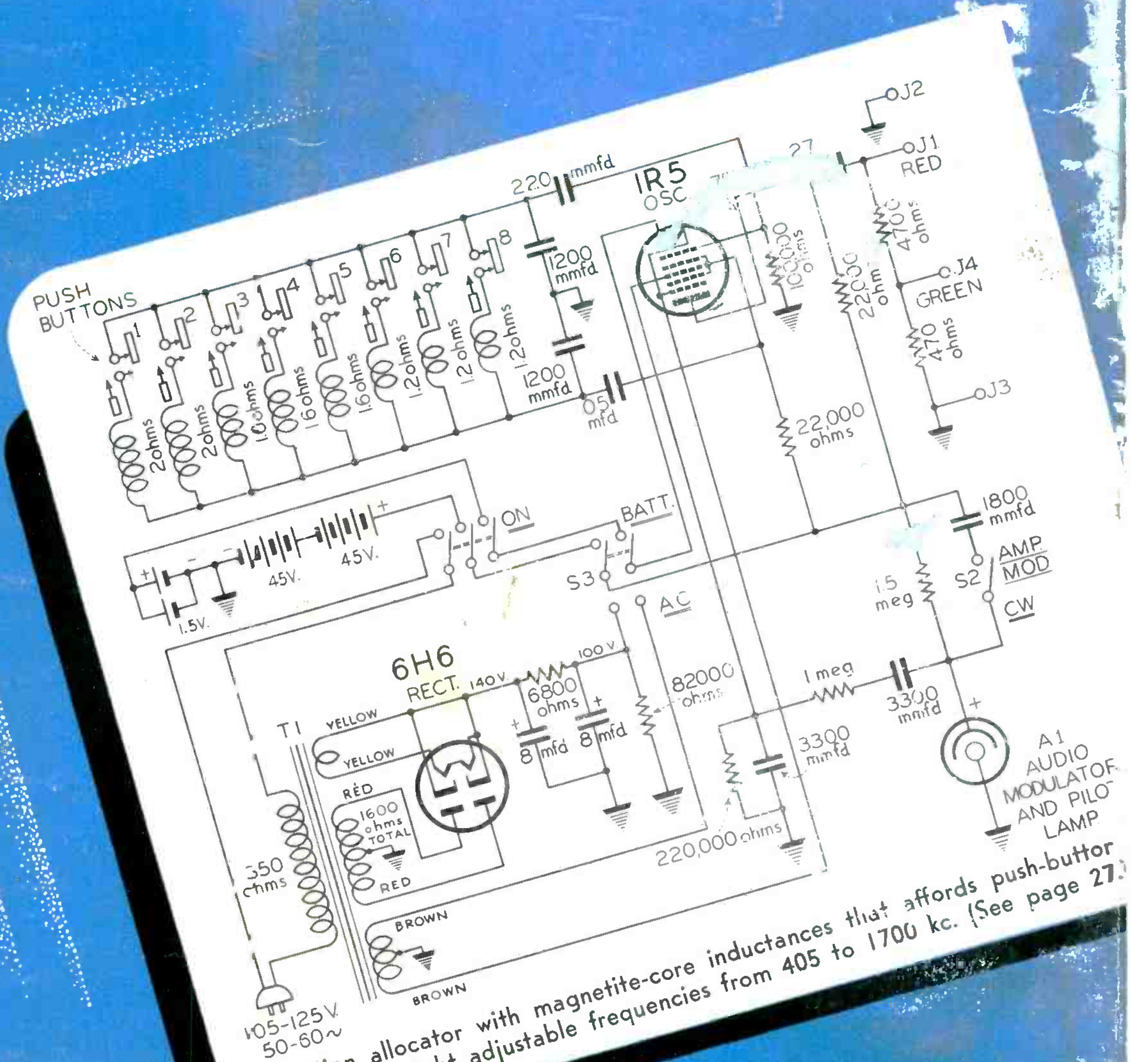
ANNUAL INDEX PAGES 15 TO 18

SERVICE

A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE



A station allocator with magnetite-core inductances that affords push-button selection of eight adjustable frequencies from 405 to 1700 kc. (See page 27.)

★ RADIO
★ TELEVISION
★ ELECTRONICS

December 1943

"In recognition of Service beyond the call of duty . . ."

In this grim business of war, the men in uniform take the risks; they deserve the decorations.

We tube manufacturers don't expect medals. When, however, credit *does* come our way . . . and when it comes from such a man as Paul V. Galvin, President of RMA . . . it makes us mighty proud and happy.

"Let me take a moment for special mention of the tube engineers. Too often they are not fully recognized. We see fine accomplishments in apparatus, but we fail to appreciate the important work that has been done behind the scenes by the tube engineer. Hats off to you—your accomplishment has been most extraordinary. But you, also, you cannot as yet rest upon your oars. The job is not finished, and new and additional accomplishments are required before we are finished with this war." *

Hytron engineers realize fully that "the job is not finished", and they continue to strive for "new and additional accomplishments" needed to win the war. Their aim is to develop better tubes to make possible better fighting equiment—let the decorations fall where they may.

* Excerpt from address of Paul V. Galvin, president of the Radio Manufacturers Association at the Institute of Radio Engineers' Rochester Fall Meeting, November 9, 1943.

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EQUIPMENT FOR SALE—Precision #832 V-O-M; Supreme #450 radio tester; Supreme #501 tube tester; Jewell 199 set analyzer; Rider chanalyst; Rider's manuals 4 to 11 incl.; Hickok 188 signal generator. M. W. Shellhamer, 224 Pitt St., Tamaqua, Penna.

TUBES TO SWAP—Will sell or trade radio tubes: 2A5; 2A7; 77; 2A3; 33; 1F5G; 1B5; 6G5; 57; 58; and others for other tubes or eqpt. My list for yours. Jack Grant, Olney, Okla.

URGENTLY NEEDED—Hallicrafter S-29 or Echophone EC-1. State price and condition in first letter. Lieut. E. E. Grubb, Hq. Co., 2nd Bn., 513th Parachute Infantry, Fort Bragg, N. C.

WANTED—3" or 5" oscilloscope; Supreme 561 or any modern oscillator; and condenser tester. Name price and describe. Radio Maintenance Service Co., 841 So. Vermont Ave., Los Angeles 5, Calif.

WANTED—All-wave signal generator, late model tube tester, Rider chanalyst and other test eqpt. Walt's Radio Service, RFD 1, Box 52, Norfolk, Va.

FOR SALE OR TRADE—Weston #301 D-C milliammeters, voltmeters, ammeters. Also Readrite #430 tube tester; Weston model 506 D-C milliammeters 0-100, 0-200. Want Rider's manuals 8-13 incl., also condenser tester. C. F. McCracken, Hughes Park, Bridgeport, Pa.

WANTED—Webber Mod. 500 radio laboratory in good condition. Must be a bargain. Quote price. Radiodell Radionics Labs., 1112 E. Carson St., San Antonio, Texas.

WANTED—For war plant jobs, jobs, model 55-C Shure dynamic microphone or #725 Electro-voice Cardak. Must be hi-impedance. H-K Amplifier Service, 250 Walnut St., Waterbury 27, Conn.

WANTED—Six 1H5GT tubes and three A-B power packs (A 1½ volts and B 190 volts). Wilmer O. Houze, Rt. 1, Box 67, Allen, Alabama.

WANTED—A good multimeter and a signal generator. Herman Crammer, 1328 Bancroft Ave., Anniston, Alabama.

FOR SALE—I. Guthman diversity coupler, never used. Will sell for cash or trade for Triplett #1200A. H. A. McElroy, 7055 Shirley Drive, Oakland 11, Calif.

WANTED—14-watt amplifier to use with guitar pick-up. Name price and describe fully. T. W. Gasnell, Route 1, Box 110, Leesville, La.

FOR SALE—One #302 Bendix tube tester and volt ammeter in hardwood carrying case. A-1 condition. $25 cash f.o.b. Want to buy a good multimeter with ohmmeter handling 10 megs., battery-operated type. Robert W. Gorseline, 6 Ocean Green S.W., Washington, D. C.

WILL TRADE—Dark room photo equipment worth $60, incl. Sun Ray enlarger f3.5 lens 35mm—½ V.P. like new. Want late tube checker and equipment worth about this sum. Julius Werner, 410 W. Berks St., Philadelphia, Penna.

URGENTLY NEEDED—Rider chanalyst and Jr. Voltohmyst or similar equipment. Lowenstein's, 228 N. Broadway, Santa Ana, Calif.

FOR SALE—Six 6', four 4½' Fox aluminum trumpets; 22—6-volt field Western Electric, Fox and Racon horn units. Need Rider's manuals, Supreme audolyzer or vedolyzer, and Supreme #561 A-F, R-F oscillator. Lester G. Poague, 7007 Nebraska Ave., Tampa, Fla.

WANTED—A good signal generator and set analyzer or multitester. Will pay good price for good units. Philip D. Howes, Patten, Me.

FOR SALE—RCA voltohmyst Jr., practically new. Best cash offer takes it. James Acheson, 1286 Mulvane Ave., Topeka, Kans.

FOR SALE—Triplett tube tester #327A with complete, up-to-date tube chart. Perfect condition. Sam Bloom, c/o Kaplans, Vidalia, Ga.

FOR SALE—Foote-Pierson tape recorder, double pen. Brush VP-1 vibration pick-up, brand new. Astatic lapel mike #218, also new. Have a number of tuning forks of various pitches—also a list of other desirable items. A. F. Toth, 3608—29th St., Long Island City 1, N. Y.

WANTED—Echophone EC-1 or other inexpensive communications receiver for use by radio students. Gus Petroplus, 918 St. Charles Road, Maywood, Ill.

WANTED—A complete set of Rider's manuals, also a record changer and pick-up arm. Will pay cash or trade test eqpt. Ted Solarz, 3033 S. Pulaski Rd., Chicago 23, Ill.

WANTED—High quality output transformer with 500 ohm sec. for P-P 6L6's. State price, make, type. Have audio and power transformers and following tubes for sale, 43, 45, 56, 58, 75, 2B7, 25Z5, 6A7 and BH. C. L. Goebel, 221 West 233rd St., New York 63, N. Y.

WILL TRADE—Have 8 assorted Weston & Triplett 2" and 3" meters; two special 5" Weston meters; 1 Thordarson T-50W12 6-volt, 12-watt amplifier brand new; 100 new radio tubes of std. makes in needed numbers; 2 IRC ladder type L-pad 50-ohm attenuators; assortment of 7 hi-fidelity low-level output, input and mixing transformers, also dozens of odd radio and sound parts. Write for details on any. Want late model all-wave signal generator and/or tube checker, Rider's Manuals, etc., incl. Perfex 44 or similar 35 mm. miniature or 2¼ x 3¼ speed graphic camera. Al Olson, 2915 Ave Q½, Galveston, Texas.

WANTED—New or used signal generator, 60-cycle. C. J. Courneya, Tweed, Ontario, Canada.

WANTED—A good test oscillator, new or used. William Hill, 14 St. Clair St., Willoughby, Ohio.

FOR SALE—At 25% off list, plus postage: 2—1A4G; 1—25Z5G; 2—36; 1—56; and 1—71A tubes; also one power transformer (new) 110 v., 60 cy., H.V. at 70 ma. 350 v. plate; 5 v. at 3 A. for rect., 6.3 v. and 2.5 v. fil. In original box with diagram. Also Triplett 1220-A free-point tester, $10. Banks Radio Service, Crowder, Okla.

FOR SALE—Have large quantity of tubes, some old types, some new; also audio and power transformers; condensers and resistors of all types; 40-meter crystals; small dry rectifier, and many other items. Write for list. What have you? Al. Lovato, 17155 Wildemere, Detroit, Mich.

WILL TRADE—Will swap Hickok #110 VTVM with acorn tube, prod and inst. sheet for any of the following, cash difference to be supplied, if any: Simpson #329 Tube Tester, Supreme #589 tube tester with 9" meter; ditto #599; ditto #561 AF and RF oscillator; or Supreme Vedolyzer, M. Chertock, 1591 West 6th St., Brooklyn, N. Y.

URGENTLY NEEDED—Hickok 19X signal generator for police radio. G. W. Swartzlander, Fremont Police Radio, Fremont, Ohio.

SWAP OR SELL—32 V. d-c to 110 V. a-c inverter, like new. Also Briggs-Stratton ¾ h.p. gas engine, in good shape. Want record changer; 0-1 d.c. milliammeter, or what have you? E. L. Hallgren, Inland Air Lines, Cheyenne, Wyoming.

FOR SALE—RCA velocity microphone MI4000, type PB90, $25; 30-watt amplifier, pre-amplifier, all tubes, in angle iron rack, $40; double button carbon mike and chrome floor stand, $10; also salvaged tubes, all test OKay, as follows: 2—6C6; 1—6K8; 1—6F6; 2—6V6; 2—7A8; 1—5Y3G; 1—5U4G; 3—RK39; 2—807, all for $12. Lewis F. Boss, Box 227, Warwick Neck, R. I.

WANTED—A good ohmmeter and a condenser tester, also radio test equipment. Floyd Beach, Route 6, Harrison, Ark.

FOR SALE—Webster-Chicago 25-watt amplifier, perfect condition; 12" P.M. speaker in wall baffle; 2—12" dynamic speakers in portable case, 2500 fields; electro-voice microphone #600; Shure mike; 879, 1852, 1853, and 7B8 tubes; also B&S and Starrett calipers, rules, micrometer, dividers, etc. H. Tanaka, 600 W. 187th St., New York 33, N. Y.

WANTED—Webber #230 signal tracer and #210 service estimators. Give full details. Albion W. Gamage Radio Service, So. Bristol, Maine.

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KOOLOHM RESISTORS

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EDITORIAL

"WHEN this war ends, we shall be on the threshold of a new era in radio . . . an era in which man will see, as well as hear," said David Sarnoff, president of RCA, in a recent talk before the American Association for the Advancement of Science.

"Radio vision will have many uses," he explained.

"It will be used to prevent collisions on highways and railroads, on sealanes, and on the airways of the world. Radio will be the new eye of transportation and commerce."

An important prediction for the Service Man to think about!

THE restrictions on the sale of blank recording discs and recording needles are off. Through a WPB amendment to limitation order L-265, consumers will again be able to secure the familiar varnish coated non-metal discs.

The Service Man was given a bit more relief, too, in ruling CMP Reg. 9A, which liberalizes restrictions on controlled materials. Service Men can now purchase $150 worth of copper wire, or 1/8 of the amount used in 1941, using the rating of AA-3 and the allotment symbol V-3.

WHEN the opening night performance at the New York City Center of Music and Drama was concluded, a prominent drama critic said . . . "All that is needed at the City Center for play productions is a sound-engineering genius."

For because of sound problems, it was impossible to know who was who, he said. Most of the cast, he explained, were at the mercy of some badly placed microphones.

Paging p-a experts!

SAVE waste paper. It's an important war job. Paper production has been curtailed. And waste paper is needed to make up for the shortage. Do your part by saving every box, newspaper, magazine, etc. Tie them up and be sure your salvage depots gets every package. Save waste paper!

SERVICE

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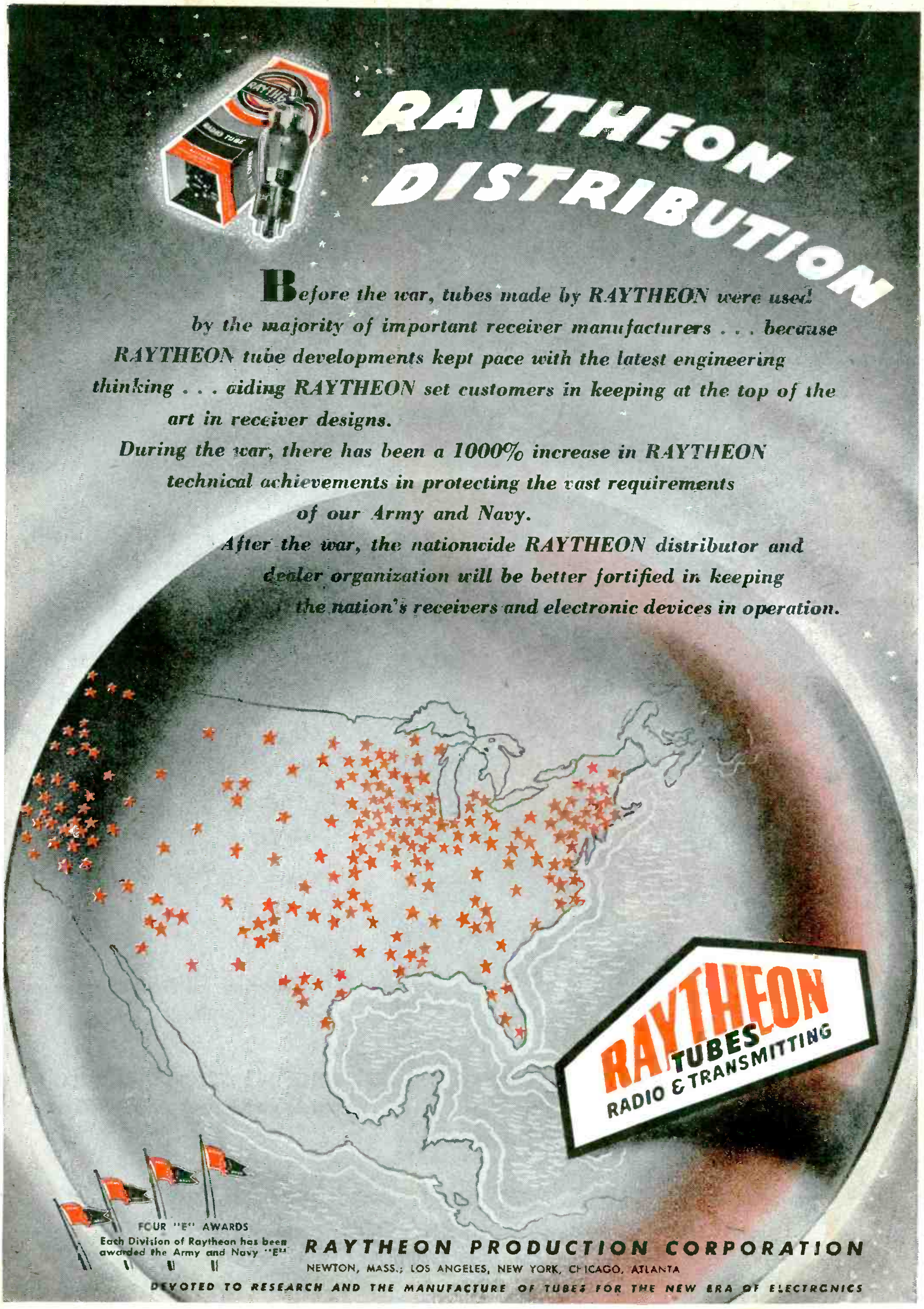
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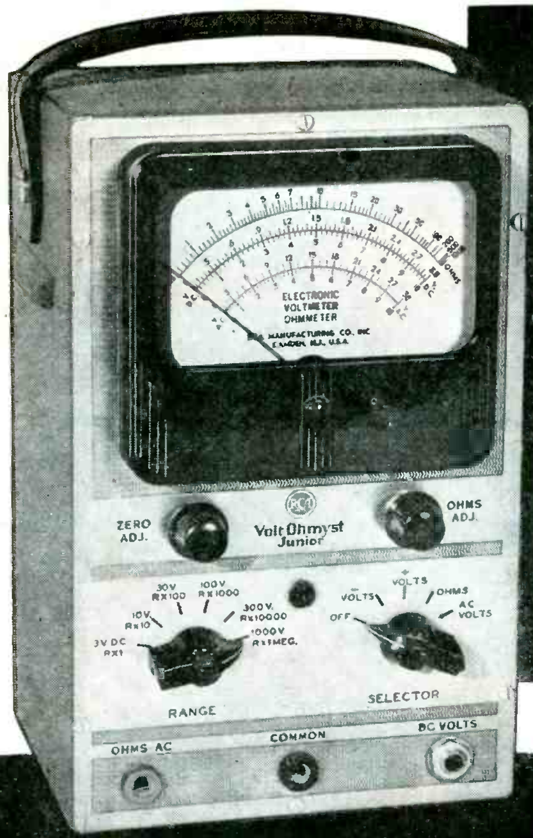

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SERVICE
A Monthly Digest of Radio and Allied Maintenance

AN ANALYSIS OF GRID-BIAS CIRCUITS

By ALFRED A. GHIRARDI

Advisory Editor

GRID bias is a voltage applied to the grid of a vacuum tube to obtain a particular type of performance from the tube, which may be closely predicted from the manufacturer's data and a family of static characteristic curves for the particular tube type in question. It is not the purpose of this discussion to go into the theory of operation of vacuum tubes. Suffice it to say that the bias determines the no-signal operating potential of the grid, the r-f or audio signal voltage causing the grid potential to vary above and below this value in exact accordance with the envelope of the signal. Taking the most common illustration of characteristic curves, the grid voltage versus plate current curve of a triode which is of the familiar elongated "S" shape, the most nearly distortionless amplification would be obtained by selecting the grid-bias voltage so that the operating point would occur at the center of the straight portion. Also, the amplitude of the signal voltage would have to be limited so that the peaks would remain on the straight portion. This is the principle of operation of the most used type of amplifier, the *Class A amplifier.*

By increasing the grid bias, with other conditions unchanged, the operating point moves down on the curve until at approximately twice the Class A value, the plate current is nearly zero. This is the Class B operating point, very useful in a number of electronic applications but of only limited value in the popular variety of radio receivers. Several years back, a few receivers made use of Class B audio amplifiers. In large console sets operating from a-c, Class B was used especially to obtain a high power output at a high efficiency. In a series of battery portables, Class B was used to obtain a sufficient power output together with considerable battery economy, taking advantage of the high efficiency of such an amplifier. The introduction of beam power tubes eliminated the need for Class B amplifiers for obtaining high audio power, thus eliminating their attendant disadvantages. Consequently, this discussion will deal almost entirely with Class A amplifiers.

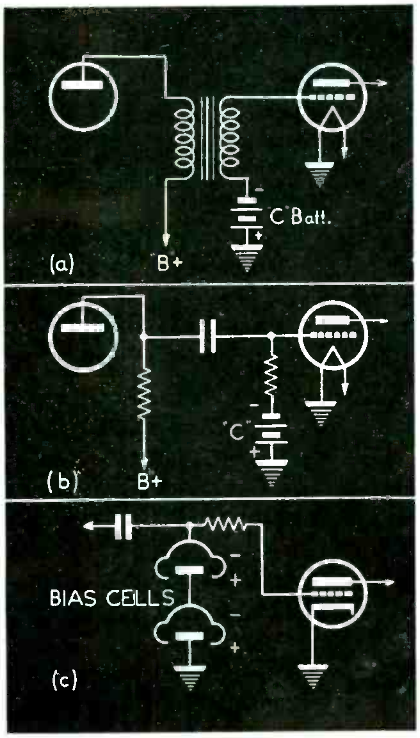
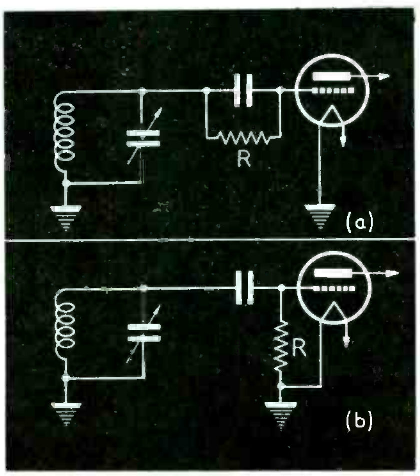


Fig. 1. Circuit arrangements for obtaining grid-bias voltage by means of a fixed source of bias voltage.

Fig. 2. Grid-leak bias methods of detection; also commonly used in oscillators to prevent distortion and to aid frequency stability.



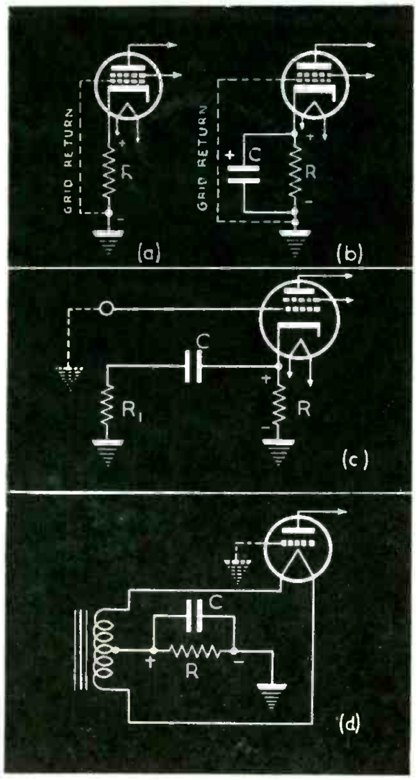
Fixed-Source Grid Bias

In the early days of radio when only batteries were used for supplying the required filament and plate power, grid bias or *C* bias as it was usually called, was used only in the first and second audio stages. One reason for this was the expense of *B* batteries which limited the plate voltages employed in the preceding r-f stages to some 45 or 67½ volts. With such low voltages on the plates of early triodes no *C* voltage was really required. Also, the advantages of using *C*-bias voltage was not very widely known. Most early audio amplifiers were transformer coupled, using a bias battery, connected as shown in Fig. 1(a), which usually consisted of a few flashlight cells. This provided a *fixed source* of *C*-bias voltage. Several years later when high-mu tubes were brought out, resistance-coupled amplifiers came into the picture with the bias battery connected as shown in Fig. 1(b). Then, with the coming of a-c receivers, the use of batteries for supplying the voltages and currents needed to operate the tubes of a receiver declined for about a decade, except for portable work and for farm receivers. But, history repeats itself—and so with radio, *C* batteries came back for use in some of the amplifier stages, but in a new compact, convenient form known as *bias cells,* brought out by Mallory. These cells, diagrammed in Fig. 1(c) are miniature no-drain cells delivering about 1¼ volts for Class A grid bias or any similar application where no current greater than the order of a microampere flows through the cell. The metal case itself is the *negative* electrode, and the black center disc is the *positive* electrode. Special holders have been designed to accommodate from one to several of these cells. They have a long life and may be connected in series when higher voltages are required.

Grid-Leak Resistor Bias Method

Another early method of obtaining grid bias which is still used in special equipment is shown in Fig. 2(a). This is the grid-leak detector which is really a diode detector combined with an audio amplifier. The grid-leak resistor *R* and grid condenser serve the same purpose as the familiar resistor and bypass condenser, now used in all sets of the superheterodyne type, in the diode detector. An a-f voltage is built up across the grid-leak *R* by the modulation of the incoming signal and

Fig. 3. Simple cathode-resistor bias arrangements.

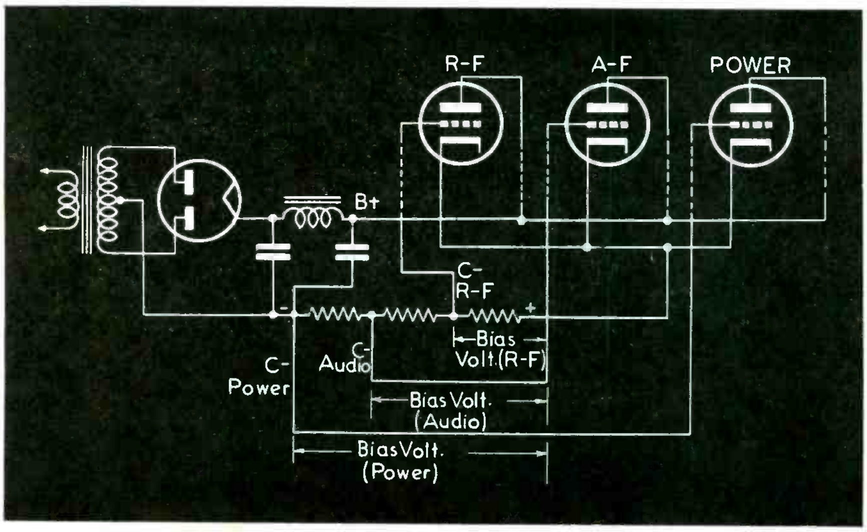


this voltage is applied between grid and cathode, more clearly shown in Fig. 2(b). It is then amplified the same as in a Class A audio amplifier except, perhaps, that the bias voltage is less negative. In the early days, the grid leak consisted of a pencil line drawn across a paper type grid condenser using the circuit arrangement Fig. 2(a). Later more stable grid-leak resistors in metallized form were employed.

The grid-leak detector is not a high-quality demodulator because the functions of detection and amplification are, to a considerable extent, incompatible. However, for low modulation factors, such as were used in the early days of broadcasting, the results were not so bad. Super-regenerative receivers used at frequencies of 50 mc and above, commonly used grid-leak detection arranged as shown in Fig. 2.

Grid-leak bias is also commonly used in oscillators of all types, including those in superhet receivers. The action obtained is self-biasing which limits the amplitude of oscillation, preventing excessive distortion and improving frequency stability. The initial bias is zero but, as soon as oscillation starts, the grid is driven positive which causes grid current to flow. The grid current creates an *IR* drop in the grid-leak resistor, applying negative bias to the grid, which prevents further build-up of oscillation amplitude. The grid-leak bias method has the advantage of simplicity and of automatically biasing the grid in proportion to the excitation voltage available. Because of this automatic action, the bias voltage developed across the grid-leak resistor is not critically dependent on the value of the grid-leak resistance. The value of the grid-

Fig. 4. Cathode-resistor bias arrangements for obtaining one or several bias voltage values.



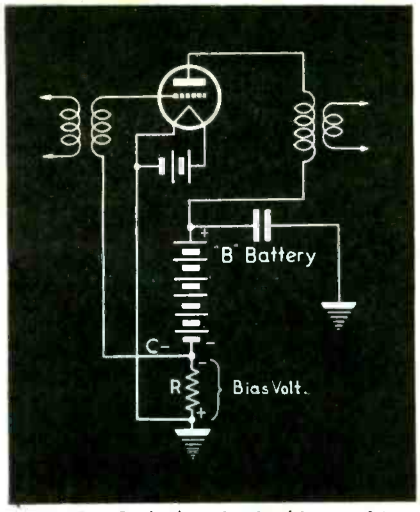


Fig. 5. Cathode circuit bias resistor method used in battery portables.

leak resistor, while not critical, should be kept within certain limits or some undesired effects may occur, such as motorboating or parasitic oscillation as well as super-regenerative action.

Cathode-Resistor Bias Method

Self-biasing of a single tube is most easily accomplished by any one of the several simple *cathode-resistor bias* methods illustrated in Fig. 3. The arrangements shown at (a), (b) and (c) are for heater-type tubes. That shown at (d) is for filament type audio or power tubes. In each case a grid bias resistor, *R*, is connected in the cathode circuit. The cathode current flowing through *R* causes a voltage drop across it, which makes the cathode *positive* with respect to the ground. Since the grid circuit is returned to ground potential in each case so it is at ground potential with respect to all d-c voltages, the grid is biased *negatively* with respect to the cathode.

The cathode current for triodes is the sum of the d-c plate current and the d-c grid current (if any). For tetrodes and pentodes, the screen current and other grid currents must also be added to this. The correct value of the bias resistor *R* (in *ohms*) is equal to the required bias (*volts*) divided by the total cathode current (*amperes*). The grid bias resistor value is not particularly critical—the nearest commercial value is usually used.

Where a grid-bias resistor alone (without a bypass condenser) is used, as at Fig. 3(a), the signal voltage developed across the bias resistor is being applied to the grid in opposite phase to the signal voltage; hence, a reduction in net input signal voltage takes place and, therefore, a reduction in signal output. This is called current *degeneration* and has some beneficial effects which are well known to

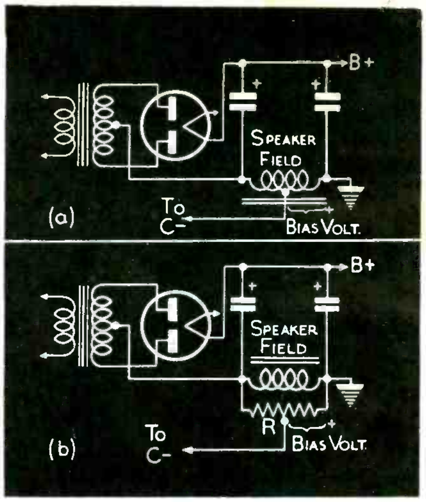


Fig. 6. Tapped speaker field arrangements for obtaining C bias.

Service Men. When maximum amplification is desired, the resistor is bypassed with a condenser, *C*, as in Fig. 3(b), large enough to have negligible reactance at the lowest important frequency to be reproduced. This calls for a 25- or 50-mfd electrolytic condenser in audio applications where a full bass is required.

The circuit of Fig. 3(c) shows an alternate method of preventing degeneration without the use of a high capacity. The resistance of R_1 must be high compared to the reactance of the condenser *C* at the lowest important frequency. *R* is the normal cathode bias resistor. Taking a typical example; let us assume that 60 cycles is the lowest bass note to be reproduced and a 0.1-mfd condenser is used. Its reactance at this frequency is 26,000 ohms. If we make R_1 ten times this value, the degeneration will be insignificant. But that is only about ¼ megohm. We can usually use up to 1 megohm for R_1 in an a-f amplifier so the stunt is an excellent one. R_1 and *C* constitutes a *decoupling filter*. The grid-bias circuit arrangement shown at Fig. 3(d) is commonly used for obtaining proper grid bias for a-c operated filament-type audio or power tubes. Connection is made to the electrical center of the filament winding by either a center-tap on the winding as illustrated, or a center-tapped resistor shunted across it. The cathode current flows through the bias resistor *C* in this cathode-return circuit, producing the bias voltage.

Variations of the Cathode-Resistor Bias Circuit

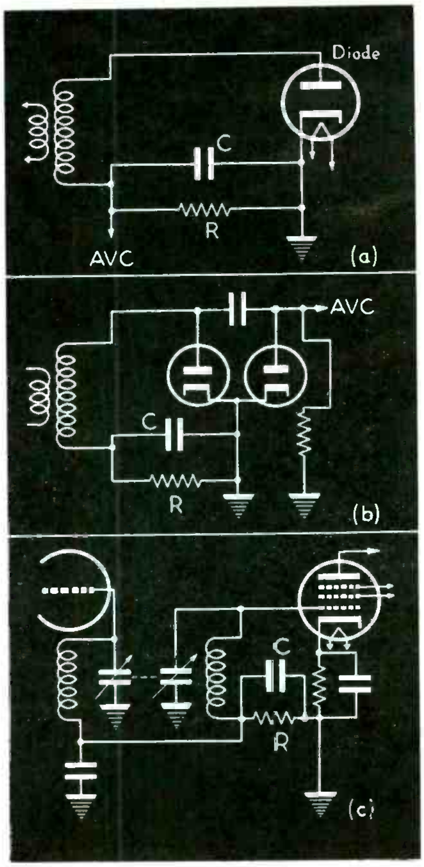
Several more complicated variations of the cathode-resistor bias arrangements just explained, are illustrated in Figs. 4, 5, and 6.

Where a number of different bias voltages are required for the various tubes of an a-c operated amplifier or receiver, the circuit arrangement indicated in Fig. 4 is often used. A series of *drop* resistors, or a voltage divider, is connected in the negative high-voltage leg of the rectifier-filter *B* supply. Plate and screen currents for the entire set pass through this divider; hence the voltages developed are very stable and fairly independent of signal voltage except in the case of violent audio overloading. Resistance-capacity filters are often used in the *C*— leads to prevent common coupling caused by the divider resistors. Since an appreciable current is carried, the resistors in the filter are wire-wound and are of fairly low resistance values.

Applying the same technique to battery portables, a resistor, *R*, is connected between the negative terminal of the *B* battery and ground, bias being obtained by the voltage drop in this resistor. This arrangement is shown in Fig. 5. The negative terminal of the *B* battery is actually the *C*— terminal, which is more negative than *ground potential*. Note that the *B*+ terminal must be bypassed to ground by a condenser, because of the added resistance in the *B* circuit.

Another method for obtaining negative bias is illustrated in Fig. 6. Here, the field coil of the speaker is connected in the negative high-voltage return circuit so that the voltage drop

Fig. 8. Bias arrangements for avc circuits.



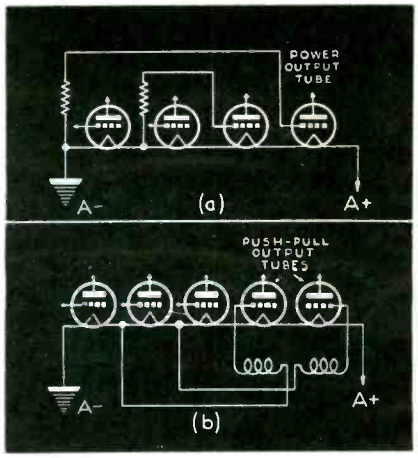


Fig. 7. Bias voltage circuits used in d-c sets or a-c/d-c series—filament portables.

across the field, or any part of it, may be utilized as *C* bias. Fig. 6(a) shows the arrangement when a tapped field is employed; Fig. 6(b) shows how the same effect may be obtained when replacement speakers not having a proper tap must be employed. The high-resistance potentimeter *R* provides the electrical tap. These connections make it necessary to use a dual electrolytic filter capacitor with a common positive terminal, as shown.

In d-c sets or a-c/d-c series-filament portables, bias voltage is obtained by using the filament string as a voltage divider as illustrated in Fig. 7. If a transformer-coupled push-pull output stage is used, a split secondary must be provided on the push-pull input transformer so that equal *C* bias voltage will be applied to both of the push-pull tubes, as shown in Fig. 7(b). Adequate bypassing with decoupling resistors are employed where necessary.

Fig. 8 illustrates the fundamental circuit of the well-known automatic volume control system widely used in receivers. This system produces a bias voltage proportional to the signal strength, the bias being applied in whole or part to r-f, converter and i-f tubes to keep the overall gain constant over a wide range of incoming signal voltages. There is an initial small negative bias voltage, independent of any signal, developed by the *contact potential* diode. This results from the flow of grid current through a high value of grid resistor, *R*, connected in the grid-return lead in each circuit shown. This grid current results from the bombardment of the grid by electrons when there is no applied negative voltage to repel the electrons. This potential is known as *contact potential*. Signal voltage is rectified and added to this basic voltage. The bias resistor *R* in Fig. 8(a) is some-

(*Continued on page* 20)

APPLICATIONS OF SPECIAL PHOTOCONTROLS

By S. J. MURCEK

ELECTRONIC control of certain manufacturing processes is most readily accomplished through visual observation of the process under control. Visual observation, in turn, is provided with a form of the photoelectronic camera, usually associated with an appropriate form of the photocontrol.

Actual process control, in such installations, is provided in the greatest part by the electronic system of the photocontrol itself.

Manufacturing processes for various end products differ widely. Thus, the photocontrol system intended for control of a given process in a textile plant is not suitable for direct application to a similar operation in a steel plant. The fundamental reason for this lack of equipment interchangeability lies in the nature of the electronic system end operation. In a given instance, the camera may suit an application specifically, but not another in a similar category. Again, the electronic system incorporated in the photocontrol may operate relays, where direct manipulation would be the most desirable end operation.

The demand for photocontrols suited to the control of only a particular operation has given rise to a distinctly new group of photoelectronic controls, termed *special photocontrols*. These new photocontrols may be of either the *static* or *dynamic* type. Thus, where the operation to be controlled is characterized by a relatively slow change in illumination level, a specific variation of the static photocontrol is used. Where the operation gives rise to a series of rapid or periodic variations of the accompanying illumination level, special dynamic photocontrols are the rule.

A special photocontrol of relatively simple nature, and, incidentally, easy to service and maintain, is a device which is designed to the specific purpose of controlling artificial illumination. This unit is shown in Fig. 1. Great savings of power, which would otherwise be uselessly consumed by a given artificial lighting system, become possible through the application of this photocontrol. A good example of such an installation is the control of lighting on an airway beacon. Here the beacon lighting is controlled automatically by the photocontrol, dispensing with the necessity for other than occasional personal attention.

This particular photocontrol is of the static type, responding to changes in the natural illumination level by the illumination of the beacon with the approach of nightfall, and extinguishing it with the approach of full daylight. Since provision is incorporated into the photocontrol to cause operation at two differing light levels, the unit is not directly suited to any other operation. Thus it is placed in the special classification embracing such devices.

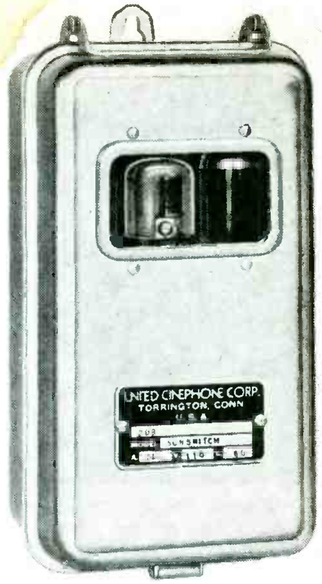


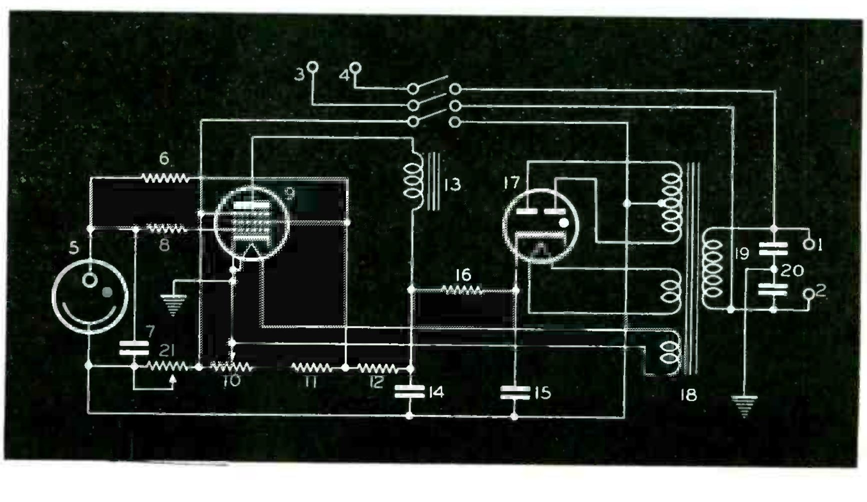
Fig. 1. A special photocontrol unit designed to control illumination. Among its uses are airway beacon lighting control. This is known as the static type control. *(Courtesy United Cinephone)*

The circuit for a special photocontrol of this type is shown in Fig. 2. In this circuit, the a-c supply line, connected to terminals *1* and *2*, powers the photocontrol. A full-wave rectifier tube *17*, affords rectification. The resulting continuous current is filtered by capacitors *14* and *15*, in combination with resistor *16*. It should be observed that resistor *16*, by virtue of the developed voltage drop, absorbs the peaks of the rectified a-c appearing across capacitor *15*, and effectively limits the return current from capacitor *14* to capacitor *15* when the a-c supply voltage is at the zero instant between alternations. This effects a pronounced smoothing, or filtering action on the rectified a-c supplied by the rectifier tube.

The d-c voltage appearing across capacitor *14* is in parallel with the voltage divider consisting of resistors *11* and *12*, and control potentiometers *10* and *21*. Each of these resistance elements is selected so that the proper operating voltage appears on the associated phototube and pentode *9*, electrodes.

In normal daylight, the conductance of phototube *5* is high, resulting in the flow of a comparatively large current through the phototube and its load resistor *6*. Since, under these conditions, the resistance of the resistor *6* is large with respect to that of the phototube, the voltage across this tube is less than that appearing between the slide contact of potentiometer *10*, the *night* adjustment, and the negative terminal of the voltage divider. The cathode of pentode *9* is common with the night potentiometer slide contact. Therefore the voltage between the cathode of this tube and

Fig. 2. Circuit of the light control photocontrol, illustrated above.



the negative terminal of the voltage divider is identical with the last mentioned voltage. Thus, the grid of tube *9* is negative with respect to its cathode, and the tube plate current is very small. As a result, relay *13* does not seal, and the a-c voltage across terminals *3* and *4*, which energize the artificial lighting system, is zero.

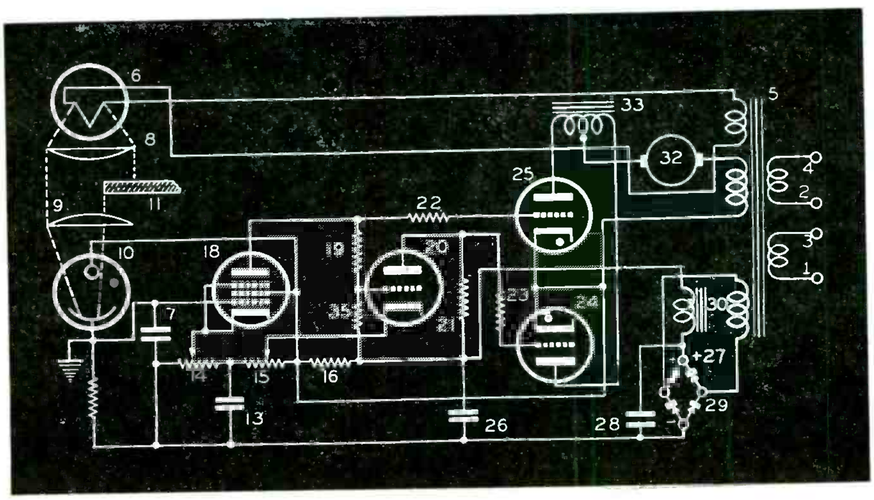
With the approach of nightfall, the illumination on phototube *5* is reduced considerably. This reduction in illumination causes the tube resistance to rise, decreasing the current in the phototube circuit. Here, the voltage across the phototube increases. Less of the circuit supply voltage appears across resistor *6*, since the resistance of the phototube now approaches that of this resistor.

The rise of the voltage across the phototube places the grid of pentode *9* positive with respect to the cathode, since the voltage across the phototube, under dark conditions, is greater than that appearing between the cathode of the pentode and the negative terminal of the d-c voltage divider. When the grid of the latter tube is positive with respect to its cathode, its plate resistance decreases, the plate current rising sharply as a result. Thus, the coil of relay *13* is energized and the relay seals, closing its *make* contacts. Power is now supplied to the artificial lighting system, and the *day* potentiometer *21* is short-circuited.

Closure of the relay contacts which short-circuit the day potentiometer reduces the voltage existing between the cathode of the pentode and the d-c supply negative terminal.

Increase in phototube illumination with the approach of daylight restores the phototube conductivity to a level which is too low to maintain closure of relay *13*, de-energizing the artificial lighting system, and reconnecting potentiometer *21* in series with the voltage divider.

Fig. 3. Circuit of a photocontrol system for holding edge of moving strip of paper in constant position.



Consideration of the circuit action reveals that the illumination level required to unseal relay *13* is less than that to effect its closure. This is due to the reduction of the pentode cathode to d-c negative terminal voltage with relay closure, which in turn insures the presence of artificial illumination with the actual decline of daylight, and the extinguishing of such illumination with sunrise. Briefly, the photocontrol is more sensitive during the night hours than at sunset. This mode of operation also prevents the operation of the control during small changes of daylight illumination, such as would occur during the passage of a cloud above the site of the photocontrol.

In Fig. 2, capacitor *7* serves to bypass small a-c modulation voltages, due to electromagnetic induction, which are present on the phototube voltage. Resistor *8* limits the pentode grid current in the event the grid of this tube becomes highly positive with respect to its cathode. This would be true if direct sunlight should strike the cathode of the phototube. Capacitors *19* and *20* bypass a-c line noise impulses between *ground* and the line itself, preventing the impression of these voltage surges across the phototube circuit.

The photocontrol of Fig. 1 should be so mounted that the phototube is not subject to direct illumination from direct sun or moonlight.

A static photocontrol which terminates in a reversible end-motor instead of an end-relay has been specifically designed for the purpose of holding the edge of a moving strip of paper in a given constant position. The complete operation involves the rereeling of paper strip from a rough reel to one suitable for shipment. The function the light beam, then results in a provide a finished roll with uniform edges. Thus, if the control maintains the edge of the paper strip in a given position, as the paper is being rewound, then the roll edges must certainly be uniform. In Fig. 3, *11* represents the edge of this paper strip. The photocontrol is termed, for this reason, an edging control.

In the circuit of Fig. 3, a-c is supplied to the circuit power transformer *5*. This transformer is provided with two primary windings, enabling operation of the device from either of two a-c supply voltages. Low voltage operation is possible through the parallel connection of these windings. In series, the operation is from an a-c source having twice this voltage. Thus, for example, the control may be operated from either a 115 or 230-volt a-c line.

The phototube exciter lamp *6* is heated to operating color temperature from the low voltage winding *7* on transformer *5*. Light rays from the exciter lamp filament are converged into a tight beam of parallel rays by lens *8*, in such a manner that the entire surface of the phototube viewing lens *9* is under its illumination. These rays are converged further by lens *9* into a spot having a diameter no larger than the phototube *10* cathode width, on which they are focussed. Thus the intrusion of the paper edge into the light beam obstructs an amount of light which is directly proportional to the area of strip obstructing the beam. Partial obstruction of the light beam, then results in a proportional reduction of the phototube conductivity.

When the light beam is unobstructed, the phototube conductivity is at a maximum, and the voltage across the phototube load resistor *12* is, as a result, also at a maximum. This voltage will then exceed that appearing between the cathode of pentode *18* and the ground return *34*, causing the grid of this tube to become positive with respect to its cathode. Under these conditions, the tube *18* plate current is high, and the voltage between the anode and cathode is correspondingly low. That is, a large voltage appears across pentode *18* plate load resistor *19-35*. This places the pentode anode negative with respect to its shield grid.

The cathodes of the rectifier thyratrons *23* and *24* are common with the shield grid of pentode *18*. Under the previously described conditions obtaining, the control grid of thyratron *23* is negative with respect to its cathode, and this tube does not, as a result, conduct.

However, the cathode of the inverter triode *20* is connected by means of the

(*Continued on page 22*)

SER-CUITS

By HENRY HOWARD

THE unusual services that a communications receiver must afford, demands a highly specialized form of circuit design. The Hallicrafters SX-28 (Fig. 1) illustrates this design feature quite effectively.

The receiver is a 5-band affair covering .55 to 43 mc. The r-f amplifier, or preselector, has two 6SK7 tubes in cascade on bands 3, 4, 5 and 6. On bands 1 and 2 more than one stage is unnecessary to obtain the required image ratio and reduction of spurious interference. With two r-f stages using three preselection circuits, the band width would be narrowed to such an extent that even expanding the i-f amplifier to its utmost would still not provide high-fidelity reception. The modern communications receiver requires two stages of preselection on the higher frequencies to accomplish only one primary object—satisfactory image rejection.

The i-f amplifier is designed for maximum stability. The first two i-f transformers are permeability tuned. In comparing this type of transformer with one having compression mica tuning condensers, it must be remembered that it takes many more turns of the adjusting screw to cause the equivalent change in tuning of the

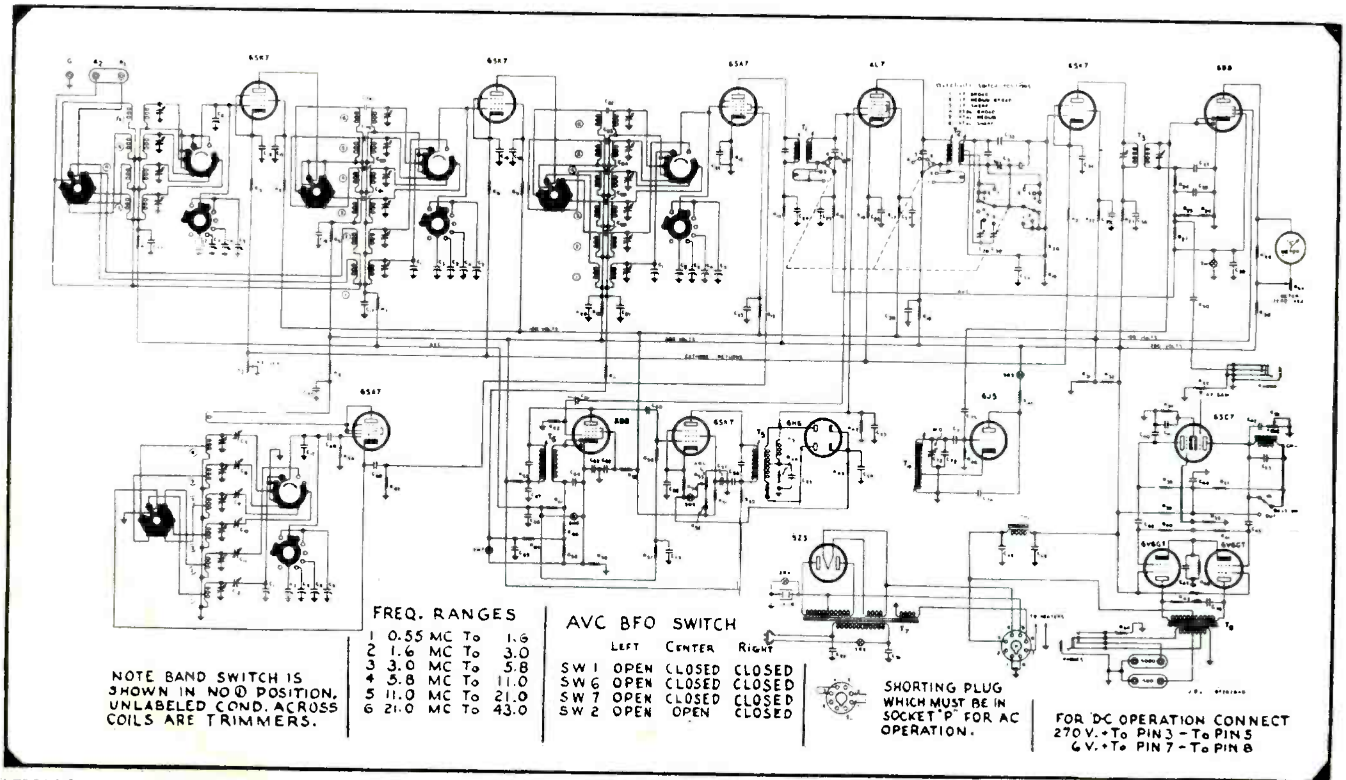
No.	Value	Voltage or Purpose	Type
C 1	Band No. 1 Tuning Condenser	......	......
C 2	Main Tuning Condenser	......	......
C 3	3 Plate Bandspread Condenser	......	......
C 4	4 Plate Bandspread Condenser	......	......
C 5	5 Plate Bandspread Condenser	......	......
C 6	50 mmf	......	Variable Air
C 7	2,160 mmf	Band No. 6 Pad	Mica
C 8	2,962 mmf	5 Pad	Mica
C 9	2,276 mmf	4 Pad	Mica
C10	1,600 mmf	3 Pad	Mica
C11	876 mmf	2 Pad	Mica
C12	515 mmf	1 Pad	Mica
C13	Temperature Compensated	Condenser	
C14	.02 mfd	400	Tubular
C15	.02 mfd	400	Tubular
C16	.02 mfd	400	Tubular
C17	.05 mfd	200	Tubular
C18	.02 mfd	400	Tubular
C19	.02 mfd	400	Tubular
C20	.02 mfd	400	Tubular
C21	.05 mfd	200	Tubular
C22	.02 mfd	400	Tubular
C23	.02 mfd	400	Tubular
C24	.02 mfd	400	Tubular
C25	.02 mfd	400	Tubular
C26	.05 mfd	200	Tubular
C27	.02 mfd	400	Tubular
C28	.02 mfd	400	Tubular
C29	20 mmf	Trimming Condenser	
C30	20 mmf	Trimming Condenser	
C31	20 mmf	Trimming Condenser	
C32	20 mmf	Crystal Phasing	Air
C33	.02 mfd	400	Tubular
C34	.05 mfd	200	Tubular
C35	.02 mfd	400	Tubular
C36	.02 mfd	400	Tubular
C37	100 mmf		Mica
C38	100 mmf		Mica
C39	.02 mfd	400	Tubular
C40	500 mmf	......	Mica
C41	10. mfd	25	Electrolytic
C42	.02 mfd	400	Tubular
C43	5000 mmf		Mica

No.	Value	Voltage or Purpose	Type
C44	10. mfd	300	Electrolytic
C45	.05 mfd	400	Tubular
C46	.05 mfd	400	Tubular
C47	40 mfd	25	Electrolytic
C48	30 mfd	400	Electrolytic
C49	30 mfd	450	Electrolytic
C50	.02 mfd	400	Tubular
C51	.01 mfd	600	Tubular
C52	.01 mfd	600	Tubular
C53	500 mmf		Mica
C54	.05 mfd	400	Tubular
C55	50 mmf		Mica
C56	.02 mfd	400	Tubular
C57	.02 mfd	400	Tubular
C58	.05 mfd	200	Tubular
C59	.05 mfd	200	Tubular
C60	100 mmf		Mica
C61	250 mmf		Mica in T_1
C62	.02 mfd	400	Tubular
C63	.05 mfd	200	Tubular
C64	100 mmf		Mica
C65	.02 mfd	400	Tubular
C66	.05 mfd	200	Tubular
C67	.02 mfd	400	Tubular
C68	50 mmf		Mica
C69	50 mmf		Mica
C70	2000 mmf		Mica
C71	100 mmf		Mica
C72	.25 mmf	BFO Control	Air
C73	500 mmf		Mica in T_1
C74	.01 mfd	600	(Braided Leads)
C75	2 mmfd		Twisted Leads
C76	2000 mmfd		Mica
C77	.05 mfd	200	Tubular
C78	10 mmfd		Ceramic
C79	5 mmfd		Ceramic
C80	5 mmfd		Ceramic
C81	2 mmfd		Twisted Leads
C82	10 mmfd		Ceramic
C83	5 mmfd		Ceramic
C84	5 mmfd		Ceramic
C85	2 mmfd		Twisted Leads
C86	5 mmfd		Ceramic

No.	Value in Ohms	Wattage or Purpose
R 1	100,000	1/3
R 2	10,000	RF Gain Control
R 3	300	1/3
R 4	1,000	1/3
R 5	3,000	1/3
R 6	15,000	1
R 7	100,000	1/3
R 8	300	1/3
R 9	1,000	1/3
R10	3,000	1/3
R11	100,000	1/3
R12	400	1/3
R13	1,000	1/3
R14	3,000	1/3
R15	100,000	1/3
R16	300	1/3
R17	1,000	1/3
R18	3,000	1/3
R19	100,000	1/3
R20	500,000	1/3
R21	400	1/3
R22	1,000	1/3
R23	3,000	1/3
R24	50,000	1/3
R25	250,000	1/3
R26	250,000	1/3
R27	500,000	1/3
R28	100	1/3
R29	500	"S" Meter Control
R30	30,000	2
R31	11,000	1 1/2 Candohm
R32	4,000	7
R33	500,000	AF Gain Control

No.	Value in Ohms	Wattage or Purpose
R34	1,000	1/3
R35	500,000	Tone Control
R36	100,000	1/3
R37	100,000	1/3
R38	50,000	1/3
R39	200,000	1/3
R40	250,000	1/3
R41	250,000	1/3
R42	200	2
R43	20,000	1
R44	5,000	10
R45	20,000	1
R46	50,000	1/3
R47	100,000	1/3
R48	100,000	1/3
R49	100,000	1/3
R50	3,000	1/3
R51	1,000	1/3
R52	50,000	1/3
R53	50,000	ANL Control
R54	600	1/3
R55	500,000	1/3
R56	1,000	1/3
R57	100,000	1/3
R58	200	1/3
R59	250,000	1/3
R60	250,000	1/3
R61	500,000	1/3
R62	500,000	1/3 Inside T_1
R63	3,000	1/3
R64	500,000	1/3
R65	50,000	1/3
R66	50,000	1/3

Fig. 1. This circuit diagram and table of capacitor and resistor values for Hallicrafters SX-28, a five-band receiver, covering the .55 to 43 mc bands.



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There are many ways in which you can remember him now and in the months ahead.

VISIT your blood bank—not just once, but as often as you can. Blood plasma may save his life—on some battle-torn field.

Buy War Bonds every payday—as many as possible—dollars are needed to give him the weapons he requires to achieve Victory.

Give generously to the USO, the Red Cross and other agencies. They can make the difference between a lonely soldier and a happy one.

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permeability tuned type. Hence a slight change in the position of the screw will have negligible effect upon the tuning. The adjusting screw is under spring tension thereby making it impossible to turn under vibration.

The diode transformer is air-tuned with two variable condensers, each with a lump capacity of 50 mmfd and a variable capacity of 50 mmfd. These air trimmers are also under spring tension so that they can withstand considerable vibration.

Variable selectivity is also afforded. Six ranges of selectivity are available, from broad high fidelity i-f to crystal sharp, which is used for c-w reception only.

A double avc system is used. The r-f and mixer tubes are operated by the broadly tuned carrier coming through only three tuned i-f circuits. The final signal however passes through six-tuned i-f circuits. As a result, when the signal is slightly detuned, the receiver output has dropped considerably while the avc action has dropped but very little. This results in a reduction of between-station noise and a more sharply defined aural tuning action.

The receiver also features an *S* or signal intensity meter. There is also an automatic noise limiter which chops off the peaks where they extend above the signal level.

A micrometer scale dial is used. This is turned by a large handwheel, which has a locking clutch allowing the dial to be locked in position. The clutch disengages the handwheel so that the receiver cannot be detuned.

The receiver also has a separate r-f gain control and tone control, and a stand-by socket, which is provided for remote relay operation of the receiver.

Philco 42-762

This 6-volt battery receiver, Fig. 2, covers broadcast and two short-wave bands. It has a 3-gang condenser in a bandspread band for wide-range tuning and a separate permeability tuned system for bandspread. A 9-point, 15-circuit switch controls tuned circuits in the antenna input, tuned r-f plate, first detector grid, oscillator and the phono connection. The detailed switching functions are . . . antenna input to various r-f transformers; grounding and shorting of non-used transformers; two sections for handling the r-f grid; trimmer selection; r-f amplifier output to one of four r-f transformers; grounding of idle transformers; two sections in the detector grid, selection of trimmers and oscillator grid; grounding of idle oscillation transformers; condenser tuning; oscillator plate and phono selection.

A shunt-fed oscillator circuit is used

with a 4700-ohm resistor and an r-f choke in the power lead. To prevent coupling to the remainder of the tubes through the *B* supply, a decoupling filter is used (10000 ohms and 5 mfd). A 100-ohm resistor is inserted in the oscillator grid to prevent parasitics.

Full avc voltage is supplied to the 7B7E r-f amplifier control grid and suppressor grid and similar i-f elements. A portion of the avc bias is also fed to the converter signal grid. A delayed avc action (superimposed negative bias) is obtained from the negative 6-volt storage battery terminal which also supplies bias to the driver and Class *B* output stage. To accomplish this, the A+ terminal must be grounded.

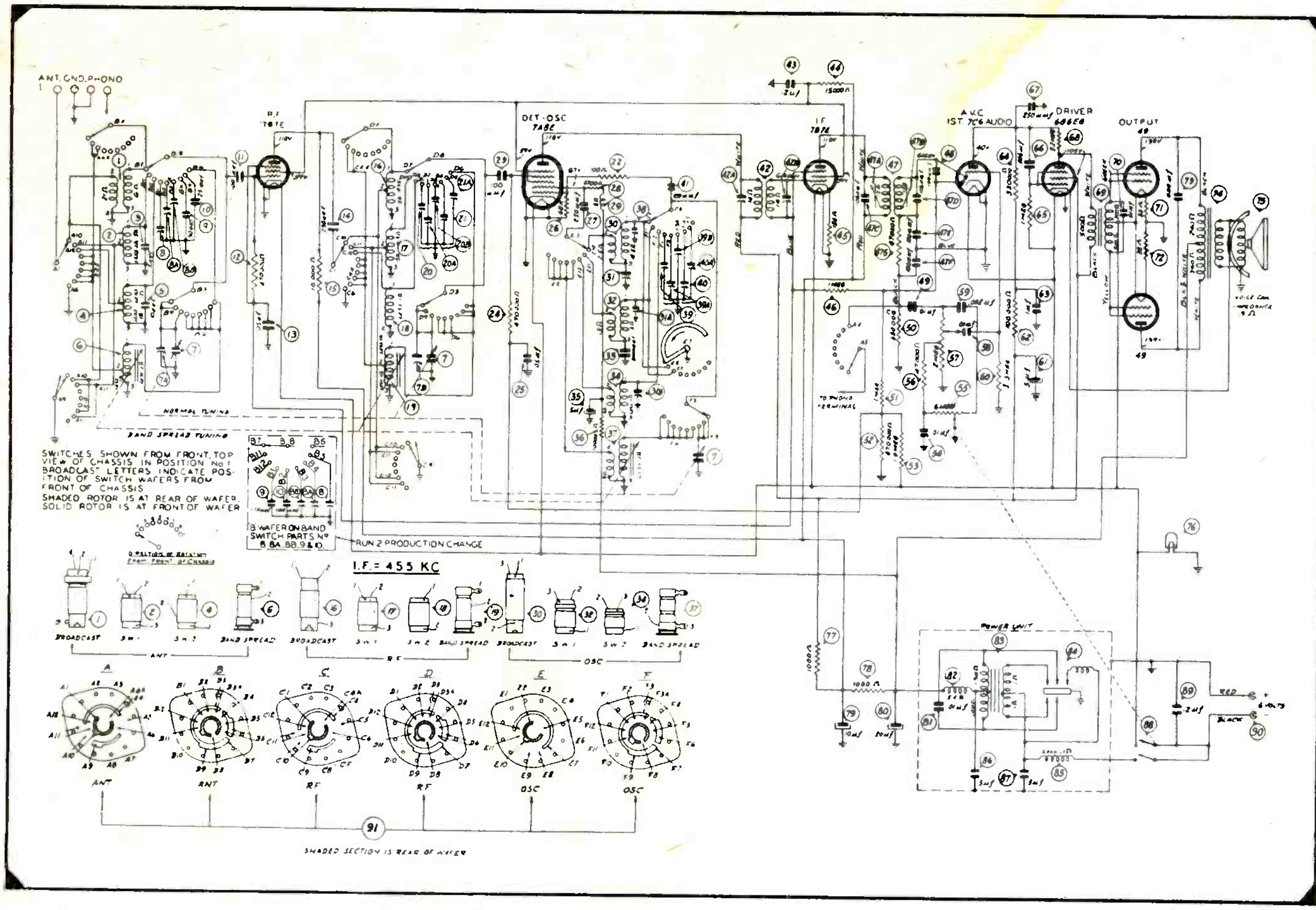
There are several interesting features in the audio amplifier. Three stages are used to supply grid power to the class *B* stage and maintain sufficient audio gain. The 7C6 detector-first a-f is conventional, using a 3.3-megohm grid leak for bias. A tapped 2-megohm volume control in combination with a 6-megohm tone control provides for bass compensation and treble or bass reduction. The *B* supply to this stage is fed through an individual filter. The second audio, or driver stage, contains a 6G6EG pentode feeding a grid input transformer. Note the 2.2-megohm denegeration resistor from the driver plate to first audio plate. Note also that the cathode receives the entire voice coil voltage for feedback. Most receivers use only a part of this voltage. One reason for the large amount of degeneration used is the need for reducing distortion due to the Class *B* stage, particularly at low levels.

A pair of 49s (2 volt, 120-mil tubes) have parallel filament connection to provide equal bias and prevent coupling due to audio currents in the filament circuit. Note the .01-mfd grid-to-grid capacitor and .004-mfd plate-to-plate capacitor.

In the power unit, a synchronous self-rectifying vibrator supplies 140 volts *B*. A dual battery switch minimizes noise coupling due to the use of a common battery for vibrator, filament and bias supply. It does this by eliminating the IR voltage drop which occurs across the vibrator switch from the other circuits.

Philco 42-788

Fig. 3 shows a high gain, high fidelity 115-230 volt a-c receiver, with a t-r-f stage, two i-f stages and three audio stages. The tuning system with the separate bandspread iron core tuning system and the bandswitch, are similar to those in the foregoing battery set. A triple tuned i-f transformer



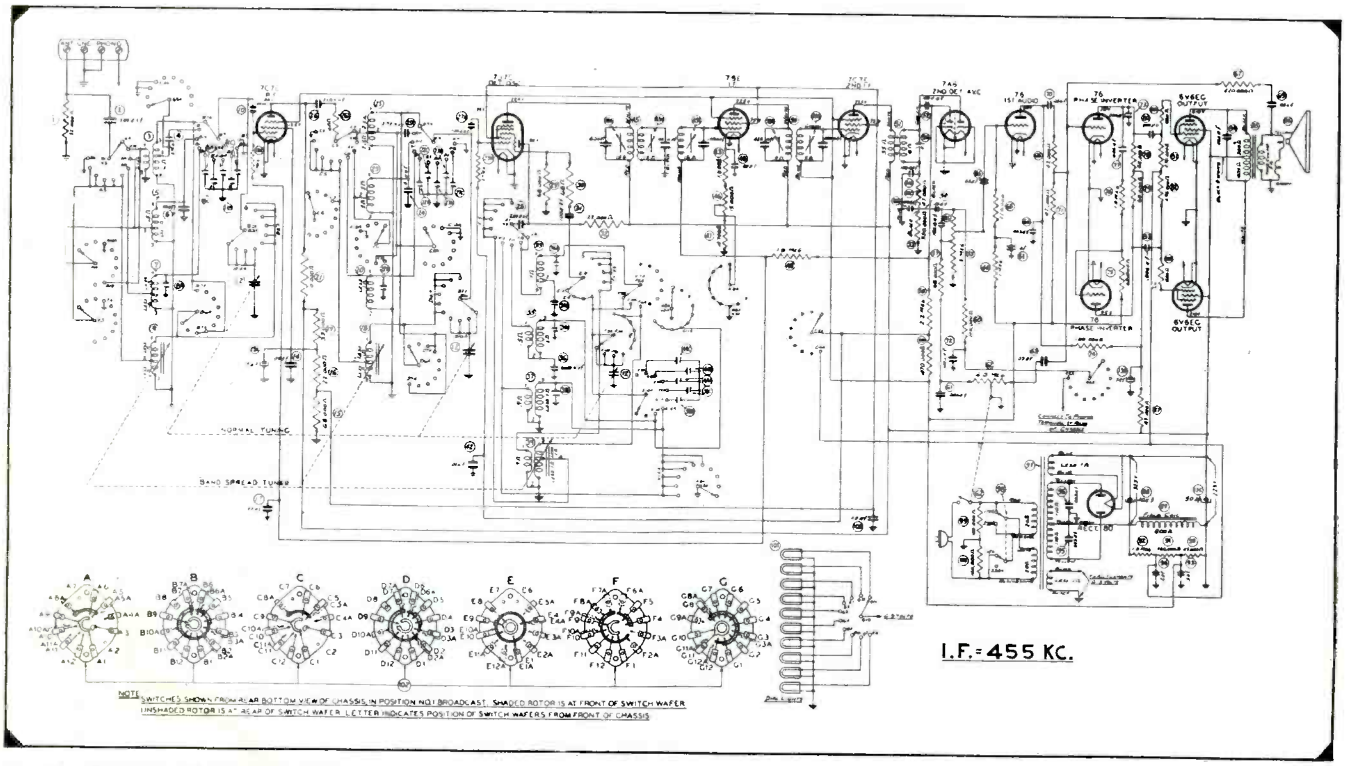
is used in the first i-f, a standard double-tuned unit in the second i-f and an iron core single-tuned unit in the detector. The first i-f cathode has a bias sensitivity control.

Fig. 3. Philco 42-788 high-fidelity receiver with iron-core tuning in the band-spread system.

Separate diodes are used for detection and avc, allowing more flexible avc, arranged in a delaying system. This is accomplished by impressing negative bias from the power unit voltage divider. Maximum avc is impressed upon the first i-f and r-f control grid. A smaller voltage is impressed on the converter grid. A fixed negative bias is applied on the control and suppressor grid of the second i-f and on r-f and i-f suppressors and

(*Continued on page* 31)

Fig. 2. Philco 42-762 six-volt battery receiver with shunt-fed oscillator circuit.



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JANUARY, 1943 — DECEMBER, 1943

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VIBRATORS

VOLUME CONTROLS

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What happens when a Shadow meets an RCA Electron Tube

JUST by itself, it's hard enough to measure to an accuracy of 1/10,000 of an inch. But on a production line, where tens of thousands of wires have to measure up to this accuracy, it's next to impossible—unless you want to spend more time measuring than producing.

However, with a simple electronic device, built around an RCA Electron Tube, thousands of small lead wires for radio tubes are now being checked for such accuracy at the rate of 5 to 8 a minute!

How is it done? Like this . . .

The wire passes before a light. As it does, it casts an enlarged shadow on a sensitive phototube whose output is measured on a meter. If the wire is 1/10,000 of an inch off, the difference is recorded on the meter and the offending wire can be rejected. If desired, the wire can be rotated to measure out-of-roundness.

This is electronics — the so-called "dream science" of tomorrow—in action *today* at RCA!

Many of you Distributors and Servicemen can remember when radio, too, was just a "dream." But *you* helped that dream "come true."

Much of the electronic equipment you may be helping to sell, install, or service tomorrow will be built around tubes, circuits, and parts already familiar to you from your radio days! ***Yes, the magic brain of all electronic equipment is a tube...and the fountain-head of modern tube development is RCA!***

TUNE IN "WHAT'S NEW?"

RCA's great new show, Saturday nights, 7 to 8, Eastern War Time, Blue Network.

This machine, while used at RCA to measure the diameter of tungsten wires by an electronic method, embodies a basic principle for measuring any critical dimension of any component that can be made to cast a shadow directly proportional to the dimension to be checked.

RCA

RADIO CORPORATION OF AMERICA

ASK ABOUT... RCA INDUSTRIAL MUSIC SERVICE

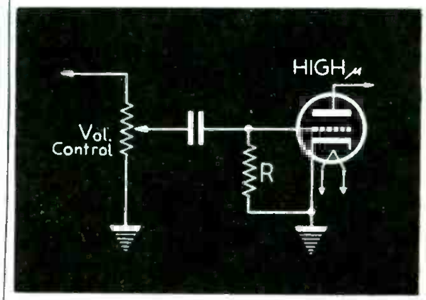
GRID BIAS

(*Continued from page 7*)

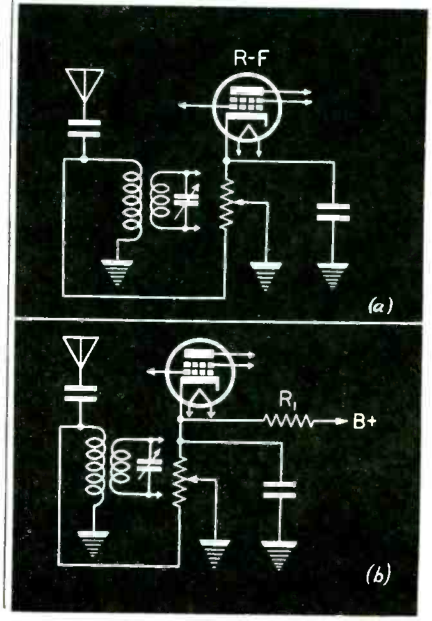
what critical in value for best results. Fig. 8(b) shows a more versatile circuit using two diodes in which a larger avc bias resistor may be used with a gain in bias voltage produced. Fig. 8(c) uses this principle for a detector overload circuit in inexpensive t-r-f receivers. When the detector is overloaded with a strong signal, avc is applied to the r-f stage which limits the blasting that would otherwise occur.

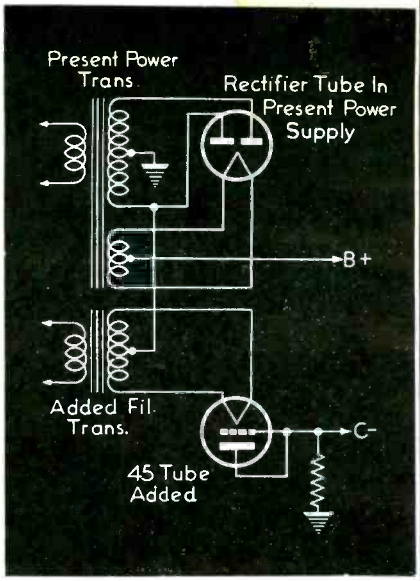
Fig. 9 illustrates a grid leak self-adjusting bias circuit that is often used in high-mu first audio stages with 6SQ7, 6SF5, or similar tubes, and can be used wherever low input voltages (approximately 1 volt) are handled. Usually, a grid-leak bias resistor *R* of 10 megohms is employed, but it may be any value between about 5 to 15 megohms. This method eliminates troublesome hum which often appears in the conventional cathode-resistor bias system of Fig. 3.

There are still some t-r-f sets to be serviced which use *C*— bias volume control in the first r-f stage as shown in Fig. 10(a). If the control obtained

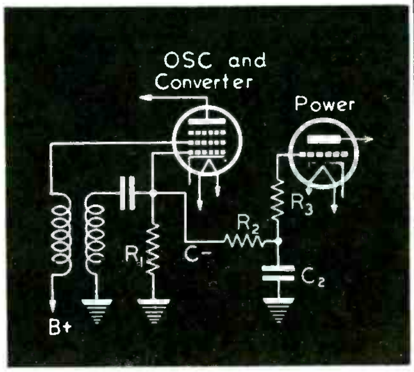


Figs. 9 (above) and 10 (below). Fig. 9, grid-leak type self-adjusting bias circuit. Fig. 10, C-bias volume control circuits.





Figs. 11 (top) and 12 (below). Fig. 11, an auxiliary C-bias voltage source where high C bias is required. Fig. 12, a "trick" bias circuit that conserves B voltage.



is inadequate (insufficient attenuation), more bias can be obtained with the circuit of Fig. 10(b) where a resistor, R_1, is connected from cathode to $B+$ to bleed some steady current through the control, independent of the tube's plate and screen current.

High-power equipment often requires large negative voltages for control devices as well as for *C* bias. By simply adding another rectifier tube to the standard power supply as shown in Fig. 11, these voltages may be obtained. The use of a type 45 tube with grid tied to plate produces a low-impedance negative bias voltage supply.

A trick circuit which conserves valuable *B* voltage in a portable receiver is shown in Fig. 12. The source of negative bias voltage is the oscillator grid where the potential exists as rectified r-f, developed across R_1, the oscillator grid leak. This voltage is filtered by R_2, C_2 and R_3 and is applied to the power tube grid as pure d-c bias. One of the troubles encountered is the fact that the oscillator grid voltage is somewhat dependent upon the frequency, so the bias is subject to a certain amount of change as the set is tuned. With care, this change may be minimized.

PHOTOCONTROLS

(*Continued from page 9*)

register *zone width* potentiometer *15* slider to a voltage level between that of the pentode shield grid and cathode. Since the plate of the pentode is negative with respect to the shield grid, the grid of the triode inverter is negative with respect to its cathode. The voltage across its plate loading resistor *21* therefore is zero. Thus, the control grid of the thyratron *24* is at the voltage level of the positive terminal of the d-c voltage divider, and positive with respect to its cathode. Now, thyratron *24* conducts.

The resulting current flow is through one-half of the differential field winding *33* in the series register motor *32*. It is then directed through the motor armature and the anode supply winding *31* on the power transformer core, causing the motor armature to rotate. The rotation of the motor shaft is in such a direction that the paper strip edge guides move the paper edge *11* into the path of the light beam between the opitcal lenses *8* and *9*.

As the motor shaft continues to rotate, due to continued conduction by the thyratron *24*, the paper edge obstructs an increasing proportion of the light beam, thus reducing the phototube conductivity.

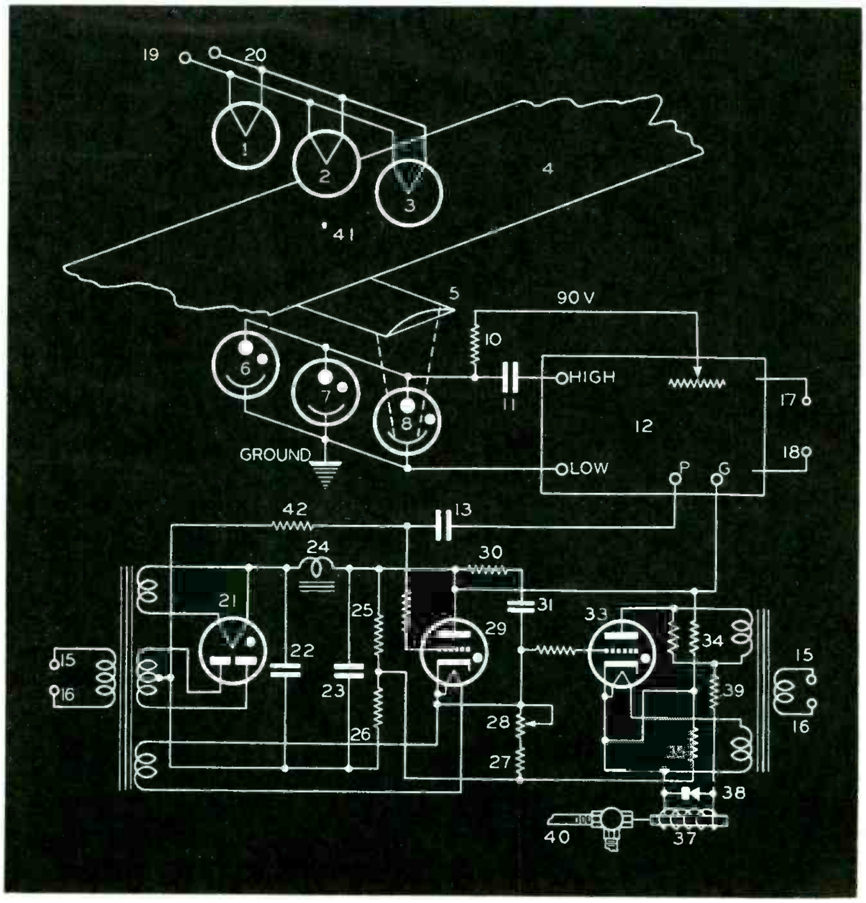
Eventually, the positive bias on the pentode control grid decreases as a result, to a level wherein the grid of the inverter triode is near zero voltage level. The triode begins to conduct in limited amount, the resulting voltage drop across the triode plate loading resistor *21* thus being increased. This places the plate of the triode, and therefore the grid of thyratron *24*, negative with respect to the pentode shield grid, this electrode then being negative with respect to the cathode. Thyratron *24* now no longer conducts and the shaft of the register control motor ceases to rotate.

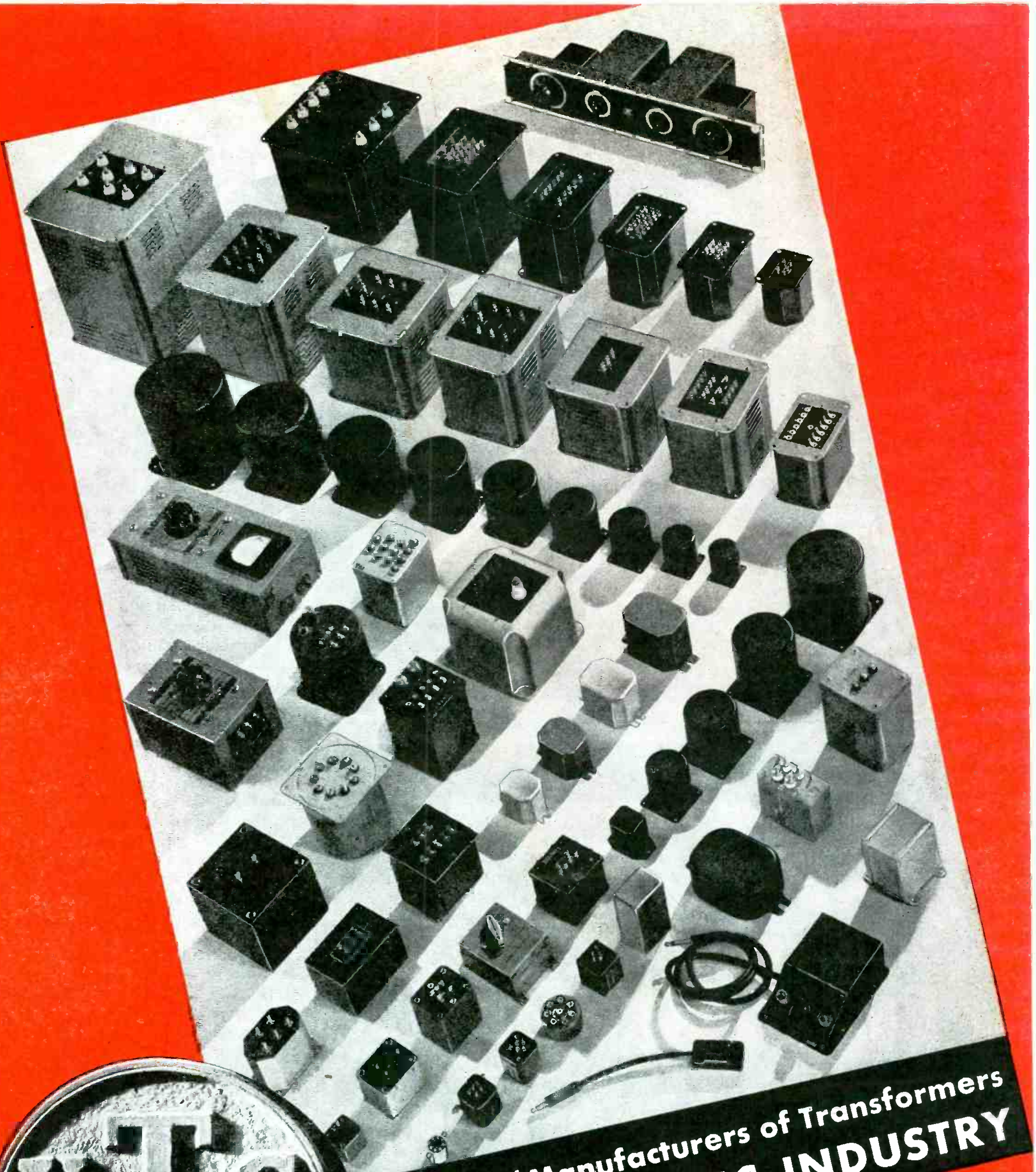
At this juncture, the edge of the paper strip obstructs perhaps half the light beam area, which places the paper edge near the center of the phototube objective lens, *9*.

If, by reason of irregularity in the warp of the paper strip, the paper edge should continue to move across the light beam in such a manner as to obstruct a greater portion of the light beam, the phototube conductivity decreases to a lower value.

The current flow through the register motor field is in a direction opposite to that prevailing when thyratron *24* conducts. Therefore, the shaft of

Fig. 4. A dynamic type photocontrol circuit. This is a pinhole detector used to detect and eliminate sections of steel strip which are perforated by small holes.





Foremost Manufacturers of Transformers to the ELECTRONIC INDUSTRY

UTC

United Transformer Co.

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

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB" the register motor now rotates in a direction opposite to that caused by the conduction of the rectifier thyratron. This causes the paper strip to be drawn in such a direction as to move the strip edge out of the light beam.

Meanwhile, the inverter grid of the inverter triode is positive with respect to its cathode, the plate of this tube now swinging negative with respect to the shield grid of pentode *18*. Therefore, the thyratron does not conduct at this time.

Continuing increase in the conductivity of the phototube through the gradual withdrawal of the paper edge out of the light beam finally causes the voltage between the grid and cathode of the pentode to swing to approximately zero volts. This causes the pentode plate current to rise to a slight degree, causing the plate to become slightly negative with respect to its shield grid. Thyratron *23* then is dark, its grid now negative with respect to its cathode. Here, the register motor shaft ceases to rotate, leaving the paper edge again near the center of the light beam.

It is obvious, from the discussion of Fig. 3, that the paper edge is automatically maintained in such a position that it is near the center of the light beam at all times, since a small change in the illumination incident on the cathode of phototube *10* is sufficient to cause operation of the register correction motor. The significance of this operation is evident when it is known that the speed of the paper strip thus held *in register* approaches 2,000 feet per minute.

Register position, or the position in the light beam where the paper edge comes to rest, is determined by the position of the slider arm of the *position control* potentiometer *14*.

Zone width potentiometer *15* functions to increase or decrease the static positive bias on the triode cathode, thus determining the pentode plate current at which the triode will conduct, by reason of the variable voltage drop across resistor *35*. Capacitors *13* and *17* function to bypass undesired voltage ripples, due to electromagnetic modulation of the sensitive phototube circuits.

The circuit of a special photocontrol in the dynamic group is shown in Fig. 4. This device is known as a pinhole detector, being utilized to detect and eliminate sections of steel strip which are perforated by small holes. Such steel strip is a raw material in the manufacture of metal food containers. Obviously, perforated material would result in a leaky container.

In the diagram of Fig. 4, the strip is shown passing under a battery of reflector type lamps, *1*, *2* and *3*. These are so arranged that a continuous path of light bathes the moving strip surface. Terminals *19* and *20*, connected with the a-c power supply line, furnish the power required by each lamp.

The photoelectric camera, consisting of a semi-cylindrical lens *5* and the phototubes *6, 7* and *8*, is suspended beneath the moving strip so that the light beam from one of the lamps above the sheet will strike the lens should a perforation be present.

A conventional high gain amplifier *12*, is utilized to increase the small voltage developed across the phototubes to a magnitude suitable for the manipulation of the thyratron tube grid circuits. To accomplish this operation, it is necessary to tap the d-c voltage divider within the amplifier at a point approximately 90 volts positive with respect to ground or negative d-c potential level. This voltage is impressed across the phototubes in series with the phototube loading resistor *10*. Dynamic coupling between the camera and the high gain amplifier is effected by means of capacitor *11*.

As the strip moves over the electronic camera lens, often at rates of speed approaching 2,500 feet per minute, a perforation in the strip will cause one of the phototubes to be illuminated, momentarily. The phototube resistance decreases momentarily as a result, the voltage across the bank of phototubes thus being decreased similarly. Capacitor *11* then discharges through the phototubes, quickly recharging in series with resistance *10* when the voltage across the phototubes returns to normal.

It is obvious, then, the *HIGH* input terminal of the amplifier is momentarily impulsed in negative polarity with respect to the negative or ground input terminal marked *LOW*, in Fig. 4.

The width of the phototube cathode, in each case, is one inch. The strip travels at a nominal rate of 1,800 feet per minute, or 30 feet per second. The time elapsed during which the strip moves a distance of one inch is 0.002783 second. Since thep hotocathode width is one inch, then this time is the duration of the phototube voltage impulse for the detection of a small hole. This corresponds to a frequency of

$$\frac{1}{.002783} \text{ or } 357 \text{ cps.}$$

Associated with the thyratron tube 29 is a delay timer, to which is coupled a high gain amplifier output. This delay timer obtains its d-c operating power from the power supply consisting of gaseous rectifier *21*, filter capacitors *22* and *23*, and filter reactor *24*. Voltage divider (*25, 26*) subdivides the d-c output voltage, appearing across capacitor *23*, into proper proportions for the operation of the timer.

Thyratron *29* cannot normally fire, even though timing capacitor *31* charges to the maximum voltage value existing between the positive terminal and the tap on the voltage divider. This is due to the fact that the grid of this tube is connected to the negative terminal of the voltage divider. Thus, the tube cathode is still positive with respect to the grid when timing capacitor *31* is fully charged.

However, when the detection camera is excited by the passage of a perforation, terminal *P* of the amplifier becomes positive with respect to the negative terminal of the voltage divider. Coupling capacitor *13* momentarily charges in series with the *P* terminal of the amplifier and the grid circuit resistor *42*, causing a momentary voltage pulse to appear across the latter. The grid end of this resistor is positive, the voltage across this resistor exceeding that across resistor *26* in the voltage divider, swinging the grid of thyratron *29* positive with respect to its cathode. Thyratron *29* then fires, discharging timing capaci-

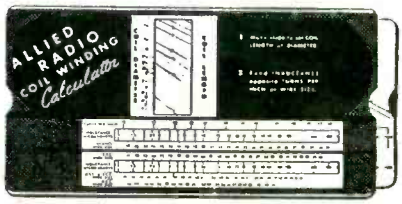
(*Continued on page* 31)

ALLIED COIL-WINDING CALCULATOR

A new slide-rule type rapid calculator for inductance, capacitance, and frequency components of series or parallel tuned r-f circuits as well as inductance, turns-per-inch, wire type, wire size, coil diameter and coil length for single layer-wound solenoid type r-f coils has been prepared by Allied Radio Corporation, 833 West Jackson Boulevard, Chicago 7, Illinois.

All values, in either case, are found with a single setting of the slide and are said to be accurate to within approximately 1% for coils ranging from ½" to 5½" in diameter and ¼" to 10" in length. All possible combinations within these limits are shown. Wire types and sizes include 11 to 35-gauge plain enamel, 11 to 36-gauge ssc, dsc, and scc, and 12 to 36-gauge dcc.

The rule is also engineered to indicate turns-per-inch from 10 to 160; inductance from 0.1 to 15 microhenrys; capacitance



from 3 to 1,000 micromicrofarads; frequencies from 400 kilocycles to 150 megacycles with equivalent wavelengths in meters. Priced at 25c each.

* * *

RCA R-F AMPLIFIER AND PHOTOTUBE

Two new tubes, the 829-B push-pull r-f beam power amplifier and 931-A multiplier phototube (9-stage electrostatically focused type), have been developed by RCA.

The 829-B is an improved design of push-pull r-f beam power amplifier having a total maximum plate dissipation of 40 watts. It is recommended especially for use in r-f power amplifier equipment. Having the same size and general appearance as the RCA-829 which it replaces, the new 829-B differs in that it has not only a higher plate-voltage rating (750 volts) but also an improved mechanical structure to permit use of the tube in applications involving considerable vibration.

The 931-A has the same size and general appearance as the 931 which it supersedes, but differs in that its current amplification has a minimum value 6 times higher, and an average value more than 3 times higher for the same voltage per stage. At 3,750 angstroms, the 931-A has a sensitivity of 1,800 microamperes per microwatt of radiant flux at 100 volts per stage, whereas the 931 had a corresponding value of 532 microamperes per microwatt, an improvement of over 3 times.

* * *

G. E. MYCALEX BOOKLET

An eleven-page publication describing properties and applications of G. E. mycalex has been published by the Specialty Division of the General Electric Company's Electronics Department, Schenectady, New York.

G. E. mycalex is used as an insulator and is produced in plates, rods, strips and disks from which parts are machined to finished shapes. It also can be compression-molded into simple shapes with and without metal inserts.

KEN BURCAW NOW CAP FLYER

Ken Burcaw, jobber sales manager of Radiart Corporation, Cleveland, Ohio, has become a flyer in the Civil Air Patrol.

* * *

WARTIME SERVICE BOOK

A 20-page manual with 250-tube substitution suggestions, methods of changing farm radios for electric operation and data on repairing burned out tubes, has been published by City Radio Company, 506 E. Washington Street, Phoenix, Arizona.

The manual, titled *Wartime Radio Service* by Charles and H. A. Middleton, is based on actual applications developed in the shop.

The tube substitution data is prepared in a very effective manner. The tube, substitute, and the circuit changes necessary are presented in column form. It thus becomes quite simple to find the data required to make the change.

Schematic information is also provided to show how farm radio changes can be made and how tube filaments can be repaired.

The price of the book is $3.00.

STATION ALLOCATOR

(See Front Cover)

On the cover this month we have the circuit of the RCA station allocator, 170. It is a modulated oscillator and was designed for rapid, accurate push-button alignment and tuning of r-f and i-f stages within the frequency range of 405 to 1,700 kc. It may be operated from either a 105-125-volt a-c supply or from self-contained batteries. Eight push-buttons provide eight frequency channels with .05% stability. Magnetite-core variable inductors and polystyrene coil forms and dielectric serve to provide this high stability factor.

The instrument and case is isolated from the power line, since a self-contained power transformer is used. This transformer draws only 5 watts. Battery operation for *A* supply is provided for by two Burgess No. 2 or Eveready No. 950 flashlight cells. Two Burgess No. W30P1 or Eveready No. 733 or 455 are used for *B* supply. The *A* drain is 50 mils at 1.5 volts; the *B* drain 2.6 mils at 90 volts.

A ¼-watt neon lamp serves the dual purpose of modulator and pilot lamp and also serves as a warning of dead *B* batteries by its failure to glow. When the modulation switch calls for modulated output the neon lamp acts as a relaxation type oscillator with a distinctive note of approximately 400 cycles. The exact frequency depends upon the supply voltage, and will, therefore, change somewhat in switching from line to battery operation. Two r-f output voltages are available, 2 or 0.2 volts with or without modulation.

For accurate setting of the allocator a beat method is used between the local broadcast station and the unmodulated allocator. If the beat is not picked up at once, the oscillator may be modulated to help bring the carrier very close to the station frequency. Then, when the modulation is removed, the beat will be heard. The recommended procedure for Service Men is to make a list of the eight most popular stations in your locality in order of frequency, allow at least a 10-minute warm-up period and then proceed to set the buttons in order of frequency. In operation, the output lead is placed close to the loop or antenna lead of the receiver and the receiver is tuned for the distinctive signal. After a preliminary tuning, the coupling of the antenna is reduced and a final adjustment made. An avc voltmeter or standard a-c output meter (with avc inoperative) should be used when available for greatest accuracy. A final check is made on the receiver by comparing push-button with manual tuning of the local station.

Now for some circuit details. The 1R5 is designed as a pentagrid converter but is used here to provide isolation of the oscillator from the output circuit. This is accomplished by electron coupling. It is also well adapted to low level modulation which is applied from the neon lamp to the signal grid (*3*). Grid *1* serves as the usual oscillator grid and *2* as the oscillator anode in a Colpitts oscillator with an untapped coil and a tapped capacitor, or capacity voltage divider. Two 1,200-mmfd condensers are grounded at the junction. The circuit is chosen for use with single, untapped variable inductors for the push buttons.

The audio oscillator circuit is unusual. The power circuit consists of 1.5-megohm resistors shunted with a 1,800-mmfd capacitor, all in series with the lamp. Combined resistance-capacity coupling delivers audio voltage to the modulating grid. Note the 220,000-ohm grid leak. The 1R5 filament is returned to A— by way of the filament winding on the transformer. The output circuit consists of a resistance-attenuator coupled to the plate through a small condenser (*27* mmfd).

THE AUDIO CHANALYST

Part III

THIS, the final installment, considers the low gain channel *B* amplifier, the audio oscillator, speaker and power supply—all sections not previously covered. Some typical applications of the chanalyst are also considered.

Amplifier Channel B

Amplifier *B* is a single stage resistance coupled 6SJ7 pentode amplifier, the output of which is rectified by one of the diodes of 6H6 and impressed upon a 6E5 indicator. The output is also brought out to two jacks, *OUTPUT VM* and *OUTPUT AF*. The former is for voltmeter measurements: the latter for audio output arranged particularly for oscillograph measurements. A two-circuit jack disconnects the rectifier and *magic eye* when a standard phone plug is inserted, preventing the clipping effect which would occur with the diode load and the consequent cathode-ray image distortion.

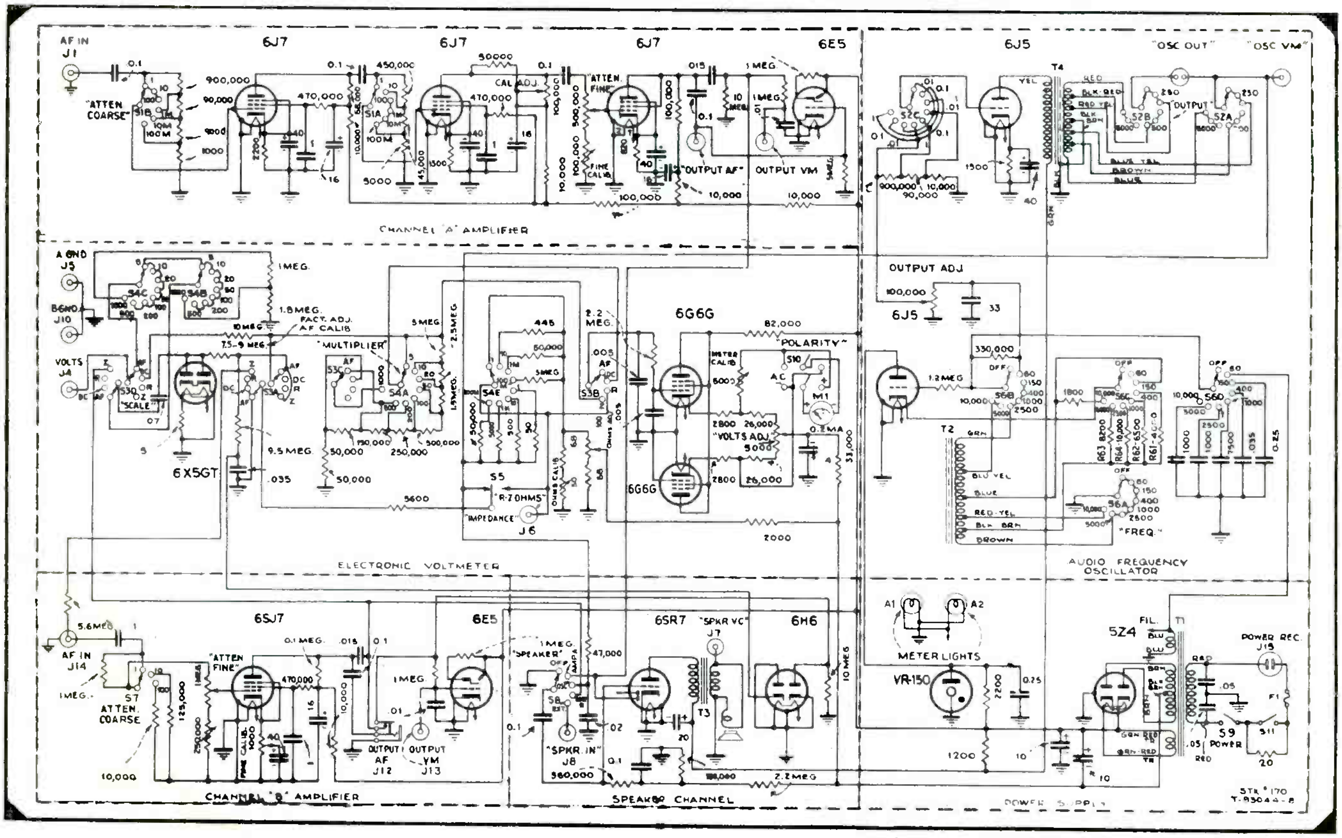
The amplifier has a sensitivity of 0.1 volt maximum, input resistance of 1 megohm, frequency characteristic essentially flat to 10,000 cycles and an attenuation ratio of 60 db (1,000 to 1). Two attenuators, *Coarse* and *Fine*, are located in the a-f input circuit to the amplifier grid. The *Coarse* control consists of a 3-point switch labelled 1, 10 and 100, and provides a voltage step-down of 100 to 1, equivalent to 40 db attenuation. The *Fine* control consists of a 1-megohm potentiometer in series with a ¼-megohm resistor and provides 10 to 1 (20 db) smooth attenuation. The maximum gain of the amplifier is adjustable by means of a 1,000-ohm cathode resistor where the amount of current degeneration is controlled. The 40-mfd bypass is connected to the potentiometer arm so the gain is proportional to the percentage of the resistance bypassed.

The output impedance is approximately 0.1 megohm (the value of the plate load resistor) so care must be exercised not to load the amplifier with high capacity shielded cable, particularly when working with high audio frequencies. Channel *B* is not calibrated to a particular zero reference level as in channel *A*, the high gain amplifier. In checking gain and in signal tracing, the sensitivity and attenuation ratio must be observed so as not to overload the amplifier or false measurement and distortion will result.

Audio Oscillator Channel

This channel consists of a hot cathode Hartley oscillator with the plate grounded through a ¼-mfd bypass condenser providing seven spot frequencies from 60 to 10,000 cycles. The frequency is governed by a tapped choke or autotransformer, five different capacitors and five different cathode resistors. It is stabilized by a regulated power supply. Isolation of the load circuit is provided by a buffer amplifier.

The oscillator tube is a 6J5 and is operated in an unusual manner with 1.2 megohms in series with the grid. The output voltage is taken from the low potential side of this resistor, being applied to the 6J5 buffer grid through a 330,000-ohm isolating resistor and a two-stage attenuator. A 33-mmfd shunt condenser, in combination with the resistor, acts as a low-pass filter to reduce harmonic distortion and as an equalizer to attenuate high frequencies slightly. The following frequencies are provided: 60, 150, 400, 1,000, 2,500, 5,000 and 10,000. The 60-cycle point is a dummy as far as the oscillator is concerned. It is provided by the 6.3-volt filament winding directly to the buffer amplifier. Note the method of applying this voltage to the oscillator out-



Circuit of the complete RCA audio chanalyst.

put tap while the oscillator is cut off by opening the cathode. The cathode resistors limit the dynamic operating range of the oscillator to maintain a good waveform and to limit the output voltage to approximately 6.3, the same as the 60-cycle source.

The buffer input voltage is controlled by a nine-point step-by-step attenuator and a 0.1-megohm potentiometer for continuous adjustment. The output transformer has a multi-tapped secondary which is grounded at the center to provide output impedances of 250, 500 and 5,000 ohms balanced to ground, and grounded output impedance of a fourth of these values, namely, 62.5, 125 and 1,250 ohms. The undistorted power output is 80 milliwatts.

Speaker Channel

This channel consists of a p-m speaker transformer coupled to a 6SR7 triode, a switch being provided to connect the grid circuit to the output of amplifier *A*, amplifier *B*, the internal oscillator or an external source. The input impedance is approximately 560,000 ohms, the value of the grid leak. Bias is obtained from a voltage divider, the cathode being directly grounded. This channel may be used to supply a sound pressure field for testing and comparing microphones as well as for the more obvious functions normally associated with audio systems such as checking hum, distortion, operation of equalizers and filters, and trouble shooting.

The speaker is very useful in checking noisy amplifiers, starting at the input and proceeding through the amplifier until the point is reached where noise is noticed. An examination of components and connections at this point should readily reveal the fault. In checking phonograph pickups the speaker channel is used in conjunction with amplifier *B*.

The Power Supply

Because no power tubes are used in the chanalyst a large power unit is not required. A 5Z4 and resistance-capacitance filters take care of all the sections except the oscillator which has a VR-150 voltage regulator supplying it. The gas type regulators have a considerable filtering action. Individual decoupling filters are used in all stages of the audio amplifiers and these filters are real *brute force* networks with 16-mfd condensers and, usually, 10,000-ohm resistors. This insures stability and freedom from hum, important when dealing with the bass frequencies.

A 20-ohm resistor with a shorting switch is placed in the primary of the power transformer to prevent voltage overload when encountering high line voltages. The primary circuit also includes a fuse and a pair of .05-mfd bypass condensers from line to chassis. These capacitors serve to minimize the induction of hum and prevent line disturbances into the amplifiers.

Applications

The prime application of the audio chanalyst is, of course, audio signal tracing. It serves to check a-f units; diagnosing troubles that such equipment is likely to experience including dead or weak operation, distortion, noise, hum, intermittent operation and oscillation. It is also suitable for gain measurement and checking frequency response. The testing and balancing of push-pull circuits including inverter performance is also an important function. Besides being noticed in the speaker output, hum is also indicated by a fuzzy pattern on the 6E5 indicator. The hum voltage may be measured by the electronic voltmeter in connection with one of the amplifier channels.

Principal causes of hum are due to a defective power supply but others are also quite common. Among these are defective tubes, leaky coupling condensers, overloaded power supply due to shorts, poor ground connections,

(*Continued on page* 31)

NEWS

ILLINOIS INSTITUTE ELECTS SIEGEL OF OHMITE TO BOARD

David T. Siegel, founder and president of the Ohmite Manufacturing Company, Chicago, was elected to the board of trustees of Illinois Institute of Technology recently.

Mr. Siegel was one of five new members named to the Institute's board. He was elected as an alumni representative to the board, having been nominated by the Illinois Tech Alumni Association.

* * *

IRC WINS SECOND WHITE STAR

For the second time the International Resistance Company has been awarded a white star for their "E" flag.

* * *

DIAL LIGHT CATALOG

A 24-page catalog describing an assortment of pilot light assemblies and accessories has been released by the Dial Light Company of America, Inc., 90 West Street, New York 6, New York.

Data on incandescent lamps, socket assemblies, jewels, and numbers, letters and trade marks available for pilot light assemblies, are included in this catalog.

* * *

MECK ANNOUNCES POSTWAR PLANS

A postwar merchandising policy has been announced by John Meck Industries, Plymouth, Ind.

In this policy according to John Meck, president, the jobber will be retained for distribution.

In describing the importance of the jobber, Mr. Meck said:

"We are well aware that many economic planners, seeking to change our time-proved distribution system, have evolved glamorous methods of direct selling which may influence postwar merchandising to some extent. Nevertheless, it cannot be established that radio parts jobbers, in the long run, either add to distribution costs from the dealer's standpoint or perform functions which are not essential to a smooth flow of goods from manufacturer to consumer, with maximum profit to the dealer.

"The stock-carrying and service facilities of radio parts jobbers unquestionably add to convenience and speed with which dealers can conduct their businesses."

NEWS OF "THE REPRESENTATIVES"

At the November meeting of the Mid-Lantic chapter a planning committee under the chairmanship of S. K. Macdonald was formed. This committee working with the chapter's president, L. D. Lowery, will consider not only postwar possibilities of the chapter, but will make immediate recommendations regarding publicity for the local organization and a new buyer's guide which will be a revised edition of the *Classified Index* published last year.

A membership committee was appointed by Norman M. Sewell, vice president, presiding in the absence of president L. D. "Doc" Lowery. It consists of chairman Roy Benge, John McKinley, and Robert Williams. Bob Williams and Don Gawthrop were accepted as new members at this meeting.

A combined dinner and meeting sponsored by the Representatives Wolverine chapter and the Michigan chapter of the National Electronic Distributors Association was recently held in Lansing, Michigan. Distributors from Detroit, Pontiac, Flint, Saginaw, Muskegon, Grand Rapids, Kalamazoo, Lansing, Jackson and Ann Arbor attended. Postwar planning was discussed.

R. T. Perron, 80 Davenport Street, Taunton, Mass., was elected chairman of the New England chapter at a recent meeting. Vice chairman of the chapter is T. Coakley, 11 Beacon Street, Boston, Mass. H. Gerber, 94 Portland Street, Boston 14, Mass., is secretary.

F. A. Emmet, 2837 West Pico Blvd., Los Angeles 6, Calif., was recently elected a member of the Los Angeles chapter.

J. Maquire of the Mid-Lantic chapter has joined the Armed Forces.

B. Whan has moved to 679 N. Wells Street, Chicago, Illinois.

* * *

LAND PURCHASED FOR SYLVANIA RESEARCH CENTER

A tract of land on Long Island has been purchased by Sylvania Electric Products, Inc., for the building of a research center. Because of wartime restrictions there will be no immediate building program, although two structures now on the property will be renovated for use by a small research group.

* * *

HALLICRAFTERS CELEBRATE 10TH ANNIVERSARY

The Old Timers' Club of the Hallicrafters Company celebrated the tenth anniversary of the company recently with a surprise dinner in honor of W. J. Halligan, president and founder.

CONNECTOR WALL CHARTS

Two wall charts showing insert, size and identification details of *AN* plugs have been prepared for all branches of the Army, Navy and industry using standard Army-Navy specifications electrical connectors, by Cannon Electric Development Company, Los Angeles, Calif.

* * *

SYLVANIA ENGINEER'S BOOK ON ELECTRONICS TO APPEAR SOON

A book entitled *A Primer of Electronics,* written by Don P. Caverly, commercial engineer of Sylvania Electric Products, Inc., will appear soon. McGraw-Hill is the publisher.

The new book is a primer and omits complex technicalities.

* * *

CENTRALAB TRIMMER CATALOG

An 8-page bulletin, 695 revised, on trimmers, has been released by Centralab, division of Globe-Union, Inc., 900 East Keefe Avenue, Milwaukee 1, Wisconsin. The construction principles and data on four styles in current production are provided. Helpful drawings and actual photographs also appear.

* * *

N. U. VISUAL AID VACUUM TUBE CHART

A visual aid vacuum tube chart for instruction purposes has just been published by National Union Radio Corporation, Newark, N. J.

The chart, 30" x 45", shows all parts of a typical radio tube individually and in relation to the final construction. It also contains element classifications and symbols for diodes, triodes, tetrodes, pentodes and multi-element and multi-unit types including diode triode, double triode, diode pentode and pentagrid converters. Sketches of base pin arrangements and numbering systems for vacuum tubes are also included.

Copies of the chart are available through National Union distributors, free of charge to recognized universities, colleges and Signal Corps instruction centers, or at $1.00 each to individuals outside of recognized institutions conducting fully accredited radio courses.

* * *

UNIVERSAL MICROPHONE TO MAKE LIP MIKES

Herbert Baumgarten, materials engineer and coordinator for the Universal Microphone Co., Inglewood, Cal., conferred with Signal Corps engineers in the East recently relative to production on the new lip model microphone.

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PHOTOCONTROLS

(*Continued from page* 25)

tor *31*, becoming non-conductive when the voltage across this capacitor is so low that the tube fails to conduct an ionization current.

Once discharged, the voltage across capacitor *31* is near zero, but rising relatively slowly as the capacitor is charged by the current conducted through the delay control and limit resistors *28* and *27*, respectively. At this time, the voltage across the capacitor is less than that across resistor *25* in the voltage divider. This causes the control grid of power thyratron *33* to assume a positive polarity with respect to its cathode, the latter electrode being connected to the tap on the voltage divider. This thyratron now conducts, energizing solenoid coil *37* of hydro-electric valve *40*. The rectified a-c passed by the thyratron through coil *37* is limited by limit resistor *39*. Rectifier unit *38* functions to short-circuit the coil self-induced voltage between pulses of rectified a-c, thus effectively maintaining a relatively constant field flux through the coil, holding the valve, *40*, open.

Operation of the hydro-electric valve causes a deflector guide to remove the perforated strip section, the latter falling into a scrap bin.

Valve *40* is held open until capacitor *31* voltage exceeds that across resistor *25*. Then the grid of thyratron *33* assumes a voltage polarity negative with respect to its cathode. Since the capacitor charging period is dependent on the resistance values of resistor *28* and *27*, adjustment of resistor *28* varies the time interval during which the valve remains opened. Resistor *27* merely functions to prevent a short-circuit condition if the resistance of the rheostat *28* is reduced to zero. Thus, rheostat *28* may be adjusted to the length of time necessary for the passage of the perforated strip section from the strip shear blade, over roll conveyor to scrap removal guide.

(*To be continued*)

* * *

SER-CUITS

(*Continued from page* 14)

second i-f control grid.

A field coil shunted by a divider resistor in the negative high voltage supplies two bias voltages; for 6V6 power output, and the foregoing avc system, and first and second audio. Ample decoupling filters are provided. The output push-pull tubes have 680 ohms in the grid leads to suppress parasitics. Inversed feedback from the voice coil is fed direct to the second a-f grid through an equalizer consisting of a 220,000-ohm resistor and a .05-mfd capacitor. The power transformer has a dual primary. A dual 150,000-ohm potentiometer is run to ground, supplanting the usual paper condensers. However, a .003-mfd by pass condenser is applied across each half of the high voltage secondary to limit disturbances coming from the a-c line.

* * *

AUDIO CHANALYST

(*Continued from page* 29)

induction hum, shorted or reversed hum bucking coils in speakers and defective or improperly adjusted hum balancers in amplifiers with filament type tubes.

Oscillation problems can be checked, too. Incidentally common form of oscillation, motor-boating, is generally caused by defective filter or decoupling circuits in the plate or screen power circuits, open grid circuits or some kind of feedback that shouldn't be! One way to tackle this one is to apply a large paper condenser from grid to ground of each stage until the culprit is found. Then the grid and power supply circuits of that stage should be checked using the electronic voltmeter channel.

JOTS & FLASHES

CONGRATULATIONS to this month's Army-Navy "E" winners for outstanding production . . . they include KenRad Tube and Lamp Corp., Utah Radio Products Co., Electronic Enterprises, Inc., Delco Radio Division of General Motors. . . . Aircraft-Marine Products, Inc., now located at 1523 N. 4th St., Harrisburg, Pa. . . . Stromberg-Carlson appoints F. Leo Granger as Radio Service Manager . . . All credit to KenRad for the star shaped Christmas Card sent to all former employees now in the Armed Services . . . it's signed by the boys and gals who are keeping production lines rolling. . . . Burt Browne, well known Chicago advertising authority on radio and electronics, back on the job after Arizona vacation. . . . Lucius E. Packard in charge of General Radio's new Chicago office at 920 S. Michigan Ave. . . . Lester Via, with 10 years' radio experience, appointed to engineering department of John Meck Industries to undertake special crystal research. . . . J. W. Whiteside appointed buyer in tube division of General Electric's Electronic Department. . . . Frank W. Warner named chief engineer of that company's plastic divisions. . . . Radio Service Men in all parts of the country report very favorably on Sprague's Trading Post Program . . . claim that it has helped them get equipment they need badly and also to dispose of material they no longer require . . . Thanks to all you Servicers for your Holiday Greetings . . . they're much appreciated and sincerely reciprocated . . . Don't forget the 4th War Bond Drive gets underway in January . . . be ready to do your share and more . . . your Uncle Sam still needs plenty $$$ to wind up this war in a hurry. . . . Robert C. Berner joins Emerson Radio as assistant to president Ben Abrams . . . Regret to report death of Frank A. Ross, senior vice-president of Stewart-Warner. . . . Universal Microphone appoints Ted Pockrandt as supervisor of production on new lip microphones for Signal Corps . . . Employee publications received and enjoyed this month include *Raytheon News*, *Hallicrafter Tuner* and *Universal Micro-Topics* . . . better start studying up on television . . . there will be plenty of activity in this field shortly after hostilities are concluded . . . looks like a profitable year ahead for radio Service Men . . . Read all available technical material carefully . . . start planning now for the postwar readjustment period . . . here's wishing you all a most prosperous New Year.

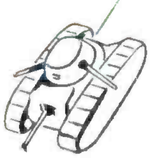
ADVERTISERS IN THIS ISSUE

SERVICE, DECEMBER, 1943

FREEZE 'EM OR FRY 'EM

• Global war means airplanes in the Arctic. It means tanks in the tropics. For fighting machines of all kinds, combat conditions call for freezing or frying — and sometimes both!

Solar is building capacitors which meet these extreme conditions. If "freezing or frying" is part of your capacitor problems — call on Solar's "temperature-engineering" services.



Facts and more facts. Complete capacitor data describing and illustrating the entire Solar line is now available to design engineers on request.

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QUAKE-PROOF CONSTRUCTION

In a few cubic inches of space National Union tube designers plan and build their electronic skyscrapers. Many fragile parts of these intricate mechanisms are precisely balanced, buttressed and welded fast.

For N. U. engineers well know the *rough sailing* that's ahead for these tubes—the shocks, concussion, vibration—relatively far more shattering than the impact of an earthquake on a modern steel and masonry building. So their war job is to build tubes which will stand up and take what comes—whose parts will *stay* in precise alignment—whose exact clearances will not be altered—whose air seal will not be broken.

To master this complicated construction problem calls for precision engineering of the first order—and a minute knowledge of the strength, rigidity and other characteristics of many metals. The point is—modern electronic tubes are scientific instruments. For post-war tubes of highest character, teamed-up with service assistance to match, service engineers can *count on* National Union.

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