p.m.; Sun. Sept. 11th, 3 and 4 p.m. Programming will include music of Tchaikovsky, Bartok, and others. —30—

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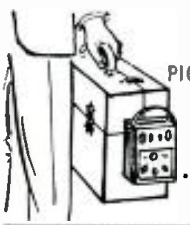

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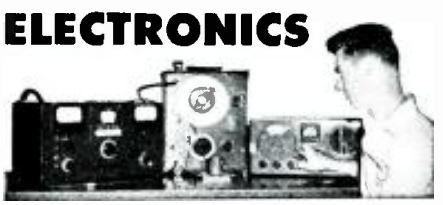

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Sound on Tape

By **BERT WHYTE**

THAT four-track tape is now an established medium is indisputable fact and no space need be wasted in discussing this point. For a very large segment of the public, 4-track tapes fill their needs very adequately. But just as there are *Fords* and *Chevys* on the market and at the other end of the automotive scale there are *Rolls Royce* and *Bentley,* so it is with recorded tape.

There still is a market, bigger than some people realize, for a recorded tape medium that appeals to the audio perfectionist. I know a considerable number of these people and frankly they will have none of the current 4-track material, or for that matter of most two-track stereo either.

Says one friend of mine very candidly, "tape quality is being sacrificed on the altar of commercialism." A strong statement, but from his ivory tower viewpoint he defends his position with vigor. "I will concede that big strides have been made in the quality of tape itself and in improvements in head structure and in more sophisticated equalization circuits," he says, "so that a speed of seven-and-a-half inches per second is sufficient for extended frequency response. However, I still insist that at 15 inches per second, there is more snap and brilliance in the transient response."

My friend goes on to say that today anyone with one of the higher quality tape recorders and a top quality mike, can make his own live recordings which, in quality, surpass anything that is commercially available. He goes on to say that he has been fortunate enough to visit a professional recording studio where he heard stereo tape that really was up to expectation.

For the first time, he related, he was able to listen to the music without the intrusion of various noises and effects due to technical limitations. "That is what I want," he told me, ". . . a recorded tape that neither adds nor detracts from the music . . . with no problems of crosstalk, with no restrictions as to frequency range and dynamic response, and above all with signal-to-noise ratio that makes tape hiss completely inaudible, even when the tape is played at relatively high room volume." And he said smiling, "since I'm asking for the moon, you might as well make sure the tape you furnish is a genuine three-channel stereo."

Whew! Quite a tall order my friend is asking for, eh? When I pointed out the commercial exigencies to him, he said rather wearily that he had heard all that jazz before and that didn't alter his desires. When I emphasized the delicate point of the cost factors involved, he came right back with this statement: "When stereo first arrived on the scene I was paying up to 16 and 18 dollars for a production. It wasn't perfect but it represented something unique and, if you will recall, by the time the stereo disc came along and the bubble burst, stereo tape at these prices had reached the proportions of a sizable market." Then he went on, "I'll admit that advances have been made so that today's tapes are equal or even superior to the older product and at a much lower price. At the same time, even with the older material we recognized its limitations and were looking for something better.

"Now my whole point is this . . . the art has advanced and the prices have come down . . . but I'm still the same guy who bought those 16-dollar tapes and my income today is better than it was back in 1953. I'm still willing to pay that kind of dough for a stereo tape, if somebody will give me a tape with the quality I have asked for and which, at these prices, should now be possible to achieve."

Well, my friend certainly has a point. The high-priced two-channel stereo tape up to the advent of the stereo disc had indeed become a sizable market and, if I recall, in the boom year of 1957 sales had reached 5-million dollars a year. Now I certainly do not advocate a return to two-track tapes and higher prices *per se.* The stereo tape market is daily becoming much greater than it ever was and has achieved a certain degree of stability which is all to the good. But it would appear that, for some enterprising manufacturer, there exists a market big enough to warrant cultivation. This is the audio perfectionist, a man of taste with a pocketbook to indulge these tastes. There are enough of these people around to keep *Cadillac* in business, and the manufacturers of cabin cruisers, and 12-year-old Scotch as well.

Nuff said, but before leaving this dream realm of quality, I'll make a statement I am pretty sure would be well supported . . . if our present 4-track tapes could be made with signal-to-noise ratio good enough to really

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eliminate tape hiss, most people would be willing to pay a few dollars extra for this boon. At least that is the impression I get from a lot of people who are not what you would call out and out audio perfectionists, but to whom tape hiss is the most annoying flaw in many commercial tapes.

RAVEL
DAPHNIS AND CHLOE (complete) London Symphony Orchestra conducted by Pierre Monteux with chorus of the Royal Opera House, Covent Garden. London 4-track LCL80034. Price $7.95.

I reviewed the stereo disc version of this fabulous work some time ago, and while my comments were generally favorable, I was unhappy with certain aspects of the sound. Here on tape is the most clear-cut evidence of the superiority of tape over disc.

On the other side of the coin, the greater clarity of the tape brings out flaws hidden in the disc. For example the wordless chorus which accompanies the opening section is not too well balanced against the orchestra at times, being too submerged in the orchestral texture.

All in all, however, this is a thing of beauty, beautifully conducted and played and with all of stereo's bright virtues shining through. Directionality is present but discreetly balanced and the depth effects, through expert handling of the acoustics and instrumental positioning, are outstandingly realistic.

HAYDN
SYMPHONY #96 ("Miracle")
SYMPHONY #104 ("London")
Vienna Philharmonic Orchestra conducted by Karl Muchinger. London 4-track Stereo LCL80017. Price $7.95

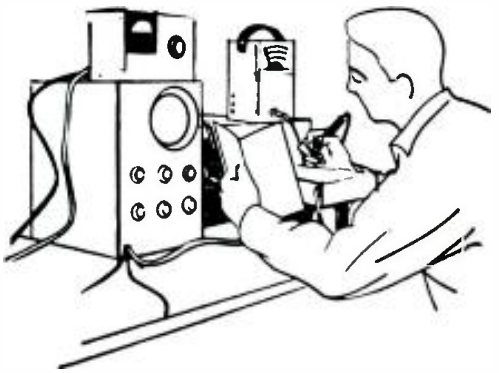
Two of the late symphonies of Haydn are here afforded carefully detailed, very scholarly performances by Munchinger and are audibly improved in sound from the previously released stereo disc.

There is nothing sensational here, but good mike placement and intelligent use of acoustics have made for very pleasant listening . . . a very clean sound that never appears strained. The stereo effects are all one could desire with this type of scoring.

THE QUEEN'S BIRTHDAY SALUTE The Herald Trumpeters and Band of the Royal Regiment of Artillery with 21 gun salute. Vanguard 4-track VTC1602. Price $7.95.

This, too, is an example of tape superiority, although not as concrete as the above. The stereo disc of this fascinating royal panoply was one of *Vanguard's* greatest achievements. Even so the thundering clatter of horses hooves and the boom of cannon have much greater weight and impact.

This was recorded outdoors in Hyde Park and it is surprising the amount of decay the sound has. There is little over-all directionality on this tape, but the run by of the artillery passes very dramatically from left to right speaker, and it is just the thing to impress new inductees to stereo! For all Anglophiles, a "must" recording. —30—



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Bell Telephone Laboratories has produced two new sound motion pictures for use in college science and engineering classes.

The films, entitled "Memory Devices" and "Similarities in Wave Behavior", were prepared under the guidance of *Bell Labs* scientists and engineers and are available on free loan through local *Bell Telephone Company* offices.

"Memory Devices" runs 27 minutes and is in 16 mm. color with sound. The second film is in 16 mm. black-and-white and runs 26½ minutes. It features a demonstration lecture by Dr. J. N. Shive. These new releases are the seventh and eighth productions in the audio-visual aids series on science education at the college and university level.

SUPREME "MASTER INDEX"

Supreme Publications, 1760 Balsam Road, Highland Park, Ill. has announced release of its 1960 "Master Index" covering radio and television manuals.

The index serves as a reference to all material included in television manuals covering the years 1948-1960 and radio volumes from 1926-1960. The index permits immediate reference to the volume in which service material for a specific make or model receiver was covered.

The index is available for 25 cents a copy, postage prepaid.

BRIDGE RECTIFIER DATA

Radio Receptor Company, Inc., 240 Wythe Ave., Brooklyn 11, N. Y. has issued a data sheet on its new miniature open bridge assembly, the selenium rectifier "Flat" 155V90.

Bulletin F-313 provides complete technical data, circuit and mounting instructions on this miniature unit which is rated 90 ma. d.c. at 155 volts r.m.s.

A copy of the bulletin or additional information on the firm's complete line of selenium "Flats" may be obtained from Dept. F of the company.

NEW ARROW CATALOGUE

Arrow Electronics, Inc., 65 Cortlandt St., New York 7, N. Y. has announced publication of its new 1960-61 "Hi-Fi, Stereo, and Amateur Radio" catalogue.

The 154-page buyer's guide to components and systems provides full coverage to equipment in the hi-fi, stereo, and amateur fields. It is available without charge direct from the distributor.

INTERCHANGEABILITY GUIDE

The Distributor Products Division of *Raytheon Company* has issued a handbook of industrial tube interchangeabilities.

The new guide lists some 900 tube types including miniatures, subminiatures, voltage regulator-voltage reference, radiation counter pencil, transmitting, klystrons, industrial CR, special purpose tubes, etc.

Common types of tubes now installed in industrial equipment are tabulated alongside their *Raytheon* direct replacement or electrical equivalent types. The brochure also invites technicians and distributors to utilize the company's engineering consulting service to answer questions on applications and replacements.

The handbook is being offered without charge by all the firm's franchised distributors.

INSTRUMENTS & METERS

Precision Apparatus Company, Inc., 70-31 84th Street, Glendale 27, N. Y. and its subsidiary *Pace Electrical Instruments Co., Inc.* have issued a combined reference-catalogue covering electronic test instruments and panel meters for industrial and communications applications.

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The catalogue features detailed electrical and mechanical specifications which should prove helpful to engineers and designers. Copies of Catalogue Number 28/Industrial are available on letterhead request only.

METER REPAIR FACILITIES

Ram Meter Inc., 1100 Hilton Road, Ferndale 20, Michigan is offering a 4-page brochure outlining its facilities for servicing meters and instruments of all types.

The booklet points out that the firm is prepared to repair and calibrate meters, modify standard meters, design and produce special scales, repair electronic instruments, and provide certification service, in addition to manufacturing special testing and indicating equipment for laboratory, production, or military applications.

FILM ON TV RECEPTION

Channel Master Corporation, Ellenville, N. Y. has produced a 4½-minute film on antenna replacement which it is offering free to TV broadcasters throughout the country.

Narrated by Robert Trout, the film stresses that clear pictures transmitted by the stations are often weak, fuzzy, or snowy on the home set because of poor antenna installations. The film shows how proper antenna installation can make a tremendous difference in the quality of reception.

Prints of the film are available through the company's advertising department.

TWO-WAY RADIO DATA

The Communication Products Department, *General Electric Company*, P. O. Box 4197, Lynchburg, Va. is offering a new 24-page bulletin covering communication equipment available for businesses.

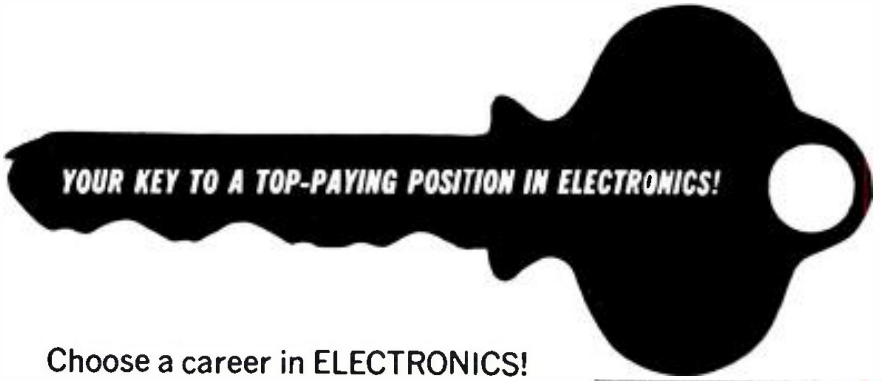
Designated as Bulletin ECR-497B, the publication describes frequency allocations and the various combinations of two-way radio possible in each frequency. Also shown is the difference between tubed and transistorized equipment. The publication carries sections covering amplifiers, portable hand-carried two-way units, desk-type base stations, floor-mounted units, selective-calling, antennas, microphones, remote control, and pocket voice-message receivers. —30—

HAM CLUB TO MEET

THE Findlay Radio Club of Findlay, Ohio, W8FT, will hold its annual hamfest on Sunday, September 11, at the Findlay Riverside Park. Families are invited.

There will be a ham equipment and ladies' handicraft swap shop as well as two Elmac AF-68 multi-band mobile transmitters as door prizes. Other prizes will be awarded. Mobile talk-in will be on 3812 kc.

Advance registration is $1.00 per family or $1.50 at the park. Tickets and information are available from Paul A. Chapin, W8K11, RFD 5, Findlay, Ohio. —30—



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Cascode Circuits

(Continued from page 67)

ply voltages. None of these are widespread (with the possible exception of the input-circuit change) and in no case will they affect the basic theory of operation, maintenance, or repair.

Cascode Troubleshooting

Several possible troubles are unique to the cascode circuit, and some of them can prove extremely difficult to pinpoint. They may be caused by tube failure, by defective parts, or by misadjustment. As in most electronic circuits, many cascode problems are caused by tube failure. The most common tube defect is a second-stage heater-cathode short, caused by the high potential between the heater and this cathode, with plate-cathode shorts in the second stage running a close second. After replacing a tube with a plate-cathode short, be sure to check for cooked resistors and coils.

One of the most puzzling cascode defects is oscillation. It may result in either a blank, white raster or a blacked-out screen when it occurs in a TV set. In an FM tuner, oscillation can produce either squeals or no sound at all. In an AM receiver, the most usual effect is a loud hiss or buzz-saw noise, with signals receivable from only the strongest stations, and then accompanied by a "siren wail."

Frequently, oscillation is caused by misadjustment of the neutralizing coil (L_6 in Figs. 1 and 3). While this coil cannot *prevent* oscillation, it may *cause* it by increasing circuit gain past the point of stability. In other cases, oscillation may result from a defective grid bypass capacitor (C_5 in Figs. 1 and 4; C_6 in Fig. 3). If this component should open up for any reason, it places the second-stage grid above r.f. ground, removing the low-impedance load from the first stage and so producing oscillation.

Lead dress may also cause oscillation. At the frequencies involved in TV and FM broadcasting, a difference of a fraction of an inch in wire spacing may mean the difference between perfect operation and wild oscillation caused by accidental feedback. A safe rule when working under the chassis of a cascode circuit is always to return every lead and part to its original position.

Failure of a resistor in the grid-clamped cascode (R_7 or R_8 in Fig. 3) will prevent the circuit from operating. These resistors can be checked most easily by measuring the second-stage grid-cathode voltage. If the grid is between .5 and 1.5 volts negative with respect to the cathode (with no input signal) the resistor network is satisfactory. Any other reading suggests a defective resistor.

Adjusting the Circuit

Basic alignment of the cascode circuit is not very different from alignment of any other r.f. amplifier. However, cascodes do have some uncommon features. The most obvious is the so-called neutralizing coil. In many TV tuners, this coil is non-adjustable; in other cascode amplifiers, it can be adjusted. Two techniques are applicable.

To follow the most accurate method, disconnect the tube's filament and turn on the set. Apply a strong input signal, and connect a v.t.v.m. across the video detector, first limiter, or second-detector load resistor, depending on the type of receiver. Adjust the coil (L_6 in Figs. 1 and 3) for minimum signal. Reconnect the filament.

With a series-filament circuit, this procedure is impractical. In this case, simply adjust L_6 for minimum noise while tuned to a weak or attenuated signal near the upper frequency limit of the amplifier. Then check carefully to make certain the amplifier does not oscillate at any point in its operating range.

For weak-signal use, the cascode circuit can be improved by adjustment of grid bias. This is done by substituting a resistor of different value in place of the first-stage cathode resistor. (This is R_1 in Figs. 1 to 4; also in Fig. 5A). Since optimum bias for least noise varies from tube to tube, the proper value of resistor to use is determined by disconnecting R_1 and putting in its place a length of shielded cable connected to a 250-ohm composition potentiometer, as in Fig. 5B. Don't use a wire-wound unit; its inductance will produce unusable results.

With the potentiometer set for maximum resistance, tune in a weak signal and adjust the potentiometer for best reception. Then, without disturbing the adjustment, disconnect the potentiometer and measure the resistance used. Wire in a fixed resistor of equal value.

Let's Look at Tubes

The original Wallman cascode circuit, as noted, used a triode-connected 6AK5 and a 6J6, but present-day cascode amplifiers use tubes designed especially for this type of service. More than a dozen special twin-triodes have been developed for cascode use; most of these tubes are plug-in replacements for each other, more or less, since nearly all of them have the same base connections and require similar operating voltages.

However, indiscriminate tube substitutions are never recommended. Before switching to another tube type, be sure you know what you intend to accomplish. The most frequent reasons for switching tubes are to achieve higher gain and to escape cross-modulation effects.

Interchangeable cascode tubes and special features of each type are listed in Table 2. When making substitutions on a set using series-string filaments, be sure that the new tube chosen has the same heater voltage and current ratings as the old one. Series-string versions exist for most of the 6-volt prototypes listed. —30—

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K. C. Licensing Killed

Circuit Court in Jackson County, Mo., invalidates ordinance on TV service.

ONE OF the few municipalities in this country to have passed local legislation licensing and regulating the activities of electronic service professionals, Kansas City, Mo., has seen the ordinance declared illegal before it was put into force. This development was the result of action by The Electronic Association of Missouri (TEAM), a group opposed to licensing, which sought to stop enforcement by seeking injunctive relief.

Other service professionals, principally those affiliated with Television Service Engineers in the same city, had endorsed the voided bill. There is evidence that proponents of service licensing will work for the early passage of a substitute ordinance whose provisions will overcome the court's objections.

The decision to void was made by the Honorable Tom J. Stubbs on July 7, 1960, in Division 5 of the Circuit Court of Jackson County, Missouri, at Kansas City. While the jurist was of the opinion that the Council of Kansas City does indeed have the charter authority to adopt an ordinance regulating the service of television equipment, he felt that the definition of television service in the particular ordinance was too broad.

He added, "I think the ordinance is bad for a further reason where, in Section 39.1087 of the ordinance, in paragraphs (a) and (c), the Board of Examiners are directed to take into account the character and reputation of the applicant for a license and, as I construe the ordinance, may refuse to recommend an applicant for a license if the Board concludes his character is such that he shouldn't have a license."

On the subject of whether or not the city has the police power to impose such a regulation as a measure of prevention of fraud, Judge Stubbs said, "No, you are going too far now; there are many laws in Missouri, state laws and city ordinances both, by which criminal conduct is punishable."

The justice's decision was based on specific provisions in the voided bill rather than on the principle of licensing itself. Since this left the path open for the introduction of new licensing legislation, the *Kansas City Times* was already reporting two days later, July 9, that an alternate television service ordinance had been introduced in the City Council.

With members of the Council apparently in favor of some kind of service licensing, it is too early to say whether the court's action does or does not mean an end to such legislation in this city. TEAM officials have expressed their intention of keeping on top of alternate proposals with an eye to blocking them. —30—

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"SERVICING VIDEO SYSTEMS" by Jesse H. Dines. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 224 pages. Price $3.95. Soft cover.

This is a comprehensive discussion of TV video systems, from the mixer to the picture tube, detailing a wealth of information, including servicing hints, that will be used by the service technician. The book is amply illustrated with diagrams and photos.

"101 MORE WAYS TO USE YOUR SCOPE IN TV" by Robert G. Middleton. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 160 pages. Price $2.50. Soft cover.

The author, a well-known writer on TV technology and servicing, here details an impressive series of tests through various parts and stages of TV receivers by using an oscilloscope. Equipment needed, connections to make, and thorough explanations of tests are covered. Photos of scope traces are included.

"2-WAY MOBILE RADIO HANDBOOK" by Jack Helmi. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 208 pages. Price $3.95. Soft cover.

Equipment, basic circuits, and servicing of mobile radios are treated in ten clearly written and profusely illustrated chapters. The author takes the reader from the microphone to the speaker and back, touching on all important points between.

"HANDBOOK OF TV TROUBLES" by Sol Heller. Published by *Holt, Rinehart and Winston, Inc.*, N.Y. 302 pages. Price $5.95.

The bulk of this volume is devoted to picture troubles, with one chapter on sound troubles and a final one covering TV interference problems. All possible causes of troubles are carefully examined, with hints for correcting them supplied. Schematic diagrams and photographs of troubled TV screens enhance the book's usefulness to the service technician.

"VIDEO SPEED SERVICING" by Samuel L. Marshall. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 160 pages. Price $2.95. Soft cover. Vol. 4.

This is the fourth in a series of volumes that present hundreds of practical troubleshooting hints, each accompanied by a diagram or partial schematic, for solving troubles in specific makes and models of TV receivers. The problems and solutions presented are based on actual cases and are indexed for easy reference.

"SERVICING TRANSISTOR RADIOS" by Sams Engineering Staff. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 160 pages. Price $2.95. Soft cover. Vol. 5.

Like its four predecessors in this series, the present volume contains a collection of "Photofact" folders covering technical and physical features of 52 domestic and foreign transistor radios produced during 1958 and 1959. A special section covers alignment, measurements, and troubleshooting hints.

"AUTO RADIO MANUAL" by Sams Engineering Staff. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 160 pages. Price $2.95. Soft cover. Vol. 10.

This is the latest in the series of bound volumes of "Photofact" folders covering auto radios. Thirty-one models produced in 1958 and 1959 are covered. Schematics, detailed photos, and parts lists are included.

THEORY AND FUNDAMENTALS

"ELECTRONICS FOR THE BEGINNER" by J. A. Stanley. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 192 pages. Price $3.95.

Simply written and clearly illustrated, this volume is intended for the absolute novice with no previous electronic training. Some theory is covered, but the book "teaches" its lessons mainly by a series of interesting and low-cost construction projects for the beginner.

"BASICS OF INDUCTION HEATING" by Chester A. Tudbury. Published by *John F. Rider Publisher Inc.*, N.Y. Vol. 1, 140 pages; Vol. 2, 144 pages. Price $3.90 per volume. Soft covers. Vols. 1 & 2. Also available in single volume, hard cover.

Aimed at readers who are familiar with electrical fundamentals, these two volumes explain the electrical and thermal aspects of induction heating as well as the mechanical problems associated with fixturing. Lively drawings help clarify points in the text.

"INDUSTRIAL ELECTRONICS AND CONTROL" by Royce Gerald Kloeffler. Published by *John Wiley & Sons, Inc.*, N.Y. 540 pages. Price $10.00.

Of primary interest to engineers or engineering students, this volume approaches its subject through solid-state theory rather than by way of vacuum and gaseous tubes. The discussion is not based on heavy mathematical ex-

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planations but does presume previous training in electronics or physics.

"APPLICATIONS OF ELECTRONICS" by Bernard Grob and Milton S. Kiver. Published by *McGraw-Hill Book Co., Inc.*, N.Y. 628 pages. Price $7.00.

Circuits and equipment are described for all modern applications of electronics. The approach of the authors is suited to the technician who has mastered fundamentals. The use of mathematics is kept to a minimum.

"ELECTRONIC FUNDAMENTALS AND APPLICATIONS" by John D. Ryder. Published by *Prentice-Hall, Inc.*, Englewood Cliffs, N.J. 721 pages. Price $13.35.

This is the second edition of a textbook for the serious, advanced student, or technician, updated to include new material on recent solid-state devices. The discussion is quantitative, and relies heavily on advanced math.

"BASIC ULTRASONICS" by Cyrus Glickstein. Published by *John F. Rider Publisher, Inc.*, N.Y. 144 pages. Price $3.50. Soft cover.

Here is a simple and basic introduction to this field. Topics covered include: theory of ultrasonic waves, their generation, design of equipment, applications, biological and chemical effects, cameras and instrumentation. Important points are highlighted with simple drawings.

"FUNDAMENTALS OF SEMI-CONDUCTORS" by M. G. Scroggie. Published by *Gernsback Library, Inc.*, N.Y. 160 pages. Price $2.95. Soft cover.

This book is a practical discussion of the theory and types of semiconductors. It covers transistors, rectifiers, photoelectric devices, thermistors, varistors, masers, and mavars. Written in simple, straightforward style, the volume is illustrated with drawings and photos.

"DIGITAL COMPUTER PRINCIPLES" by Wayne C. Irwin. Published by *D. Van Nostrand Co., Inc.*, Princeton, N.J. 321 pages. Price $8.00.

This introduction to the subject is aimed at students and industrial personnel without previous specific training. It includes a basic discussion of computation methods and then gradually develops the topics essential to the use of digital computers.

"ELECTROMAGNETIC FIELDS, ENERGY, AND FORCES" by Robert M. Fano, Lan Jen Chu, and Richard B. Adler. Published by *John Wiley & Sons, Inc.*, N.Y. 520 pages. Price $12.00.

This book develops electromagnetic theory and discusses the relation between circuit theory and field theory. Based on work at the Massachusetts Institute of Technology, it is developed in successive steps from the Lorentz force, the integral form of Maxwell's equations in free space, and suitable macroscopic models of polarized and magnetized matter. —30—

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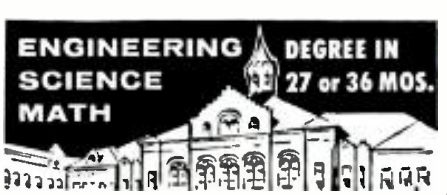

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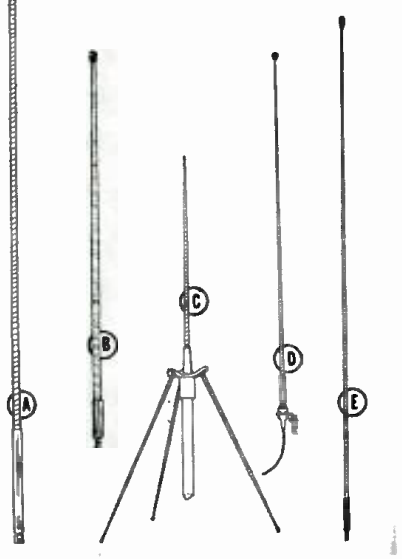

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Electronic pH Measurement

(*Continued from page 46*)

and will give greater accuracy in service.

The calomel electrode, having a small asbestos fiber connecting the outside solution being tested with the KCl (Fig. 5) will come protected by a rubber cap, which must of course be removed before placing it in service. Since the KCl (potassium chloride) *can* slowly leak out and evaporate, always check the KCl level in the calomel electrode and replenish if necessary.

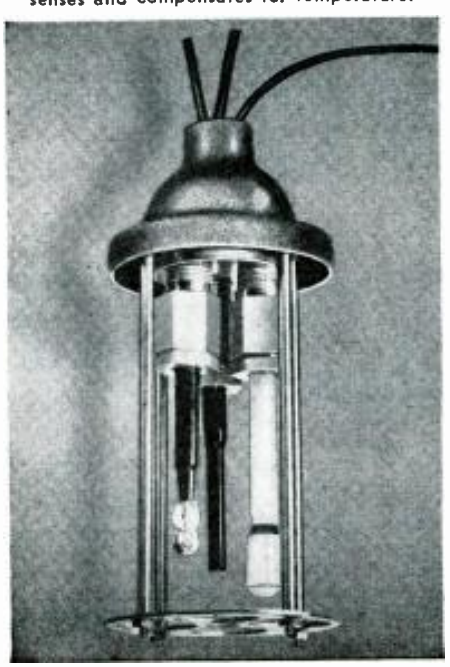
A strong alkali can attack the very thin glass of the glass electrode, even though a special sodium-free glass is used. Over a period of time the strong base would dissolve part of the glass and change readings. Eventually it would eat through the glass, making a pin-hole somewhere.

Electrodes must be kept free from encrustation and the only way to safely remove crusts from the glass is to soak the electrode in a weak solution of opposite nature—acid for base crusts, and base for acid crusts. Do not use extremely hot water or slosh the electrode around wildly. Remember it is extremely delicate—and quite expensive!

An erratic reading of *p*H may not be a malfunction of the instrument or the electrodes at all. Solutions which are not in water but in some other liquid may not have an evenly distributed *p*H, and may cause the erratic movements. Always test with some standard test solution, as will be specified by the equipment manufacturer, before assuming the instrument or the electrodes have gone haywire.

Where the electrodes are mounted in some continuous-process piping system,

Fig. 9. Black rod between electrodes senses and compensates for temperature.



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they will of course be protected by a screen against possible damage from rapidly moving particles which may be carried in the liquid. In that case, encrustation or fouling of the protective screen may be one cause for erroneous readings. Regular checks are recommended. Finally—if all common-sense checks have been made for cleanliness, proper installation, and intact electrodes—look for circuit problems.

Most circuit difficulties in *pH* measurement arise from electrical leakage. Because of the very high resistance of the electrodes, any inadvertent shunting in the circuit has a disastrous effect on the accuracy of measurement. Because the *pH* equipment is necessarily placed in a liquid-carrying environment, scrupulous cleanliness must be observed for the electrode terminals, leads, and connectors.

Next most frequent are grounding problems. Thorough grounding of the case, the amplifier, and the piping involved may be of help. Ground loops and a.c. pickup are as much a problem here as in any hi-fi installation. Precipitation or encrustation of the electrodes and supporting structure may restrict the flow of liquid around them. Frequent inspection of the electrodes may be required. Accidental shorting or loading of the electrodes will cause polarization. They will recover, if left alone, but it may take a long time, possibly days.

If radioactive material is present in the liquid, ions may collect around the electrodes and give false (high) readings. Sodium, lithium, and potassium in high concentrations will cause the electrodes to respond more vigorously, and corrections must be made for these solutions. The manufacturer of the electrodes will supply the data needed. What we have said for *pH* is also mostly valid for other potentiometric measurements made with these electrodes.

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FM Reception on Wheels

(*Continued from page 65*)

sensitivity with high conversion efficiency and superior frequency stability.

The subsequent i.f.-limiter-detector strip might seem overdesigned for a home receiver—but this isn't a home receiver. V_2 and V_3 are conventional i.f. amplifiers. These are followed by two stages of limiting, V_4 and V_5. Furthermore, the limiters are double-acting affairs providing both grid and plate limiting. The signal path so far provides excellent gain and limiting. In fact, this could be considered quite good in an FM home tuner whose discriminator is of the Foster-Seeley type, which provides no limiting on its own. Where a ratio detector, which also provides good limiting, is employed, the manufacturer begins to cut down on stages of i.f. amplification or pre-detector limiting. This is not so here, where the ratio detector is used. The combination of exceptionally good noise clipping with high sensitivity gives the user a much better chance in his battle against vehicular handicaps.

While sensitivity and noise rejection (as far as the circuit is concerned) have been considered, the four limiting points (grids and plates of two stages) prior to the detector accomplish another purpose. All signals strong enough to produce limiting tend to be cut down to the same size. Thus fluctuations in signal strength occurring during motion, which would ordinarily produce fading and fluttering in the audio output, are well controlled above a certain threshold. Where comparable limiting appears in home FM sets, the a.v.c. loop is often left out. However, since the control of fading is particularly important here, a feedback loop originating at the grid of the first limiter, up to which signal-strength variations still exist, is returned (point *D*) to the front end for a.v.c.

There is still a need to consider stability, both of frequency and voltage. As to the former, we have an a.f.c. loop involving a back-biased semiconductor diode (E_2) between the center of the balanced ratio detector (point *C*) and the grid of the converter stage. Such diodes act as voltage-sensitive variable capacitors. The error voltage provided by the detector when the set is off frequency retunes the oscillator tank correctly. This takes care of frequency stability and also gets rid of the problem of critical tuning. As with most a.f.c. circuits, there is a fairly broad range on either side of the precise tuning point over which a desired station may be pulled in easily, without the driver having to pull his car over to the curb to make the adjustment.

Voltage stability becomes particularly important where a biased diode is used in an a.f.c. loop. If the biasing voltage varies, for example, erratic action of the diode may do more harm than leaving the diode out altogether. A neon bulb (E_1, which may be found between the top of E_2 and the lead from the power supply) provides the necessary voltage stability.

Of additional interest in the FM-900 are the power supply and audio circuits. Although the set uses tubes mixed with transistors, it cannot be called a conventional hybrid receiver, in which the tubes use low plate voltages. The latter types would doubtless require unacceptable design compromises. Thus conventional tubes requiring "B+" in the order of 100 volts are found here. While this requirement could be met with a vibrator type of power supply, noise problems might again arise. Thus a transistor power oscillator, V_{101}, with a step-up transformer is used to provide a satisfactory a.c. voltage, which is rectified by a selenium diode and filter. A varistor (R_{103}) at the rectifier output also helps stability here. The power pack is on a separate subchassis.

Receiver controls (left to right in Fig. 1) are "Volume-On-Off," "Tone," "Speaker Selector," and "Tuning." A pair of push-pull 2N176 transistors provide 15 watts of peak audio output, 9 watts undistorted. A feedback loop keeps response flat from 50 to 10,000 cps. Sensitivity is given as 3 microvolts for 20 db quieting. A 12-volt battery system, with battery negative grounded, is required. An accessory "radio switch" permits alternate use of an existing AM receiver.

The accessory kit contains ignition-suppression equipment to be installed *in addition* to that which may already exist for AM. A .5-μf. capacitor (Fig. 3) must be installed on the generator. A .1-μf. unit (Fig. 5A) is installed on the voltage regulator. (If more suppression is needed here, the .5-μf. unit shown in Fig. 2 is also added later.) Another .1-μf. capacitor (Fig. 5B) is installed on the ignition coil. If still more suppression is needed, ignition wiring should be checked to make certain that it is of the resistance-wire type. If it is not, replacement with resistance wire is in order.

Ground straps to prevent ground loops by insuring good electrical conductivity between various metal parts of the car may also cut down ignition noise. Suggested points are from the engine block to the firewall; from the engine block to the car frame; from the negative battery terminal to the car body; and from this battery terminal to one of the voltage-regulator mounting screws. Where noise is stubborn, rear-deck mounting of the antenna can help. These useful hints apply to any FM auto installation.

Suppression effectiveness can be checked by driving the car away from a transmitted signal to the point where "picket fencing" begins. This is the audio flutter produced in the moving vehicle as it goes out of transmitter range toward the fringe. If background noise does not become evident until the picket-fencing level is approached, suppression is effective. —30—

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British TV Changes Looming

By **PATRICK HALLIDAY**

Gradual change from 405- to 625-line system recommended.

THE long-awaited report of the official British Television Advisory Committee—representing government departments, broadcasting authorities, and the electronics industry—recommends a gradual change from the British 405-line system (in use since 1936) to 625-line definition with a full 8-mc. channel.

The new standards would apply at first only to projected u.h.f. stations in Bands IV (470-585 mc.) and V (610-960 mc.) but later all existing television stations in Bands I (41-68 mc.) and III (174-216 mc.) will, if the report is implemented, be converted to 625 scanning lines.

To avoid political and commercial repercussions among the 10-million owners of 405-line receivers, the British Postmaster General has emphasized that 405-line services will be continued for "many years" but has estimated that 625-line programs on u.h.f. could start by 1964.

The Committee, backed by the research facilities of the *British Broadcasting Corporation*, has been carrying out field trials with a 10-kw., 650-mc. vision transmitter radiating a 5-mc. video channel, as widely used in continental Europe and Australia. It is reported that although the 625-line pictures did not prove, on over-all assessment, to differ significantly from 405-line pictures, there was marked reduction in the visibility of the scanning lines. The Committee believes that by adopting a 5.5-mc. video bandwidth with a 1.25-mc. vestigial sideband, requiring an 8-mc. channel—as at present used in some Iron Curtain countries—the picture would show a definite over-all superiority over the existing ones.

Even higher definition pictures, for example, the French 819-line, 13-mc. channel ones, have been rejected on the grounds that the wide bandwidth would reduce drastically the number of possible programs. A major advantage of the 625-line system is that it would facilitate the international exchange of programs along the Eurovision network. At present, all programs coming into or going out of the United Kingdom are passed through "standard converters" with resulting degradation of picture.

There seems little chance of British viewers seeing regular color programs for a long time to come; the Committee which has been experimenting with a 405-line color system adapted from NTSC standards has now urged that plans for color service be delayed. —30—

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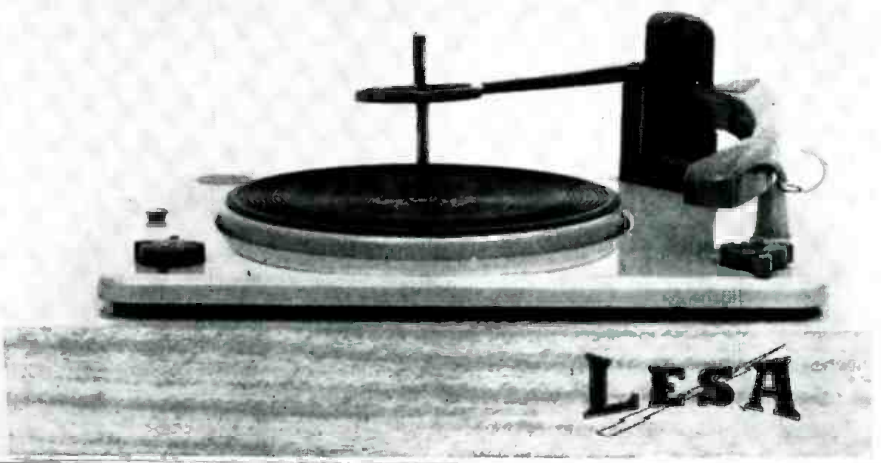

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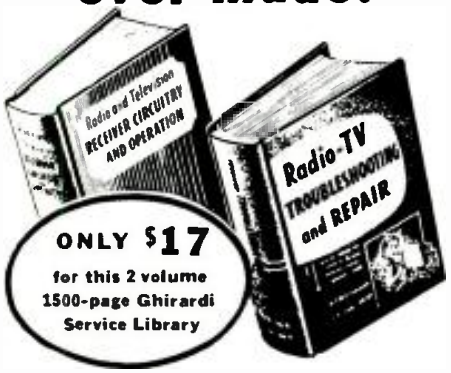

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Home-Built Speaker System

(Continued from page 63)

If the mid-range speakers are used, a suitable crossover at about 700 cps is required. Fig. 4 shows one such network which provides a 6 db-per-octave attenuation. Further details as to network construction can be found in the "References" at the end of the article. An "L" pad should be used with the mid-range speakers since they are more efficient than the woofers and require some attenuation for proper balance.

When wiring the speakers together they must be properly phased. The woofers can be phased together since their polarity is known. The same is true for the mid-range speakers. However, when the tweeter or mid-range system is combined with the woofers, the phasing can be accomplished by working with two systems at a time. The tweeter is connected to the woofers and the leads to one reversed until the sound seems most natural. Probably the easiest way to do this is by using a test record of speech or a single instrument and reversing the leads to one of the speaker systems until the sound seems to come from a single source instead of two distinct sources.

Results

As with all speaker systems, the proof of the sound is in the hearing. Test curves show little since so many factors enter into the over-all performance of a system. The author feels that the system described here sounds almost as well if not as well as the medium-priced commercial systems. Tests were made with speech and piano, the acid test of any speaker and they sounded exceptionally well. Steady-state frequency response is indicated in Fig. 2. This curve is only qualitatively meaningful since so many factors enter into recording responses of this type and they must not be regarded as a definite criteria of speaker performance. The response curve shown in Fig. 2 was made using the woofers and electrostatic tweeter without the mid-range system. The mid-range system smooths the mid-region slightly but the woofer and tweeter alone seem adequate.

Since the acoustic spring is stiffer than the mechanical springiness of the cone itself, the speaker system will be somewhat inefficient compared to conventional systems. However, in return for a loss in efficiency, the performance is more linear and tighter. A 20-watt amplifier will prove adequate and one of half that power will drive this system. However, in order to have reserve power on the peaks and minimize distortion, the more power the better, and 60 watts is not too much.

REFERENCES

1. Hitchcock, R.: "A Survey of Crossover Networks," *Audio Engineering*, November, 1956.
2. Cohen, A. B. and Cohen, P. D.: "Hi-Fi Crossover Network Design Charts," ELECTRONICS WORLD, *May, 1959.*

—30—

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Don't Underrate Transistors

(*Continued from page 53*)

tion rating if the ambient temperature is kept below 25°C.

One method of lowering the ambient temperature is to mount the transistor on a suitable heat sink and then immerse the entire assembly in ice water to a point just short of shorting out the transistor leads. Many mechanical arrangements can be devised to obtain this type of ice bath, and with it, it is possible to maintain an ambient temperature of 0°C (32°F).

The maximum allowable collector dissipation with a depressed ambient temperature can be determined by substituting the appropriate values in equation (2).

$$P_c = \frac{65 - 0}{0.065}$$

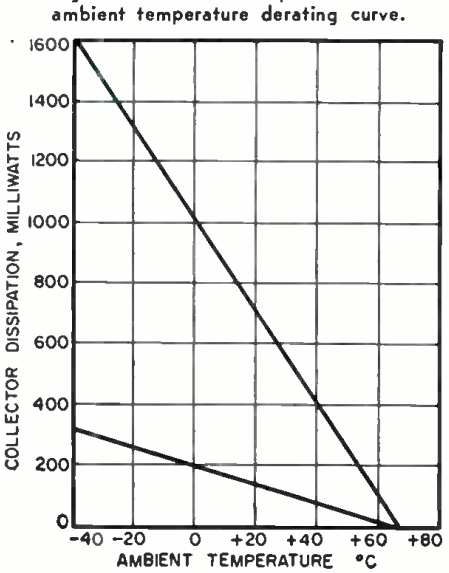
$P_c = 1000$ mw.

These calculations indicate that it is possible to operate the transistor with a collector dissipation of 1 watt if the ambient temperature is 0°C. The new value of k for operation with a heat sink was obtained from Table 1. Of course, for continuous operation precautions must be taken to insure that the 0°C ambient temperature is maintained. Fig. 5 shows the output characteristic curves with the 1-watt power dissipation curve.

Since the power output of a transistor power amplifier is approximately equal to collector dissipation times collector efficiency, any increase in collector dissipation without exceeding the manufacturer's absolute maximum ratings results in increased power output.

Many manufacturers, rather than providing the values for k, give a *collector dissipation—ambient temperature* derating curve. Fig. 6 is such a curve for the transistor described in Table 1. From this curve it is possible to read the allowable maximum collector dissipation in milliwatts for any ambient temperature. -30-

Fig. 6. Collector dissipation versus ambient temperature derating curve.



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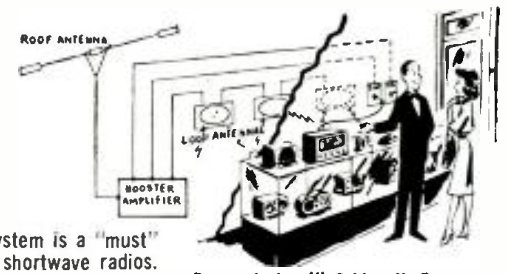

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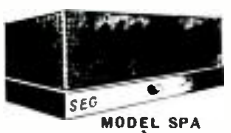

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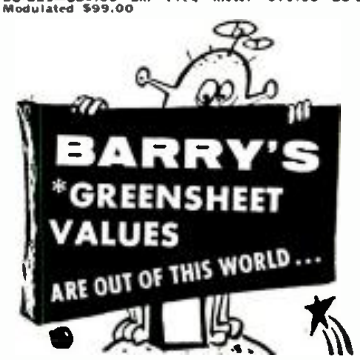

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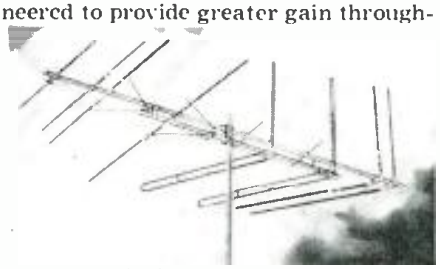
What's New in Radio

"T-BIRD" ANTENNA

Technical Appliance Corporation, Sherburne, N. Y. has developed an improved broad-band yagi which is being marketed as the *Taco* "T-Bird."

The new antenna has been engineered to provide greater gain throughout channels 2 through 13 and an improved pattern which virtually eliminates all side lobes, resulting in cleaner, sharper pictures on the TV receiver screen.



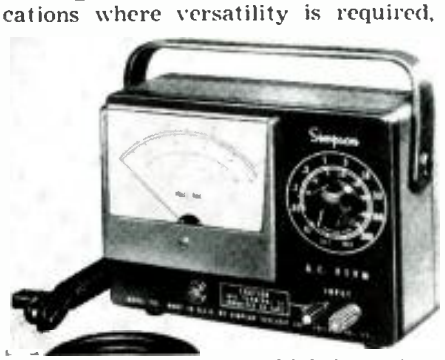
Among the electrical features are a T-match system which provides electrical coupling for both the high and low band, completely eliminating "deadening" on any channel in the v.h.f. band. Also incorporated is the new signal injector which maintains electrical stability throughout the v.h.f. frequency range. The "T-Bird" utilizes multiple driven elements for higher gain and better impedance match to the transmission line. All parasitic elements are electronically tuned to operate on every channel.

The antenna is currently available in three models. The company will supply a data sheet giving complete details on request.

NEW A.C. V.T.V.M.

Simpson Electric Company, 5200 W. Kinzie St., Chicago 44, Ill. has added the Model 715 a.c. vacuum-tube voltmeter to its line of test instruments.

Designed for general-purpose applications where versatility is required,



the instrument features high input impedance, multi-voltage ranges, and wide frequency response, making it suitable for hi-fi and general low-level work such as hum and ripple measurements as well as for i.f. gain and vibration analyzing.

The new unit measures a.c. sine-wave voltages from 0.2 millivolt through 300 volts r.m.s. with frequency response 10 cps through 400 kc. A specially designed meter scale provides decibel markings on both the voltage-range positions and the meter scale.

A data sheet on the Model 715, giving complete specifications, is available on request.

BETA TESTER

The Hickok Electrical Instrument Company, 10514 Dupont Ave., Cleveland 8, Ohio has announced the development of a versatile dynamic *beta* transistor tester, the Model 870.

The new unit tests transistors according to manufacturers' specifications. Collector current and collector voltage can be varied to provide the proper conditions for correct *beta* measurements.

The tester measures large-signal d.c. *beta* on power transistors as well as small-signal a.c. *beta* on low- and

medium-power units. Collector test current is variable up to 2 amperes, permitting measurements of power transistors.

The instrument has three I_{cbo} ranges and two *beta* ranges. Setups can be made quickly on the easy-to-read panel. Settings for over 1500 popular transistors are included on the built-in roll chart.

"FLEXI-CORE" TRANSFORMERS

Sylvania Electric Products Inc., Ipswich, Mass. has introduced a new type of electrical transformer which is smaller and lighter than conventional types with identical operating characteristics.

Tradenamed "Flexi-Core," applications for the new transformer range from the home to the launching pad. The heart of the new transformer is a formed core that consists of nests of laminations, or layers, of fabricated steel strips from a continuous roll. Each of these cores consists of two "U"-shaped nests of strips; two nests

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SPECIFICATIONS

Superheterodyne Receiver with the 1000 DK has RF Stage. One micro volt sensitivity, over two watts Audio Transmitter 5 Watts of RF. 100% AM Modulated. 40 to 80 Ohms Antenna Output. Power Transformer operates on 6VDC, 12VDC and 117VAC. All units can be operated as base or mobile.

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are fitted together, with the strips at the top of the "U's" interleaved. The resulting unit is a hollow rectangle, square, or other shape. The flexibility of core design permits transformers to be engineered for specific applications rather than circuits designed around existing transformers.

Inquiries regarding this new component should be addressed to Dept FT of the company.

TWO-METER CONVERTER

American Electronics Co., 178 Herricks Road, Mineola, N. Y. is now marketing a two-meter converter in both kit and wired versions.

The converter is crystal-controlled and features a 6ES8 high-gain, low-noise cascode first r.f. amplifier, a 6U8A second r.f. amplifier and mixer, and a 6J6 oscillator-multiplier.

Spurious and image rejection is better than 70 db while the noise figure is better than 4 db. Gain is said to be in excess of 30 db while i.f. rejection is over 100 db. Power requirements are 30 ma. at 100 to 150 volts d.c. and 1.26 amps. at 6.3 volts which can be obtained from the companion receiver or from the company's model PS-1 power supply which is housed in a matching chassis.

A data sheet on both the 2-meter and 6-meter converters, available from the company, will be forwarded on request.

LINE VOLTAGE REGULATOR

Vidaire Electronics Mfg. Corp., 44 Church St., Baldwin, N. Y. has introduced its Model LR-10 voltage regulator. The device is designed to restore proper operating voltage to equipment when the line voltage varies up or down from the nominal 117-volt rating.

The LR-10 is said to provide a full 350 watts without undue heating. A four-position slide switch may be used to increase or reduce line voltage by 10 per-cent, feed line voltage direct, or shut off the equipment. Additional data is available on request.

PROGRAMMER FOR PC'S

The Industrial and Automation Division, *Radio Corporation of America*, 12605 Arnold Avenue, Detroit 39, Mich., has developed a high speed tape-controlled unit which is capable of punching up to 10,000 holes per hour in printed circuit boards. The unit will handle boards up to 6" wide x 18¼" long, as well as multiples of sheets which can be held in the same plane by means of suitable fixtures. All holes are accurately punched on 1/10" coordinates without breakout.

The new programmer involves a perforated tape which may be prepared simply and easily. The tape, 12" wide x 36" long, is ruled in ⅕" coordinates and perforations are made with a dinking

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die at selected intersections to conform to the desired pattern. A vacuum head pickup on the reader bar eliminates the need for precise location of the holes in the tape.

The punching cycle is automatic. The punch head contains 59 free-floating punches .052" diameter for component insertion and one with a .105" diameter for the locating or processing hole. Spacing of the .052" holes is 1/10" which establishes the cross grid. Indexing rate is 180 per minute.

3-IN-1 TESTER

Mercury Electronics Corp., 77 Searing Avenue, Mineola, N. Y. is now offering a "three-in-one" instrument as its "Model 300 Combination Tester."

"The unit incorporates a versatile multiple-socket tube tester, a CRT tester-reactivator, as well as a volt-

ohmmeter (20,000 ohms per volt). The tube tester checks emission of over 700 tube types, checks for interelement shorts and leakage, checks for gas content, and each section of multipurpose tubes.

The CRT-tester-reactivator tests the quality of every black-and-white or color picture tube (including 110-degree tubes) from 8" to 30". It will test each color gun separately as well as for interelement shorts and leakage up to 1 megohm. There is a separate short test provided for each element in the picture tube. Reactivation is seen and controlled on the meter as it takes place, eliminating the danger of stripping the cathode of the oxide coating.

The unit comes in a hand-rubbed oak carrying case with detachable cover. It measures 17½"x13⅛"x4½".

PROXIMITY PICKUP

Electro Products Laboratories, 4500 N. Ravenswood Ave., Chicago 40, Ill. has announced a new miniature pickup for use as a sensing unit in proximity control systems.

Designated as model 4912-AN, this unit is reported to detect metal parts having a diameter of less than 1/10 inch whether they are stationary or moving past the pickup at a rate of 60,000 per minute. Additional information may be obtained from the manufacturer.

ANTENNA FOR MARINE CB

Mark Mobile Inc., 5441 Fargo Ave., Skokie, Ill. has developed a new antenna which has been specifically designed for class D marine CB use.

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The "Heliwhip" antenna, Type HW-11-6M, has been engineered for boats made of fiber glass or wood where a conventional quarter-wave type of antenna would otherwise require radial wires or a large metal surface.

The HW-11-6M is 6 feet long and operates in half-wave resonance, with a unique impedance launcher-matcher cable section. It can be mounted virtually anywhere that is convenient and may be connected by any length of 50-ohm coax to the transceiver equipment.

Write the manufacturer for a four-page spec sheet on this and other CB antennas in the line.

CB CRYSTAL METER

Seco Electronics Incorporated, 5015 Penn Ave., So., Minneapolis, Minn., is now offering a compact tester designed especially for use with class D CB and other crystal controlled two-way radio equipment.

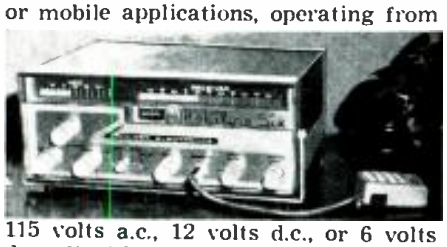
The Model 500 CB test set is said to cut servicing and installation time and be capable of handling both transmitters and receivers. It will check crystal activity on third-overtone transmitter crystals with a visual indication on a separate output meter scale, and check fundamental types and third-overtone receiver crystals at the fundamental frequency.

Completely self-contained and portable, the Model 500 is powered by a 1.5-volt "C" battery. It measures 2¼" x3¼"x6¼" and is fully transistorized. It comes complete with 15-foot remote cable and "C" battery.

6-METER MOBILE TRANSCEIVER

Globe Electronics, Inc., 22-30 South 34th Street, Council Bluffs, Iowa is now marketing a new mobile 6-meter transceiver which has been tradenamed the "Mobiline Six."

This compact transmitter and receiver can be adapted for either fixed or mobile applications, operating from



115 volts a.c., 12 volts d.c., or 6 volts d.c., all with the power supply provided. The unit weighs only 20 pounds and measures 5"x12"x12".

The receiver portion uses seven tubes, including an r.f. stage delivering better than 1-μv. sensitivity. A squelch control is also provided. The transmitter section features internal v.f.o. which is voltage-regulated and shock-mounted to provide maximum stability under mobile conditions. The 2E26 final amplifier stage is conservatively rated at 20 watts input power. Other features

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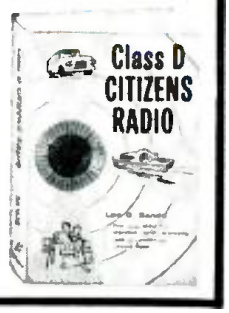

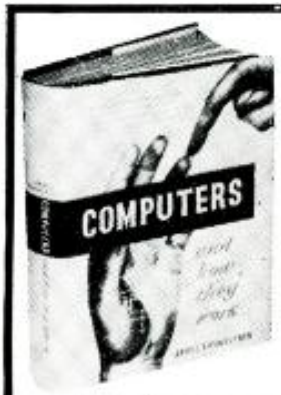

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Here is a fact-filled exciting guidebook to the wonderworld of electronic computers, with more than 110 illustrations and easy-to-follow tables in 10 big chapters. Step by step, you'll see and understand the workings of many types of computing machines. This important new book illustrates the basic principles of computers in methods that require no knowledge of electronics. You'll learn all about computer memories, flip-flops and the binary counting system. You'll learn the mathematical language of computers where 1 + 1 = 10. Other chapters show you how computers use tubes and transistors to make complex logical decisions in thousandths of a second. COMPUTERS AND HOW THEY WORK is must reading for career minded students and for electronics pros who want a more complete knowledge of this field. **$4.95**

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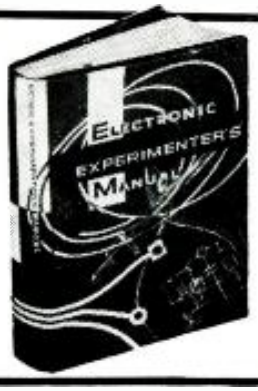

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Just as a reminder, the Editors of ELECTRONICS WORLD are always interested in obtaining outstanding manuscripts, for publication in this magazine, covering the fields of audio and high-fidelity and radio-TV-industrial servicing. Articles in manuscript form may be submitted for immediate decision and projected articles can be outlined in a letter in which case the writer will be advised promptly as to the suitability of the topic. We can also use short "filler" items outlining worthwhile shortcuts that have made your servicing chores easier. This magazine pays for articles on acceptance. Send all manuscripts or your letters of suggestion to the Editor, ELECTRONICS WORLD, One Park Avenue, New York City 16, New York.

Answer to Puzzle
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CALENDAR of EVENTS

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SEPTEMBER 7-9

First Joint Automatic Control Conference. Sponsored by ISA, AIChE, AIEE, ASME, IRE. Massachusetts Institute of Technology, Cambridge, Mass. Contact Dr. James Mozley, Johns Hopkins University, Baltimore, Md., for details.

SEPTEMBER 7-11

1960 New York High Fidelity Show. Sponsored by Institute of High Fidelity Manufacturers, Inc. New York Trade Show Building, N.Y.C. Open to public: Adults, $1.00; children under 12, 50 cents.

SEPTEMBER 11-17

Reliability Training Conference. Sponsored by IRE and American Society for Quality Control. Dallas-Ft. Worth, Tex. Contact Henry Schifflett, Texas Inst., Box 3-12, Dallas, Texas.

SEPTEMBER 14-15

Fourth Annual Joint Military-Industrial Electronic Test Equipment Symposium. Sponsored by Office of Director of Defense Research and Engineering and Dept. of Army Signal Corps. Armour Research Foundation, Chicago. Inquiries should be addressed to R. Brausch, conference secretary, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

SEPTEMBER 15-17

Upper Midwest Electronic Conference. Minneapolis Auditorium, Minneapolis. Open to purchasing agents, engineers, distributors, factory reps, and manufacturers. Write the conference at 1915 Hiawatha Ave., Minneapolis.

SEPTEMBER 19-21

1960 National Symposium on Space Electronics and Telemetry. Sponsored by PGSET of IRE. Shoreham Hotel, Washington, D. C.

SEPTEMBER 23-25

Ninth Annual Chicago High Fidelity Show. Sponsored by International Sight and Sound Exposition, Inc. Palmer House.

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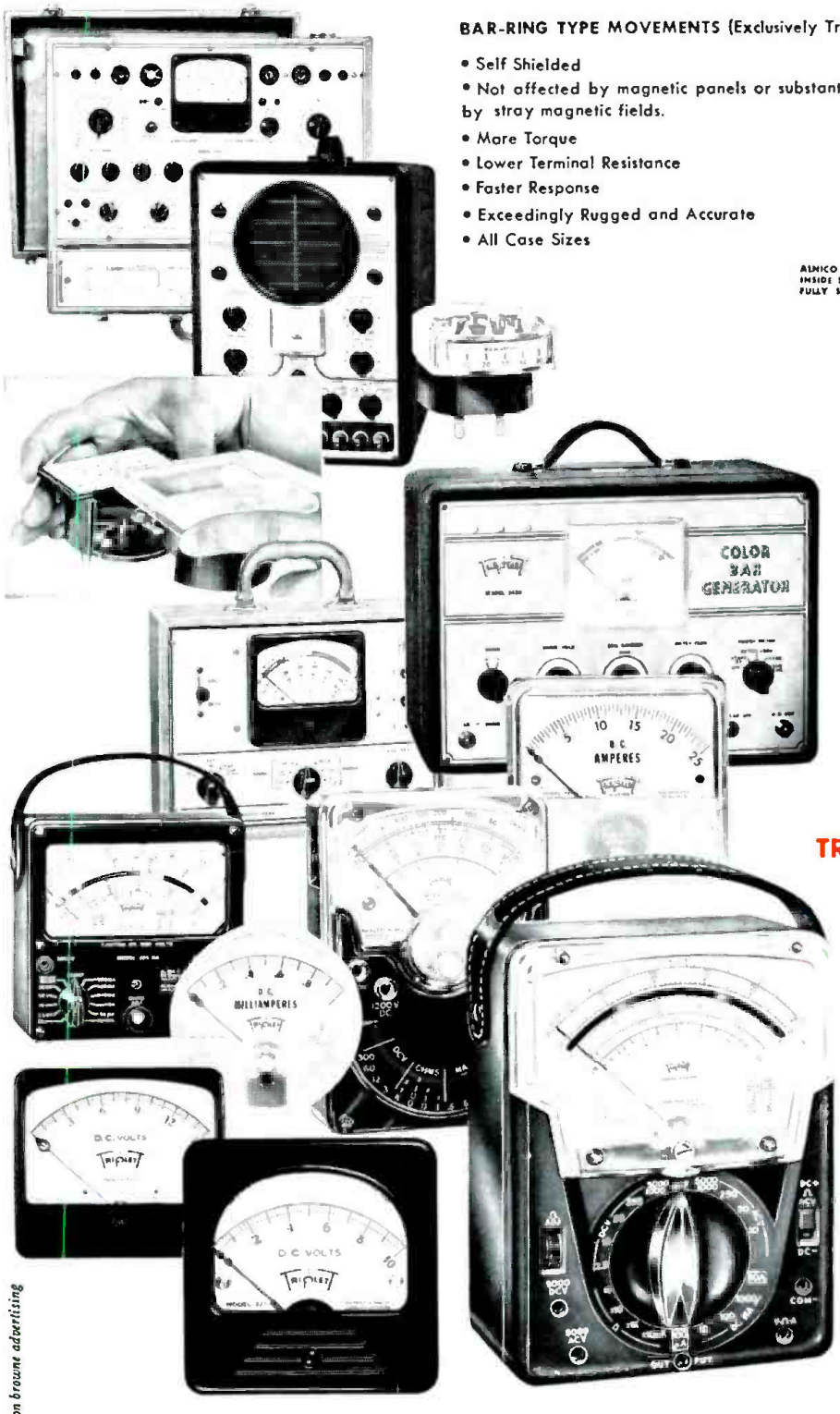

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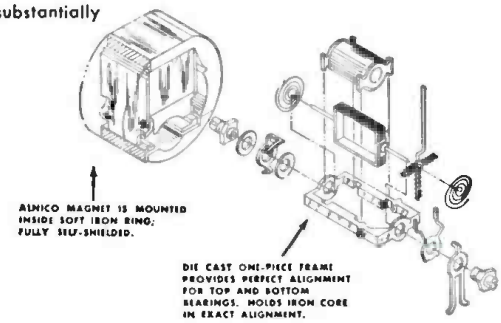

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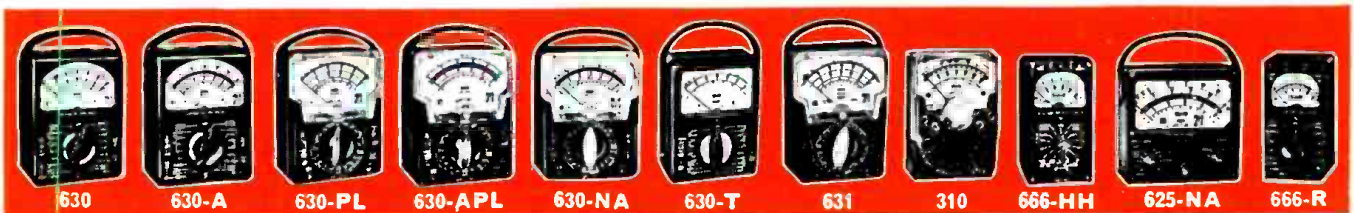

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