TELE-TECH

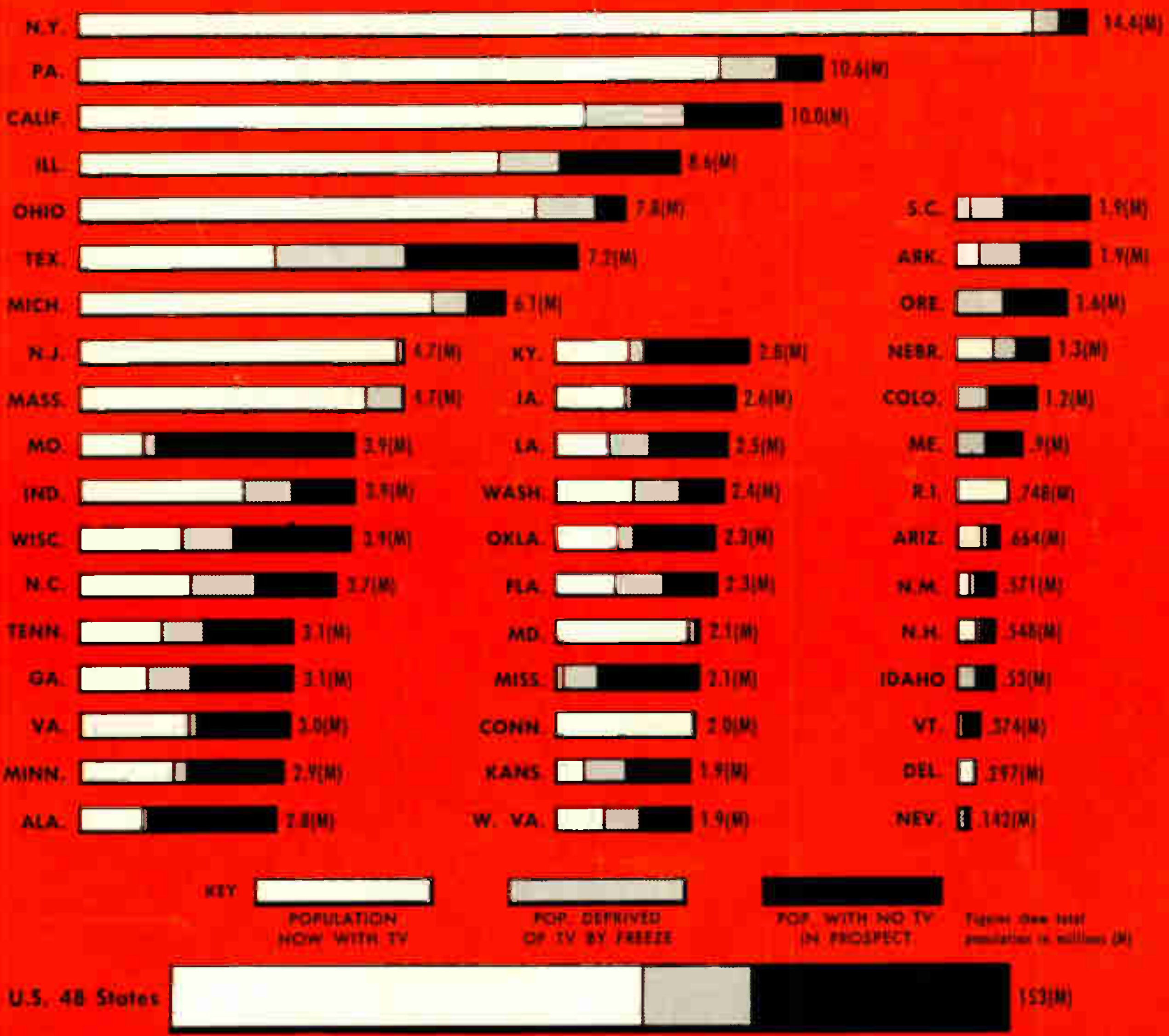
Formerly ELECTRONIC INDUSTRIES

TELEVISION • TELECOMMUNICATIONS • RADIO

IN TWO PARTS • PART ONE

April • 1950

CALDWELL-CLEMENTS, INC.



HOW TV "FREEZE" AFFECTS STATES' POPULATIONS

1950 NAB Chicago Convention

Speech and Music Recorder Specifications

Precision Reference Voltage Power Supply

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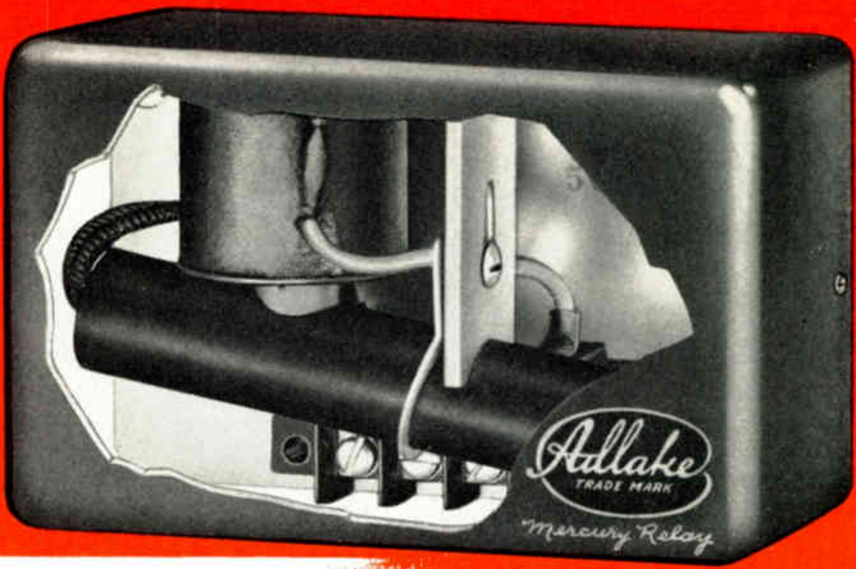
ONLY 7 MILLIAMPERES IN COIL CONTROLS 5-AMPERE CONTACT!

New ADLAKE *No. 5000* SENSITIVE RELAY



Because of its amazingly high load-input ratio, the No. 5000 relay operates at 115 volts 60 cycles on *only 0.007 ampere*—a fraction of the current consumed by any other type of mercury relay! With this low amperage operating the coil, the contacts will handle 5 amperes at the same voltage! And tests indicate the No. 5000's life to be over *30 million operations!*

Designed especially for sensitive thermo-regulation, it is ideally suited for use in electronic tube circuits where the output of the tube is limited. It can be used as a pilot relay operating from a very sensitive thermo-regulator—serves equally well for high and low temperature control—and functions perfectly with either mercury-and-glass or bi-metal regulators.

FOR FULL INFORMATION on this sensational relay, write The Adams & Westlake Company, 1117 N. Michigan, Elkhart, Indiana. No obligation, of course.

Every ADLAKE Mercury Relay Brings You These Advantages!

- **Hermetically sealed—(dust, dirt, moisture, oxidation and temperature changes can't interfere with operation)**
- **Silent and chatterless**
- **Requires no maintenance**
- **Absolutely safe**

THE
Adams & Westlake
COMPANY

Adlake TRADE MARK

Established 1857 ELKHART, INDIANA New York • Chicago

Manufacturers of Hermetically Sealed Mercury Relays for Timing, Load and Control Circuits

TELE-TECH

Formerly ELECTRONIC INDUSTRIES

TELEVISION • TELECOMMUNICATIONS • RADIO

Edited for the 15,000 top influential engineers in the Tele-communications industry TELE-TECH each month brings clearly written, compact, and authoritative articles and summaries of the latest technological developments to the busy executive. Aside from its engineering articles dealing with manufacture and operation of new communications equipment, TELE-TECH is widely recognized for comprehensive analyses and statistical surveys of trends in the industry. Its timely reports and interpretations of governmental activity with regard to regulation, purchasing, research, and development are sought by the leaders in the many engineering fields listed below

•

Manufacturing

TELEVISION • FM
LONG & SHORT WAVE RADIO
AUDIO AMPLIFYING EQUIPMENT
SOUND RECORDERS & REPRODUCERS
AUDIO ACCESSORIES
MOBILE • MARINE • COMMERCIAL
GOVERNMENT
AMATEUR COMMUNICATION
CARRIER • RADAR • PULSE
MICROWAVE • CONTROL SYSTEMS

Research design and production of special types
TUBES, AMPLIFIERS, OSCILLATORS, RECTIFIERS, TIMERS, COUNTERS, ETC. FOR LABORATORY • INDUSTRIAL USE
ATOMIC CONTROL

Operation

Installation, operation and maintenance of telecommunications equipment in the fields of

BROADCASTING • RECORDING
AUDIO & SOUND • MUNICIPAL
MOBILE • AVIATION
COMMERCIAL • GOVERNMENT

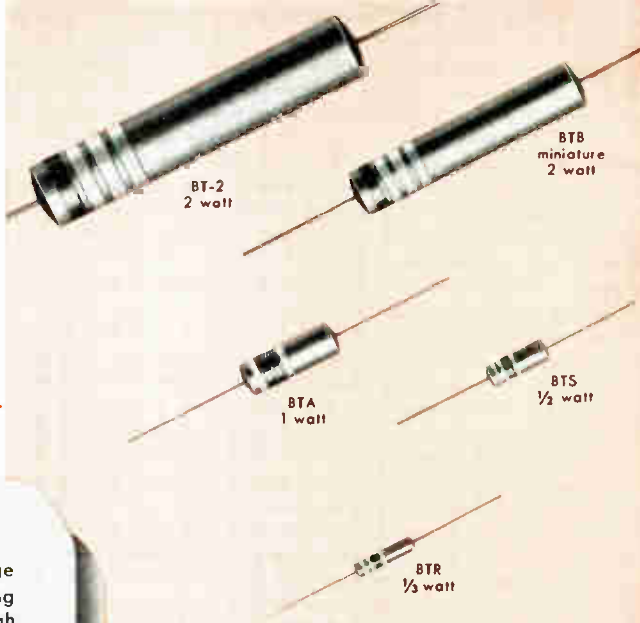
APRIL, 1950

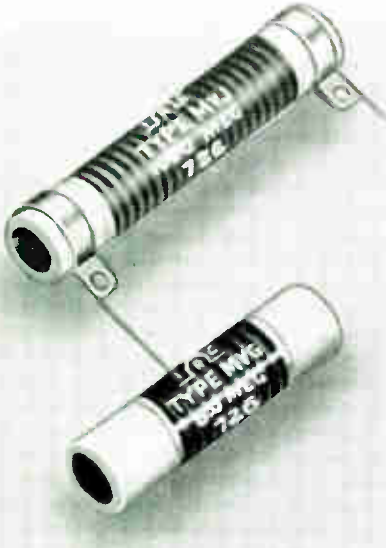
PART ONE:

CALDWELL-CLEMENTS, INC., Publication, Office, Orange, Conn., Editorial & Executive Offices 480 Lexington Ave., New York 17, N. Y., Tel. Plaza 9-7880

Publishers also of RADIO & TELEVISION RETAILING

important





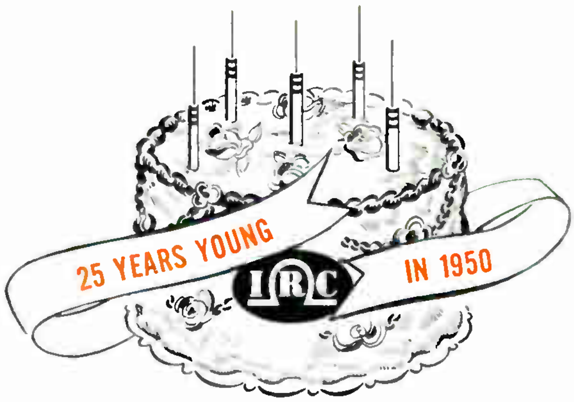
LESS THAN 3% change from original value due to aging has been proven for MV High Voltage Resistors. The resistance coating of Type MV's is stabilized at high temperature. Application of this filament coating in helical turns on a ceramic tube gives a conducting path of long effective length and permits the use of up to 100,000 volts for the MVR resistor. For high voltages where high resistance and power are required Type MV's are available in a wide range of values, sizes and terminals, all described in Bulletin G-1. Use the coupon to get your copy.

AGING IS NO PROBLEM

with Advanced BT Resistors. Filaments are pre-cured and stabilized, practically eliminating any possibility of resistance change through aging. Engineered to meet JAN-R-11 specifications for fixed composition resistors, IRC BT's have established their superiority in all important characteristics. Let us prove it to you . . . check the coupon for 12 page technical data Bulletin B-1. 21 characteristic charts compare IRC performance to rigid JAN specifications.

AFTER 10,000 CYCLES

of rotation IRC's new Q Control shows less than 10% change in resistance for values below 1 megohm, and not over 15% change for values of 1 megohm and above. Noise level after the same rigorous tests remains well within the industry standard for new controls. Investigate the many advantages of this modern size 15/16'' diameter control. Complete mechanization in manufacture assures you of absolute uniformity and a dependable source of supply. Coupon brings you full details on Bulletin A-4.



IRC

Wherever the Circuit Says —/\/\/—

Power Resistors • Voltmeter Multipliers • Insulated Composition Resistors • Low Wattage Wire Wounds • Controls • Rheostats • Voltage Dividers • Precisions • Deposited Carbon Precistors • High Frequency and High Voltage Resistors • Insulated Chokes

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INTERNATIONAL RESISTANCE CO.
407 N. BROAD ST., PHILADELPHIA 8, PA.

Please send me complete information on the items checked below:

☐ MV High Voltage Resistors (G-1) ☐ New Q Controls (A-4)
☐ Advanced BT Resistors (B-1) ☐ Name of Local IRC Distributor

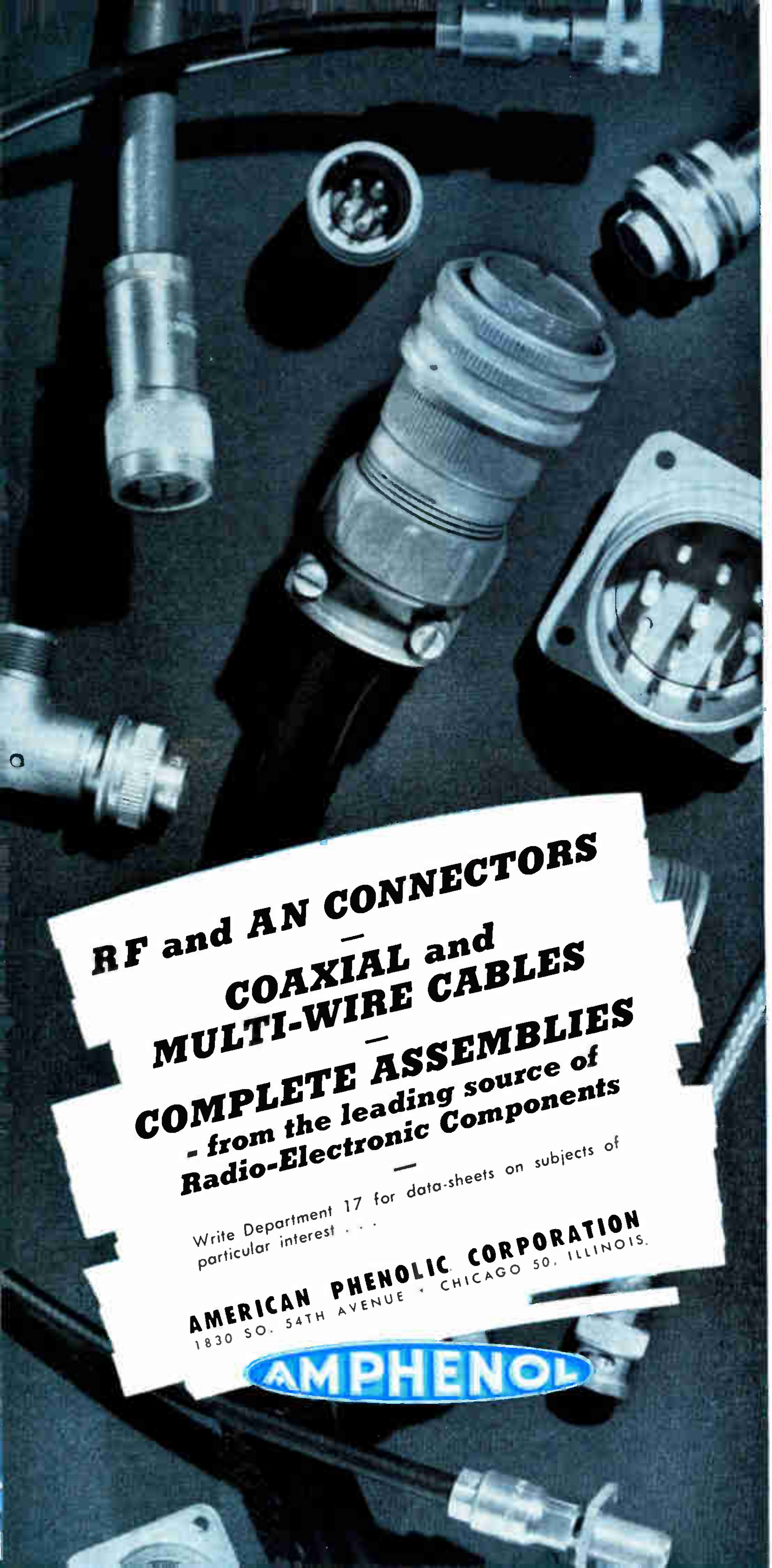
NAME ______________________________

TITLE ______________________________

COMPANY ______________________________

ADDRESS ______________________________

J. F. ARNDT & CO., ADV. AGENCY



TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

Formerly ELECTRONIC INDUSTRIES

Tele-Tech*, April 1950, Vol. 9, No. 4. 40 cents a copy. Published Monthly by Caldwell-Clements, Inc. Publication office, Orange, Conn. Editorial, Advertising and Executive Offices, 480 Lexington Ave., New York 17, N. Y. M. Clements, President; Orestes H. Caldwell, Treasurer. Subscription rates: United States and Possessions, $3.00 for one year, $5.00 for two years. Canada, $4.00 for one year, $6.00 for two years. All other countries, $5.00 for one year, $7.00 for two years. Please give title, position and company connection when subscribing. Entered as second class matter June 9, 1947 at the post office at Orange, Conn., under the act of March 3, 1879. Copyright by Caldwell-Clements, Inc., 1950. Printed in U. S. A. *Reg. U. S. Pat. Off.

TELE-TIPS

TV's $2½ BILLIONS—Infant among American industries, television already represents an investment of over two and a half billion dollars, to wit:

Five million television sets, with their installation costs, repairs, etc. make up bulk of this investment, at $400 per set, or $2,000,000,000 total.

Television dealers and distributors represent $300,000,000 with their inventories; servicers, $100,000,000.

Television manufacturers in plants and equipment total another $130,000,000. Coaxial cables, $50,000,000.

The 100 TV stations already on the air, total $50,000,000.

Add to this the huge sums the industry has spent in research, patents, FCC hearings, legal controversies, etc. and another 50 million is easily accounted for.

Combining the preceding items, we come up with a total present television investment of $2,680,000,000.

ALL PURPOSE RADIO — Increased use of radio by the petroleum industry is forecast by the grant to date of more than 800 licenses for over 6500 radio units. This type of use together with geophysical and other industrial and special services foretells wider market possibilities for makers of mobile equipment. Practically every type of industrial use is included in the latter category and ranges from auto manufacturing to farming.

SHOW THIS TO YOUR GIRL-FRIEND—Engineers have the best hearts for marriage, Dr. James Bender, director of the National Institute for Human Relations, told a convocation at the Carnegie Institute of Technology. But he warned that most engineers are shy fellows and need prodding.

He named six reasons why engineers are good prospects for lifelong Valentines:

1. They apply logic to morals, economics, science and job loyalty.
2. They are a bit shy—one-women men who don't get involved with their secretaries.
3. They are homebodies who like to putter around the house.
4. They are "tender lovers" and good parents who like large families.
5. They are the least neurotic of all vocational groups and rarely quarrel

Quality . . . Plus Adaptability
CLEVELAND

COSMALITE* AND CLEVELITE* SPIRALLY LAMINATED PAPER BASE PHENOLIC TUBES

Cosmalite is known for its many years of high quality performance. Clevelite is the new improved tubing designed to meet more exacting specifications.

"Cleveland" has an enviable record of service and dependability. Your orders receive prompt attention. Deliveries are made in time for your production schedules.

For the best . . . "Call Cleveland."

Samples on request.

*Trade Mark

Of Proven Performance in the Radio and Television fields.

Excellent for Motors, Relays Transmitters, Fans, Controls, Switches, Bobbins, and many others.

The CLEVELAND CONTAINER Co.

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PLANTS AND SALES OFFICES at Plymouth, Wisc., Chicago, Detroit, Ogdensburg, N.Y., Jamesburg, N.J.
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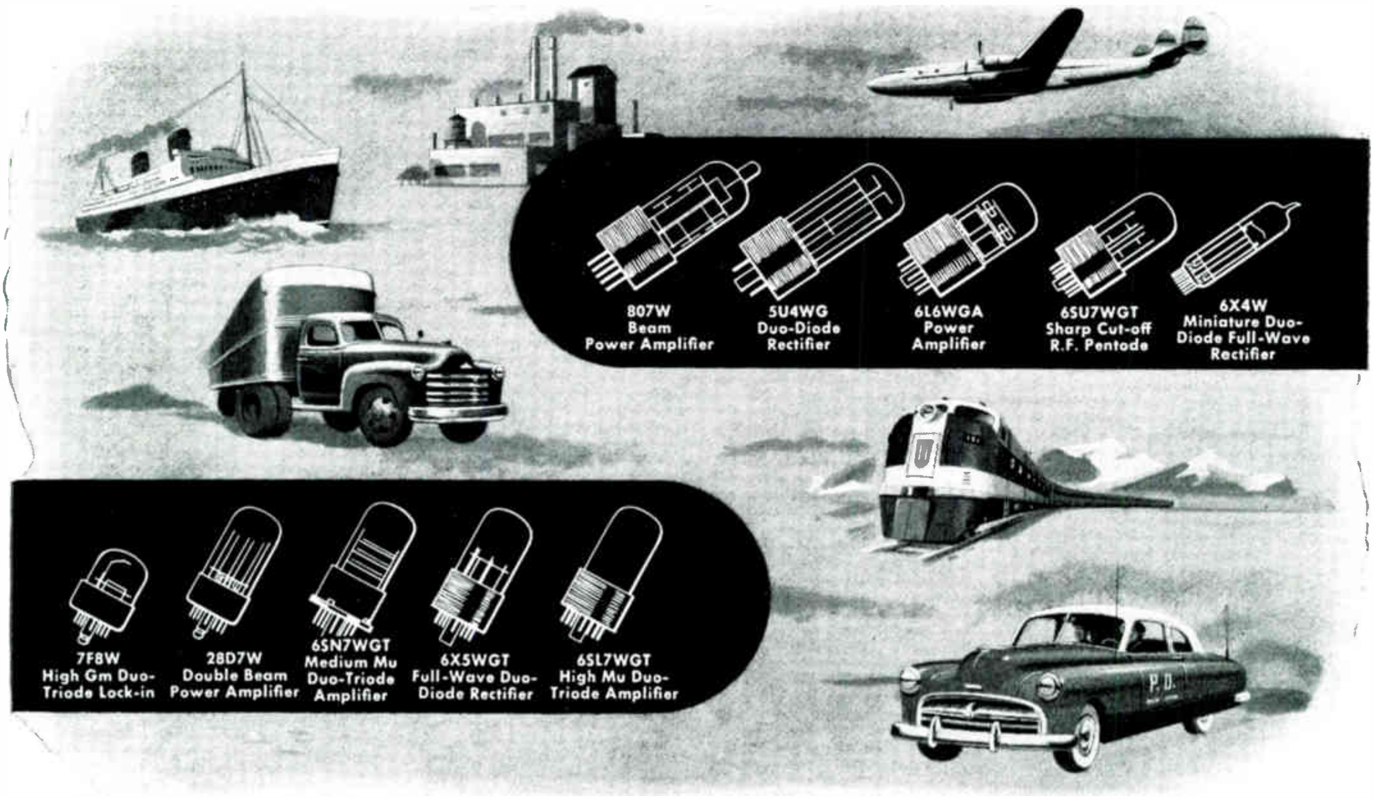
10 Times More Rugged—

New Sylvania shock-tested tubes withstand shocks greater than 400 G's



Ideal for industrial radio applications... for aircraft...buses...trains...police cars... or wherever shock and vibration are problems

Troublesome problems of tube failure resulting from shock or heavy vibration are now being solved . . . for keeps . . . by these new Sylvania "Ruggedized" or "W" tubes.

Originally designed to government specifications to withstand shock and vibration caused by artillery action, these tubes keep operating under vibration up to 2-½ G's . . . withstand shocks more than 400 times the force of gravity.

A dozen new design techniques have gone into the perfection of these tubes. More than that, they are *precision*-built from precision parts. Exhaustive lab and field tests have definitely proved them as much as 10 times more rugged than ordinary tubes. Electrical characteristics are similar to those of standard types.

Note too, their reduced overall length and their straight glass bulbs . . . features which make possible smaller and more compact equipment design.

Maximum ratings and other characteristics of these new "Ruggedized" types are available from Sylvania Electric Products Inc., Dept. R-2404, Emporium, Pa.

CHECK THESE 10 "RUGGEDIZED" FEATURES for longer life and better performance

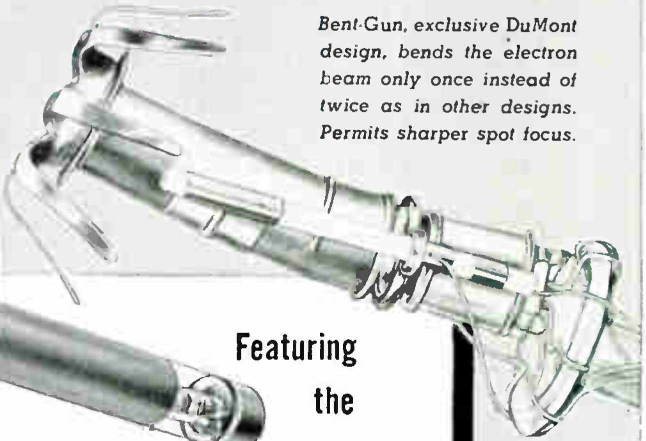
1. Double thickness micas
2. Heavier side-rod supports
3. Shorter leads
4. Straight glass bulb
5. Flat, circular header
6. Fewer internal connectors
7. Shorter elements
8. Reduced overall height
9. Additional mount supports
10. Low-loss phenolic base

SYLVANIA ELECTRIC

RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS

the new DUMONT type 12LP4A TELETRON*

New Du Mont gray face plate



Bent-Gun, exclusive DuMont design, bends the electron beam only once instead of twice as in other designs. Permits sharper spot focus.

Specifications

Overall Length	18¾"
Diameter of Bulb	12 7/16"
Useful Screen Diameter	11"
Base	Duodecal 5 Pin
Bulb Contact	Recessed Small Cavity Cap
Anode Voltage	11,000 Volts D. C.
Grid No. 2 Voltage	250 Volts D. C.
Focusing Coil Current	110 Approx. Ma D. C.
Ion Trap Current	120 Approx. Ma D. C.
Grid No. 1 Circuit Resistance	1.5 Max. Megohms

DUMONT Teletrons

FIRST WITH THE FINEST IN T-V TUBES

Featuring the

BENT-GUN

For the first time this popular tube type is offered with all the refinements of the Du Mont design.

Modification of the Bent-Gun makes possible the use of single or double magnet beam-benders thus assuring direct interchangeability with other 12LP4's, yet assuring that extra sharpness possible only with the Du Mont gun structure.

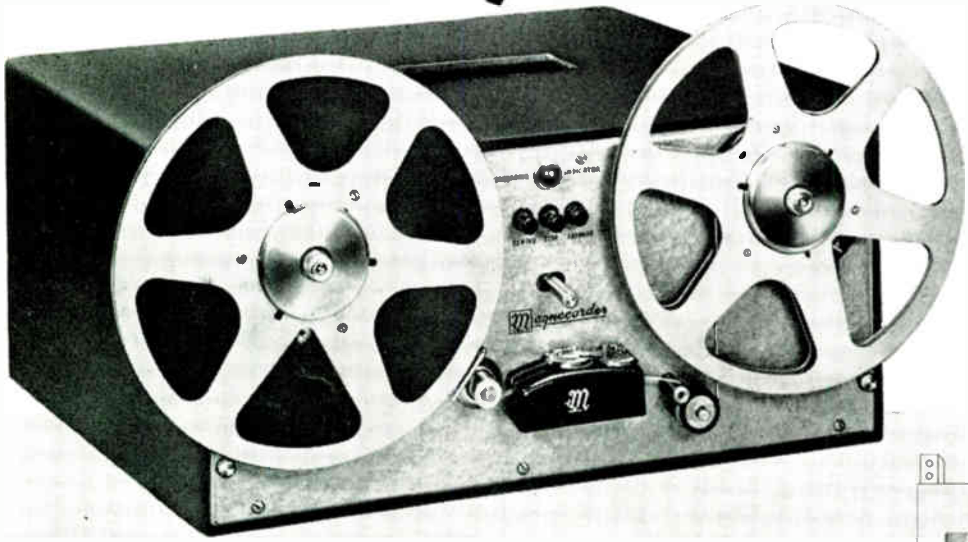
An ideal tube for improving the performance of existing receivers, using the Type 12LP4, or for incorporation in new receiver design.

Literature and quotations on request

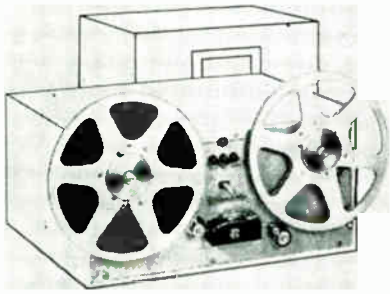
*Trade-Mark

ALLEN B. DU MONT LABORATORIES, INC., Tube Division, Clifton, N. J. Plants at Allwood and Passaic, N. J.

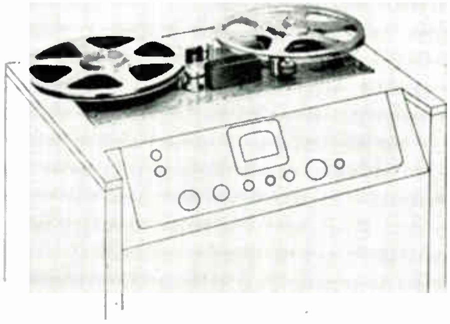
Announcing the NEW Magnecorder PT7



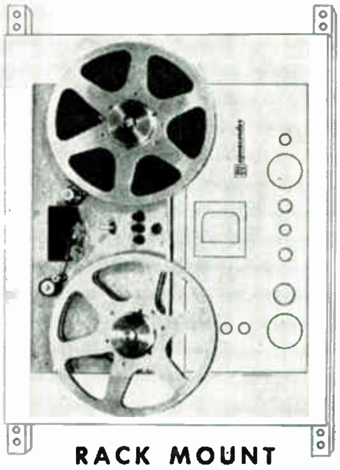
NOW ALL 3!



PORTABLE



CONSOLE



RACK MOUNT

NEW POSITIVE DRIVE

Two-speed hysteresis synchronous motor prevents timing errors, lost program time.

N.A.B. 10½" REELS

Now get long playing time even on portable equipment. No overlap on rack mount.

PT7's Greater Flexibility Means Greater Value

The PT7 Recorder Mechanism and Amplifiers incorporate Magnecord's exclusive Unit Construction. The same equipment can be used in console cabinet, rack mount, or for portable operation. New PT7-P amplifier features high-level mixing for 3 high impedance microphones.

Write For Detailed Information

Revolutionary new PT7 specifications have just been released. Write for your copy today.

Magnecord, INC.

360 N. MICHIGAN AVENUE • CHICAGO 1, ILLINOIS

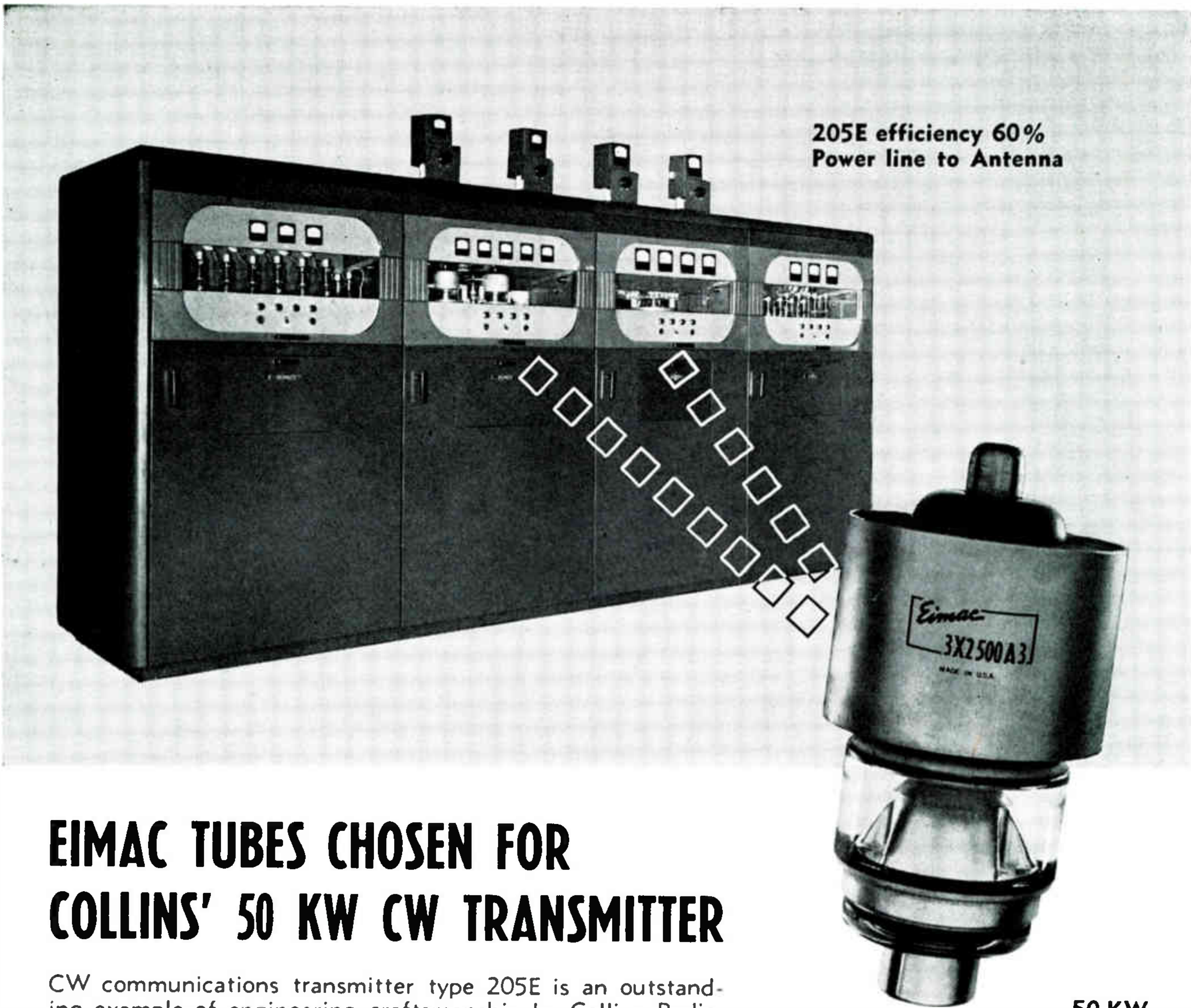
3 HEADS

Separate heads for Erase, Record, and Playback now allow monitoring off the tape.

PUSHBUTTON CONTROLS

Separate buttons for "Forward," "Rewind," and "Stop" can be operated by remote control.

World's Largest and Oldest Manufacturers of Professional Magnetic Recorders



EIMAC TUBES CHOSEN FOR COLLINS' 50 KW CW TRANSMITTER

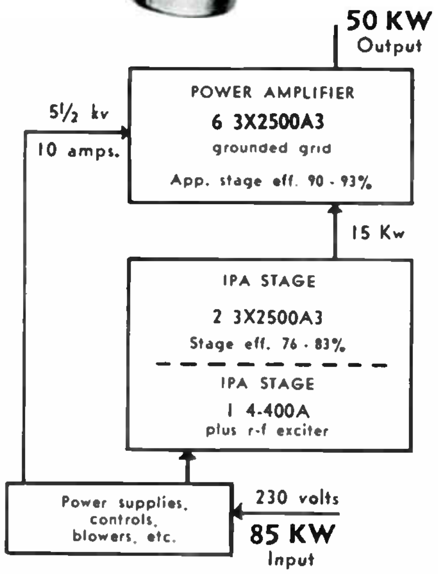
CW communications transmitter type 205E is an outstanding example of engineering craftsmanship by Collins Radio. Designed for military and civilian service between 4 and 26 Mc. the 205E will provide 50 kw CW output with remarkable economy from the standpoint of both power consumption and tube cost.

Overall efficiency of the transmitter through all stages, from the 230 volt power line to the antenna, is 55% to 60%.

Collins engineers say, "We can attribute the largest percentage of this performance to our use of Eimac tubes. The 3X2500A3 triodes operate with low filament-power, and their high power-gain and high efficiency permit economical exciting equipment. Further power saving is effected because of the simple air-cooling requirement."

You, too, can take advantage of Eimac tubes' functional design, economical operation, and higher performance.

Complete catalogues covering operational data and characteristics on all Eimac tubes are available without charge . . . write today.



EITEL-McCULLOUGH, INC.
San Bruno, California

Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

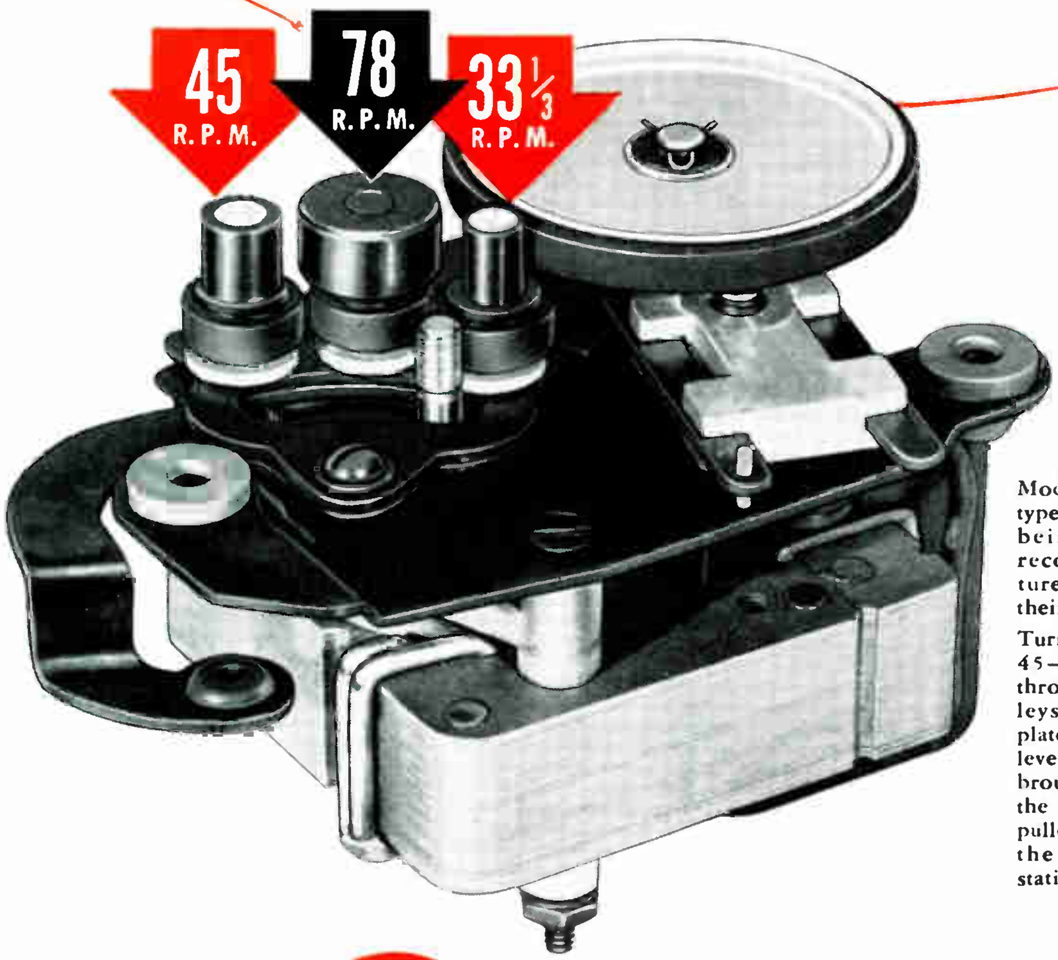
Follow the Leaders to Eimac TUBES The Power for R-F

244

GENERAL INDUSTRIES ...covers the *3-Speed* PHONOMOTOR MARKET

"A motor for *every* phonograph requirement"... this General Industries slogan is as true today as it was thirty years ago when it was first introduced. Today General Industries manufactures a complete line of single-speed, dual-speed and three-speed motors for use in every type of record player and automatic record changer.

General Industries offers you the popular belt-drive Model TS 3-speed motor for both automatic record changer and manual use, and the turret model 3-speed motor illustrated for automatic record changer applications. Write today for complete details.

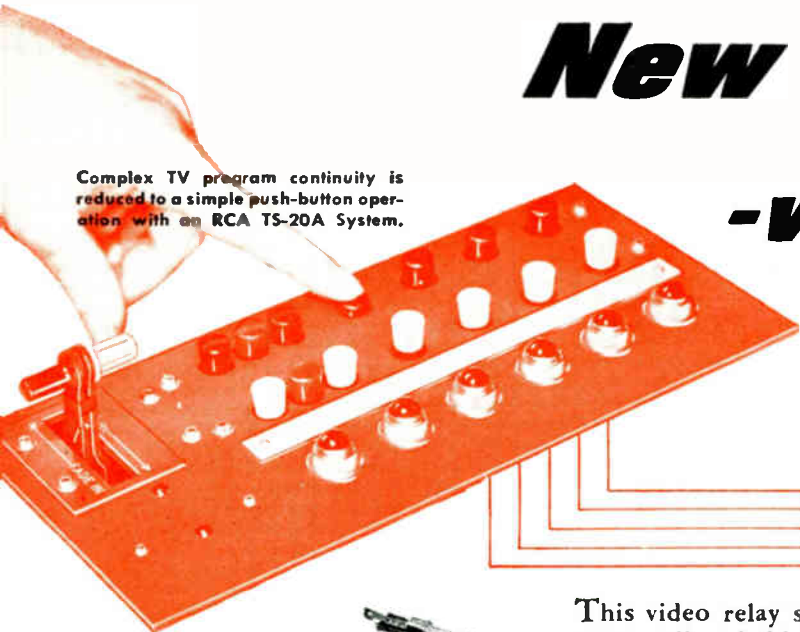


Model illustrated is a turret-type 3-speed motor currently being supplied only to record-changer manufacturers, and incorporating their own specifications.

Turntable speeds of 33⅓—45—78 RPM are secured through three separate pulleys mounted on a turret plate. By means of a simple lever, the desired pulley is brought into contact with the idler wheel. The two pulleys not in contact with the idler wheel remain stationary.

The GENERAL INDUSTRIES Co.

DEPARTMENT L • ELYRIA, OHIO



Complex TV program continuity is reduced to a simple push-button operation with an RCA TS-20A System.

New Era in Video -via REMOTE

This Relay Switching System does what RCA's Audio Relay Systems have

This video relay system removes all switching restrictions from equipment operations. It imposes no limitation on equipment installation—no matter where you set up your units. It provides unlimited flexibility—enables you to add facilities as your station grows, *without losing a penny's worth of your original equipment investment.*

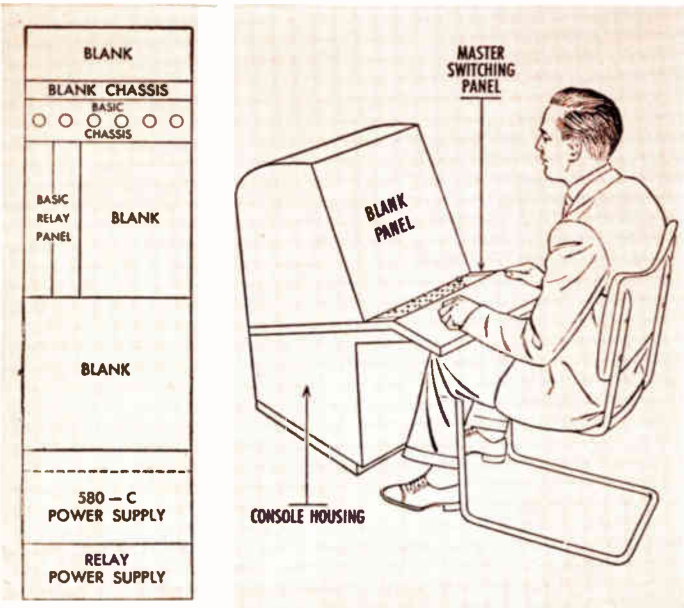
Actual switching in the RCA TS-20A system is done by d-c operated relays *located in the video line itself!* Designed by RCA for this special service, these relays are controlled by simple d-c lines from any point you choose. No expensive coaxial line required to and from control points. No extra cable connectors needed. You can rack-mount the relays wherever you want them. You can set up your control positions wherever you like. There are circuit provisions for sync interlocks and for tally lights.

The RCA TS-20 System provides complete master or studio facilities for program monitoring, production talk-back, and video switching between studio camera, film camera, remote pick-up and network programs. For example, you can fade or lap

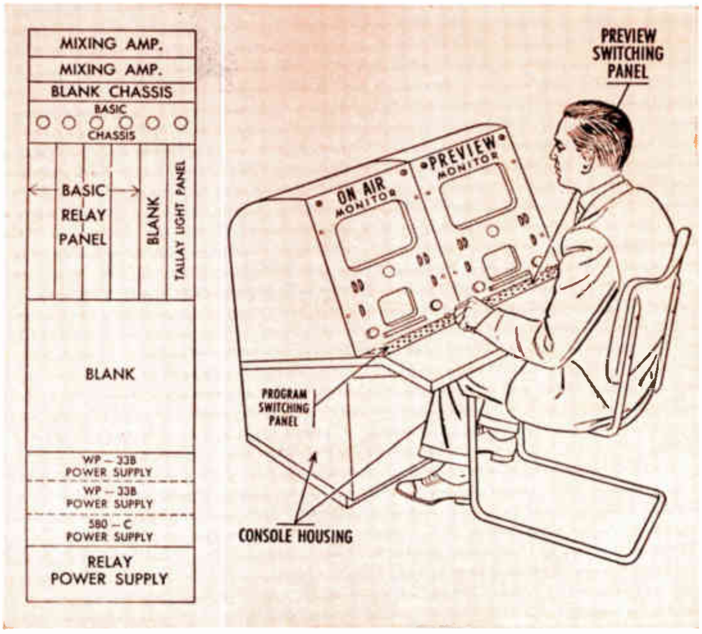
TELEVISION BROADCAST EQUIPMENT
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

3 OF THE MANY ADD-A-UNIT SET-UPS POSSIBLE WITH



1. Minimum Master Control arrangement. Combines simple operation with economy. Provides switching of 6 inputs to either of 2 outputs.



2. Simple Studio Control layout. Additional facilities include: Preview monitoring and line monitoring, fades, lap dissolves, and superimposition.

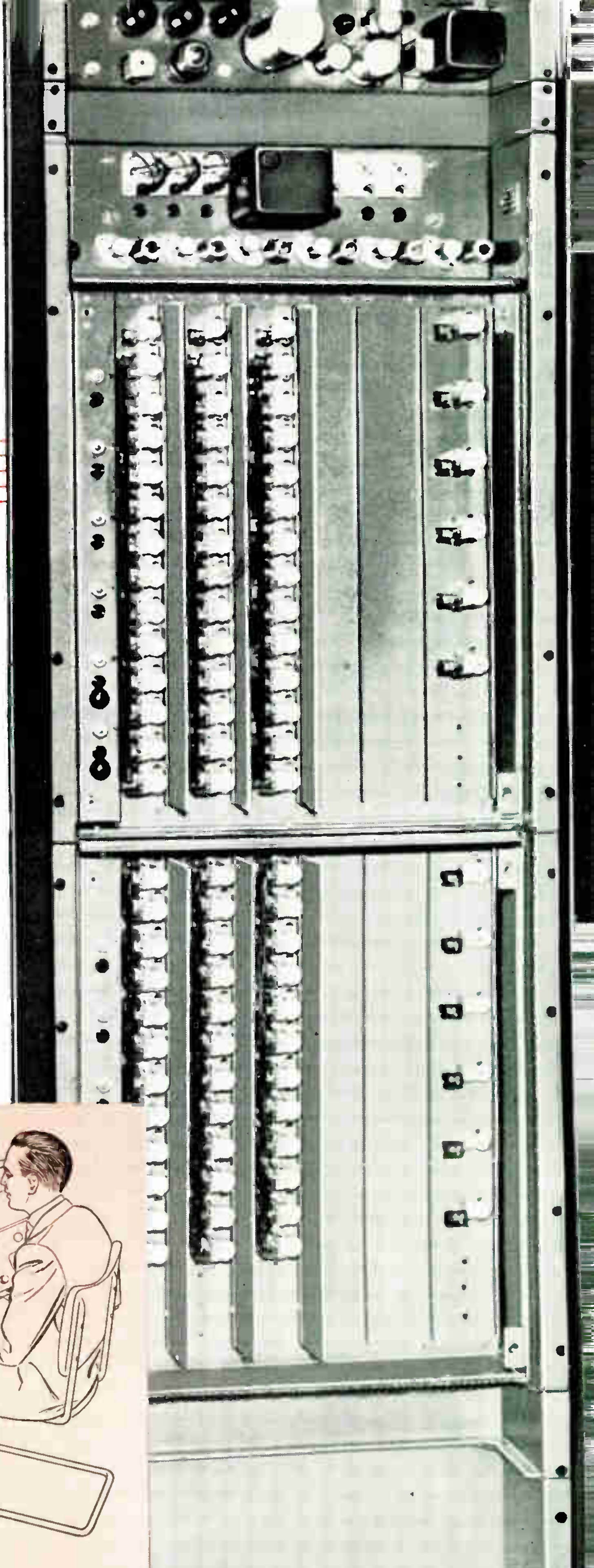
Switching RELAYS!

for TV master or studio control done for aural broadcasting.

dissolve between studios. You can set up for program previewing and other monitoring functions (up to 5 program monitors available). You can combine the TS-20A System with audio switching *and presetting*, so that the sound switches with the picture *automatically!*

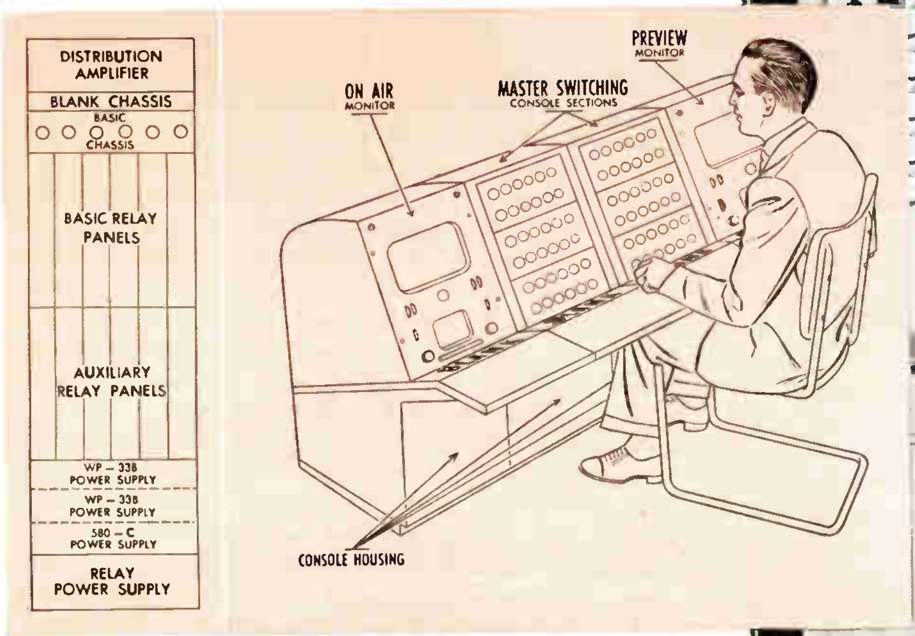
• • •

For long-range planning of your TV programming facilities, overlook none of the advantages of this revolutionary new relay switching system. Ask your RCA Broadcast Sales Engineer about it. Or write Dept. 87 D, RCA Engineering Products, Camden, N. J.



Heart of the TS-20A Switching System is the special d-c operated video relays developed by RCA. No complex electronic circuits in this system. No picture reflections. No tubes to fail. This rack also houses the amplifiers and power supplies.

RCA'S TS-20A SYSTEM.



3. A more elaborate master control room set-up than shown in No. 1. Switches any of 12 inputs to any of 5 outgoing lines. Includes preview and line monitoring.

Throughout history, scouting parties have gone out ahead of man, ahead of settlements, ahead of civilization itself. Today, Bell System scouts are engaged in a new kind of exploration — charting a path for microwaves — using equipment specially designed by Bell Telephone Laboratories.

The portable tower shown is constructed of light sections of aluminum and in a few hours may be built up to 200 feet. Gliding on rollers, the "dish," with its microwave transmitter or receiver, is quickly positioned for line-of-sight transmission, then oriented through electric motors controlled from the ground.

Test signals show how terrain and local climate can interfere with microwave transmission. Step by step, Bell's explorers avoid the obstacles and find the best course for radio relay systems which will carry television pictures or hundreds of simultaneous telephone conversations.

A radio relay link similar to the one between New York and Boston will be opened this year between New York and Chicago. Later it will be extended, perhaps into a nation-wide network — another example of the way Bell Telephone Laboratories scientists help make the world's best telephone system still better each year, and at lowest cost.

BELL TELEPHONE LABORATORIES

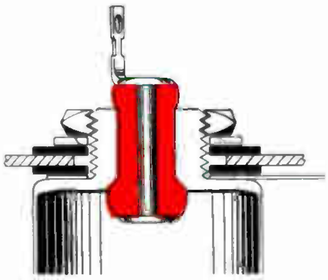
EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

Here is a cylindrical d-c paper-dielectric capacitor that remains positively sealed, regardless of the position in which the unit is mounted. The G-E Case Style 40 utilizes a deep-drawn aluminum case with double-rolled base seams, avoiding solder-seams. The silicone bushing eliminates gaskets, maintains the hermetic seal by compression alone. And beneath the case, these units embody the excellent materials and construction, give the outstanding performance characteristic of General Electric capacitors.

The Case Style 40 capacitor for direct panel mounting with solder-lug terminals, is built in these ratings:

600 volts—1, 2 and 4 mu f
1000 volts—1 and 2 mu f
1500 volts—.25, .5 and 1 mu f

This is but one case style of a complete line of d-c capacitors made by General Electric to JAN-C-25 Specifications and suitable for both commercial and armed services applications. G-E paper-dielectric capacitors are available in characteristics E (Mineral Oil) or F (Pyranol®) and in case styles 40, 53, 54, 55, 61, 63, 65, 67, 69 and 70. *Apparatus Department, General Electric, Schenectady 5, N. Y.*



This is how the silicone bushing permanently compression-seals the new G-E Case Style 40 capacitor. Note that the conventional gasket is completely eliminated. This CP-40 can be freely handled with no worries about rupturing its seal.

Please address inquiries to Transformer & Allied Product Div., General Electric Co., Pittsfield, Mass.

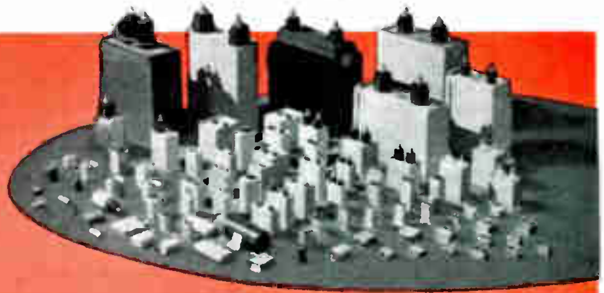
GENERAL ELECTRIC

407-165

Specialty Capacitors FOR

- Motors
- Luminous-tube transformers
- Fluorescent lamp ballasts
- Industrial control
- Radio filters
- Radar
- Electronic equipment
- Communication systems
- Capacitor discharge welding
- Flash photography
- Stroboscopic equipment
- Television
- Dust precipitators
- Radio interference suppression
- Impulse generators

AND MANY OTHER APPLICATIONS



The Newspaper that the "Savannah" delivered

The first steamship to cross the Atlantic, it is said, brought back a newspaper containing the report of a famous European scientist "proving" that practical marine propulsion by steam was impossible.

That, of course, was in the knee-pants days of the Scientific Age. Today, it would be a rash scientist who would apply any such label to a proposed development. "Unknown" or "yet to be proved" perhaps, but not "impossible." Imagination is as much a part of modern research and engineering background as physics or mathematics.

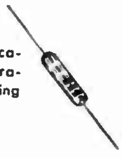
In electronics alone, a generation of progress was crowded into a few hectic war years. Products not known — for jobs that had never been done—became commonplace. Yet all of this represents only a fresh beginning . . . not an end. As in the past, Sprague research continues on the assumption that even the best of today's components are only test models for tomorrow's even more difficult assignments.

SPRAGUE PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

SPRAGUE ELECTRIC COMPANY
North Adams, Massachusetts

GLASS-TO-METAL SEALS, pioneered by Sprague, have paved the way to new and higher standards of protection and efficiency in thousands of capacitor and resistor types.

SUBMINIATURE Sprague molded Prokar* capacitors, rated for —50°C. to +125°C. operation, are playing a big part in revolutionizing the engineering of ultra-small equipment.



SPRAGUE KOOLOHM* RESISTORS, wound with ceramic insulated wire, doubly protected by outer ceramic shells, have answered one difficult resistor problem after another.

* T. M. REG.

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

O. H. CALDWELL, Editorial Director ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York (17) N. Y.

OUR TV-LESS 66 MILLIONS

FCC's "Big Frost" and How It Deprives State Populations of Television

(See Front Cover)

Until September, 1948, television was growing by leaps and bounds. The end of 1946 found six stations on the air with a potential of 52, including CP's; at the same time there were 16,000 receivers in use. 1948 was a "millenium" year for the infant industry—the millionth receiver was in the hands of the public and there was a potential of 124 television stations.

Came September, 1948, and blight was introduced innocuously by a beneficient FCC in the guide of a short hiatus or "freeze" to correct the errors in the post-war TV allocations plan. New station construction and outstanding grants declined, while the trunk of the TV industry withered. Only the young limb — receiver sales — blossomed and prospered. In the eighteen months since "the big frost" 60 stations have gone on the air and the number of CP's has dwindled from 83 to eight. When these eight are consummated — and some will probably fall by the wayside — there will be no further expansion of television service to the people of America until the bureaucrats fumble their way to a solution.

★ ★ ★

Our cover shows the status of television in the 43 states which have television service now and in those states where service was denied by reason of the freeze. White strips show state populations now getting TV, and gray strips represent the twenty million people who now would be able to receive TV in those 43 states if it had not been for the freeze. The sad plight of the remainder of the country where there is no prospect of TV is suitably indicated in black! That these many millions are without TV should comfort those radio broadcasters who fear for their AM audiences. Also pointed up is the need for a decision in the Clear Channel Case so that areas where there is neither TV nor adequate AM service at present may at least be permitted to enjoy the latter.

1950 Census figures are not yet available, but of the 153,000,000 U.S. population (or about 42,000,000 families), only 87,000,000 are within range of a TV station, leaving 66,000,000 without TV service. These latter people are as much a part of the United States of America as the favored "have" group. Denver, Colo., is an outstanding example of a major market which is denied TV, although many applicants stand ready to operate the minute a grant is made. The 400,000 people in this area have as much right to see ten-year-old movies and phony wrestling as the inhabitants of Denver, N.Y., or Denver, Ill!

★ ★ ★

We need, above all, to have the freeze lifted. Then decide about color; and while the FCC's lawyers argue about grants the industry can recommence to manufacture TV station equipment. But, the millions in the unserved areas where frustrated applicants have stood ready for many months to provide TV service, must be granted TV facilities without further delay.

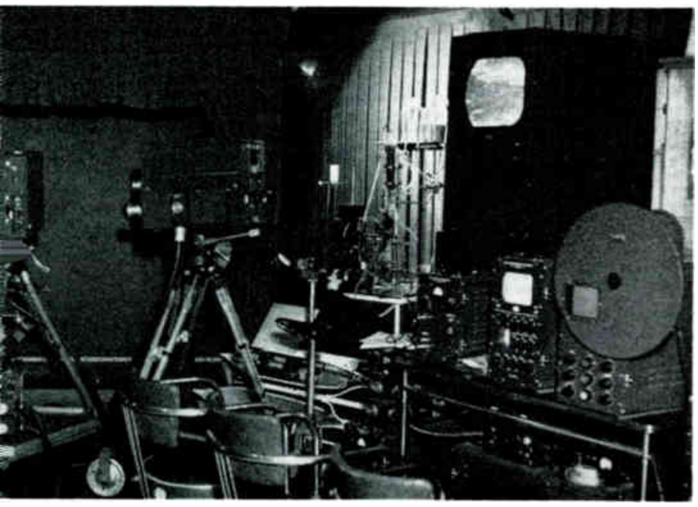
The RADARSCOPE Revealing at a Glance,

RE-ARMAMENT

$6 BILLIONS is the amount the three Armed Services plan to spend with American industry during the fiscal year 1951, beginning July 1. A large part of this will go for radio and electronic equipment, and the problem now facing the experts of the Munitions Board at Washington, is the method of computing requirements and industrial potential, in order to spend the preparedness dollar to accomplish maximum preparedness, based on the overall economy of the nation. This advance expenditure will have the effect of shortening the time before the country would be in full productive swing, in event of a war emergency.

FCC OUTLOOK

COMMUNICATIONS POLICY BOARD—Topping the FCC in power and influence, broad guideposts and policies for standards in the sharing of the frequencies of the crowded spectrum between government and private radio services in relation to the steadily growing demand, are slated to be formulated by the new Communications Policy Board in recommendations to President Truman by next October 31. There is no question but that the Board's membership knows the frequency problems thoroughly—Dr. Stewart served three years (1934-37) as FCC Commissioner; Dr. DuBridge and Dr. Everitt in their wartime work had to deal with and evaluate frequencies. Thus, the government's assignment and uses of radio frequencies as planned through the Interdepartment Radio Advisory Committee (IRAC) will receive a scrutiny by an impartial and most competent body. This should be a result of great satisfaction for all parties concerned—the proponents and critics of IRAC—because it will be a fair and unbiased survey of this government machinery for the designation of frequencies for use by the military services and the non-defense government agencies.



AIRPLANE RADIO

SAFER BLIND LANDINGS—Improved GCA equipment is now being installed in many existing and newly built airports. The first of the new installations was made in Los Angeles a few weeks ago. Built by the General Electric and Gilfillan companies, about thirty units will be provided. Although no changes in frequency have been made, power has been increased, and as much as 300 kw peak power is now used in ASR, or Surveillance Radar. Former equipment was limited to about 35 miles from the field, but aircraft have been observed at ranges of 60 miles with the improved models. As in the case of ASR, Precision Beam Radar (or PBR) power has been increased together with stability and it is now used continuously instead of intermittently.

COLOR TELEVISION

COMPOSITE standards for color television, taking the better portions of each system that is compatible with black and white video, and broad enough to allow improvement in the new art is viewed as possibly the best solution of the difficult color TV investigation of the FCC, Chairman Edwin Johnson of the Senate Interstate Commerce Committee said after he had witnessed on March 13 a highly successful demonstration of the system of Color Television, Inc. of San Francisco. The Senator, who has been responsible for generating the FCC's intense interest in color television, feels that multiple standards to permit the public to buy any of three or more systems approved by the FCC should only be a last resort.

After the March 13 showing, Senator Johnson stated that "no one can discount the CTI system after this demonstration." CTI, using standard projection television receivers and regular telecast programs from WMAL-TV, Channel 5, had a remarkably improved system compared to its previous showings.

TV PRODUCTION

MINIATURE STAGE SETTINGS—The television broadcaster continues to be hamstrung by financial restrictions, such as scenery costs, to cite only one example. If a new system of stage backgrounds, recently shown in New York City, is as successful in studio operation as it appeared to be in demonstrations, it could mean the end of heavy, expensive scenery. With this "scenery of the future" contained in a small "black box" attached to the camera lens, any bare room becomes a studio with three stage settings available.

Du Mont has color TV for industry. Picture shows color cameras and control setup for new Allen B. Du Mont Laboratories, Inc., closed-circuit industrial color TV system, shown at IRE convention, New York, last month.

All camera movements such as dolly and trucking shots are said to be possible. Although full details are not available it is believed that this "Pandora's Box" uses a combination of electrical and optical devices to superimpose miniature sets over the characters without any "bleed" or show-through when one image falls on top of another.

TV FILMS

MOVIE FANS are promised better TV movies as the result of new developments in film recording. Use of the image orthicon in place of the outmoded inconoscope produces TV pictures free from the "flare" to which the latter is heir. While resolution may not be quite as good, this is more than outweighed by the superior general appearance of the screen. Before long, this method will be in everyday use in one of the major TV network stations. Filming live shows directly on two or three cameras running continuously used in the same manner as live cameras is already proving its worth. The system first mooted by the makers of the "Auricon" camera is now used by the largest TV film studio in the country. Each camera has a capacity of 1200 feet of film, sufficient for 33 minutes filming. During editing the three films are projected simultaneously the editor calling his shots as for a live show. A synchronized film counter identifies the splicing points. The poor quality of kinesope recording is eliminated and the advantage of film is retained. A new British kinerecording camera uses continuously moving film and rotating prisms to stop movement optically, thus overcoming the problem of camera and system synchronization.

MARINE

HARBOR NAVIGATION—Radar, the war baby that has been adopted in numerous peacetime pursuits, is still suffering some growing pains in the guise of technical and operational problems which have arisen in experimental harbor surveillance units. Several were enumerated by FCC Commissioner Webster in addressing the Institute of Navigation, Washington, D. C. Experimental harbor surveillance radar stations which have been installed in Baltimore, Md. and Long Beach, Calif, have been assigned frequencies in bands allocated to merchant marine radar. According to Commissioner Webster this brings up the question "whether frequency assignments to shore-based radar should be different so as to avoid interference to ship radar." Then there is the additional problem of determining how information should be exchanged between the harbor stations and ships entering or leaving port. Naturally some means of radio communication will be adopted but will the delay in transmission and reception of position, etc., render these reports useless? Also, can the difficulty in quickly and accurately identifying individual ships on the harbor scope be overcome?

At IRE President's luncheon—H. R. Skifter, Airborne Instruments; Sir Robert Watson-Watt, London; Maj. General F. L. Ankenbrandt, Director of Communications, U. S. Air Force; and Raymond F. Guy, NBC, New York, president of the Institute.

COMPONENTS

FASTENERS—TV set manufacturers can be sure that at least 50% of the chassis bolts, backcovers screws, and self-tapping screws for such chassis components as high-voltage cages, will be left off by the first two or three servicemen who handle the set.

Therefore why not: (1) Keep all such bolts and screws down to a minimum, (2) See that the heads of the screws and bolts as well as the holes they screw into will stand up under the stress of several removals, and possibly (3) Devise new fasteners which can be removed and replaced in one simple operation? All three of these possibilities might encourage servicers to replace those which the manufacturer considers an irreducible minimum.

ENGINEERS' EARNINGS

SUPPLY VS. DEMAND—This year, in the closely controlled medical field, only 4,000 MD's will be graduated, barely replacing the 4,000 deaths and retirements among physicians. Thus for 1949-50 the shortage of doctors will continue even more stringent in a growing population, putting physician's services increasingly at a premium.

In comparison, 40,000 engineers were graduated this year from 136 technical colleges, increasing the total engineer population by about 15%. (Not one quarter of all engineering graduates ever become members of engineering societies).

From this picture of (over)supply and demand, some striking individual earnings figures emerge. In the tightly regulated medical field, average earnings for MDs run $15,000 yearly. In the wide-open and freely competitive engineering profession, average earnings are under $5,000!

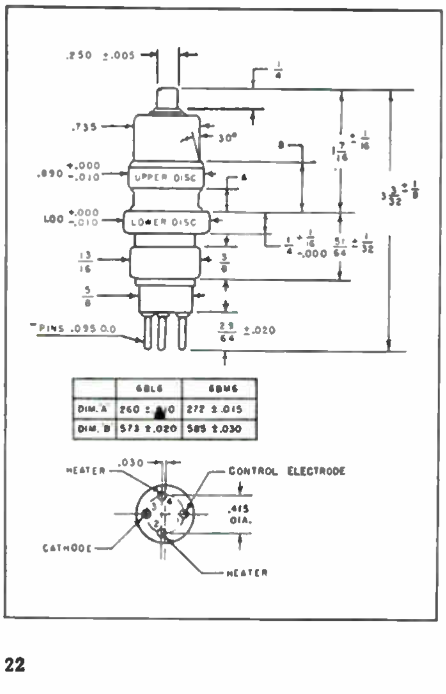
A Wide Range 600-7000

Design features of broad-band test cavity for 6BL6 and 6BM6 reflex ceivers where 2:1 frequency coverage is desirable, as signal gener-

By ***PETER JANIS,*** *Sylvania Electric Products, Inc., 83-30 Kew Gardens Road, Kew Gardens 18, N. Y.*

DURING the development of the wide frequency band 6BL6 and 6BM6 reflex-klystron local oscillator tubes (Fig. 1) there was the problem of obtaining a suitable single unit broad-band test cavity which would fully cover the frequency range 600 to over 7000 MC when used in conjunction with these tubes. A cavity meeting these specifications would provide a comparatively simple means of evaluating characteristics for the above two tubes. This frequency range extends from the low end of the 6BM6 reflex-klystron which is about 600 MC in its 1¾ tube mode to higher than 7000 MC for the 6BL6 reflex-klystron in its 3¾ tube mode. Figs. 2 and 3 show the typical repeller and power output operating characteristics for the 6BM6 reflex-klystron for its respective 1¾ and 2¾ tube modes of operation, which together cover a frequency range from approximately 600 to 2850 MC. Figs. 4 and 5 show the typical 6BL6 reflex-klystron repeller and power output operating characteristics for its respective 1¾ and 2¾ tube modes of operation, which together cover a range of frequencies from 1800 to over 4300 MC. The 2¾ mode is actually capable of going much higher. The tubes in each case were so designed that each of the respective operating tube modes shown will give better than 2 to 1 frequency coverage. The 6BL6 is also capable of operation at frequencies higher than 7000 MC for its 3¾ tube mode of operation.

Fig. 1: Outline dimensional drawings of Sylvania's 6BL6 and 6BM6 reflex klystrons



Short-Circuited Cavity

For the type of laboratory and experimental measurements needed over the required frequency range it was decided to use a short-circuited coaxial line oscillator cavity, Fig. 6, whose wide frequency coverage has been found to be vastly superior to other cavity types. This type of coaxial-line resonator has its main advantage in that its TEM mode is its principal mode of transmission, which is widely separated from the other high order TE and TM modes[1] over comparatively large frequency ranges and furthermore the TEM mode has no cut-off wave length. In the cavity used, the TEM mode is the propagating mode with the only noticeable interference being the TE_{11} mode interference in the ¾ cavity mode operation at about 4600 MC, and is primarily determined by 0.75 times the cut-off wave length of the TE_{11} mode as determined by the mean diameter of the cavity. The exact point of this interference is shifted by the end effects introduced by the tube's resonator section, and since the tubes by the nature of the construction of their resonator grids present a capacity-type termination the TE_{11} interference frequency point will be raised if the grid-gap capacity is increased. Conversely it will be decreased if the grid-gap capacity is lowered. In the ¼ cavity mode this type cavity is free from above interferences, and where possible it is the desirable operating mode and may be used up to approximately 2900 MC.

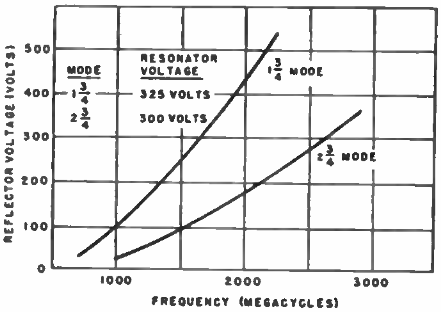


Fig. 2: Typical reflector voltage vs. frequency characteristics for the 6BM6

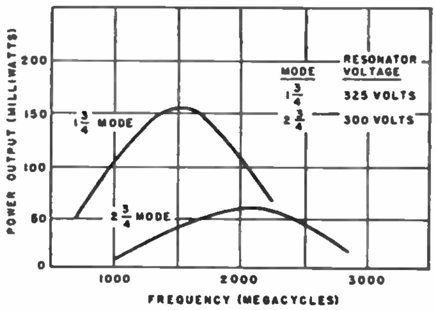


Fig. 3: Power output vs. frequency for 6BM6

Since the tubes act as capacity terminations the resonant wave length in centimeters will always be longer than the length of the resonator for its mode of operation. For example, in the experimental cavity shown in Fig. 6 using the 6BM6 tube and operating the cavity in its ¼ mode with a cavity Z_o length of 5.3 cm, the resonant wave length is 23.2 cm, of which a ¼ wave length is 5.8 cm which is electrically 0.5 cm longer than the physical cavity length. Furthermore, for a given cavity length and a given tube capacity termination, the ratio of the resonant wave lengths between the quarter cavity mode and the three-quarter cavity mode will always be greater than three. For two different

MC Local Oscillator

klystrons described. Tubes find applications in high frequency re-ators, sweep frequency oscillators, and as low power transmitters

tube types the above ratio is varied by the difference in the tube capacity terminations which are present, as in the 6BM6 and 6BL6 reflex-klystrons. If the cavity shown is set at the above cavity Z_o length of 5.3 cm the 6BM6 klystron, which is operated over its entire range in the ¼ cavity mode, will be resonant

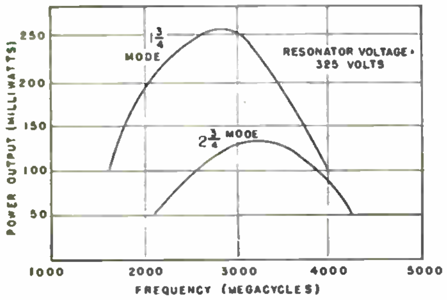


Fig. 4: Power output vs. frequency for 6BL6

at a wave length of 23.2 cm and the 6BL6 reflex-klystron, which is usually operated in the ¾ cavity mode, will be resonant at a wave length of 9.1 cm. This ratio of 2.55 is less than 3.0, rather than greater, because of the increase in the effective capacity of the 6BL6 compared to the effective capacity of the 6BM6.

The cavity shown in Fig. 6 was the one used in obtaining the characteristics for repeller and power output versus frequency as shown in Figs. 2, 3, 4, and 5. This cavity proved to be very satisfactory as a broad-band laboratory type local oscillator source when used with the 6BM6 and 6BL6 reflex-klystron oscillators, which gave a frequency coverage from less than 600 MC to over 7000 MC, as in Fig. 7 and requires only a single set of low voltage beam and reflector power supplies. Fig. 7 shows typical tuning operation for the respective 1¾ and 2¾ tube modes.

The essential cavity dimensions are shown in Fig. 6. The lower grid disc contact is a recessed beryllium-copper .012-in. wire spring, silver plated. The upper disc contact is a conventional finger contact machined out of beryllium-copper having 24 fingers approximately ⅜-in.

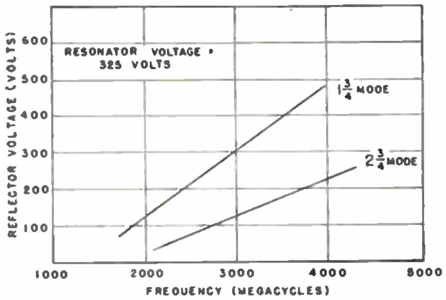


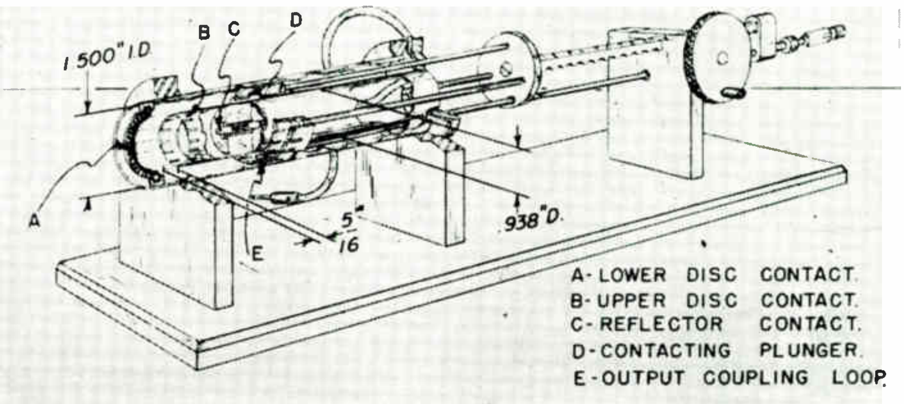
Fig. 5: Typical reflector voltage vs. frequency characteristics for the 6BL6

long, equally spaced with .015-in. spacing between fingers and is silver plated. It is very important that every precaution be taken to insure uniform firm contact on both discs, as a poor non-uniform contact will result in erratic operation and large losses in power. In addition, poor contact will tend to excite undesirable parasitic TE modes due to the introduction of eccentric discontinuities as would be caused if several fingers are not in direct contact with the upper disc. In general, full hard silver plating on all the effective cavity surface areas as well as on all effective resonator contact points will increase the power output from 10% to over 20% over that obtainable with non-silver-plated cavities. The tuning plunger is of the contacting type made of beryllium-copper 24 fingers equally spaced with .015-in. spacing. It is ½-in. long and is ¼ wave length of 6000 MC. The importance of taking every possible precaution to insure good contact between the fingers and the respective inner and outer conductors of the cavity cannot be overstressed. If one or more plunger fingers make poor contact, high power losses, erratic operation, and back cavity resonances may result. If it is desired to make a fixed-frequency cavity with a solid short in place of a movable short, the front face of the solid short and the cavity walls must make intimate contact, because even a small fractional clearance will introduce a cavity discontinuity which may show up as a large decrease in power level and eccentric operation. If the above simple precautions are observed, efficient, trouble free, reproducible operation will be maintained.

Noncontacting Plunger

The type of plunger described above is excellent for very broad frequency coverages with an adjustable loop, however, where continuous repetitive frequency cycling is encountered, which may run into the order of a million or more cycles with a fixed coupling loop, the noncontacting type of plunger is desirable. In general it may be said that where the desired frequency coverage is of the order of 1.5 to 1 or less, for instance 2400 MC to 3600 MC, that a ¼-wave bucket

Fig. 6: Dimensions and details of the wide range reflex klystron coaxial cavity



WIDE RANGE OSCILLATOR (Continued)

type non-contacting plunger with cavity to plunger clearances up to .010-in. has been found very satisfactory. If the desired frequency coverage is 2 to 1, for example 2150 MC to 4300 MC, then the "S" type non-contacting plunger is generally used and its cavity-to-plunger wall clearances are usually less than .010-in. for best operation.

Power Output

Power output in the cavity under discussion is taken out as shown in Fig. 6 by means of a coupling loop projecting through the contacting plunger as shown and is brought out of the cavity through a cylindrical tubing to an end connector. The construction is such that the loop is free to rotate until optimum matching is obtained as indicated by maximum reading of the power meter and it was found that this method of matching power out into a 50-ohm load eliminated the necessity of additional tuners. The size of the loop is determined by the frequency under consideration. The width of the loop is held constant at approximately ⅛-in. but the length is varied from ¾-in. at low frequencies around 1000 MC to ¼-in. at

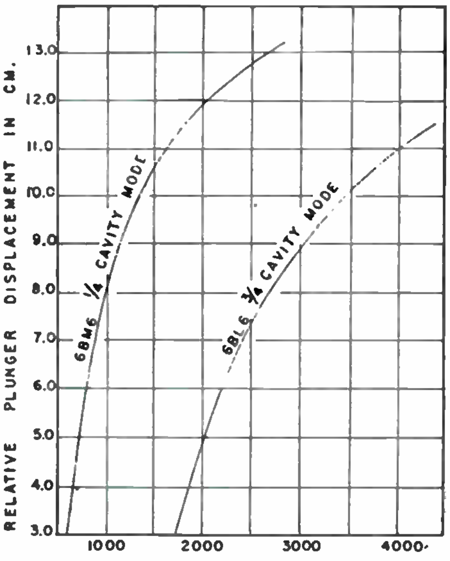


Fig. 7: Typical tuning for broadband coaxial cavity with 6BM6 — 6BL6 klystrons

4500 MC to 1/16-in. at 6000 MC. If the loop is of the proper size for the frequency under consideration one should go through four maximum power points as the loop is rotated through 360° with the cavity length fixed. Fig. 8 is typical data obtained with two size loops and shows how with the smaller loop the power is increased at the high frequency and whereas the larger loop increases the power at the low frequency. Usually where it is desirable to maintain a fixed loop in a fixed position over a wide frequency range the size of the loop is governed by the power requirements at the high frequency end with a sacrifice of efficiency at the low frequency end because the loop attenuating effects as seen from Fig. 8 are much greater. The loop itself can be very nicely used as an attenuator by controlling the amount by which the loop extends into the cavity and if care is exercised not to rotate the loop there should not be any noticeable frequency pulling. Other methods of coupling power out are fixed-position loops set in the wall of a ¾ wave length resonator ½ wave length in front of the plunger at the point of maximum magnetic field intensity or combination loop-probe methods which type output coupling acts as a loop at the high frequency end of the cavity and a probe at the low frequency end of the cavity.

In the above discussion reference was made only to the 6BM6 and the 6BL6 reflex-klystrons which were essentially developed for C-W operation, where amplitude modulation is usually obtained by modulating the reflector through an isolation transformer and the control electrode which is part of the gun structure being tied back to the cathode. If it is desirable to use cathode pulse modulation it is necessary to use about 300 volts on the control electrode to obtain cut-off. To provide a more suitable cathode pulse control electrode where pulsed power output is desirable a specially designed control electrode was developed for the SD-1103 and the SD-1104 reflex-klystrons, which retain all the desirable characteristics of the 6BL6 and 6BM6 respectively with regard to frequency coverage, reflector tracking and power output, in addition to providing a low voltage control electrode for pulsing where pulsed output is desirable. The SD-1103 and SD-1104 reflex-klystrons are normally operated for maximum broad-band coverage with a control electrode voltage of plus 10 v. with respect to the cathode drawing approximately 3 to 5 ma. Complete current cut-off is obtained at approximately 15 v. negative with respect to the cathode, making it possible to use a fairly simple pulsing circuit. This new electrode adds an additional

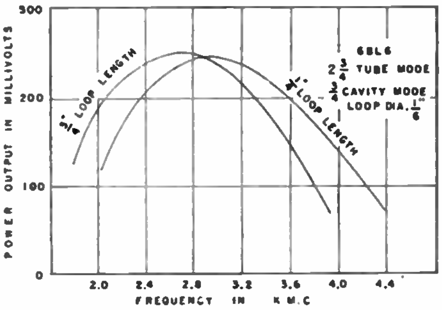


Fig. 8: Data for loop size vs. power output for the 6BL6; 2¾ tube mode, ¾ cavity mode, and loop diameter ⅛-in.

convenient means of adjusting power output levels if it is desirable to do so, in addition to the well known methods of beam voltage and reflector voltage controls.

Frequency Test Points

In the course of the development of these tubes, fixed frequency test points were established at the high and low end of each tube frequency range. These tests are performed in fixed frequency cavities. The frequency and repeller variation limits from tube to tube were rigorously established, resulting in extremely uniform tubes which track over 2 to 1 frequency with a minimum of circuitry adjustment to compensate for tube-to-tube variations. This uniformity has been accomplished by working out rather exacting technics such as maintaining extreme uniformity of grid curvature, keeping the accuracy of the resonator grid spacing to within ±0.0005-in., maintaining very close controls on reflector and cathode gun spacing, maintaining and controlling the size and shape of critical parts, etc. These are only some of the many controls which have been developed and put into effect with the result that the tube characteristics are very uniform and far better than it was heretofore considered possible to maintain consistently over 2 to 1 frequency ranges.

Acknowledgment is made to Joseph W. Kearney of Airborne Instrument Laboratories and Gordon P. McCouch of Aircraft Radio Corporation for their technical advice and assistance on some of the cavity problems that arose and to the many associates at Sylvania Central Engineering that made the above work possible.

Built-In Grating Generator

Simple, low-cost test equipment for TV remote and studio use enables rapid linearity and aspect ratio tests to be made under operating conditions

By DAVID MARTIN
Supervisor, Remote Studio Operations, WMAR-TV, Baltimore, Md.

As competition becomes more active between the television stations in any area, the technical excellence (or lack of it) becomes an increasingly large factor in selling program time and station facilities. In order to assure good technical performance, adequate, easily available test equipment is a necessity. In this connection a grating generator is a basic piece of test gear since it makes possible accurate checks of system linearity and aspect ratio.

Commercial generators are available, but they are large and comparatively expensive, which makes building them into each equipment group (studio and remote) somewhat impractical. For remote use, in particular, the generator should be small in size and weight. In any installation there is great convenience in having a built in, permanently connected, grating generator available for instant operation.

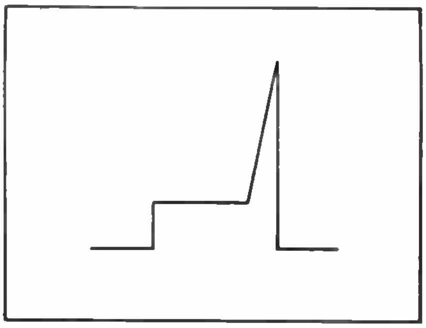


Fig. 2. Wave-shape of 900 cycle signal from clipper stage of standard sync. generator

The grating generator to be described meets all of these requirements. It is only 9x8x5 in. in over-all size and uses easily obtainable parts in its construction. Parts cost runs about $25 per generator. Existing designs have been modified and simplified to meet the broadcaster's specific needs.

The vertical bars, referred to hereafter as bars, are produced by a free-running twin-triode cathode coupled oscillator V-1, shown in Fig. 1. In this circuit the grid normally grounded is connected to the horizontal drive bus, and negative pulses of about 4 volts level at 15750 cycles are applied to lock in the oscillator at a chosen multiple of the horizontal sweep rate. With the values shown, any number of bars from 15 to 25 may be obtained. This allows setting the ratio of horizontal bars—or bands—to vertical bars so that squares may be produced over the entire raster when the equipment linearity and aspect ratio are set correctly. The number of bands is fixed at fifteen since 900 cycles is available from the sync generator.

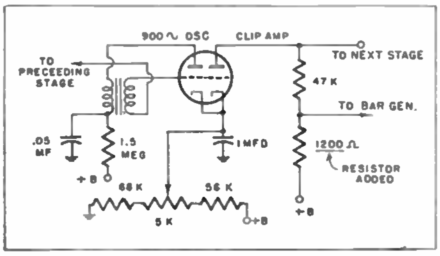


Fig. 3 Modifications to clipper stage of 900 cycle oscillator in sync. generator to obtain drive voltage for the horizontal bars

The oscillator drives one-half of V-2 and V-3 as clippers and the resultant square wave is differentiated by the 10 mmf. capacitor to give sharp pulses which produce the desired bars in the output of V-4, the cathode follower.

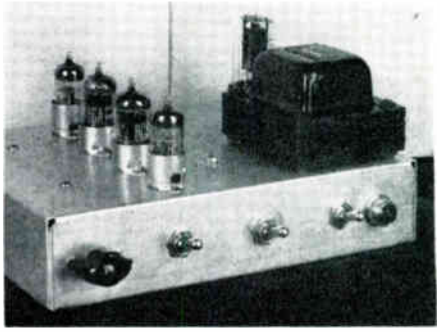
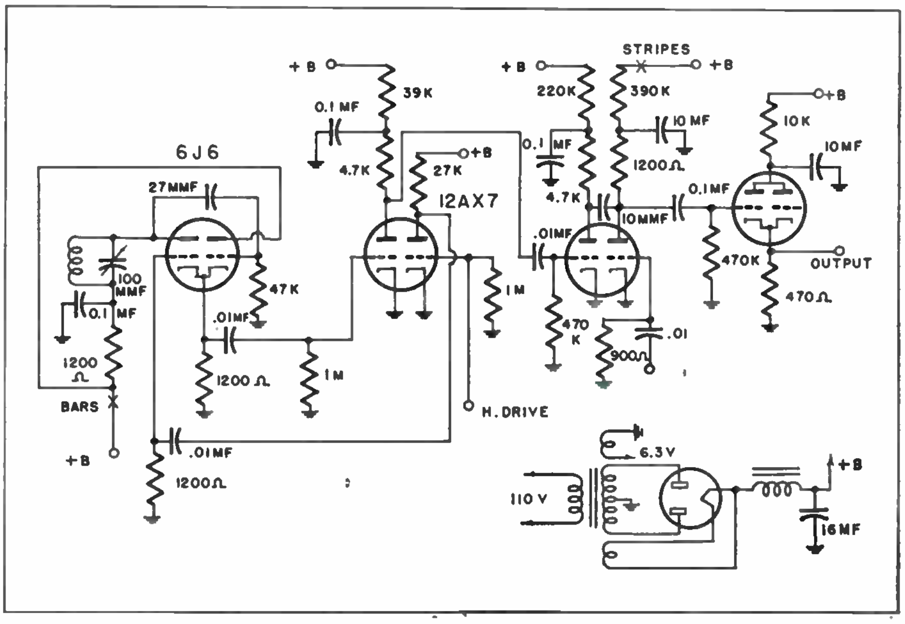


Fig. 4. Top of chassis showing controls.

The 15 stripes are obtained by using the clipped, amplified output of the 900 cycle blocking oscillator in the counter string of the frequency divider of the sync generator. The 900 cycle drive voltage is obtained by adding a 1200 ohm resistor to the B+ end of the plate resistor in the clipper amplifier of the sync generator as shown in Fig. 3. This output has a waveshape similar to Fig. 2 at a 900 cycle rate. The spike is clipped off by the

(*Continued on page 71*)

Fig. 1. Schematic diagram of grating generator. The oscillator and cathode follower output tubes are 6J6's; 12AX7's are used for clipping and differentiating the diving pulser



Research Facilities for

A review of the engineering and equipment required at National Union

Laboratory Equipment Studies

First of a Series

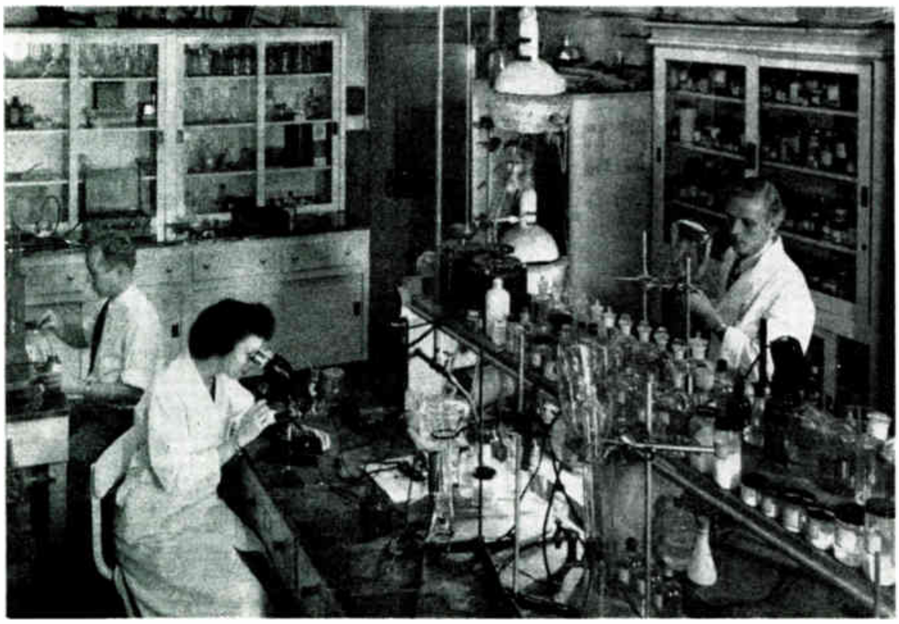
IN the tremendous growth of Electronics during the past ten years, applications and systems research have often gotten ahead of vacuum tube research. Thus, in many new electronic devices the only kinds of tube available are those that were developed primarily for radio receivers. Specialized tubes designed for specific functions would often enhance the performance and would simplify the equipment. The difficulty of procuring special tubes has promoted the very common idea among designers that it is easier to do a job by circuitry, using standard tubes, than by more complicated ones specifically designed for the job.

There are, however, limits to what one can do if restricted to the use of standard listed tubes of the radio receiving type. The greatest possible progress can be realized only if equal emphasis is placed on both tube and circuit research. Tubes having unusual constructional details or characteristic features are probably the only item that an equipment or circuit design engineer cannot have made up in his own shop, or by outside model shop facilities that are available in all cities for handling any other forms of components.

Few people in the radio industry have paid more than passing interest to the details of tube construction, the materials and technics of assembly, or to the vast amount of research on basic effects, the special tests, and other problems that precede the introduction of a new tube. Few realize that the costs of such a development may run over a hundred thousand dollars in spite of the many and unique design and production facilities that are in common use in tube research.

An insight into the utilization of such expedients is afforded by a survey of the facilities of the Research Division of National Union Radio Corporation, a major independent tube company not a part of a radio set manufacturer. This group has been occupied exclusively in vacuum tube research since 1943 and their facilities are of interest since they emphasize the development of highly specialized and often complicated tubes, which perform peculiar functions in electronic equipment.

Fig. 1: One of several air conditioned chemistry laboratories where the materials for screens for both fluorescent type and dark trace type cathode ray tubes are prepared



The work has not only concerned N.U. research on standard tubes but a great deal on special tubes and on developments for outside organizations on a contract basis. Presently under development are a number of tubes employing secondary emission multiplication to obtain very high-band gain factors in the UHF region. Two tubes of this nature are presently available. Another development of tubes for the UHF service has resulted in a new line of subminiatures.

Projection CR Tube

The present program in the cathode ray department includes the development of a miniature projection cathode ray tube for television and an extensive fundamental investigation of the dark trace tube or skiatron. Other specialized types of tubes under development perform unique functions by scanning an electron beam across a target structure, necessities in certain computing machine developments.

No research organization is better than the men who form the technical staff, and in the present case of electronic tubes, the staff is made up of physicists, chemists, electrical and mechanical engineers. They have, collectively, a wide experience gained from working with all types of tubes. Associated with this theoretical and designing group are a number of "old timers" who have grown up with the vacuum tube industry, able to carry out any assignment in the assembly of the practical tube.

The second part of the problem is to give these workers access to all facilities that are needed to study any problem that might be encountered. Much of the equipment must be selected for use in research purposes only — as production test methods and apparatus are not suitable for the usual development project.

A complete survey of such equipment that has been made available to the National Union project engineers would show quite an intricate

Complex Vacuum Tube Development

Radio Corp., Orange, N. J. laboratories in developing special purpose tubes

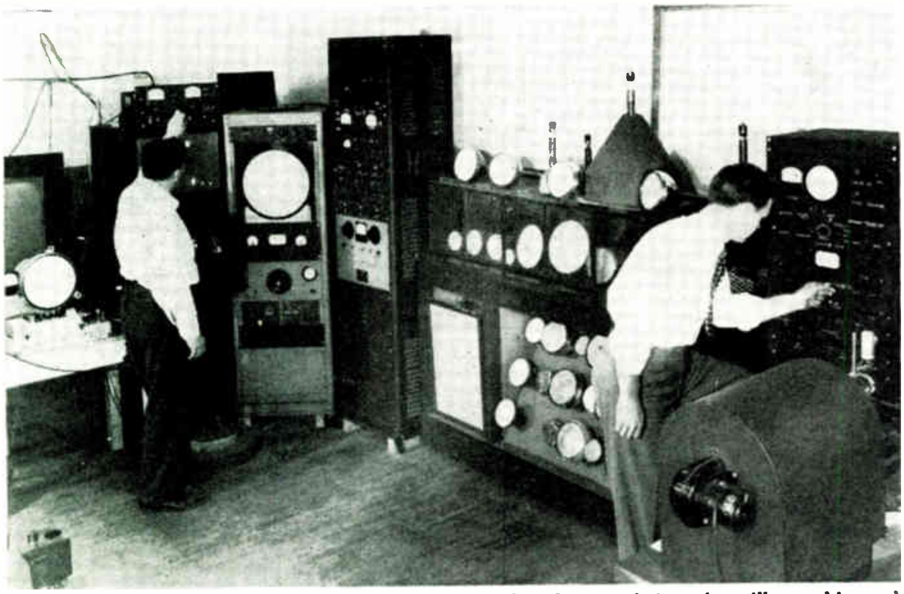


Fig. 2: A section of the testing laboratory where the characteristics of oscillographic and television cathode ray tubes, and of dark trace cathode ray tubes are studied and measured

setup. The list might be divided roughly in two parts — those items of laboratory apparatus that are specifically used for one class of tubes (such as cathode ray tubes), and items that cover problems which are encountered in all electron tubes.

For example, a cathode ray tube development might be scheduled aimed to bring about some specific characteristics. While, in general, some of the materials that would be selected have known characteristics and effectiveness, still the engineer may want to reinvestigate many items under a new set of operating conditions, such as the glass for composition, its thermal expansion, strength, and workability when molten to study the bulb shape, safety factors, etc. A precision analytical job in chemistry must be done in conjunction with phosphor studies. These problems require access to the facilities of a chemical laboratory which would have the usual laboratory tables, sinks, and glassware, together with services of water, air, gas, electricity, chemicals, and raw materials. Metallurgical binocular microscopes with vertical illumination would be needed. Also ball mills with rollers, exhaust hoods, an analytical balance, and an automatic electric water still capable of producing distilled water of 45,000 ohms per cm^3. Special items would include an aquadag coating machine, bulb drying rack and ultra-violet lamps delivering 2537°A for silicates and 3650°A for sulfides. A portion of this laboratory is shown in Fig. 1.

In another section a furnace room, containing an electric furnace with automatic controls for temperatures up to 1250°C, an optical pyrometer, and a bulb bakeout furnace for temperatures up to 550°C in addition to a forced draft drying oven.

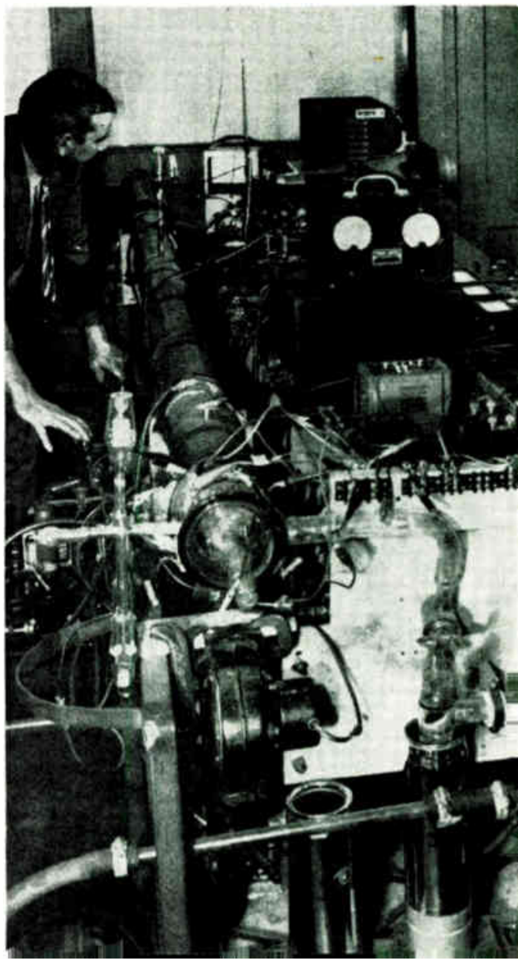
Applying Phosphor

For applying the phosphor a settling room is needed that is air conditioned, has constant temperature, and is dust free. Bulb cleaning facilities are provided, including a laboratory type sink, a good exhaust hood for HF fumes, a bulb drying rack, a specially developed settling table, a tilting and siphoning machine and a siphoning table.

One may also wish to measure the X-ray emission level, the secondary emission factor, optical characteristics of the glass for halation studies, the spectral characteristics of phosphors under a wide variation of operating conditions. Instruments must be at hand for these checks, and a complete measurement laboratory is available, part of which is shown in Fig. 2. Here in addition to many types of basic dc power supplies, for high and low voltages are found oscillographs, both direct view and recording. A variety of sweep circuits (magnetic & electrostatic), pulse generators, audio oscillators, video amplifiers, and TV tuners. Since projection tubes are a vital part of present tube research TV projection optical systems of various types are at hand. Photoelectric constant and decay measuring equipment, photometers and several forms of spectrophotelometers are found. For another series of checks, we find a filament and cathode aging unit, and many life test racks and associated equipment. An electrolytic tank for electrostatic field studies forms a part of the special facilities provided to the designers, as well.

An important phase of the continuous research on tube improve-

Fig. 3: Ions of various substances being investigated are shot down this 9-ft. long evacuated tube, a mass spectrograph, as part of research program on basic materials



ments is centered around cathode structure. The evolution of gas from metals, methods of their de-contamination and the measurement of secondary emission from typical electrodes, cathode base materials and their coatings require still another group of laboratory instrumentation. This laboratory, also air conditioned, contains a spray booth, spray guns and jigs. Air transformers, ball mills, and a bott.e roller. In addition general instruments such as a torsion balance, an analytical balance, micrometers and microscopes are at hand.

For coating filaments by cataphoresis several ovens automatically controlled between 0-300°C, 0-1000°C and 0-1100°C are available, together with a hydrogen furnace, automatically controlled between 0-1650°C.

Other items finding frequent use are an optical pyrometer, water still, infrared lamps for drying, apparatus for electroplating and electropolishing, another aquadag coating machine, with other facilities for spraying aquadag, and special stamps and inks for branding are in use.

Of interest here is the extreme lengths that are taken in the search for ideal cathode coating materials. The most interesting is the mass spectrograph (Fig. 3) where ions emitted from emission surfaces are shot along a nine foot evacuated tube for a critical study of their makeup. The precision desired from these checks requires an evacuation of this tube to a degree one or more orders higher than is needed for a production radio tube.

The search for improved materials may also go into basing cements, marking etches, etc. requiring analytical instruments of a different character although not of particularly unusual types.

So far, we have covered only the study of materials. The problem of electrode design and their placement requires other equipment. Of late an increasing number of developments in tubes deal with directed beams of electrons, where the electron current is controlled, not only as to their amount or density, but as to their direction. Beam pentodes and cathode ray tubes are two common forms. A development in this field particular to the National Union research program, is a series of radial beam, multi-element switching tubes (Fig. 4), requiring a somewhat formidable array of seal leads as the photo indicates.

Electrode Structure

Tube designers tackling the problem of electrode structure, where the matter of controlled direction is paramount, have available a practical check for the complicated computations involved: rubber membrane model (Fig. 5). This equipment utilizes an analogy between electrostatic fields in a vacuum tube and the "sag" in the membrane between members that duplicate the proposed electrodes to scale, physically and as to position. Small steel balls free to roll over its surface follow the same paths as electrons would in a tube built according to the relations set up in this form of analog "computer".

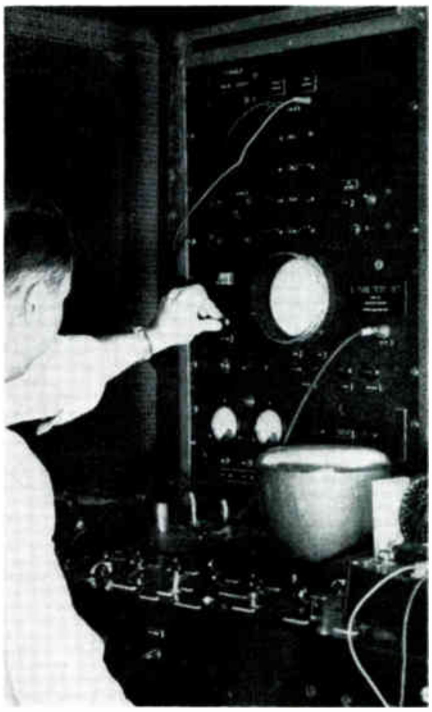
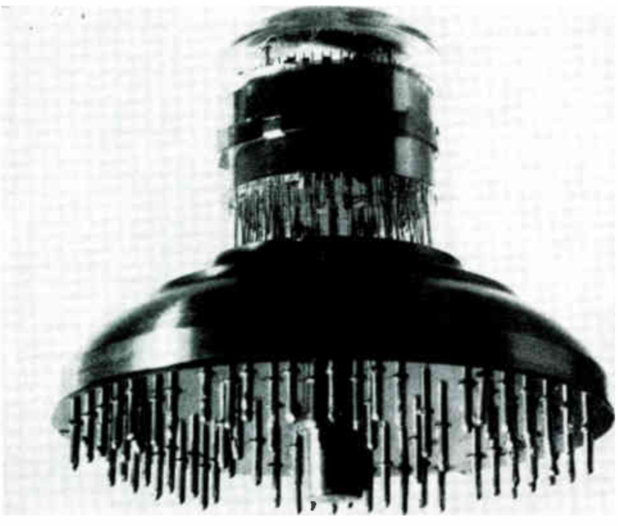


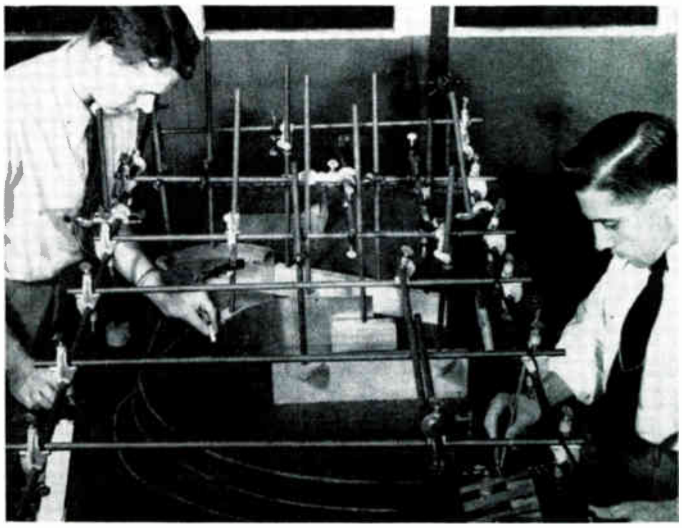
Fig. 6: Many of the tests on characteristics of experimental cathode ray tubes must be conducted inside of a shielded cage to eliminate effects of electrical interference

From these checks the designer finds out all details of the electrode areas, spacings, for a given set of operating potentials and drawings can be prepared for a model. For the latter the skill of many specialists in experimental tube construction is called upon for the production of electrode structures, their mounting and sealing, and subsequent handling. In the case of large tubes, much of this work is done on unit exhaust positions. Each position is complete with its own test instruments. In many cases it may be necessary to prepare "tempo-

(Continued on page 70)

Fig. 4: (left) A forest of pins in the base of this tube is needed to connect with all of the elements of this radial beam tube. Fig. 5: (right) A rubber membrane provides an analogy with the electric fields in a vacuum tube. Here small steel balls, free to roll over its surface, follow the same paths as the electrons in the finished tube. This provides check on theoretical placement



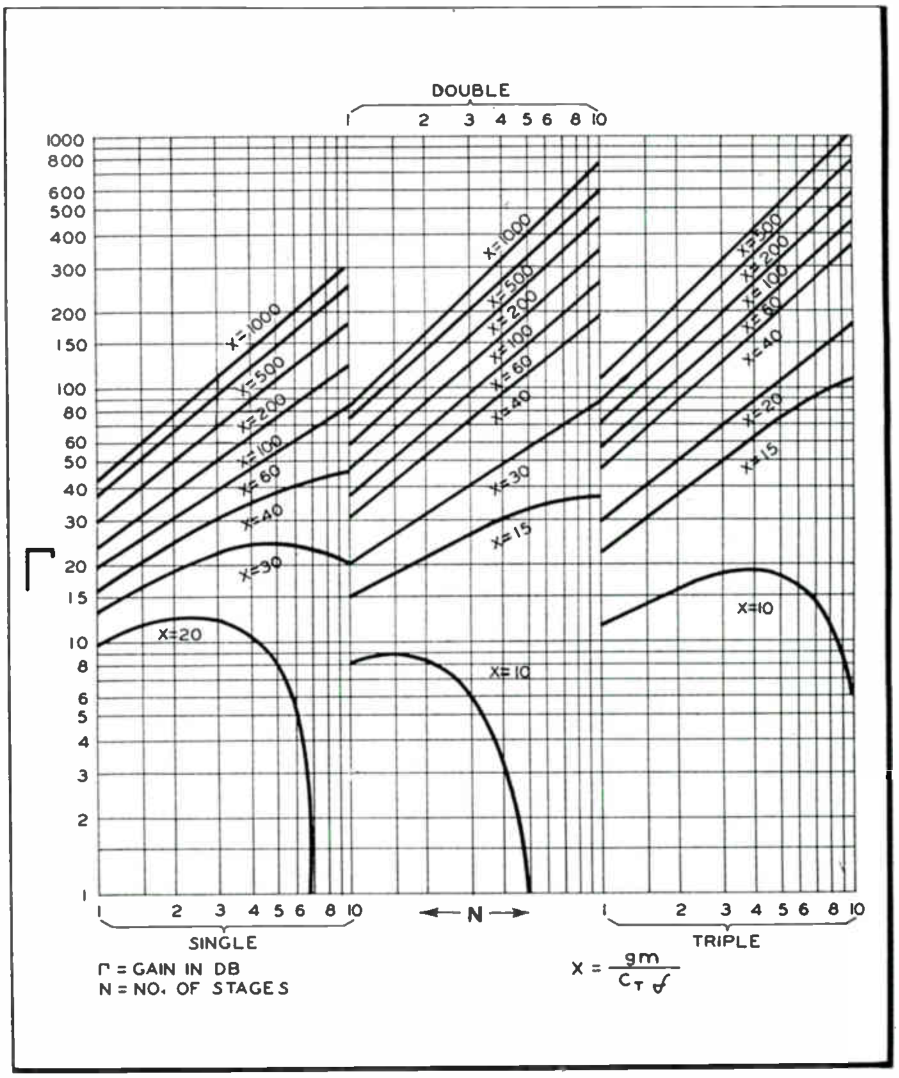


Page from an Engineer's Notebook

STAGGER GAIN CALCULATOR

Number 7

Contributed by EARL R. JENKINS, 1213 N. Wolcott, Chicago 13, Ill.



IN the design of wide band amplifiers determining the number of stages required is a method of successive approximations necessitating considerable investigation to obtain optimum results. The graph below makes the determination of the number of stages required automatic.

Here a family of curves of various values of a partial design factor X is plotted against the number of stages (horizontal scale) and the gain in decibels (vertical scale). The value of $X = g_m/C_T\delta$ where δ is the overall bandwidth in megacycles, with the other values respectively in micromhos, micro-microfarads. g_m/C_T is the figure of merit.

The gain Γ is a logarithmic function of the bandwidth reduction factor divided by the overall bandwidth since all other factors are constant in any particular case. We may proceed to plot both gain and the number of stages required on log-log paper by plotting $X = g_m/C_T\delta$ for various values to obtain a family of curves. Since the graph has as its abscissa the number of stages N, the bandwidth reduction factor was not included.

As an example assume a problem of designing an amplifier with an overall gain 100 db and an overall bandwidth of 2 MC with a mean frequency of 50 MC. Assume a tube transconductance of 4000 μmhos with a distributed capacity per stage of 10 $\mu\mu$f. From this value X = 200.

Investigating the number of stages required for a single, we find from the chart that 7.3 stages (or 8 singles are required). Likewise we may find that 2.3 doubles are required or 6 tubes are necessary. Or else that 1.5 triples are needed or 6 tubes. Based on tube economy we have a choice between 3 doubles and 2 triples. However, we note that 3 doubles corresponds to a gain of 125 db, whereas 2 triples corresponds to a gain of 130 db giving a safety factor of 30 db if we use triples compared to 25 db for doubles, making it desirable to use triples.

In deriving this graph a relation was set up between gain, overall bandwidth, figure of merit, and the number of stages required in any stagger tuned amplifier, as follows:

By definition:

$\Gamma = 10Nr \log G$
r = number of tubes per stage
G = gain per tube
N = number of stages required
B_w = bandwidth
C_T = stage capacitance

$$G = K_1\left(\frac{gm}{C_T}\right)\left(\frac{1}{Bw}\right)$$

$$\Gamma = 10Nr \log\left[K_1\left(\frac{gm}{C_T}\right)\left(\frac{1}{Bw}\right)\right]$$

$$= 10Nr \log\left[K_1\left(\frac{gm}{C_T}\right)\left(\frac{\sqrt[r]{2^{1/n}-1}}{\delta}\right)\right]$$

since $$Bw = \frac{\delta}{\sqrt[r]{2^{(1/n}-1)}}$$

A Precision Reference-

***Double regulated system with low impedance maintains substan-
30 volts. For different loads between 0-10 ma output varies***

*By E. E. BREWER, Convair Engineering Designer,
Consolidated Vultee Aircraft Corp., San Diego 12, Calif.*

BEFORE a regulated power supply can have a high degree of voltage stability, certain rigid design criteria must be satisfied. A voltage regulated power supply can be considered as a voltage source which is connected to a load through a variable resistance whose value changes to compensate for load variations. A typical regulator uses a gas tube for a reference voltage source, a dividing network to obtain a fraction of the output voltage, a vacuum tube to amplify the difference between this output fraction and the reference voltage, and a current passing tube to serve as a variable resistance to compensate the difference between input and output voltage. Fig. 1 is a simplified schematic of such a regulator whose operation is as follows: An increase in load current causes a drop in the regulated voltage E_o. A fraction of E_o is applied to the grid of V_2 through the dividing network $R_1R_2R_3$ and any change in E_o causes a change E_g in the grid to ground voltage of V_2. Since the cathode of V_2 is maintained at a fixed potential by a gaseous regulator tube V_3, there is no degeneration in the amplifier V_2 and the change in the plate voltage of V_2 is very nearly μE_g where μ is the amplification factor of V_2. The plate of V_2 is directly coupled to the grid of V_1, the current passing tube, and a decrease in voltage at the grid of V_2 raises the plate voltage of V_2 and the grid voltage of V_1. This increases the transconductance of V_1, allowing more current to pass and offsetting the effect of the increased load.

The most desirable regulator circuit is one having the smallest regulator factor and the lowest internal resistance because changes in input voltage and output current will then have the least effect upon the output voltage.

If ΔE_o is the change in output voltage due to input voltage ripple or change in load current and B is the fraction of this change which is applied to the grid of V_2, the change in voltage at the plate of V_2 and the grid of V_1 will be $\Delta E_o AB$ where A is the gain of the amplifier V_2. The cathode-grid change on V_1 becomes $\Delta E_o(1+AB)$ and the total loop gain opposing ΔE_o becomes $a\Delta E_o(1+AB)+\Delta E_o$ where a is the gain of the series tube V_1. Dividing by ΔE_o gives us a ripple reduction factor of:

$$1+a+aAB \qquad (1)$$

From this formula, it is apparent that both the μ of the series tube and the gain of the amplifier stage should be high for the best ripple reduction and lowest regulation factor.

In predicting the stability of a regulated power supply under changing load conditions, both of a slow and high frequency nature, a knowledge of its output impedance is necessary. For high frequency changes, the output impedance is

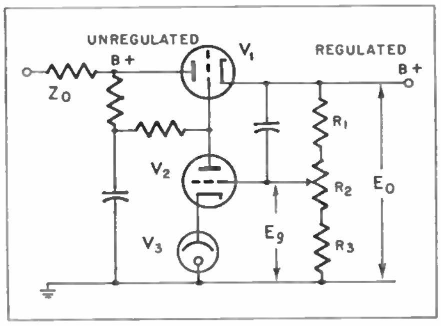


Fig. 1: Simplified schematic of regulator

approximately equal to the reactance of the last filter condenser but for slow changes near zero frequency, the output impedance is approximately:

$$\frac{R_p+Z_o-\mu Aa}{1+\mu+\mu AB} \qquad (2)$$

where R_p is the dynamic plate resistance of the current passing tube, μ is the amplification factor of this tube, A is the gain of the amplifier stage, B is the voltage feedback factor and a is the current feedback factor which is zero in the regulator of Fig. 1. Z_o is the output impedance of the unregulated supply. Z_o cannot be neglected because the current passing tube V_1 acts as a cathode follower and an impedance in its plate circuit appears as an addition to its plate resistance.

From an examination of the output impedance formula (2), several things become apparent. For the regulator to have the lowest output impedance, a current passing tube of low dynamic plate resistance should be used. The μ of the passing tube as well as the gain of the amplifier stage should be as high as possible. An effort should be made to maintain a low internal resistance in the unregulated supply.

The output impedance of the regulator of Fig. 1 is of the order of a few ohms but can never be reduced to zero regardless of the amount of feedback or gain in the degenerative loop. This is due to the fact that the information regarding output voltage correction must come from the output voltage itself. Thus the output voltage must change to provide a correcting voltage to counteract the change. This suggests the need for anticipating the change in voltage output and to do this the voltage correcting information must be obtained from the input circuit itself. Likewise, to correct output voltage fluctuations due to changes in load current, the correcting information must come from the load current itself. This is another way of saying that current feedback as well as voltage feedback is necessary for perfect regulation. With positive current feedback as well as negative voltage feedback, formula (2) can become zero or even negative. The extent to which such voltage and current feedback compensations can be carried to improve the operation of a regulator circuit is dependent upon the linearity of the various circuit elements. This suggests high stability in the sampling, comparison, and control circuits and high stability and linearity in the amplifiers.

With the foregoing requirements for a good regulator in mind, the supply shown in Fig. 2 was constructed. This supply uses two regulators connected in series which hold the regulation factor to prac-

Voltage Power Supply

tially constant voltage output when input varies by as much as less than 0.05%. Both voltage and current feedback are used.

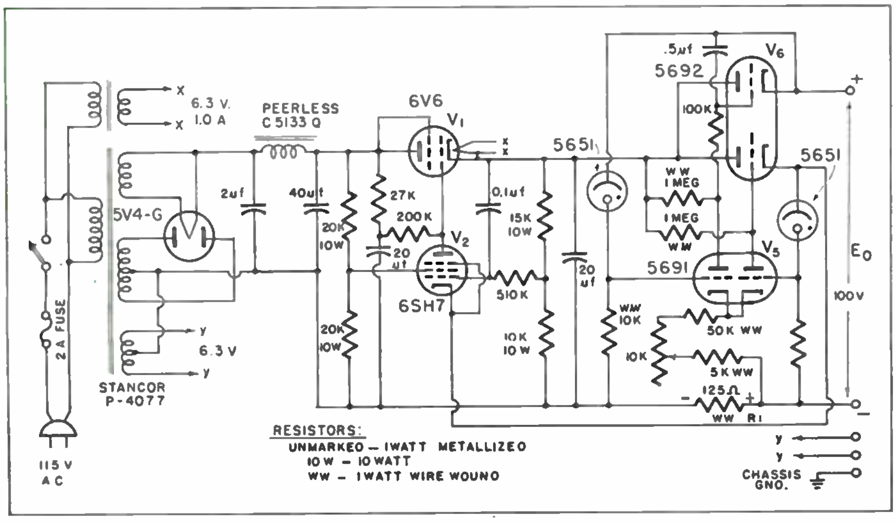


Fig. 2: Reference-voltage supply uses two regulators connected in series with second regulator having both voltage and current feedback to reduce its output impedance to zero. 5V4G rectifier tube type was selected because of its low internal resistance

tically zero. The second regulator has both voltage and current feedback to reduce its output impedance to zero. The 5V4G rectifier was selected because of its low internal resistance. This helps to maintain a low impedance in the unregulated supply and improve the regulation and lower the output impedance of the first regulator. A high plate transconductance passing tube and a high gain pentode make up the first regulator. An RC filter is inserted in the plate voltage supply to V_2 because this voltage comes from the unregulated side of the supply and contains a ripple component. Since any ripple voltage would be 180° out of phase with the amplified plate voltage of V_2, it would reduce the gain of V_2. The second regulator works in much the same manner as the first except that a change in load current through R_1 raises the cathode voltage of V_5 which in turn increases the transconductance of both sections of V_6 and holds the voltage output constant.

Since this supply was designed for a reference voltage source, its long time stability was of some concern. Such stability is impaired principally by the slow changes in the characteristics of the sampling circuits, the comparison circuits, the reference elements and the components of the amplifiers. Short time stability may be impaired by microphonic effects or noise within the amplifier tubes or one of the elements in the degenerative loop. Every effort has been made to eliminate these sources of instability. The new type 5651 gaseous reference tube is used to supply reference voltages. This tube experiences less than .1 volt change in its voltage characteristics when operating within its current rating. It is also free from photo-electric disturbances. To maintain uniformity between sections, the new red tubes 5691 and 5692 are used in this regulator. They are built more ruggedly than the standard tubes and are not subject to microphonics. At all critical points where resistors are marked W.W., precision low drift resistors are used to prevent changes in the degenerative loop characteristics.

In spite of all these efforts to secure stability, the performance of the circuit is not as perfect as might be inferred because of the fact that zero impedance can only be maintained at one operating point. This results from the non-linearity of the vacuum tubes. However, for any load between 0 and 10 milliamperes, there is less than .05% change in output voltage. The input line voltage may vary between 100 volts and 130 volts and cause less than 25 millivolts change in the 100 volt output.

Interior view of RCA's new tube plant in Marion, Indiana, showing women operators at glass lathes where neck section of 16-in. metal TV tubes are fused to the cones. The plant, which at present is largely devoted to the manufacture of short-necked 16-in. tubes, is expected to become one of the world's largest TV tube producers

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Reduction of Hum Levels in Magnetic Recorders

MANY tape recorders on the market today, with the exception of the higher priced professional machines, have hum levels as high as —40 db. In most cases this can be traced to heavy magnetic fields from the drive motors and power transformer induced into the playback head.

It has been found that by disturbing these fields about the playback head, by placing small pieces of high quality Mumetal on the unshielded head, a reduction of the hum level can easily be made, often as high as 15 db.

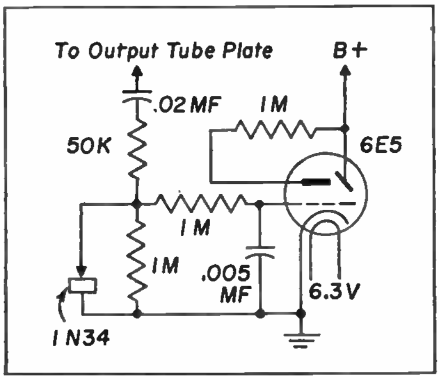
The following method is suggested. Cut a piece of light gauge Mumetal into 3/8 in. squares, and cement a short piece of solid hoopup wire to the centers with household cement. These short pieces of wire will serve as a handle for the metal squares, so that they can be easily oriented about the playback. A steel pliers or tweezer cannot be used for holding these squares as they would influence the magnetic fields. After the wire handle is secure, connect the recorder output to a noise meter and with the motors operating and gain control up, measure the hum level. Take one of the Mumetal squares and very carefully orient it in contact with the playback, at all angles and surfaces until a minimum indication is obtained on the noise meter. Then carefully cement the square in this exact spot. The wire handle should be cut off. It is advisable to try several squares in this manner until minimum hum is obtained. The actual final placement will be found to be very critical and care must be taken not to move the plate from the correct position while cementing it.

Another method of reducing hum levels in tape recorders is to buck out the effect of these stray fields with an external source. In this case a small 6.3 v. filament transformer is used. The secondary should be loaded with a 10 to 15 ohm resistor to increase the field around the transformer. While monitoring the hum level on the noise meter carefully orient the transformer about tape recorder cabinet until a decrease in hum level is noted. Try all angles and positions on this transformer and mount in this position with brackets. A position inside the cabinet can often be found that will work satisfactorily. The filament transformer can be wired in parallel with the drive motors so that it is excited when the recorder is started. A reduction of 15 db in hum level has often been found possible with this method. A swivel mount on the transformer will help greatly in making final adjustments in the minimum hum position.—G. HAROLD BREWER, Chief Engineer, WARK, Hagerstown, Md.

* * *

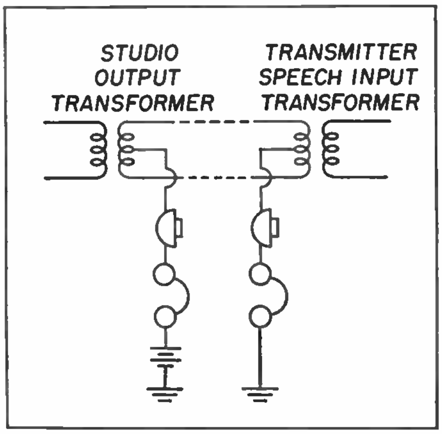
Substitute VU Meter

IN the event that a remote pickup amplifier is not equipped with a VU meter, a very satisfactory substitute can be assembled from a 6E5 Magic Eye tube and a few parts. With typical amplifiers, the values shown will cause the eye tube to close at an output level of plus 4 VU. However, by increasing the value of the 50,000 ohm resistor, the eye shadow can be made to close at plus 8 VU, or any level desired. The rectifier and filter circuit give the eye shadow a very clean edge resulting in an easy to read level indicator of good accuracy. Calibration should be checked after installation or replacing the 6E5 tube by loading the amplifier with a 600 ohm resistor and checking against a standard VU meter at the output. — T. A. HILDEBRAND, Chief Engineer, KMBY, Billings, Mont.



Turntable Remote Control and Lineless Telephone

TO save time when getting a transcription onto the air, spare terminals on the TT switch on the console are wired to close a relay in either Program or Audition side. The relay controls the ac motor on the turntable, (the switch on the turntable being left "on"). Thus, the announcer on duty cues up the record, and has only to throw one switch to get it on the air, as the same switch completes the input circuit and controls the motor.

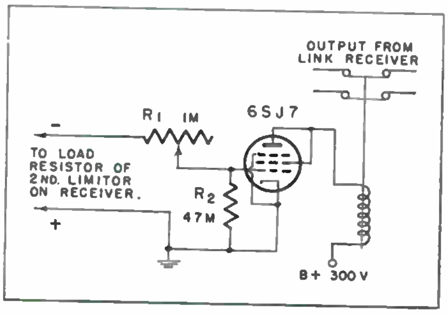


A direct phone from studio to transmitter without extra lines is often useful. The center taps of the 500 ohm line transformers are used. Ground completes the circuit. This system has been used with good success, but the system must be balanced. — L. E. JONES, KEIO, Pocatello, Idaho

* * *

STL Carrier Monitor

IN the use of link equipment between studio and transmitter it has been found that some means of muting the output of the link receiver is necessary when failure of the r-f section in the transmitter or receiver occurs. If the link equipment is of the UHF type there is a loud hiss when the carrier is absent. The ideal place for such muting would be at the second limiter in the receiver. It was found that the voltage at the limiter load varies between 6 v. with 0.05 r-f signal and 35 volts with a full scale r-f reading of 1 on the tuning indicator. This points to the use of a dc amplifier with a relay for muting. There are many ways of doing this but the beauty of the following is its simplicity. With an r-f signal the tube is biased to cut-off and the relay is not energized. This means that in case of relay tube failure the output is unaffected. A 6SJ7 was used because of its sharp



cut-off characteristics since the relay must not be energized over such a large change of input and yet operate without chattering on anything below 6 v. It was connected to the receiver power supply and had no effect on the voltage output since the tube is cut-off with r-f signal present. When the relay is energized it draws about 10 ma. By means of R_1 the voltage at which the relay is energized can be controlled. Resistor R_2 is required for fast operation of relay.—WALTER R. KRAHN, WRZE, York, Pa.

* * *

Field Strength Indicator for Loading Mobile Transmitters

THIS small, handy field strength indicator permits quick and easy tuning and loading of the final stages of a mobile transmitter to give maximum r-f output from the antenna.

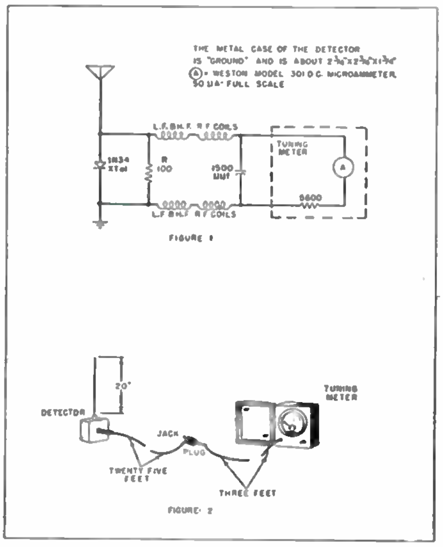
Fig. 1 is the simplified schematic diagram of the indicator. The LF r-f coils consist of about 75 turns of small wire wound on a form about 1¼ inches in length and ¼ in. in diameter. The HF r-f coils consist of about 45 turns of small wire wound on a form about 5/16 inch in length and 5/32 in. in diameter. The coils and 1500 μμf capacitor are used to prevent the r-f currents from passing through the tuning meter.

A 25 foot extension cable is used between the detector and the tuning meter. A PL-68 plug is used on the tuning meter cable and a similar plug and corresponding jack on the extension cable.

To tune and load the final stages of a mobile transmitter in the trunk of a passenger car, the tuning meter is placed in the trunk where it can easily be seen while tuning is in progress. The detector is set in the clear and as far as possible from the car. (It may be on the ground, and must be close enough to get a reading on the tuning meter when the transmitter is turned "on"). The transmitter is then turned "on" and the final stages and loading network tuned for a maximum reading on the tuning meter. This condition indicates maximum power radiated from the antenna.

This method can be used as an *indicator only;* as the absolute readings will be influenced by the shape of the vehicle, distance of the detector from the antenna, and the presence of nearby objects. Nearby moving objects will change the reading on the tuning meter when the transmitter is "on".

This indicator can be used over a wide range of frequencies. The 20 inch antenna shown in Fig. 2 is satisfactory for use in the 148-174 MC band; however, a longer an-



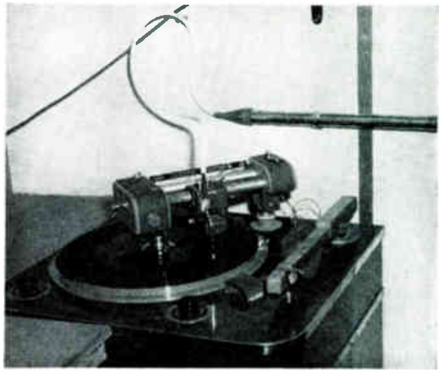
tenna may be satisfactory for use in the 25-50 MC band.

The sensitivity of the indicator may be increased by adjusting the length of the antenna, and by increasing the value of the resistor R. —M. EUGENE COOK, Mobile Radio Engineering Dept., Federal Telephone and Radio Corp., Clifton, N. J.

* * *

Chip Chaser

MANY small stations that have disc recording equipment are not in a position to purchase suction



equipment to dispose of the chip. If the recording equipment employs center pin drive, chip disposal becomes an irritating problem, especially from outside-in cuts. A 10 or 15 minute cut will leave a mess around the center pin and it requires full time attention to keep the chip brushed clear of the cutting surface.

This problem was solved by using a vacuum cleaner, a 6 inch length of ¼ in. copper tubing, 3 ft. of ribbed ¼ in. rubber hose, and the rubber insulator from a large battery clip. The accompanying photograph shows the equipment ready for use. It presents a clean appearance and does a good job.

The large end of the insulator fits over the vacuum cleaner pipe and the small end holds one end of the ¼ in. ribbed hose. One end of the copper tube is flared out and the other inserted into the ribbed hose. Mount the copper tube perpendicular on the recording head carrier with the flared end about ⅜ in. from the recording surface. Some recorder manufacturers can supply a flared tube and clamp to hold it in the proper position, as RCA did for WWBZ.

This vacuum cleaner method will work without the ¼ in. ribbed hose but it is clearly not as flexible and requires an unsightly overhead hook. Ribbed hose was used because it holds its shape better and prevents kinks. Longer lengths of hose were tried first and worked well when recording at 33 1/3 rpm, but choked up at 78 rpm. No background noise has been noticed on any of the records cut to date.—C. V. MULLEN, Chief Engineer, WWBZ, Vineland, N. J.

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Send in Your Ideas!

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Our usual rates will be paid for material used.

TELE-TECH

RECORDER SPECIFICATIONS

Home, Commercial and Broadcast Equipment

TELE-TECH

Manufacturer's Name and Address and Model Numbers	Type	List Price (Dollars)	Type Service Intended	Cabinet Type	Primary Accessories	Normal Recording Time	Auxil. Features Included	Recorder Speeds	Speaker Size (Ins.)	Play-back Out-put	No. Input Chan-nels	Recorder Frequency Response	Lines/In., Channels Tape or Film Recorded
Air King Products Co., 170-53rd St. Brooklyn, N. Y.													
A-725	W	99.95	H, CO	T	M (a)	1 hr			5	1 5			
A-750	W	139.50	H, CO	T	M (a)	1 hr	PH		5	1 5			
Allied Recording Products, 21-09 43rd Ave., Long Island City, N. Y.													
17¼ in. Turntable	D	500.00	PR (1, 2), CO	C, P	AMP (b), TA (b), CU (b)			33⅓, 45, 78 RPM					88-240 lines/in
Ampex Electric Corp., 1155 Howard Ave., San Carlos, Calif.													
300	TP	1575.00	PR (1, 2)	C,P, R	MCP (c), MI (c)	35 min @ 15 in		7.5, 15 in/sec			1	50-15,000 (d)	1 track
450	TP	550.00	H, PR, CO	C		Playback only		3.75, 7.5 in/sec				50-15,000 (e)	2 tracks
Amplifier Corp. of America, 398 Broadway, NewYork 13, N. Y. (TWIN-TRAX)													
810 B	TP	285.00	H, PR (1, 2)	T	VIE (a), M (c), FS (c), HP (c), TK (c), RC (c), VI (c)	1 hr	PH	7.5 in sec	6x9	5	2	50-9.000	2 tracks
810 C	TP	345.00	H, PR (1, 2)	T	VIE (a)	½ hr		15 in sec	6x9	5	2	30-13,000	2 tracks
810 G	TP	375.00	H, PR (1, 2)	T	VIE (a)	1 hr @ 7.5 in	PH	7.5. 15 in/sec	6x9	5	2	30-13,000 (d)	2 tracks
810 B-OV	TP	375.00	CO (5)	T	VIE (a)	1 hr		7.5 in/sec	6x9	5	2	50-9,000	2 tracks
910 B	TP	495.00	H, PR (1, 2)	T	VIE (a)	4 hr	PH	7.5 in/sec	6x9	5	2	50-9,000	2 tracks
580 B	TP	395.00	CO (3)	T		1 hr		7.5 in/sec	6x9	5	2	50-9,000	2 tracks
808 A	TP	89.50		CH		1 hr	PH	7.5 in/sec				50-9,000	2 tracks
Ampro Corp., 2835 N. Western Ave., Chicago 18, Ill.													
730	TP	94.50	H, CO (3, 7)	P	TM (a), M (a), VIN (a)	2 hrs		3.75 in/sec	4x6	2	1	150-5,000	2 tracks
Audiograph Co., 1414 El Camino Real, San Carlos, Calif.													
PR 1200	TP	1250.00	PR (1, 2)	P	AMPS (a), MI (a), VI (a), RC (a), LS (a),	16 min @ 15 in/sec		7.5, 15 in/sec	8	3	4	40-15,000 (d)	1 track
CR 2400	TP	950.00	PR (1, 2)	C	VI (a), RC (a)	33 min @ 15 in/sec		7.5, 15 in sec			1	40-15,000 (d)	1 track
Audio Industries, 1101 Green St., Michigan City, Ind.													
Ultratone	D	129.50	H	P	M (a), VIN (a)	8 min @ 33⅓	AM, PH	33⅓, 78 RPM	5	5	2	80-4500	110 lines/in
Bell Sound Systems, Inc., 555 Marion Rd., Columbus 7, Ohio													
RC-47	D	135.00	H	P	M (a)	11 min @ 33⅓		33⅓, 78	6	2½	3	100-5000	125 lines
RT-50	TP	159.50	H	P	M (a)	1 hr		7.5 in/sec	5¼	2	2	70-5000	2 tracks
RT-50R	TP	189.50	H	P	M (a)	1 hr	AM	7.5 in/sec	5¼	2	2	70-5000	2 tracks
Berger Communications, 109-01 72nd Rd., Forest Hills, L. I., N. Y.													
822	D		H	P	M (a)	4 mins		78 RPM	5	3	2	100-4000	96 lines/in
Berndt-Bach, Inc., 7377 Beverly Blvd., Hollywood 38, Calif. (AURICON)													
CM-72 (16 mm)	F	695.00	H, CO (7), PR (1)		AMP (a), HP (a), M (a)	2¾ min	PH	36 ft min			2	50-5500	1 track
CM-71 (16 mm)	F	1191.00	PR (1), CO (7)		AMP (a), HP (a), M (a)	5½ min	PH	36 ft min			2	30-7000	1 track
RT-80 (16 mm)	F	864.00	PR (1), CO (7)		AMP (a), HP (a), M (a)	5½ min	PH	36 ft/min			2	30-7000	1 track
Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio (SOUNDMIRROR)													
BK-411-U	TP	199.50	H	T	M (a), LS (a), AMP (a)	½ hr		7.5 in/sec	8		2	-5000	1 track
BK-427	TP	209.50	H	T	M (a), LS (a), AMP (a)	1 hr		3.75 in/sec	8		2	-3800	1 track
BK-414	TP	229.50	H	P	M (a), LS (a), AMP (a)	½ hr		7.5 in/sec	6		2	-5000	1 track
BK-414-S	TP	239.50	H	P	M (a), LS (a), AMP (a)	1 hr		3.75 in sec	6		2	-3800	1 track
BK-428	TP	249.50	CO (7)	T	M (a), LS (a), AMP (a)	½ hr		7.5 in/sec	8	2.5	2	-7000	1 track
BK-403	TP	375.00	H	P	M (a), LS (a), AMP (a)			4.5, 7.5 in sec	6x9		3	-5000	1 track
BK-435	TP	195.00	PR	CH	AMP (a), LS (b)	½ hr		7.5 in sec			2	100-5000	1 track
BK-435-S	TP	125.00	PR	CH	AMP (b), LS (b)	½ hr		7.5 in sec					1 track
BK-430	TP		CO (6)	R		4 hrs		3.75 in/sec			14		14 tracks
Crescent Industries, Inc., 4140 W. Belmont Ave., Chicago 41, Ill.													
H-19A1	W	199.50	CO (3, 4, 5, 6)	T	M (a), FS (c), HP (c), TK (c)	1 hr		2 ft sec	3	1	1	80-9000	
H-20A2	W	149.50	H	P	M (a)	1 hr		2 ft sec	5¼	2	3	50-10,000	
Crestwood Recorder Corp., 624 W. Adams St., Chicago, Ill.													
201	TP	189.50	H	P	M (a)	1 hr		7½	6x9	7	1	50-8000	2 tracks
Dictaphone Corp., 420 Lexington Ave., New York, N. Y.													
TIME MASTER	B	350.00	H, CO (3)	T	SM (a)	15 or 30 min		8.8 in/sec	1.5,4	2	2	150-5000	200 lines/in
Eicor, Inc., 1501 W. Congress St., Chicago, Ill.													
15	TP	134.95	H, PR (1, 3, 4), CO (7)	P	VIN (a), M (a), AMP (a)	1 hr		7.5 in sec	6	3	2	80-7500	2 tracks
Fairchild Recording Equipment Corp., 154th St. 87th Ave., Whitestone, N. Y.													
523	D	2985.00	PR (1, 2)	C	CU (a), MC (a), SP (a)	½ hr @ 33⅓		33⅓, 78			1	30-10,000	80-500 lines in
539-K	D	1395.00	PR (1, 2)	C	CU (a), MC (a), SP (a), TA (a)	20 min @ 33⅓		33⅓, 78			1	30-10,000	96, 112, 120, 136
539-G	D	985.00	PR (1, 2)	P	CU (a), TA (a)	20 min @ 33⅓		33⅓, 78			1	30-10,000	96, 112, 120, 136
100	TP	2750.00	PR (1, 2)	C		33 min		15 in/sec			1	30-15,000	1 track
PIC-SYNC	TP	4000.00	PR (1, 2)	C		33 min		15 in/sec			1	30-14,000	1 track

Gates Radio Co., Quincy, Ill.													
CB8R	D	795.00	PR (2)	C	TM (a), SP (a), AMP (c), VI (c), M (c)	17 min @ 33⅓		33⅓, 78 RPM			1	300-7000	96, 104, 112, 120
General Industries Co., Olive & Taylor Sts., Elyria, Ohio													
250	TP, D		H	CH		TP—1 hr, D5— min	PH	3¾ in, 78 RPM					120 lines/in
R90L	D	47.50	H	CH		11½ min @ 33⅓	PH	78, 33⅓ RPM					120 lines/in
R85L-LP	D	53.50	H	CH		15½ min @ 33⅓	PH	78, 45, 33⅓ RPM					180 lines/in
Gray Manufacturing Co., 16 Arbor St., Hartford, Conn. (AUDOGRAPH)													
Master	D	356.77	CO (3, 4)	P	M (a), FS (a)	30 min			4	2	1	100-6000	260 lines/in
Executive	D	318.57	CO (3, 4)	P	M (a), FS (a)	30 min				2	1	100-6000	260 lines/in
Secretarial	D	294.71	CO (3, 4)	P	M (a), FS (a)	30 min				2	1	100-6000	280 lines/in
Grem Engineering Co., 206 8th Ave., Brooklyn 15, N. Y.													
50-1235	TP		H	P	M (a)	½ hr		15 in/sec	8	7	2	50-10,000	1 track
Hallen Corp., 3503 W. Olive Ave., Burbank, Calif.													
B-22	MF	1850.00	PR	P		11 min		18 in/sec	6x9	2	2	30-10,000	
Hallen, Jr.	MF	895.00	PR	P		11 min		18 in/sec	6x9	2	1	30-8500	
Lear, Inc., 110 Ionia Ave., N. W. Grand Rapids 2, Mich.													
WC-318	W	495.00	H, PR	P	M (a)	1 hr	AM, PH	2 ft/sec	8	10		80-7,000	1 track
Lekas Mfg. Co., 111½ S. Fourth Ave., Ann Arbor, Mich. (MUSICON)													
7	TP	199.50	PR (1,2), CO (3,4,5,8)	T	AMP (c)	Playback only		3.75, 7.5 in/sec					2 or 4 tracks
Magnecord, Inc., 360 N. Michigan Ave., Chicago 1, Ill.													
PT6-A	TP	278.00	PR (1, 2)	P, R	AMPS (b)	64 min @ 3.75 in		3.75, 7.5, 15 in/sec				50-15,000	1 track
PT7-A	TP		PR (1, 2)	P, R, C	AMPS (b)	64 min @ 7.5 in		7.5, 15 in/sec				50-15,000	1 track
Magnetic Recorders Co., 7120 Melrose Ave., Beverly Hills, Calif.													
Kaltron	TP	218.15	PR (7)	T	M (a)	1 min			6	2.5	1	100-4000	
J. A. Maurer, Inc., 37-01 31st St., Long Island City 1, N. Y.													
"E"	F	4775.00	PR (1, 2)	P, R	M (a), MI (a)	33 min		36 ft/min			4	80-7500	6 tracks
Miles Reproducer Co., Inc., 812 Broadway, New York 3, N. Y. (RECORDALL)													
DeLuxe	B	890.00	PR	P	AMP (a), LS (a), M (a), TK (a)	7 hrs			4,6 or 8	4	2	50-7500	380 lines/in
Basic	B	550.00	PR	P	AMP (a), LS (a), M (a), TK (a)	7 hrs			4,6 or 8	4	2	50-7500	380 lines/in
Walkie	B	250.00	CO (3)	P	AMP (a), LS (a), M (a), TK (a)	80 min			4,8 or 8	4	2	50-7500	380 lines/in
Walkie	B	375.00	CO (3)	P	AMP (a), LS (a), M (a), TK (a)	80 min			4,6 or 8	4	2	50-7500	380 lines/in
Molded Insulation Co., 335 E. Price St., Philadelphia, Pa. (WIRETONE)													
MR-6	W	149.50	H, PR (1)	T	M (c)	1 hr	PH, AM	2 ft/sec	4	3	1	80-7500	
"O" (office)	W	135.00	CO (3, 4, 5, 8)	T	FS (c), HP (c), TK (c), VIN (c)	2 hrs		1 ft/sec	4	3	1	80-7500	
Movie-Mite Corp., 1105 Truman Rd., Kansas City 8, Mo.													
MAGNEFILM (18 mm)	F	2250.00	PR (2), CO	P	MI (b), HP (c), MI (c), VI (a), LS (a)	28 min		72 ft/min	4x6	8	2	50-10,000	
Mohawk Business Machines Corp., 743 Fifth Ave., New York 22, N. Y.													
Sound Magnet A & D	W	138.75	H, CO, PR	P	FS (a), M (a), TM (a)	1 hr		2 ft/sec	4x6	1.4	3	80-7500	
Telemagnet	W	279.50	H, CO, PR	T	M (a)	1 hr	TKA	2 ft/sec	2	1.4	2		
Operadia Mfg. Co., St. Charles, Ill.													
DUKANE	TP	189.50	H, CO (3,5,8), PR (1,2)	P	M (a)	1 hr		7.5 in/sec	8x9	7	1	50-7000	2 tracks
Peirce Wire Recorder Corp., 1328 Sherman Ave., Evanston, Ill.													
260C	W	400.00	CO (3, 4, 5)	P	VIN (a), LS (a), M (a), FS (b), HP (b), TK (c)	1 hr		2 ft/sec	4	1	1	300-3000	
260	W	390.00	CO (3, 4, 5)	P	M (a), FS (b), HP (b), LS (a), TK (c)	1 hr		2 ft/sec	4	1	1	300-3000	
285	W	350.00	CO (3, 4, 5)	P	M (a), LS (a)	1 hr		2 ft/sec	4	1	1	300-3000	
270	W	300.00	CO (3, 4, 5)	P	FS (b), HP (b)	Playback only		2 ft/sec		0.5			
Pentron Corp., 611 W. Division St., Chicago 10, Ill.													
W 748	W	199.50	H, PR	P	M (a), TM (a)	1 hr	AM, PH					75-7500	
T 3	TP	154.50	H, PR	P	M (a), VIN (a)	1 hr		7.5 in/sec		5		80-8000	2 tracks
C 2	TP	189.50	H, PR	P	M (a), VIN (a)	1 hr	AM	7.5 in/sec		5		60-8000	2 tracks
BW 100	W	149.50	CO (3, 5)	P	M (a), FS (a), TM (a)	1 hr							
Presto Recording Corp., Paramus, N. J.													
PT-900	TP	895.00	PR (1, 2)	P, R	AMPS (a), VI (a)	½ hr		7.5, 15 in/sec		0.6	4	50-15,000	1 track
SR-950	TP	2230.00	PR (1, 2)	C	AMPS (a), VI (a)	2 hrs		7.5, 15 in/sec		0.8	1	50-15,000	1 track
8-DG	D	2644.00	PR (1, 2)	C	AMP (b), SU (b)	¼ hr		33⅓, 78 RPM			1	50-10,000	88-136 lines/in
66-G	D	996.00	PR (1, 2)	C	AMP (b), SU (b)	¼ hr		33⅓, 78 RPM			1	50-10,000	
6-N	D	735.00	PR (1, 2)	P	AMP (b), SU (b)	¼ hr		33⅓, 78 RPM			1	50-10,000	
Y-5	D	771.00	PR (1, 2)	P	AMP (a)	½ hr	PH	33⅓, 78 RPM	10	10	3	50-10,000	112, 224 lines/in
K-10	D	348.00	PR (2), CO (7)	P	AMP (a)	½ hr	PH	33⅓, 78 RPM	8	5	2	50-8000	112, 224 lines/in
Process & Instruments, 80 Greenpoint Ave., Brooklyn 22, N. Y. (BATTRECORDER)													
103*	TP	350.00	CO (3, 4, 5, 6), PR (1)	P	AMP (a), LS (c), M (a), HP (a), TK (c)	½ hr		7.5 in/sec		0.06	1	100-5000	
Radio Corp. of America, RCA, Camden, N. J.													
73-B	D	1250.00	PR (1, 2)	C, T	AMP (b), SU (b)	15 min @ 33⅓		33⅓, 45, 78				30-10,000	90-154
RT-11A	TP		PR (1, 2)	C, T, R	AMP (a)	64 min @ 7.5 in/sec		7.5, 15 in/sec			1	30-15,000	1 track

* Battery Operated and Completely Portable.

** Includes One-year Maintenance.

† Net. Includes Speech and Music recorders only.

B—Plastic Belt
C—Console
D—Disc
F—Film
H—Home
K—Kit
M—Microphone
P—Portable

R—Rack
T—Table
W—Wire
AM—Radio
CH—Chassis
CO—Commercial
CU—Cutting Head
FS—Foot Switch

HP—Headphones
LS—Loudspeaker
MC—Microscope
MF—Magnetic Coated Film
MI—Mixer
PH—Phono
PR—Professional
RC—Revolution Counter

SM—Combination Microphone-Speaker
SP—Spiral
SU—Suction Equipment
TA—Pickup Arm
TK—Telephone Pickup
TM—Timing Meter
TP—Tape
VI—Volume Indicator Meter

AMP—Amplifier
TKA—Automatic Telephone Pickup
MCP—Meter Control Panel
VIE—Volume Indicator Magic Eye
VIN—Volume Indicator Neon
(a)—Included in list price
(b)—Required but not included
(c)—Available but not required
(d)—@ 15 in./sec.

(e)—@ 7.5 in. sec.
(f)—@ 78 RPM
1—Broadcasting
2—Sound Studio
3—Office
4—Factory
5—Store
6—Airport
7—School

Manufacturer's Name and Address and Model Numbers	Type	List Price (Dollars)	Type Service Intended	Cabinet Type	Primary Accessories	Nominal Recording Time	Auxil. Features Included	Recorder Speeds	Speaker Size (Ins.)	Play-back Out-put	No. Input Chan-nels	Recorder Frequency Response	Lines/In., Channels Tape or Film Recorded
Rangertone, Inc., 73 Winthrop St., Newark, N. J.													
R-4P	TP	2025.00	PR (1, 2)	P	LS (a), RC (a), VI (a), MI (c)	3 hrs @ 7.5		3.75, 7.5, 15, 30	8		4	45-15,000 (d)	1 track
R-4C	TP	3000.00	PR 1, 2)	C	LS (a), RC (a), VI (a), MI (c)	3 hrs @ 7.5		3.75, 7.5, 15, 30				45-15,000 (d)	1 track
Rek-O-Kut Co., Inc., 38-01 Queens Blvd., Long Island City, N. Y. (CHALLENGER)													
Standard	D	329.95†	PR (1, 2) CO (7)	P		15½ min. @ 33⅓		33⅓, 78	8		3	50-15,000	109, 120, 144, 192
Custom	D	369.95†	PR (1, 2) CO (7)	P		15½ min. @ 33⅓		33⅓, 78					108, 120, 144, 192
Deluxe	D	399.95†	PR (1, 2) CO (7)			15½ min. @ 33⅓		33⅓, 78			4	30-20,000	108, 120, 144, 192
Revere Camera Co., 320 E. 21st St., Chicago 16, Ill.													
T-100	TP	159.50	H, CO (3, 4)	P	M (a), AMP (a), LS (a), RC (a), VIN (a)	1 hr		3.75 in/sec	5x7	5.5	2	50-7,000	2 track
TR-200	TP	199.50	H, CO (3, 4)	P	M (a), AMP (a), LS (a) RC (a) VIN (a)	1 hr	AM	3.75 in/sec	5x7	5.5	2	50-7,000	2 track
Robinson Recording Laboratories, 35 S. 9th St., Philadelphia 7, Pa.													
Professional	D	800.00	PR (1, 2)	CH	SU (a), SP (c)	15 min @ 33⅓		78, 33⅓					88, 96, 120, 136
Mark Simpson Mfg. Co., Inc., 32-28 49th St., Long Island City 3, N. Y.													
375	TP	189.50	H	P	M (a), VIN (a), RC (c)	1 hr		3.75 in/sec	6x9	5	2	100-7000	1 track
R-3	TP	218.50	H	P	M (a), VIN (a), RC (c)	1 hr	AM	3.75 in/sec	8x9	5	2	100-7000	1 track
Scully Machine Co., 62 Walter St., Bridgeport, Conn.													
Master	D	3875.00	PR	T	SU (a)	20 min @ 33⅓		33⅓, 45, 78					88-385
Sonar Radio Corp., 59 Myrtle Ave., Brooklyn 1, N. Y.													
T-10	TP	395.00	H, PR, CO	P	M (a)	1 hr	AM, PH	7.5 in/sec	12	10	5	35-9,000	2 tracks
RPA	TP	45.00	H	CH	M (a)			7.5 in/sec				35-9,000	
RPA-1	TP	275.00	PR (1), H	P	M (a)	1 hr	AM	7.5 in/sec	5	2	2	35-9,000	2 tracks
S.O.S. Cinema Supply Corp., 602 W. 52nd St., New York 19, N. Y.													
S.O.S.	F	3375.00	PR (2)	T	AMP (b), M (b)	10 min		90 ft/in			1	50-7,500	
SoundScriber Corp., 148 Munson St., New Haven, Conn. (TYCOON)													
Recorder	D	350.00**	CO (3)	T	SM (a), TK (a)	15 min		33⅓		3	1	100-4,000	275 lines/in
Transcriber	D	323.00**	CO (3)	T		15 min		33⅓		0.3			
Combination	D		CO (3)	T		7½ min		33⅓		3			
Speak-O-Phone Recording & Eq. Co., 23 W. 60th St., New York 23, N. Y.													
HR-48	D	159.00	H	P	VI (c), M (c), HP (c)	12 min @ 33⅓		78, 33⅓	6	5	2	100-5,000	112 lines/in
Stancil-Hoffman Corp., 1016 N. Highland Ave., Hollywood 38, Calif.													
Minitape*	TP	212.50	PR, CO, H	P		15 min		7.5 in., 15 in/sec			1	100-5,000	
R4	TP		PR, CO, H	P, C, T		2-2/5 hrs		7.5 in, 15 in/sec	5	3	3	45-15,000	
Tapetone Mfg. Corp., 202 Tillary St., Brooklyn, N. Y.													
Tapetone	TP	229.00	H, PR	P	M (a), LS (a)	1 hr	PH	7.5, 3.75 in/sec	8	3.5	2	100-7,500 (e)	2 tracks
Tapetone	TP	125.00	H, PR	K	M (b), LS (b)	1 hr	PH	7.5, 3.75 in/sec	8	3.5	2	100-7,500 (e)	2 tracks
Universal Moulded Products Corp., Bristol, Va.													
C-1-A	TP	219.00	H, PR, CO	P	M (a), VIE (a)	1 hr		7.5 in/sec	5	4	3	70-8000	2 tracks
Webster-Chicago Corp., 5610 W. Bloomingdale Ave., Chicago 39, Ill.													
180	W	149.50	H	P	M (a), TM (a)	1 hr		24 in/sec	5¼	2	1	70-7,000	
181	W	98.50	H	T	M (a), TM (a)	1 hr		24 in/sec	5¼	1.5	1	70-5,000	
178	W	107.50	H	CH	M (a), TM (a)	1 hr		24 in/sec			1	70-5,000	
Webster Electric Co., 19th & DeKoven, Racine, Wis. (EKOTAPE)													
101-4	TP	389.50	H, CO (3, 4, 5, 7)	P	M (a), VIE (a)	½ hr		7.5 in/sec	8	5	1	80-6,000	1 track
101-5	TP	395.00	H, CO (3, 4, 5, 7)	P	M (a), FS (a), VIE (a)	½ hr		7.5 in/sec	8	5	1	80-6,000	1 track
102-4	TP	407.00	PR (1), CO (7)	P	VIE (a)	½ hr		7.5 in/sec	8	5	1	80-6,000	1 track
102-5	TP	435.00	PR (1), CO (7)	P	FS (a), VIE (a)	½ hr		7.5 in/sec	8	5	1	80-6,000	1 track
105	TP	595.00	PR (1, 2)	P	VI (a)	½ hr		7.5 in/sec		.001	2	80-6,000	1 track
107	TP	1095.00	PR (1, 2)	P	VI (a)	1 hr @ 7.15 in/sec		7.5, 15 in/sec		.001	1	50-12,000 (d)	1 track
Wilcox-Gay Corp., Charlotte, Mich.													
OA10	D	139.50	H, PR (2), CO (3, 7)	P	M (a), VIN (a)	12 Min @ 33⅓	PH	33⅓, 45, 78	5¼	3	2	70-5,000 (f)	120 lines/in
OJ10	D	59.95	H, CO (3)	P	M (a), VIN (a)	4¾ min	AM, PH	78	5	3	1		110 lines/in
OC10	D, TP	187.50	H, CO (3, 7), PR (2)	P	M (a), VIN (a)	D:5 min., TP:1 hr	PH	78 RPM, 3.75 in	5x7	3	2	70-5,000	110 lines/in
Wireway Corp. of America, 1331 Halsey St., Brooklyn 27, N. Y.													
WP	W	149.50	H, CO	P	VIN (a), M (a), FS (a), HP (a), TK (a), TM (a)	1 hr	PH		4x6	1	2	100-5,000	
WS	W	199.50	CO	P	VIN (a), TM (a), FS (a), M (a), HP (a)	2 hrs	PH		4	2	1	250-5,000	
W-N Recorder Corp., 130 W. 48th St., New York 19, N. Y.													
TMP-3	D	159.95	H	P	LS (a), M (a), AMP (a)	15 min @ 33⅓		33⅓	5	4	2	80-8,500	360 lines/in

* Battery Operated and Completely Portable.
** Includes One-year Maintenance.
† Net. Includes Speech and Music recorders only.

B—Plastic Belt
C—Console
D—Disc
F—Film
H—Home
K—Kit
M—Microphone
P—Portable
R—Rack
T—Table
W—Wire
AM—Radio
CH—Chassis
CO—Commercial
CU—Cutting Head
FS—Foot Switch
HP—Headphones
LS—Loudspeaker
MC—Microscope
MF—Magnetic Coated Film
MI—Mixer
PH—Phono
PR—Professional
RC—Revolution Counter
SM—Combination Microphone-Speaker
SP—Spiral
SU—Suction Equipment
TA—Pickup Arm
TK—Telephone Pickup
TM—Timing Meter
TP—Tape
VI—Volume Indicator Meter
AMP—Amplifier
TKA—Automatic Telephone Pickup
MCP—Meter Control Panel
VIE—Volume Indicator Magic Eye
VIN—Volume Indicator Neon
(a)—Included in list price
(b)—Required but not included
(c)—Available but not required
(d)—@ 15 in./sec.
(e)—@ 7.5 in./sec.
(f)—@ 78 RPM
1—Broadcasting
2—Sound Studio
3—Office
4—Factory
5—Store
6—Airport
7—School

NAB Engineering Conference, 1950

Line-up of new equipment and expert speakers promise maximum interest to broadcasters

Neil McNaughten
Director of Engineering, NAB

THE fourth annual broadcast engineering conference of the National Association of Broadcasters will be held April 12-15 at the Stevens Hotel in Chicago. Registration will begin on the morning of Wednesday, April 12.

In addition to the formal meetings of the conference, 40 manufacturers of broadcast equipment and services will sponsor exhibits. Heavy equipment firms which are NAB associate members will occupy the Stevens' exposition hall, while manufacturers of lighter equipment and NAB associate members engaged in service enterprises will use rooms on the fifth floor for display and reception.

Following is the technical paper program.

WEDNESDAY, APRIL 12

Registration Desk open for Engineering Conference.
Location: Exposition Hall, Stevens.
Exhibits Officially Open—Exposition Hall, Stevens.
Meeting, NAB Engineering Executive Committee, Stevens Hotel.
Reception for Conference Registrants, Stevens Hotel.

THURSDAY, APRIL 13

Morning Session

Presiding: J. R. Poppele, WOR, New York City; Member, NAB Engineering Executive Committee.
Five KW Air-Cooled Television Transmitters for VHF, E. Bradburd, Federal Telecommunication Labs., Inc., Nutley, N. J.
Objectives of the NBC Bridgeport, Conn., UHF Installation, Raymond F. Guy, National Broadcasting Co., New York City.
The Bridgeport Installation,
Part I: A One KW UHF Television Transmitter, T. M. Gluyas, RCA Engineering Products, Camden, N. J.
Part II. A Supergain UHF Television Transmitting Antenna, O. O. Fiet, RCA Engineering Products, Camden, N. J.
A Five KW Television Transmitter of Advanced Design, John Ruston, Allen B. DuMont Labs., Inc., Passaic, N. J.
Television Camera Lenses, Dr. F. G. Back, Television Zoomar Corp., New York City.
16mm Telecasting Projectors, Blair Foulds and Frank N. Gillette, General Precision Labs., Pleasantville, New York.

Luncheon Session

Presiding: Neal McNaughten, Director of Engineering, NAB.
Welcoming Address, Judge Justin Miller, President, NAB.
History of Broadcasting, Raymond F. Guy (NBC), President, Institute of Radio Engineers.

Afternoon Session

Presiding: Oscar C. Hirsch, KFVS, Cape Girardeau, Mo.; Member, NAB Engineering Executive Committee.
Television Sound Diplexing in a Television Link, Leo Staschover and H. G. Miller, Federal Telecommunication Labs., Inc., Nutley, N. J.
A Moderate Size Television Studio and Transmitter Installation, Ernest L. Adams, WHIO-TV, Dayton, Ohio
Operation of Bell System Television Network Facilities, Charles E. Schooley, American Telephone & Telegraph Corp., New York City.
A Supergain Antenna for VHF Television WCON, Atlanta, Georgia Installation), L. J. Wolf, RCA Engineering Products, Camden, N. J.
The Evolution of Studio Lighting, Richard

Exhibitors at NAB Conference

Altec Lansing Corp., 1161 North Vine Street, Hollywood 38, Calif.
Amperex Electronic Corp., 25 Washington St., Brooklyn, N. Y.
Ampex Electric Corp., 1155 Howard Ave., San Carlos, Calif.
Andrew Corp., 421 Seventh Ave., New York, N. Y.
Broadcast Advertising Bureau, 270 Park Ave., N. Y. C.
Broadcast Music, Inc., 580 Fifth Ave., N. Y. C.
Capitol Records, Inc., 1483 Vine St., Hollywood, Calif.
Collins Radio Co., 2920 First Ave., Cedar Rapids, Iowa
Columbia Transcriptions, 799 Seventh Ave., New York 19, N. Y.
The Daven Co., 191 Central Ave., Newark, N. Y.
Allen B. DuMont Laboratories, 2 Main Ave., Passaic, N. J.
Federal Telecommunication Laboratories Division, Nutley, N. J.
Bruce Eells & Associates, 2217 Maraville Dr., Hollywood 28, Calif.
Federal Telephone and Radio Corp., 67 Broad St., New York, N. Y.
Gates Radio Co., Quincy, Ill.
General Electric Co., 570 Lexington Ave., New York, N. Y.
General Precision Laboratory, 63 Bedford Road, Pleasantville, N. Y.
H. S. Goodman Radio & TV Productions, 19 E. 53 St., N. Y. 22, N. Y.
Gray Research & Development Co., 521 Fifth Ave., New York, N. Y.
Graybar Electric Co., 420 Lexington Ave., New York, N. Y.
International News Service, 235 E. 45th St., New York 17, N. Y.
Keystone Broadcasting System, 580 Fifth Ave., N. Y. C.
Lang-Worth Feature Programs, 113 W. 57 St., New York, N. Y.
London Library Service, 16-18 W. 22 St., New York 10, N. Y.
C. P. MacGregor Co., 729 S. Western Ave., Los Angeles 5, Calif.
Machlett Laboratories, Inc., 1063 Hope Street, Springdale, Conn.
Magnecord, Inc., 360 N. Michigan Ave., Chicago, Ill.
McIntosh Engineering Laboratories, Silver Spring, Md.
Charles Michelson, Inc., 23 W. 47th St., New York 19, N. Y.
Presto Recording Corp., Paramus, N. J.
RCA, Engineering Products Dept., 30 Rockefeller Plaza, N. Y., N. Y.
RCA Recorded Program Services, 120 E. 23 St., New York, N. Y.
Raytheon Manufacturing Co., 190 Willow St., Waltham 54, Mass.
SESAC Inc., 475 Fifth Ave., New York 17, N. Y.
Standard Radio Transcription Services, Hollywood 36, Calif.
Westinghouse Electric Corp., Sunbury, Pa.
World Broadcasting System, 501 Madison Ave., N. Y. 22, N. Y.
Frederick W. Ziv Co., 1529 Madison Road, Cincinnati 6, Ohio

Blount, General Eelectric Co., Nela Park, Cleveland, Ohio.

FRIDAY, APRIL 14

Morning Session

Presiding: John H. DeWitt, WSM, Nashville, Tenn.; Member, NAB Engineering Executive Committee

UHF Propogation Tests at KDKA, Pittsburgh, Ralph Harmon, Westinghouse Radio Stations, Washington, D. C.

Selecting a Television Transmitter Site for 600 MC and Channel 4, Using Pulse Technique, Lucien Rawls, WSM, Nashville, Tenn.

Theatre Television Control Facilities, Robert Bigwood, DuMont Television Network, New York City.

Graphical Design of Grid Modulated Power Amplifiers for Television, John Lorber, Raytheon Manufacturing Co., Waltham, Mass.

Television Economics, Robin D. Compton, WOIC-TV, Washington, D. C.

Luncheon Session

Presiding: A. James Ebel, WMBD, Peoria, Ill.; Chairman, NAB Engineering Executive Committee.

Afternoon Session

Presiding: K. W. Pyle, KFBI, Wichita, Kans.; Alternate Member, NAB Engineering Executive Committee.

Engineering Aspects of Transit Radio, Charles Sheridan, Transit Radio, Inc., Cincinnati, Ohio.

Facsimile—Present and Future, John V. L. Hogan, Hogan Labs., Inc., New York City.

A New One KW AM Broadcast Transmitter, Lauren K. Findley, Collins Radio Co., Cedar Rapids, Iowa.

Magnetic Recording Advances in 1949 and 1950, W. Earl Stewart, RCA Broadcast Audio Engineering, Camden, N. J.

FCC Audio Proof of Performance Tests, George Adair, Consultant, Washington, D. C.

SATURDAY, APRIL 15

Morning Session

Presiding: Neal McNaughten, NAB

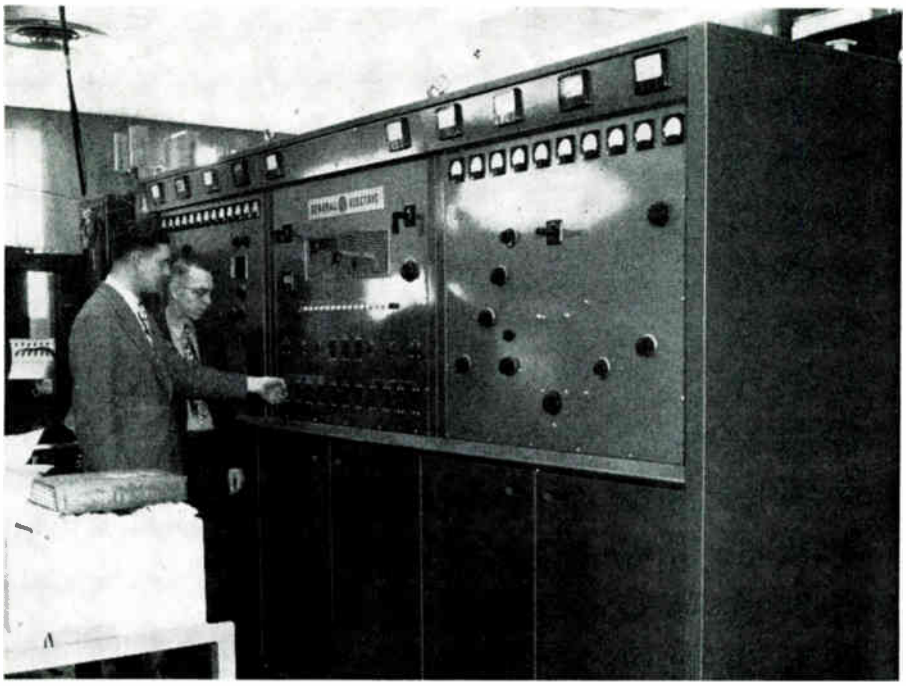
Ten Watt FM for Education, Thane E. McConnell, Collins Co., Cedar Rapids, Iowa.

Engineers and Management, (Name of speaker to be announced).

FCC—Industry Roundtable, Presiding: Stuart L. Bailey, Jansky & Bailey, Washington, D. C.

FCC Participants: John A. Willoughby, Acting Chief Engineer; James E. Barr, Chief, Standard Broadcast Division; Cyril M. Braum, Chief, FM Broadcast Division; Curtis B. Plummer, Chief, TV Broadcast Division; Edward W. Allen, Chief Technical Research Division; Edward W. Chapin, Chief, Laboratory Division.

Industry Participants: (to be announced).



New GE 5 KW low channel TV transmitter—type TT-10-A is cooled by air instead of water and has exceptionally low power consumption and low cost tube complement. This transmitter together with a number of new pieces of TV equipment will be unveiled at the NAB Engineering Conference at Chicago April 12 through 15. Among the other new equipment for studio TV use is a wipe amplifier which produces wipes from left to right and vice versa, full wipes and also local/remote wipes. Because it completes the range of special effects available for TV producers, wide application in TV studios is anticipated

Color TV Demonstration by CTI

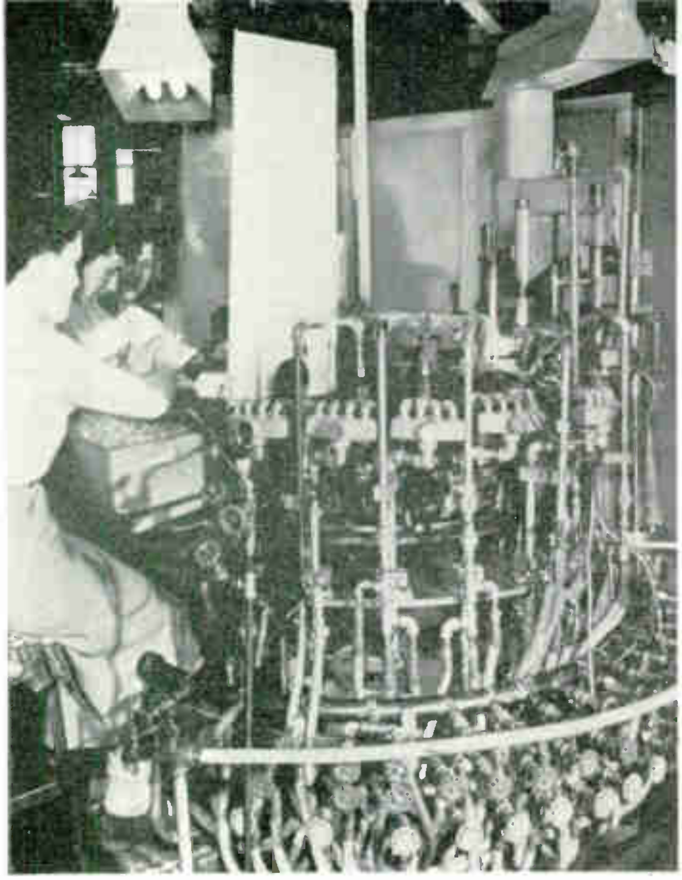
Color Television, Inc. of San Francisco gave their first demonstration for the FCC on Feb. 20 in Washington and three days later joined in the comparative tests at Laurel, Md. The quality of the color images on both occasions was disappointing.

The resolution was low, about 100 lines; the pictures averaged 3 ft.-lamberts; although mis-registration detracted somewhat the color fidelity was judged to be fairly good. The engineers apparently had trouble in making the equipment perform because CTI claimed much better results were shown in Califorfnia. They demonstrated the "vertical shift" whereas they claimed that the "horizontal shift", which they could not get to work, would give increased resolution.

By March 13 the equipment had been reworked and was again shown to the press and informally to members of the FCC. The "horizontal shift" still was not working. The resolution was still about 100 lines but some of the early fuzziness was gone: mis-registration still was a problem and color fidelity was fairly good in spite of color contamination at the outlines of large objects; picture brightness was considerably improved to about 5 ft.-lamberts.

With this improved picture a better evaluation of the present system could be secured. Close examination indicated considerable line jitter, correct interlacing was not obtained, with the result that the resolution was considerably below that shown by RCA and less than the 180 lines read from the CBS test chart by the FCC engineers. CTI stated that when the "horizontal shift" plus the "double shift" was made to work it was believed that the resolution and the degree of interlace would be equal to that of a 525-line monochrome picture. Before work on these improvements can go forward it is necessary for the CTI staff to return to their San Francisco laboratory.

If the line interlaced CTI system is to be considered in an early FCC decision on Color Standards it might be necessary for some other TV laboratory, say RCA or Philco, who have suitable equipment, to show, under carefully controlled conditions, line interlaced pictures utilizing any "shift" CTI might specify, even the "horizontal" plus the "double shift." Engineering standards should not be determined by observing TV pictures in color of pretty girls, bowls of fruit or baskets of flowers. Scientific color and resolution charts have been devised which measure the effectiveness of a system in concrete numbers, not subjective impressions.



(Left) Three operators feed wire leads and glass flares into a stemming machine which automatically fabricates them into stems on which the gun elements are mounted. This is an extremely important operation for errors in the gun mounting such as a poor weld or loose seal can show up later in processing causing an expensive and sometimes irreparable reject

(Above) Sealing-in operation in which the electron gun is automatically located in the neck of the tube and sealed into position by an oxygen-gas torch. Welding flat screens to rectangular cones calls for the highest degree of care and precision in manufacture of blanks to avoid uneven pressures

Manufacture of Rectangular TV Tubes

Mass production of these new type picture tubes introduces new processing and handling technics in the Hytron plant, Salem, Mass.

(Left below) Depositing fluorescent material on the inner face of the tube. The dispenser in the center of the illustration positioned above the base end of the tube pours a measured quantity of fluorescent solution. Vibration-proof mounting assures an even screen coating. After baking at 385° C. the gun is sealed into the tube which is then based and tested

(Right) Rectangular TV tubes undergoing the standard production performance tests. Ion trap test ensures proper operation with all types of trap

A Simple Microwave

Designed to meet the communication requirements of utility, mining, oil small size, use of standard components, lower costs, and ease of main-

By *MAURICE G. STATON, Communications Products Group, Engineering Products Dept., RCA Victor Div., Camden, N. J.*

IT is understandable why private companies which have operated their own conventional wire and carrier communication systems for many years are intrigued by the possibilities of microwave radio relaying but hesitant about installing a radically new type of communication system. However, work started in the early thirties and carried on continuously since that time at RCA has proved that microwave radio relaying can provide efficient and economical point to point communication facilities which are so vitally needed by private and public organizations today.

There are a number of frequency bands assigned to operational point to point service not for hire. "Operational" means communication circuits such as telemetering, supervisory control, teletype, and voice communications as applied to the control of a power system or pipe line system.

There are advantages and disadvantages to be gained at either the high end or the low end of the microwave spectrum but the following factors indicate that the 890-940 MC and 952-960 MC frequency blocks in the low end of the microwave spectrum are ideally suited for systems of moderate capacity:

1—A relatively small transmitter and receiver using conventional type tubes throughout is possible. Klystrons, magnetrons or planer grid tubes need not be used.

2—Sufficient transmitter power together with antenna gain is available to permit operation of a multiple voice band system over paths up to 60 miles in length.

3—Microwave components are kept to a minimum.

4—Overall cost for an installation is lower.

5—Propagation characteristics are more desirable.

6—Power supply voltages do not need to be excessive or well regulated.

7—Crystal control for both transmitter and receiver is not too difficult.

8—Design can be almost entirely along conventional lines permitting maintenance by service men normally handling mobile communication equipment.

The higher antenna gain to be realized at the higher microwave frequencies is offset by the increased difficulty in obtaining transmitter power, the higher cost of components and tubes and the difficulty in stabilizing transmitter frequency at the higher microwave frequencies.

Basic Radio Equipment

Two complete RCA CWTR-5A Terminal Equipment units, designed to operate in the 952-960 MC band, are shown in Fig. 1.

CWTR-5A units are designed for unattended multihop operation, the maximum number of consecutive hops being dependent upon the number of channels and quality of circuit desired. Each channel of a

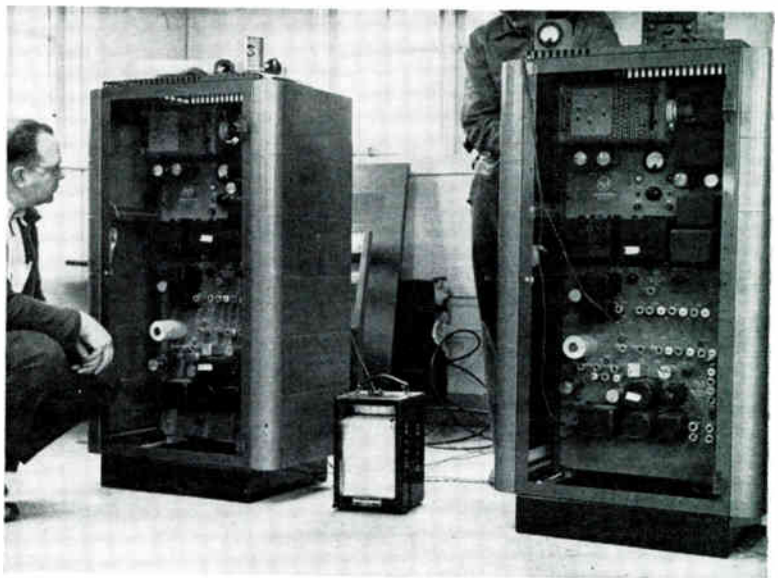


Fig. 1: (Below) Two complete CWTR-5A equipments that have been under continuous test operation. (Left) Antennas used with 952-960 MC installation

Relay Communication System

and other public and private organizations, this new equipment features tenance. Details of a typical power utility installation are described.

four-channel system over a 60 mile path will have a signal-to-noise ratio of about 40 db. The random nature of noise on a microwave circuit is such that a perfectly intelligible conversation can be carried on over a channel with a signal-to-noise ratio as poor as 10 db.

The usable band width available over the radio circuit for transmission of intelligence is 200 to 30,000 cps. By means of a simple type frequency division channeling equipment this 30 KC band can be broken down into a maximum of five 3000 cps channels for facsimile or voice transmission. Each of these voice channels can be subdivided by small frequency division units into as many as 16 signaling channels suitable for telegraph, teletype, telemetering or supervisory control functions. The signaling speed will determine the number of signal circuits available in each voice channel.

The transmitter and its power supply are mounted on a standard 19-in. panel 19 in. high. The exciter unit which obtains its power from the transmitter is mounted on a 7-in. panel. Except for the final tube in the transmitter unit all the tubes are of the common types now used in the HF or VHF frequency ranges.

Fig. 2 is a block diagram of the transmitter and the associated exciter. The transmitter frequency is controlled by a standard type quartz crystal having an accuracy of better than 0.005%. Stability requirements for this band are 0.01%. The crystal oscillator operates at approximately one megacycle depending upon the final carrier frequency. A modified Van B. Roberts phase modulator follows the oscillator and this is followed by four multiplier stages. The frequency at the exciter output is roughly 50 MC and this is connected to the transmitter by a short section of coaxial line. The frequency is then doubled, tripled and tripled again in the final to produce the 960 MC carrier. The first two transmitter stages are a 2E26 and an 829. The final stage is a 4X150A. This tube is a tetrode of conventional structure except for the fact that it is designed for use in a coaxial circuit. The grid, screen and plate instead of being brought out to tube prongs are all connected to pins and rings which are concentric to each other. Fig. 3 is a drawing showing a cutaway view of the final stage coaxial cavity in which the 4X150A tube is mounted. All the exciter and transmitter tubes are operated well below their rated value for the purpose of obtaining the maximum in tube life.

Tuning of both the exciter and the transmitter is simple and direct. Sufficient metering is provided and it is only necessary to peak each stage. The tuning of the final

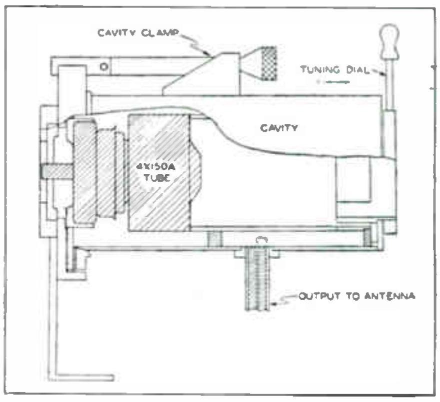


Fig. 3: Diagram of transmitter final coaxial cavity mounting the 4X150A

output cavity is by means of a single little circular disc actuated by a short metal arm.

The exciter will accept input levels as low as −40 dbm which is one-tenth of a microwatt in a 600 ohm line. This low input level permits full modulation from extremely low power sources and permits the use of a simple bidirectional connection to a through circuit at a repeater station. The transmitter power output is not less than three watts and the frequency swing of the 960 MC carrier when 100% modulated is plus and minus 150 KC.

Fig. 4 is a rear view of the double superheterodyne receiver with its self-contained power supply

Fig. 2: Block diagram of transmitter and the associated exciter. The transmitter frequency is crystal controlled by a standard type quartz crystal having an accuracy that is better than 0.005%

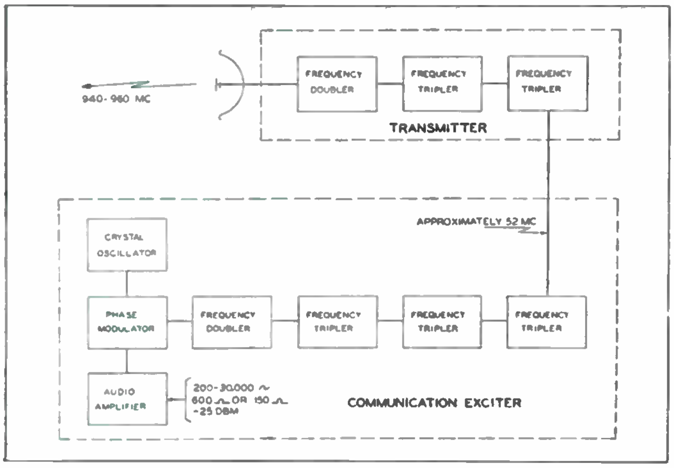
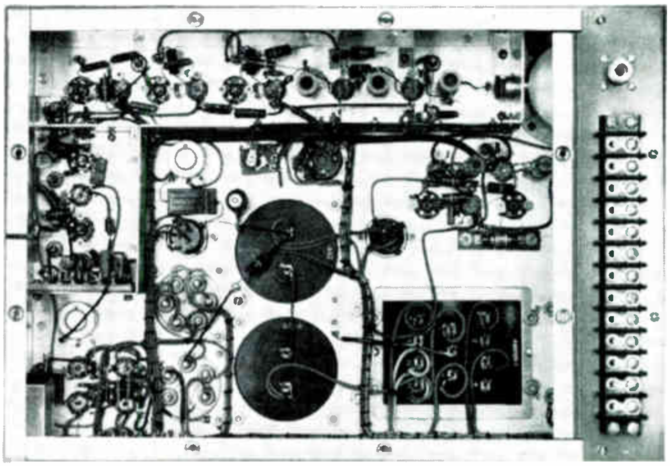


Fig. 4: Rear view of the double superheterodyne receiver with its self-contained power supply. Unit mounts on standard 19-in. panel and is 12¼-in. high. Conventional miniature tube types are used.



mounted on a standard 19-in. panel 12¼ in. high. Primary consideration in the design of this receiver has been given to long life, stable operation and ease of maintenance. All components are easily accessible. Except for the power supply rectifier tube all the receiver tubes are conventional miniature type tubes operating below 450 MC. The block diagram of the receiver shown in Fig. 5 shows how closely the layout follows conventional design.

The unusual part of this receiver is the coaxial input cavity which is the one part in the receiver operating at the frequency of 960 MC. The single moving part in the cavity is for tuning, as shown in the cutaway preselector drawing of Fig. 6. The first intermediate frequency obtained from this cavity is 120 MC and the second i-f frequency is 19 MC. The discriminator is followed by an audio amplifier having the low distortion necessary for multichannel service, the output level and characteristic being determined by whichever of three de-emphasis networks are selected. In addition to the broadband output there is an additional audio amplifier stage which will provide an output of approximately 0.5 watts for a monitor speaker. Also included in the receiver is a carrier-operated relay which operates whenever a proper carrier is received and can be used to operate a VHF transmitter or as an alarm indicator for loss of carrier or circuit failure.

The antenna for both the transmitter and receiver consists of a dipole mounted at the focal point of a 42-in. spun aluminum parabola. In front of the dipole is a round metal disc which reflects the forward radiation of the dipole back into the parabola. The gain of this antenna and associated parabola is roughly 17 db greater than an omnidirectional dipole. Thus the combination of the transmitting and receiving parabola gives a power gain of 34 db or 2500 times. The received signal is equivalent to that of a 12½ kw transmitter using a dipole antenna. The antenna can be located as far as 300 to 400 ft. from the radio equipment. Either RG-8/U solid line or ⅞" semi-flexible gas-filled line can be used, depending upon the loss permissible.

Monitoring Repeater Equipment

In an installation requiring unattended repeater stations it is highly desirable to have some means of monitoring the performance of the repeater equipment. Often the repeater station will be at some remote location and if suitable fault indicating equipment is in operation the repeater station in trouble can be determined prior to emergency visits. A compact fault indicator panel has been designed which will send indications to all terminals whenever trouble occurs. It will indicate which repeater station is in trouble and which unit has failed at that station. Thus, needless maintenance trips can be kept to a minimum.

All the radio equipment for a two-way terminal can be mounted in a single 49-in. rack. A complete two-way repeater station can be mounted in a single 84-in. rack. Space required for channeling equipment will be determined by the circuit requirements. However, since the channeling equipment is designed to mount on both sides of an open frame rack and since the individual modem panels are only 3½ in. high, it would require a very heavily loaded circuit to exceed a single rack of equipment. The channeling equipment can be located next to the radio equipment or at any reasonable distance. The only restriction is that the tie line must have a good frequency characteristic up to 20 KC and low attenuation.

The equipment in Fig. 1 has been in continuous operation at one of the test houses for over a year. It was left in normal operation during this period to prove the design, determine average tube life and operating characteristics. Performance has been excellent and minimum tube life which is such an important factor in a system operating continuously, has been in excess of 5000 hours.

A typical power utility communication system is shown in Fig. 7. The dispatcher's office is usually located in the business district, often at a relatively low elevation. This office controls two hydro plants, an interconnecting substation, and a mobile service VHF fixed station. One hydro plant is served via two relay stations — "A" and "B". The second hydro plant is served via relay station "A". The interconnecting substation is served via a direct radio link from the dispatcher's office. At relay station "A" there is also located the mobile VHF fixed station which permits good radio coverage of the area served by the radio equipped service cars.

This is merely an example of what a power system network

Fig. 5: Block diagram of receiver using coaxial input cavity

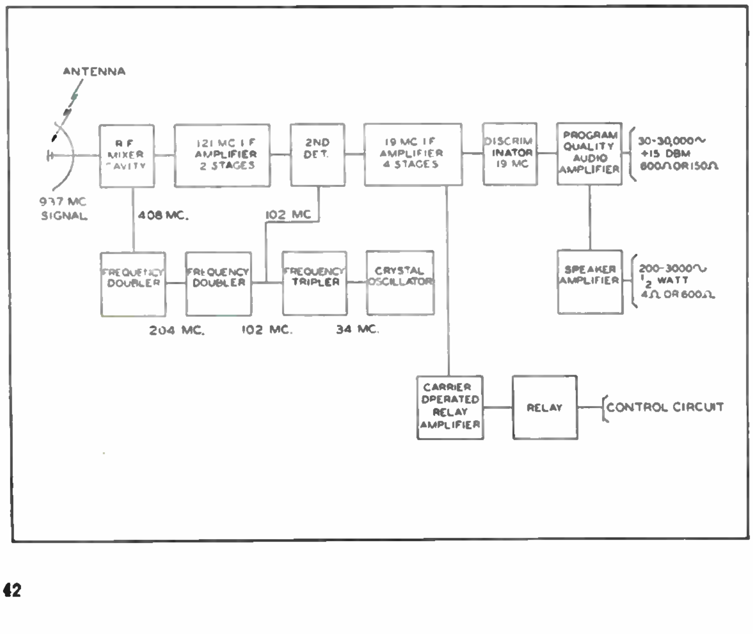
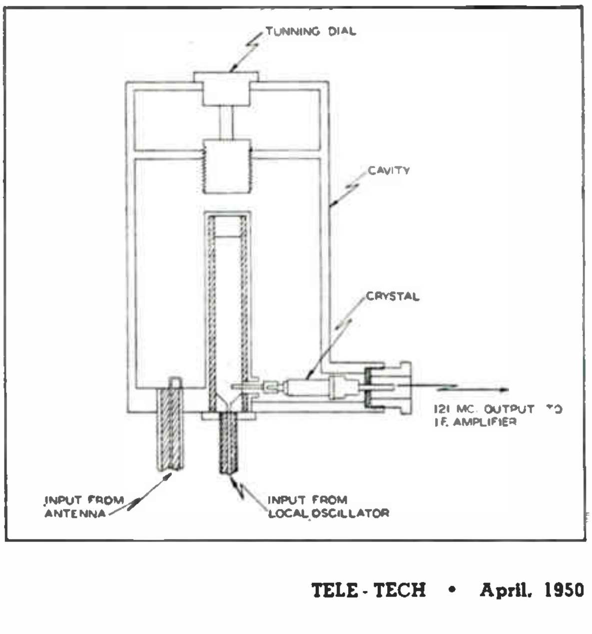


Fig. 6: Preselector drawing showing single tuning element



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might look like. A water system or gas system would be similar except that the radio circuits would serve pumping plants, gas-holder installations, etc.

What this typical system might look like in the way of channels is shown in Fig. 8. The blocks labeled "T" and "R" represent the 960 MC transmitters and receivers respectively. The blocks labeled 1, 2, 3 and 4 represent voice-band channeling equipment. The blocks marked "TEL", "TM" and "LC" at the various stations represent the various telephone, telemetering and load-control terminations. It will be noted that the dispatcher's office has direct telephone communications with each station, telemetering channels incoming from each hydro plant or substation and load control or supervisory control channels outgoing to each station. The link out to relay station "A" also provides a duplex voice channel which connects with the VHF transmitter and receiver.

It is evident that a single 960 MC circuit is capable of carrying a sufficient number of channels to control quite a large system for the blocks marked "TM" and "LC" actually represent many single circuits.

For such an installation the number of r-f channels required is not large since the same frequencies can be used over and over. For instance, only two frequencies are required for the entire two-way circuit from the dispatcher's terminal to the most distant hydro station. By alternating the direction of transmission of each frequency at each relay station interference is eliminated.

This illustrates how a microwave radio circuit might be applied to assist in the operation of a power, gas, water system or oil pipe line. The building blocks are available for a simple installation or an extremely complicated system covering a great area. Some installations may use duplicate radio circuits to prevent such things as tube failures from causing a circuit break. The degree of reliability desired will determine the standby equipment required and the type of emergency power equipment.

Selecting Station Sites

Performance of a microwave circuit over a path of reasonable length and known terrain can be predicted to a good degree of accuracy. In surveying, planning and installing microwave installations in various parts of the United States during the last five years, it has seldom been found possible to achieve paths over 35 miles in length without the necessity of installing towers over 200 ft. in height. Such factors as access roads, existing commercial power lines, desired location of terminal telephone equipment in relation to surrounding hills and desired circuit reliability influence the selection of station locations and hence the path length. Actual installations made to date have an average path length in the order of 20 to 25 miles.

The best starting point in laying out a proposed system is a U.S.G.S. contour map of the area concerned. Tentative relay station and terminal station sites can be selected and profiles plotted of the paths. The contour maps, due to their age and changes which occur during the years, do often show sizeable errors in elevation. After the tentative paths are plotted it is essential that the elevation of the station locations be checked in the field with an accurate altimeter. The elevation of obstructions or near obstructions showing on the profiles should also be checked in the field with an altimeter. These high spots in the path or near the path should also be inspected to locate buildings or high trees which can be an effective obstruction to the microwave beam.

Calculating Path Loss

After the tentative paths are selected, the anticipated path loss should be calculated using simple formulas and curves showing the estimated loss due to obstructions or near obstructions in the paths.

During the past five years a file of path profiles in various locations and their associated calculated and measured path losses have been collected in order to be better prepared to predict performance over paths for new installations. Due to the fact that this reference information is far from complete it has been necessary to provide portable propagation test equipment to actually check in the field the path loss for proposed installations. The portable microwave test equipment and gas engine power supplies are actually set up in the field at the proposed station locations. The dipole antennas with their two foot parabolic reflectors are raised on portable aluminum masts. The received signal strength is measured and compared with the calculated path loss. If the disagreement is greater than the allowable margin of error, the profile is rechecked and if necessary the station locations are modified until actual performance is within the allowable path loss limits.

Fig. 7: Operating locations in typical power utility system

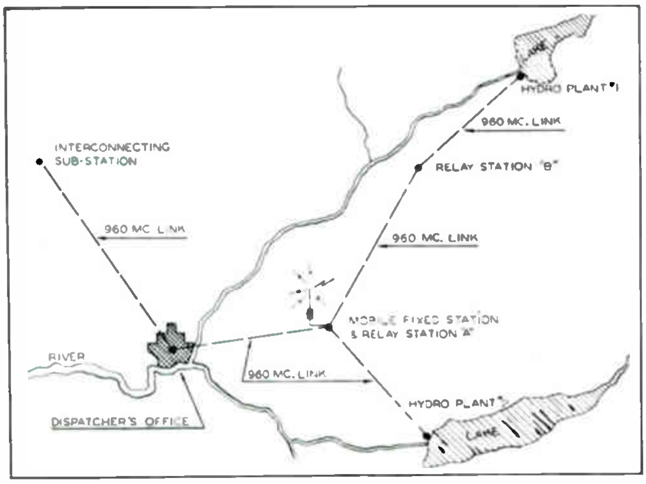
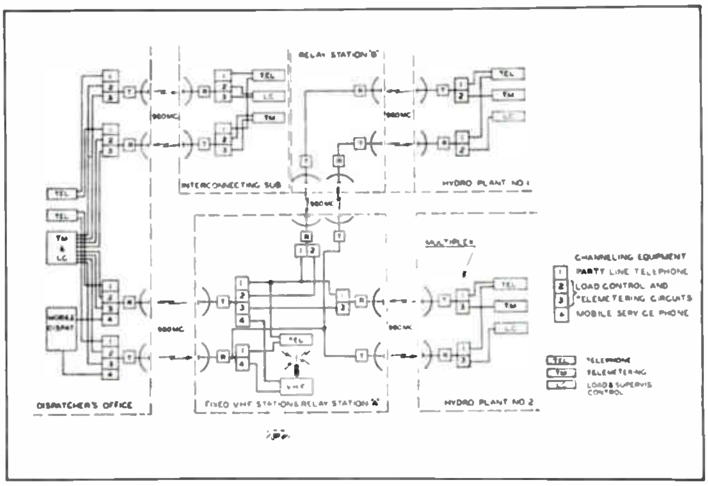


Fig. 8: Diagram showing communication channels of typical system



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WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by Tele-Tech's Washington Bureau

(Because of the importance of this highly competent Presidential Board's studies of the frequency situation, we are summarizing this development here (and on the Radarscape page) at greater length than is usually devoted to news events in the National Capital. — Editors)

PRESIDENTIAL FREQUENCY BOARD, with notable engineers in majority, to scrutinize frequency problems—Radio-electronic engineers can rest assured that the engineering viewpoint will be given the fullest consideration in the problem of radio frequencies and the determination, "on a continuing basis," of a sound and equitable allocation of the limited frequency supply, by the new national Communications Policy Board of President Truman. This follows because of the selection of three outstanding engineers of the country and the board chairman, West Virginia University President Irvin L. Stewart, former FCC Commissioner and wartime top assistant to Dr. Vannevar Bush in the Office of Scientific Research and Development.

DISTINGUISHED ENGINEERS on the new CPB are President Lee A. DuBridge of the California Institute of Technology who headed the Massachusetts Institute of Technology Radiation Laboratory during the war; Dean William L. Everitt, head of electrical engineering of the University of Illinois, former president Institute of Radio Engineers, and wartime director of operational research and development for the Signal Corps; and President James R. Killian, Jr., of the Massachusetts Institute of Technology. The fifth board member is David H. O'Brien, retired vice president of Graybar Electric Co. and former assistant administrator of War Assets Administration (war surplus).

END OF COLOR—TV HEARINGS—The torturous trail of the FCC's color television hearings has now been virtually concluded and the Commission will be in a quandary for a decision until its staff has fully analyzed and digested the record of the testimony. Hence no decision appears likely until Summer or maybe early Fall. There has been one outstanding development in that the RCA system has so steadily improved and the progress in simplification of color receivers has been so notable that the FCC is now definitely thinking in terms of the RCA and CBS systems on an even plane, where previously CBS was out in the forefront. Color Television Inc. of San Francisco has also demonstrated its color-video system before the FCC and if its improvements come along fast its system might well bulk into the Commission's final determinations.

FCC REVIEWS COLOR UHF, FREEZE—Meanwhile, the FCC has let another concern into the color-TV proceedings, the Celomat Corporation of New York which declares it has developed a converter adapted to the CBS system which can be manufactured at a low cost. At the same time, the Commission denied intervention in the proceedings for (2) the Wells-Gardner & Co., a leading radio manufacturing company, and (2) the Communication Measurements Laboratory of New York which has a proposed dot-sequential color television system designed to operate in an 8-MC channel. At any rate, the FCC, if it follows the demands of the television field, should buckle down immediately on an intensive proceeding regarding the UHF allocation plan and the lifting of the VHF "freeze".

SPREADING OF MILITARY CONTRACTS—In an effort to stimulate the spreading of radio-electronic procurement contracts by the Armed Services, the Munitions Board Communications-Electronics Committee in a meeting March 28 with leading representatives of the radio manufacturing industry, who form a so-called "task group" of the Electronics Equipment Industry Advisory Committee to the Board, presented a tentative blueprint toward this goal. The plan would be that large military equipment contracts would not just be awarded to a single company but would be spread among two or three manufacturers even though the cost of the apparatus might be slightly higher to the Armed Services. But the value would be that the various manufacturers would be able to establish production machinery for these different types of apparatus which could be implemented quickly in the event of a war emergency.

AVIATION RADIO BLAZING TRAIL—Aviation radio may be pointing the way to other major radio services with international frequency problems in the present plan of regional ICAO conferences on coordination and conservation of frequency space. That the outcome of the extraordinary Administrative Radio Conference of the International Telecommunications Union, slated to start probably at Geneva in September is all-important to radio services of the United States so as to bring about international standardization of frequencies and equipment was recently the warning of FCC Commissioner E. M. Webster in an address. Commissioner Webster, one of the two engineer-commissioners, urged American radio interests and manufacturers to prepare fully to present through the Government delegation at the coming conference the standards of this country for the rest of the world's guidance because the United States leads the globe in "know-how" in the telecommunications field.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

TELE-TECH's NEWSCAST

Belvoir Field Station Opened

A new radio propagation field station which will make continuous measurements of radio waves reflected from the upper atmosphere has been established at Fort Belvoir, Virginia, by the National Bureau of Standards. The Belvoir Field Station, made possible by the cooperation of the Army's Corps of Engineers and Signal Corps, is one of a system of 14 stations operating under the supervision of the Bureau's Central Radio Propagation Laboratory as part of a world-wide network of over 50 radio observatories.

The station, occupying some ten acres of countryside near the Potomac River, 13 miles south of Washington, consists of four separate buildings designed for ionospheric and geophysical measurements. Equipment includes the latest in field intensity recorders, ionospheric recorders, and visually-recording magnetographs. Data gathered at the new station will be used in the preparation of predictions three months in advance of the best frequencies for short wave radio communication as well as warnings of sudden radio disturbances.

Motorola Microwave Communications Installation

Motorola, Inc., has been awarded a contract by the Texas Gas Transmission Corp. for a pilot installation of microwave communications equipment. If this pilot installation proves satisfactory, plans will be made to eventually adopt microwave communications for the company's entire pipe line system.

Consisting of two terminal stations and one repeater station, the system will utilize a frequency with a wave length only 1¾ in. long. Using parabolic and flat reflectors and three 150 ft. towers, it will transmit narrow beams of these high-frequency radio waves between the stations.

New TV Transmission Line Unveiled by Army

A revolutionary telephone and television transmission line having many industrial and military uses was announced by the Army Signal Corps at the annual convention of the IRE last month. The line, which is simple, highly efficient, and costs little to manufacture, promises to open up wholly new possibilities in microwaves and home television. It is a single wire with special insulation and funnel-shaped terminals.

Inventor of the line is 43-year-old Dr. Georg Goubau of the Signal Corps Engineering Laboratories, Fort Monmouth, N. J., who presented a paper to the IRE entitled "Surface Wave Transmission Line." His work was based on a paper published in 1899 by A. Sommerfeld of the University of Munich. The Signal Corps, which calls the device a "G-string" after the inventor's initials, expects it to bring important improvements to radar operation. It also may replace coaxial cable, which is both intricate and expensive, for many applications.

One immediate use of the "G-string" may be as an inexpensive means of distributing television programs to city homes on a "wired wireless" basis—at present prohibitively high in cost. It also may be possible to pipe television programs at relatively low cost to areas of the United States now out of television range; for instance, to midwestern farm belts.

Joint AFCA-Signal Corps Program at Ft. Monmouth

What is expected to be the most pretentious communications and electronics program in the long history of the Army Signal Corps will be presented at Fort Monmouth, N. J. on Saturday, May 13 under the sponsorship of Fort Monmouth Chapter, Armed Forces Communications Association and the Signal Corps.

The Fort Monmouth program is scheduled for the day following the annual National AFCA convention at the Commodore Hotel, New York, under the auspices of the New York Chapter. The annual dinner meeting will be held at the Commodore the same night, with a nationally important speaker not yet announced.

The program will feature elaborate displays from the Signal Corps Engineering Laboratories, the Armed Services Electro-Standards Agency and The Signal School of Fort Monmouth; parachute drops by the 82nd Airborne Division, weather permitting, wire laying demonstrations by helicopter and bazooka, and a combat communication problem in which 82nd Airborne troops will figure if the weather is good. The completed problem will be designed to stress signal communications.

SMPTE Makes Stand on TV and Films

The Society of Motion Picture and Television Engineers (SMPTE) has issued a statement summarizing its position regarding motion pictures & television. The Society regards sound films as most desirable for public entertainment presentations. It urges the wide use of film programs wherever possible.

As regards use of film for television broadcasting, the Society proposes that film producers study all new methods of film production, whether arising from television operations or otherwise, which may lead to economic and acceptable films for the theatre or television broadcasting.

SUPER BEAM TRIODE

Dr. L. P. Garner, head of Advance Development Labs., RCA Lancaster, Pa., tube plant shown with the new "super-power beam triode" which is capable of 500 kw output, and which has been tested at one million watts input. Compact design weighs only 135 lbs. and measures 38¾ in. in length. Present applications are for CW high power operation and for international broadcasting

Bell Adds Memphis to TV Networks

Memphis, Tenn., was joined to the Bell System's expanding television networks on March 1, bringing to 26 the number of cities receiving network telecasts by means of Bell System facilities, which now extend about 9,000 channel miles in length.

Inclusion of Memphis makes it the southernmost point reached by network television at the present time. The new television net work link was made possible by adding special equipment to an existing section of coaxial cable which runs south from St. Louis, Mo.

Programs from New York reach St. Louis via Chicago. En route to Memphis the cable crosses the Mississippi from east to west at St. Louis and again, this time from west to east, at the Tennessee metropolis. This cable has for many months been providing hundreds of long distance telephone circuits to help carry the heavy telephone traffic along the route between the midwestern and southwestern areas of the nation.

Ionospheric Physics

The Pennsylvania State College, State College, Pa., will be host on July 24, 25, and 26 to a three day conference and symposium designed to acquaint scientists in the field of physics, relative to the upper atmosphere, with the latest theoretical and experimental developments. Approximately twelve papers will be presented and speakers from several foreign countries are expected to participate.

Coming Events

April 3 (week of)—URSI-IRE Joint Meeting on Antennas and Propagation, Navy Electronics Laboratory, San Diego, Calif.

April 4-8—National Production Exposition, Sponsored by Chicago Technical Societies Council, Hotel Stevens, Chicago.

April 5-7—Midwest Power Conference, Sponsored by Illinois Institute of Technology with cooperation of 18 universities and professional societies, Sherman Hotel, Chicago.

April 12-15—National Association of Broadcasters, Fourth Annual Engineering Conference, Stevens Hotel, Chicago.

April 15—New England Radio Engineering Meeting, Sponsored by North Atlantic Region of the IRE, Somerset Hotel, Boston, Mass.

April 19-22—Electrochemical Society, Fourth Annual Meeting, Hotel Statler, Cleveland, Ohio.

April 24-28—Society of Motion Picture and Television Engineers, National Symposium on Film Technics for Television, Drake Hotel, Chicago.

April 29 — IRE, Cincinnati Section, Fourth Annual Spring Technical Conference, Engineering Society Hdqts., Cincinnati, Ohio.

May 3-5 — IRE Conference, Dayton Section, Dayton Biltmore Hotel, Dayton, Ohio.

May 12-13—Armed Forces Communications Association. Fourth Annual Meeting, Astoria, New York City, and Fort Monmouth, N. J.

May 22-25—Parts Distributors Show, Hotel Stevens, Chicago.

June 26-30 — American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N. J.

July 10-13 — National Association of Music Merchants, Annual Convention, Palmer House, Chicago.

July 24-26—Conference on Ionospheric Physics, Pennsylvania State College, School of Engineering, State College, Pa.

August 23-26—AIEE Pacific General Meeting, Fairmont Hotel, San Francisco, Calif.

August 28-31—Associated Police Communication Officers, Inc., National Conference, Hotel Hollenden, Cleveland, Ohio.

September 13-15—IRE West Coast Convention and 6th Annual Pacific Electronic Exhibit, under joint sponsorship of the IRE and the West Coast Electronics Manufacturers Assoc., Municipal Auditorium, Long Beach, Calif.

September 25-27—National Electronics Conference, Edgewater Beach Hotel, Chicago, Ill.

October 17-21—AIEE Midwest General Meeting, Netherland Plaza Hotel, Cincinnati, Ohio.

LETTERS . . .

Lift the Freeze NOW!—

Editors, TELE-TECH:

The television industry has been hamstrung long enough by the Frozen Communications Commission. The manufacturers have warehouses full of transmitter equipment which was built in the belief that television was going ahead. Now they cannot give it away, and sales staffs are being released since there are no customers. In this time when the nation needs high productivity and first class economy the broadcast industry is being forced to retrench, which will in turn affect the pockets of almost every taxpayer due to increased relief payments and lowered income taxes from manufacturers. If the VHF freeze were to be lifted it would be a wonderful present for the industry, and many men, who today wonder if they will be working by mid-1950, would have an easier time. The color probe has served merely to delay the result of the hearings and benefit some of the very large companies who can afford to weather out the doldrums while the smaller ones without much capital resources may soon begin sinking. I say lift the VHF freeze now and consider color and the UHF later. There may be no need to go to the UHF band if as TELE-TECH points out the government's stranglehold on unused frequencies can be eased.

JAMES B. FORREST

Chicago, Ill.

Matching Links

Editors, TELE-TECH:

In re-reading the text I forwarded on "Coaxial Impedance Matching Links" which was published in the December issue of Tele-Tech as a Page from an Engineer's Notebook, I feel that a few additional paragraphs might be desirable from the standpoint of completeness. These are as follows:

The circuit of Fig. II shows no paths directly from the load terminals to ground. This implies that the load is located in free space. In all practical cases, these paths exist and are not always of high impedance. These paths are important because they carry unbalanced currents which place the entire load at some voltage to ground. This results in a measured impedance different from the true impedance. These paths become important sources of error when their impedance is low and when the length of the transformer is far from a half wave length. The corrections obtained by equation (2) are such that a single transformer is seldom used farther than 30% from its half wave frequency. This is not far enough to cause serious trouble from the load to ground impedance normally encountered.

The load to ground impedance can be evaluated at any frequency, but the computations required are more work than that required to make a new transformer nearer a half wave length long at the frequency under consideration."

F. E. BUTTERFIELD

Andrew Corp.
Chicago, Ill.

Protests Color-TV that Brings Lowered Standards

Editors, TELE-TECH:

The hearings on TV color are now about at the peak of interest. Your pages have described the systems being studied, and have noted the comments pro and con about the systems. It seems that all the proposed systems are deficient. In many ways, therefore, thoughtful friends of TV must concur with those far-sighted engineers who object to any retrogression in the quality of television reproduction.

While a colored version is nice, yet to get it at the cost of going back to the quality standards of a decade ago, (441 or even 405 lines), seems a bit hard to swallow. Dropping to 24 frames, in addition, is a little destructive. When one considers, (as engineers immediately do) that the 10 to 15% loss of time in the fly-back interval results in a 50% increase in total lines lost, compared to the present system, the results are most discouraging.

Assuming that the flyback interval can be kept down to 10% a 441-line raster is still under 70% effective, giving something around a 300-line picture. This is well below the capabilities of all other parts of the system and places a potential limit to future

(*Continued on page 64*)

Tape vs. Disc Recording Trends

AN interesting direct-mail survey of recording engineers in the broadcasting and transcription fields was recently conducted by a prominet blank recording disc manufacturer. TELE-TECH editors were privileged to review the results of this survey and present herewith some of the more interesting findings.

The magnitude of interest in tape recording is amply demonstrated by the fact that in spite of the length of the questionnaire, which asked twenty questions with subdivisions, 458 (appr. 50% of total mailing) engineers and transcription people took the trouble to complete and return it.

As to the future of tape recording, the particular question asked was, "Do you believe that tape recording will eventually supplant disc recording (except perhaps for the phono-record industry)?" Considering only the direct answers, 299 people said, "No" as against 89 who answered, "Yes". In other words, only about one recording man in four believes that magnetic tape will ultimately replace discs.

The second half of the question asked, "If not (that is, *tape will not supplant discs*), what percentage of recording do you believe will be done on tape?" Answers ran the gamut from 5% to 99% with three-quarters of the opinions in the middle bracket ranging from 25% to 80%, and the largest single group (68 answers) estimating 50%.

Additional light is thrown on the tape vs. disc situation by the answers to the question, "Since you began using tape recording, has your consumption of blank discs decreased, increased, or remained about the same?" 270 said *decreased,* 33 said *increased,* 90 said *remained about the same.*

Of those who experienced a decrease, the average of all estimates indicated a decline in disc use of about 50%. Since, however, approximately one engineer in three that now does at least *some* tape recording still consumed as many as or more discs than previously, it follows that disc recording even with tape users is not off an average of more than 25 or 30%. Considering also that a substantial section of the sound recording industry has not yet begun to use tape and that the applications for both kinds of recording seem to be widening, it appears that, because of tape, overall disc consumption may be off at the most 10 or 15%.

(*Continued from page 62*)

progress toward better quality, by edict rather than by circuit limitations. Why should engineers strive to circumvent those limitations when a system bottleneck is prescribed that might make further progress futile?

Other engineers have been curious about the many circuit changes involved for dual sets: black and white at the standard rates of the present, and color at a 144-field, 31752 line system, when flyback voltage sources, deflection systems, and other parts of the set are so intimately tied up to the horizontal line frequency.

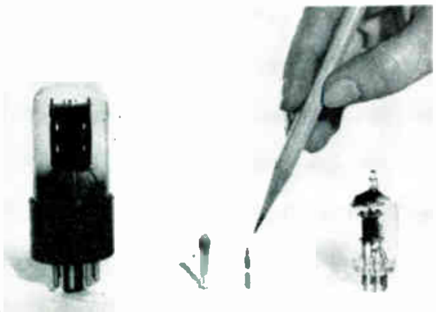
The technical aspects of present TV have been developed by following the advancements of the engineers, of the industry—not the promoter's ideas. The color systems so far discussed are all ingenious and interesting and the industry should be given the greatest encouragement to continue its work on an experimental basis. But this is no time to disrupt TV's growth by deciding technical matters by governmental edict, that would catch 90% of the research and engineering men off base.

New York, N. Y. JOHN K. PRENTISS

Plummer Named FCC Chief Engineer

Curtis B. Plummer, 37, chief of FCC Engineering Bureau's Television Division, has been named FCC chief engineer succeeding John A. Willoughby, who has held position on "acting" basis since January 1948. Mr. Willoughby was named assistant chief engineer.

NEW TRANSISTOR DESIGN



Shown above is the latest version of the transistor. Developed by the Air Material Command of the U. S. Air Force its small size is emphasized by comparison with standard tubes. Very similar to the original transistor, it differs only by having high input and low output impedances and is known as a "Fieldistor". Small size and weight renders it valuable for air-borne radio

Fifth TV Antenna on Empire State Bldg.

WCBS-TV will be the fifth station to transmit TV signals from the Empire State Building. Already used by WNBT, and WJZ-TV with an interim installation, the tower of the building will be extended by the addition of a 200 foot mast carrying the five antennas (WNBT, WJZ-TV, WPIX, WABD, WCBS-TV). The successful integration of five powerful VHF transmitters operating on such widely varying frequencies will pose complicated problems for the engineers responsible for the project.

BOOKS

Radar Systems & Components

By The Technical Staff of the Bell Laboratories. Published in 1949 by D. Van Nostrand Co., 250 Fourth Avenue, New York 3, N. Y. 1042 pages. Price $7.50.

Generally speaking, this book is not a detailed technical discussion but more a description of the individual components which constitute a radar system. However the chapters on reflex oscillators, radar antennas and cavity effects go into considerable length in their investigation of the phenomena observed. A chapter on testing radar is so thorough that it seems almost adequate as a basis for establishing a radar test section. This reviewer did not have the good fortune to become familiar with the subject during the recent conflict, hence the entire contents of the book are of great interest to him. Even for the more familiar reader there is much to make this a worthwhile addition to his library.

Giant Brains, or Machines That Think

By E. C. Berkeley. Published November 1949 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 270 Pages. Price $4.00.

Beginning with a clear picture of how a computer works, the author follows with a detailed analysis of many other forms of computers, now classified in the science of cybernetics. These include the electro-mechanical form of computers such as Harvard's Mark I and II, and the second Differential Analyzer at M.I.T., and other forms such as the Bell Telephone Relay Calculators and the EINAC, the pioneer electronic digital. A useful supplement is included on mathematical ideas and terms, and a list of references to over 250 scattered articles and papers.

Introduction to Luminescense of Solids

By H. W. Leverenz, RCA Labs., Princeton, N. J. Published January, 1950 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 569 pages, 172 illus.; 6 by 9¼. Price $12.00.

Basic information is given on the chemistry, crystallography, and physics of phosphors in the first chapter. Two other chapters present the factors involved in selecting, applying, and using phosphors for particular results. Phosphors are described in terms of preparations, compositions, structures, and physical characteristics, using specific examples of phosphors to illustrate each general feature.

The author gives practical help with specific mention of the best present phosphors and their methods of application for use in, for example, "fluorescent" lamps, cathode-ray tubes, electron microscopes, "radium dials," nuclear particle counters, x-ray fluoroscope screens, displays with ultraviolet ("black light"), sniperscopes and snooperscopes, infrared-sensitive metascopes, and icaroscopes. References list practically all the worthwhile literature in the field (over 1000) drawn chiefly from the published work of the last decade.

16mm Sound Motion Pictures

By William H. Offenhauser, Jr. Published by Interscience Publishers, Inc., 215 Fourth Avenue, New York 3, N. Y., 1949. 580 pages. Price $10.00.

This is a book which has long been overdue in the field of semi-professional motion pictures. The whole gamut of 16mm film theory and application is covered, from raw-stock manufacture to release prints. Certainly it is a book which should be in the hands of everyone in the field of television who has anything to do with film operations.

Although primarily a technical reference book it is not so technical that the reader needs to be a graduate engineer. In fact, mathematics and involved explanations are omitted. Projectors and cameras are described in detail as well as the means whereby prints are made. Color receives moderate treatment as does processing. As is to be expected from the title, sound is treated in great detail and everything the film user needs to know about sound recording on film is included.

Technic of Radio Design—2nd Edition

By E. E. Zepler. Published 1949 by John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. 394 pages, 283 illustrations. Price $5.00.

The author has endeavored to systematize the technics by proper theoretical analyses from which a radio receiver designer will be able to foresee complications and work out constructional and circuit principles so that operational troubles are not likely to occur. Starting with a general review of high frequency theory, the "paper" work accompanying the designing of a radio receiver is outlined, from the antenna coupling through the various forms of oscillators, amplifiers and detectors, to the speaker. Chapters are devoted to selectivity, noise, gain control, hum, spurious beats and distortion. The principles of screening and feedback are discussed. Finally, several chapters relate to the practical application of these principles to actual equipment and to its subsequent testing.

BOOKS RECEIVED

Television Tube Location Guide

Published 1950 by Howard W. Sams Co., Inc., Indianapolis 5, Ind. First Edition. Contains tube layouts for 219 television receiver chassis. 5½ by 8½ in. Price, $1.50.

IRE West Coast Meet

The "IRE West Coast Convention of 1950" will be held in the Municipal Auditorium, Long, Beach, Calif., on September 13-15.

The important technical program combined with the Sixth Annual Exhibit of the West Coast Electronic Manufacturers Association makes this one of the outstanding IRE events of the year.

FCC Converter for CBS Color TV

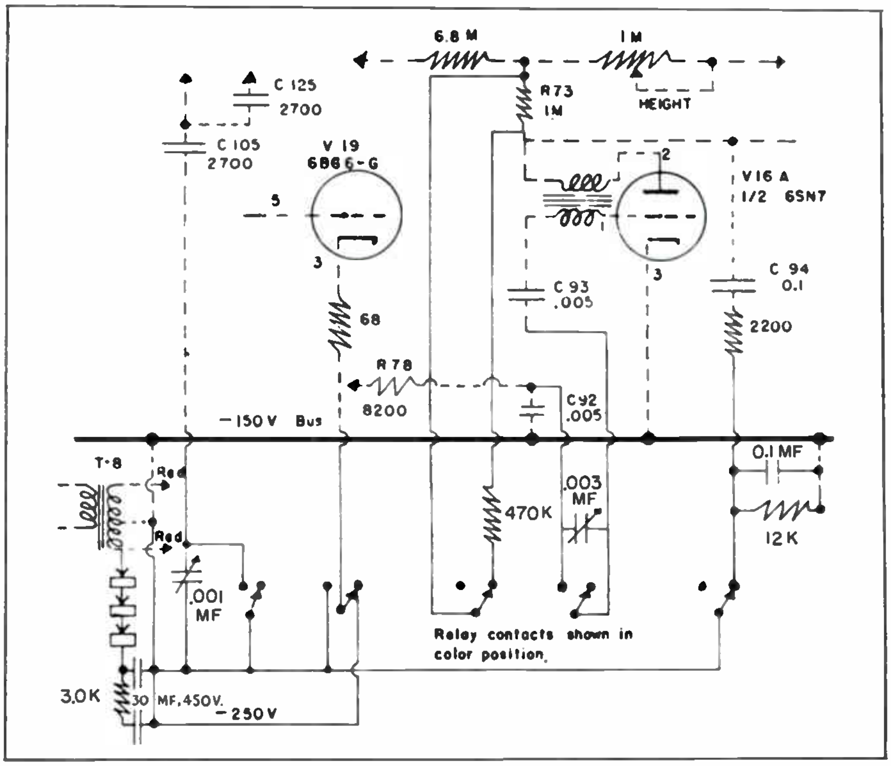


Fig. 1. Sweep circuit of Bendix receiver showing changes made to permit automatic changeover from 525 line transmission to 405 lines. Broken lines indicate original circuit.

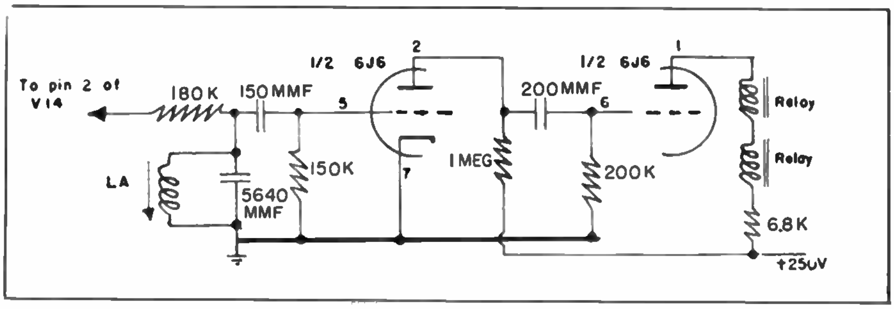


Fig. 2. Schematic diagram of frequency selective circuit which operates the relay to change circuit constants. The selector circuit is tuned by LA, an RCA linearity control.

DURING the FCC Color Hearing E. W. Chapin, Chief of the Laboratory Division of the FCC, developed a frequency selective relay control circuit which automatically changes the receiver scanning frequency to 405 lines if a CBS color transmission is received.

The receiver used in the tests was a Bendix, type 235M1, and the changes made in the scanning circuits are shown in the schematic diagram, Fig. 1. Fig. 2 shows the frequency selection circuit. The relay is a 5 P.D.T. 3 ma movement operating in the plate circuit of a 6J6. When the relay is tripped by a 405 line scanning signal it changes the cathode bias on the 6BG6 and the circuit constants of the vertical and horizontal oscillators, thus automatically setting the receiver controls for color characteristics. The total parts cost is given as $16.34, but this of course would be considerably reduced in commercial production.

V. OF A. USES TV—An unpublicized application of television to international politics is the installation in the Voice of America Studios, 224 West 57 Street, New York City. A complete receiving system made by Industrial Television Inc., Clifton, N. J., has screens in every announce studio. This makes it possible for a running commentary to be made with the proper propaganda angle, while watching the event on television.

PERSONNEL

Harry R. Seelen has been named manager of the Lancaster Engineering Section of the RCA Tube Dept. He succeeds **Dr. Dayton Ulrey**, who has retired and is now a consultant to the company.

William E. Neill, former sales engineer of the television and microwave engineering department of Raytheon Manufacturing Co., Waltham, Mass., has joined WFMY-TV, Greensboro, N. C., as chief engineer.

Roger Bowen has been named chief engineer of Cannon Electric Development Co., Los Angeles, Calif. He has been acting chief since 1947.

Joshua Sieger has been elevated to the post of vice president in charge of engineering of the Freed Radio Corp., 200 Hudson St., New York City.

L. G. Haggerty has been appointed director of manufacturing of the Capehart-Farnsworth Corp., Fort Wayne, Ind., a subsidiary of the International Telephone and Telegraph Corp.

Dr. Edward B. Doll is a recent addition to the engineering staff of Stanford Research Institute, Stanford, Calif. For the past three years he was chief engineer of North American Philips Company of New York.

Dr. Antonio R. Rodriguez has been named head of Electrical Reactance Corp.'s ceramic laboratory at Franklinville, N. Y. He was previously affiliated with Zenith Radio Corp.

Arthur L. Chapman has succeeded **E. E. Lewis** as general manager of the Colonial Radio and Television Division, Sylvania Electric Products, Inc.

Jay L. Fisher has been appointed production control manager of the tube division of the Allen B. Du Mont Laboratories, Inc.

At the last meeting of the board of directors of the Capehart-Farnsworth Corp., Fort Wayne, Indiana, **Joseph C. Ferguson** was elected assistant vice president in charge of research and advanced development.

Howard C. Callahan, formerly assistant to the chief engineer of the U. S. Recording Co., has been named as chief engineer for WASH-FM by Everett L. Dillard, president and general manager of the station.

Gerald C. Schutz has been appointed chief engineer of Gibbs Manufacturing & Research Corporation, Janesville, Wis. Mr. Schutz was formerly chief of the radar technics unit at Air Materiel Command.

RESEARCH FACILITIES

(*Continued from page 28*)

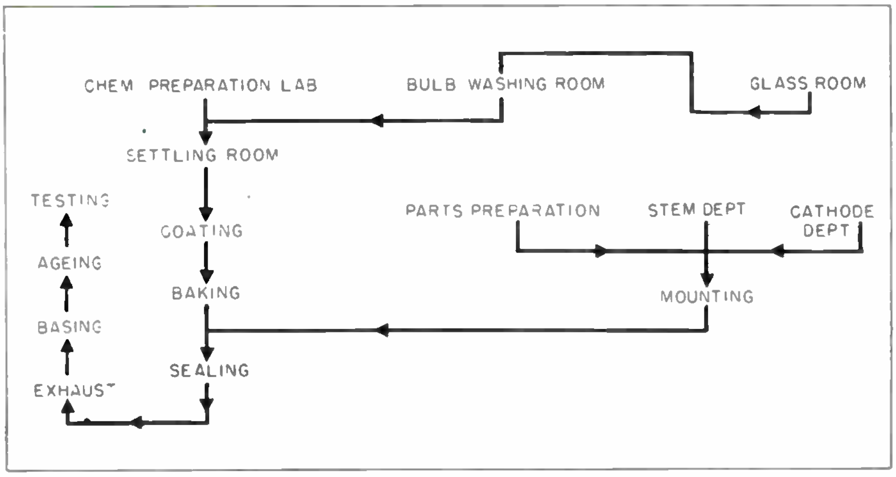


Fig. 7: Preparation of samples of experimental cathode ray tube types requires a long sequence of construction steps as illustrated by the functional flow chart above

rary" dies so that the pieces are all true to size. In some cases, other fabrication methods are used, such as spinning.

When completed, the tube is subjected to many tests beyond those usually associated with common tube characteristics, such as: an overload test, its performance under high ambient temperatures, shock and vibration tests. Such tests may be made at varying filament voltages. In addition long life investigations (10,000 hours), effect of immersion in acid solutions to test corrosion, and specific heat shock tests are under way.

For such measurements, a laboratory with equipment with many special types is available to the project group: specially designed shock machine, vibrators and centrifuges, cold chambers, humidity chambers, and many items of an elaborate electrical equipment that might ordinarily not be expected in a tube production line. Data from this continual flow of tube models is collected and correlated and once in a while a design is perfected that becomes a commercial type.

Another function of a laboratory of this type which is engaged in perfecting versatile line of vacuum tubes, is to conduct basic research in many fields. A few typical problems are: Carbon mixtures for accurate resistors operating in vacua, secondary emitter studies, cataphoretic coating methods for insulating materials, new deflection systems for beam tubes and high-current guns.

Such basic research laboratory requires scientific instruments of many fields. The above mentioned mas spectrograph is one example of the great length to which a physicist goes to learn a little more about some of the unexplained effects that occur in a tube. Many other unusual research setups might be found in other rooms in this division. Some ten other basic problems are under investigation at present. Some of these go on almost continuously. We find studies on the wetting of metals by glass, research on production of tubes with over 100 leads, and tubes with transconductances of over 50,000 micromhos.

A research organization is charged not only with the development of new tubes, but with anticipating production problems and outlining procedures and technics that will prevent costly delays. When once tooled up and in production, millions may be made in a single run. It is not generally realized that the development, tooling and other costs on even a small receiving tube, that may not appear to be different from others already in production, may exceed $50,000.00.

In the case of larger tubes, as, for instance, cathode ray tubes, the problem is even greater in view of the greater number of separate steps in the process, as the flow chart shows.

CBS Color TV Progress

Dr. Peter Goldmark announced during the recent FCC color hearing that the principle of dot interlace scanning has been adapted to the CBS color TV system. This method is already well known, having been developed by Philco and RCA. In principle it operates in much the same way as line interlace in the vertical direction, and results in virtually doubling the horizontal resolution. Six tubes are required, in addition to the usual number, to obtain the dot interlace, however, this figure will probably be reduced as development continues. Provided incorporation of this feature can be accomplished without increased cost it should improve the acceptance of CBS color which has often been criticized on the grounds of alleged inferior horizontal resolution.

In line with this announcement comes word of a new disc converter made by the Celomat Corporation of 521 West 23 Street, New York, N. Y. This converter is made in two models, one which will sell for about $9.00 and have a manual synchronizing control and another which will be raised about $20.00 and have automatic sync. phasing. In each case the disc is driven by a planetary reduction gear between the motor and disc.

Grating Generator

(*Continued from page 25*)

remaining half of V-3, and the clipped wave is then fed to the cathode follower to form the bars in the output.

The output of the grating generator is direct-coupled to the high side of the input gain control on the camera control. This supplies sufficient signal to the camera to couple into the viewfinder and give a clear grating, and also feeds through the camera control to give an excellent signal to the camera control monitor and any following master or line monitors. Because of the high plate load of V-4, the dc. component coupled into the station equipment is too low to cause any trouble. Direct coupling has the advantage of giving more clearly defined stripes.

Visually, the overall signal consists of narrow black lines followed by narrow white lines. This is very convenient since the black lines are more practical for checking camera and master monitors with their fairly large screens, while the white lines are best for the view-finders with their smaller screens and higher ambient light.

Geer Color TV Tube Sold to Technicolor

Dr. Willard Geer of the University of Southern California, holder of patents on a three-color television tube, has sold his invention to the Technicolor Corp. The Geer tube employs a screen of pyramid sections. Each pyramid face is coated with color sensitive material and fluoresces red, blue or green under the bombardment of three guns.

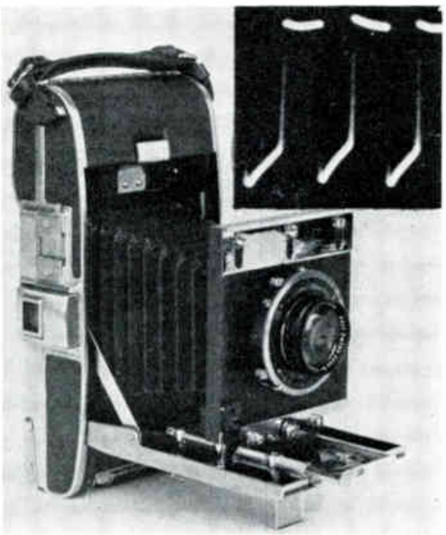
RCA has also obtained some rights to the invention, and it is understood that $500,000 will be spent by Technicolor on development of the tube.

Polaroid-Land Photography for CROs

By ***ELI BLUTMAN***
Signal Corps Engr., Labs.,
Ft. Monmouth, N. J.

IN photographing cathode ray traces on oscilloscopes there is considerable delay in viewing the finished photographic image due to the necessity of relatively slow and troublesome darkroom processing. Where a series of photographs is to be taken, developing the film after each exposure becomes quite tedious. Separate handling of individual exposures is eliminated by the use of 35mm roll film cameras, but the complete series must be photographed and the entire film developed before any exposure can be viewed. Repetition of an entire earlier phase of the experiment is often required to replace an unsatisfactory exposure when this method is used.

The direct camera method of oscilloscope recording can be facilitated by the Polaroid-Land process which uses a novel film and "dry" developing to yield a finished print one minute after exposure. At present, however, this film and process is commercially available only in an amateur type camera, which is not very suitable for CRO photography.



Modified Polaroid-Land camera has a front which accepts standard Speed Graphic lensboard and has an added focusing screw and scale. Inset is photo of 100 cycle multivibrator wave shape taken at 1/25 sec. exposure, f/4.5, magnification 1/3, viewed on a 5PLI tube in a DuMont 208B type scope

At the Signal Corps Engineering Laboratories, Fort Monmouth, New Jersey, a Polaroid-Land camera was modified for this purpose by designing a new camera front to accept the standard Speed Graphic lensboard. This modification permits choice of a wide variety of available lenses and shutters. An added focusing screw and scale permits setting the selected lens for predetermined image sizes in sharp focus.

The Polaroid-Land film has a speed rating and spectral response comparable to Super XX, allowing short exposures at f/4.5 with any of the commonly used phosphors. In the course of making a series of records, the correct exposure is easily determined and adjusted as necessary, since the photograph is available one minute after the exposure is made.

Electric Instrument Manual

A new, revised edition of General Electric's "Manual of Electric Instruments" has been announced by the company's Meter and Instrument Divisions. Its thirteen chapters explain the fundamentals of such instruments as thermocouples, synchroscopes, frequency meters, and electric telemeters. Priced at $1.00 per copy, the "Manual of Electric Instruments" (GET-1087A) may be obtained from General Electric Co., Schenectady 5, N. Y.

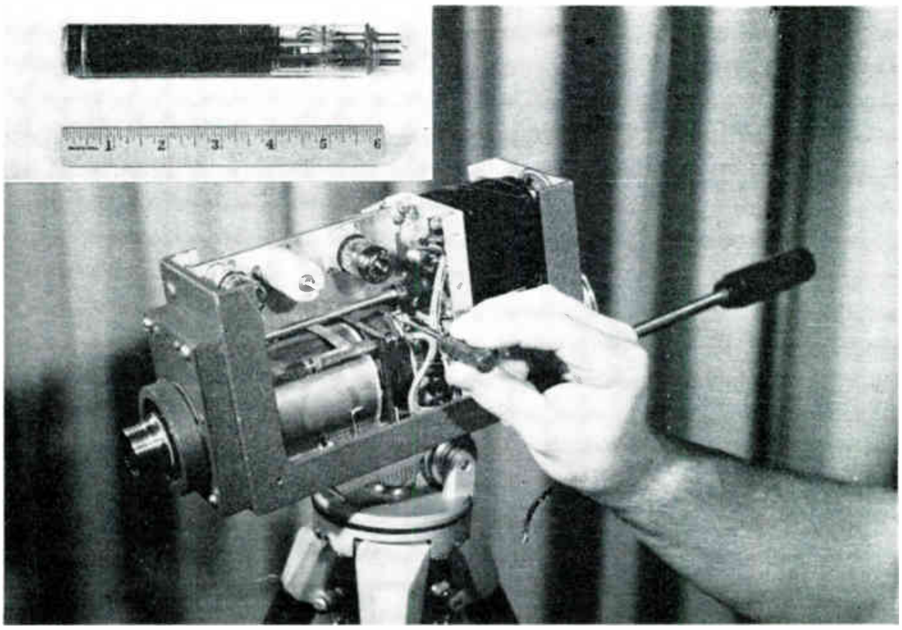
Kingsize TV Tubes

Dr. Allen B. DuMont has announced the development of a 30 inch television tube. Long a protagonist of large tubes rather than projection units for television receivers this is in line with his theories. Public use receivers are expected to find greater use for these mammoth tubes than home receivers. Technical details will be available shortly.

New Corning Plant

A new glass plant to be constructed in Albion, Michigan, for the manufacture of glass bulbs for television picture tubes has been announced by William C. Decker, president of Corning Glass Works. The plant, which will have a floor area of more than 300,000 square feet, will be erected on a thirty-one acre site.

The Albion plant marks the latest expansion of Corning's television bulb manufacturing operations, which began 22 years ago when the company supplied the first hand-made bulbs for experimental work in research laboratories.



Interior of Vidicon camera used in the new RCA industrial television system which was introduced at 1950 IRE convention. Tube, shown in inset is only 1-in. in diameter and 6-in. long. Pictures can be transmitted at normal lighting levels and attain a resolution of more than 500 lines. Camera measures 10 x 3¼ x 5-in. and has a remote focusing mount which permits operator to adjust optical focus by remote control from master unit. The master control unit is 24 x 8¼ x 15-in., weighs 58 lbs., and contains regulated power supply, small synchronizing signal generator, video strip and all scanning deflection equipment for both the camera and a 7-in. monitoring kinescope which is located within the unit.

Color TV System for Closed-Circuit Use

The first color television system designed specifically for industry was demonstrated at the IRE Convention last month by Allen B. Du Mont Laboratories, Inc. Dr. Du Mont emphasized that his organization had developed a high color fidelity, high resolution, wide-band television system, specifically for non-broadcast, closed-circuit industrial applications. Television broadcasting's problem of narrow bandwidth and compatibility which has restricted picture resolution and color fidelity in other color systems was ignored in the design of this new industrial system.

BULLETINS

"Ruggedized" Instruments

The Marion Electrical Instrument Co., Manchester, N. H. has released a new booklet describing its line of "Ruggedized" electrical panel instruments. These instruments were firmly mounted to panels and subjected to 2,000 ft-lb. blows in each of three orientations with respect to direction of applied blow. They were unaffected by severe vibration tests for six hour periods and tumble testing in a large compartmented barrel for one hour.

Rotary Switches

The new 12-page catalog of ESCO Type P rotary switches gives detailed, up-to-the-minute information on the use of these multi-pole, snap switches. Catalog 1950-P is free on request to Electro Switch Corp., 167 King Avenue, Weymouth 88, Massachusetts.

Components

Radio Shack Corp., 167 Washington St., Boston 8, Mass. has just published the largest catalog in its history — a 152-page catalog covering the fields of industrial electronics, communications, television, high fidelity music systems, recording, testing, and research.

Instrument Transformer Design

A 12-page booklet (B-4319) recently released by the Westinghouse Electric Corporation describes construction features of the complete Westinghouse line of instrument transformers. Methods of insulating current and potential transformers using, oil, plastic, or dry-type construction are explained for all voltage classes.

Printed Circuit Solder

The growing use of silver printed circuits and ceramic capacitors, has necessitated the development of special solders for attaching wire leads and tubes to these assemblies. The Division Lead Company has long pioneered in the production of special alloys for particular purposes, and now offers two new alloys for use with all types of silver printed or plated conducting mediums. Engineering details and prices can be obtained by writing to the Division Lead Company, 836 West Kinzie Street, Chicago 22, Illinois. Dept. J-90

Light Dimming Equipment

The Superior Electric Co., Bristol, Conn., has announced its 1950 line of Powerstat light dimming equipment in a colorful, file-size 12-page bulletin. Complete with photographs, circuit diagrams, outline dimensions and descriptive material, the bulletin displays POWERSTAT Dimmers from the small, 1,000-watt manually-operated single unit through the heavy duty motor-driven "ganged" unit with an output up to 30,000 watts.

Voltage Regulator Standards

A new American standard test code for step-voltage and induction-voltage regulators has been announced by the American Standards Association, 70 East 45th St., New York 17, N. Y. Copies of the new test code (C57.25-1949) and the revised regulator standard (C57.15-1949) are available at 50 cents each from the American Standards Association.

Magnetic Tape Equipment

The latest news and developments in the field of magnetic tape recording are featured in "Magnecord INK," a new monthly publication of Magnecord, Incorporated, Chicago manufacturers of professional magnetic tape recording equipment. Written by recognized authorities and staff experts, the magazine is available free of charge to persons interested in tape recording. Send your request to Dept. H, Magnecord, Inc., 360 N. Michigan Avenue, Chicago 1, Ill.

Solder Pre-Forms

"How to Speed Up Soldered Assemblies with Solder Pre-Forms" is the title of the new four-page bulletin recently made available by Soldering Specialties of Summit, N. J. Arranged to tell the what, how, and when of the uses of pre-formed solder shapes, the bulletin is terse and informative, with a special illustrated chart which shows diverse applications.

TELE-TECH
Advertisers April 1950

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

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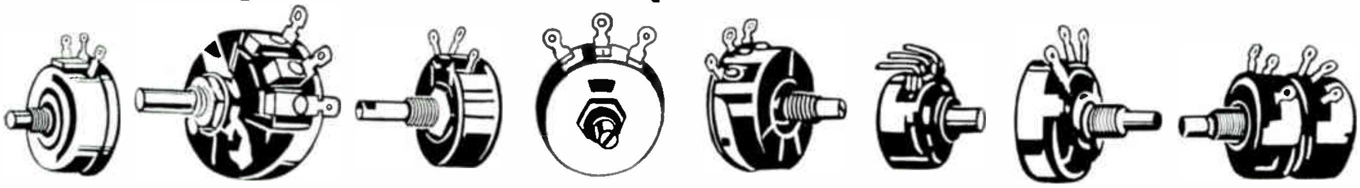

AB — Allen-Brodley
SP — Stockpole
CLA — Clorostot
CTS — Chicogo Telephone Supply
LIN — Lineor
AUD — Audio
RHE — Rheostot
S — With Switch

IRC — Internotionol Resistor Co.
CRL — Centrol Rodio Lobs
MY — Mollory
GIB — Gibbs Microkot
CA — Corbon
WW — Wire wound
OB — Open Bock
M — Midget

WIR — Wirt
DeJ — DeJur
UTA — Utoh
WE — Western Electric
SD — Screw Driver Slot
* — Knurled Shoft
Lx — Lock-Type Bushing

STOCK NO	OHMS	MFR	SHAFT LENGTH	TAPER	TYPE	WATT	UNIT PRICE
360-1	3	MY	1 1/8	RHE.	WW	4	$0.27
360-202	5	IRC	1/4 SD	LIN.	WW	1 1/4	.23
360-401	6	IRC	[illegible]	RHE.	WW	6	.32
360-281	10	MY	1/4	RHE.	WW	4	.27
360-2	10	MY	1/4 SD	LIN.	WW	4	.25
360-386	15	MY	1/4	RHE.	WW	4	.27
360-510	20	UTA	SD	LIN.	WW	—	.20
360-518	50	CTS	1/4 SD	LIN.	WW	5	.29
360-415	75	CTS	1/2 Flat	RHE.	WW	3	.25
360-3	75	CTS	2 1/8	LIN	WW	5	.29
360-192	75	CLA	[illegible]/16	LIN.	WW	3	.25
360-74	100	CLA	SD	LIN	WW	2	.23
360-76	100	CRL	2 1/2	LIN.	WW	3	.25
360-84	100	CTS	SD	LIN.	WW	3	.23
360-80	100	CTS	SD	LIN.	WW	5	.27
360-6	100	CTS	SD	LIN.	WW	5	.27
360-454	100	CTS	3/8	LIN.	WW	5	.29
360-88	100	CTS	SD	LIN.	WW	5	.29
360-193	100	IRC	1/4	LIN.	CA	1 1/4	22
360-515	100	IRC	1/4	LIN.	WW	6	.32
360-384	150	CLA	[illegible]/16-S	LIN	WW	4	40
360-141	150	CTS	1/2	LIN.	CA	1	.22
360-492	150	IRC	SD	LIN	WW	3	.23
360-390	200	CRL	SD	LIN.	WW	3	.23
360-391	200	CTS	[illegible]	RHE.	WW	3	.25
360-487	200	CTS	1/8	LIN.	CA	1	.22
360-145	200	CTS	1/4 SD	LIN.	WW	5	.27
360-502	200	CTS	1/4*	LIN	WW	5	.29
360-473	200	CTS	7/8*	LIN.	WW	5	.29
360-89	200	CTS	SD	LIN.	WW	5	.27
360-522	200	IRC	1/4 mil	LIN.	WW	3	.25
360-397	200	MY	[illegible]/16	LIN.	WW	4	.27
360-527	250	CTS	1/4 SD	LIN.	WW	3	.23
360-521	250	UTA	[illegible] SD	LIN.	WW	3	.23
360-10	255	CTS	[illegible] SD	LIN.	WW	5	.27
360-91	300	CTS	SD	LIN.	WW	5	.29
360-524	300	MY	SD	LIN.	WW	4	.27
360-291	500	CLA	1/2	LIN	WW	3	.25
360-387	500	CLA	1	LIN.	CA	1	.22
360-512	500	CRL	1/4	LIN.	WW	3	.25
360-99	500	CTS	SD	LIN.	WW	3	.23
360-58	500	CTS	2 1/2	LIN.	WW	3	.25
360-422	500	CTS	1/4*	AUD.	WW	3	.25
360-101	500	CTS	SD	LIN.	WW	5	.27
360-477	500	CTS	1/4 SD	LIN.	WW	5	.27
360-19	500	CTS	1/2 SD	LIN.	WW	5	.27
360-379	500	CTS	7/8	LIN	WW	5	.29
360-139	500	CTS	7/16 SD	LIN.	WW	5	.27
360-92	500	CTS	3/4 SD	LIN.	WW	5	.27
360-478	500	CLA	1	LIN.	CA	2	.27
360-476	500	CLA	1/4	LIN.	WW	3	.24
360-523	500	MY	1/4 SD	LIN.	WW	4	.25
360-7	600	CRL	7/16	AUD.	WW	3	.25
360-614	600	CRL	1/4	LIN.	CA	1 1/4	.22
360-21	600	IRC	SD	LIN.	WW	1 1/4	.20
360-196	750	CRL	1/8	LIN.	WW	3	.25
360-102	750	CTS	[illegible] SD	LIN.	WW	3	.23
360-374	750	UTA	7/8	LIN.	CA	2	.22
360-111	950	CLA	1/4 SD	LIN.	WW	3	.23
360-11	1K	CLA	1/2	LIN.	WW	3	.25
360-455	1K	CRL	7/8	LIN.	WW	3	.25
360-474	1K	CTS	1/8 SD	LIN.	WW	3	.23
360-26	1K	CTS	3/4	LIN.	WW	3	.25
360-475	1K	CTS	[illegible]	LIN.	WW	5	.29
360-146	1K	CTS	1/4 SD	LIN.	WW	5	.27
360-491	1K	CTS	1/4	LIN.	WW	5	.29
360-488	1K	CTS	1/4	AUD.	WW	5	.29
360-121	1K	CTS	1/8	AUD.	WW	5	.29
360-513	1K	CTS	3/8 SD	LIN.	WW	5	.27
360-140	1K	CTS	1/2	LIN.	WW	5	$0.29
360-457	1K	CTS	1/2	LIN.	WW	5	.29
360-27	1K	CTS	1/2 SD	LIN.	WW	5	.27
360-138	1K	CTS	1/2 SD	LIN.	WW	5	.27
360-481	1K	IRC	3/8	AUD	CA	1 1/4	.23
360-212	1K	IRC	2 1/2	LIN.	WW	3	.25
360-500	1K	MY	1/4 SD	LIN.	WW	4	.27
360-313	1K	MY	3 knob	LIN.	WW	4	.30
360-377	1K	UTA	1 1/2	LIN.	CA	2	.24
360-22	1.2K	CTS	3/8	LIN.	CA	1	.24
360-458	1.5K	CRL	5/8 SD	LIN.	WW	3	.23
360-131	1.5K	CTS	SD	LIN.	WW	3	.23
360-456	1.5K	CTS	1/4	LIN.	WW	3	.29
360-203	1.5K	CTS	1 1/2	LIN.	WW	3	.29
360-28	1.5K	CTS	SD	LIN.	WW	5	.30
360-372	2K	CRL	3/4	LIN.	CA	1 1/4	.22
360-14	2K	CTS	1 1/4 SD*	LIN.	CA	2	.22
360-30	2K	CTS	SD	LIN.	WW	3	.27
360-405	2K	CTS	SD	LIN.	WW	3	.27
360-284	2K	CTS	3/8	LIN.	WW	3	.30
360-295	2K	WIR	1/4 mil	LIN.	WW	3	.30
360-105	2K	IRC	SD	LIN.	WW	3	.27
360-459	2K	IRC	SD	LIN.	WW	3	.35
360-116	2.5K	CRL	SD-M	RHE.	CA	1/2	.22
360-307	2.5K	CTS	2 1/2	LIN.	CA	1	.24
360-107	2.5K	CTS	SD	LIN.	CA	1	.22
360-441	2.5K	CTS	1 1/2	LOG.	CA	2	.22
360-462	2.5K	CTS	1/2 mil	LIN.	WW	3	.29
360-108	2.5K	CTS	SD	LIN.	WW	3	.27
360-468	3K	CLA	3/8 SD	LIN.	WW	3	.27
360-31	3K	CTS	SD	LIN.	CA	2	.22
360-411	3K	CTS	1 1/2 SD	LIN.	CA	2	.24
360-297	3K	CTS	3/8 SD	LIN.	WW	3	.29
360-130	3K	CTS	SD	LIN.	WW	5	.30
360-77	3K	CTS	2 1/2	LIN.	WW	5	.34
360-453	3K	MY	1/8	LIN.	CA	2	.24
360-210	3K	MY	SD	LIN.	WW	4	.29
360-371	3K	MY	5/16	LIN.	WW	4	.30
360-451	3K	MY	3/8 SD	LIN.	WW	4	.29
360-400	3K	WE	[illegible]/16	LOG.	WW	—	.30
360-240	3.5K	SP	1/4 SD	RHE.	CA	2	.24
360-180	4K	CRL	3/8	LIN.	CA	1	.24
360-416	4K	SP	1/4 mil	LIN.	CA	3	.31
360-34	5K	CLA	1/4 SD	LIN.	WW	3	.29
360-117	5K	CRL	SD-M	RHE.	CA	1/2	.30
360-125	5K	CRL	3/8	LIN.	CA	1 1/4	.25
360-90	5K	CTS	3/8	AUD.	CA	1	.25
360-514	5K	CTS	SD	LIN.	CA	2	.25
360-303	5K	CTS	SD	RHE.	CA	2	.25
360-494	5K	IRC	3/8	LIN.	WW	3	.30
360-288	5K	MY	1/4 SD	LIN.	CA	2	.27
360-485	5K	MY	1/4 SD	LIN.	WW	4	.32
360-357	5K	SP	9/16	LIN.	WW	3	.30
360-20	6K	SP	1/4	LIN.	CA	3	.32
360-298	7K	IRG	1	LIN.	WW	3	.34
360-220	7.5K	UTA	3/8	LIN.	Open Back*		.25
360-396	10K	CLA	[illegible]/16	LIN.	WW	4	.38
360-43	10K	CLA	SD	LIN.	WW	3	.30
360-185	10K	CRL	1/4	LIN.	CA	1 1/4	.28
360-304	10K	CTS	1 1/4	LIN.	CA	1/2	.28
360-258	10K	CTS	1/4	RHE.	CA	2	.30
360-363	10K	CTS	3/8 mil	AUD.	CA	2	.30
360-362	10K	CTS	3/8	AUD.	CA	2	.30
360-48	10K	IRC	SD	LIN.	WW	3	.30
360-222	10K	IRC	SD	LIN.	WW	3	.30
360-356	10K	MY	SD	LIN.	WW	4	.36
360-148	10K	SP	SD	LIN.	CA	1/2	.24
360-95	10K	SP	1 1/4	LIN.	CA	1/2	.26
360-49	10K	SP	3/8	LIN.	CA	3	.32
360-496	10K	UTA	2 1/2	LIN.	WW	3	$0.35
360-486	10K	WIR	SD	LIN.	WW	3	.30
360-150	15K	CTS	SD	LIN.	CA	2	.24
360-427	15K	CTS	SD	LIN.	WW	3	.30
360-472	15K	CTS	SD	LIN.	WW	3	.30
360-223	15K	UTA	SD	LIN.	WW	3	.30
360-460	20K	CLA	3/8 SD	LIN.	CA	2	.26
360-187	20K	CRL	SD-M	LIN.	CA	1/2	.24
360-342	20K	CRL	1/2	LIN.	WW	3	.32
360-305	20K	CTS	2 1/2	LIN.	CA	1/2	.26
360-224	20K	CTS	SD	AUD.	CA	2	.26
360-119	20K	CTS	1/4	LIN.	WW	3	.32
360-97	20K	CTS	1/8 SD	LIN.	WW	3	.32
360-166	20K	CTS	3/8	LIN.	WW	3	.32
360-154	20K	CTS	SD	LIN.	WW	3	.30
360-340	20K	DeJ	5/8	LIN.	WW	6	.85
360-349	20K	GIB	5/8				5.50
360-278	20K	GIB	1/2				5.50
360-277	20K	GIB	1 1/4				5.50
360-354	20K	SP	2 1/2 H	LIN.	CA	2	.28
360-50	20K	SP	3/8	LIN.	CA	3	.32
360-452	25K	CLA	3/8 SD	AUD	WW	3	.30
360-328	25K	CLA	3/8 SD	LIN.	WW	3	.30
360-235	25K	CLA	3/8 mil	LIN.	WW	3	.32
360-65	25K	CTS	SD	LIN.	CA	1	.30
360-353	25K	CTS	SD	LIN.	CA	2	.32
360-127	25K	CTS	1/4 SD	LIN.	CA	2	.34
360-499	25K	CTS	1/4	LIN.	CA	2	.32
360-336	25K	IRC	1/4	LIN.	CA	1 1/4	.30
360-332	25K	MY	SD	LIN.	WW	4	.36
360-226	25K	SP	2 1/2 H	LIN.	CA	2	.36
360-329	25K	WIR	1 1/4	LIN.	WW	4	.38
360-283	25K	MY	SD	LIN.	CA	2	.32
360-290	30K	CLA	3/8	LIN.	WW	3	.36
360-403	30K	IRC	SD	LIN.	CA	1 1/4	.32
360-156	40K	CTS	SD	LIN.	CA	1	.32
360-265	40K	CTS	2 1/2 H	LIN.	CA	1	.34
360-51	50K	CTS	1/4	AUD.	CA	1	.34
360-517	50K	WIR	1/2	LIN.	WW	4	.38
360-261	50K	SP	5/16	AUD	CA	1	.34
360-237	50K	WIR	SD	LIN.	WW	4	.36
360-470	50K	WIR	5 1/2 Flex	LIN.	WW	4	.40
360-200	70K	MY	3/8 SD	LIN.	WW	4	.38
360-327	70K	WIR	5/16	LIN.	WW	4	.38
360-52	75K	CLA	2	LIN.	CA	2	.36
360-236	75K	SP	SD	LIN.	CA	2	.34
360-529	100K	CRL	SD	LIN.	CA	1 1/4	.32
360-518	100K	CTS	SD	LIN.	CA	1	.36
360-64	100K	IRC	2 1/2 H	LIN.	CA	2	.34
360-54	100K	SP	SD-M	LIN.	CA	1/2	.45
360-322	100K	WIR	1/2 SD	LIN.	WW	4	.36
360-282	150K	CRL	1/4 mil	RHE.	CA	1	.36
360-56	150K	CTS	7/16	RHE.	CA	2	.36
360-66	150K	CTS	2 1/2 H	LIN.	CA	2	.36
360-205	150K	CTS	SD	LIN.	CA	2	.34
360-206	150K	IRC	SD	LIN.	CA	2	.34
360-530	150K	IRC	SD	AUD.	CA	2	.34
360-287	200K	CTS	2 1/4 SD	LIN.	CA	2	.36
360-516	200K	SP	1/4	LIN.	CA	3	.38
360-483	250K	SP	1 1/2	AUD.	CA	2	.36
360-441	1M	CRL	SD	LIN.	CA	1 1/4	.40
360-438	1M	CTS	SD	AUD.	CA	2	.40
360-484	1M	IRC	3/8	AUD.	CA	1 1/4	.42
360-448	1M	SP	SD-S	AUD.	CA	2	.55
360-507	2M	SP	2 1/2	LIN.	CA	2	.50
360-508	5M	CRL	2	AUD.	CA	2	.44
360-511	5M	CTS	2	AUD.	CA	2	.44
360-161	7M	CTS	SD	LIN.	CA	1	.40

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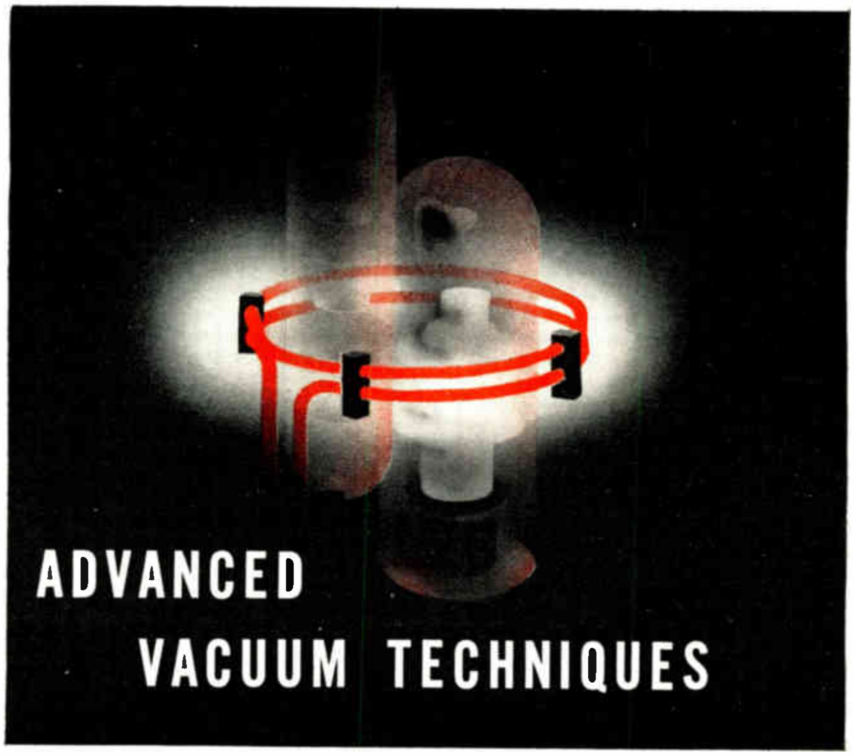
Example...



Two electron tubes may look exactly alike, their ratings and operating characteristics may be similar, but their processing in manufacture can—and does—result in a fundamental difference between them. For it is the things you can't see in a tube, the intangibles—which are as important as the physical structure itself—that ultimately determine the tubes' true worth. It is the ability of the manufacturer to understand the problems involved and to effectively solve them through the application of all the skills at his disposal—skills which can only be gained through specialization and long years of experience.

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Its' unique series of vacuum techniques—the essential elements in electron tube manufacture—is an outstanding example of the importance of the "unseen" in tube performance and life. Machlett standards—based on long experience—require more than the conventional "pumping" or "exhaust" procedure. High voltage exhaust, rigorous pre-exhaust vacuum firing and the extreme in sanitary techniques are standard practice on all Machlett tubes. In many instances final seals are made by Machlett's unique method of R.F. brazing—thus eliminating the usual flame-formed glass to glass seal and so providing greater freedom from contamination of internal structures and misalignment of electrodes.

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