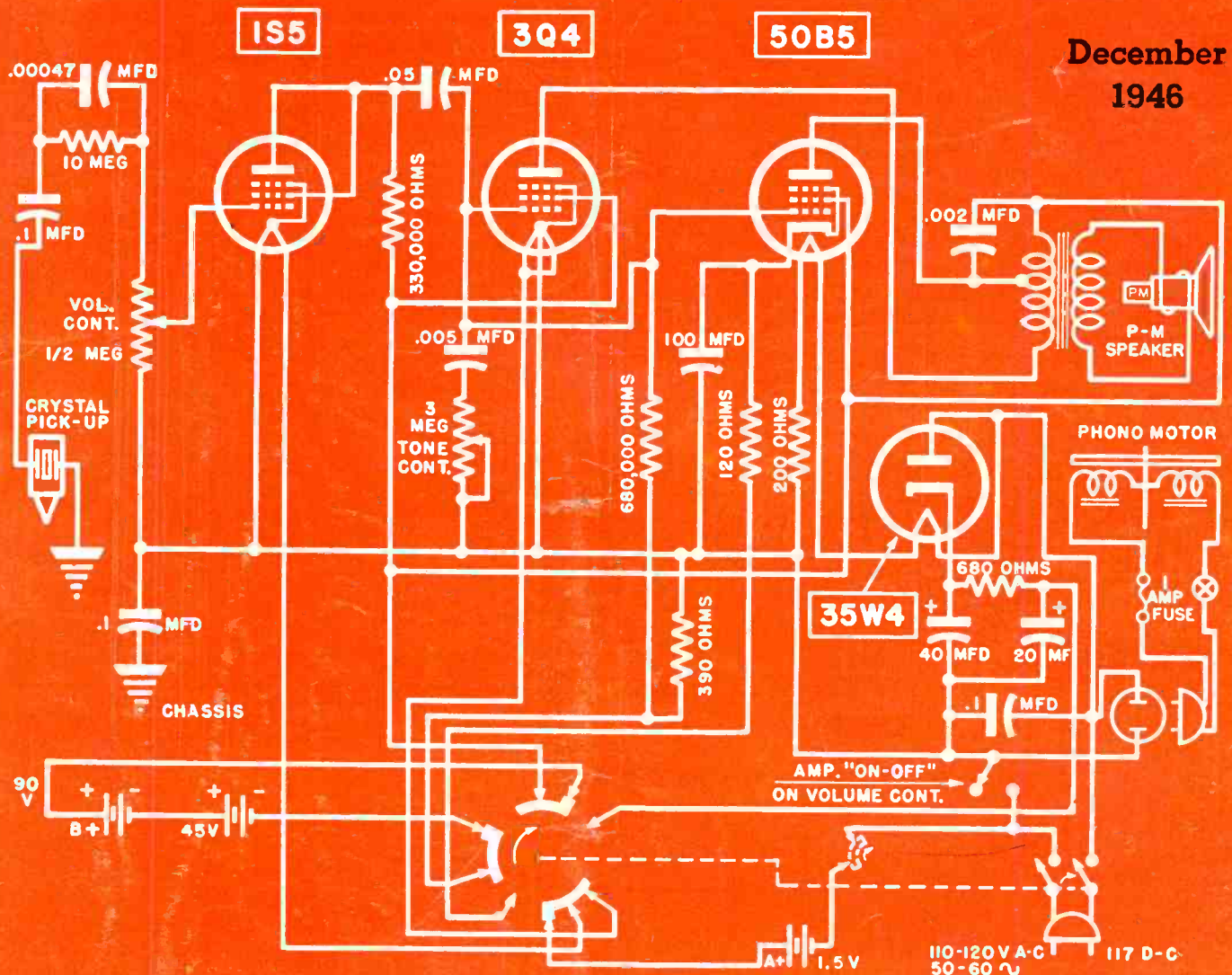
RADIO • TELEVISION • ELECTRONIC

SERVICE

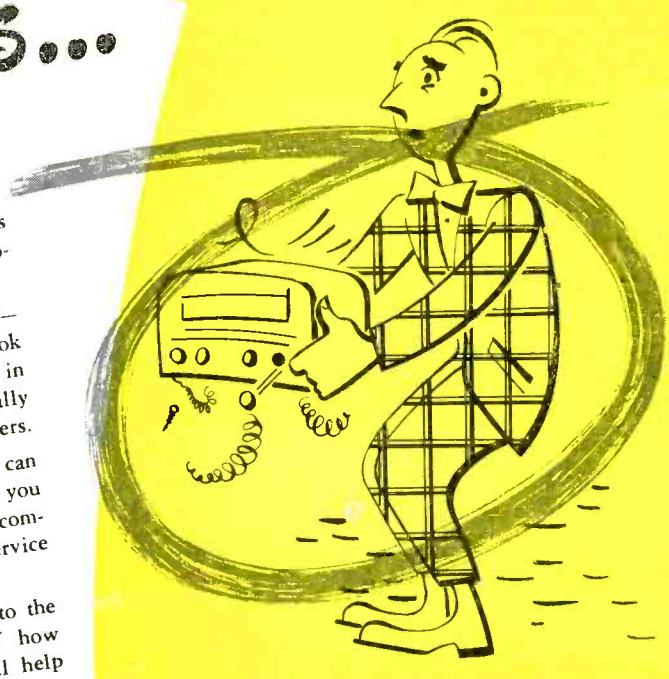
December 1946



An a-c/d-c/battery phono portable using miniature tubes. [See page 41]

THE TECHNICAL JOURNAL OF THE RADIO TRADE

Service Business... and lots of it



That's what you want, isn't it? And brother, it's what you'll get when C-D's new, pre-tested promotional program goes to work for you.

Eye-catching post cards—punchy mailing pieces—attention-getting newspaper ads—hard-selling book matches—all these and lots more are included in this big promotional program which has actually *proved* its ability to help bring in service customers.

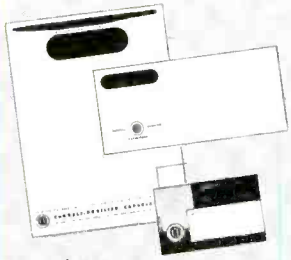
With the field getting crowded you no longer can depend on the sign in your window to keep you in business. Now is the time to step out from competition and build *your* name as *the* radio service shop in your community.

Don't wait until some competitor beats you to the draw. Find out from your jobber TODAY how C-D's new, tested promotional material will help you to build up the service business you want.

C-D HELPS THAT WILL BRING CUSTOMERS TO YOUR SHOP

You can get them all through your jobber

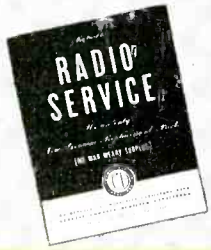
NEWSPAPER MATS



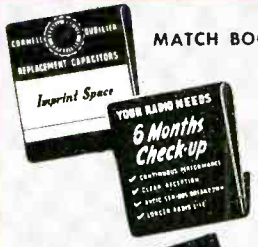
STATIONERY

DECALS

COUNTER CARDS



POSTCARDS



MATCH BOOKS

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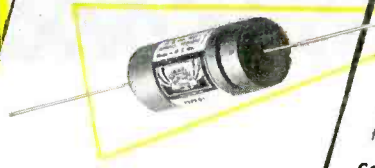
WORLD'S LARGEST MANUFACTURER OF

CAPACITORS

Your reputation depends on the parts you use



Don't take chances—use C-D's Dwarf Tigers. They're top quality, long-lasting—fine where heat and humidity make the going tough.

FREE

your subscription to the "CAPACITOR" — the service man's bible. All the radio data of the month — every month — condensed for you. Mail coupon TODAY.

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South Plainfield, New Jersey

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ADDRESS .....

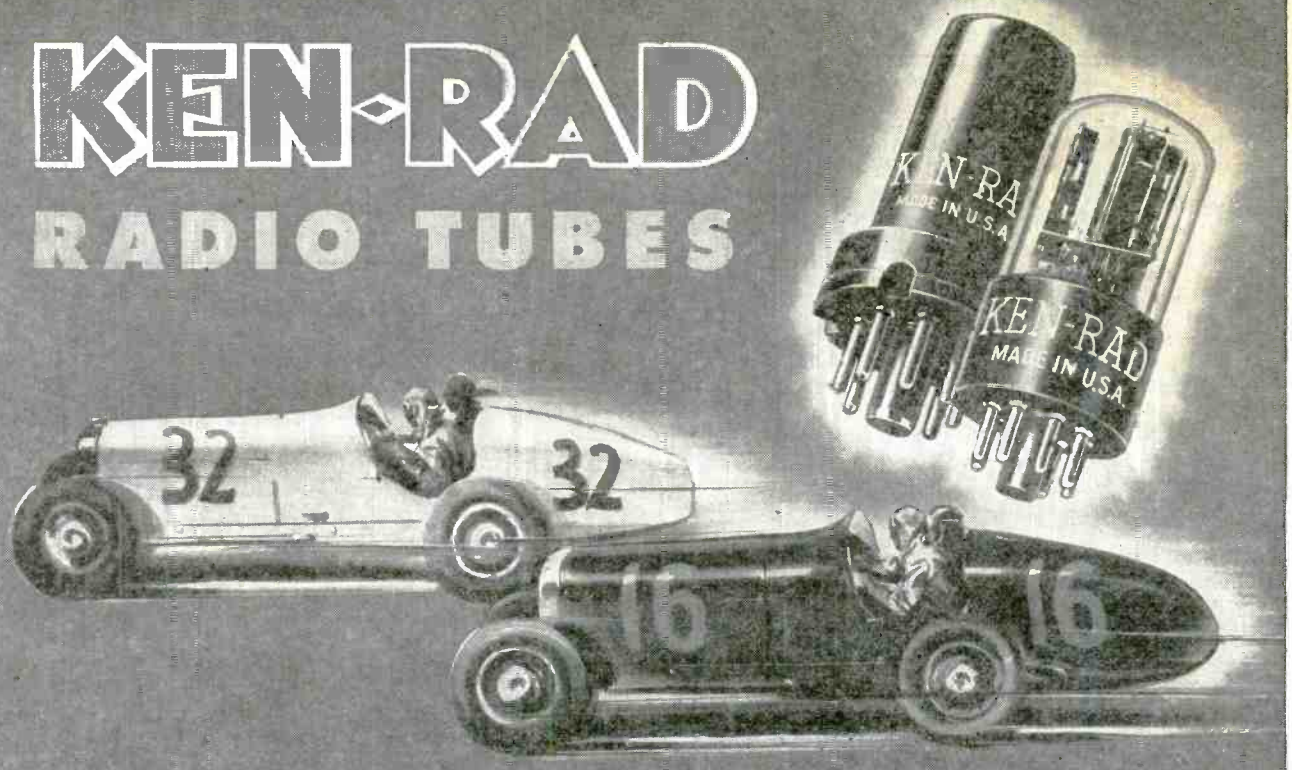
CITY .....

STATE ..... ZONE .....

CORNELL-DUBILIER CD CAPACITORS

MICA • DYKANOL • PAPER • ELECTROLYTIC

KEN-RAD
RADIO TUBES



WITH KEN-RAD TUBES
You'll Set the Pace
in SALES-SERVICE VOLUME...and PROFITS!

AHEAD of the field *always*—that's the position Ken-Rad tubes offer you as dealer or service man! New sets, with new circuits, are pouring into the market. Ken-Rad's up-to-the-minute research—*General Electric backed*—brings new-design tubes to you as needed, enabling you to work with confidence in the field of FM and other postwar radios.

Clients properly served are your backlog of future business. *You'll serve all radio owners better with Ken-Rad tubes* . . . because in addition to their modern design, tone-rich performance is a feature . . . because each precision-made Ken-Rad tube is uniformly, *dependably* like others of its type . . . because 100-percent manufacturer responsibility is cartoned with every tube that you sell!

So team up with Ken-Rad for more sales to more customers, new and repeat—now and tomorrow.

Behind Ken-Rad radio tubes stands Electronics' first and greatest name—GENERAL ELECTRIC.

Write for Booklet ETR-16, "Essential Characteristics," the most complete digest of tube information available.

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KEN-RAD

DIVISION OF GENERAL ELECTRIC COMPANY

OWENSBORO, KENTUCKY

EDITORIAL

PLANNING, not only work of the day, but work of the future, has always been a profitable program to follow. During the next few years, the planning program will be more important than ever to the Service Man.

With the prospects of new highs in the sales of f-m and television receivers, and a-m receivers with their new types of circuits and components, Service Men will, with a carefully-planned installation, repair and maintenance program, be in a bright position to capitalize on the innumerable possibilities that will present themselves.

Such a program will demand the widest assortment of tools and test equipment that financial conditions will permit, and a working familiarity with new types of circuits and components used. To acquire this familiarity will require a careful study of all manufacturer's bulletins, latest technical data such as appear in SERVICE, new books, technical bulletin service, data and modern business practice books and bulletins now being published.

Familiarity with new housing developments also will be found to be an invaluable planning-program feature, for it will provide many leads for new business. And many set dealers will be found to be a useful source of new business leads, for they're always anxious to cooperate with local Service groups in both installation and maintenance work.

In including f-m as an important factor in the planning program, Government authorities have been used as a basis for this recommendation. In a recent talk before broadcasters in Chicago, FCC chairman Charles R. Denny said: "F-m is not coming. It's here. And it's growing fast. Already there are 66 stations in operation and 564 more authorized. In addition, there are 307 applications pending. Our long range plans for f-m look forward to the day when every square inch of every state from the Atlantic Ocean, west to the middle of the Dakotas, Nebraska, Oklahoma and Texas will be covered night and day with city f-m signals. Similarly f-m signals will blanket the Pacific Coast states." That's quite a statement. The FCC also has expressed the same enthusiasm in television. It won't be long before telecasts will be made in dozens of other cities besides those presently operating. The telephone company is rushing their coaxial cable program from coast to coast for television broadcasts.

The Service Man who will take full cognizance of these prospects and plan for the future will be a mighty busy man during the next few years.

RADIO · TELEVISION · ELECTRONIC
SERVICE
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Vol. 15, No. 12 December, 1946

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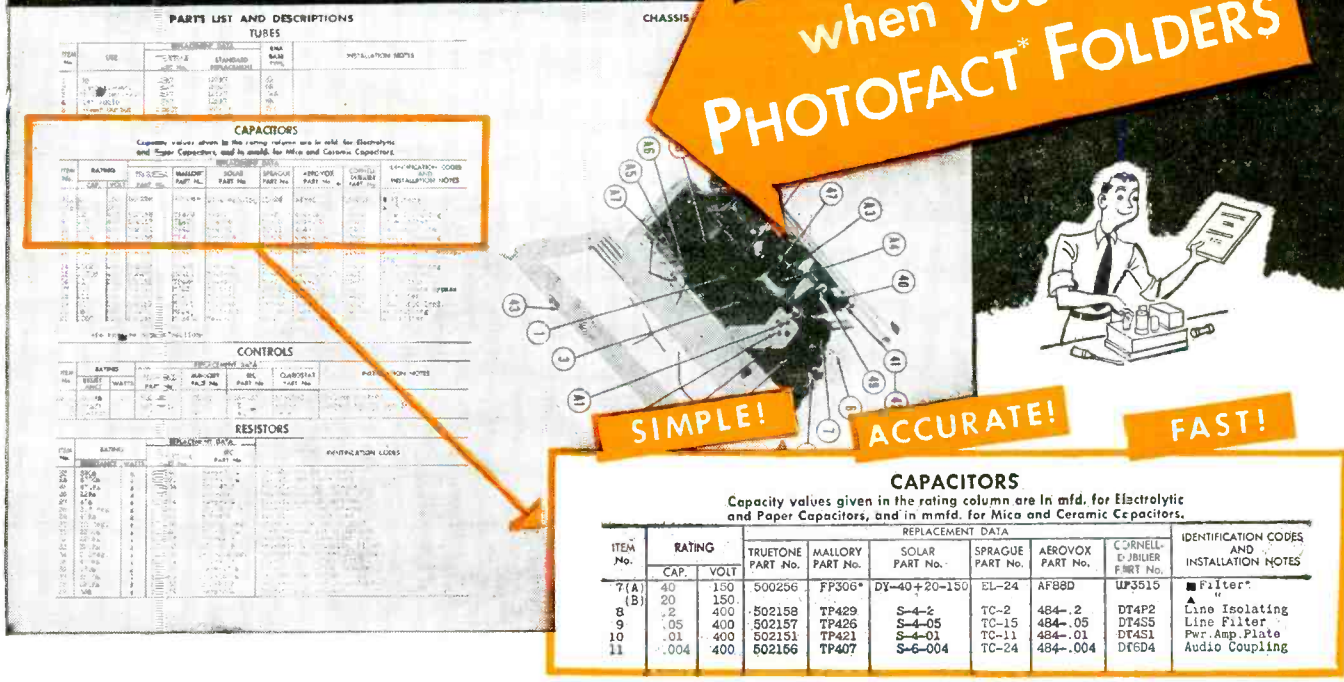
Radio Parts are EASY to identify

when you use PHOTOFACT* FOLDERS



CAPACITORS

Capacity values given in the rating column are in mfd. for Electrolytic and Paper Capacitors, and in mmfd. for Mica and Ceramic Capacitors.

ITEM No.	RATING CAP.	RATING VOLT	REPLACEMENT DATA TRUETONE PART No.	MALLORY PART No.	SOLAR PART No.	SPRAGUE PART No.	AEROVOX PART No.	CORNELL-DUBILIER PART No.	IDENTIFICATION CODES AND INSTALLATION NOTES
7(A)	40	150	500256	FP306*	DY-40+20-150	EL-24	AF88D	WP3515	■ Filter*
(B)	20	150							▲
8	.2	400	502158	TP429	S-4-2	TC-2	484-.2	DT4P2	Line Isolating
9	.05	400	502157	TP426	S-4-05	TC-15	484-.05	DT4S5	Line Filter
10	.01	400	502151	TP421	S-4-01	TC-11	484-.01	DT4S1	Pwr.Amp.Plate
11	.004	400	502156	TP407	S-6-004	TC-24	484-.004	DT6D4	Audio Coupling

What's your biggest headache when servicing radios? Identifying parts? With PHOTOFACT FOLDERS it's easy to locate and identify any item you want to find. Just look at the Complete Parts List . . . a list that's keyed to clear chassis photographs and a full page, easy-to-read schematic diagram. For instance, the capacitor listing alone gives complete data on capacity, voltage rating, function, replacement types . . . even includes installation notes.

No service problem can stump you when you use PHOTOFACT FOLDERS. They result from the actual examination of the receiver involved, and are not copied from the manufacturer's service data or from looking at his schematics. They tell you everything you need to know about any set manufactured since January 1, 1946—**even to the restringing of dial cords.** They do this by means of pictures, full-page schematics, *original* technical notes that help you work faster, more accurately...easily increase the number of jobs you can do in a week by fifty percent.

PHOTOFACT FOLDERS are sold in sets of 40, each set covering new radios, phonographs, record changers, intercommunication systems, recorders and power amplifiers *within a short time after they reach the market*. Their cost is only $1.50 a set, including membership in the Howard W. Sams Institute. No other radio service compares with PHOTOFACT FOLDERS in completeness, accuracy or timeliness. Use the coupon. *Mail it to your nearest radio parts supply house.*

*Trade Mark Reg.

In Each PHOTOFACT FOLDER *You Get—*

1. A cabinet view of the receiver to help you establish identity and control functions. **2.** A top view of chassis and speaker to identify component parts and alignment points. **3.** A bottom view of chassis and/or accessories. **4.** A complete list giving keyed reference to all parts, alignment and schematic diagram. **5.** A complete, full-page schematic diagram. **6.** Stage gain measurements listed on the schematic diagram. **7.** A complete voltage and resistance analysis chart for rapid check of operational values. **8.** Complete alignment instructions on the receiver consistent with the keyed alignment points indicated on photographs. **9.** Dial cord diagram and restringing instructions. **10.** Complete disassembly instructions where required.

PUBLICATION DATES:
Set No. 9 . . . . . December 19
Set No. 10 . . . . . December 29

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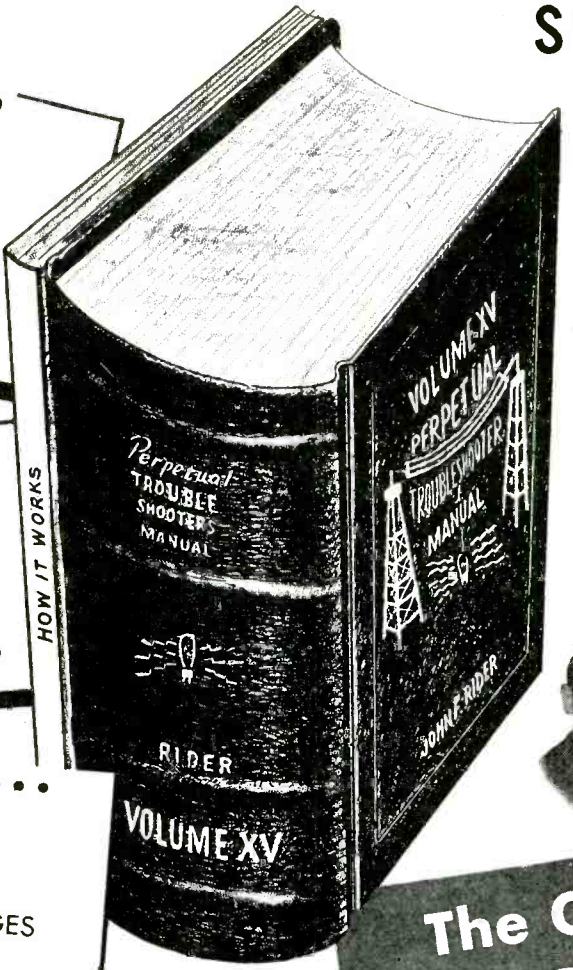

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This new Rider Book, soon to be announced, will be of lasting usefulness to everyone interested in any phase of radio.

yesterday proved its quality

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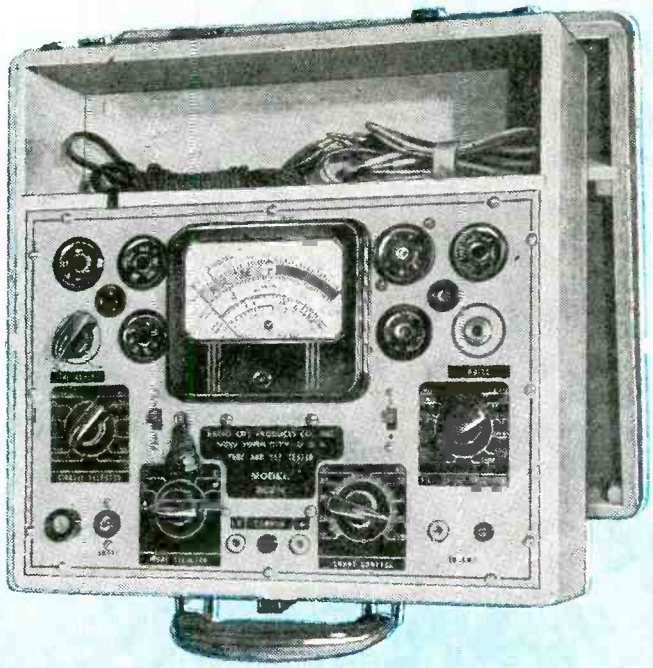


IN THE FIELD

IN THE SHOP

Combination "DYNOPTIMUM" tube and set tester Model 802N

Accurate — dependable — compact — with a degree of flexibility that places it in a class all its own.

There you have it in a nutshell—a *partial* description of RCP's new, improved Model 802N. But *only* a partial description—because you can't describe this remarkable servicing instrument *fully* to anyone who has never used it.

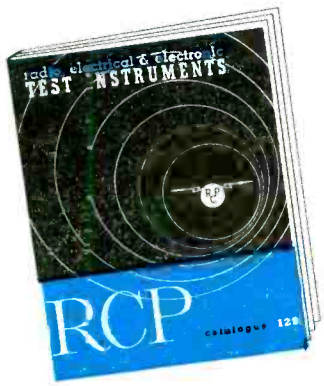
Only by using it yourself can you learn all the features that make Model 802N the unquestioned favorite of radio service men everywhere.

Examine Model 802N next time you see your jobber. Use it. Find out how it can speed up your work — add dollars to your income.

In handsome hardwood carrying case, complete with self-contained battery and test leads—**Price $59.50.**

Check these features

- Exclusive method of A-C voltage measurements which elminates temperature and frequency errors.
- Famous Dynoptimum test circuit employs 6H6 tube and has zero temperature characteristic while providing an extremely wide frequency range of 30 cps to 50 kc.
- 100,000 — ohm range is battery operated permitting resistance checks when regular A-C supply is not available.
- Capacity meter for testing electrostatic and electrolytic capacitors for leakage.
- Special adaptions are included for checking individual sections of multi-purpose tubes.
- Convenient jack for head-phone noise test to check swinging, noisy, or high-resistance connections.
- Large, rugged 4½" square-face meter with Alnico high-torque movement for quick, accurate readings.
- Housed in handsome, hand-rubbed, hardwood carrying case with compartment and self-latching cover. Furnished with high-voltage test leads.



RANGES

D-C VOLTMETER: 0/10/50/500/1000 volts. (1000 ohms per volt)

A-C VOLTMETER: 0/10/50/500/1000 volts.

D-C MILLIAMETER: 0/1/10/100/1000 milliamperes.

D-C AMMETER: 0/10 amperes.

OHMMETER: 0/500/5000 ohms, 0/0.1/1/10 megohms.

DECIBEL METER: -8 to +15, +15 to +29, +29 to +49, +32 to +55 DB.

OUTPUT METER: 0/10/50/500/1000 volts.

If you'd like to have a complete display of America's finest line of testing equipment, write for a free copy of Catalog No. 129.

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SPRAGUE TRADING POST

is coming Back!

Your Own Swap, Buy or Sell Advertisement Run FREE—Send it in today!

Have you any parts or equipment you'd like to trade or sell to some other radio man who could put them to good use?

Are there any hard-to-get items you'd like to buy?

Want to get a radio job — or to hire a helper?

If so, write up your advertisement in brief form, rush it to Sprague. We'll run it ABSOLUTELY FREE OF CHARGE in the famous Sprague Trading Post that will start again next month in seven leading radio publications: RADIO NEWS, RADIO CRAFT, QST, SERVICE, RADIO SERVICE DEALER, RADIO MAINTENANCE and RADIO & TELEVISION RETAILING.

This famous Sprague service needs no introduction. During the war over 12,000 individual free classified advertisements were run for our friends. Everything, from parts and equipment to complete radio shops, was bought, sold and exchanged as a result.

In discontinuing The Sprague Trading Post at the close of the war, we thought there was no longer any need for it. But we were wrong! Hundreds of letters flooding in from all parts of the country tell us so. *"We need this sort of thing now as much as we ever did!"* is the gist of what our service and amateur friends say, *"Start it going again!"*

And so we're doing it! Send in your swap, buy or sell advertisement today!

Sincerely yours,

Harry Kalker

Harry Kalker
Sales Manager

THIS IS THE WAY YOUR FREE AD WILL LOOK

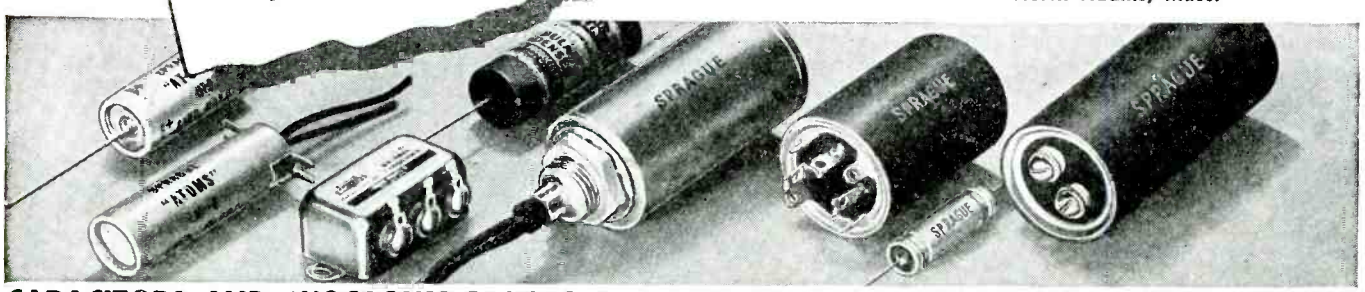
FOR SALE — Standard model all-wave signal generator, $25; modern tube tester with adapters, $27.50; popular phono motor, $15; power transformers and other parts. Write for list. YOUR NAME and ADDRESS HERE.

WANTED — Input i-f transformer and oscillator coil assembly for Model 15 Majestic. Will pay cash or trade. What do you need? YOUR NAME and ADDRESS HERE.

HELP WANTED — Need radio service man for busy dealer store in small Midwestern city. Well equipped shop. Write giving full details of experience. YOUR NAME and ADDRESS HERE.

INSTRUCTIONS: Print or type your advertisement CLEARLY. Hold it to 40 words or less including name and address. Confine it to radio subjects only. MAKE IT EASILY UNDERSTANDABLE! No commercial advertisements are acceptable. Sprague reserves the right to reject any copy that, in our opinion, does not fit in with the spirit of this free service. Your advertisement will be run in the first possible issue of at least one of the seven magazines on our list.

Write it now. Mail it to
Dept.
SPRAGUE PRODUCTS COMPANY
North Adams, Mass.



CAPACITORS AND *KOOLOHM RESISTORS FOR EVERY RADIO SERVICE AND AMATEUR NEED

*Trademark Reg. U. S. Pat. Off.

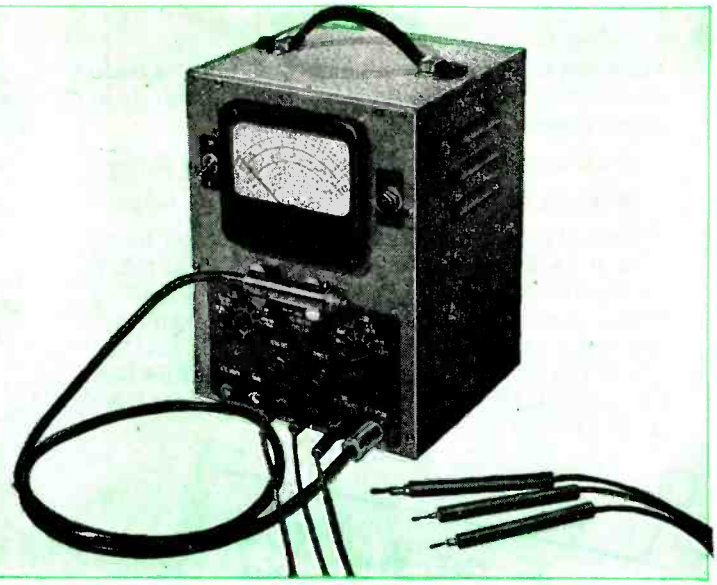
SYLVANIA NEWS
RADIO SERVICE EDITION

DEC. *Prepared by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1946

ONE DEVICE NOW USED BY RADIO SERVICEMEN FOR GREAT VARIETY OF TESTS

Electrical Measurements Made Easy With New Sylvania Unit!

The **SYLVANIA Poly (MULTI-PURPOSE) Meter**



Radio servicemen now can use the new Sylvania Poly (MULTI-PURPOSE) Meter type 134 to facilitate a multitude of electronic measurements and tests to radio equipment.

This product of Sylvania Research is stabilized against errors due to voltage variations or gas current in tubes. All accessories included. See your Sylvania Distributor.

CHARACTERISTICS AND SPECIAL FEATURES

Tests audio, A.C. and R.F. voltages from 20 cps to 300 mc through use of proximity fuze-type tube built into handy probe. Full scale range of 3, 10, 30, 100, 300.

Measures D.C. from .1 to 1,000 volts in full scale ranges of 3, 10, 30, 100, 300, 1,000.

Measures D.C. current from .1 milliampere to 10 amperes in full scale ranges of 3, 10, 30, 100, 300, 1,000 milliamperes and 10 amperes.

Measures resistance from ½ ohm to 1,000 megohms in full scale ranges of 1,000, 10,000, 100,000 ohms and 1, 10, 1,000 megohms.

ACCURACY

D.C. ranges ±3% of full scale.
A.C. ranges ±5% of full scale up to 30 volts and ±7% above 30 volts.
R.F. ranges ±5% of full scale up to 10 volts; ±7% from 10-100 volts; ±10% on 300 volt range.
Ohms ±6% to the left of ½ scale; ±13% to the left of ¾ scale.
Current ±3% of full scale on all but 10 ampere scale which provides ±5% of full scale.

INPUT IMPEDANCES

R.E. ranges—2.7 megohms resistance shunted by approximately 3 mmf. capacity.
A.C. ranges—2.7 megohms resistance shunted by approximately 40 mmf. capacity.
D.C. ranges—16 megohms resistance.

Remember the Sylvania Poly (MULTI-PURPOSE) Meter type 134. It's beautifully styled, compactly designed, has easily read meter and dials.

SYLVANIA ELECTRIC

Emporium, Pa.

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

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MIDGET COMPONENTS For British Portables

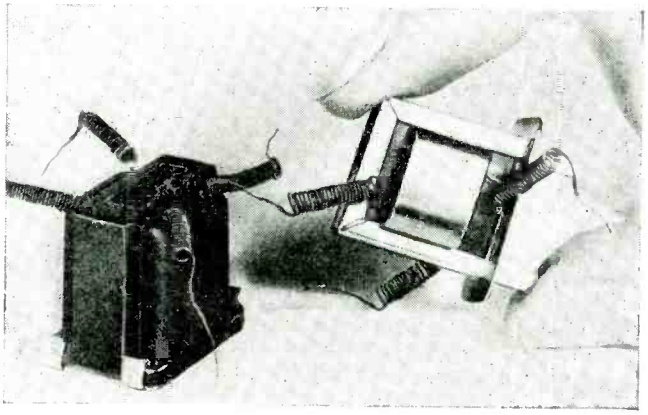


Fig. 1. Midget audio-frequency transformers which are available in skeleton form or with a bakelite case.

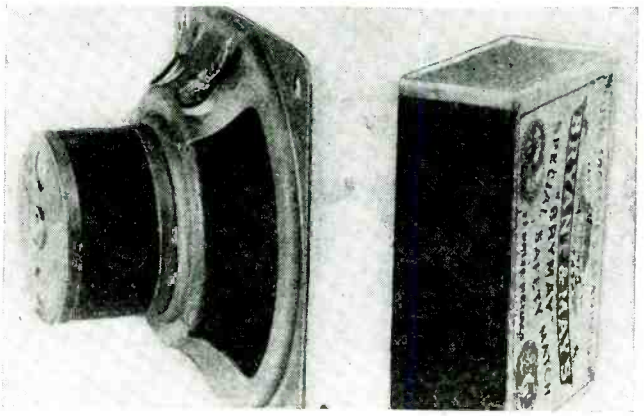


Fig. 2. Miniature permanent-magnet moving-coil loudspeaker which handles an input of ½ watt.

by H. W. BARNARD

London, England

ONE OF THE BIGGEST MANUFACTURING problems with which Britain's radio industry was faced during World War II was that of reducing the size of components to a fraction of their standard dimensions.

There had been little or no demand in Britain for *personal* portables and manufacturers had not, therefore, gone into the question of miniaturization. When, however, the Supply Ministries requested industry to produce miniature components for lightweight equipment to be used by forward troops and for such apparatus as combined transmitter-receivers small enough to be worn on the belt by agents and members of resistance groups in enemy-occupied territory, research workers in Britain's radio industry set about getting the proverbial quart into a pint bottle.

An excellent example of miniature design was the miniature capacitor developed for the proximity fuse, a tubular paper capacitor, rated for a d-c working voltage of 500. The overall length for capacitances of from 0.0005 to 0.01 mfd was ¾", excluding connecting wires, while the diameter varied from $\frac{3}{16}$" to $\frac{11}{32}$". The units, wound and connected to provide mini-

(*Continued on page 28*)

Fig. 3. Parts of a small moving coil headphone, compared with a safety razor blade. The moving coil is only ½" in diameter.

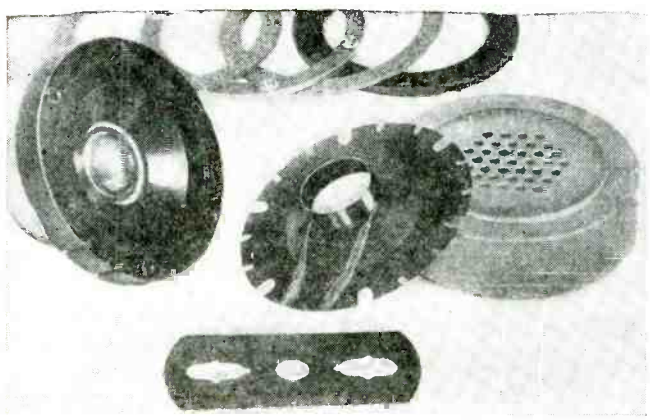


Fig. 4. Prototype of Britain's first miniature 4-tube 2-band superhet portable, with its layer-built high-voltage battery photographed against a telephone for comparison. Plastic case for set is 8¼" x 3⅜" x 3⅝". (*Courtesy Vidor*)

POSTWAR V-T-V-M

An analysis of the Vomax, with practical operation and maintenance data based on twelve months of field experience.

Fig. 1. Control panel of the vacuum-tube voltmeter which measures resistance, d-c, db, d-c and a-c volts from 20 cycles to over 100 mc.

by M. E. LEWIS

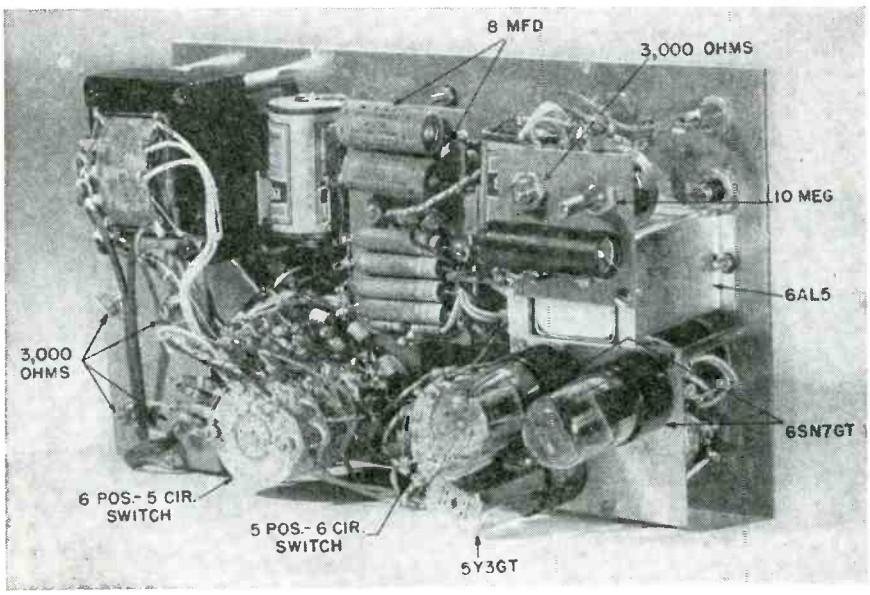
IN LOCATING AND CORRECTING troubles in receivers, accurate measurements must be used. It is impossible, for instance, to check operating potentials of the many vacuum tube circuits in the modern receiver without measurement equipment. Measurements are the basic, fundamental yardstick by which proper or faulty operation must be diagnosed.

Before the war voltage measurements, due to limitations of then available meters, were pretty much restricted to measurement of voltages present in power circuits of receivers—circuits in which voltages to be measured would not be disastrously dropped by application of low-resistance, power-consuming meters. Then usual voltmeters could not be used to measure actual operating voltages upon avc-controlled grids, series-resistance-isolated plates and screens, high-resistance avc lines, or at resistance-coupled amplifier grids and plates. The possibility of really time-saving measurement of a-f, i-f and r-f *signal voltages* lay in the distant future. This was because the usual 1000 ohm-per-volt d-c meter required significant *power* to function, power not available in such circuits. In a-c circuits the situation was even worse. Copper-oxide rectifiers, used to convert a-c voltages into current required to actuate the d-c meters, not only showed very low input resistance, but exhibited errors seriously increasing with frequency even in the low a-f range.

The need to measure voltages, present in circuits of such high resistance that they could not possibly supply the current required to actuate simple volt-ohm-milliammeters resulted in the development of vacuum-tube voltmeters. In their prewar forms v-t-v-m units were afflicted with errors due to variations in operating potentials of their own vacuum tubes, errors due to changes in characteristics of ageing tubes, and false readings due to small but real residual gas and ion current in these tubes. Nevertheless the v-t-v-m was a great step forward. Their general usage only awaited further development of the art. That development has been achieved, prewar deficiencies have been overcome and the v-t-v-m has become a *must tool* of every Service Man.

In developing a postwar v-t-v-m, one designer[1] has produced a combination unit, a vacuum-tube-volt-ohm-db-ma meter. This instrument, the Vomax, shown in Fig. 1, features a removable r-f probe for direct contact to r-f and i-f circuits.

Fig. 2. Interior view of v-t-v-m.



V-T-V-M Operation

In placing the unit in operation, the r-f probe must be fully inserted into its panel receptacle, with black (negative) and red (positive) test prod tips *not* inserted in panel jacks. The a-c plug is then inserted in line, *Adj.Ω* knob is turned so that *on-off* switch clicks on and pilot bezel illuminates. While allowing 30 to 60 seconds for tube warm-up, *Function* knob is set to *D.C.+* and *Range* knob to 3 V. Then meter pointer is set to zero on meter scale by adjusting *Set V. Zero* knob.

As tubes warm up meter pointer may move up or down scale, possibly even off scale. Incidentally, the meter cannot be injured by over-scale deflection. It can be injured only by overload in direct-current measurement, but is protected against burnout in all voltage, resistance and db operations. If this meter deflection isn't desired during tube warm-up, *Function* knob may be set to *ma* position for initial 30 to 60 second warm-up period.

With these initial adjustments completed, several interesting instrument-characteristic tests may be conducted. It is possible, for instance, to see to what extent errors due to grid and gas current have been eliminated by moving the *Range* knob from 3 V progressively through all six positions to 1200 V.

Meter zero will not shift more than 1% to at most 2% of full scale as *Range* switch is rotated. In rotating this switch the value of grid resistance (meter's d-c input resistance) of the upper section of the center 6SN7GT is changed from 50

[1]McMurdo Silver.

With Ohm-Db-Ma Measurement Features

megohms progressively down to 125,000 ohms, a range of variation sufficient to reveal the slightest trace of grid or gas current.

Shifting *Function* knob from *D.C.* — to *D.C.*+ reverses polarity of d-c input, making it possible to keep meter cabinet and receiver chassis under test at the same potential while d-c voltages positive-to-chassis are measured with red test-prod *plus*. Voltages negative-to-chassis can also be measured with meter and red prod polarity reversed by a flip of *Function* knob.

Six basic ranges of 0-3, 0-12, 0-30, 0-120, 0-300 and 0-1200 volts, available with the *Range* knob, are graduated upon the meter scale. Six identical ranges, but in reverse polarity are provided by shifting *Function* knob from *D.C.*+ to *D.C.*—. Six more d-c voltage ranges can be added positive, and six more identical ranges negative, if red test wire tip is shifted from the $+V—\Omega MA$ jack to the *V x 2.5* jack. Each of these new ranges is 2½ times greater in full-scale voltage value than indicated by each *Range* knob setting. Thus, using the *V x 2.5* jack, d-c voltage ranges of 0-7.5, 0-30, 0-75, 0-300, 0-750 and 0-3000 volts are available at 126 megohms meter resistance, all read by mentally multiplying meter scale readings by 2.5.

Dual-Function Test Prod

Another interesting instrument feature is the *dual-purpose* red test prod which has a 1-megohm resistor built in to isolate instrument capacity from r-f, i-f and a-f grids and plates when measuring their d-c operating voltages dynamically during receiver operation. For all measurements *except* d-c voltage tip is screwed into the end of red prod from which flexible cord emerges. For d-c voltage measurements the tip must be screwed into the far end of the red prod to include the 1-megohm resistor in circircuits.

Ohmmeter

Having established meter zero by adjustment of the *Set V. Zero* knob while *Function* knob was set to *D.C.*+ and *Range* knob to 3 V, *Function* knob can be shifted to Ω position to check the ohmmeter. Meter pointer will now move up scale. It is set to exact full-scale reading by the *Adj.* Ω knob, and resistances between .2 ohm and 2,000 megohms can be measured. The upper meter scale is graduated 0 through 2K (2 kilohms, or 2,000 ohms). To use, the black prod wire tip is inserted into *Com. Gnd. jack*, red prod wire tip into $+V—\Omega—MA$ jack, and the two prod tips are connected to a resistor to be measured. In reading values a multiple of the *Range* knob pointer to the actual meter reading is used. Thus 10 at meter mid-scale is read as 10 ohms for 2KΩ position of *Range* knob, increasing in multiples of 10 for each advance of the *Range* knob. The center-scale figure (5th or 2MΩ) would yield 100,000-ohm reading. The 6th, or 2,000-MΩ position, involves a further multiplier of 100 times, center-scale 10 indicating 10 megohms.

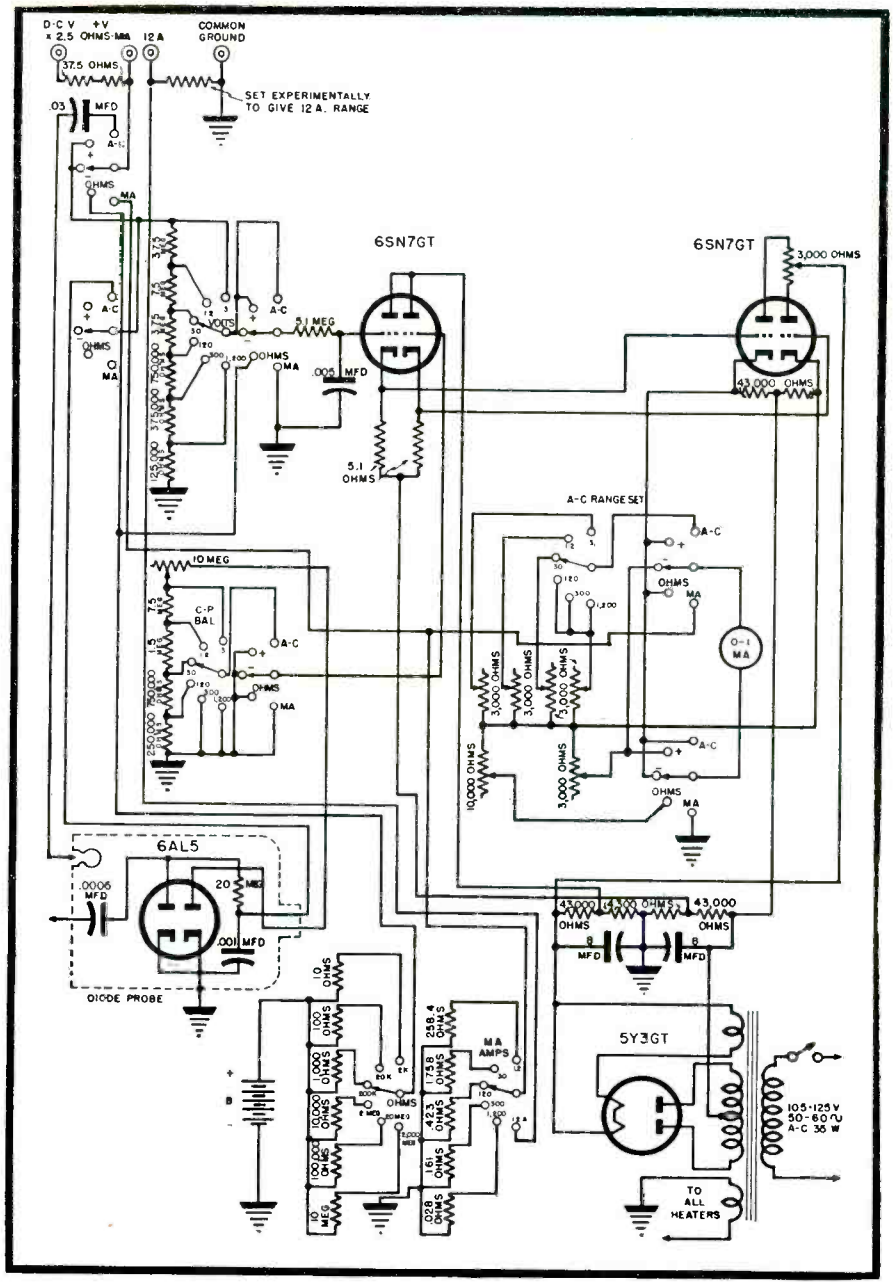


Fig. 3. Circuit diagram of vacuum-tube voltmeter described in this paper.

The Milliammeter

The milliammeter uses different internal current-shunt resistors to provide six-current ranges selected by *Range* knob. Meter accuracy can be checked by measuring known direct currents. To check *Range* knob should be set to 12 amperes position. The high range is used so as not to burn the meter out by applying excessive current to a low-current range. *Range* knob is moved to left until the current flowing through the meter yields an easily read value upon the upper or lower center meter scale. All ranges starting with figure 3 about the *Range* knob are read on the upper center scale. All ranges beginning with figure 12 are read upon the lower center scale marked 12 at the right end. For 3 and 12-volt ranges appropriate scales are read directly. For higher ranges zeroes are added to observed readings.

Checking A-C Operation

With both test lead tips *removed* from panel jacks, with meter set to read zero

(*Continued on page 25*)

R-C AMPLIFIER

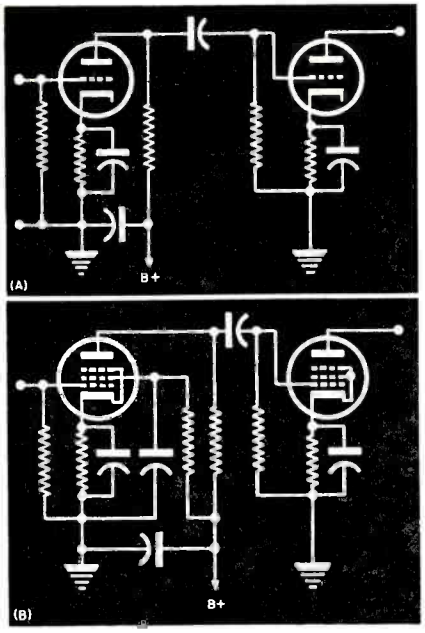


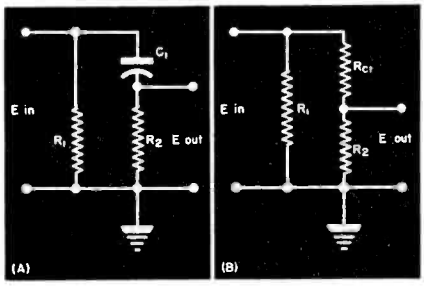
Fig. 1. Two typical resistance-capacitance coupled audio amplifiers. In *a* we have a triode type. In *b* a pentode has been substituted. The essential difference between the two circuits is the use of the screen-grid circuit. Component values are a function of the frequency response and the gain.

THE TWO IMPORTANT characteristics of an audio amplifier are the stage gain and the frequency response. In audio stages using resistance and capacitance in the coupling network, both frequency response and amplification are, in part, a function of component values, and are also closely related to each other.

Fig. 1 shows two typical resistance-coupled amplifiers, one employing a triode, the other a pentode. In essence, both employ the same system.

In Fig. 2 we have the *r-c* network of the triode, isolated from the associated tubes for simplicity. In *a* R_1 represents the plate load resistor. This is shown as returning directly to ground, since for audio voltages the *B* supply filter capacitor acts as an effective short, due to its very low reactance or a-c resistance to audio frequencies. R_2 is the grid return resistor of the following stage while C_1 is the coupling capacitor. In *b* the coupling capacitor has been replaced by its equivalent a-c resistance. It will be noted that the capacitive resistance, in conjunction with the grid-return resistor, form a virtual voltage divider for any voltages developed across the plate load resistor.

Fig. 2. Here the *r-c* component of the audio amplifier of Fig. 1 has been isolated. In *a* the components have been arranged to show that the coupling capacitor and grid resistor form a voltage divided network. In *b* the resistor, R_{c1}, is used to represent the equivalent resistance of the coupling capacitor.



Since the a-c resistance of the coupling capacitor will vary depending on the frequency of the impressed voltage, the voltage across the grid resistor will also vary. In explanation, the formula for computing the reactance of a capacitor for any frequency is

$$X_c = \frac{10^6}{2\pi f C}$$

Where: X_c = capacitive a-c resistance in ohms
f = frequency of voltage in cycles
C = capacitance in microfarads

Once the reactance of a capacitor has been established, the action of voltage and current is the same as in d-c circuits. Thus, a .016-mfd capacitor has a reactance of 100,000 ohms at 100 cycles, 10,000 ohms at 1,000 cycles, and 1,000 ohms at 10,000 cycles.

Since the value of the grid resistor remains constant at all frequencies, a proportionately greater percentage of the imposed audio voltage will appear across the grid resistor, as the frequency increases.

Now let us assume that in the network of Fig. 2*a* the capacitor, C_1, has a value of .016 mfd, R_1 is a .25-megohm resistor and R_2 is a .5-megohm unit. For an input voltage of 10, the drop across R_2 will be:

At 100 cps..... $\dfrac{R_2}{RC_1 + R_2} \times E$

or $\dfrac{.5}{.1 + .5} \times 10$ or 8.85 volts

At 1,000 cps.....

$\dfrac{.5}{.01 + .5} \times 10$ or 9.8 volts

At 10,000 cps.....

$\dfrac{.5}{.001 + .5} \times 10$ or 9.99 volts

If the value of C_1 were increased to .16 mfd, its reactance or a-c resistance would be 10,000 ohms at 100 cps, 1,000 ohms at 1,000 cps, and 100 ohms at 10,000 cps. Solving for the grid voltages at these frequencies, we would have 9.8, 9.99 and 9.999 volts, respectively. Thus, increasing the value of the coupling capacitance would tend to give a more uniform output over the audio range.

A similar expedient would be to increase the value of grid resistor. Thus, if the grid resistor were increased to 1 megohm, with a coupling capacitance of .016 mfd, the grid voltage for a 10-volt input would be 9.1 volts at 100 cps, 9.9 volts at 1,000 cps, and 9.99 volts at 10,000 cps. Therefore, increasing either C_1 or R_2 will achieve a more uniform response over a band of frequencies, as well as increase the voltage at all frequencies. In another sense, it may be said that the low frequency response has been improved, since both expedients afford a greater effect at the low frequencies than at the high frequencies.

The actual resistance values are slightly lower, due to the presence of the tubes. This will be discussed later in this article.

The next influence on the operation of the *r-c* amplifier is the cathode network, consisting of the cathode resistor and associated bypass capacitor.

The cathode bypass capacitor is, as the term implies, a bypass for any audio voltages developed across the cathode resistor; Fig. 3. In *a*, a typical resistance-coupled audio amplifier stage is shown. Fig. 3*b* shows the equivalent resistive load on the *B* supply. R_p designates the resistance of the plate-to-cathode path within the tube. Any a-c voltage developed across this circuit would cause voltage drops to appear across all three resistors. However, for a-c voltages, the tube's plate resistance and cathode resistor are actually in parallel with the load resistance; Fig. 3*c*. In the presence of the reactance introduced by the bypass capacitor, the a-c voltage drop across the cathode resistor would be reduced, since the capacitor is in parallel with it. This has two important aspects.

First, since the a-c voltage drop across the cathode resistor would serve no useful purpose in the amplification functions of the tube, the drop across the plate-load resistor would be increased, slightly. However, this is not the chief purpose of the bypass capacitor.

The effective input circuit is directly between grid and cathode. Therefore

DESIGN FACTORS

by MARTIN B. ROGGERS

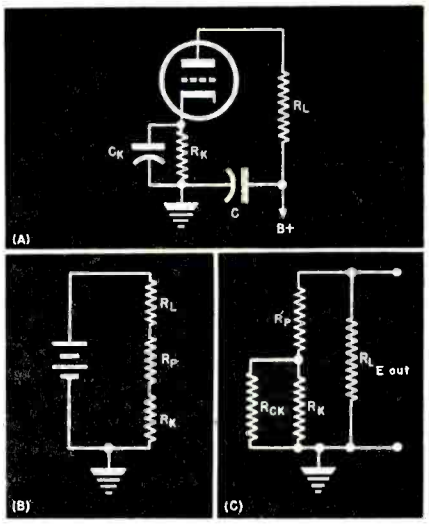


Fig. 3. In *a* an individual triode r-c amplifier is shown. In *b* appears a plate network across the *B* supply. In *c* we have the equivalent plate impedance. It will be noted that the reactance of the cathode bypass is in shunt with the cathode resistor for audio voltages.

any voltage, either a-c or d-c, would affect the sum voltage impressed on the grid. Since the a-c voltage developed across the cathode resistor is in opposite phase to the input voltage impressed on the grid, it would buck the input voltage. Thus, the input voltage would be decreased, and, in turn, the resultant plate voltage. This principle is the basis of inverse feedback, and tends to reduce the stage gain. And thus we have the second purpose of the capacitor; where gain is desired, the value of bypass capacitor determines the stage gain. In this respect, since the reactance of the capacitor increases as the frequency decreases, the stage gain will be reduced at low frequencies and increased as the frequency increases. Thus, a high farad bypass capacitor would increase the gain at low frequencies in much the same manner as it does when used for circuit coupling.

In receiver design, where component cost is a factor, the lowest capacitance consistent with adequate design is used, since the cost is less. In service work the same cost factor does not obtain. For this reason, it is permissible to use a 25-mfd bypass to replace a 5-mfd. In some respects this procedure is advised providing a reduction in hum, since many tubes introduce hum in their cathode circuit, due to the proximity of the tube cathode sleeve to the a-c heated filament. Leakage between the cathode sleeve and the filament will create a slight 60-cycle voltage across the cathode resistor, which, in turn, will be amplified by the tube. On the other hand, some receivers purposely use low-farad capacitors which permits a slight hum in the first audio stage. By using a low-farad capacitor, a low-frequency bucking voltage is created in the cathode circuit which cancels out the hum, along with other low frequencies.

The value of cathode resistor is determined by the operating voltages and plate-load resistance. In general, the higher the value of plate-load resistance the higher will be the value of cathode resistance. Again, the higher the applied *B voltage, the lower will be the cathode resistor.*

The cathode voltage also influences the stage gain and fidelity. Thus, too high a cathode voltage may cause the tube to approach its cutoff voltage, in which case not only will the stage gain be reduced, but since the plate current will approach the zero point, amplitude distortion will be introduced. This is equivalent to the detector action of the tube, in which only half of the a-c envelope is amplified. The action is demonstrated in Fig. 4.

The cathode voltage also determines the maximum permissible input driving voltage. If the input voltage at the grid were to exceed the cathode, the net grid voltage would then be positive and the grid would then draw current. This would cause distortion, since the load on the input source would vary from practically no load when the grid is biased, to a comparatively heavy load when the grid is positive. It should be noted that most a-c and v-t meters measure rms voltages, which are 70% of the peak value. Therefore, for each volt of cathode bias, only .7 volt of input voltage, as measured on a v-t voltmeter is permissible.

The maximum value of grid resistor, which should always be used, is usually found by consulting the tube manual. In general, higher values of grid resistance are used with cathode bias than with fixed bias. The value of grid resistance is determined by the tube characteristics and its construction. Some gas always remains in the tube when it is evacuated. This gas has a tendency to create some current flow in the grid circuit. This current flow will create a positive grid voltage which will, to some extent, cancel the bias voltage. In some tubes this action may continue until the excessive plate current destroys the tube. In those tubes employing cathode bias, the self-regulating action of the bias resistor prevents this action, since any increase in plate current increases the bias, which in turn, decreases the plate current. Thus, the cathode resistor acts as a safety factor.

The screen voltage, like the cathode voltage, determines the plate current. And, like the cathode circuit, introduces an impedance into the plate circuit. Thus, in pentode circuits, the screen voltage should be adjusted to give the desired plate current. The plate current, in turn, determines the ratio of actual plate voltage to the voltage drop in the plate-load resistor. The proper size screen-dropping resistor may best be determined by consulting tube manual tables for resistance-coupled amplifiers. Since the screen grid introduces impedance in the plate circuit, the value of bypass capacitor will affect the low-frequency response in much the same manner as the cathode bypass. Generally, a .5-mfd capacitor is sufficient, although higher values will increase the low frequency response.

The gain of an audio stage is a function of the amplification factor of the tube and the load resistance in the plate circuit. An important aspect of component values comes to light when the circuit is analyzed in terms of effective load impedance. Fig. 5 shows the total load impedance of an *r-c* amplifier stage for both high and low frequencies. For the low frequencies the plate resistance of the tube is in parallel with the plate-load resistance. These, in turn, are in parallel with the reactance of the coupling capacitance which, in turn, is in series with the grid resistor of the following stage.

At high frequencies, the coupling capacitor loses its importance, but two additional factors are introduced. These are the input and output capacitances of the tubes involved. For example, the input capacitance of a 6C5 is 4.4 mmfd and the output capacitance is 12 mmfd. Since these capacitances are in parallel, they may be represented by their equivalent reactance, or resistance. At 10,000 cps this is equivalent to a load impedance of less than 1 meg-

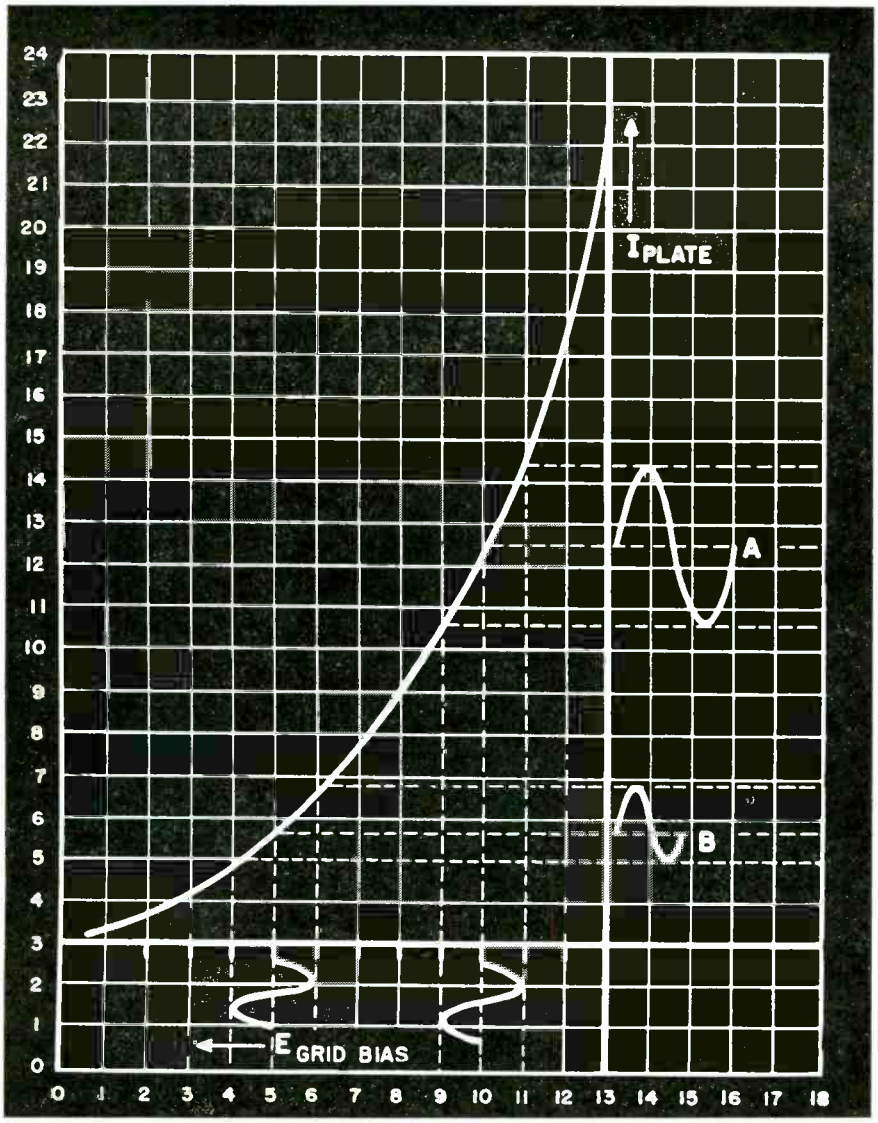


Fig. 4. Here is shown the effect of incorrect bias on an audio tube. Curve *A* is the response at normal bias, while *B* shows the distortion resulting from too high a bias. The action is equivalent to that of a biased detector.

ohm. Its effect on the high-frequency response will therefore be considerable, if higher resistance plate and grid resistors are used. On the other hand, the 6SF5 has input and output capacitances of 4 and 3.6 mmfd, permitting higher values of load resistance.

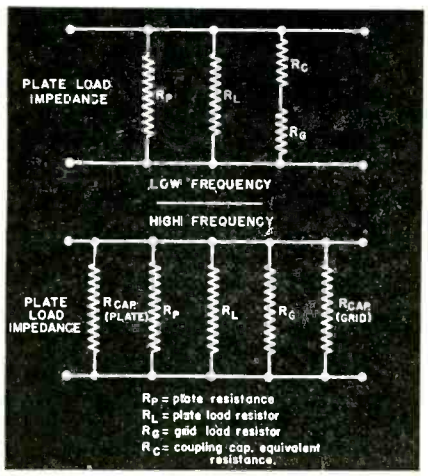


Fig. 5. The true plate load impedances at low and high frequencies. At low frequencies, the reactance of the coupling capacitor is a factor, while at high frequencies the input and output tube capacitances affect the plate load impedance.

Where Fig. 5 shows the equivalent plate-load impedance, it also shows the equivalent grid-load impedance. The same logic applies to this circuit. Therefore the size of grid resistance is also limited by the input and output capacitances of the tubes employed.

The foregoing has been explained to show that increasing the value of plate and grid resistors will not necessarily increase the stage gain or the frequency response beyond certain limits. Therefore, when designing *r-c* amplifiers, all factors must be taken into consideration.

Practical design factors influence the choice of components. For example, cathode bypass and coupling capacitances are limited in value, when used for low frequency improvement, by the filter systems used. Using large values may sometimes cause regeneration and feedback, or oscillation. To prevent this, *r-c* filter networks may have to be used in the plate and grid circuits of *r-c* amplifiers. The control grid filter network is only used when fixed bias is employed. Again, the design of the stage will be influenced by the purpose of the stage. That is, whether the stage is to be used for low-level or high-level operation. If low-level operation is intended, higher values of plate-load resistance may be used. On the other hand, if high output voltage is needed, components must be so selected that the voltage at the plate of the tube represents at least 50% of the supply voltage. For high gain at low levels, the actual plate voltage may be reduced to 20% of the supply voltage.

Where low-frequency response is desired, fixed bias is sometimes preferable to self bias. By obtaining the bias voltage from a bleeder resistor, a lower impedance path is thus possible, permitting the return of the cathode directly to ground. Since the bleeder network utilizes higher currents than are obtainable from the individual tubes, bias-resistance paths of 25 to 50 ohms are possible. However, *r-c* filter networks may be necessary in the grid circuits for decoupling purposes. This is particularly desirable where pentode tubes are used, since the same reasoning applies to the screen-grid supply.

In some receivers, it will be noted that the 6SQ7, when used as a detector and first audio tube, does not use any bias voltage. Where this condition obtains, it will be noted that the grid resistor is of the order of 5 to 10 megohms. The same is true of many battery-type tubes. There are several factors which influence this type of design. The first, of course, is the cost factor. The elimination of a cathode resistor and bypass is a saving. Electrically, this method is feasible, since it is only used where low *B* voltage supplies are used. Since the gain of the tube is quite high, and since they are usually used in conjunction with beam-power type output tubes which require very low driving voltages for maximum output, the applied grid-input voltage is always a very small portion of one volt. The high resistance in the grid circuit prevents any appreciable current drain on the input system, since even a one-microampere grid current would create a bias voltage of 5 to 10. Again, since the input

(*Continued on page* 43)

TOOLS And ACCESSORIES For the NEW SERVICE SHOP

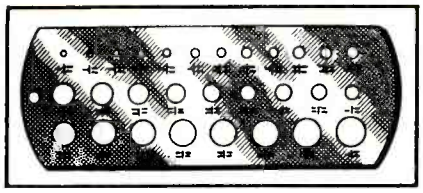


Fig. 1. A twist drill gauge.

by ALFRED A. GHIRARDI

Advisory Editor

[*Part VII . . . Supplementary and Special-Purpose Tools*]

OTHER TOOLS OF IMPORTANCE TO the Service Shop include drill gauges, rules and scales, dividers, trimming knives, woodworking tools, and trouble-shooting lights.

Twist Drill Gauge

The various uses for a drill gauge were explained in the first article (*Basic Tools*) of this series,[3] so they will not be repeated here. A simple gauge of the type shown in Fig. 1 will suffice.

Rules and Scales

Only a few simple measuring tools are required for making all necessary measurements of size, distances, etc. Some form of long measuring rule is assumed to be necessary for some jobs —for example, measuring the length of wire needed for outdoor antenna installations, extension wiring, etc. A 6′ flexible steel push rule of the type illustrated at (*a*) of Fig. 2 will come in handy for such work. A 2′ folding rule of the type shown at (*b*), which contains a metallic sliding caliper for measuring the diameter of such round objects as bolts, tuning capacitor shafts, tube sockets, etc., is also recommended.

An extremely useful multi-use rule and gauge that costs only a dollar, and is supplied in a leather case, is illustrated at (*c*). In laying out the holes that are to be cut in a chassis or panel for objects such as tube sockets, control shifts, meters, etc., just to cite one example, the rule and gauge may be used as a center-finding tool (because the center of a hole which may have been spotted by drawing the circular outline of the object to be mounted can be found with it). It may also be used as a square, as a level protractor for measuring or laying out angles, or as a circle divider. These uses are illustrated by the inset drawings at the right of (*c*) of Fig. 2. When twist drills are being resharpened, the proper fixed angle to which the drill point should be ground may be checked with it, as illustrated in the main drawing at (*c*). Of course the 5″ ruled scale also has many uses.

Dividers

Dividers are extremely useful in chassis or panel layout work. Wing dividers of the kind illustrated at (*a*) of Fig. 3 are recommended. Distances between mounting and other holes can be laid out accurately with them. They

(*Continued on page* 34)

[3] SERVICE, April, 1946.

Fig. 2. A few simple types of rules or scales that enable all ordinary measurements to be made. (*Courtesy General Hardware Mfg. Co.*)

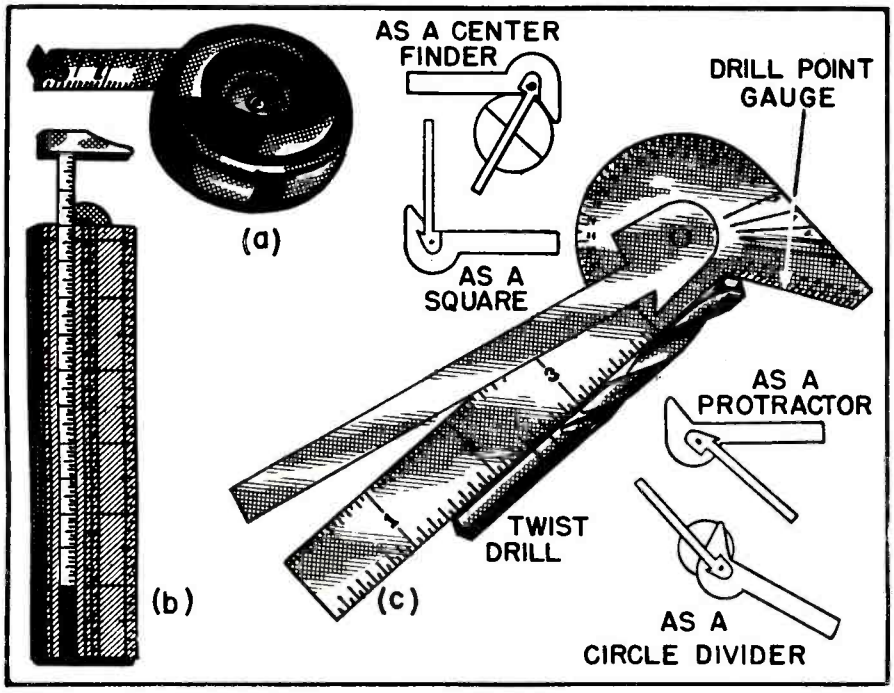
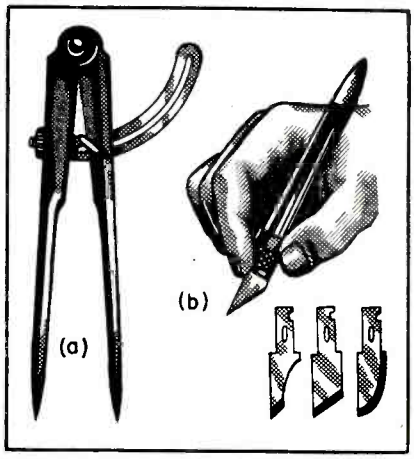


Fig. 3. At (*a*), a pair of wing dividers. At (*b*), a trimming knife with three interchangeable blades of different sizes. (*Trimming knife views, courtesy Somar Specialty Corp.*)



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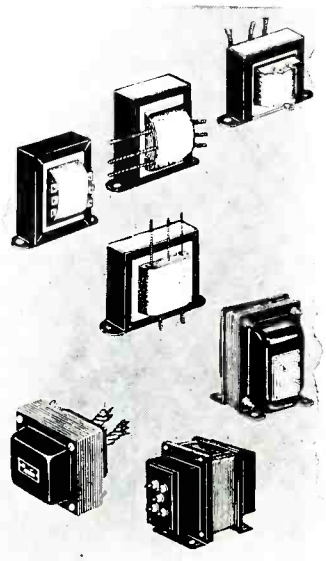

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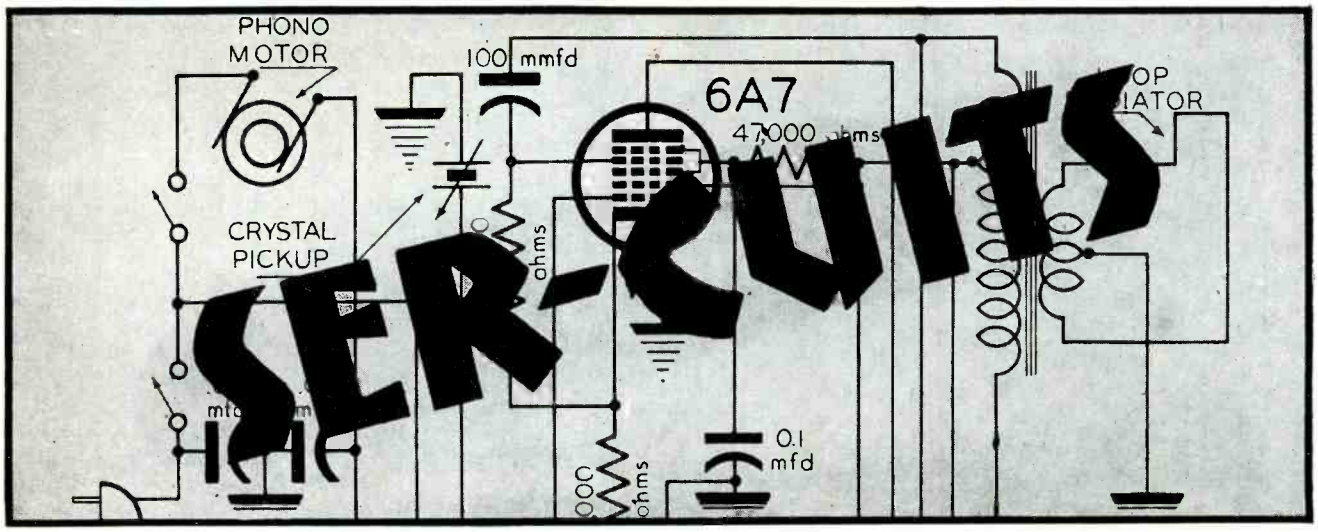
STANDARD TRANSFORMER CORPORATION
1500 NORTH HALSTED STREET · CHICAGO, ILLINOIS



by HENRY HOWARD

WITH INCREASED PRODUCTION of f-m and television receivers operating in the v-h-f bands has come the need for special types of instruments to service and maintain these sets. To meet such a need, Sylvania recently developed a test unit, the type 134 Polymeter, that can be used up to 300 mc.

The unit, Fig. 1, uses a vacuum-tube probe with a 1247 proximity-fuse-type tube.

Features of the tester include a balanced amplifier that is practically independent of line voltages and normal amplifier tube changes, preset factory

(*Continued on page* 42)

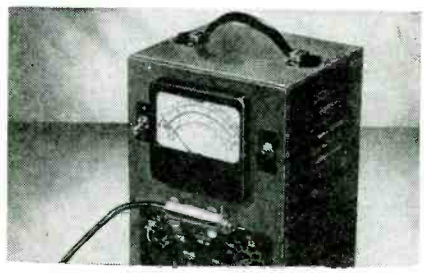
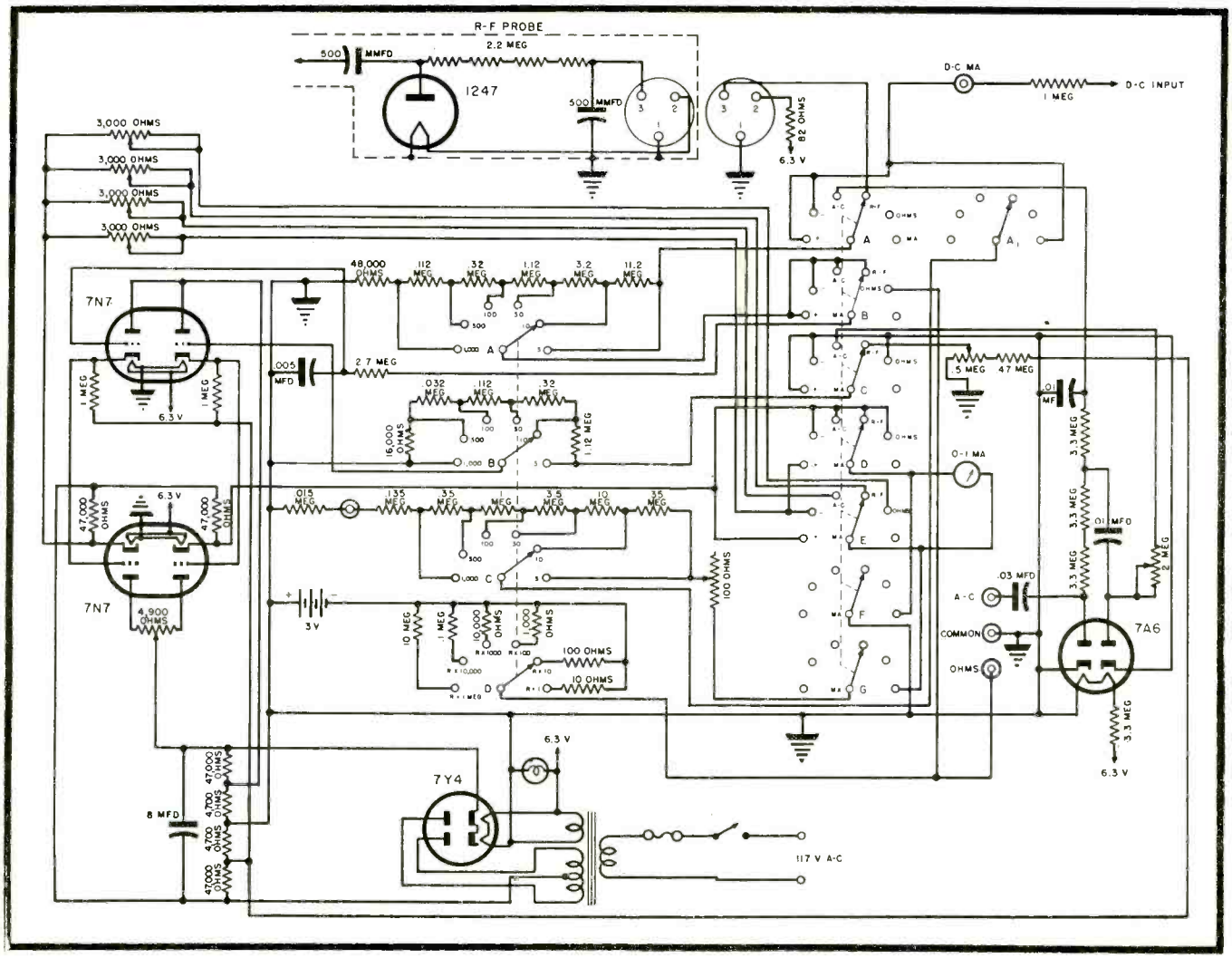
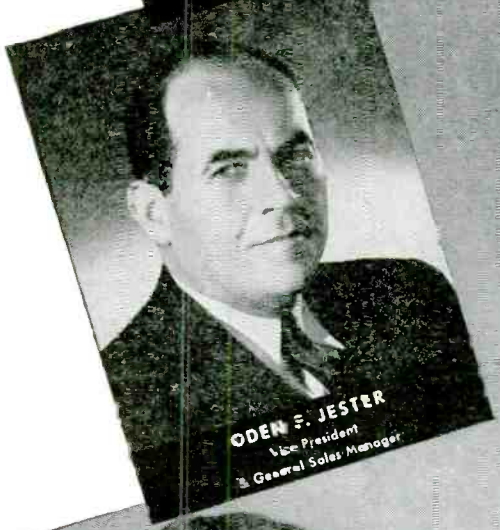


Fig. 1. The Sylvania Polymeter.





A VERY

Merry Christmas

We pause at this age-old season of good-will to greet our many friends in the radio and electronic industries and to extend to all of them our best wishes for a Merry Christmas and a Happy New Year. A year has passed since the formation of the Electronic Distributor and Industrial Sales Department . . . a year during which we have developed into a smoothly functioning organization, known from coast to coast for the quality of our three great lines, Thordarson, Meissner and Radiart. We are proud of this success and we are grateful to those in the industry who have helped to make it possible.

Now as we stand at the beginning of a new year we are firmly resolved that the products and services of these member companies will continue to reflect the wealth of engineering skill and production know-how which has distinguished them in the past.

Russell Maguire
O. E. Jester
R. M. Kare

MAGUIRE INDUSTRIES INCORPORATED

ELECTRONIC
DISTRIBUTOR
AND INDUSTRIAL SALES DEPARTMENT

336 N. MICHIGAN AVENUE • CHICAGO 11, ILLINOIS

MEISSNER • THORDARSON • RADIART

ANNUAL SERVICE INDEX

JANUARY, 1946 — DECEMBER, 1946

ANTENNAS

CAPACITORS

CHARTS

CIRCUIT ANALYSES

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JANUARY, 1946 — DECEMBER, 1946

FREQUENCY MODULATION

INTERCOMMUNICATIONS

LIMITERS, DISCRIMINATORS, AVC, AFC AND DETECTORS

MINIATURE TUBES

NOISE

OSCILLATORS

PARTS

PERMEABILITY TUNING

PHONOGRAPHS, PICKUPS, RECORD PLAYERS, ETC.

PORTABLES

POWER SUPPLIES

RECEIVERS

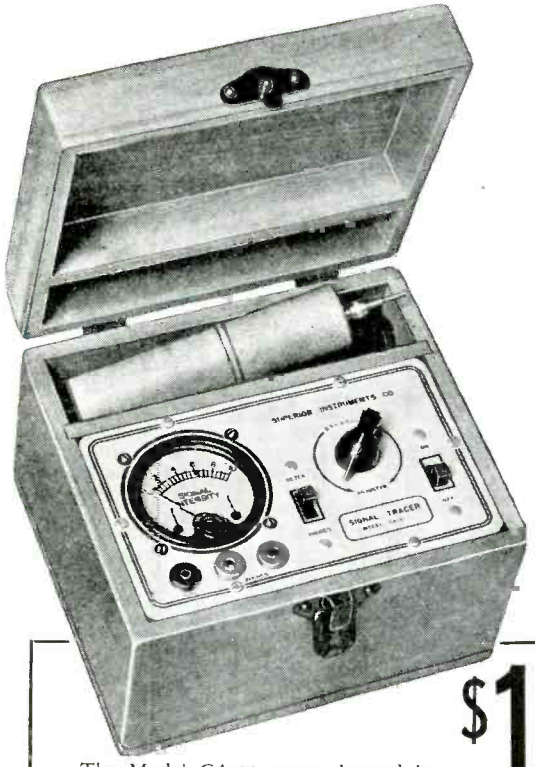
NOW AVAILABLE FOR IMMEDIATE SHIPMENT!

Please place your order with your regular radio parts jobber. If your local jobber cannot supply you, kindly write for a list of jobbers in your state who do distribute our instruments or send your order directly to us.

The New Model CA-11

SIGNAL TRACER

Simple to operate . . . because signal intensity readings are indicated directly on the meter!



The Model CA-11 comes housed in a beautiful hand-rubbed wooden cabinet. Complete with Probe, test leads and instructions.....Net price **$18.75**

Essentially "Signal Tracing" means following the signal in a radio receiver and using the signal itself as a basis of measurement and as a means of locating the cause of trouble. In the CA-11 the Detector Probe is used to follow the signal from the antenna to the speaker — with relative signal intensity readings available on the scale of the meter which is calibrated to permit constant comparison of signal intensity as the probe is moved to follow the signal through the various stages.

Features:

- ★ SIMPLE TO OPERATE — only 1 connecting cable — NO TUNING CONTROLS.
- ★ HIGHLY SENSITIVE — uses an improved Vacuum Tube Voltmeter circuit.
- ★ Tube and resistor-capacity network are built into the Detector Probe.
- ★ COMPLETELY PORTABLE — weighs 5 lbs. and measures 5" x 6" x 7".
- ★ Comparative Signal Intensity readings are indicated directly on the meter as the Detector Probe is moved to follow the Signal from Antenna to Speaker.
- ★ Provision is made for insertion of phones.

The New Model 450

TUBE TESTER

SPEEDY OPERATION assured by newly designed rotary selector switch which replaces the usual snap, toggle, or lever action switches.

The model 450 comes complete with all operating instructions.

Size 13"x12"x6". Net weight 8 lbs. Our Net Price..... **$39.50**

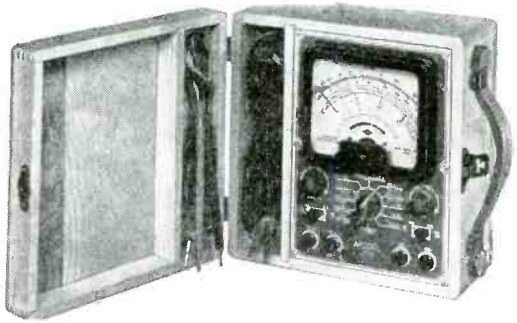
Specifications:

- Tests all tubes up to 117 Volts including 4, 5, 6, 7, 7L, Octals, Loctals, Bantam Junior, Peanut, Television, Magic Eye, Hearing Aid, Thyratrons, Single Ended, Floating Filament, Mercury Vapor Rectifiers, etc. Also Pilot Lights.
- Tests by the well-established emission method for tube quality, directly read on the scale of the meter.
- Tests shorts and leakages up to 3 Megohms in all tubes.
- Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.
- New type line voltage adjuster.
- NOISE TEST: Tip jacks on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.
- Works on 90 to 125 Volts 60 Cycles A.C.

The New Model 670P

SUPER-METER

A Combination Volt-Ohm Milliammeter plus Capacity Reactance Inductance and Decibel Measurements



Specifications:

D.C. Volts: 0 to 7.5/15/75/150/750/-1,500/7,500 Volts.
A.C. Volts: 0 to 15/30/150/300/1,500/-3,000 Volts.
Output Volts: 0 to 15/30/150/300/1,500/-3,000 Volts.
D.C. Current: 0 to 1.5/15/150 Ma. 0 to 1.5 Amperes.
Reactance: 0 to 500/100,000 ohms. 0 to 10 Megohms.
Capacity: .001 to .2 Mfd. .1 to 4 Mfd. (Quality test for electrolytics).
Reactance: 700 to 27,000 Ohms. 13,000 Ohms to 3 Megohms.
Inductance: 1.75 to 70 Henries. 35 to 8,000 Henries.
Decibels: —10 to +18. +10 to +38. +30 to +58.

Added Feature:

The Model 670P includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 volts.

The Model 670P is housed in a hand-rubbed, portable oak cabinet complete with cover, test leads and all operating instructions. **$35.75** NET

SUPERIOR INSTRUMENTS CO.

DEPT. B - 227 FULTON STREET, NEW YORK 7, N. Y.

ANNUAL SERVICE INDEX

JANUARY, 1946 — DECEMBER, 1946

SERVICING HELPS

SPEAKERS

SOUND

TELEVISION

TEST EQUIPMENT

TONE COMPENSATION

TOOLS

VOLUME CONTROLS

POSTWAR V-T-V-M

(*Continued from page 11*)

by *Set V. Zero* knob with *Function* knob set to *D.C.+* and *Range* knob set to 3 V, *Function* knob is shifted to a-c position. Meter zero will not change more than 1% to 2%. If zero *does shift* an old, unsheathed, or poorly grounded a-c power line will usually be the cause. The remedy is simple. If reversing the a-c plug in the a-c power outlet does not make a-c meter zero coincident with *D.C.+* zero, a lead from a good ground should be clipped onto one of the four panel screws of the instrument.

The unit also permits the measurement of the actual magnitude of a-c voltage radiated by the local power line, electrical appliances and all similar sources of such undesired radiation. For this measurement the red test lead tip is inserted in the *+V—Ω—MA* jack, allowing it to act as an antenna. The meter reading may be anything from a fraction of one volt up to 30 volts or more. This is actually a-c energy being picked up by the unterminated red test lead acting as an antenna. This can be proved by handling this lead, moving it about, touching its metal tip, and noting the increase in voltage registered, which our body adds, when a finger touches the red prod tip. The long time-constant of the diode input circuit can also be checked during these tests by touching the red prod tip to a panel thumb-screw. Meter reading will take several seconds to fall to zero, due to desirably slow leaking off of charge built up on .03-mfd capacitor by local a-c fields discharging through a 20-megohm resistor and 37.5 megohm through 125,000-ohm resistors in series.

If the black test lead tip is inserted into the *Com. Gnd.* jack and both red and black prod tips are contacted to a source of a-c voltage, the *false* but quite real voltage registered by the meter due to the antenna effect of the lead when unterminated and exposed to locally radiated a-c fields will disappear, and the correct voltage of the source being measured will be indicated.

By providing an unshielded red test lead input capacity of the instrument has been kept low and the instrument can be used to measure a-c voltages beyond 100 kc. Where the user is more concerned with a-c voltage measurements at a-c power-line frequency, the antenna effect of the intentionally unshielded red test lead may be eliminated by using a shielded test lead consisting of an ordinary test prod terminating the inner conductor of a length of one-wire shielded microphone cable. The far end of this test lead would plug into the *+V—Ω—MA* jack, the shield braid of which would terminate at meter end either at the *Com. Gnd.* jack or through a spring clip to a panel thumb-nut.

The R-F Probe

To study operation of the probe, it should be withdrawn from its shell from the panel receptacle. No change in meter zero will be observed. If a finger is now applied to the *live* tip of the r-f probe, the meter will register locally present a-c voltage fields, since the body is now acting as an antenna to pick them up. Touching the probe tip to a panel thumb-

(*Continued on page 26*)

POSTWAR V-T-V-M

(*Continued from page 25*)

nut will cause the meter reading to fall to zero, since the meter input is short-circuited, and cannot pick up voltage radiated from the power line, etc.

We can now check a-c meter accuracy together with r-f probe operation. The *Range* knob is set to 120 volts, *Function* knob to *A.C.*, and the probe is inserted in its panel receptacle. Red and black test prods are connected to the a-c line. Meter should read the voltage of same accurately to within ±5%. Now the r-f probe should be withdrawn and its tip contacted to one side of the a-c line, the shell (or tip of the black prod) being connected to the other side of the line. The meter will read only about 80-odd volts. This is quite proper. When we measure voltages using the r-f probe directly, we have substituted a .0005-mfd capacitor for .03-mfd capacitor in the diode rectifier input circuit. The .0005-mfd unit is suitable for a-c voltage measurement in the 15,000 cycle up to over 100 megacycles range. Its reactance is too high for accurate low-frequency measurement. That's why the instrument automatically replaces the .0005 with a .03 when the r-f probe is plugged into panel, to make low-frequency (down to 20 cycles) measurements possible through the panel jacks which include the .03-mfd capacitor in their circuit.

[*To be continued*]

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WIRE RECORDER PREVIEW

Webster-Chicago wire-recorder preview test at plant at 5610 Bloomingdale Avenue, Chicago.

•

TRAILER P-A

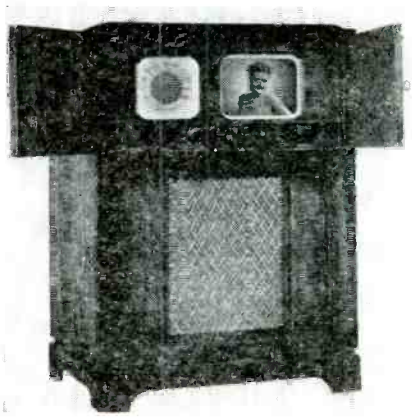
A p-a system recently installed in a trailer by Broadcast Recorders, Inc., 1538 N. Cahuenga Blvd., Hollywood, Calif. Unit included a 5-channel mixer, recording amplifiers and two recorders.

•

ACKNOWLEDGMENT

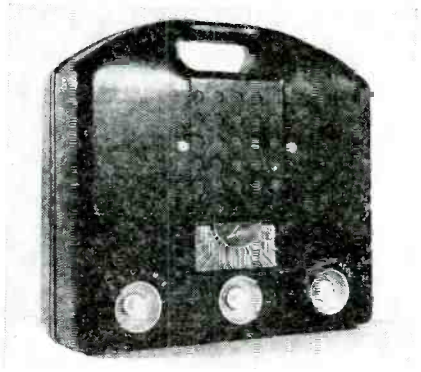
The November issue carried schematic diagrams on Learadio models 561-562-563 and also the Philco model 43-200 series. These were reproduced without required permission from Howard W. Sams Photofact Folios. We are deeply regretful that this occurred.

NEW MODELS

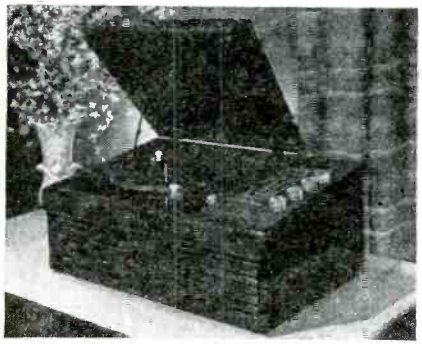


G.E. 801 direct-view television receiver producing a 10" picture. Receiver covers a-m broadcast channels.

Bendix 747-A f-m/a-m receiver using ratio detector.



Lewyt a-c/d-c/battery portbale.



Air King combination 6-tube superhet featuring automatic record changer for 10" or 12" records. Has beam-power output.

BRITISH PORTABLES

(*Continued from page 9*)

mum inductance, were dried and impregnated under vacuum in petroleum jelly and then immersed in high-melting-point wax.

This design technique prompted the recent development of a plain-foil electrolytic capacitor, $1\frac{9}{16}$" x $\frac{11}{32}$". This has been made possible by mounting the small negative electrode within a thin metal case and then closing the ends of the case on to synthetic rubber end-plugs, through which the connecting tags pass. They are said to have exceptionally good temperature characteristics. At −50° C, the capacitance is still approximately 50% of its value at 15° C; maximum working temperature is 71° C. There are six values available, the smallest being 1 mfd and the largest 20 mfd, their maximum peak working voltages being 350 and 12 respectively. Other miniature capacitor designs have included paper capacitors in aluminum tubes with synthetic rubber end-plugs, varying in diameter from 1/5" to $\frac{3}{8}$" and in capacity from 0.001 to 0.1 mfd, with overall lengths from 1" to $1\frac{1}{2}$".

Using wartime miniature design techniques, a manufacturer recently produced thumbnail type a-f chokes and transformers. Despite their small size these transformers and chokes, which measure 1 3/64" long, $\frac{3}{32}$" deep and $\frac{1}{8}$" high, have a very uniform response throughout the audio range.

A series of i-f transformers, designed for maximum gain and selectivity, yet occupying a minimum of space, manufactured during the war for inclusion in walkie-talkie sets and miniature receivers for beach landing parties, are now available for general use. The coils are contained in enclosed pot-type iron-dust cores with adjustable iron-dust center cores. Trimming capacitors are mounted inside the screening can which measures $1\frac{1}{8}$" deep by $\frac{1}{8}$" square. Tested between a 6K7 and a standard voltmeter, these transformers had a gain of 60 at a frequency of 1 mc; at 2.1 mc the gain was 28 and at 4.86 mc it was 15.

The most outstanding reduction in size is probably that of the midget p-m moving-coil loudspeaker. One type has an overall diameter of $2\frac{1}{2}$" and occupies a depth of $1\frac{1}{8}$". This miniature speaker, the voice coil of which is half an inch in diameter, is capable of handling inputs of up to ½ watt.

A recently produced moving-coil earphone uses a miniature moving coil and cone diaphragm; the permanent

magnet is less than an inch in diameter and the moving coil, ½" in diameter, consists of four layers of 46 s-w-g in a 0.032" gap.

Multi-Contact Switch

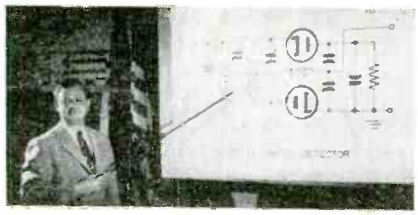
In response to a request from Britain's Ministry of Supply for a miniature multi-contact switch, capable of withstanding conditions in the Far Eastern war zone, one company produced a rotary wave-change switch with all moving parts and contacts hermetically enclosed in a ¾" diameter and $\frac{13}{16}$" deep container. In producing this switch it was necessary to silver-plate the very small contacts with a very fine finish to provide a relatively small contact area that had a contact resistance of 1/100th of an ohm and a current-carrying capacity of 50 ma. The problem was solved by making the contact springs from phosphor bronze strip on which pure silver, a thousandth of an inch thick, was rolled. The switch is now available with 12 contacts, in single-, two-, three-, and four-pole.

Miniature two-gang and three-gang tuning capacitors, with an overall depth behind the panel of 1.87" and 2.67", respectively, also produced for the Forces, will be available for general use very shortly.

Other components and accessories which have been greatly reduced in size during the past year or two are composition fixed resistors, now little thicker than a pencil lead, selenium rectifiers and *B* batteries.

•

AT BENDIX SERVICE SCHOOL



D. H. Kresge, service manager for radio and television, Bendix Radio Division, Bendix Aviation Corporation, discussing operation of the ratio-detector system, used in Bendix f-m receivers, before members of a service school recently conducted by Bendix.

•

SYLVANIA TEST EQUIPMENT STUDY

Sylvania test equipment under study at the Emporium plant by . . . (left to right) R. W. Andrews, G. C. Isham, J. T. Mallen, S. J. McDonald, H. G. Kronenwetter, John Hauser, R. F. Henderson, H. C. L. Johnson, H. H. Rainier, G. R. Wannen and R. P. Almy.

SERVICING HELPS

by FRANK C. KEENE

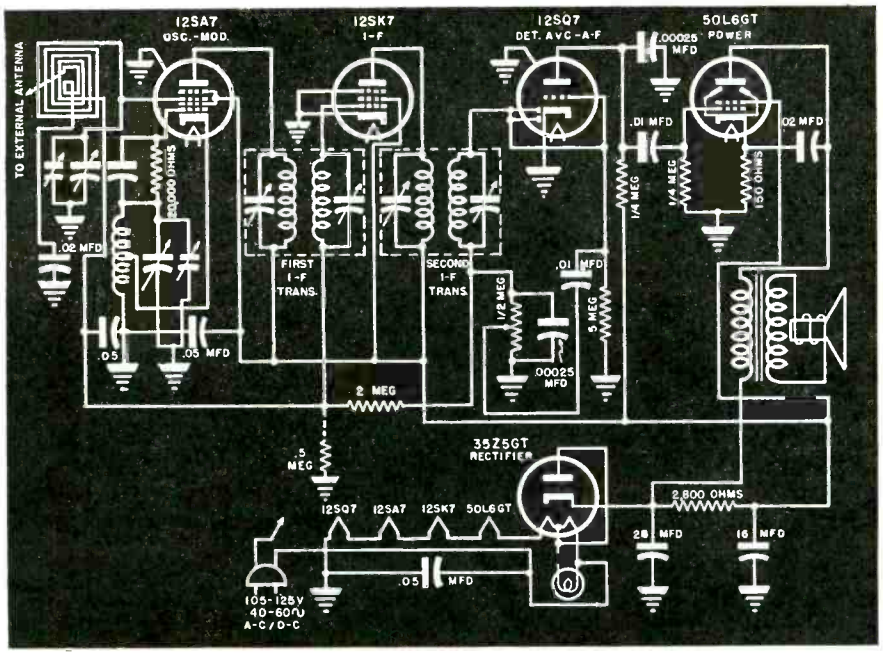


Fig. 1. (*Van Houton Query*). G.E. LCP 508 used to study lack of sensitivity problem.

I HAVE FOUND THAT *a-c/d-c receivers several years old seem to lack sensitivity, even though a stage-by-stage check reveals normal gain. Are there any cures for this deficiency?—James Van Houten.*

To analyze this problem, let us study a typical midget receiver; Fig. 1 (G. E. LCP 508). If realignment and new tubes do not have the desired effect, the filter network should be checked. A voltage check may show that the filters need replacing. The use of high farad capacitors is recommended.

Three other kinks may help when other methods fail. The first is to insert a .5-megohm resistor from the avc bus to ground at the r-f end of the avc filter resistor. This would have the effect of reducing the avc action, decreasing the bias on the r-f tubes, and increasing the apparent gain of the receiver. This should only be used where there are no exceptionally strong local signals.

The second kink is to move the loop antenna further away from the chassis. This, in effect, improves the loop's *Q*. If this is not feasible, a thin copper sheet might be inserted between the loop antenna and the chassis proper. The sheet should be attached to the chassis. This is equivalent to an electrostatic shield between the chassis and the loop, and reduces the signal absorption of the chassis.

•

IN SERVICING A *1934 Sparton 74, I found what appeared to be an oscillating first i-f. That is the set played weakly with the grid cap off, but with the cap on, hum, oscillation and instability appeared. The trouble was particularly acute on the high-frequency end of the dial. Neither changes of components nor the usual circuit changes cured the trouble. Have you any suggestions?—Murray A. Pett.*

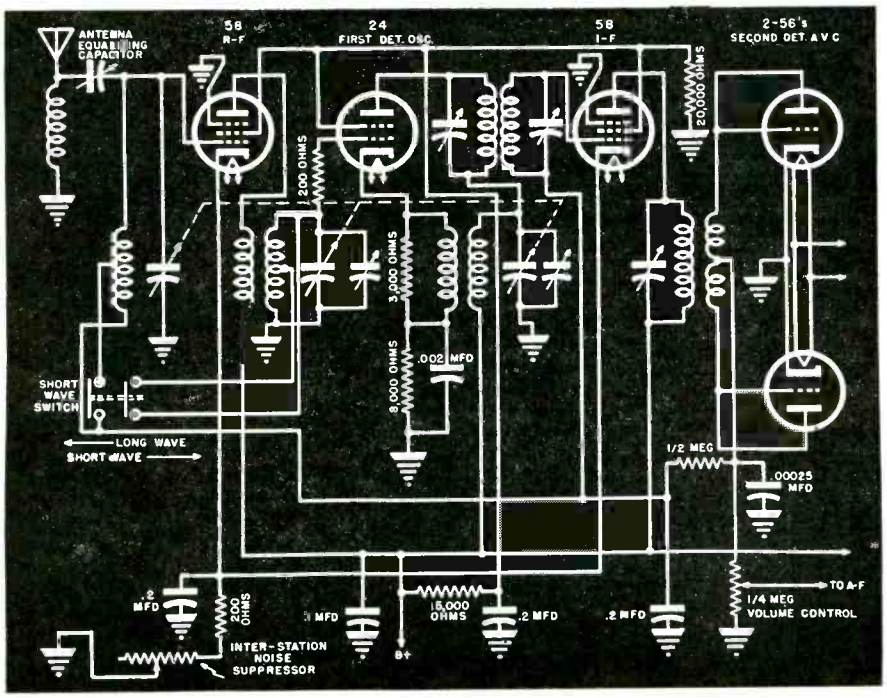


Fig. 2. (*Pett Query*). The r-f portion of Sparton 74 analyzed in the oscillation problem of Mr. Pett.

It seems that the trouble does not lie in the i-f stage proper, but in the r-f portion of the receiver; Fig. 2. It is unlikely that the i-f would oscillate only at the high frequency end of the dial. Oscillation is due to feedback, which means that some portion of the signal is getting back from the output to the input of a tube. If the wiring of the receiver has not been changed, this type of trouble can be traced to a defective r-f bypass capacitor.

There are three points where this trouble may arise. These are the control grid, the screen grid and the cathode circuits. In this particular receiver the most logical point to test first is the avc system. It will be noted

(*Continued on page* 43)

FOR THE BROADCAST STATION
THE HIGH FIDELITY AMPLIFIER
THE LABORATORY

LINEAR STANDARD

Linear Standard audio units are the closest approach to the ideal component from the standpoint of frequency response, wave form distortion, efficiency, shielding, and dependability. Guaranteed response ± 1.3 DB, 20—20,000 cycles. The standard of the broadcast industry . . . units available for every audio and power application.

ULTRA COMPACT

For compact, high fidelity equipment, UTC Ultra Compact units are unequalled. Light in weight, yet providing frequency response ± 2 DB from 30 to 20,000 cycles. All units except those carrying DC in primary employ true hum balancing coil structure which, combined with high conductivity outer case, insures good inductive shielding. Units available for all audio applications up to + 10 DB in operating level.

INTERSTAGE FILTERS

UTC Interstage Filters (10,000 ohms impedance) are available in low pass (LPI), high pass (HPI), and band pass (BPI) types for all frequencies from 200 to 10,000 cycles. Designed to effect 6 DB loss at cutoff frequency . . . 35 DB at .75 and 1.5 times cutoff frequency . . . 40 DB at .5 and twice cutoff frequency. Dual alloy magnetic shielding reduces pickup to 150 Mv. per gauss.

VARITRAN

Varitran units provide an ideal means of voltage control for AC equipment. Performance features include high efficiency . . . excellent regulation . . . universal mounting features . . . self-contained fuse protection. Available in 115 volt and 230 volt models with from 1 to 11 Amp. output rating. These units afford stepless adjustment of voltage from 0 to 113% of line voltage.

United Transformer Corp.

150 VARICK STREET • NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

NEWS

BEN FRENCH JOINS SAMS' PHOTOFACTS

B. V. K. French has been named director of field relations of Howard W. Sams & Co., Inc., Indianapolis, Indiana.

Mr. French will act as liaison between the manufacturer and the servicing profession.

Mr. French was formerly supervisor of the Mallory Research Laboratory.

* * *

R. B. UNGER NOW WARD PRODUCTS ASSISTANT SALES MANAGER

Roy Brown Unger has been appointed assistant sales manager of the jobber division of the Ward Products Corporation, Cleveland.

* * *

COLLINS BECOMES AEROVOX CHIEF ENGINEER

Joseph L. Collins has been named chief engineer of the Aerovox Corporation, New Bedford, Mass. He has been head of the electrolytic engineering division since 1938, and before that in charge of electrolytic engineering of Sprague Electric Company.

* * *

SCENIC RADIO CATALOG

A 16-page catalog has been issued by Scenic Radio & Electronics Co., 53 Park Place, New York City 7, N. Y.

Items featured in the catalog include volt-ohm-milliammeters, signal generators, tube testers, oscilloscopes, vacuum-tube voltmeters, signal tracers, audio amplifiers, phonograph players, automatic record changers, loudspeakers, tubes, microphones, antenna kits, radio text books, etc.

Harry Adelman is president of Scenic Radio.

* * *

S. LUBIN JOINS SPRAGUE ELECTRIC

Samuel Lubin has joined the staff of the field engineering department of the Sprague Electric Company, North Adams, Mass. Mr. Lubin will locate in

Washington, D. C., in charge of contacts with all government agencies.

Mr. Lubin was formerly with the new development section of the Technical Standards Division of R. E. A.

* * *

STROMBERG-CARLSON F-M ADAPTER

To convert prewar f-m receivers to the new 88-108 mc bands, a simplified adapter has been invented by George Driscoll, manager of Stromberg-Carlson Company f-m station WHFM, Rochester, N. Y.

The adapter is being marketed by Stromberg-Carlson.

* * *

KOETKE JOINS NEDA

Norman A. Koetke has joined the executive staff of the national office of NEDA.

* * *

OPERADIO APPOINTS FRED D. WILSON GENERAL SALES MANAGER

Fred D. Wilson has become general sales manager of Operadio Manufacturing Co., St. Charles, Ill. Mr. Wilson has been in charge of jobber sales of the company's commercial line and trademarked equipment.

* * *

RADIOLAB CATALOG

A catalog, No. 6E-2, listing multi-testers, signal generators, oscilloscopes, sound amplifier systems and student construction kits for schools and laboratories, has been issued by the Radiolab Publishing & Supply Co., 652 Montgomery St., Brooklyn 25, N. Y.

* * *

WNBT AND WPTZ TO EXCHANGE TELEVISION PROGRAMS

An agreement providing for the exchange of commercial and sustaining television programs between WNBT in New York and WPTZ in Philadelphia has been signed by the National Broadcasting Company and Philco Corporation.

* * *

BENDIX RADIO APPOINTS MASTER SERVICE DEALERS

Seven servicing organizations have been named to service Bendix aviation radio equipment by George Myrick, manager of personal aviation sales for Bendix Radio. The service organizations are

(*Continued on page 37*)

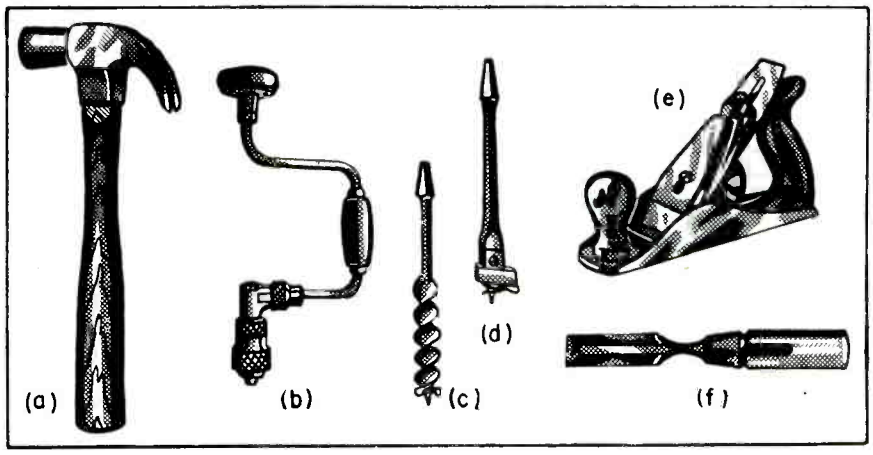


Fig. 4. Some of the essential woodworking tools that are often used around the shop.

TOOLS

(*Continued from page* 16)

can be used for transferring distances directly from a rule, or for scribing circles or parts of circles. They often are needed merely for measuring distance of separation between parts already mounted, or for dividing spaces into equal parts, or determining the dimensions of irregularly shaped work. Their points should be kept sharp. A pair of wing dividers about 6" long will be satisfactory.

Trimming Knives

One of the handy little craftsman's knives, made to take several interchangeable surgical steel blades of various sizes and shapes, is handy for all trimming operations on dial cords, speaker cones, speaker grille cloth, and a variety of other uses. The three blade shapes illustrated with the knife at (*b*) of Fig. 3 are practical for Service Shop use.

Woodworking Tools

A few of the more essential woodworking tools should be included in the tool equipment of the Service Shop, for they are needed when counters, shelves, cupboards, etc., are to be installed, for alteration work on wooden radio cabinets, and for a variety of other construction and alteration jobs around the shop. If a test bench is to be built, or altered, they are absolutely necessary!

Tools required include a medium size *crosscut* saw for cutting across the grain of wood, and a medium size *rip* saw for cutting along the grain.

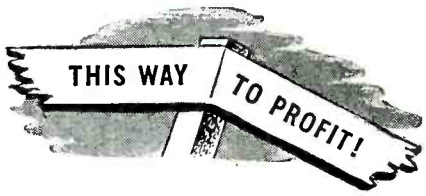
A carpenter's claw hammer is needed for driving nails. The claw is useful for removing nails from wood, etc. One is illustrated at (*a*) of Fig. 4.

A carpenter's hand brace of the type illustrated at (*b*) is required for turning wood-boring tools. Needed too are some of the other types of hole-cutting tools already described. The carpenter's brace has a 2-jaw chuck

(*Continued on page* 36)

High Efficiency Auto Antennas

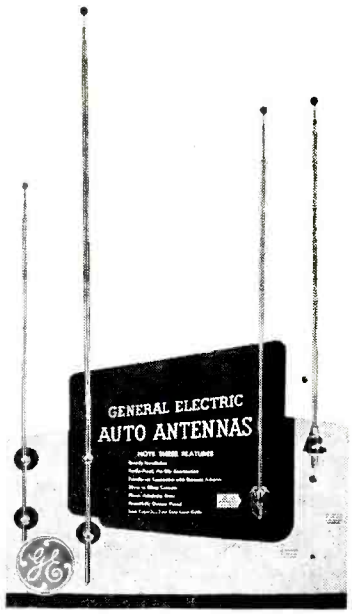
PUT more mileage on your cash register with this distinctive line of auto antennas. They're a hit with the car owner every time he hits the road. Built to pull in programs clearly, they keep noise reception at a low level. Designed to fit every car, these five models are bound to pull in profits for you. It's a self-starter program with plenty of powerful sales follow through. For more information, write: *General Electric Company, Electronics Department S-6811, Syracuse 1, New York.*



Check and double check this list of

FEATURES:

- Completely equipped with a newly developed low capacity, low loss lead cable.
- Speedy installation, positive interference-proof, lead coupling.
- Ferrule-set connection with bayonet adapter.
- Rattle-proof, no-slip, fluid type construction.
- High efficiency, low resistant silver to silver contacts.
- Finest Admiralty brass, beautifully chrome plated.



Free display board with every order for 24 antennas.

GENERAL ELECTRIC

168-E3

Model 2450
ELECTRONIC TESTER

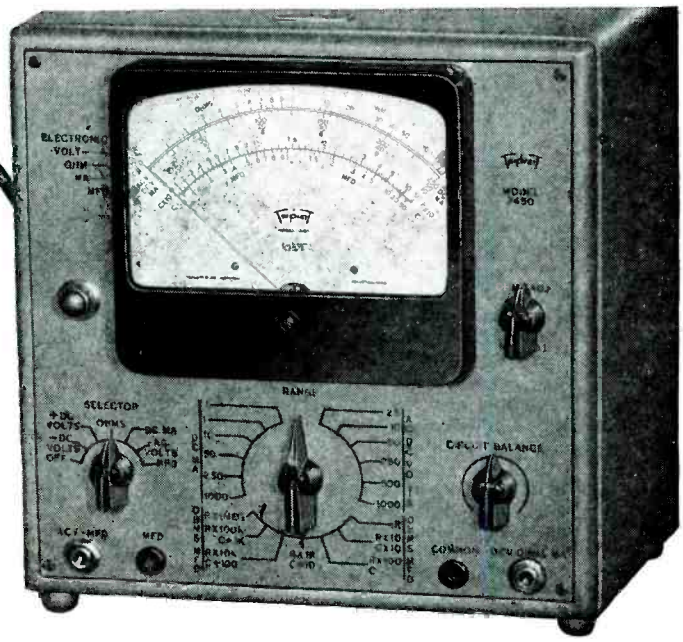
★

There's never been a tester like this!

Here's a tester with dual voltage regulation of the power supply DC output (positive and negative), with line variation from 90 to 130 Volts. That means calibration that stays "on the nose"! That means *broader service* from a tester that looks as good as the vastly improved service it provides. This model includes our Hi-Precision Resistor which outmodes older types.

HIGHLIGHTS—42 ranges: DC and AC Volts 0-2.5-10-50-250-500-1000 • DC MILLIAMPS: 0-0.1-1.0-10-50-250-1000 • OHMS: 0-1000-10,000-100,000 • MEGOHMS: 0-1-10-100-1000 • CAPACITY IN MFD: 0-.005-.05-.5-5-50 • LOAD IMPEDANCE: 5 megohms on DC Volts • CIRCUIT LOADING: Low frequencies. Circuit loading equal to 8 megohms shunted by 35 mmfd. High frequency circuit loading equal to 8 megohms shunted by 5 mmfd.

Detailed catalog sheets on request.



Precision first ..to last

Triplett

STANDARDS ARE SET BY TRIPLETT

ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

TOOLS

(*Continued from page* 34)

which clamps the square bit shank diagonally across opposite edges. It will be well to purchase a brace that is equipped with a ratchet for working in close quarters.

Along with the brace should go several wood auger bits, shown at (*c*). Sizes sufficient for all ordinary purposes are: ¼", ⅜", 7/16" and ½".

For boring larger holes in wood, an expansion bit of the type illustrated at (*d*) is useful. This has a cutter whose position may be adjusted for drilling holes of various sizes. These bits are made in several sizes; the one illustrated will bore holes from ½" to 1" diameter. When larger holes are to be bored, the fly-cutter illustrated at (*c*) of Fig. 4 may be used.

Whether or not a plane, shown at (*d*), is to be purchased depends upon the scope of the carpentry work to be done, and finances.

A small ½" or ¾" wood chisel, of the type shown at (*f*), will certainly be needed. One having an unbreakable type handle and a high grade steel blade that will retain its cutting edge should be chosen.

A small combination oil stone (medium-fine) will enable you to keep the cutting edges of all the fine cutting tools around the shop in good workable condition.

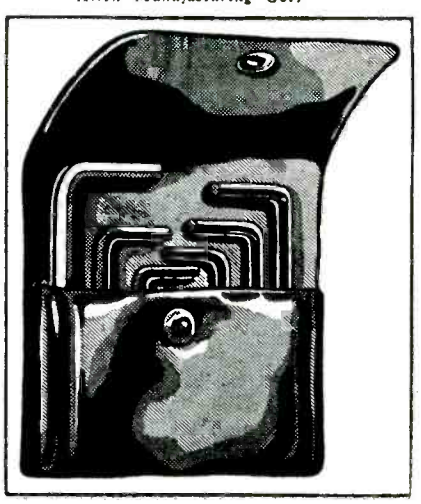
Adequate Tool Equipment

A Shop that contains most, or all of, the tools listed and described thus far in this series may consider itself well equipped from the standpoint of *mechanical* tools.

Articles to follow will describe additional special-purpose time-saving devices, and accessories, that also are desirable.

(To be Continued)

Fig. 5. A handy Service Man's vest pocket kit containing 6 hex key wrenches. (*Courtesy The Allen Manufacturing Co.*)



NEWS

(Continued from page 33)

Palo Alto Airport, Inc., Palo Alto Municipal Airport, Palo Alto, California; Aircraft Sales and Service, Inc., Boeing Field, Seattle, Washington; Aero Enterprises, Inc., Sky Ranch Airport, Denver, Colorado; Northwestern Aeronautical Corporation, Holman Field, St. Paul, Minnesota; U. S. Flying Services, Inc., Albert-Whitted Airport, St. Petersburg, Florida; Page Airways, Inc., Municipal Airport, Rochester, New York; and D. L. Grubb, John Rodgers Airport, Honolulu, Hawaii.

* * *

SUPERIOR ELECTRIC CATALOG

A 12-page catalog describing variable-voltage transformers, automatic voltage regulators and test units has been prepared by the Superior Electric Company, 713 Laurel Street, Bristol, Conn.

* * *

DE MAMBRO OPENS NEW HAMPSHIRE BRANCH

The De Mambro Radio Supply Co., Inc., have opened a branch at 1308 Elm Street, Manchester, N. H. Ted Von Hagen is manager of the new branch.

* * *

ELECTRO-VOICE CARDYNE CARDIOID DYNAMIC MICROPHONE BULLETIN

A 2-page bulletin (No. 131) describing the Cardyne cardioid dynamic microphone has been issued by Electro-Voice, Inc., Buchanan, Michigan.

Bulletin shows unidirectional polar patterns of the microphone providing wide-angle pickup at front.

* * *

METROPOLITAN ELECTRONIC CATALOG

A 16-page catalog describing signal generators, volt-ohm-milliammeters, signal tracers, multitesters, tube testers, capacitance-resistance bridges, decade boxes, oscillographs, and record changers, has been issued by Metropolitan Electronic and Instrument Co., 6 Murray Street, N. Y. 7, N. Y.

* * *

SUPREME PUBLICATIONS DIAGRAM INDEX

An index to six volumes of the "Most-Often-Needed Radio Diagrams" manuals has been published by Supreme Publications, 9 South Kedzie Avenue, Chicago 12, Illinois.

* * *

SOLAR MOLDED PAPER CAPACITORS NOW SIGNAL CORPS-AAF COLOR CODED

The Signal Corps-AAF color code has been adopted for the molded paper capacitors of the Solar Manufacturing Corp., 285 Madison Avenue, N. Y. 17, N. Y.

* * *

OLSON CATALOG

A 32-page catalog listing microphones, amplifiers, fluorescent fixtures, and assorted parts has been published by Olson Radio Warehouse, 73 East Mill Street, Akron, Ohio.

* * *

ERNEST L. WARD ELECTED SPRAGUE ELECTRIC VICE PRESIDENT

Ernest L. Ward has been elected vice president of the Sprague Electric Company, North Adams, Mass.

* * *

MALLORY MYE ENCYCLOPEDIA

The 5th edition of the MYE servicing encyclopedia containing over 4,000 replacement listings has been published by P. R. Mallory, Inc., Indianapolis, Ind.

Replacement data covers controls, capacitors and vibrators.

* * *

BUNTING NOW GARRARD S-M

Lee Bunting has been appointed sales manager of Garrard Sales Corporation, New York, American agents for the Garrard automatic record changer.

Mr. Bunting was formerly sales manager of the record changer division of Maguire Industries, Inc.

* * *

DON E. CORSON JOINS SOLAR

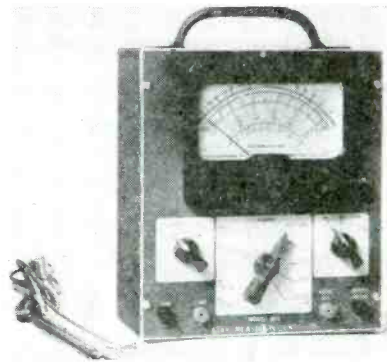
Don E. Corson has been appointed manager of the special products division of Solar Manufacturing Corporation.

NEW PRODUCTS

STAR TESTER

A volt-ohm-milliammeter, model M II Star Tester, has been announced by Star Measurements Company, 442 East 166th St., New York 56, N. Y. Voltage ranges are provided up to 1,000 volts on both a-c and d-c. Current ranges up to one ampere and resistance ranges up to five megohms are also incorporated. Calibrated db scales are provided for measurements as high as 54 db; zero power level is based on a 6 mw level in a 500-ohm line.

Instrument features a 4½", 400 microampere Marion meter. Entire instrument weighs 4 pounds.

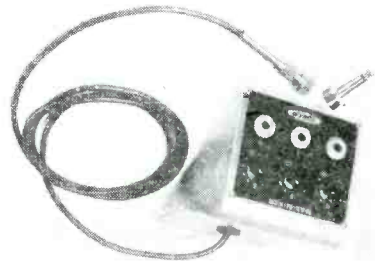


* * *

SPECO P-A MIXER

Max-Mixer, providing the use of additional microphone inputs to amplifiers, has been released by Special Products Company, Silver Spring, Maryland.

Mixer permits plugging in of one, two or three microphones.



* * *

ALTEC LANSING AMPLIFIERS

A-c/d-c 4-watt amplifiers, A-319A and A-319B, have been announced by Altec Lansing Corporation, 1161 North Vine St., Hollywood, Calif.

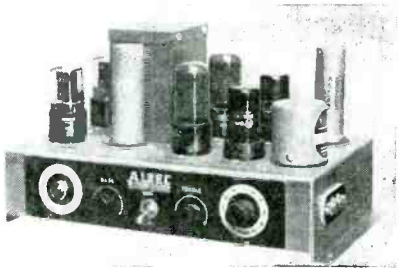
A-319A amplifier has a balanced bridging-input transformer with a 5000-ohm input designed for bridging across 250-500-600 ohm lines without requiring isolating transformers.

The A-319B amplifier has a high impedance input for crystal pickup use.

Both amplifiers have an adjustable low-frequency *bass* boost. The A-319A has an adjustable high-frequency *treble* boost to compensate for line losses. A-319B has an adjustable high-frequency control to eliminate needle scratch. Amplifiers have inverse feedback taken from a tertiary winding on the output transformer thus leaving the output ungrounded.

Nominal output load impedance, 8 to

15 ohms. Tubes include **6SJ7**, 6J5, (2) 25L6, (2) 25Z6.



* * *

NATIONAL UNION VIBRATORS

Universal type auto vibrators, Univibes, standardized to a minimum of 8 types, that are said to serve the replacement demands of over 2500 different models of auto receivers, have been announced by National Union Radio Corporation, Newark, New Jersey.

* * *

JFD CEMENTS AND SOLVENTS

JFD Manufacturing Co., 4117 Fort Hamilton Parkway, Brooklyn 19, N. Y., has reorganized its line of radio cements, solvents and carbon tetrachloride. Each of these items will come packaged in the four most popular sizes. These are the 4 ounce, 8 ounce, 16 ounce, and the 1-gallon sizes. Line of cements will come with the brush affixed to the metal cap.

* * *

G. E. A-M/F-M TUNING TUBE

An electron-ray indicator, 6AL7-GT, that is said to be particularly useful in f-m sets, has been announced by the tube division of G. E.

In this tube patterns appear on a fluorescent screen located near the end of the glass bulb. The 6AL7-GT employs a translucent screen, or target, consisting of a transparent disc on which the fluorescent material is deposited. The fluorescent pattern can be viewed through the screen.

The translucent-type screen enables all other tube electrodes such as heater, cathode, deflecting plates, etc., to be behind the target and out of sight. In previous tubes with reflecting-type targets it has been necessary to locate cathode and deflecting plates in front of the screen, thereby making it necessary to mask out the center of the screen.

By controlling the bias of the space-charge grid the target current and pattern brightness can be affected. Six volts negative grid bias is sufficient to black-out completely the pattern if the target voltage is less than 315 volts d-c.

On tune is indicated when two halves of a pattern which appear on the screen at the end of the tubes are aligned. Deviation from the proper tuning condition on one side of resonance will raise one edge of the pattern and deviation on the other side of the resonance will lower the pattern edge.

In receivers where squelch voltage is available the pattern can be made to disappear completely between stations thus providing a difference between *on tune* and *between-station* presentation.

RCA TUBES

Four new tubes have been announced by the tube department of RCA.

Two of these new tubes—1P42 and 3C33—are for industrial control applications; the other two—12AU7 and 35B5

(*Continued on page* 40)

NEW PRODUCTS

(*Continued from page 39*)

—are additions to the miniature tube family.

The 1P42 is a very small *head-on* type of high-vacuum phototube. Diameter ¼".

Semi-transparent cathode surface is sensitive to light sources predominating in blue radiation.

The 3C33 power amplifier contains two, high-perveance triode units in an envelope. Has a 12.6-volt heater.

The 12AU7 is a small, twin-triode amplifier having characteristics which are very similar to those of the larger types 6SN7-GT and 12SN7-GT.

Mid-tapped heater permits operation from either a 6.3- or a 12.6-volt supply.

The 35B5 is a beam power amplifier and is for use in the output stage of a-c/d-c receivers. It is capable of providing 1.5 watts output.

TRIPLETT TRANSCONDUCTANCE READING TUBE TESTER

A tube tester, 2425, providing micromho (dynamic mutual conductance) readings has been announced by Triplett Electrical Instrument Co., Bluffton, Ohio. Transconductance readings are made possible through measurements directly proportional to gm.

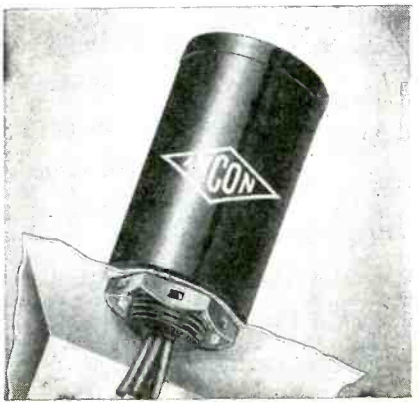
Short and *open* tests of every tube element.

Metal case, 10" x 10" x 5¾". For counter or portable use.

* * *

AMCON PLASTIC CAPACITORS

Plastic case capacitors, Amcon Little PL, 2⅛" high and 1⅜" diameter, have been announced by the American Condenser Company, 4410 N. Ravenswood Ave., Chicago 40, Illinois.



PHONO PORTABLE For A-C/D-C/Battery

(See Front Cover)

THE ADVENT OF MINIATURE tubes has permitted the development of many unique receivers and amplifiers. Recently, for instance, Capitol Phonographs of Hollywood produced an a-c/d-c/battery portable phono, model U-24, using a 1S5 diode-pentode as a triode first-stage voltage amplifier feeding a 3Q4 battery-power pentode and a 50B5 line-powered beam-power tube in parallel.

This 3-way portable, with a battery life of approximately 250 hours when operated intermittently, features a double-spring wind-up motor for battery and d-c line operation in addition a standard type a-c motor. The mechanical motor is capable of playing three ten-inch records with one winding.

A crystal pickup feeds a ½-megohm volume control through a 0.1-mfd isolating capacitor and bass attenuating equalizer. The equalizer consists of 10 megohms in parallel with a .00047-mfd capacitor, making the reactance equal the resistance at 33.6 cycles and causing this frequency to be attenuated about 91%. The 1S5 is operated without grid bias except for a small drop through the volume control. Plate load consists of 330,000 ohms in parallel with a 680,000-ohm power-stage grid leak and a series tone-control circuit with a 3-megohm resistor and .005-mfd capacitor.

The 3Q4 is used for battery operation only, obtaining its bias from 390 ohms in series with the *B* battery. Its filaments are operated in parallel for convenient 1½-volt *A* supply. Audio power output is about 150 milliwatts. The 50B5 serves as the power output tube on line operation, delivering about 1 watt into the tapped output transformer. Full primary is used to match the higher impedance 3Q4, only part of the winding to match the 50B5. Filament power for the 1S5 is obtained by running the cathode current of 50 ma through the 1S5 and 120 ohms, the audio frequencies being effectively shunted by a 100-mfd capacitor.

A *battery-line* switch, with three circuits, opens *B* battery at negative terminal; opens *B* battery at positive terminal, connecting the plates and screen grids to the rectifier output; and opens *A*+ lead, disconnects the 3Q4 filament and connects the 1S5 filament to 120-ohm cathode bias resistor.

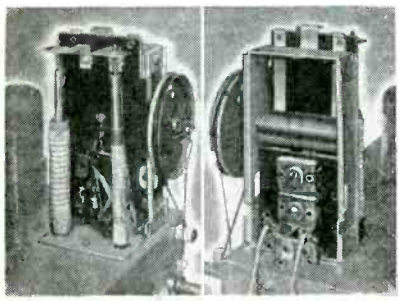
SER-CUITS

(*Continued from page* 18)

adjustments permitting correct zero setting for all ranges through one front panel adjustment, range switch for multiplier values and five jacks for plug-in test-lead readings of a-c and d-c volts, ohms, amperes and milliamperes.

Measurement Ranges

Measurement ranges include: d-c volts . . . 0-3, 0-10, 0-30, 0-100, 0-300, 0-1000; a-c volts (a-f, 20-15,000 cps) 0-3, 0-10, 0-30, 0-100, 0-300; r-f volts (10 kc-300 mc) 0-3, 0-10, 0-30, 0-100, 0-300; d-c current, 0-3 ma, 0-10 ma, 0-30 ma, 0-100 ma, 0-300 ma, 0-1000 ma, 0-10 amperes; resistance, 0-1000 ohms, 0-10,000 ohms, 0-100,000 ohms, 0-1 megohms, 0-10 megohms and 0-1000 megohms.



The E-L Vario-Tuner. Left, coil side; right, trimmer side.

E-L Vario-Tuner

Many have requested additional information on the permeability-tuning type units that were mentioned in the editorial of the November issue of SERVICE. In Fig. 2 appears a recently-announced type Electronic Lab Vario-Tuner, that offers many of the features pointed out in the editorial. It consists of an r-f tuned unit and an oscillator section.

Tuner Features

Designed to cover the 540 to 1,620-kc range, with an i-f of 455, the r-f coil has an inductance of 220 microhenries ± 2%, tapped at 53 microhenries ± 2%. The r-f trimmer capacity is 30 mmfd. Approximately 12 mmfd is added to this trimmer by the input capacity of the r-f amplifier tube.

To tune, a ribbon drive mechanism is used.

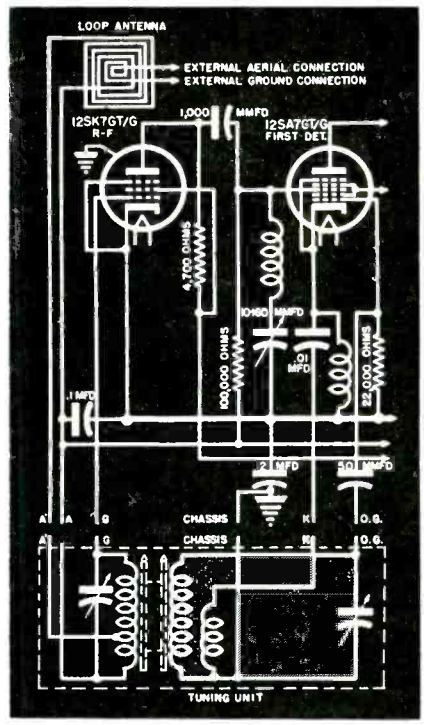


Fig. 2. Electronic Laboratories permeability tuning unit connected to input of an a-c/d-c receiver. Loop shown in circuit is also an E-L unit with an inductance of 147 microhenries.

WHEN YOU CHANGE YOUR ADDRESS

Be sure to notify the Subscription Department of SERVICE at 52 Vanderbilt Ave., New York 17, N. Y., giving the old as well as the new address, and do this at least four weeks in advance. The Post Office Department does not forward magazines unless you pay additional postage, and we cannot duplicate copies mailed to the old address. We ask your cooperation.

SERVICING HELPS

(*Continued from page* 30)

that the avc feeder is common to both the r-f and i-f circuits. Therefore, the first point to check is the .2-mfd bypass capacitor. It is suggested that the capacitor in the receiver be removed from the circuit when checking.

The next point to check is the value of resistance in this circuit. An appreciable increase in resistor value, more than 15%, may affect the receiver operation adversely.

The .2-mfd screen grid bypass capacitor should be checked next. The use of a high value of screen grid bypass, say 5 mfd or more, will sometimes improve the response. You should use a capacitor with a voltage rating equal to the plate voltage, since surges may blow out a smaller voltage rated capacitor.

Since the cathodes of the r-f and i-f amplifiers are tied together, a defective bypass at this point would also induce oscillation. In addition, an open interstage noise suppressor would cause weak signals, or no signals at all.

In these days of tube shortages, it is interesting to note that the three *56* tubes (one not shown is the first audio stage) could be replaced with a single duo-diode-triode, such as the 6R7.

•

R-C AMPLIFIER

(*Continued from page* 14)

source is a diode, which itself draws current, the fractional current drain of the tube will not cause distortion. The high plate-load resistance coupled with the low-plate voltage supply would prevent any appreciable current drain with resultant damage to the tube. This particular type of tube is designed for a high value grid resistance.

•

6-SPEAKER PHONO

British phono model, the London Reproducer, recently introduced in this country. Features a 4-stage push-pull amplifier with three sets of 6J5 triodes and a pair of PX25 outputs. In the first three stages, negative feedback is used. Volume control between the second and third stages is provided by twin resistance-capacitance circuits shunted across the output of the second stage, plate to plate, the capacitive portions of the network providing bass compensation at low-volume levels. Speaker system consists of six 12" p-m units connected in parallel.

JOTS AND FLASHES

SERVICE SCHOOLS are now being run by many manufacturers to train distributor organization service manager and key service personnel the latest techniques in both business management and repair of modern equipment. Several distributors are, in turn, presenting similar sessions for local Service Men. Training certainly appears to be a key item in servicing today! . . . The need for special provisions for television antennas in new apartment houses was stressed by Dan D. Halpin, RCA television receiver sales manager at a recent meeting of the Building Owners and Managers Association in Philadelphia. Mr. Halpin described the recent installations of the RCA Antennaplex System in the Hotel Pennsylvania and Hotel New Yorker to solve a multiple-dwelling antenna problem. . . . Half-wave and doubler power supply systems are analyzed in a 16-page Mallory technical manual reprint now being distributed by the Federal Telephone and Radio Corporation. . . . Milo Radio and Electronic Corp. have been appointed exclusive distributors for the St. George Recording Corporation wire recorder. Unit, which can be hooked up to any amplifier, also plays standard records. . . . Del Wakeman has resigned as advertising manager of the Magnavox Company, Ft. Wayne, Indiana and joined Ekco Products Company, Chicago, as advertising manager. . . . A special television demonstration room has been installed by the Fair Store in Chicago. Up to eleven receivers can be demonstrated in this room. . . . William Carduner, president of the British Industries Corporation, recently sailed to England on the Queen Elizabeth. . . . A 3-color window display promoting tubes has been prepared by Sylvania Electric Products Co., Inc. . . . Frank Folsom, executive vice president of RCA, in charge of RCA Victor Division, has received a certificate of appreciation from the War Department. . . . Newark Electric Company has acquired additional office and warehouse facilities at 242-50 W. 55th Street, New York City. . . . Edward Miller is now field representative for Snyder Manufacturing Company, Philadelphia. . . . Walter F. Marsh, sales manager of Allied Radio Corporation, has been delivering talks on wire recorders before various associations and clubs. . . . Folders describing intra-video antenna systems and television receivers have been released by the Telicon Corporation, 857 Madison Avenue, New York 21, N. Y. . . . Myron J. Morris is now manager of the service division of ECA. . . . A listing of exact duplicate controls appears in the November issue of the "Centralab Jobber Outlook". . . . Paul K. Povlsen has been named assistant to the president of the Galvin Mfg. Company. Mr. Povlsen was formerly vice president in charge of production and engineering for the J. I. Case Company, Racine, Wisconsin. . . . Charles Friedman has been named sales manager of the communications division, Radio Receptor Company, Inc., 257 W. 19th Street, New York. . . . Employees of Meck Industries received a "cost-of-living" increase recently. . . . Robert E. Sargent, Paul Nichols and Walter C. Hustis, formerly with Jefferson-Travis, have formed a sales representative company, Land-C-Air Sales, Inc., 14-16 Pearl Street, New York.

ADVERTISERS IN THIS ISSUE

SERVICE INDEX—DECEMBER, 1946

. . . our greatly increased production on Simpson Model 260 makes it available to you NOW at your jobber's

The Simpson 260 is easily the world's most popular set tester for television and radio servicing. You cannot touch its precision, its useful ranges, or its sensitivity in any other instrument selling for the same price or even substantially more.

It has been a long time since we have been able to produce enough 260's to meet the demand, because the 260 has consistently out-sold every other remotely similar test instrument. The reason is simple: it out-performs and out-values them all. Simpson advanced engineering and unyielding standards of quality and precision manufacture enable it to *stay* accurate under conditions ordinary instruments cannot survive.

Incidentally—production on other Simpson instruments is clearing, too. We feel confident that it will not be long before you can buy those Simpson instruments you have waited for.

Ask your jobber for the Simpson 260—he has it now!

SIMPSON ELECTRIC COMPANY
5200-5218 W. Kinzie St., Chicago 44, Ill.

Simpson

INSTRUMENTS THAT STAY ACCURATE

SIMPSON 260, HIGH SENSITIVITY SET TESTER FOR TELEVISION AND RADIO SERVICING

Ranges to 5000 Volts—Both A.C. and D.C.
20,000 Ohms per Volt D.C.
1000 Ohms per Volt A.C.

At 20,000 ohms per volt, this instrument is far more sensitive than any other instrument even approaching its price and quality. The practically negligible current consumption assures remarkably accurate full scale voltage readings. Current readings as low as 1 microampere and up to 500 milliamperes are available.

Resistance readings are equally dependable. Tests up to 10 megohms and as low as ½ ohm can be made. With this super sensitive instrument you can measure automatic frequency control diode balancing circuits, grid currents of oscillator tubes and power tube, bias of power detectors, automatic volume control diode currents, rectified radio frequency current, high-mu triode plate voltage and a wide range of unusual conditions which cannot be checked by ordinary servicing instruments. Ranges of Model 260 are shown below.

Price, complete with test leads **$38.95**
Carrying case **5.55**

Volts D.C. (At 20,000 ohms per volt)	Volts A.C. (At 1,000 ohms per volt)	Output
2.5	2.5	2.5 V.
10	10	10 V.
50	50	50 V.
250	250	250 V.
1000	1000	1000 V.
5000	5000	5000 V.

Milli-amperes D.C.	Micro-amperes	Ohms	
10	100	0-1000	(12 ohms center)
100		0-100,000	(1200 ohms center)
500		0-10 Megohms	(120,000 ohms center)

(5 Decibel ranges: —10 to +52 DB)

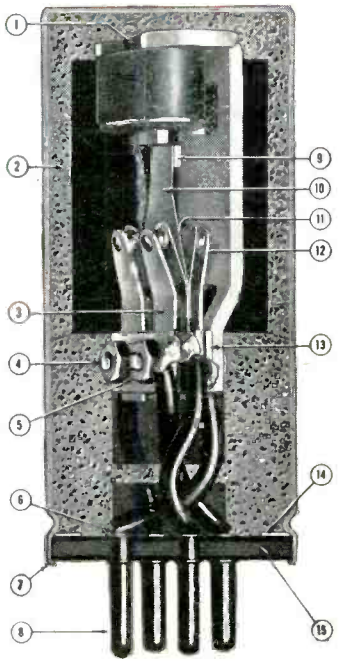
ASK YOUR JOBBER

UNIVIBE... The Universal Vibrator!

8 TYPES SERVICE OVER 2500 AUTO RADIOS

N. U. AUTO RADIO VIBRATORS ARE BUILT FOR ENDURANCE!

1. Welded pole pieces for lifetime adjustment accuracy.
2. Snug fitting synthetic sponge insulation for quiet operation.
3. Spot-welding of fingers, in contact against each other and the center reed, reduces voltage drop in center reed assembly.
4. Vibration proof adjustment by means of double-screw stack.
5. Pressure plate on top of stack keeps stack tight under tension over wide ranges of temperature.
6. Extra flexible roped wire leads eliminate strain and weakening.
7. Metal can, spun at bottom, seals vibrator against dust and dirt.
8. Plated pins assure minimum contact resistance.
9. Face of center reed weight is surface-ground to improve magnetic coupling.
10. Center reed uniformly stressed to prevent breakage.
11. Specially tempered reed and side contact arms.
12. Corrosion resistant silver-plated side contact arms.
13. Precision ground bakelite spacers for structural and dimensional stability.
14. Steel ring, molded into shock mount, centers and holds vibrator upright when can is sealed.
15. Neoprene wafer in hermetically sealed vibrators effectively seals vibrator against atmospheric pressure changes and moisture.



Typical Synchronous Vibrator Construction

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