THE

Radio Masters

MONTHLY

DEVOTED EXCLUSIVELY TO THE

INTERESTS OF THE RADIO SERVICEMAN

JUNE 1940

FIFTEEN CENTS THE COPY

"Servicing by Signal Substitution" with the combination of the Precision Series 920 tube and set tester and the Series E-200 Signal Generator, will solve your problems with new, amazing speed and simplicity.

ELECTRONOMETER Series 920

DYNAMIC MUTUAL CONDUCTANCE TUBE AND SET TESTER

An indispensable single compact instrument for both field and service laboratory ★ 33 AC-DC set testing functions ★ AC-DC voltage ranges to 3000 *volts* ★ DC current ranges to 12 *amperes* ★ Resistance ranges to 10 *megohms* ★ Decibel readings from —10 to +64 DB ★ Output ranges to 3000 *volts* ★ Electrolytic and paper condenser leakage tests ★ All on large, easy reading, 400 microampere, 4⅝" square type bakelite cased meter. *A Single Master Rotary Range Selector* permits simplified, rapid check of voltage, current, resistance, etc., in troublesome stages, quickly localized through *"Servicing by Signal Substitution."*

Series 920 P etc. illustrated above........................ **$53.95**

E-200 SIGNAL GENERATOR

FEATURING "SERVICING BY SIGNAL SUBSTITUTION."

Not only an efficient laboratory Signal Generator, but *ALSO* specifically designed for complete, systematic dynamic signal analysis of every receiver stage from loud speaker to antenna post, regardless of age, make, type, through *"Servicing by Signal Substitution"* with a *minimum* and *economical* selection of *Basic* test equipment.

Here's only a *FEW* of innumerable applications, in addition to purposes of alignment, which the Series E-200 provides ★ *Direct* R.F. and I.F. gain-per-stage measurements; *Finds* open, dead or mistracking oscillators, shorted I.F. - R.F. transformer turns, open R.F. or audio condensers, etc.

Series E-200 etc. illustrated above........................ **$35.95**

Now in preparation, and FREE to all present owners and future purchasers of Series E-200, a new illustrated test describing this amazingly simplified speed approach to receiver adjustment problems, *"Servicing by Signol Substitution."*

PRECISION TEST EQUIPMENT

Standard of Accuracy **SEE THEM AT YOUR JOBBER**

See the more than 40 PRECISION 1940 models at any of the following authorized PRECISION distributors:

TERMINAL RADIO CORP. *2 Stores in New York City* 80 CORTLANDT STREET 68 WEST 45th STREET	**HARVEY Radio Company of N. Y.** 103 WEST 43rd STREET NEW YORK, N. Y.	**DOUGLAS RADIO CO.** 89½ CORTLANDT STREET NEW YORK, N. Y.

SUN'S *New* P. A. CATALOG

— 24 PAGES CHOCK-FULL OF SOUND VALUES —

SERVICEMEN . . . DEALERS!

Here is a book to be valued, bound to show you the way to increased business and higher profits. SELLING SOUND has opened new visages of endeavor and SUN RADIO is again foremost in presenting BETTER QUALITY EQUIPMENT at LOWER COST.

•

On the following pages are listed some of the many representative manufacturers whose products will be found illustrated in SUN'S P.A. CATALOG. Reserve your copy TODAY and use it as your guide to BETTER BUSINESS.

FREE TECHNICAL SERVICE

SUN RADIO is staffed by an experienced group of engineers who are amply qualified to solve any of your technical problems. If you require assistance in the proper planning of installations or the selection of suitable P.A. equipment, SUN RADIO and its entire staff are at your disposal.

COUNTLESS OPPORTUNITIES . . . for 'sound' sales lie in your own immediate neighborhood — clubs — schools — colleges — churches — auditoriums — skating rinks — swimming pools — taverns — bowling alleys — auction rooms — banquet halls — dance halls — restaurants — funeral parlors — political clubs — athletic fields, etc. Get in on this highly lucrative field!

•

AMPLIFIERS AND COMPLETE SOUND SYSTEMS OF EVERY TYPE AND FOR EVERY PURPOSE IN SUN'S NEW P.A. CATALOG

- AMPLIFIERS
- COMPLETE SOUND SYSTEMS
- INDOOR-OUTDOOR INSTALLATIONS
- PORTABLE SYSTEMS
- MOBILE SYSTEMS
- SPEAKERS
- MICROPHONES • PICK-UPS
- RECORDERS • RECORDS
- RECORD BLANKS
- TUNERS

RESERVE YOUR COPY TODAY

READY SOON!

SUN RADIO COMPANY
212 FULTON STREET — DEPT. RM
NEW YORK CITY

Gentlemen:—
Please RUSH my copy of your new P.A. Catalog as soon as it is off the press.

NAME ....

ADDRESS ....

CITY .... STATE ....

SUN RADIO COMPANY

212 FULTON STREET — NEW YORK CITY

Cable: "SUNRADIO" • BArclay 7-7647

Established 1922

ADD PLEASURE TO YOUR P. A. EQUIPMENT with MEISSNER TUNERS

AVAILABLE IN COMPLETE KIT FORM — EASILY CONSTRUCTED —

Add a Meissner Tuner and make your P.A. System ***really*** complete! Three models to cover **every** purpose. A ***New*** High Fidelity model for local or high-level station reception; a Dual-Band model for Short Wave and standard broadcast reception; and a Utility model for general purpose use — portable or stationary, ideal for local and distant reception. Just listen to a Meissner Tuner and enjoy radio at its best!

ACHIEVE *REAL* HIGH FIDELITY!

Specially designed for reception from local or nearby, powerful broadcast stations — 535 to 1600 Kc. Wide-band selectivity permits true high fidelity reproduction heretofore undreamed of. Exceptionally low hum-level. 6 tube T.R.F. circuit with AVC. Cabinet size: 8⅜" x 8⅜" x 12½".

ADDITIONAL FEATURES

- FLAT AUDIO RESPONSE — 40 TO 10,000 CYCLES
- 4 GANG, 365 MMFD. TUNING CONDENSER
- CALIBRATED 5¼" DIAL SCALE
- MONITORING JACK

Complete Kit (less tubes) .... NET **$28.95**

SEE SUN RADIO'S NEW P.A. CATALOG for complete description of all models OUT SOON!

BUILD YOUR OWN!

Meissner P.A. Tuners are furnished in complete kit form (only less tubes), are readily assembled, and may be used with any good external audio amplifier. Kits include all parts necessary for construction—all coils, condensers, resistors, transformers, controls, chassis, panel, cabinet, dial, escutcheon, knobs, hardware, solder, wire, etc. Supplied with complete instructions, including pictorial and schematic diagrams that are easy to follow. Also available if desired less cabinet and panel.

RESERVE YOUR COPY TODAY!

IT'S GARRARD — ALL THE WAY!

UNIVERSALLY ACCLAIMED AS THE FINEST RECORD CHANGERS IN THE FIELD!

SUPERB POWERFUL MOTOR

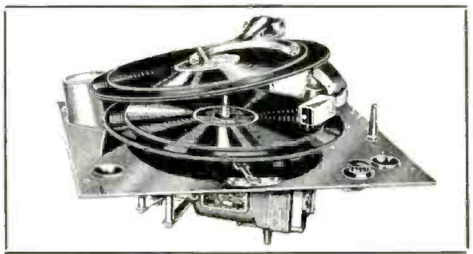
NOISELESS

TANGENT PICK-UP ARM

AUTOMATIC STOP

NON-SLIP SPINDLE

SPEED REGULATOR



MODEL RC-50 DE LUXE MIXER-CHANGER

Here is the ULTIMATE in record-changing, record-playing units. Almost human in performance. Plays up to eight 10" or 12" records in any assortment, any combination. Silent, smooth-running, infallible. Automatic rejector. **Swivel-head crystal pick-up.** For 100/130 and 200/250 volts 50/60 cycles. A.C. operation.

DEALER NET PRICE $52.90

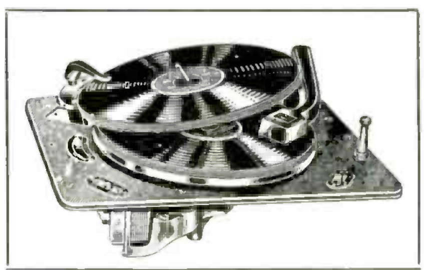
•

MODEL RC-10 AUTOMATIC CHANGER

Embodies many of the unique features of the De Luxe RC-50. Plays either eight 10" or eight 12" records in sequence. Spring mounting eliminates vibration and acoustic feedback. Self-lubricating, powerful motor. Complete with crystal pick-up. For 100/130 and 200/250 volts 50/60 cycles A.C. operation.

DEALER NET PRICE $38.22

A SOURCE OF NEW PROFIT AND NEW ENJOYMENT!



OTHER GARRARD PRODUCTS

- PHONOGRAPH ASSEMBLIES
- PICK-UPS CRYSTAL MAGNETIC
- TRANSCRIPTION MOTORS
- PORTABLE PHONOGRAPHS
- NEEDLES SAPPHIRE CHROMIC

***See* SUN'S *New* P. A. CATALOG *for* COMPLETE DESCRIPTIONS**

OUT SOON!

SUN RADIO CO. New York City

212 FULTON STREET **BArclay 7-7647**

IT'S SUN RADIO — *for* P. A. LEADERSHIP

MODEL DR-42 . . . Air column length 3½ ft., Overall length 17½". Bell Opening 21". Frequency cut-off 140 cycles. Projection angle 80°. Supplied complete with Speaker Unit Model PM-23, and Mounting Bracket.

DEALER'S NET PRICE **$29.40**

•

MODEL DR-72 (illustrated) . . . Air column length 6 ft., Overall length 25", Bell Opening 29", Frequency cut-off 90 cycles. Projection angle 100°. Supplied complete with Speaker Unit Model PM-23, and Mounting Bracket and Base (less unit cover).

DEALER'S NET PRICE **$45.57**

ATLAS SOUND CORPORATION

"MORNING GLORY" Exponential Projectors

Double Re-entrant Air Columns . . Permanent Magnet Units

HERE you have the ultimate in high acoustic conversion efficiency . . . a new line of speakers developed by Atlas Sound engineers. The "MORNING GLORY" Projectors and "DYNA-FLUX" Permanent Magnet Compression Type Units offer speaker efficiency heretofore unattainable.

★ You'll welcome this new achievement in speaker design . . . allows the use of superpowered p. a. reproducers at a price within your reach. The new projector line offers air column sizes for all public address purposes. The driver units are available with varied power ratings, and in different price ranges.

★ The projectors and units are 100% STORM-PROOF . . . COMPACT . . . DIRECTIONAL. The sound beam emitted from these high-velocity projectors overcomes adverse or cross-wind conditions . . . a desirable "Splash Effect" is produced at the area requiring coverage.

★ This is the ideal speaker for all outdoor and indoor speaker applications. It's dependable . . . produced by engineers who have years of experience in the design and manufacture of high quality public address reproducers.

STORM-PROOF . . . COMPACT . . . STURDY BRACKET

"ATLAS SOUND — HEARD 'ROUND THE WORLD"

★ *See* **SUN'S** *New* **P. A. CATALOG**

for complete listing of other ATLAS products

★ "CHANDELIER" BAFFLES — "MARINE" HORNS
"VELVET ACTION" MICROPHONE STANDS
"HOLD-TITE" CONNECTORS — other ACCESSORIES

★ ***OUT SOON!—Reserve Your Copy Today!***

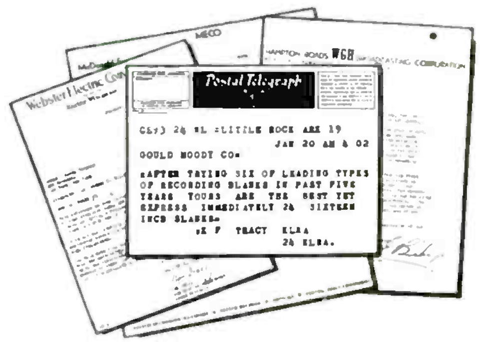
ATLAS HEARD ROUND THE WORLD SOUND

WHAT HUNDREDS OF SATISFIED USERS SAY

about GOULD-MOODY "PERFECTED" RECORDING DISCS

From coast to coast recording studios and radio stations are wide in their acclaim of Gould-Moody "Perfected" Recording Blanks as being the finest they have ever used. For sheer perfection in composition, cutting and true fidelity reproduction none other can match the flawless qualities attained in a Gould-Moody disc.

Heretofore available only to the most discriminating and professional consumer due to their higher price. Today, popular demand and increased production have brought their cost down within reach of all.



DEALERS SPECIAL NET PRICES

Size	List Price	25 Lot Price	Broken Lot Price
6"	$ .50	$ .30	$ .33
8"	.70	.42	.47
10"	1.00	.60	.67
12"	1.25	.75	.83
16"	2.50	1.50	1.67
11¼"	1.55	.93	1.03
13¼"	2.25	1.35	1.50
17¼"	3.75	2.25	2.50

25 LOTS ARE PACKED IN SPECIAL HERMATICALLY-SEALED TINS

JUST LOOK AT THESE FEATURES!

- NO SURFACE NOISE
- REQUIRES LITTLE "CUTTING" PRESSURE
- HOMOGENEOUSLY COATED
- NO STATIC ELECTRICAL CHARGE
- ABSOLUTELY FLAT
- NO ABRASIVE MATERIAL
- CUTS CLEANLY

SEE THEM AT SUN!

SUN RADIO CO. New York City

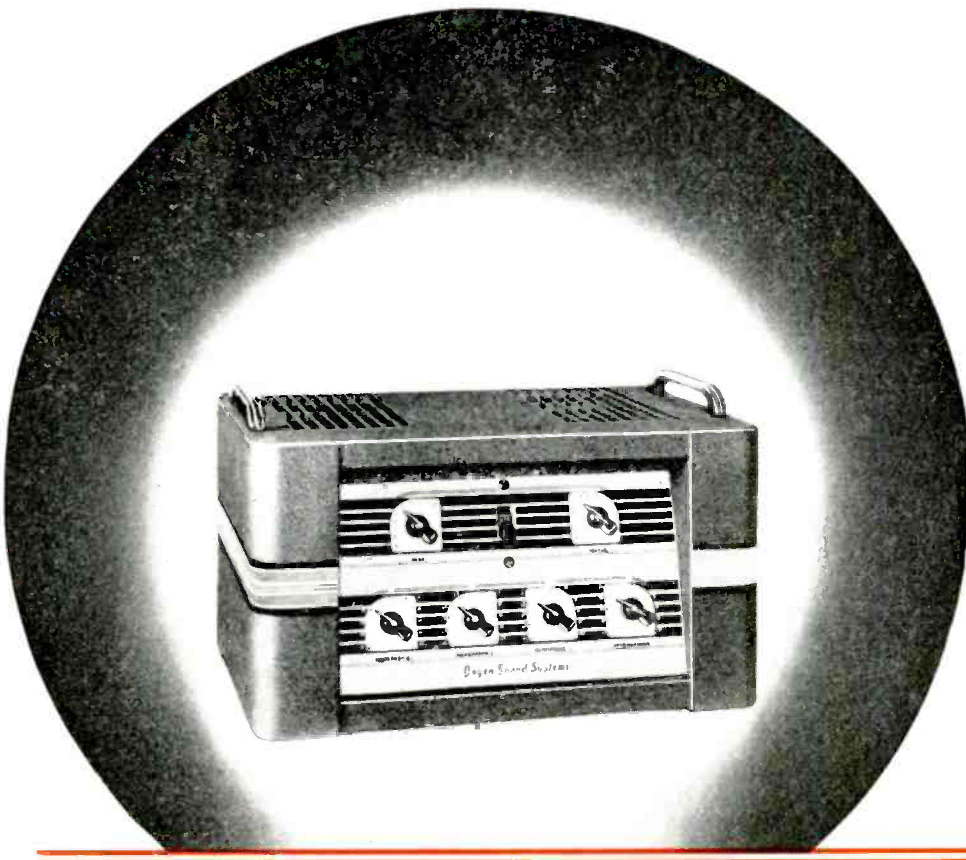
212 FULTON STREET BArclay 7-7647

SOUND HEADQUARTERS *for* BOGEN

Since 1922 SUN RADIO has consistently presented only the highest quality equipment—and always at the lowest prices. In Bogen Sound Systems we offer a line unsurpassed in P.A. annals for "doller for dollar value."

For quality and outstanding performance it's Bogen — "Best by Test."

Only Bogen has the New Triple-Range Electronic Tone Corrector



HITTING A NEW HIGH!

Watch for the New BOGEN features in SUN'S P.A. CATALOG

OUT SOON!

•

RESERVE YOUR COPY NOW!

AMPLIFIERS and COMPLETE SYSTEMS

There's A Bogen Amplifier or System for Every Purpose

MOBILE SYSTEMS • PORTABLE SYSTEMS • INDOOR-OUTDOOR INSTALLATIONS

SUN RADIO CO. • 212 FULTON STREET BArclay 7-7647 • NEW YORK CITY

LEWIS WINNER
Editor

THE Radio Masters MONTHLY

DEVOTED EXCLUSIVELY TO THE INTERESTS OF THE RADIO SERVICEMAN

VOLUME 1 JUNE, 1940 NUMBER 3

this month

State Licensing takes on a new fervor of interest. (Page 8)

Intriguing four tube push-pull parallel audio circuit affords enormous power, with striking quality. (Page 10)

Three point loop permits tuning in of broadcast, police and foreign stations. (Page 12)

Case histories can win you some money. (Page 14)

Vertical and horizontal synchronizing circuits in the television receiver, traced in a novel way. (Page 20)

15c THE ISSUE

Published Monthly and Copyrighted 1940 by
THE RADIO MASTERS
53 Rumsey Road, Yonkers, New York

$1 A YEAR

Jack Grand, Publisher ... Lewis Winner, Editor

Editorial and Advertising Offices, 116 Broad Street, New York City. Telephone: BOwling Green 9-9838.

Address all business and subscription communications to 53 Rumsey Road, Yonkers, New York, and editorial and advertising communications to 116 Broad Street, New York City.

news and views

DURING the past few months of RADIO MASTERS broadcasts, such outstanding authorities as FRED HORMAN, instructor in charge of radio and television servicing at the RCA Institutes; ADOLPH SUCHY, instructor of radio at the Brooklyn High School for Specialty Trades; MAX SPITALNY, former instructor of radio at Stuyvesant Evening Trade School; BARTON YAGER, radio instructor of Brooklyn High School and a host of servicemen, have debated on the topic "Should Servicemen be Licensed". During the ensuing weeks, we have received a host of comments and letters from servicemen, dealers, manufacturers, distributors and others allied with radio servicing, offering their ideas and opinions on this important topic.

Some of the letters received have indicated a definite desire to see servicemen licensed, implying that by such licensing, it will be possible to standardize procedure in a technical and business way. In other words, codes that would be established, would give the serviceman a standard of practice with an actual definity to follow. Now, others have said that licensing would tend to discriminate and subjugate those who possibly couldn't qualify in a licensing examination. Thus, those who may have been in business many years, may find themselves outside looking in.

We feel that licensing has many advantages that should be put into practice. It will certainly assist in the selection of those servicemen who are able to service the public in the proficient manner, necessary today. A licensed serviceman will quickly gain greater confidence of the public, than ever before. The public, being advised of this licensing, will thus be assured of the most expert knowledge and attention available in his area. For that serviceman,, who is so licensed, will have successfully passed an examination prepared by a leading group of authorities of the industry or state educational units. Thus, that serviceman will have demonstrated that he is equipped, in every way, to cope with every problem with which he may be faced, in an effective and quick manner. In addition, a licensed serviceman will be obliged to follow a code of ethics, just as a medical man is obliged to do. Here again, the public will be certain that his particular problem is being handled by an expert with every care and every thoroughness possible. By this, we do not imply that the present methods of approach by servicemen are not of the highest calibre. They are, but unfortunately, due to a lack of understanding on the part of the public, this confidence has not been fully won. Licensing will help to create that confidence and win the support of the public, so deserved by a majority of the servicemen.

A NOVEL educational project has been introduced by Harold Davis, a jobber in Jackson, Miss. Mr. Davis has said that experienced radio servicemen throughout the country can come to Jackson, Miss. for a post-graduate course in radio, at nothing per week in tuition fee. A course of thirty-six lessons will be given over a period of two weeks from July 15th to July 27th, with instruction by radio's leading engineers. The only expense that a serviceman will meet will be living expense. And

Mr. Davis says that room and board can be had for $7.50 per week. To keen servicemen everywhere who can spare the time and small expense, this is an unusual opportunity.

THE New York Metropolitan Chapter of the Radio Servicemen of America are instituting an educational program, during which mathematics, television, frequency modulation and facsimile will be discussed. Upward to two hundred can be accommodated in each class, and to become a member it is only necessary to drop a post card to Horace Guthman, Treasurer, 1218 Union Street, Brooklyn, N. Y. or 'phone SLocum 6-4111

Members will conduct the teaching with outside lecturers. Arrangements are being considered to have actual laboratory work introduced from time to time during actual demonstration-lectures. It is expected that these classes will be a sustaining part of the regular chapter work of the R.S.A., to be repeated as often as there are servicemen to attend. Each of the important subjects above mentioned will be covered during the classes of an evening.

TELEVISION enthusiasts will be keen to learn of an unusual contest announced by the DuMont Laboratories of Passaic, New Jersey. It is known as a Cathode-Ray Symposium prize contest, which began on June 1st and will end on May 31st, 1941. The contest is open to everyone regardless of position, title, academic or engineering qualifications. Contestants are asked to submit any number of papers dealing with new, practical, actual applications of the cathode-ray tube and allied equipment. Theoretical discussions, contemplated projects or mere suggestions will not be considered. Photographs, drawings and sketches will count heavily but they are not essential if the text is sufficiently explicit. Outstanding authorities in the cathode-ray field will act as judges and their decision will be final. All papers will become the property of Allen B. DuMont Laboratories, Inc. and none can be returned. Papers accepted for publication in the DuMont monthly "OSCILLOGRAPHER", will receive $10 per paper. In addition, there will be awarded three grand prizes of $100, $50 and $25 for the three best papers submitted during the contest.

IN the latter part of this issue, will be found an important announcement, covering the debut of a new and unusual presentation entitled "Your Service Shop". For the first time, a completely staged show created expressly for the serviceman will be held in this area. These shows will be held on July 11th and July 25th, and admission will be free to every serviceman. So set aside these two dates on your calendar now, and be sure to attend.

THAT metals play a very important part in radio is well known. The importance, however, of some metals and their part in radio can never be too strongly emphasized, particularly nickel and its application in the radio tube.

To Dr. Lee DeForest, the inventor of the grid controlled radio tube goes the credit for first using nickel in the grid and plate in his original triode instead of the costly platinum, according to EDMUND M. WISE, of International Nickel, who spoke on this interesting subject during a recent RADIO MASTERS broadcast.

Said Mr. Wise, "Nickel was found to be amazingly responsive to the demands of the tube engineer. Nickel can be formed, welded reliably and heated hot without damage or distortion and most important, it doesn't corrode or rust during manufacture. In addition, it can be carbonized without making it brittle.

"Practically all the vital elements in a tube contain solid nickel, but since the elements are so small, the amount of nickel used usually is only four grams or even less where nickel-plated parts have been partially substituted for solid nickel.

"By using Dumet wire, a wire with a core or nickel iron alloy which expands less than glass, plus a thin coating of copper which expands more than glass, as leads to be brought out through glass, it is possible to avoid cracks or leakage; for when these metals are heated or cooled, they expand and contract at the same rate as glass. In the newer metal locktal tubes, an alloy of nickel and iron, or nickel cobalt and iron are used.

"Nickel also has a low gas content, a very important factor in tube manufacture since it aids in assuring successful tube structure".

service highlights

A Resume of Important Electrical and Mechanical Developments

STANDARD BROADCAST RECEIVING SETS

THE Zenith Model 1503 receiver is one of the first commercial sets to make use of a push-pull parallel output stage of four 6V6's. This is used in preference to an output amplifier of two 6L6 tubes because of great advantages in increased power sensitivity, reduced plate current drain, and greater available output power, all with reduced plate voltage.

The output stage is driven by the 6F8G inverter in a degenerative phase-inverting circuit. That is, the phasing triode in the 6F8G is fed a larger signal than necessary to produce the proper driving voltage at the second 6V6G group grids. Degeneration is used to bring the delivered driver voltage to the proper value. This is accomplished through the 330 M ohm and 39 M ohm resistors where the plate signal between grid and the 330 M ohm resistors to ground, is also fed back to the same triode's grid across the 39 M ohm resistor. The phase inversion circuit of this receiver is similar to the R.C.A. developed inverter and is greatly superior to the previously popular resistance network methods. The 330 M ohm and 39 M ohm resistors are not at all critical. Deviations of 50% are permissable without materially affecting performance.

The means for obtaining bias in this receiver is worthy of some mention. A bleeder is used, through which flows current for the speaker field, the I.F., R.F. and A.F. circuits, (exclusive of the output stage). A portion of this bleeder is used as a fixed bias supply for the 6F8G phase inverter as well as the audio tubes. This negative voltage source is used, in addition, to provide a zero-signal bias voltage in the R.F. and I.F. amplifier stages. Thus, advantage is taken of a fixed bias supply and its attendant stability.

The output stage itself, paralleling such tubes as the 6V6, provides the following characteristics, unmatched in any single tube of the same voltage—power characteristics, as a pair of 6V6's. The transconductance is 8200 micromhos per parellel pair; plate current drain is only 68 milliamperes per pair. At 250 volts plate supply, 9 watts is available per pair, or 18 for the set of four. It is seen that even two 6L6's cannot match four 6V6's in these characteristics.

In conclusion, it can be reasonably stated that the push-pull parallel connection of four 6V6 type tubes is one of the best medium power amplifiers available with ordinary tubes.

—*Stanley Rich*

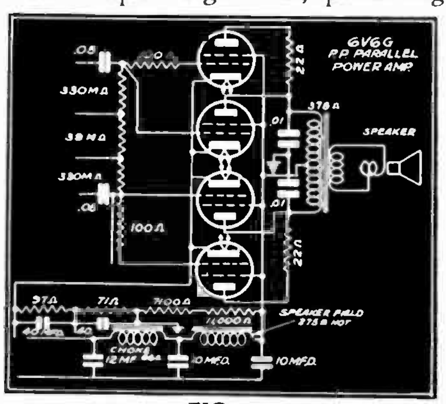


FIG. 1

COMMUNICATION RADIO RECEIVERS

THE use of at least two stages of tuned radio frequency amplification ahead of the first heterodyne detector in communication receivers is necessary for the following reasons . . . (a)—protection against 'image' and other spurious responses; (b)—proper agc action on phone signals requires a high voltage gain (about 70 db) between antenna and the first detector; (c)—prevents appreciable voltage from the local high frequency oscillator from getting on to the antenna and thus into the other receivers.

In view of the above, special diversity receiving equipment as used by RCA Communications, uses four tuned circuits ahead of the first detector. Most of the standard receivers use two stages.

Shielding and filtering are very important in these sensitive receivers. Common coupling through return paths, through the chassis must be avoided. Filtering of the plate, screen grid, filament and bias supplies are thus naturally of the best design. This insures stability of the amplifier itself and provides against radio frequency voltages appearing on the various supply leads. Care is exercised in the choice of radio frequency filter chokes and bypass condensers so that they do not contribute as high impedance anti-resonant circuits to cause oscillation at some low radio or intermediate frequency. When this happens, all signals are modulated by the oscillation frequency, resulting in unrecognizable side bands which appears to be interference.

The required maximum radio frequency gain is obtained from consideration of several factors, such as the maximum band width, etc. For the intermediate frequency band width of 10 KC. the noise equivalent at the grid of the first detector, according to Nyquist's equation would be 4.5 micro-volts. The signal level at which this detector overloads may range from 1.0 volt down to 0.3 volt, and must at the same time be sufficiently greater than 4.5 micro-volts to give a satisfactory signal to noise ratio. With an intermediate frequency gain setting which gives a low noise level on a strong signal, the agc must be capable of following the signal down to the noise level as fading sets in. Thus the agc must handle a wide range of signal strengths. Experience and laboratory work has shown that radio frequency voltage gains of this type of equipment should have a maximum of not less than 3000.

Super-heterodyne receivers are always

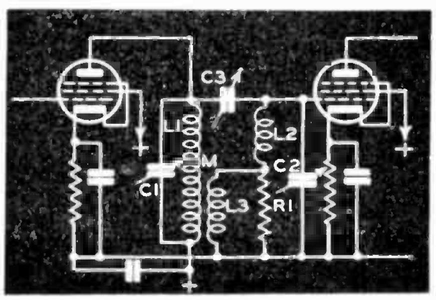


FIG. 2

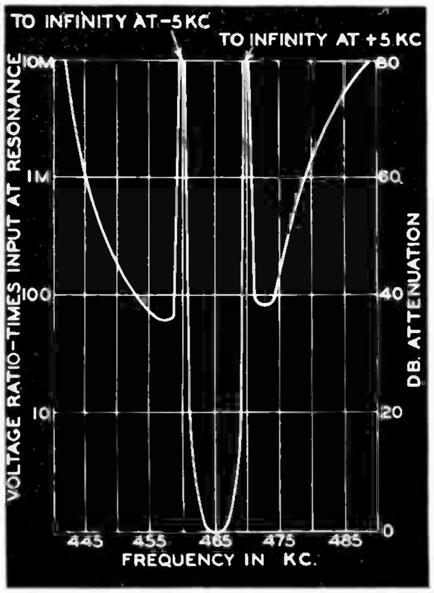


FIG. 3

subject to image response. The higher the carrier frequency, the more difficult is the problem of keeping the image-response to low levels. Thus in most equipment, a ratio of about 1000 is the minimum that has been adopted as satisfactory.

With the properly designed first detector, the harmonic content of its output is not high enough to cause trouble from "harmonic trouble" responses. This type of interference is caused by a signal whose frequency is mid-way between that of the desired signal and the local high frequency oscillator. This signal beats with the local oscillator and produces a signal of one-half of the IF frequency. This signal then appears in the output of the first detector and if it is not operating properly, the second harmonic of the unwanted signal coincides with the IF frequency of the receiver and an unwanted interfering signal results.

Changes in frequency, due to variations in plate or heater supply are minimized in many receivers by regulated supplies and ballast tubes in the heater transformer primary windings. In a well built commercial receiver, the frequency change amounts to 0.4 cycle/million percent and 1.5 cycles/million percent respectively. The temperature coefficient of frequency ranges from about 60 to 100 cycles per million ° C.

Either of four IF systems are used in communication receivers: (a)—variable selectivity air core IF transformers . . . (b)—variable selectivity iron core IF transformers . . . (c)—infinite off frequency rejection circuit IF transformers . . . (d)—two intermediate frequencies.

Receivers using variable selectivity transformers have the control within easy access of the operator. This control simultaneously varies the coupling between the primaries and secondaries of the IF transformers. Since both the primary and secondary are tuned, this variation of coupling changes the response characteristics from a single sharp peak in the minimum coupling position to a wide double-humped curve in the position of maximum coupling. The control is usually continuously variable so that any intermediate band width between these two extremes is readily obtainable. Except when agc is used, there results a large variation in gain. With agc not in operation, the receiver gain rises rapidly as the coupling is increased, until optimum coupling exists, after which the gain again falls as the response characteristics widens and the double hump appears. This change in gain is not noticeable when agc is used.

The above also applies to iron core IF transformers, except that the response characteristics for minimum is very steep. Successful communication receivers have been made with both air core and iron core IF transformers.

A system known as the "infinite off-frequency rejection" is used in one of the popular type of "communications" receivers. This method is diagrammed in Fig. 2. The mutual inductance M and the capacity coupling C3 are so chosen that at some determined frequency off resonance, the voltage induced in C3 is opposite in sine to the voltage induced through M. That is, no coupling exists at this particular frequency. In order to achieve infinite rejection at this undesired frequency, correction for power factor in the circuit must be made. R1 is the power factor corrector. The rejector control C3 can be varied over a fairly wide frequency range of rejection without noticeable interlocking effects on the IF frequency. By using two of these infinite attenuators, one on each side of the IF frequency, a response curve similar to Fig. 3 is obtained. This curve was obtained by using two similar IF stages in cascade, with a rejector circuit in each, one tuned 5 KC. above and the other 5 KC. below the IF frequency.

In the strictly commercial receivers, two intermediate frequencies are used in each of the diversity receivers. With an RF system as described heretofore, an IF frequency of not less than 300 KC. is desirable. It is impractical to obtain a frequency characteristic with a flat top of 1 to 2 KC. and reasonably sharp cutoff immediately outside this band at 300 KC. Therefore two intermediate frequencies are used. The first is made sufficiently high to obtain the required RF image ratios. The second one is chosen so that band widths from 1 to 10 KC. are obtained. The frequencies used are 300 KC. and 50 KC. respectively.

The 300 KC. IF unit consists of a multi-section band-pass filter of the inductively coupled type. It provides all the selectivity required without the use of tubes.

The second IF system is duplicated in each receiver. That is, there are two 50 KC. amplifiers, one having a narrow band width of 1 and 3 KC. and the other a wide band width of 6 and 10 KC. Thus, a choice of four band widths is provided.

The optimum frequency characteristic for each band width is obtained by varying the coupling between the primary and secondary and by the use of a proper terminating resistance in shunt with each. By terminating the primary and secondary of each transformer with the correct value of resistance, the optimum frequency characteristic can be obtained. With proper coupling and terminating resistances, a flat topped characteristic with fairly sharp shoulders and steep cut off is obtained for any band width.

The 50 KC. signal is rectified by diode detectors in push pull. Push pull is used in order to double the ripple frequency and simplify the filtering problem. With the diode outputs of two or three receivers in diversity combination, it is essential that the IF ripple frequency be effectively filtered out before the rectified outputs are combined. Otherwise beat notes between the different IF signals will appear in the common diode load circuit.

The remainder of the unit consists of a monitoring circuit which provides an audio frequency beat note from the 50 KC. signal, which is used for tuning, centering of the signal in the IF band pass, checking of interference, monitoring of the signal itself, and sometimes for aural copying of the signal when it is too weak to operate the tone keyer.

The single control dual diversity system, popular today differs from the commercial system in that instead of using separately tuned receivers with individual high frequency oscillators, a common oscillator is used, which feeds the first detectors of two receivers. The tuning condensers of the RF circuits of the two receivers and the common oscillator are mechanically ganged together. The advantages claimed for this receiver are: simpler tuning, and the elimination of the need of the expensive

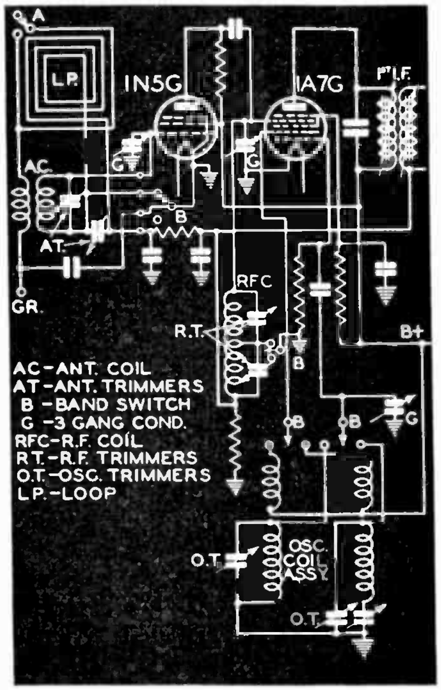


FIG. 4

precaution found necessary in the commercial type to prevent the high frequency heterodyne oscillator of one receiver from feeding into one of the antennas or input circuits.

STANDARD BROADCAST RECEIVING SETS

MOST portables are equipped with two-gang condensers and no stage of R.F. amplification. This affords sufficient sensitivity and selectivity for bringing in the powerful local stations. They are, however, of little value in the mountains, on lakes, in steel buildings, in trains or in any place where reception difficulties abound. Accordingly, three-gang condensers with an additional stage of tuned R.F. amplification before the mixer, plus push-

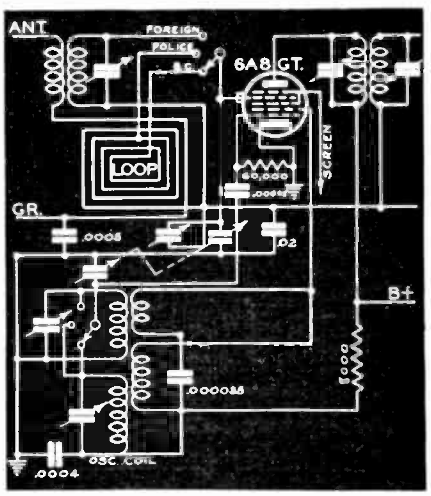


FIG. 5

pull output are excellent for the following reasons, and have thus been included in the Pilot portables, (FIG. 4).

This method permits: (1) — The noise-to-signal ratio to be lowered considerably, due to the addition of the R.F. stage; (2) Adjacent channel selectivity to be increased; (3) Reduction and elimination of "birdies", "tweets", etc.; (4) Greater sensitivity and better selectivity.

Push-pull output in these models gives more power output and better tone reproduction due to the cancellation of even harmonics which are sensitive to the ear and cause distortion.

* * *

THE model 729 Crosley super-het. portable has a number of interesting features particularly in that unit using a three band loop antenna with a mechanical push-button tuning system. The circuit is conventional but an unusual method is used in the loop to afford three band coverage. That is, it is possible to receive foreign, police and broadcast bands with a switching arrangement on the loop. The police band makes use of the image frequency (2 X IF frequency more than fundamental) and the tapping on the loop which is resonated at 2.4 megacycles. When aligning, the special police band can be checked by using a .001 mfd. condenser in series with the signal generator output lead, turning a switch to POL position. The signal generator is set to 2.5 MC and then the generator signal is tuned in. This should come in with the dial pointer near the end of that band. (See FIG. 5).

SPEAKERS

DURING the past few years, the trend in sound reproduction has been in the direction of smaller and smaller cabinets together with a corresponding reduction in size of the loudspeaker mechanism. The obvious result has been a reduction in the low frequency response and quality. In order to improve the low frequency response of small loudspeakers, the radiation resistance must be improved and means provided for allowing a larger excursion of the diaphragm as well as a lower fundamental resonance. The radiation resistance may be improved by a suitable environment for the loudspeaker mechanism. The allowable excursion of the diaphragm may be increased and the low frequency resonance decreased by means of an accordion suspension system.

A cross-sectional view of a loudspeaker mechanism employing an ac-

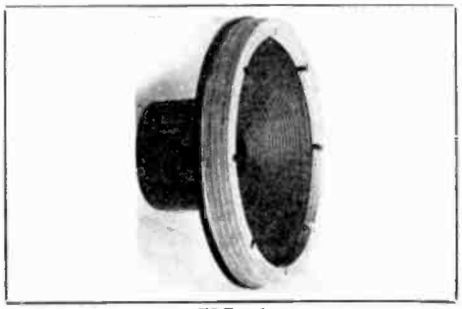


FIG. 6

cordion type suspension is shown in FIG. 7. This suspension reduces the radial constraining forces which arise in the conventional suspension. The reduction of these constraints decreases the stiffness and thereby lowers the fundamental resonance frequency. The use of the second supporting suspension prevents circulation or air leakage between the front and back.

In addition to reducing the stiffness this suspension presents a constant stiffness over a greater amplitude range than the conventional suspension. This results in a very marked reduction in nonlinear distortion. As a consequence the reproduction of low notes is clean cut and well defined.

This suspension does not cause nonuniform response in the range above 500 cycles which occurs in the conventional suspension when the stiffness is reduced.

The radiation resistance at the low frequencies may be increased by means of a suitable enclosure provided the fundamental resonance frequency of the mechanism is sufficiently low. The accordion suspension provides the means for obtaining the low resonance frequency. The combination of the loudspeaker mechanism with the accordion type suspension with an enclosure having the proper acoustical constants affords a frequency response from 80 to 7000 cycles, sloping off to 30 cycles on the low end and to 1400 cycles on the upper end. The voice coil impedance of the speaker used in this new unit is 6 ohms. Will handle up to 3 watts continuously.

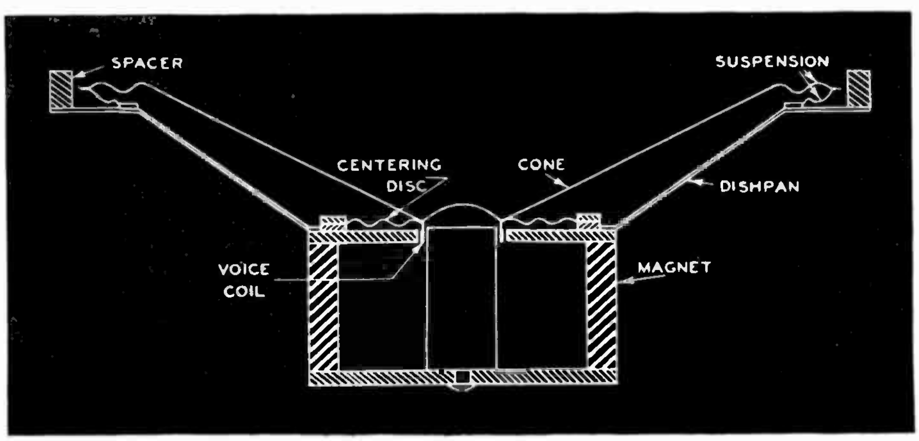


FIG. 7

SOUND SYSTEMS

IN the discussion of "zero-level", last month, varying standards of "zero levels" were covered. In addition, given power level or db. levels were also analyzed. Now, let us continue. In radio work, the 12.5 level is used as well and often, as the 6 milliwatt zero level. The lines that connect the broadcast stations, transmitters and other remote points are using the 6 milliwatt zero level. R.C.A. control room audio frequency circuits use the 12.5 milliwatt zero level. This being so, it might be well for you to remember, that in case you are using a calibrated db. meter having a 6 milliwatt zero level, by simple calculation you can convert the reading to 12.5 milliwatt. Last month we learned that doubling the power output is equal to a gain of 3 db. In this case, we are increasing the hypothetical input power by 12.5 divided by 6, which is a little more than double and which, therefore, would be equal to a loss of approximately 3 db. for the same power output. So when using a meter calibrated to 6 milliwatts, correct values referring to 12.5 milliwatts can be had by subtracting 3 db. from the meter reading. In Fig. 8 the relationship between various db. levels and the corresponding power at that level (zero level 12.5 milliwatt) is given. Using 12.5 milliwatts as a reference level we can learn how the word "decibel" is used. For instance, if the output of an amplifier is plus 30 db., we could say that the amplifier has an output of 12.5 watts. Microphones are also rated in db. levels and we can see by the chart that their output is very small, minus 60 db., for example, being only a fraction of a watt. It can also be seen, that doubling the power output of an amplifier, does not double the db. level, meaning the actual sound intensity from the loudspeaker. You can also readily see from the chart that for every increase of 10 db. in sound level, the power output of the amplifier has to be increased 10 times, and for every decrease of 10 db. the power of the amplifier has to be decreased 10 times. You must also remember that the decibel is the unit of actual sound intensity, so that every time you double the db. value, the density of the sound to the ear is also doubled. but doubling the power output of the amplifier does not produce double the intensity to the ear.

DB LEVEL	WATTS POWER
Plus 40 db	125.0
Plus 30 db	12.5
Plus 20 db	1.25
Plus 10 db	.125
Plus 0 db	.0125
Minus 10 db	.00125
Minus 20 db	.000125
Minus 30 db	.0000125
Minus 40 db	.00000125
Minus 50 db	.000000125
Minus 60 db	.0000000125
Minus 70 db	.00000000125

FIG. 8

In FIG. 9 the actual gain in db. is plotted against the power ratio. The power ratio in this instance is the over all amplification of an amplifier sound system. That is we use the formula

$$\frac{\text{power output}}{\text{power input}} = \text{amplification.}$$

—*Werner Mueller*

WATTS POWER	DB LEVEL
.0125	0
.125	plus 10
1.25	plus 20
2.5	plus 23
5.0	plus 26
10.0	plus 29
12.5	plus 30
20.0	plus 32
25.0	plus 33
40.0	plus 35
50.0	plus 36
80.0	plus 38
100.0	plus 39
125.0	plus 40

DB GAIN	AMPLIFICATION
0	1
3	2
6	4
10	10
13	20
16	40
19	80
20	100
23	200
26	400
30	1000
40	10.000
50	100,000
60	1,000,000
70	10,000,000

FIG. 9

case histories

Compiled by ARTHUR E. RHINE

SPECIAL NOTICE: *ONE DOLLAR is yours, if you can send in a case history that is interesting enough for us to publish. See if your case histories are good enough to win this cash award. Address case histories to The Editor, The RADIO MASTERS Monthly, 116 Broad Street, New York City.*

ANY MAKE — **ANY MODEL**

PROBLEM

Noise caused by BX cabling.

SOLUTION

When receiver, tubes and installation all check "OK", examine BX cables, especially in basements of private homes, for parallel touching pairs. When touching each other, BX cables especially when wet, set up a current out of phase with ground. Noises are generated and carried through house wiring and into the receiver. Insertion of a stack of ordinary blotters between such adjacent pairs will effectively absorb dampness and insulate them from each other.

Submitted by Martin Seel

SPARTON — **1937 PHONO-COMBINATION**

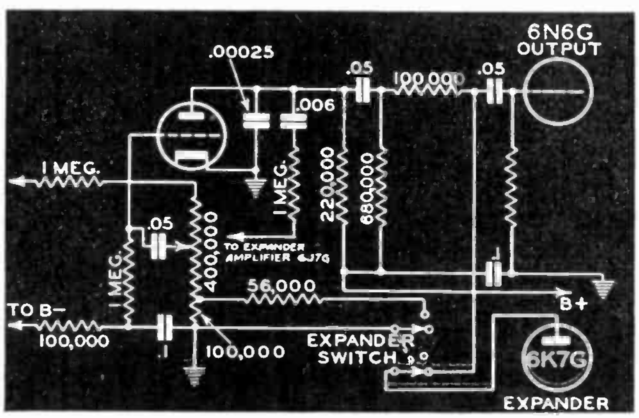
PROBLEM

Change of volume level when switching from volume expander to normal radio position.

SOLUTION

Volume control in this receiver is tapped at 100,000 ohms. When the expander is switched to "off" position, a 56,000 ohm resistor is shunted across the 100,000 ohm volume control section. Replace the 56,000 ohm resistor, if defective; or replace or repair expander on off-switch, if it fails to ground, or replace defective 500,000 ohm volume control.

Submitted by Jack Grand



PHILCO — **MYSTERY CONTROL**

PROBLEM

Set turns on; volume control continues to full volume; starts back to low gain; shuts set off, continues cycle without stopping.

SOLUTION

Examine switching arm. If it catches as it comes back, gently file contacts with an orange stick. If catching of arm is not the cause, it will be found that metallic dust or metal filings have settled between the points. If this is found to be the case, remove such foreign particles with a bit of cloth, which has been dipped in alcohol. Particles will adhere to damp cloth. Do not attempt to change tension of the springs.

Submitted by Charles Feldman

STROMBERG-CARLSON — **AMPLITUDE-FREQUENCY MODULATION MODELS**

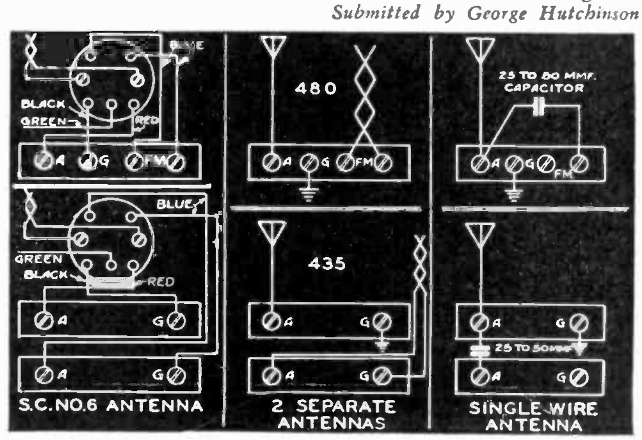
PROBLEM

What are the correct methods for connecting various types of antennas to these receivers, using the Stromberg-Carlson No. 6 antenna system, two separate antennas, or a single wire antenna?

SOLUTION

The diagrams below illustrate the various methods of connection. In the sketch for the Stromberg-Carlson No. 6 antenna system, the "red" lead is shown connected. The "green" lead may be connected in place of the "red" lead to eliminate interference between stations on a standard broadcast range.

Submitted by George Hutchinson



ANY MAKE — ANY MODEL

PROBLEM

Removing metal particles from voice coil apertures of dynamic speakers.

SOLUTION

Obtain a length of spring steel, five-thousandths of an inch in thickness and cut it to a maximum of 1/16th of an inch in width. The length will depend entirely upon the size of the magnet you must employ in conjunction with its use. Five or six inches should be sufficient. Snap the steel spring onto the magnet, letting as much of the length protrude from the magnet as possible. The magnet will now have become a "one-hand-tool" leaving the other hand free. Insert the spring into the voice coil opening and when withdrawn you will find that all metal particles within its magnetic influence have adhered to the steel. This is the simplest and most effective means of doing the job other than complete dismantling.

Submitted by A. E. Rhine

RCA — MODEL D9-19

PROBLEM

Weak reception. Tuning eye inoperative.

SOLUTION

Look for oil soaked trimmer condensers in 2nd I.F. transformer, causing mis-alignment. Clean entire I.F. assembly and trimmers with alcohol. Dry thoroughly and realign all trimmers. For best results, replace with new I.F. transformer, and caution set owner on over-oiling phono motor. Play safe by inserting an ordinary desk blotter between top of chassis and under side of phono-mechanism.

Submitted by Jerry Winthrop

ZENITH — 70 SERIES

PROBLEM

No reception on low frequency end of band when reception on high frequency is good.

SOLUTION

Remove variable condenser shield and center the condenser plates by loosening the two screws on the top and bottom on each section shorted. Then tighten these screws after centering. Adjust trimmers.

Submitted by Louis Fialkoff

ZENITH — MODELS 4V31/59 (CHASSIS 5405)

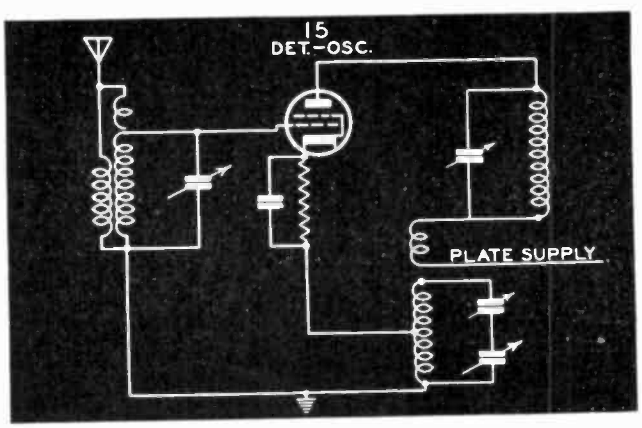
PROBLEM

Reception at high frequencies. None at low.

SOLUTION

Replace first detector-oscillator 15 tube.

Submitted by Ralph Jackson



EMERSON — MODEL 34C, 101
CHASSIS 6C-D6

PROBLEM

Inoperative.

SOLUTION

Capacitor C-25, a .1 mfd. by-pass condensers shorts, causing burnout of R4 (6600 ohms) a portion of metal clad wire-wound tapped resistor. Replace condenser with .1 mfd. 600V tubular unit and place a 10 watt, 7000 ohm resistor across burned out portion of tapped resitor. Occasionally C9 a .1 mfd. 200 volt condenser also shorts, causing burnout of R2, a 10,400 ohm portion of wire-wound tapped resistor. Replace condenser with a .1 mfd. 400 volt tubular condenser and 10,000 ohm 10 watt resistor, across burned out portion of voltage divider.

Submitted by Charles Detjen

RCA — MODEL 88K

PROBLEM

Inoperative.

SOLUTION

Check R.F. plate voltage. If low or nil, then test .0047 mfd. condenser (6C) for short. This condenser is on first detector coil. Replace condenser and 1000 ohm resistor R2 in series with the plate supply to R.F. tube which usually burns up or is badly damaged by the shorted or leaky condenser.

Submitted by William Johns

EMERSON — MODEL D-138, D-139, D-140
(See Model D-134)

PROBLEM

Noise.

SOLUTION

Replace capacitor out of which the wax has melted. You will find that this has been caused by a bleeder which was factory assembled, too close to the capacitor. Heat from the bleeder is sufficient to again cause trouble unless care is exercised to separate these two constants.

Submitted by Stephen Redman

GENERAL ELECTRIC — MODEL 107-F

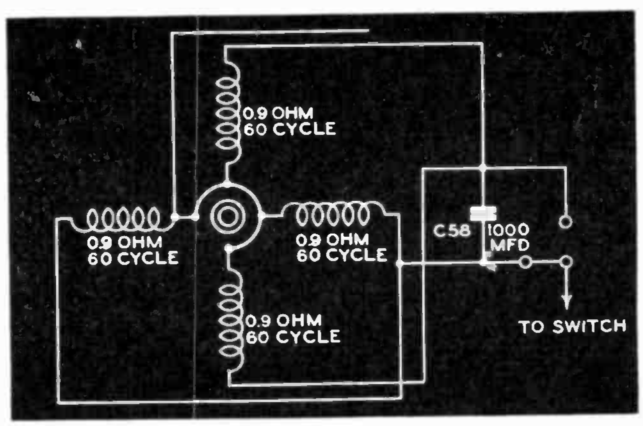
PROBLEM

Tuning dial motor slows down, almost stopping.

SOLUTION

Replace 1000 mfd., 12 volt condenser.

Submitted by George Brooks



stepping up those sales

With Milton Reiner . . . John F. Rider

TEST instruments, today, are much more effective and consequently so much more popular, than those made five to ten years ago. Multi-function instruments have contributed to a great extent to make this possible.

"Today, a single meter tester may be conveniently operated as the equivalent of more than forty different individual function and individual range meters", said MILTON REINER of Radio City Products Company, during a recent RADIO MASTERS broadcast.

"As a result, the cost is only a fraction of the total cost, of the total equivalent individual meters. Today, we are able to design low range ohmmeter scales with the middle of the scale reading only 2 ohms and the first ten divisions each reading 5/100 of an ohm. This is done at a very low current drain on the ohmmeter battery permitting accurate measurements of voice coils, shorted turns of transformers, poor contacts, resistance and so on.

"Many advancements have also been made for AC measurements. For instance, at our laboratories we have originated and perfected an arrangement for using the tube as a meter rectifier that practically eliminates most of the large errors prevalent in copper oxide rectifiers. This system eliminates temperature and wave form errors. Frequency errors are negligible up to 200,000 cycles. Using this form of rectification, we have developed instruments that measure current in AC and DC from microamps up to 25 amperes. Of course these same instruments perform many other functions. For instance, we have a tester that has forty-four different functions with five direct reading capacity ranges, measuring from 1/10,000 of a microfarad to 300 microfarad.

"Another useful testing instrument is the oscilloscope. If properly designed, it is more desirable than other forms of testing. However there are many instances where oscilloscopes have been bought and then have never been used at all by the servicemen due to a lack of technique on his part. Furthermore, the majority of circuit difficulties can be determined with less effort and in less time with the conventional test equipment of today.

"Generally speaking, all test equipment today is more compactly designed. We now have pocket-sized instruments that provide many more measurements than the relatively clumsy ones of ten years back. Parts used today in instruments are infinitely better in quality and accuracy. Panels have attractive layouts with discriminating use of color. Cases are made of fine woods and well finished. There is more protection today against obsolescence and more protection against misuse. Meters are fused against burn out and most plug-in equipment is double line fused. On the whole we have, today, at considerably less cost, instruments that are more comprehensive in scope, more accurate, more compact, more convenient to use and far more attractive in appearance. The serviceman, today, cannot afford to be without adequate test equipment of the latest design".

MAPS are closely allied to the servicing of radio receivers according to

PHILCO — **MODEL 46DC**

PROBLEM

What is the correct alignment procedure for this receiver?

SOLUTION

First, be absolutely certain that all constants are correct. This is of utmost importance because any incorrect resistor or condenser values will make neutralization and dial calibration an almost impossible task. Stability can be anticipated only when constants are definitely correct and not "nearly so". Having checked these characteristics, connect signal generator to the antenna post using a 200 mmfd. condenser in series with the signal generator lead. Now, set the dial at either 120 or 140 and the signal generator at either 1200 or 1400 k.c. Adjust the trimmers located on top of the variable condenser gang as follows: first—detector trimmer; second—R.F. trimmer, and third—antenna trimmer. Make these three adjustments so that the maximum output of signal is obtained. Do not change the volume control setting; signal generator setting, or dial setting during these operations.

Submitted by Arthur E. Rhine

SEARS ROEBUCK — **MODEL 1722X/1732X**

PROBLEM

Noise.

SOLUTION

Examine rectifier tube. Too often you will find that some inexperienced person has purchased an "83" rectifier tube, ignorant of the fact that he should have asked the dealer for an "83V". An "83" Mercury Vapor rectifier cannot be used in this receiver as it has not been designed for its use. Correct replacement of the proper "83" rectifier will cure the trouble.

Submitted by Eric Hoffman

GENERAL ELECTRIC — **MODEL 107-F**

PROBLEM

Push buttons fail to operate tuning device.

SOLUTION

With a hot holdering iron, resolder cold solder joint of the common lead to push button contacts.

Submitted by Martin Scel

RCA — **RADIOLA 64**

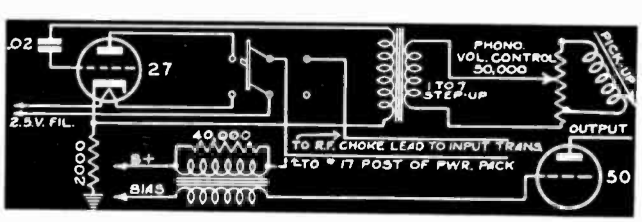
PROBLEM

Installation of phonograph amplifier.

SOLUTION

Build a simple amplifier unit consisting of a 27 tube, a one to seven step up transformer and a double pole, double throw switch as outlined in the diagram below.

Submitted by Arthur Elliott



ANY MAKE — **ANY MODEL**

PROBLEM

Noise.

SOLUTION

A prolific source of noise is often found inside of fuse boxes. Loose or poorly seated fuses and loosely screwed terminal wires connected to fuse holders, are very common conditions. The smart serviceman always tightly seals all fuses and tightens all screwed fuse box wire connections. Loosely seated electric light bulbs raise noise havoc. Some people unscrew these bulbs rather than use the off-on switch. They should be instructed to either use the switch or to unscrew bulb to a full turn and be sure to seat bulb tightly when lighting same.

Submitted by Jack Grand

PHILCO — **MODEL 62D**

PROBLEM

Distortion.

SOLUTION

This receiver has a single 42 output tube and the screen is connected directly to speaker field. Due to the voltage drop in output transformer the plate voltage is considerably less than the screen. Correct this condition by placing a 5000 ohm resistor in screen circuit of 42. Also check the .02 mfd. coupling condenser between 75 1st audio and 42 output tube for leakage.

Submitted by Charles Detjen

PHILCO — **MODEL 37-116X**

PROBLEM

Gradual fading after set has been in operation a while, with stations detuning on dial settings.

SOLUTION

Condenser C-28, a .05 mfd. tubular unit located under R.F. compensator condenser, is the trouble-maker. Remove compensator assembly, remove old condenser and replace with a .05 mfd. 450 volt tubular unit. Replace compensator condenser assembly, and re-align set.

Submitted by Clarence Timmons

STEWART-WARNER OR DELCO — **MODEL R-149 (SW) AND MODEL R-1118/9 (DELCO)**

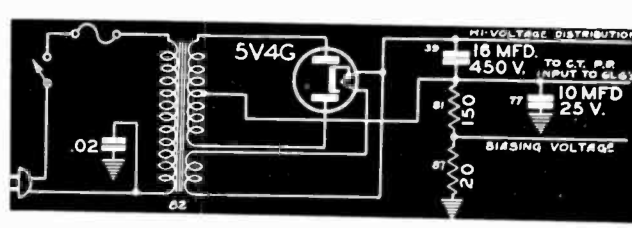
PROBLEM

The 5V4G tubes repeatedly burn out.

SOLUTION

Replace the .006 mfd. plate condensers with .005 mfd., 1500/1600 volt condensers.

Submitted by Arthur E. Rhine



JOHN F. RIDER, outstanding authority on radio servicing.

Said Mr. Rider, during a recent RADIO MASTERS broadcast, "If we follow the evolution of the map, we can see what a close parallel there is between the map and our servicing today."

"Maps, as we all know, have played a very important part in the life of man", continued Mr. Rider.

"Many have died making them, so that others would know of the lands and seas existing in the far distant corners of the earth. Many died seeking them, and the hidden treasures they were supposed to disclose. Even today, we hear rumors about the map which tells where the notorious Captain Kidd hid his fabulous treasures. Yes, men have died for the want of maps and the guidance they contained. History tells us that the first known maps, now in the hands of the British Museum, are a series of circular clay tablets, and show a survey of lands in Babylonia, and date back to about 2300 B.C. These maps guided the tax collector . . . told him who owned the land, its area, and where it was located. About 600 B.C. or 1700 years later, Anaximander, a Greek teacher of Ionian philosophy, designed what was supposed to be the first map of the world. He considered the earth to be a section of a cylinder suspended between the heavens. This was almost contradicted by Anaximenes, a pupil of Anaximander, who said that the earth was rectangular resting between the heavens on compressed air beneath it. Many hundreds of years passed and many thousands of men traveled into far distant lands. Maps increased in scope . . . each was a guide for the next traveler. From the Egyptians to the Greeks, and from the Greeks to the Romans, and from the Romans to the Arabs, and Persians. Astronomers, mathematicians, philosophers, travelers . . . all made their contributions so that man could roam and trade and commerce could grow. A thousand years pass, and many famous names pass in review . . . Marco Polo, De Conti, De Gama, Columbus, Magellan, Cook and others. The map of the world grows. Latitude . . . Longitude . . . Rivers . . . Mountains . . . Oceans . . . all appear on paper, wood, parchment, copper, marble, all for the guidance of man. Where to go . . . how to go . . . and what to expect is clearly depicted on the map.

Maps, charts and plans to lead man, appear in many ways. The architect's floor plan is the map of the building. The marine engineer's blueprint is the map of the ship and **the radio man's schematic is the map of the receiver.** Just as the marine charts, land maps, architect's plans, engineer's blueprints, guide the men concerned, just so do wiring diagrams guide those who are interested in radio equipment. Just as land maps and marine charts have increased in importance as world activity increased, just so has the radio schematic become of importance to the technical men and the public alike. To the technical man, it is vital because it points the way . . . showing what is in a radio system, just like a marine map or chart shows reefs, ocean depths, and the nature of the sea bottom, and land maps show roads, cities, rivers and mountains.

"For every valuable item we find on a map, a comparable item is to be found on radio diagrams. The components or parts are cities and towns. The connecting leads are the connecting roads or rivers. The constants are the road marks, lighthouses, beacons, and so on. To use a radio wiring diagram is like removing a blindfold to relieve one's self of the necessity of groping in the dark; to operate with the certainty of knowledge as a bulwark against mistakes. It means sure, rapid progress, with no loss of time or accuracy or detail to the uncertainty or lack of information.

"The use of such wiring diagrams by a serviceman is not a reflection upon his ability, any more than the use of maps, plans, charts or blueprints is a reflection upon the motorist, engineer, ship builder or army strategist. On the contrary, it is the proper scientific approach to the problem of radio maintenance. The fact that such data has become available to the men responsible for the maintenance of America's radio receivers, has proved of inestimable value to the radio public. It means that the public can have the utmost confidence in the men who are responsible for the restoration of a defective receiver. It means that the men who work on the receiver or radio system, have in their possession all the vital data, all the facts pertinent to the proper operation of the system, all the information that might not only rapidly and accurately establish the defect, but help to institute the corrective measures and economically. It means that the public's investment in radio equipment daily being placed into the hands of the servicemen of the nation, is in good, competent hands."

amateur radio

By STANLEY RICH, W2DIW

THE receiver described in this column in the April-May issue is intended as a basic unit to which other features may be added. One of these is an audio-output stage to permit loudspeaker operation. Since the output stage needed is so simple of construction and the advantage gained by its use so desirable, it should be the first unit added to the basic receiver.

In FIG. 1 we have a schematic of the amplifier itself. The only change necessitated in our basic unit is the substitution of switch S.W. for the head phones in the plate circuit of the 6C5G audio stage. By means of this switch, the head phones may still be used when the switch is in the left hand position. In this arrangement, no plate voltage is placed on the 41 output stage while the head phones are used. When the switch is in the right hand position, a 50,000 ohm load resistor replaces the head phones and through it, connection is made to the 41 output stage. Plate voltage is then applied to the 41 and the audio signal is coupled through the .01 mfd. condenser to the output grid.

In the stage itself, it is to be noted that an .006 mfd. condenser is used across the output transformer. Also, no by-pass condenser is called for across the cathode bias resistor of 500 ohms. The reasons for these two features are based in the function of the receiver. It is primarily a code receiver which must operate through severely crowded signal conditions. Therefore, as much interference as possible should be removed electrically so that the desired signal may be distinguished by the ear. The .006 mfd. by-pass condenser in the plate circuit will reduce high frequency audio signals. The omission of the cathode by-pass condenser will cause all low frequencies to be attenuated. Only middle audio frequencies between 300 and 1500 cycles will be fully amplified, permitting greater selectivity of the receiver as far as the ear is concerned.

The loudspeaker may be any inexpensive permanent magnet type dynamic. Six inches is suggested as a compromise between size and sensitivity and has always behaved well for the author. This should be ample for good volume on most signals.

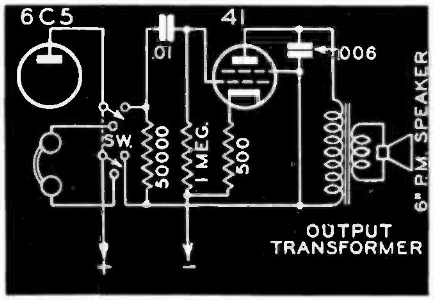


FIG. 1

Analyzing The Crystal Filter Circuit

Last month, the I.F. crystal filter was analyzed as a means for obtaining great selectivity in the I.F. amplifier. There are, of course, other and purely electronic means of increasing gain and selectivity. These shall be this month's subject of analysis.

In FIG. 2 is shown a regenerative I.F. stage with means provided for controlling the voltage applied to the screen. We have here a method for increasing the gain of a receiver while at the same time we increase selectivity.

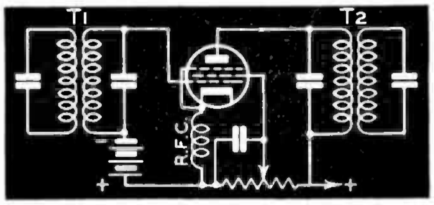


FIG. 2

This is accomplished by feeding back a portion of the signal in the plate circuit of the stage to the grid circuit by means of the choke R.F.C. The larger voltage in the grid circuit is reamplified, becoming still larger, etc. The limit is self oscillation, in this case undesirable. However, it is seen that before oscillation may occur, enormous amplification is still possible.

Our interest, despite the high gain possible in regenerative amplifiers, is the selectivity which may accompany the increase in signal. Here, advantage is taken of the fact that, in resonant circuits, such as those in I.F. transformers, the circuit action is resistive only exactly at resonance (FIG. 3). It is seen that, only exactly at resonance, is the capacitive reactance equal to the inductive reactance. Therefore, only at resonance can the circuit act as a pure resistance.

Now, if we feed a portion of the output signal back to the grid in a regenerative I.F. amplifier, the greatest feedback will take place exactly at resonance because of the effect described. That is, the feedback voltage will be exactly in phase with the input voltage only at resonance. Therefore, the amplification of the resonant frequency will be greatest and regeneration will be less effective on each side of this frequency.

In practice, selectivity may be obtained of comparable sharpness to that of a crystal filter. A band width of 500 cycles or less is practicable.

In addition, the regenerative I.F. offers the added advantage of continuous control over band width and gain of such degree as to far surpass the crystal.

This type of I.F. is being incorporated into many new commercial receivers. It is, in summation, an effective, simple and inexpensive way of obtaining high gain and sharp selectivity.

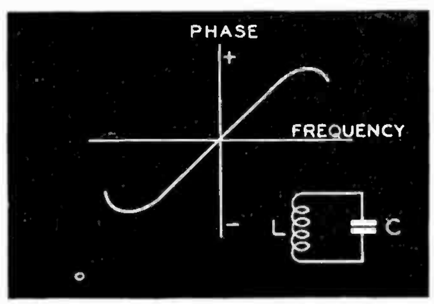


FIG. 3

CODE PRACTICE SCHEDULE

As promised, a special series of code practice schedules have been planned to afford everyone an opportunity to learn the code. The schedule, shown below, became effective May 10th, and will be in force without interruption, until further notice.

Mon. 7-7:30 P.M.	W2DIW	1893 KC
Fri. 7:30-8:30 P.M.	W2MGX	7185 KC
Fri. 8:30-9:30 P.M.	W2MCA	28050 KC

your page of knowledge

Television . . Fundamentals in Radio . . Test Instruments

TELEVISION

By HENRY HESSE

Part 2

LAST month the r.f. amplifier, converter, video and sound i.f. amplifiers were discussed noting their differences from conventional sound superheterodynes. Vestigal sideband transmission and single control tuning of both sound and sight signals were also described.

This month the television signal will be further analyzed with particular reference to the synchronizing portion of the signal. The signal will be traced from the detector thru the various video amplifiers, synchronizing circuits, synchronizing pulse generators to the actual picture produced by the cathode ray tube.

A television signal is composed of the picture signal and vertical and horizontal synchronizing pulses (FIG. 1). Of course, the three types of signal cannot be transmitted simultaneously so they must be sent in a definite sequence that has been standardized. The three signals must be separated at the receiver and sent to different parts of the cathode ray tube to perform their assigned functions (FIG. 2). The picture signal is directed to the C.R. tube grid. The vertical pulses are separated and directed to the vertical saw tooth oscillator. The horizontal or line pulses are directed to the horizontal saw tooth oscillator.

The American system of television utilizes negative modulation of the picture; that is, zero modulation is white, and about 75% modulation is black with increasing modulation decreasing picture intensity. The picture signal does not modulate above 75% so as to allow the vertical and horizontal synchronizing pulses to have a greater amplitude than the picture. By doing this the C.R. tube grid will cut off the electron stream at 75% modulation (black) and the higher amplitude synchronizing pulses will therefore not appear on the screen to mar the picture. Also the return trace or flyback, is completed during the synchronizing blackout.

To prevent the picture signal from falsely pulsing either synchronizing circuit, the first synchronizing separator tube is biased far beyond cutoff, and at low plate voltage. Cutoff bias is chosen so that plate current starts at about 75% modulation, thereby passing only the synchronizing pulses on to trigger the vertical or horizontal oscillators. In order to make certain that the picture signal will not falsely operate the oscillators, causing the picture to lose synchronism and become blurred, some receivers employ more than one synchronizing separator tube with high bias and low plate voltage. The operation of these tubes is quite similar to the usual Class C transmitter tube operation. It is to be noted that the synchronizing separator only starts to function on high amplitude signals while the C.R. tube grid functions in the opposite manner by cutting off at high amplitudes. Thus it may be said that the picture is separated from the synchronizing pulses by the opposite effects of AMPLITUDE upon the C.R. tube and the synchronizing separator tube.

The vertical and horizontal synchronizing pulses, of 60 and 13,230

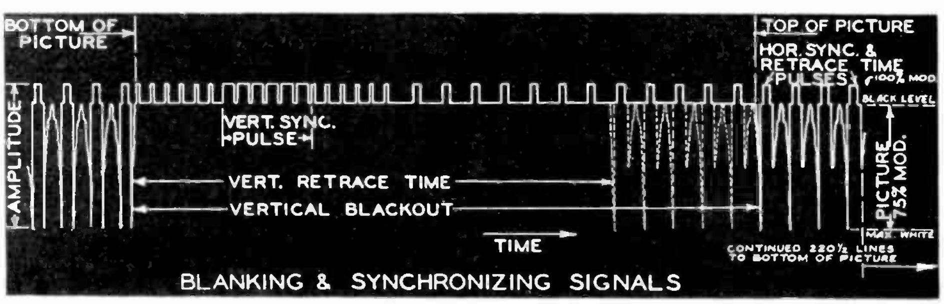


FIG. 1

per second respectively, are separated from each other by low and high pass filters. These filters are usually simple combinations of resistance and capacitance. The low pass filter in the plate circuit of the vertical synchronizing amplifier consists of series resistors and shunt condensers while the high pass filter in the plate circuit of the horizontal amplifier consists of the reverse combination of a small series condenser and a shunt resistance.

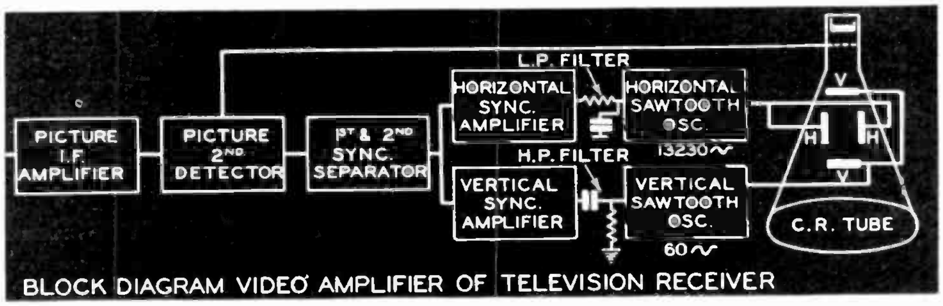


FIG. 2

The grids of both the vertical and horizontal amplifiers are connected together and supplied from the second synchronizing separator tube. Because of the low output obtained from the low voltage operation of the synchronizing separator circuits, amplification is required to obtain enough voltage to control and lock in the vertical and horizontal saw tooth oscillators, to the exact frequency of the 60 and 13,230 cycle pulses, as transmitted. In fact, the horizontal pulses are sent during the time of the vertical synchronizing pulse to prevent the horizontal oscillator from losing synchronism at any time.

The vertical and horizontal saw tooth sweep oscillators may be of the multivibrator type, blocking grid type, or gas triode type and may be single ended or push-pull. Also different arrangements are required for electrostatic deflection of the C.R. tube and for magnetic deflection of the C.R. tube. All sweep oscillators are characteristically unstable, and this may be thought to be a disadvantage, but on the contrary, the instability permits the oscillator to easily be locked into the controlling synchronizing pulses. The one important characteristic of sweep oscillators is the linearity of the sweep. Any nonlinearity of the saw tooth sweep will cause distortions in the picture, similar to the view thru poor window glass.

Summarizing the important points explained above: (1)—A television signal is composed of—(a)—the picture elements; (b)—vertical synchronizing pulses, and (c)—horizontal synchronizing pulses. (2)—The picture is separated from the synchronizing pulses by

CAN YOU ANSWER THESE QUESTIONS?

1. What is the difference between electron flow and current flow?
2. What is the right hand rule for determining the magnetic field about a wire?
3. What is the right hand rule for the magnetic field about a coil?
4. How many parts can you name in a radio receiver that produce a steady magnetic field?
5. How many parts can you name that produce a varying magnetic field?
6. Upon what factors does the strength of the magnetic field of a coil depend?
7. What is the action of the field coil in a dynamic speaker?

1. What is a television signal composed of?
2. What does the American system of television use?
3. What is done to prevent the picture signal from falsely pulsing the synchronous circuit?
4. How are the vertical and horizontal synchronizing pulses separated?
5. What are the saw tooth oscillator characteristics?
6. What output is obtained from the synchronizing separator circuits?
7. What are the characteristics of sweep oscillators?
8. What is the major characteristic of a sweep oscillator?

1. Why do we use a resistance in series with the meter when measuring voltage?
2. Can you draw a diagram of a multi-range voltmeter using a switch to change multipliers?
3. Calculate the resistors necessary with an 0 - 1 milliammeter to make this instrument read 50, 150, 250, 500, 1000 volts.
4. What do we mean by the term "ohms-per-volt"?
5. Why have the "ohms-per-volt" values, increased in the past 10 years?
6. How can you increase the range of a 1000 ohm-per-volt meter from 250 volts to 2500 volts?
7. What are the best resistors to use as multipliers? Why?

In the event corrections of your answers are desirable, THE RADIO MASTERS MONTHLY will be glad to lend a hand through their special answer department. Simply send your answers to "Page of Knowledge" department, and include a self addressed stamped envelope plus ten cents in stamps or coin to cover cost of mailing.

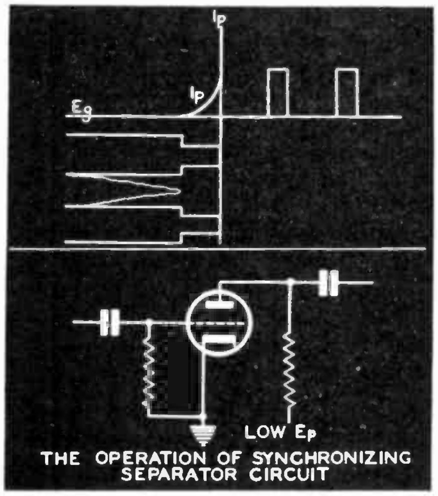


FIG. 3

a difference of AMPLITUDE. (3)—The synchronizing pulses are separated from each other by a difference of FREQUENCY. (4)—The 60 cycle vertical synchronizing pulses are separated by a low pass filter consisting of series resistances and shunt capacitances. (5)—The 13,230 cycle horizontal synchronizing pulses are separated by a high pass filter consisting of a small series condenser and a shunt resistor. (6)—Saw tooth oscillator characteristics are—instability of frequency to easily lock in to the controlling pulse, and absolute linearity of sweep for distortionless pictures. (7)—Picture signal applied to the grid of the C.R. tube controlling the INTENSITY of the electron beam striking the screen. (8)—Vertical and horizontal saw tooth sweeps applied to the plates or deflection coils of the C.R. tube, to control the POSITION of the electron beam on the screen.

(To be Continued)

FUNDAMENTALS IN RADIO

By MAX SPITALNY

Part 3

THOSE properties of electro-static charges involving the electron at rest and the field about it are important in radio work, but even more so are the effects produced when the electron is in motion.

When the electrons move in a conductor we have a flow of current. We explained in Part 2 why we consider the electron as having a negative electric charge. Therefore, when electrons move they flow from negative to positive, from minus to plus. However, the laws of electrical current flow were worked out before scientists knew about the electron, and they followed closely the laws governing the flow of water in pipes, the flow being from a high potential (pressure) to a lower potential (pressure). Therefore, current flow is considered to be from positive to negative, from plus to minus. When considering the direction of motion it is important to remember whether we are dealing with the electron movement or the current.

One of the most important properties of an electric current is its magnetic effects. Whenever a current flows in a conductor, it is always surrounded by magnetic lines of force. These lines of force are in the form of concentric circles around the conductor or wire (FIG. 4). The direction of this magnetic field depends upon the direction of the current and can be determined by a simple right hand rule.

Hold the wire in the right hand with the thumb pointing in the direction in which the current is flowing (from plus to minus); the fingers will then point in the direction the magnetic lines of force encircle the wire—from N to S, (FIG. 5).

The magnetic lines of force are distributed along the entire length of a wire, and therefore, the magnetic strength at any point is small. But if the wire is wound in the form of a coil, the lines of force are concentrated in a small space and the magnetic effect is greatly increased. The coil acts like a magnet. Lines of force are concentrated inside the coil, leave the coil at one end (N), pass through the space outside the coil and re-enter the coil at the other end (S).

Since a magnetic flux will pass more readily through iron than through air, by placing an iron core in the coil the lines of force are still further concentrated and a more powerful magnet is formed. The strength of such a magnet (electro-magnet) depends upon:

(1)—Current strength (amperes).

(2)—Number of turns of wire.

(3)—Type of core.

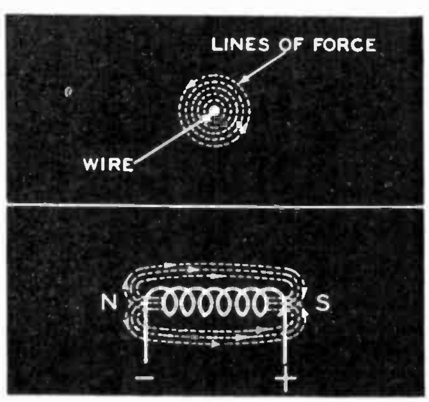


FIG. 4 (top) FIG. 5 (bottom)

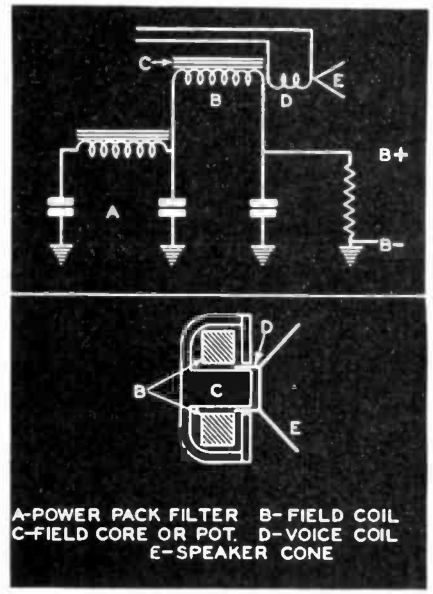


FIG. 6

When two magnets are placed near each other they follow laws similar to those for electro-static charges*. The like poles will repel each other and the unlike poles will attract, the force being directly proportional to the magnetic strength and inversely proportional to the square of the distance. Two coils through which current is flowing act as magnets and follow the same laws. If the physical properties of the coils (number of turns, type of core) are fixed, then the magnetic strength will vary in direct proportion with the current flow.

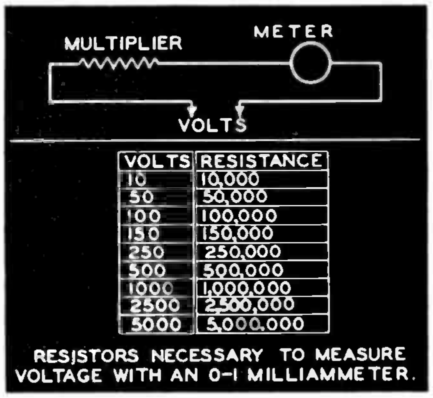
The magnetic effects explained above exist in every wire and in every coil in a radio receiver. In units operating with direct current this effect is steady and may be noticeable, as in the field coil in a dynamic speaker or the power pack filter choke coils. In these cases where the current is quite large, the magnetic pull may be considerable.

In units operating with alternating current, the magnetic flux is constantly changing. Here a direct attractive pull is not observed but other important effects result. These will be considered in the next article (Induced Currents).

The rules governing magnetic effects are particularly important in the design and operation of speakers, filter chokes, A.F. and I.F. transformers and test equipment.

A particularly good example is the operation of a dyn. speaker (FIG. 6). Here, there are two coils; the field coil and the voice coil. The field coil is a large coil with an iron core producing a

*The RADIO MASTERS Monthly, March, 1940



VOLTS	RESISTANCE
10	10,000
50	50,000
100	100,000
150	150,000
250	250,000
500	500,000
1000	1,000,000
2500	2,500,000
5000	5,000,000

FIG. 7A (top) FIG. 7B (bottom)

strong magnetic field. The current flowing through it is D.C. Since this coil is often used as the second filter choke in the power pack, performing a double duty, there may be some A.C. ripple in it. This may be compensated for by a bucking coil, a few turns of wire wound in the opposite direction to oppose this ripple or hum voltage. The net effect is a reasonably steady, strong magnetic field.

The voice coil is a small, very light coil that is directly attached to the speaker cone. It is held in position by a light spring metal support and is free to move in accordance with the pull of the magnetic field.

When no current flows through the voice coil there is no motion. When a varying current flows there is an interaction between the magnetic fields of the voice coil and the field coil. The voice coil, being free to move, will respond to these changes being alternately attracted and repelled. Since it is attached to the speaker cone these movements or vibrations result in sound.

(To be Continued)

RADIO TEST EQUIPMENT

By ADOLPH SUCHY

Part 3

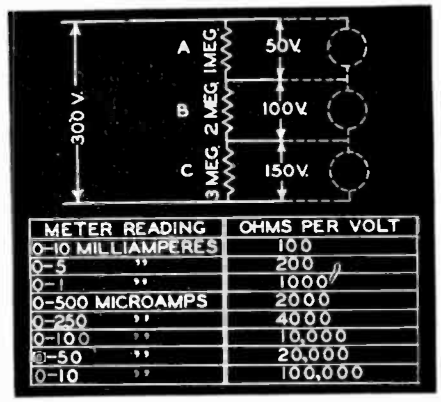
OUR last lesson brought us to the point where we were about ready to use our basic instrument, the D'Arsonval meter, as a voltmeter. Let us begin, then, by taking an 0 - 1 milliammeter and with it calculate the necessary resistors to use. Of course, a voltmeter is always connected in parallel with the circuit. The resistors necessary in a voltmeter are connected in series with the meter as in FIG. 7A. They are called multipliers but in effect they are really current limiting resistors which are used to keep the current going through the meter down to a safe value. Our 0 - 1 milliammeter, then, can only have passed through it safely a total current of one milliampere. Let us take a voltage of, let us say, 250 volts, and see what this series resistor must be. Now what resistance, if shunted, across 250 volts would draw a current of one milliampere? By Ohms law we know that

$$\text{RESISTANCE} = \frac{\text{current}}{\text{voltage}}$$

By simple substitution into this formula, we know that the resistance must be 250,000 ohms. But what about the resistance of the meter itself; isn't that in the circuit also? It is, but the resistance is so small, that it will not affect the reading, being less than 100 ohms usually. However, when measuring low voltages, 10 volts or less, it becomes necessary to consider this resistance and subtract it from the multiplier. So, for the same meter to measure say, one volt, (the meter having an internal resistance of 50 ohms) we would have to subtract the 50 ohms from the 1000 ohms necessary to limit the current and the resulting multiplier would then be 950 ohms.

We could use the simple method described above in calculating each multiplier resistor for each range of the meter. But this would take considerable time and an unnecessary amount of paper work. Perhaps the easiest way to calculate multiplier resistors is first, to find out the necessary resistance to limit the current to the range of the meter, when one volt is used. This time, let us take as an example, an 0 - 5 milliammeter. Now how much resistance is necessary to limit the current to five milliamperes, when this meter is placed across one volt? Well, returning to Ohms law, we find that 200 ohms are necessary. Now, all that we have to do is to multiply the voltage we desire to measure by this figure, in this case 200, to obtain the necessary resistance. For example, if we should desire to measure 100 volts we would need 20,000 ohms, etc. The chart for an 0 - 1 milliammeter is shown in FIG. 7B. The multiplying value that we get is known as the "ohms-per-volt" value of the meter. When purchasing an instrument, it is well to look into the "ohms-per-volt" value.

Until recently, the standard instrument for the service man was an 0 - 1 milmeter. This, of course, is still useful in servicing, but because of the nature of the design of radio receivers, it has become necessary to revise the meter situation. The 1000 ohms-per-volt meter is no longer adequate for doing many types of jobs because it draws too much



METER READING	OHMS PER VOLT
0-10 MILLIAMPERES	100
0-5 "	200
0-1 "	1000
0-500 MICROAMPS	2000
0-250 "	4000
0-100 "	10,000
0-50 "	20,000
0-10 "	100,000

FIG. 8

current from the circuit. Suppose, for example, we had a radio receiver to service, that had the network of resistors shown in FIG. 8. According to Ohms law there would be 50 volts across the one megohm resistor; 100 volts across the 2 megohm resistor, and 150 volts across the 3 megohm resistor.

Now let us put 0 - 1 milliammeter, with 50,000 ohms resistance, across the one megohm resistor to measure the voltage. We already know that when two resistors are connected in parallel, the resultant resistor will have less value than the smallest resistor. So our resulting resistance in circuit "A" will be less than 50,000 ohms. The voltage, therefore, will drop to about 2½ volts which, of course, is not a true reading. The same holds true with circuit "B" and "C". However, if we had a 20,000 ohms per volt meter, the resistance in parallel with the circuit would be 1 megohm and the voltage across the resistor would not be upset quite so much.

Suppose we had a 1000 ohms per volt meter, and we wanted to increase the range from 500 volts to 2500 volts, what do we have to do? Obviously, we must add resistance to the meter. How much resistance? If we use the resistance in the 500 volt scale and just add the resistance to make up the difference between 500 volts and 2500 volts, we will have it. That means 2000 volts at 1000 per volt or 2 megohms is needed.

There are many types of multipliers on the market at present. The serviceman has carbon resistors around his shop that could be used. These carbon resistances, however, have characteristics which make them unsuitable for use as multipliers. The resistance rarely remains constant over long periods of time. With age, the binder used, begins to crystallize and the resistor changes value. Also, heat and moisture affect these carbon resistors.

(To be Continued)

Current Information

(For Copies of the Following, Use the Special Coupon, below)

1—ULTRA HF RECEIVER—The rapidly growing need among commercial engineers, amateurs and experimenters for a receiver that will cover as low as two meters and receive both amplitude and frequency modulated signals, has been met by a new HALLICRAFTER receiver, Model S27 that is attractively illustrated and described in a new booklet.

* * *

2—TUBE BASE CHART—A new chart with 118 views covering the 367 tube types now available, with a complete index and cross-index for all tubes and base views, has just been released by SYLVANIA. The chart is printed on heavy-coated paper and is suitable for mounting.

* * *

3—SIGNAL SPLICER — How to increase signal strength insure, accurate impedance match between any type antenna and receiver, reduce noise and minimize image rejection with a signal splicer is told in a circular just released by MEISSNER.

* * *

4—ANALYZER — To test condenser and resistor characteristics and in addition check D.C. voltages and milliamperes, SPRAGUE has developed a Tel-Ohmike condenser and resistor analyzer that is completely described in a new descriptive bulletin.

* * *

5—REPLACEMENT GUIDE—With expanding sales of portable radio receivers and test instruments, servicemen and dealers face a perplexing problem when asked for the correct types of replacement batteries. To simplify this selection, BURGESS has printed two guides; one for instruments and one for receivers.

* * *

6—INTERFERENCE FILTERS — Fluorescent lighting fixtures are likely to be a prolific source of radio interference of moderately low intensity but nevertheless distinctly troublesome to nearby radio sets. Such interference can be eliminated by special filters, described in a CORNELL-DUBILIER release. Two filters are available, one for existing fluorescent lamps of the plug-in type and the other for mounting directly in the lighting fixture.

* * *

7—INTERCHANGEABLE TUBE CHART — A small pocket-type chart showing what HYTRON bantams are interchangeable with metal "G" and "MG" tubes, has just been released. According to this chart, 72 Hytron "GT" tubes will handle replacement of a total of 153 types.

MAIL THIS COUPON FOR FREE LITERATURE!

Service Department
THE RADIO MASTERS MONTHLY
116 Broad Street, N. Y. City

I should like a copy of each of the following . . . FREE!

NO. .... NO. .... NO. .... NO. ....

NO. .... NO. .... NO. .... NO. ....

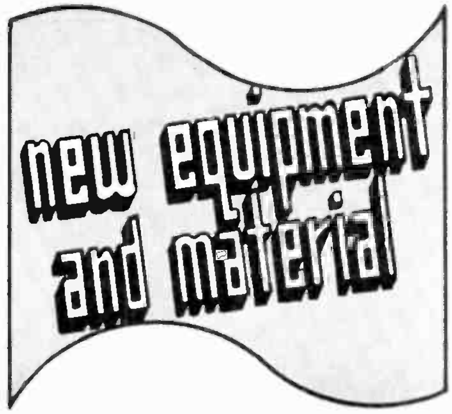
NAME .... POSITION ....

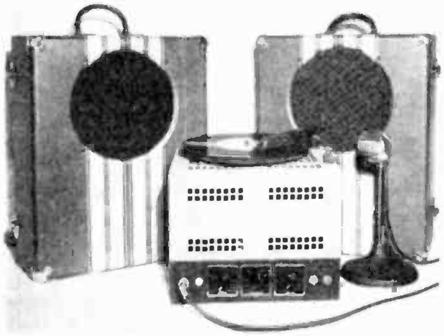
FIRM ....

MAILING ADDRESS .... ☐ HOME ☐ BUSINESS

CITY .... STATE ....

RM-3



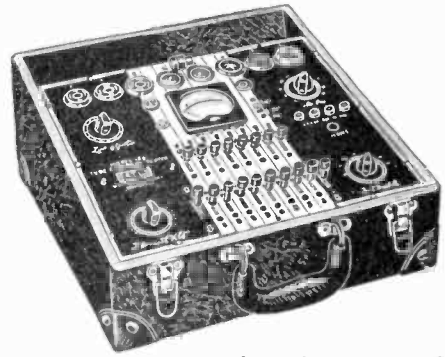


PORTABLE AMPLIFIER — A new 14 watt portable amplifier system is now being featured in the new line of Mercury public address equipment available from SUN RADIO. It consists of a high gain amplifier with built in phonograph motor, turntable and pick up in a single carrying case and two 10" dynamic speakers with 50 feet of cable in portable carrying cases. A desk mount crystal microphone and cable is also supplied. This unit is also available with two walnut speaker baffles instead of portable case units for semi-permanent or permanent mounting.

* * *

SIGNAL GENERATOR—For increased efficiency in radio and television receiver alignment work, RCA has announced the "Signalyst", a companion to the RIDER "Chanalyst" and "Voltohmst." This new instrument has a fundamental frequency range of 100 kilocycles to 120 megacycles on 10 bands. Its maximum output voltage is .05 volts at low range and 1.3 volts at high range.

* * *



TUBE TESTER — To accommodate any possible combination of heater and control elements of all existing sockets and for all tubes that may be introduced in the future, RADIOTECHNIQUE LABORATORY has developed the Model 120. Not only can radio tubes be tested, but even pilot lamps and Christmas tree bulbs. A new permutation switch system has been included to afford flexibility.

* * *

MULTI RANGE TESTER — The latest addition to the PRECISION line of test equipment is a new Series 832 multi-range tester affording six direct current voltage ranges at 1000 ohms per volt up to 1200 volts; six alternating current ranges at 500 ohms up to 2400 volts; four direct current ranges up to 1200 milliamperes; three ohmmeter ranges to five megohms, etc.

* * *

BREAK-IN SWITCH — Modern microphone modernization is offered by the

(Continued on Page 26)

NEW EQUIPMENT

(Continued from Page 25)

new ATLAS SOUND break-in switch for press-to-talk and on-off switching, adaptable to all microphones or circuits having single conductor shielded cable connections.

* * *

MASTER FM ANTENNA SYSTEM—Anticipating the popular use of FM receivers, TACO has announced a master system that will feed from 15 to 25 receivers. Special high frequency iron dust cores permitting full isolation of primary and secondary transformer winding, are used. Unique spacing of the windings afford a blocking of noises. A store demonstration unit is

(Continued on page 27)

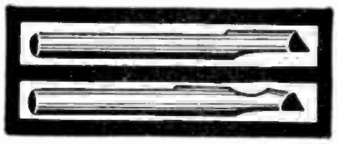
NEW EQUIPMENT AND MATERIAL

(Continued from Page 26)

also available for handling from 6 to 8 sets simultaneously.

* * *

CUTTING NEEDLES — Employing special Swedish steel alloy, the Recoton cutting needles now retain a cutting edge not heretofore possible. This cutting edge is polished with diamond dust to afford a quiet, accurately made groove. To prevent insertion of the needle at a wrong angle, a flat surface on the shank has been included.

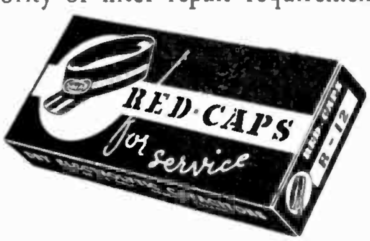


* * *

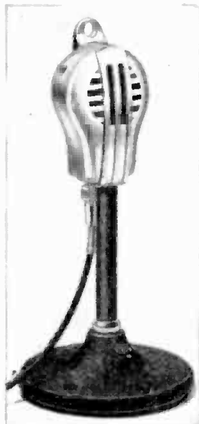
BATTERY TESTER — For showing the percentage of useful life as well as the active voltages, Triumph Manufacturing Company of Chicago have produced the Model 633 battery tester now available through NATIONAL UNION by a special deal.

* * *

HANDY CONDENSER CARTON — SOLAR'S new condenser package houses twelve RED CAPS useful for thirty different ratings, to meet the majority of filter repair requirements.



MICROPHONE — Shaped to fit snugly into the hand, this new microphone by TURNER has a number of very effective uses. Available in both crystal and dynamic styles and suitable for close speaking or voice and music pick up, where the performer may operate at a distance. Model also has a hook for hanging and will also fit on to any stand or desk or floor stand.



* * *

AC-DC TESTER — For checking up to 500,000 ohms; 2500 volts DC; 1500 volts AC; up to 1 ampere, and up to 50 DB., RADIO DESIGN has produced a new compact test instrument.

INDEX TO ADVERTISERS

The Radio Masters

announce with pride

the

premiere performances

of

"YOUR SERVICE SHOP"

A 2½ hour stage presentation, covering a series of typical events of the day in a modern radio service shop. Through the cooperation of a group of the world's leading manufacturers, the successful approach to every problem that may be encountered by the serviceman in the store or in the home, will be told for the first time by a distinguished cast of leading authorities. The setting will be that of the up-to-date serviceman's store, in which instruments and all of the better parts carried by the serviceman will be attractively displayed. Included in this stage show will also be a special sound motion picture, and a host of specially prepared demonstrations, including the guest appearance of brilliant

Harry Volpe

World Famed Guitarist and Star of Stage and Radio

and

The Volpe Instrumental Trio

In addition, a powerfully dramatic prologue depicting the evolution of sound will be on view for the first time, and a sensational announcement about the annual "Radio Masters Service Award" will be made.

This outstanding staging will be presented for the exclusive attention of the METROPOLITAN SERVICEMAN

to whom

Admission Will Be Free

on

**July 11th in New York City and July 25th in Newark, New Jersey*

These distinctive stage shows are being sponsored by the

Amperite Company

Cornell-Dubilier Electric Corporation

International Resistance Company

John F. Rider

Supreme Instruments Corporation

And Their Distributors

Whose outstanding products, of which many are shown on the following pages, will play a distinctive and important role in these new and strikingly different presentations.

***Hotel in which presentation will be held will be announced in special mailings and July issue of The RADIO MASTERS Monthly. Watch for announcements!**

EXTRA!!

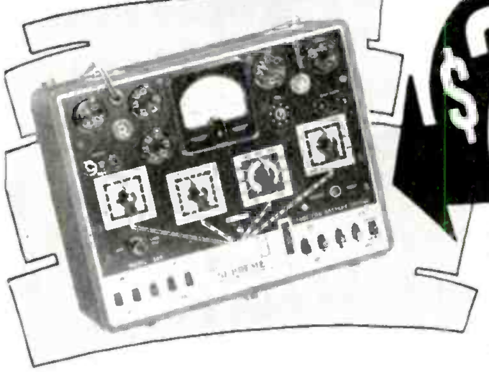
EXTRA!!

EXTRA!!

THE complete 1941 Supreme line of instruments will be on display at the RADIO MASTER presentations in New York, July 11—and in Newark, N. J., July 25. Don't fail to be present and see these new money making instruments.

Supreme has the most complete line on the market. Tube Checkers, Set Testers, Vacuum Tube Voltmeters, Signal Generators, Oscilloscopes, and the famous Audolyzer and Vedolyzer.

SHOW PREVIEW 2 OF 22 NEW MODELS



$29.95

Terms: $1.00 cash and 8 monthly payments of $3.63

FREE TUBE SETTING SERVICE FOR ONE YEAR

IN producing Model 589 there has been no compromise in the circuit design or materials. The same manufacturing methods, careful inspection and accurate calibration is incorporated in this instrument as in all other SUPREME testers. It will pay you to investigate and see this tester before you buy. Its price is the lowest at which a GOOD tube tester can be built.

MODEL 589 TUBE AND BATTERY tester has a completely modernized circuit. The tube test sockets are not wired directly to the circuit, but, instead, pass through the patented SUPREME Double Floating Filament Return Selector system which automatically re-connects all tube elements to any possible tube base arrangement. Due to the fact that any or all elements of each socket can be rotated to any desired position, only one socket of each type is necessary. Tests every type of tube from 1.4 volts to full line voltage at its correct anode potential under proper load. Tests **separate sections** in multi-purpose tubes. Checks all leakages, shorts, open elements and **filament continuity** with a neon lamp. A circuit insert is provided for checking noise, leakage, loose and bad connections.

The battery testing circuit of the Model 589 provides the proper load at which each battery is to operate, plainly marked on the panel, for all 1.5, 4.5, 6.0, 45 and 90 volt portable radio types. The condition of the battery is indicated on an English reading scale.

This is the fastest and easiest tester to operate. Just "follow the arrows"—you can't go wrong. Roller type tube chart with brass geared mechanism lists tubes in logical numerical order. Each tester carries a one year free tube setting service. SUPREME engineering and construction PLUS the best materials the market affords, make the 589 your biggest dollar value. You will be proud to own this instrument.

MODEL 599 TUBE AND SET TESTER is very similar in appearance to the Model 589, and includes all the features and advantages of this instrument. In addition, it provides the following ranges:

0.2 TO 1500 D.C. VOLTS—5 carefully selected ranges—0/6/15/150/600/1500 volts. 1000 ohms per volt STANDARD sensitivity.

0.2 TO 600 A.C. VOLTS—4 A.C. ranges—0/6/15/150/600 volts. Rectifier **guaranteed** with instrument and **fully** protected from overload damages.

0.2 M.A. TO 600 M.A.—3 direct current ranges 0/6/60/600 allow measurement of screen, plate, "B" supply and D.C. filament loads.

0.2 TO 600 OUTPUT VOLTS—0/6/15/150/600—ideal for alignment. No button to hold down—no external condenser necessary.

0.1 OHM TO 20 MEGOHMS—4 ranges 0/200/20,000 ohms, 0/2/20 megohms. A low range at high current with 3.5 ohms center scale.

ELECTROSTATIC—ELECTROLYTIC LEAKAGE TEST—Sensitive calibrated 20 megohm range provides excellent leakage test of paper and electrolytic condensers.

Just as the 589 is your best value in a tube and battery tester, the 599 is your best value in a combination tube tester, battery tester and set tester. Remember, you have all the features of the 589 PLUS a complete AC. DC volt, ohm, megohm, milliammeter, at a cost of only 47c per range.

Dealer Net Cash Price
$39.50

Terms: $4.50 cash; 9 payments of $1.33.

Illustrated above is the Model 589 in a counter type metal case. This model is available with option of 7" or 9" illuminated meters. Has two neon lamps for sensitive or super-sensitive tests.

SUPREME
SUPREME INSTRUMENTS CORP.
GREENWOOD, MISSISSIPPI, U. S. A.

Metal cabinets as illustrated for the Model 589 at left and 599 above are identical—can be used either in a horizontal position or vertical position by merely reversing the instrument panel. Write for information.

These Jobbers Have the New Supreme Instruments in Stock. Ask Them About the S.I.C. Payment Plan.

NEW YORK JOBBERS

Radio Wire Television, Inc.	100 Sixth Avenue, New York City
Radio Wire Television, Inc.	542 E. Fordham Road, Bronx, N. Y.
Radio Wire Television, Inc.	90-108 — 166th St., Jamaica, L. I., N. Y.
Chanrose Radio Stores, Inc.	160-16 Jamaica Ave., Jamaica, L. I., N. Y.
Mac Radio	57 E. 3rd St., Mt. Vernon, N. Y.
Sun Radio Co.	212 Fulton St., New York City
H. L. Dalis, Inc.	17 Union Square, West, New York City
Benray Distributing Co.	507 Coney Island Ave., Brooklyn, N. Y.

NEW JERSEY JOBBERS

Radio Wire Television, Inc.	24 Central Ave., Newark, N. J.
Jersey Television Supply Co.	113 Elizabeth Ave., Elizabeth, N. J.
Nidisco	682 Newark Ave., Jersey City, N. J.
Nidisco	205 Madison Ave., Passaic, N. J.
Nidisco	301 Perry St., Trenton, N. J.
Nidisco	658 Anderson Ave., Cliffside, N. J.

they may look alike but what a difference in performance!

Ball players or capacitors ...

they look pretty much alike reporting for duty. The rookie pitcher and the veteran wear the same uniform. They may even use the same wind-up. But what a difference in performance! In the seasoned pitcher's sureness, in his stamina and dependability, you recognize *experience*.

Behind the "uniform" of today's capacitor units there's a difference, too. Put to the test, one capacitor —CORNELL-DUBILIER—outperforms the field in life expectancy, dependability, surviving economy. And the reason . . .

Cornell-Dubilier's thirty years of manufacturing experience. Experience is the yardstick knowing engineers use in measuring capacitor value. That is why there are more C-D capacitors in use today than any other make. That is why it pays to specify Cornell-Dubilier for every capacitor requirement.

HERE ARE FIVE CORNELL-DUBILIER ETCHED FOIL* ELECTROLYTIC CAPACITORS THAT LOOK LIKE MANY OTHERS . . . UNTIL YOU

put them to the test!

TYPE BR & TYPE BRL

C-D TYPE BR "BLUE BEAVER"** ELECTROLYTICS—most universal capacitors for use where single section units are required. Small, handy, completely eliminating use of exact duplicate replacement capacitors. Hermetically sealed, vented — practical for all radio receiver circuits.

C-D TYPE BRL "BLUE BEAVER"** dual common negative electrolytic capacitors. Capacities, voltages and polarity of the leads are clearly defined by color coding. One-screw-mounting under the chassis assembly. Also available in the Type BRS common positive.

TYPE EZ

C-D TYPE EZ ELECTROLYTICS—popular for radio servicing where low cost replacements are required. Certainly the most practical all-around replacement capacitors available. Completely sealed in moisture-proof cardboard tube casings. Facilities for both upright and sub-chassis mounting.

TYPE UP

C-D TYPE UP ELECTROLYTIC is the smallest can type capacitor made. Hermetically sealed in aluminum cans . . . mountable in vertical position. Exceptionally low leakage and power factor. Especially dependable in operation over wide temperature variations with minimum capacity change.

TYPE UM

C-D TYPE UM ELECTROLYTIC universal replacement capacitors. Cover a wide variety of requirements where units of special capacity and voltage combinations are needed. All Type UM capacitors are clearly stamped with capacity and voltage of sections, including color coding of leads to prevent any error in wiring.

BE WISE—SPECIFY C-D's, the capacitors widely imitated, often copied, but never duplicated. The dealers listed below will be glad to supply you with Cornell-Dubilier capacitors. *For complete listing of all C-D capacitors send for free capacitor manual. Remember! All C-D capacitors are union made and competitively priced!*

*ETCHED FOIL—NOT FABRICATED PLATE **REG. U.S. PAT. OFF.

CORNELL-DUBILIER ELECTRIC CORPORATION
1006 HAMILTON BOULEVARD
SO. PLAINFIELD, NEW JERSEY

specify CORNELL-DUBILIER!

THE WORLD'S LARGEST MANUFACTURER OF CAPACITORS...

CORNELL-DUBILIER JOBBERS IN THE METROPOLITAN AREA

Eagle Radio Co.
84 Cortlandt St., N. Y. C.

Harrison Radio Company
12 West Broadway, N. Y. C.

Harvey Radio Co.
103 West 44th St., N. Y. C.

O & W Radio Company
81 Cortlandt St., N. Y. C.

Sun Radio Company
212 Fulton St., N. Y. C.

Bronx Wholesale Radio Co.
470 E. Fordham Rd. New York

Wilco Distributing Co.
231 Willis Ave., Bx., N. Y. C.

Benray Distributing Co.
507 Coney Island Avenue, Brooklyn, N. Y.

Berman Distributing Co.
1188 Broadway Brooklyn

Chanrose Radio Co.
170-16 Jamaica Avenue Jamaica

Terminal Radio Corp.
80 Cortlandt St., N. Y. C.

Radio Wire Television, Inc.
100 Sixth Ave., N. Y. C.
24 Central Avenue Newark
542 East Fordham Rd. Bronx
90-08 166th Street Jamaica

Peerless Radio Distributors
92-96 Merrick Road Jamaica
82 Livingston Street Brooklyn

Nidisco Radio Co.
658 Anderson Avenue
Cliffside, New Jersey
208 North Broad Street Trenton
682 Newark Avenue Jersey City
205 Madison Avenue Passaic

Jersey Radio & Television Co.
1115 Elizabeth Avenue
Elizabeth, New Jersey

Aaron Lippman Company
246 Central Avenue Newark

Bennett Radio Supply Co.
105 Lewis Street
Perth Amboy, New Jersey

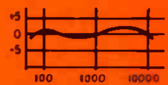
Mac Radio Co.
50 East 3rd Street Mount Vernon

L & S Radio Sales Company
124 North Street Middletown

AMPERITE Announces the BIGGEST ADVANCE in the Dynamic since its Inception!

P.G.
PRESSURE GRADIENT
DYNAMIC

- **UNI-DIRECTIONAL.** NEW SUPERIOR ELIPSOID PICKUP PATTERN
- **ELIMINATES FEEDBACK** TROUBLE BECAUSE IT HAS LOWEST FEEDBACK POINT OF ALL DIAPHRAGM TYPE MICROPHONES
- **FLAT RESPONSE.** FREE FROM ANNOYING PEAKS, GIVING STUDIO-QUALITY REPRODUCTION.



FLAT RESPONSE OF P.G. DYNAMIC

The P.G. diaphragm follows air particle velocity where amplitude is a **GRADIENT** of the **PRESSURE.** In ordinary dynamics amplitude is restricted from following air particle velocity.

The P.G. DYNAMIC is a radical improvement in this type of microphone. You can actually hear the difference. Case is designed according to modern acoustic principles. Rugged, not affected by temperature, altitude or humidity. **HAS UNUSUALLY HIGH OUTPUT, —55 DB.**

MODEL PGH (PGL, 200 ohms). Excellent for high fidelity P.A. installations, broadcast studio, and professional recording. With switch, cable connector, 25' cable. Chrome finish, **LIST $32.00** (4)- 10 000 C.P.S.)

MODEL PGAH (PGAL, 200 ohms). For speech and music. 70-8000 C.P.S. Switch, cable connector, 12' cable. Chrome, **LIST $25.00**

COMBINATION VELOCITY-DYNAMIC ACHIEVED WITH ACOUSTIC COMPENSATOR

An exclusive Amperite feature: By moving up the Acoustic Compensator you change the AMPERITE VELOCITY to a DYNAMIC microphone without peaks. At the same time you reduce the back pick-up, making the microphone practically UNI-DIRECTIONAL.

WITH ACOUSTIC COMPENSATOR:
MODEL RBHk; RBMk (200 ohms) with switch, cable connector.
Chrome, **LIST $42.00**

RSHk; RBSk (200 ohms). Switch, cable connector, Acoustic Compensator.
Chrome or Gunmetal. **LIST $32.00**

AMPERITE KONTAK MIKE
Puts Musical Instruments Across

So beautiful is the tone produced with the Kontak Mike, that it was used in the Philadelphia Symphony to amplify a mandolin solo. Gives excellent results with any amplifier, radio sets, and record players.

MODEL SKH (hi-imp)	**LIST $12.00**
MODEL KKH, with hand volume control.	**LIST 18.00**
Plug extra	List 1.50
FOOT PEDAL, for making beautiful crescendos	**LIST 12.00**

WRITE FOR FREE SALES AIDS AMPERITE Co. 561 BROADWAY, N. Y. U.S.A.

Specify AMPERITE

AMPERITE PRODUCTS ARE AVAILABLE FROM THE FOLLOWING AUTHORIZED DISTRIBUTORS

Dale Radio Co., Inc., 1780 Broadway, N. Y. C.
Fischer Distributing Corp., 19 Park Place, N. Y. C.
H. L. Dalis, Inc., 17 Union Square, N. Y. C.
Sun Radio Co., 212 Fulton Street, N. Y. C.
Terminal Radio Corp., 68 W. 45th St., N. Y. C.
Radio Wire Television Inc., 100 Sixth Ave., N. Y. C.
Shupack Radio Corp., 482 Sutter Ave., Brooklyn, N. Y.
Aaron Lippman and Co., 246 Central Ave., Newark, N. J.
Advance Radio Corp., 309 Park Ave., Paterson, N. J.
Radio Wire Television Inc., 24 Central Ave., Newark, N. J.