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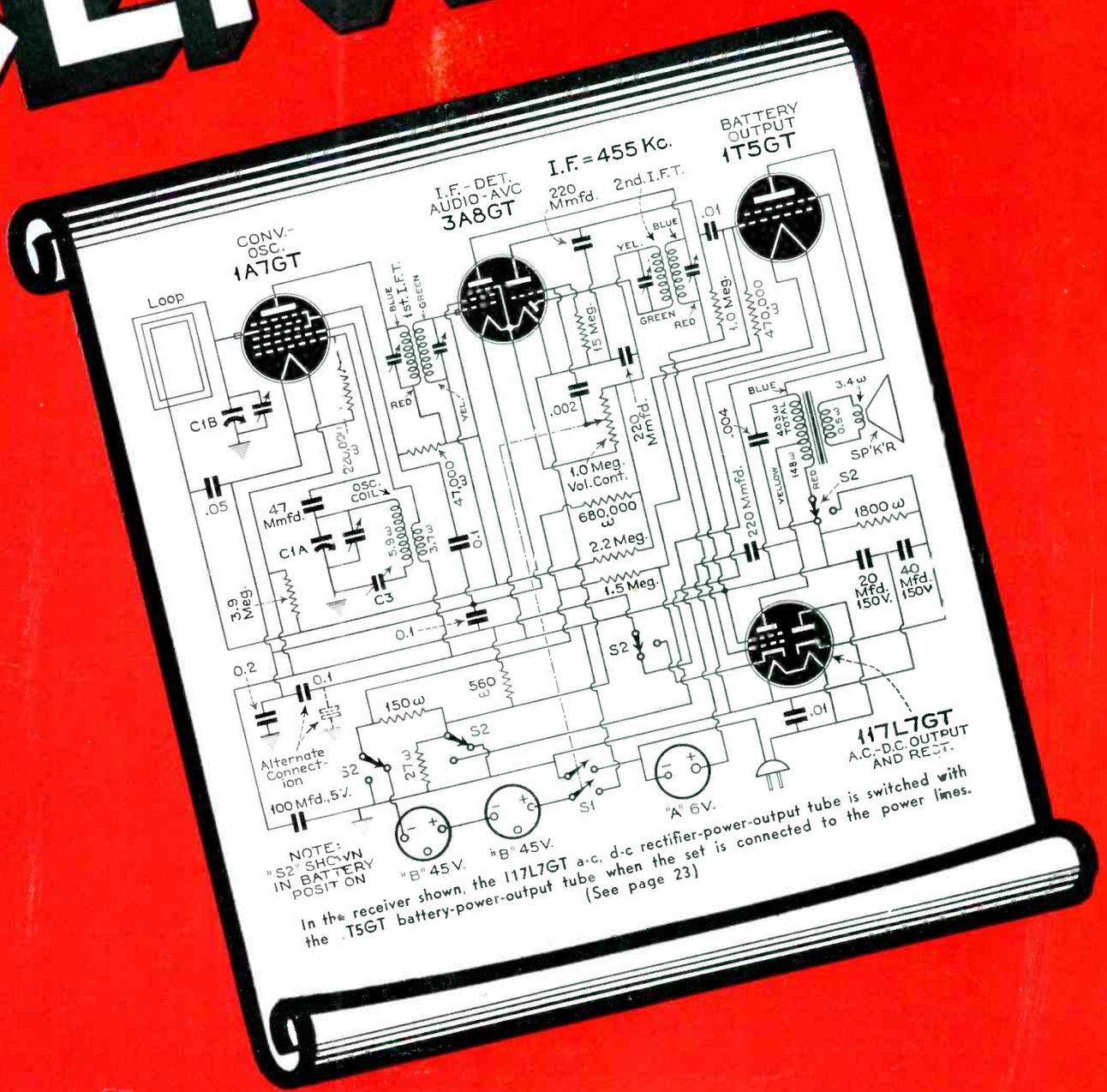

In the receiver shown, the 117L7GT a-c, d-c rectifier-power-output tube is switched with the 1T5GT battery-power-output tube when the set is connected to the power lines.

(See page 23)

January
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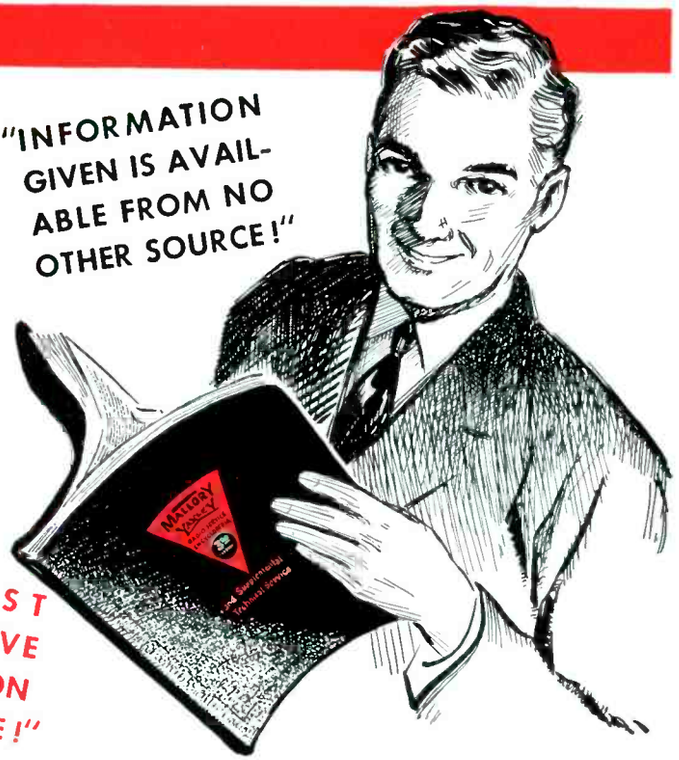

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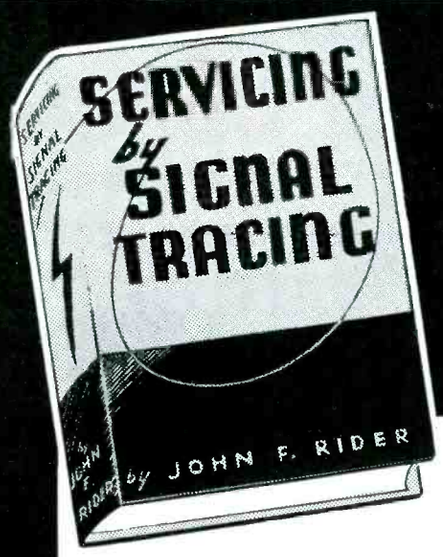

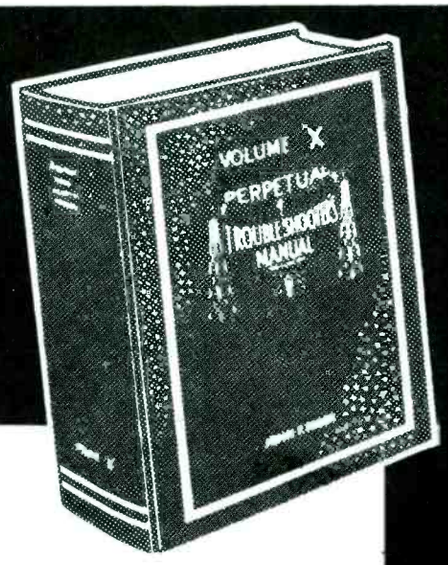

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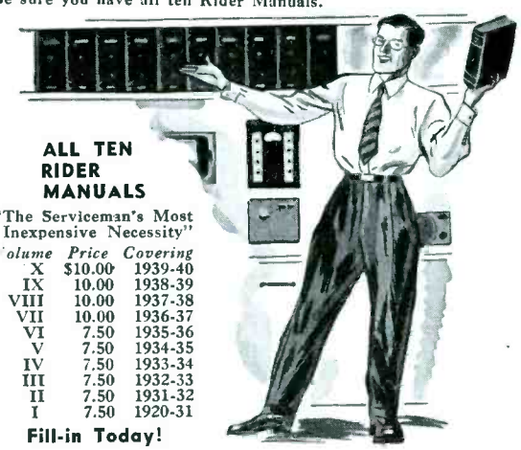

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

ROBERT G. HERZOG, Editor

MEMBER AUDIT BUREAU OF CIRCULATIONS

Reg. U. S. Patent Office

EDITORIAL

JULIUS C. BUETTNER, Jasper, Indiana, writes us that he has quit the service business. He figures his "average earnings were about five and a half cents an hour. This low figure due to the high overhead (instruments, stock and transportation). The public does not want to pay for good service," he says ". . . the pay is less than that for a garbage collector. . . ."

Be that as it may, the Economy Radio Service in Gloversville, N. Y., has recently advertised in the local newspaper "Ashes drawn—5c a can." It seems that they, too, have found ash collecting much more profitable than radio servicing.

We, however, do not agree. The servicing of radio receivers can be (and thousands of SERVICE readers attest that it now is) a profitable business. If a particular Service Man finds that he has sufficient excess time to enable him to draw ashes at 5c a can, he should instead spend that time in drumming up more Radio Service Business. If the public can be convinced that you are giving them the very best service, they will pay prices that will ensure a legitimate profit. That some sound basis of service charges is necessary goes without saying, but what is even more important is an educational campaign which will convince the public that the radio Service Man can and does deliver the goods and also that he is entitled to earn a fair living. The NAB-RMA-RSA campaign is a proper step in this direction.

THE article beginning on page 14 of this issue is a review of the developments in the various phases of the radio industry during 1939 in an attempt to predict the immediate trends for 1940. Wherever reliable figures for 1939 were available these are given and correlated to the technical advances.

In making any predictions for the future, however, due consideration must be taken of the international situation and other disturbing factors.

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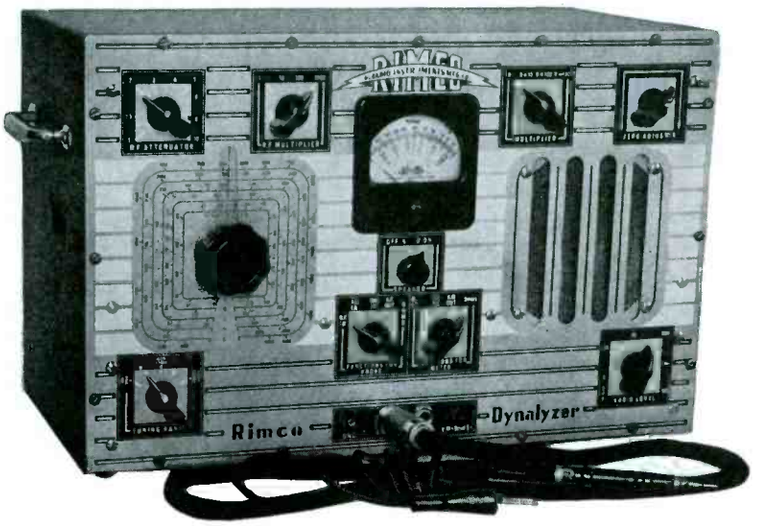

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TUBES

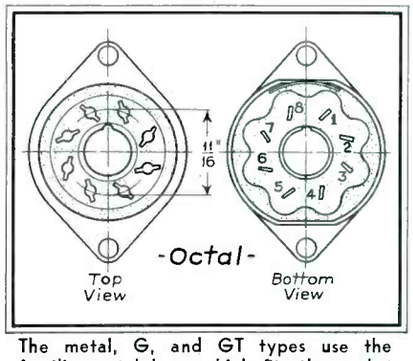
By JOHN H. POTTS

OCTAL, loktal, octalox, miniature tubes, bantam tubes, glass and metal tubes . . . tubes in radically different sizes and shapes and with assorted filament voltages and operating characteristics have emerged from the laboratories and plants of tube manufacturers during the past year. Many of these types were described in SERVICE[1]; since then, however, over 70 types have crashed the market to the unconfined dismay of jobbers, Service Men and tube checker manufacturers.

Before discussing the charts giving the operating characteristics and pin connections of these new tubes (which are reproduced in this issue) let us pause and consider the significance of this trend toward new tube forms and designs insofar as they promise to affect the design and servicing of present and future receivers.

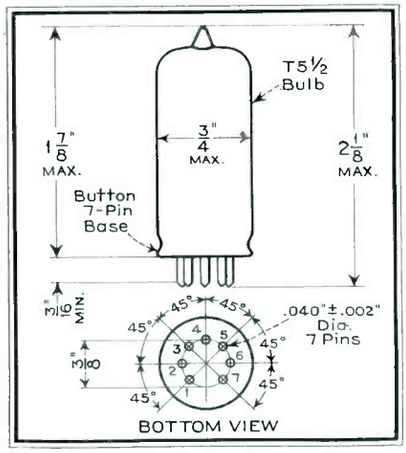
• • • portables

Time was when a battery-operated portable receiver required the services of a hardened piano-mover to transport



The metal, G, and GT types use the familiar octal base which fits the socket shown. RMA pin numbers are indicated on the bottom view.

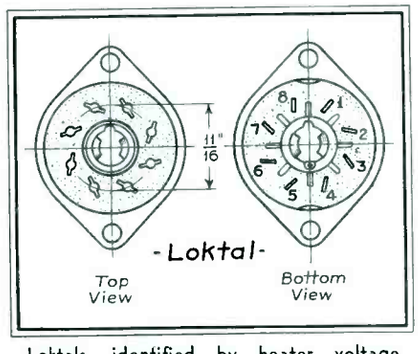
it. Not so the new ones, with 1.4 volt tubes, which may be carried without inconvenience by a child. While a great deal of the reduction in weight in the new portables has been achieved through the increased efficiency of tube and circuit design, practically all the receivers now in use employ a 90-volt B battery. This B supply usually consists of two 45-volt units and, to render reasonably long service, they must have a certain size and weight. In this year's portables, this weight generally exceeds that of all the rest of the receiver, including the A battery. In many portables the later is of insufficient ampere-hour capacity to give economical service. The unholy appetite of these portables for A-battery juice has been no unmixed blessing for dealers and Service Men. Since it is not usual to fit receivers of this type with pilot lights, it is easy for the user to forget to turn the receiver off when it is not being used. As a result, the A battery is quickly exhausted—and replacements are not cheap. Too often the battery replacement cost discourages the use of the receiver and has a deterring effect on sales.



The decrease in size has been made possible, in the new miniature tubes, by eliminating the conventional base and bringing the wires from the seal directly through a 7-pin glass-button base.

A step forward in overcoming these limitations is represented in the new miniature battery tubes, just announced by RCA. These tubes, as illustrated, are smaller than any of the more conventional types. The maximum overall length is 2⅛ inches and the maximum diameter but ¾ inch—just about the size of a dime. The decrease in size has been made possible by eliminating the conventional base and bringing the heavy wires from the seal directly through a 7-pin glass button base so that they serve as pin connections to the socket, which is a special miniature type.

Due to this method of construction, it is possible to retain the same length of filament, grid and plate elements as are employed in conventional 1.4-volt tubes, yet the amount of space taken by the complete tube is less than that required by a standard GT type. This makes possible the design of a still more compact portable chassis.



Loktals, identified by heater voltage rating, employ an 8-pin base. A metal guide locks into the socket shown. RMA pin numbers on bottom view.

Of particular note, however, is the fact that these new tubes are designed to operate efficiently on but one-half the B voltage usually employed in portable

[1]Tubes, by D. Bee, SERVICE, Feb. 1939, p. 62. Also New Tubes, SERVICE, March, 1939, p. 133.

The new miniature tubes are smaller than any of the more conventional types. The maximum overall length is 2⅛ inches and the maximum diamter but ¾ inch—just about the size of a dime. The four types shown are now available. All are single-ended types—that is, there are no top caps.

(Photo courtesy RCA)

receivers. Since the limiting factor in the design of such receivers to achieve compactness is the space taken by the batteries, efficient operation on 45 volts means a considerable saving in size and weight. While the A battery requirements are the same, it is still possible to increase the size of the A battery to acquire more economical operation and yet make a smaller and lighter receiver.

These new miniature tubes are available in four types and permit the design of an efficient four-tube receiver with a total B-current drain of about 10 ma at 45 volts, with an output power of 65 milliwatts.

The four tube types are the 1R5 pentagrid converter, 1S4 power amplifier pentode, 1S5 diode-pentode and 1T4 super-control r-f amplifier pentode. All these tubes are single-ended types; that is, there are no top caps.

As compared with the standard 1N5GT r-f pentode, the new miniature 1T4 has a mutual conductance of 700 micromhos with a plate and screen voltage of 45 at zero grid bias, while the mutual conductance of the 1N5GT is 750 at zero grid bias and twice the plate and screen voltages. In other words, the new miniature 1T4 will provide about 93 percent as much amplification with but 50 percent of the B voltage required by the 1N5GT. However, the plate current and screen current drain of the 1T4 at 45 volts amount to 2.6 ma, while the total B-current drain of the 1N5GT is but 1.5 ma at 90 volts. To summarize, then, the 1T4 will provide substantially the same gain at 45 volts as the 1N5GT at 90 volts, but the 1T4 will require more B current at the lower voltage. The filament voltage and current for each of these tubes are the same, 1.4 volts at 50 ma.

The type 1R5 converter is designed to give much better performance at 45 volts than other battery type converters at 90 volts. However, the only data available show its operation as a mixer, with a separate oscillator, so that direct comparison with standard types used as converters cannot be given at the present writing.

The voltage gain of the pentode section of the 1S5, with a plate and screen supply voltage of 41 is rated at 30, when the plate load resistor is 1 meg, and the screen resistor 3 megs.

The 1S4 power amplifier pentode has a maximum undistorted output at 45 volts of about one-fourth that of an equivalent pentode of the conventional type at 90 volts. This means that the *sound volume* will be about one-half that obtained at 90 volts with a larger output pentode, both requiring the same filament voltage and current.

These new tubes should work out well in hearing aids and other devices where efficiency, compactness and light weight are prime considerations.

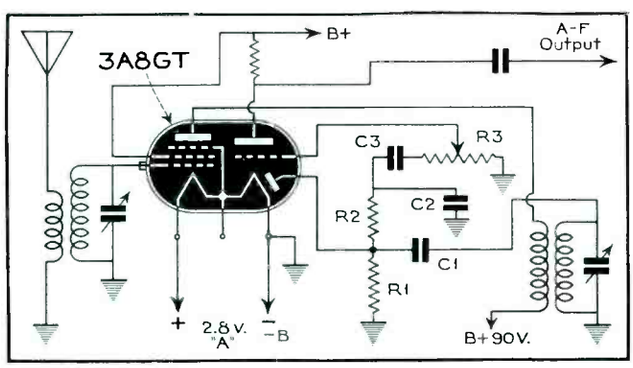
There is a growing tendency toward combining a-c, d-c operation along with battery operation of small portables. Accordingly, a new rectifier has been announced—the 117Z6GT—which is designed to operate directly from the line supply. As shown in Fig. 1, this new tube may be installed to provide both A and B supply for the portable, thus greatly extending the life of the batteries when the receiver is used in the home. Each of the sections of the 117Z6GT is designed to supply a maximum of 60 ma. Thus, as shown, one section may be filtered to supply the 50-ma drain of the filaments in series, while the other section may be used in the same manner for the B supply. Since the B-current drain is normally low, it is possible to use resistance-capacity filtration in this section without appreciable voltage drop. The high drain of the filaments is filtered through a choke, though in some cases the choke might be omitted and a resistance-capacity filter likewise used here. The voltage-dropping resistor R will be necessary if the choke is used to limit the filament current to 50 ma.

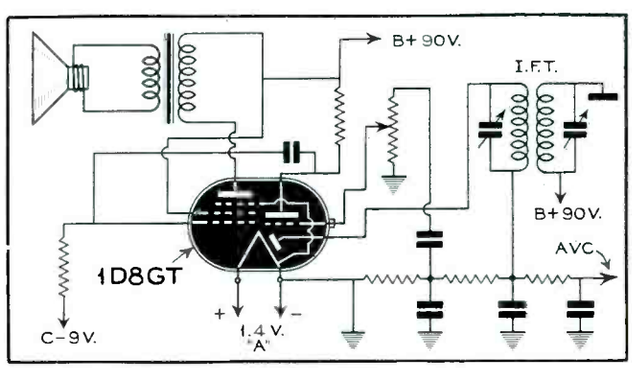
The heater of the 117Z6GT is center-tapped. Therefore, the heater sections may be connected in parallel and operated at 58.5 volts, if desired. If this is done, one or more additional heater-type tubes may be employed in conjunction with the 117Z6GT to enable greater power output when the portable is operated from the power lines.

This new tube should prove handy and simple to adapt as a source of field excitation for dynamic speakers used in conjunction with p-a systems, "ham" receivers, etc. With cathodes and plates, respectively, tied together the total rated output is 120 ma.

The circuit diagram of the G. E. HB412, shown on the front cover of this issue, illustrates the application of another tube type which employs a 117-volt heater, the 117L7GT. This tube is a combination rectifier and power out-

Figs. 2 (left) and 3. We have had double purpose tubes for some time but now they come three in one envelope. The 1D8GT and the 3A8GT are combination diode-triode-pentodes. The pentode section of the latter is designed with a remote-cutoff grid for r-f applications. The pentode section of the 1D8GT is for power output applications.





put type. The rectifier section supplies both A and B power for the HB412 receiver for a-c or d-c power line operation. For line operation the power-output section of this tube delivers 2-watts of audio power to the set's speaker. This receiver also employs other tube types which have been introduced within the last year and are listed in the accompanying characteristic chart. The entire receiver circuit and its functioning are discussed elsewhere in this issue.

• • • multi-purpose types

We have had double-purpose tubes for some time; now they come three in one envelope. Witness the 3A8GT and the 1D8GT, shown in circuit applications in Figs. 2 and 3.

The 3A8GT is a diode-triode-pentode detector-amplifier. The pentode section is designed for use as an r-f amplifier and the triode section as an a-f amplifier to follow the diode detector. The filament requires 50 ma at 2.8 volts, or, since it is mid-tapped, the two filaments may be connected in parallel and operated at 1.4 volts and 0.1 amp.; the latter is also the voltage and current rating of the 1D8GT.

The diagram, Fig. 2, shows the 3A8GT in an operating circuit in which the pentode section is connected to a tuned antenna transformer. The output of the pentode section is fed to the diode detector through a tuned stage. The demodulated a-f voltage is developed across the diode load resistor R1 and the r-f is filtered by the resistance-capacity filter R2-C2. The audio voltage then appears across the volume control, R3, the blocking condenser C3 preventing the d-c component developed across the diode-load resistor from

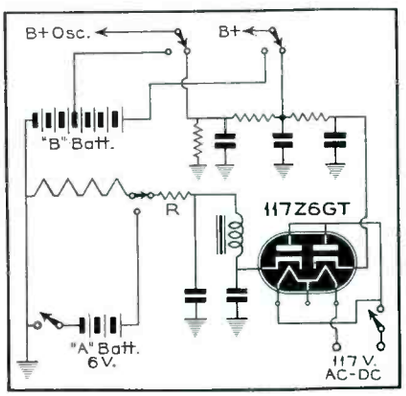


Fig. 1. In accordance with the growing tendency toward combining a-c, d-c operation of small portables, along with battery operation, a new 117-volt rectifier has been announced.

biasing the triode section. All returns are made to ground as is the negative filament. This means that all grids are at zero potential, neglecting such bias as will result from contact potential.

The G. E. HB412, shown on the front cover, employs the 3A8GT as an i-f, detector-audio-avc stage, and provides an excellent circuit application.

The 1D8GT is likewise a diode-triode-pentode, but the pentode section is a power amplifier type. Consequently, with this tube, we have a complete detector-a-f system for a portable receiver. The pentode provides a power output of 200 milliwatts at 10-percent distortion when operated with 90 volts on the plate and screen and a 9-volt negative grid bias.

The circuit shown in Fig. 3 represents a suggested application in a superheterodyne receiver, whereby avc voltage is supplied in addition to the other functions.

• • • television types

Sylvania has announced the 1232, a loktal-type triple-grid amplifier somewhat similar to the 1231 but with improved shielding. This tube is designed to be used in television video amplifiers and other applications where a tube with high mutual conductance (4500 micromhos) is desirable.

In keeping with the extremely small size of the miniature tube, sockets have been designed which require a minimum of chassis space. The overall diameter of the socket is slightly less than that of the tube. Similar reductions in size of other components will probably follow.

(Illustration courtesy Amphenol)

The 1232 is a single-ended tube, with low inter-electrode capacitance for a tube of this type. The grid-plate capacitance is .007 mmfd, input capacitance, 9.0 mmfd and output capacitance is 7.0 mmfd. This tube should work out well in u-h-f and frequency modulation receivers as well as in television applications. It is small and highly efficient. The relative size of this tube is shown in the accompanying photograph.

RCA has a new video beam-power amplifier, the 6AG7. This is a special purpose tube for use in the final stage of a video amplifier to modulate a picture tube. It is capable of giving a voltage output of approximately 70 (peak to peak). A typical video amplifier circuit incorporating the 6AG7 is shown in Fig. 4. This amplifier, having a band width of 4 mc, will undoubtedly find many other useful applications.

A number of new pictures tubes have also been announced which are not included on the charts, since we wanted to confine this month's discussion to receiving tubes only. The picture tubes

(Photo courtesy Philco)

The relative size of the loktal tube can be determined by comparison with that of a man's hand.

will receive consideration in an early issue.

• • • charts

In the accompanying tube charts the new tube types are listed in numerical and alphabetical order, without regard to their type of application. For service purposes, this seems a more useful form than that of classifying the tubes first as to their application and then listing the types in the order given.

Most of us know that the suffix G after a tube type number usually indicates that it is a glass tube with an octal-type base; some of the other suffixes are not so familiar.

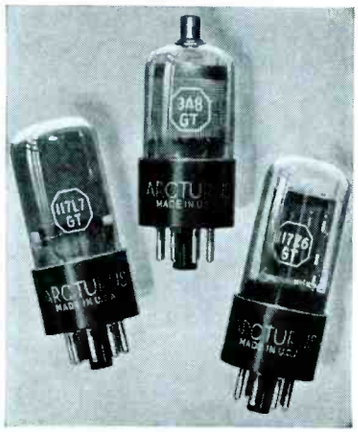
When the G tubes were made with a small tubular bulb, the initial T for the tubular form was added to the G, thus making the total suffix GT. The majority of the tubes found listed on these charts are of this type. These tubes are designed to fit an octal socket.

The designation 7 for the heater voltage indicates that the tube is designed to fit a loktal socket, and has a glass bulb. Other loktal-glass types are the 1231 and 1232. A suffix LM is used by RCA for octalox-metal tubes and LT for octalox-glass types. All fit the loktal socket.

The T bulb is tubular and bears a number which indicates its height. T7 has an overall height of 1-1/16 inch, T8 is 3-5/16 inches. The battery tubes bear an additional letter to indicate the bulb height and shape. For instance, the T9A, T9B, T9C bulbs are all 1-3/16 inches in diameter and vary in height; the —A type is 4-3/16 inches, —B, 4 inches and —C 4-5/16 inches.

• • • testing new tubes

In testing tubes, we need to know the operating voltages, first and foremost. Also, we want to know what function it is designed to perform, if it is being



(Illustration courtesy Arcturus)

The large majority of the new tubes announced during the past year have been of the GT type. The three shown are for making combination line-battery portables more efficient and compact.

tested in the receiver. All these data, together with other design characteristics, are tabulated on the chart.

With regard to the socket types, the only new one is the miniature type used for the 1R5, 1S4, 1S5 and 1T4, and the same one is used for all four. The octalox type of base fits the loktal socket, so there is nothing to worry about on that score. In general, too, the characteristics of the new GT types listed, correspond closely to those of their larger predecessors in glass and metal. If your tube checker does not list settings for testing these tubes, check over the characteristics of the GT or loktal type and compare them with one of the fore-runners of the same general type. If the characteristics are substantially the same, then no new test data will be required in order to check the tubes.

Standard bases are of eight types, designed to fit 4, 5, 6, small 7, large 7, loktal, octal and miniature types. The last listed are used for the new RCA miniature tubes—a 7-prong type. There are, of course, special types, such as the acorn, and junior bantam which are not in large production. The main types as listed above, meet the requirements for tube checker use. In fact, the miniature 7-prong might well be omitted for the present, since there are only four new tubes using this type of socket.

• • • heater characteristics

All the 1.4-volt tubes listed are designed to operate directly from a 1.5-volt battery with no voltage-dropping resistor. The 2.8-volt types may be operated in the same manner from a 3-volt source, or, if desired, the two 1.4-volt filaments may be connected in parallel and operation is then the same as any 1.4-volt tube, but the filament current is then doubled.

In battery-type tubes, the grid voltage listed is with respect to the negative terminal of the filament. This means that the grid must return directly to the negative terminal of the A battery if operating at zero bias. If a C-battery is used, the positive terminal of the C battery should connect to the negative terminal of the A battery. If self-bias is used, the grid should return to B minus and the bias resistor should likewise connect to this point, thence to the negative terminal of the A battery. The self-bias voltage reduces the effective plate voltage by the amount of the bias voltage. This should be taken into consideration if the maximum output at low plate voltages is desired.

The 7-volt tubes are designed for use at 6.3 volts as well as 7 volts and the characteristics of such tubes, as listed, are based on operation at 6.3 volts.

Many of the tubes listed have tapped heaters; some are center-tapped to permit either series or parallel operation, others have a tap for connection of a pilot light. Typical of the latter is the 45Z5GT (announced last March), which has a 7.5-volt tap for a pilot lamp.

• • • tube ratings

A new system of rating receiver tubes has recently been adopted by the Radio Manufacturers Association and will be followed generally by tube manufacturers. Formerly all tubes were rated at maximum operating voltages but designers usually made their calculations on the basis that the maximum operating voltages would be obtained at an average line voltage, in the case of a-c operated receivers, of 117 volts or less. However, the line voltage varies at different times of the day in the same location and in different locations. As a result, the receiver often operates at voltages both above and below that for which the design calculations were made. For instance, we may note that the maximum operating plate voltage of a 6L6 is 400 volts under a given set of conditions. If this maximum point is reached when the line voltage is 117, it will be exceeded if the line voltage increases with a resulting decrease in the life of the tube.

Many tubes are designed with a factor of safety so that the maximum rated operating voltages may be slightly exceeded without serious decrease in length of service; others are not. To standardize these ratings, all tubes are now to be rated according to the "design maximum" rather than to the "absolute maximum" as heretofore. As applied to the various electrodes and types of service, the following conditions will be observed:

Cathode: The heater or filament voltage is given as the normal value unless otherwise stated. This means that transformers or resistances in the heater or filament circuit should supply the full rated voltage to the heater or filament under average supply-voltage conditions. The cathode design is such that a moderate drop in heater or filament voltage will not cause a decided falling off in response, nor will moderate increases in heater or filament voltage above the design maximum cause a marked reduction in the life of the cathode.

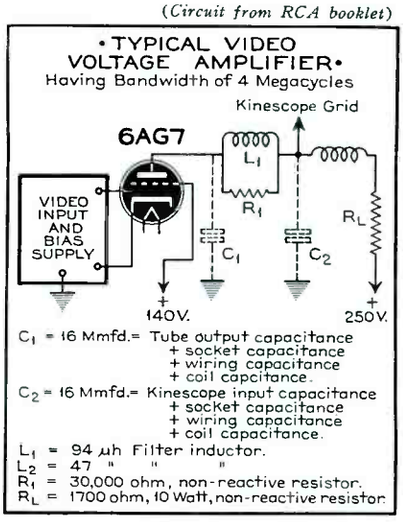
Plate and screen: For a-c and d-c power lines, equipment should be so designed that the maximum rated operating plate and screen voltages do not exceed the values specified when the line voltage is 117 volts. (Note that this is the new design maximum—it does not apply to ratings published prior to the introduction of this system except in instances where a wide safety factor was included in such prior ratings.) When so designed, the equipment may be used over a range of 105-125 volts with satisfactory performance and serviceability.

Automobile storage batteries: The average voltage value of automobile batteries has been established as 6.6 volts. In practice this value varies over a greater proportionate range than power line voltages, both above and below the average value. Therefore, the plate and screen operating voltages, as well as the plate and screen dissipation, and the rectified load current should not exceed 90 percent of the design maximum at 6.6 volts and this should be taken into consideration in the design of the equipment.

B batteries: Equipment operated from B batteries should be so designed that under no condition of operation will the plate voltage, the screen voltage, the plate dissipation or the screen dissipation exceed the recommended respective

Fig. 4. The 6AG7 video amplifier is especially designed for use in the final stage to modulate the picture tube in a television receiver.

(Circuit from RCA booklet)



• TUBE CHARACTERISTICS ····· (TENTATIVE) •

TUBE TYPE	SERVICE	BASE	PIN CONNECTIONS † 1	2	3	4	5	6	7	8	CAP	FILAMENT Volts	Amps	Type	CONT. GRID Volts	PLATE Volts	Ma.*	Res.	Load	SCREEN Volts	Ma.*	μ	CONV. COND. or Gm μmhos	POWER OUTPUT Milli watts	TUBE TYPE
1A7GT	PENTAGRID CONVERTER	OCTAL	NC	F+	P	G_3 G_5	G_1	G_2	F-	NC	G_4	1.4	0.05	F	0	90	0.55	0.6 Meg.	—	45	0.6	—	250	—	1A7GT
1B7GT	"	"	NC	F+	P	G_5	G_1	G_2	F-	NC	G_4	1.4	0.1	F	0	90	1.5	350,000	—	45	1.3	—	900	—	1B7GT
1B8GT	DIODE, TRIODE BEAM PWR AMP.	"	NC	F+	P_P	S_{rp}	G_P	P_T	F-	DP	G_T	1.4	0.1	F	T. 0 / BPA-6	90	0.15 / 6.3	.24 Meg. / —	— / 14,000	90	1.4	66 / —	275 / 1150	— / 210	1B8GT
1D8GT	DIODE, TRIODE PENTODE	"	NC	F+	P_P	S_{rp}	G_P	P_T	F-	DP	G_T	1.4	0.1	F	T 0 / P G	90	1.1 / 5.0	43,500 / 0.2 Meg	— / 12,000	90	1.0	25 / —	575 / 925	— / 200	1D8GT
1E4G	TRIODE	"	Sh	F+	P	NC	G	NC	F-	NC	—	1.4	0.05	F	0 / −3	90	4.5 / 1.5	11,000 / 17,000	— / —	—	—	14.5 / 14	1325 / 825	—	1E4G
1G4G	TRIODE DET.-AMP.	"	NC	F+	P	NC	G	—	F-	NC	—	1.4	0.05	F	−6	90	2.3	10,700	—	—	—	8.8	825		1G4G
1G6G	CLASS A AMP. CLASS B TWIN TRIODE	"	NC	F+	P_2	G_2	G_1	P_1	F-	NC	—	1.4	0.1	F	0 / 0	90	1.0 / 20 (PEAK)	45,000 / —	— / 12,000	—	—	30 / —	675 / —	— / 675	1G6G
1LB4G	POWER AMP. PENTODE	LOKTAL	F	P	G_{sr}	—	—	G	—	F	—	1.4	0.05	F	−9	90	5	12,000	12,000	90	1	—	925	210	1LB4G
1N5GT	R-F PENTODE AMP.	OCTAL	NC	F+	P	G_{sr}	NC	—	F-	NC	G	1.4	0.05	F	0	90	1.2	1.5 Meg.	—	90	0.3	1160	750	—	1N5GT
1N6G 1N6GT	DIODE POWER PENTODE	"	NC	F+	P	G_{sr}	G_1	DP	F-	NC	—	1.4	0.05	F	−4.5	90	3.1	0.3 Meg.	25,000	90	0.6	—	800	100	1N6G 1N6GT
1P5GT	VARIABLE-MU PENTODE	"	NC	F+	P	G_2	NC	—	F- G_3	NC	G_1	1.4	0.05	F	0	90	2.3	0.8 Meg.	—	90	0.7	640	800	—	1P5GT
1Q5G 1Q5GT	BEAM POWER OUTPUT	"	NC	F+	P	G_{sr}	G	—	F-	NC	—	1.4	0.1	F	−4.5	90	9.5	—	8000	90	1.6	—	2100	270	1Q5G 1Q5GT
1R5	PENTAGRID CONVERTER	MIN. 7-PIN	F-G_5	P	G_2 G_4	G_1	F-G_5	G_3	F+	—	—	1.4	0.05	F	0	90	0.8	0.75 Meg.	—	45	1.8	—	250	—	1R5
1S4	POWER AMP. PENTODE	"	F-G_3	P	G_1	G_2	F-G_3	P	F+	—	—	1.4	0.1	F	−4.5	45	3.8	0.25 Meg.	8000	45	0.8	—	1250	65	1S4
1S5	DIODE PENTODE	"	F-G_3	NC	DP	G_2	P	G_1	F+	—	—	1.4	0.05	F	0	90	1.2	0.5 Meg.	—	90	0.3	—	525	—	1S5
1T4	R-F PENTODE	"	F-G_3	P	G_2	NC	F- G_3	G_1	F+	—	—	1.4	0.05	F	0	90	2.0	0.8 "	—	45	.65	—	750	—	1T4
1T5 1T5G 1T5GT	BEAM POWER OUTPUT	OCTAL	Sh NC	F+	P	G_{sr}	G_1	—	F-	NC	—	1.4	0.05	F	−6	90	6.5	—	14,000	90	1.4	—	1150	170	1T5 1T5G 1T5GT
2W3GT	HALF-WAVE RECT.	"	NC	F	—	P	—	NC	—	F	—	2.5	1.5	F	—	350 A.C.	55 Ma. D.C. Output								2W3GT
2X2/879	HALF-WAVE RECT.	4-PIN	H	—	—	KH	—	—	—	—	P	2.5	1.75	H	—	4500 A.C.	12,000 V. Inverse peak 7.6 Ma. D.C. Output								2X2/879
3A8GT	DIODE-TRIODE R-F PENTODE	OCTAL	F_C-G_5 INT SH	F+	P_P	S_{rp}	G_T	P_T	F-	DP	G_P	2.8 / 1.4	0.05 / 0.1	F	T 0 / P 0	90 / 90	0.15 / 1.2	.24 Meg. / 0.6 "	— / —	— / 90	— / 0.3	65 / —	275 / 750	— / —	3A8GT
3C5GT	POWER AMP. PENTODE	"	NC	F+	P	G_S	G	—	F-	F_C	—	2.8 / 1.4	0.05 / 0.1	F	−9	90	6	—	10,000	—	—	—	1450	260	3C5GT
3Q5GT	BEAM P'W'R OUTPUT	"	NC	F+	P	G_{sr}	G	—	F-	F_C	—	2.8 / 1.4	0.05 / 0.1	F	−4.5	90	9.5	0.1 Meg.	8000	90	1.6	—	2100	270	3Q5GT
6AE5GT	LO-MU TRIODE	"	NC	H	P	—	G	—	H	K	—	6.3	0.3	H	−15	95	7.0	3500	—	—	—	4.2	1200	—	6AE5GT
6AF5GT	TRIODE	"	NC	H	P	—	G	—	H	K	—	6.3	0.3	H	−18	180	7.0	4900	—	—	—	7.4	1500	—	6AF5GT
6AG7	VIDEO BEAM POWER AMP.	"	BEAM PLATES	H	INT. SHIELD	G_1	K	G_2	H	P	—	6.3	0.65	H	−10.5	300	25.0	0.1 Meg.	—	300	6.5	770	7700	—	6AG7
6AL6G	BEAM P'W'R AMP.	"	NC	H	—	G_{sr}	G	—	H	K	P	6.3	0.9	H	−14	250	72	—	2500	250	5	—	6000	6500	6AL6G
6C5GT	TRIODE	"	NC	H	P	—	G	—	H	K	—	6.3	0.3	H	−8	250	8	10,000	—	—	—	20	2000	—	6C5GT
6E8G	TRIODE-HEXODE	"	NC	H	P_H	G_{sr}	G_3 G_T	P_T	H	K	G_1	6.3	0.3	H	T. 0 / Hex. −2	150 / 250	— / —	— / 1.25 Meg.	— / —	— / —	— / —	— / —	2800 / 630	— / —	6E8G
6F5GT	HIGH-MU TRIODE	"	NC	H	—	P	—	—	H	K	G	6.3	0.3	H	−2	250	0.9	66,000	—	—	—	100	1500	—	6F5GT
6K6GT	POWER PENTODE	"	NC	H	P	G_2	G_1	—	H	K	—	6.3	0.4	H	18.5	250	32	68,000	7600	250	5.5	150	2200	3400	6K6GT
6J5GT	TRIODE	"	NC	H	P	—	G	—	H	K	—	6.3	0.3	H	−8	250	9.0	7700	—	—	—	20	2500	—	6J5GT
6P5G	TRIODE	"	NC	H	P	D_2	D_1	—	H	K	—	6.3	0.3	H	−13.5	250	5.0	9500	—	—	—	13.8	1450	—	6P5G
6R7GT	DUO-DIODE TRIODE	"	NC	H	P	D_2	D_1	—	H	K	G	6.3	0.3	H	−9	250	9.5	8500	10,000	—	—	16	1900	280	6R7GT
6V6GT	BEAM POWER AMP.	"	NC	H	P	G_{sr}	G	—	H	K	—	6.3	0.45	H	−13 / P.P. −15	315 / 250	34 / 70	77,000 / 60,000	8500 / 10,000	225 / 250	2.2 / 5.0	218	3750	5500 / 10,000	6V6GT
6W6GT	BEAM POWER AMP.	"	NC	H	P	G_{sr}	G	—	H	K	—	6.3	1.25	H	−9.5	135	58	—	2000	135	12	215	9000	3300	6W6GT
6W7G	TRIPLE GRID AMP.	"	NC	H	P	G_{sr}	Su	—	H	K	G	6.3	0.15	H	−3	250	2.0	1.5 Meg.	—	100	0.5	1850	1225	—	6W7G
7A4	TRIODE	LOKTAL	H	P	NC	NC	NC	G	K	H	—	7.0	0.32	H	−8	250	9.0	7700	—	—	—	20	2600	—	7A4
7A5	BEAM POWER AMP.	"	H	P	G_{sr}	NC	NC	G	K	H	—	7.0	0.75	H	−9	125	40	17,000	2700	125	8	—	6100	1900	7A5
7A7	VARIABLE-MU PENTODE	"	H	P	G_{sr}	Su	SLEEVE	G	K	H	—	7.0	0.32	H	−3	250	8.6	0.8 Meg.	—	100	2	1600	2000	—	7A7
7C7	R-F PENTODE	"	H	P	G_{sr}	Su	SLEEVE	G	K	H	—	7.0	0.16	H	−3	250	2.0	2 Meg.	—	100	0.5	—	1300	—	7C7
7E6	DUO-DIODE TRIODE	"	H	P	G	K	DP	DP	K	H	—	7.0	0.32	H	−9	250	9.5	8500	—	—	—	16	1900	—	7E6
7E7	DUO-DIODE PENTODE	"	H	P	DP_1	DP_2	G_2	G	K-G_3 INT SH.	H	—	7.0	0.32	H	−3	250	7.5	0.7 Meg.	—	100	1.6	—	1300	—	7E7
7F7	TWIN-TRIODE AMP.	"	H	K_1	P_1	G_1	G_2	P_2	K_2	H	—	7.0	0.32	H	−2	250	2.3	44,000	—	—	—	70	1600	—	7F7
7J7	TRIODE-HEXODE CONVERTER	"	—	—	—	—	—	—	—	—	—	7.0	0.32	H	T. −3 / Hex. −3	150 / 250	7.5 / —	10,400 / 1.5 Meg.	— / —	— / —	— / —	— / —	1350 / 350	— / —	7J7
7Q7	PENTAGRID CONVERTER	"	H	P	G_2 G_4	G_1	G_5 INT SH	G_3	K	H	—	7.0	0.32	H	−2	250	3.4	0.8 Meg.	—	100	8	—	450	—	7Q7
12A6	BEAM POWER AMP.	OCTAL	NC	H	P	G_{sr}	G	—	H	K	—	12.6	0.15	H	−12.5	250	30	50,000	7500	250	3.5	218	3000	2500	12A6
12B7G	VARIABLE-MU PENTODE	LOKTAL	H	P	G_{sr}	Su	NC	G	K	H	—	12.6	0.15	H	−3	250	9.2	0.8 Meg.	—	100	2.4	360	2000	—	12B7G
12E5GT	TRIODE	OCTAL	NC	H	P	—	G	—	H	K	—	12.6	0.15	H	−13.5	250	5.0	9500	—	—	—	13.8	1450	—	12E5GT
12K7G	TRIPLE GRID AMP.	"	Sh	H	P	G_{sr}	Su	—	H	K	G	12.6	0.15	H	−3	250	10.5	0.6 Meg	—	125	2.6	990	1650	—	12K7G
12K8	TRIODE-HEXODE	"	NC	H	P_H	G_{sr}	G_H G_T	P_T	H	K	G_3	12.6	0.15	H	T. −3 / Hex. −9	100 / 250	2.5 / 9.5	8500	—	— / 100	— / 6	16	1900	—	12K8
12SF5	HIGH-MU TRIODE	"	NC	K	G	—	P	—	H	H	—	12.6	0.15	H	−2	250	0.9	6600	—	—	—	100	1500	—	12SF5
12SR7	DUO-DIODE TRIODE	"	NC	G	K	DP_1	DP_2	P	H	H	—	12.6	0.15	H	−9	250	9.5	8500	—	—	—	16	1900	—	12SR7
25AC5G 25AC5GT	HIGH-MU POWER TRIODE	"	NC	H	P	—	G	—	H	K	—	25	0.3	H	−15	110	45	15,200	2000	—	—	58	3800	2000	25AC5G 25AC5GT
25B8GT	TRIODE PENTODE	"	G_3 K_P	H	P_P	G_2	P_T	K_T	H	G_T	G_1	25	0.15	H	T. −1 / P. −3	100 / 100	0.6 / 7.6	75,000 / 185,000	— / —	— / 100	— / 2.0	112.5 / 370	1500 / 2000	— / —	25B8GT
25C6G	BEAM POWER AMP.	OCTAL	NC	H	P	G_{sr}	G_1	—	H	K	—	25	0.3	H	−14	200	66	18,300	2600	135	9	—	7100	6000	25C6G
25Y4GT	HALF-WAVE RECT.	"	NC	H	NC	—	P	—	H	K	—	25	0.15	H	—	125 A.C.	—	—	75 Ma. D.C. Output				—	—	25Y4GT
25Z4GT	HALF-WAVE RECT.	"	NC	H	NC	—	P	—	H	K	—	25	0.3	H	—	125 A.C.	—	—	125 " " "				—	—	25Z4GT
50C6G	BEAM POWER AMP.	"	NC	H	P	G_{sr}	G	—	H	K	—	50	0.15	H	−14	200	61	18,300	2600	135	2.2	—	7100	6000	50C6G
50L6GT	BEAM POWER AMP.	"	NC	H	P	G_{sr}	G_1	—	H	K	—	50	0.15	H	−7.5	110	50	10,000	2000	110	11	82	8200	2200	50L6GT
50Y6G	RECT. VOLTAGE DOUBLER	"	NC	H	P_1	K_1	P_2	H_C	H	K_2	—	50	0.15	H	—	125 A.C.	—	85 Ma./plate D.C. Output							50Y6G
50Z7G	FULL-WAVE RECT. (TAPPED HEATER)	"	NC	H	P_1	K_1	P_2	H_C	H	K_2	—	50T	0.15	H	—	117 A.C.	400 Ma. A.C. Peak 65 Ma./plate D.C. Output								50Z7G
70A7GT	RECT.-BEAM POWER AMP.	"	K_R	H	P	G_{sr}	G	P_R H_C	H	K_A	—	70 / 7.5	0.3	H	RECT. / −7.5	125 A.C. / 110	— / 40	— / —	60 Ma. D.C. OUTPUT / 2500	110	3.0	80	— / 5800	— / 1500	70A7GT
70L7GT	"	"	K_R	H	P	G_{sr}	G	K	H	P_R	—	70	0.15	H	RECT. / −7.5	125 A.C. / 110	— / 43	— / 15,000	70 Ma. D.C. OUTPUT / 2000	110	6	—	— / 7500	— / 1800	70L7GT
117L7GT	"	"	K_R	H	P	G	G_{sr}	P_R	H	K	—	117	0.09	H	RECT. / −5.5	105 A.C. / 105	— / 45	— / 20,000	75 Ma. D.C. OUTPUT / 4000	105	4	—	— / 4000	— / 5500	117L7GT
117Z6G 117Z6GT	FULL-WAVE RECT.	"	H_C	H	P_1	K_1	P_2	—	H	K_2	—	58.5 / 117	.15 / .075	H	—	VOLTAGE DOUBLER 117 A.C. MAX. 235	350 Ma. A.C. Peak 65 Ma./plate D.C. Output								117Z6G 117Z6GT
1232	TRIPLE GRID AMP.	LOKTAL	H	P	G_{sr}	Su	INT. SH.	G	K	H	—	7	0.48	H	−2	250	6	0.8 Meg.	—	100	2	—	4500	—	1232

† RMA Pin numbers are used NC = No Connection F = Filament H = Heater P = Plate G = Grid Sr = Screen K = Cathode
Sh = Shell DP = Diode Plate Su = Suppressor
* WHERE VARIABLE, MAXIMUMS ARE GIVEN Fc OR Hc = Filament Tap Gp = Grid, Pentode Section, etc. GT = Grid, Triode Section

maximum values by more than 10 percent.

Other electrodes: When a tube is of the multi-grid type, the voltages applied to the additional electrodes, when positive, will be subject to the same considerations as those stated for the plate and screen.

Typical operation: Typical operating conditions are not to be considered as ratings; they are intended merely to serve as a guide for the use of each type. The tube can be used in any circuit or under any operating conditions providing its rating limitations are not exceeded.

RCA has just issued an application note (No. 105) which gives charts showing the new design maximum (and minimum) ratings as applied to a group of standard tubes.

It can be seen from these charts, which we reproduce herewith, that the new design maximum ratings for many power-amplifier and rectifier types have been reduced from the former absolute maximum values. For some other tube types, the design maximum ratings are the same as those previously specified as absolute maximum ratings. By maintaining the same rating, under the new basis of interpretation, the result is, in effect, an increase in the rating. For instance, in some of the voltage-amplifier types, the previous absolute maximum of 250 volts has been retained as a design maximum under the new system. Further, in a number of other voltage amplifier types, the rating has been increased to 300 volts as a design maximum in place of the former 250-volt absolute maximum.

With reference to the 6L6 and 6L6G, note that the new design maximum rating is 360 volts for the plate and a screen maximum of 270 volts, as compared with the former ratings of 400 and 300 volts, respectively. However, the new design maximum for the plate voltage of the 6V6 has been increased from 300 to 315 volts, while the screen maximum has been reduced from 300 to 250 volts. It would be a good idea, in servicing receivers which use these tubes at their former maximum ratings, to alter the voltages to correspond with the new ratings. This applies likewise, of course, to p-a systems and ham transmitters.

The 25B6G must be standing the gaff unusually well; we note under the new listing that the design maximum for the plate voltage has been jacked up from the previous absolute maximum rating of 135 to the new listing of 200. The screen voltage rating remains the same at 135.

The new design maximum ratings for many power-amplifier and rectifier types have been reduced from former absolute maximum values. For some other types design maximums are the same as previously specified as absolute values; for still others the rating has actually been increased.

The 25L6G seems to be doing better in the field if we are to judge by the new ratings. As listed, the plate and screen design maximums are now 117 volts as compared with previous absolute maximum ratings of 110 volts.

For the popular 6F6, the plate maximum under the new rating remains unchanged at 375 volts for the pentode application and 350 volts, when used as a triode. The design maximum for the screen is 285 volts, as compared with the previous absolute maximum of 315 volts. The new listing is, therefore, an effective increase in the plate voltage rating since it implies, on all listed tubes, that the plate voltage may increase to an absolute maximum 7 percent higher than the value listed without rendering the performance and serviceability unsatisfactory.

Those of you who are in neighborhoods where high line voltages, in the vicinity of 125 volts, are frequently encountered should take heed of the new RMA ratings for rectifier tubes. If they pop too often for comfort in sets

(*Continued on page 24*)

NEW MAXIMUM RECEIVING-TUBE RATINGS ACCORDING TO RMA SYSTEM

POWER AMPLIFIERS

TYPE	NAME	MAXIMUM PLATE VOLTAGE Volts	MAXIMUM SCREEN VOLTAGE Volts	MAXIMUM PLATE DISSIPATION Watts	MAXIMUM SCREEN DISSIPATION Watts
6F6	AS PENTODE	375	285	11.0	3.75
6F6-G	AS TRIODE	350	-	10.0	-
6G6-G	PENTODE	180	180	2.75	0.75
6K6-G	PENTODE	315	285	8.5	2.8
6L6	AS BEAM TUBE	360	270	19.0	2.5
6L6-G	AS TRIODE	250	-	10.0	-
6V6	BEAM				
6V6-G	POWER AMPLIFIER	315	250	12.0	2.0
6Y6-G	BEAM POWER AMPLIFIER	200	135	12.5	1.75
25A6					
25A6-G	PENTODE	160	135	5.3	1.9
25B6-G	PENTODE	200	135	12.5	2.0
25L6-G	BEAM POWER AMPLIFIER	117	117	4.0	1.25

CONVERTERS AND MIXERS

TYPE	NAME	MAXIMUM PLATE VOLTAGE Volts	MAXIMUM SCREEN SUPPLY Volts	MAXIMUM SCREEN VOLTAGE Volts	MAXIMUM ANODE-GRID SUPPLY Volts	MAXIMUM ANODE-GRID VOLTAGE Volts	MAXIMUM DISSIPATION PLATE Watts	MAXIMUM DISSIPATION SCREEN Watts	MAXIMUM DISSIPATION ANODE-GRID Watts	MAXIMUM TOTAL CATHODE CURRENT Milliamperes	MINIMUM EXTERNAL SIGNAL-GRID BIAS Volts
6A8											
6A8-G	PENTAGRID CONVERTER	300	300	100	300	200	1.0	0.3	0.75	14	0
6D8-G	PENTAGRID CONVERTER	300	300	100	300	200	1.0	0.3	0.75	13	0
6K8											
6K8-G	TRIODE-HEXODE CONVERTER	300*	300	150	-	125#	0.75**	0.7	0.75##	16	0
6L7											
6L7-G	AS MIXER	300	-	150	-	-	1.0	1.5	-	-	-

* Hexode plate voltage. # Triode plate voltage. ** Hexode plate dissipation. ## Triode plate dissipation.

TUNING INDICATORS

TYPE	NAME	MAXIMUM PLATE SUPPLY Volts	MAXIMUM TARGET VOLTAGE Volts	MINIMUM TARGET VOLTAGE Volts
6E5	ELECTRON-RAY TUBE	250	250	100
6N5	ELECTRON-RAY TUBE	180	180	100
6U5/6G5	ELECTRON-RAY TUBE	250	250	100

VOLTAGE AMPLIFIERS

TYPE	NAME	MAXIMUM PLATE VOLTAGE Volts	MAXIMUM SCREEN SUPPLY Volts	MAXIMUM SCREEN VOLTAGE Volts	MAXIMUM DISSIPATION PLATE Watts	MAXIMUM DISSIPATION SCREEN Watts	MINIMUM EXTERNAL GRID BIAS Volts
6B6-G	DUPLEX-DIODE HIGH-MU TRIODE	250	-	-	-	-	-
6B8							
6B8-G	DUPLEX-DIODE PENTODE	300	300	125	2.25	0.3	0
6C5	DETECTOR AMPLIFIER TRIODE	300	-	-	2.5	-	0
6C5-G							
6C8-G	TWIN TRIODE AMPLIFIER	250	-	-	*1.0	-	0
6F8-G	TWIN TRIODE AMPLIFIER	300	-	-	*2.5	-	0
6J5	DETECTOR AMPLIFIER TRIODE	300	-	-	2.5	-	0
6J5-G							
6J7	AS PENTODE	300	300	125	0.75	0.1	0
6J7-G	AS TRIODE	250	-	-	1.75	-	0
6K7	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	300	300	125	2.75	0.35	0
6K7-G							
6L7	AS CLASS A_1 AMPLIFIER	300	-	100	1.5	1.0	-
6L7-G							
6S7	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	300	300	100	2.25	0.25	0
6S7-G							
6S07	DUPLEX-DIODE HIGH-MU TRIODE	250	-	-	-	-	-
6U7-G	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	300	300	100	2.25	0.25	0
6W7-G	TRIPLE-GRID DETECTOR AMPLIFIER	300	300	100	0.5	0.1	0
12S07	DUPLEX-DIODE HIGH-MU TRIODE	250	-	-	-	-	-

* For each plate.

RECTIFIERS

TYPE	NAME	MAXIMUM PEAK INVERSE VOLTAGE Volts	MAXIMUM STEADY-STATE PEAK PLATE CURRENT PER PLATE# Milliamperes	MAXIMUM D-C HEATER-CATHODE POTENTIAL volts	CONDENSER INPUT TO FILTER MAXIMUM A-C PLATE VOLTAGE* Volts (RMS)	CONDENSER INPUT TO FILTER MAXIMUM D-C OUTPUT CURRENT Mill. Amp.	CONDENSER INPUT TO FILTER MINIMUM TOTAL EFFECTIVE PLATE-SUPPLY IMPEDANCE* Ohms	CHOKE INPUT TO FILTER MAXIMUM A-C PLATE VOLTAGE* Volts (RMS)	CHOKE INPUT TO FILTER MAXIMUM D-C OUTPUT CURRENT Milliamperes	CHOKE INPUT TO FILTER MINIMUM VALUE OF INPUT CHOKE Henries
5T4	FULL-WAVE	1550	675	-	450	225	150	550	225	3
5U4-G	FULL-WAVE	1550	675	-	450	225	75	550	225	3
5V4-G	FULL-WAVE	1400	525	-	375	175	65	500	175	4
5W4	FULL-WAVE	1400	300	-	350	100	25	500	100	6
5W4-G										
5X4-G	FULL-WAVE	1550	675	-	450	225	75	550	225	3
5Y3-G	FULL-WAVE	1400	375	-	350	125	10	500	125	5
5Y4-G	FULL-WAVE	1400	375	-	350	125	10	500	125	5
5Z4	FULL-WAVE	1400	375	-	350	125	30	500	125	5
6X5	FULL-WAVE	1250	210	450	325	70	150	450	70	8
6X5-G										
6ZY5-G	FULL-WAVE	1250	240	450	325	40	225	450	40	13.5
25Z4	HALF-WAVE	700	750	350	235	125	100	-	-	-
25Z6	VOLTAGE-DOUBLER	700	450	350	117	75	0°	-	-	-
25Z6-G	HALF-WAVE	700	450	350	235	75	100	-	-	-

When a filter input condenser larger than 40 μf is used, it may be necessary to use more plate-supply impedance than the MINIMUM value shown.
* Per plate.
° Zero ohms for full-wave voltage-doubler circuit; 30 ohms for half-wave voltage-doubler circuit (in which one d-c terminal is connected to one side of a-c line).

LEARN TO SELL

By V. E. JENKINS

WESTON ELECTRICAL INSTRUMENT CO.

Usually, the Service Man who calls at the customer's home is technically minded. He forgets, and sometimes doesn't even know, that he should first of all be a good salesman.

EVERY Service Man who expects to make a success in radio must first of all consider himself a salesman. The ability to analyze technical problems is possessed by thousands of Service Men, but relatively few possess a proper understanding of the fundamental approach to effective salesmanship.

Beginners are prone to look upon this business as one which affords an outlet for their technical ability. This thought is fundamentally correct, but there is a constant tendency to lose sight of the fact that servicing at a profit is essentially the result of effective selling.

After all, the Service Man daily meets the same kind of people who are subjected to the appeals of large commercial advertisers. These advertisers have found that the great majority of people respond to certain psychological stimuli. To sell automobiles via the radio, or newspapers, they base their appeals on comfort, luxury, economy and pride of ownership. We seldom hear anything about gear ratios or piston clearances. No doubt many of you will agree that the technical man plays a very important part in the production of automobiles. However, he relies upon the salesman to create a demand for his product. It is the public demand for fine automobiles which creates the need for his services.

Psychologically, the meeting of two strangers is a delicate situation. Your customer will be quick to note any over-aggressiveness or irritating qualities in your personality.

These same principles apply whether you are selling automobiles, breakfast food or radio service. Your problems are somewhat different in that you should be both a technician and a salesman. A technical knowledge of radio is of prime importance but we must not forget that to capitalize this training we must create a demand for our services through effective salesmanship.

I have said that the problems confronting the Service Man are different. Well, how are they different, and how can Service Men increase their profits by becoming service-salesmen?

Let's first look at the matter of appearance. Now I don't mean personal appearance because most of us know that any salesman must be neat and clean. What I do mean is this: When a customer enters my shop or when I call at his home—how do I greet him? Do I give him a sincere, friendly smile? Or do I curtly say, "Well, what can I do for you?" Believe it or not, this first step is mighty important. Psychologically, the meeting of two strangers is a delicate situation. Your customer will be quick to note any over-aggressiveness or irritating qualities in your personality. If you can immediately disarm him with a pleasant smile and helpful attitude you've won a friend. More important . . . you've won his business.

These little tricks in personal selling are fairly well understood by salesmen working in a dealer's store. In the field however, we face a somewhat more difficult situation. Usually, the man who calls at the customer's home is technically-minded. He forgets, and sometimes doesn't even know, that he should first of all be a good salesman. The average housewife doesn't have much patience with strangers. She has to put up with house-to-house salesmen, collectors and beggars. Watch out for danger signals; use a good personal approach; do your darndest to please her.

When you get down to actually checking a set, talk to her . . . don't try to be mysterious. The chances are she'll stay right with you—if she fully trusted you she'd leave you to your business. But she doesn't, she wants to keep her eye on you. The quicker you gain her condence the better off you'll be. If you enter her home carrying several pieces of test equipment, and park them all over the room, she won't like it. She'll think she's in for a major operation instead of a minor repair. (I mean the set, not her). In other words, she'll be confused, not impressed. But if you use one or two modern, up-to-the-minute test units she will be impressed. Your test equipment will help build you up . . . in her mind you become a professional man, instead of a screw-driver mechanic. With modern testers, you'll be able to locate trouble quickly, give an accurate estimate, and get the job.

Don't be afraid to tell the customer what work you'll have to do. If you just give her a bill listing three tubes and two condensers, she, or her husband, will feel that they are being over-

(*Continued on page 25*)

WE EXPECT
FOR 1940

By

Robert G. Herzog

EDITOR

1939 will be highlighted in history for the many marked advances in the field of radio. The introduction of television, frequency modulation, and facsimile services and the commercial sponsorship of international broadcast programs are but a few of the most outstanding. And, too, it has been a decidedly profitable year for the industry. Unit sales of sets and tubes were quite in the lead over other years. Broadcast network billings were also higher than in any previous year.

At this point we feel sure that 1940 will be even better. The coming presidential election and the increased listening due to the events abroad cannot help but improve tube and set sales. Such increased sales, as in previous years, should set a lively pace for the rest of the industry. To give a basis for our optimism let us measure the existing trends in each field, separately, and point the way toward developments to follow.

• • • receiver sales figures, 1939

The best available figures place receiver sales somewhere between 9 and 10 million[1]. These figures are based on RCA license reports for the first 9 months of the year and are estimated for the remaining quarter. 20% of the year's sales are attributed to each of the first two quarters, 25% to the third and 35% to the last quarter. This follows the general division of sales as found in previous years.

Figures just released[1a] state that at least 84% of the total families in the U. S. have at least one radio receiver. At this time there are slightly over 34 million families in the U. S.[1]

The accompanying charts[2] (Figs. 1 and 2) show the long time trends in the broadcast receiver industry. Among other things, they predict a steadily increasing market for secondary receivers.

It has been calculated[2] that in each year since 1935 about 75% of the listening public replaced receivers bought 7 years previously. Considering the extent of improvements in receivers it would seem that this is an excessively long period. Concentration on new features and higher priced models, especially on phonograph combinations, should help break down this resistance on the part of the purchaser. The trend seems to be in this direction. There can be no doubt that with improved economic conditions the listener will purchase a replacement receiver earlier. Many of the large percentage of phonograph combinations sold during 1939 must have been for replacement of old receivers. The high average list price of receivers sold during 1939 also seems to point to a larger figure for replacements than that predicted in Fig. 2.

There should be an attempt, on the part of set manufacturers and merchandisers, to develop new markets for receivers other than for use in homes. For example, TWA have installed receivers in some of their transcontinental planes. The equipment also permits the captain to cut-in and give flight bulletins, etc. In addition to further expansion of this airplane market, it is suggestive of similar service on overland busses and trains. (See photo.)

[1] From a paper "Review of Broadcast Receiver Field for 1939" delivered by D. E. Foster, RCA License Labs, to the IRE, N. Y., Jan. 3, 1940.

[1a] From an address by Edward M. Kirby (NAB) before the National Ass'n of Cleaners and Dyers, Washington, D. C., Jan. 18, 1940.

[2] "Basic Economic Trends in the Radio Industry," by Julius Weinberger, RCA License Labs, Proceedings of the IRE, Nov. 1939, p. 704.

There should be an attempt, in 1940, on the part of set manufacturers and merchandisers, to develop new markets for receivers other than for use in homes. In addition to further expansion of the market for receivers in planes (left), this use is suggestive of a similar service on overland busses and trains.

Illustration, courtesy TWA

• • • new features

Every year the set manufacturers work up some outstanding characteristic which is designed to make the new line more attractive to the present set owner . . . new features which can be stressed in advertising copy or make front page news. In the 1938-39 line, for example, push-button tuning was the big feature (in 40% of models *offered* . . . .The currently offered (1939-40) line is pushing the battery-operated portable[3] (11% of all models *offered*) and the self-contained loop antenna[4] (31% of all models *offered*).

At this point we can predict, with some degree of certainty, that **home recording facilities will be added as a major feature by many set makers to their 1940-41 consoles.** If the prices of the units and of the record blanks are sufficiently low this should prove to be a very popular feature.

We can, of course, also expect models which will provide for frequency modulation reception in addition to the regular a-m stations.

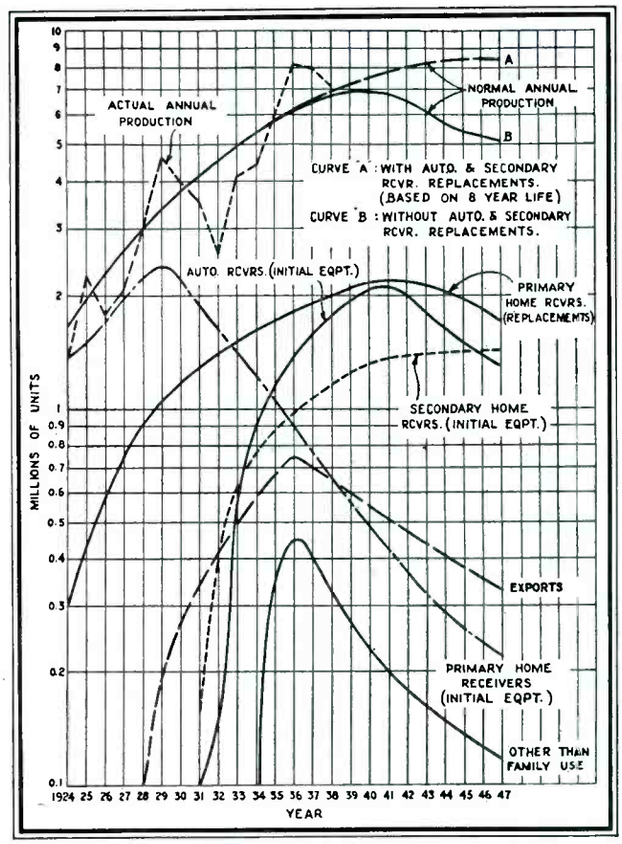
• • • simplicity

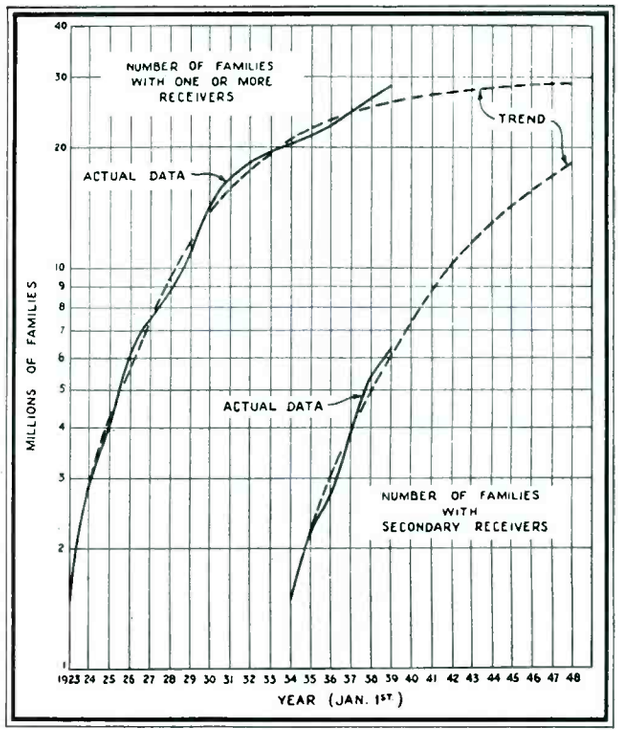
In a recent series of articles in SERVICE[5] we discussed the myriads of new kinks and clever circuit features which the receiver manufacturers are offering in their 1939-40 lines. Since

[3] "Battery Portables," by Henry Howard, SERVICE, May, 1939, p. 230.

[4] "Loop Antennae," by Mark and Edward M. Glaser, SERVICE, August, 1939, p. 375.

[5] "Receiver Trends for 1940," by Henry Howard, SERVICE, Sept., 1939, p. 419, and also Oct., 1939, p. 472.





Figs. 1 and 2. The charts[2] shown are calculated according to present data and predict the long time trends for receiver sales. They show that the primary market for receivers is practically saturated and that future sales will be largely for replacements and secondary sets.

then additional material has been available. In all, data on some 650 different receiver models, introduced by the manufacturers between April and December 15, 1939, were studied for the survey presented here. These receivers are generally characterized as 1939-40 models.

The large majority of sets offered throughout the years contained 5 or 6 tubes. The percentage of 5-tube models, however, has been steadily increasing. For the 1939-40 season, about 42% of all models offered have 5 tubes, approximately 20% have 6, and 10% have 7 tubes. The season before (1938-39) 38% were 5 tube sets, 18% were 6 tube and 11% were 7 tube models. In former years sets with as many as 25 tubes were offered; the maximum number of tubes in any one 1939-40 model is 18 tubes.

There is also a definite trend in the new models towards simplicity of circuit. Motor tuning has been abandoned in all but a few higher priced models, as has afc, amplified avc and noise suppression. This trend is further evidenced by the gradual move towards fewer tuning bands. Almost 50% of the models offered this season had but a single band as compared with 35% so limited among last season's models. Approximately 2% of the receivers offered for 1939-40 possessed more than 3 bands; there were over 8% among the 1938-39 presentations.

[6]Census of Manufactures: 1937, U. S. Department of Commerce.

• • • phono-radio combinations

Sales of phonograph combinations for 1939 have been a pleasant surprise. In fact, the rise for the past few years has been phenominal. From a lowly 23,400 units in 1935[6] sales jumped to 57,800 in 1937[6] and then to about 400,000 in 1938. One manufacturer estimates phono-radio combination sales for 1939 at 600,000 with an average list price around $100.

We hesitate to make any predictions for 1940 but there seems little doubt but that even more units will be sold. Improvements in records and the added novelty of home recording (discussed previously) should help swell the figures.

Record sales have also been increasing during the last few years. From about 40 million records in 1938 the number sold jumped to 60 million last year. Here again we hesitate to make any predictions but because of the extremely large number of combinations sold last year there should be a much larger differential this year.

• • • battery portables

The set designers skill now makes available really small portables[3] with remarkable performance and has made this field a very active one both from the point of view of sales and of developments. With the recent crop only a little over a year old, there are approximately 50 varieties ranging from 3½ to 35 lbs. (12 lbs. average) all with self-contained loop and about 20% capable of both line and battery operation. Over 1½ million have been sold since their introduction and sales are progressing regardless of the season.

From the very beginnings of radio the possibility of a vestpocket receiver has been the dream of many a set designer and the desire of ardent fans. The announcement of the new miniature tubes[7] brings us many strides nearer the accomplishment of that dream. We look forward to an increased number of smaller battery portables.

The growing tendency toward combining a-c, d-c operation along with battery operation of small portables has been bolstered by the introduction of several 117-volt tubes, namely the 117Z6GT and the 117L7GT[7]. The former is a rectifier designed to operate directly from the power lines and supply both A and B power for the receiver when it is plugged into the power lines. The 117L7GT is a combination half-wave rectifier and power output tube. The rectifier section supplies both A and B power while the power output section is substituted in the output stage during line operation for improved performance.

A generator manufacturer is work-

[7]"Tubes," by John H. Potts, SERVICE, Jan., 1940 (this issue), p. 7.

Photo, courtesy Wilcox-Gay

We expect that home recording will be added as a major feature by many receiver manufacturers to their 1940-41 consoles.

ing on a small unit, powered by a hand-wound spring, which will provide both A and B power for the portable receiver. Should this be perfected shortly **we can expect a completely self-powered portable, functioning without batteries or power-line connection,** before the year is out. The introduction of a new and highly powerful magnet alloy, within the last few weeks, brings this possibility much closer to realization.

The excellent performance, small size and low price of battery portables in general should prove influential in making every listener a prospect for one or more of these receivers, swelling the market for secondary sets.

• • • communications receivers

The communications receiver field has been marked by noteworthy technical advances during each recent year. 1939 has been no exception. In addition it witnessed progress of a new trend toward lower price levels and greater values. This comes partly as a result of increased sales that permit the economies of large-scale production and partly through design and production innovations which permit many heretofore deluxe features to be incorporated in receivers of modest price. It is unquestionably a fact that at the close of 1939 a modest pocketbook could buy more communications receiver than ever before. There is every indication that this trend is to continue during 1940.

It is probable that temperature compensation and more accurate maintenance of frequency calibration will be two objectives of the manufacturers during 1940. This year will probably see a marked migration of hams to the ultra-high-frequency bands with a resulting demand for communications equipment to cover at least down to 2½ meters. Amateur portable-mobile operation will likely become more popular also due to the reduced dx activities resulting from the war. This again calls for new types of equipment.

• • • broadcasting

Since its inconspicuous beginning almost 20 years ago, radio broadcasting has come a long ways . . . from 1 station to over 760, with over 47 million receivers in the hands of the American public. Network billings for 1939 showed increases ranging from 10 to over 30% above 1938. One authority[8] figures the total gross billing at over 83 million dollars. Increasing interest in news from abroad, a national election, and an expected advance in general business conditions presage 1940 to be even better.

• • • television

There are two good reasons why there should be plenty of television activity this year. There is the increased quantity and improved quality of programs and the reduction announced in the list prices of television receivers. In spite of the previous lamented lack of good programs, merchandising experiments in Newburgh, Middletown and Poughkeepsie, New York, have shown that television sets can be sold in quantity if the price is low enough. 1940 will really mark the beginning of active sales of television sets. Let us review the situation before we pass further comment.

It has been estimated that approximately 1800 television receivers were sold to the public during 1939. At an average list price of $350 this represents a total of $630,000—while not all that was anticipated—it still represents a fair sum for the very first year of a new industry.

A little stressed, but important, point has been the familiarization of a great many people with television during the past year. In addition to the programs broadcast by the stations on both coasts, large crowds attended demonstrations at the World's Fairs, at their dealers, in department stores, theatres, etc.—at least one travelling demonstration outfit was in operation a good deal of the time, while several broadcast stations had similar television equipment in operation. It is encouraging to note that in most instances the viewing public was agreeably impressed with the results. This type of educational work will expand considerably during 1940.

A very encouraging action was the recent adoption by the FCC of their television committee's recommendation which permits television broadcasters to accept sufficient commercial programs to cover operating costs. This is undoubtedly a step in the right direction since the expense of program production is one of the broadcaster's paramount charges. Clarification of this ruling was the subject of an FCC hearing held on January 15.

As we mentioned previously, programs are likely to increase in number and improve in quality during 1940. In the first place New York City will shortly have a second station on the air with a regular program schedule. . . . It is also anticipated that several other stations will be licensed before the end of the year. In addition to the FCC ruling concerning commercial programs, the experience gained in programming is already having its effect on the types of material televised. In this respect there is a trend towards more diversified material, with increased emphasis being placed upon spot news, sport events, and the like, and less upon drama and movies.

During the year television transmitters will be simplified, improved and cheapened. Portable equipment housed in carrying cases has been put on the market[9, 10]. These units permit good quality transmission and are used for relaying programs to the main transmitter (operate in vicinity of 325 mc). Since they are cheaper than the usual mobile units they are suitable for the smaller stations where they may be used in the studio as well as for out-of-door pickups.

Television studio equipment is becoming more nearly standardized[11]. Lighting methods[12] and pickup technique[13] also fall into this category. Concerning the transmission of films, both 35-mm and 16-mm varieties will be widely used this year, the latter for the first time.

In receivers there is a trend towards larger picture tubes. Estimates as to desirable picture size for home reception range from 12-in diameter tubes to screens 8 or 10 ft wide. It is believed, however, that ultimately good pictures ranging from 18 to 24-in in width will be considered satisfactory for the average living room.

Increase in receiver picture size can be accomplished by producing larger tubes or by means of projected images from very small tubes. Both methods are the object of experimental work. The advantages and disadvantages of each system are too well known to warrant discussion here. Attempts are also

[8] Broadcasting, Jan. 15. 1940. p. 84.

[9] "RCA Television Field Pickup Equipment," by T. A. Smith, RCA Review, Jan. 1940, p. 290.

[10] See "Television Economics," Part XII, by Dr. Alfred N. Goldsmith, COMMUNICATIONS, Jan. 1940, p. 20.

[11] "New U-H-F Transmitters, COMMUNICATIONS, Dec. 1939, p. 10.

[12] "Television Lighting," Part 1, by W. C. Eddy, COMMUNICATIONS, May 1939, p. 17.

[13] "Miniature Staging," by W. C. Eddy, COMMUNICATIONS, April 1939, p. 22.

For HIGHER FIDELITY

CINAUDAGRAPH SPEAKERS

SATISFY THE MOST DISCRIMINATING USERS

Points to Remember About The New Line of CINAUDAGRAPH SPEAKERS

The 27" CINAUDAGRAPH SPEAKER, the largest and most powerful commercially available, illustrates the wide range and variety of CINAUDAGRAPH SPEAKERS, each designed for a specific application.

SPECIFICATIONS

Power capacity, watts	85
Standard resonance c.p.s.	25 to 30
Voice coil diameter	6"
Voice coil impedance at 400 c.p.s.	16
Outside diameter	26¾"
Diameter of baffle opening	23"
Depth front to back	18"
Diameter of magnet	14"
Field coil voltage	300 volts
Field coil load	190 watts
Weight of speaker	455 lbs.
Shipping weight	Total 600 lbs.

PRICES FURNISHED ON REQUEST

1. All CINAUDAGRAPH SPEAKERS are fitted at every stage of assembly into fixtures of micrometer accuracy, assuring positive relationship of all parts.

2. The voice coil is located exactly concentric with the speaker frame by means of a circular corrugated centering device attached to the frame. This new moisture proof centering device, developed by CINAUDAGRAPH, opposes radial thrust and permits maximum motion in the axial direction. This assures true low note reproduction and permanent alignment of the voice coil.

3. The polyfibrous cones used on all high fidelity CINAUDAGRAPH SPEAKERS are composed of a series of bands of differing characteristics. These cones are made entirely in the CINAUDAGRAPH plant from the grinding of the actual pulp in the paper making machine to the final pressing of the cone. The correct blending of these fibrous bands has made possible the unequalled fidelity characteristics of the many CINAUDAGRAPH models.

4. The voice coils of the larger CINAUDAGRAPH SPEAKERS are wound on ACIM, a hard, non-elastic, non-hygroscopic material, whose permanence assures continued full fidelity and non-distortion characteristics. Ribbon wire is used in most larger voice coils to assure maximum space factor, vital to both quality and efficiency.

WRITE for bulletin #839 describing Permanent Magnet CINAUDAGRAPH SPEAKERS

UNITED TELETONE CORP.

150 VARICK STREET ★ NEW YORK, N. Y.

EXPORT DIVISION: 100 VARICK STREET NEW YORK, N. Y. CABLES: "ARLAB"

being made to shorten picture tubes. Shorter tubes means greater flexibility in cabinet design as well as mechanical layout.

Good high-quality sound programs are now being transmitted on television stations at times when no picture is on the air. Hence it would not be surprising if some of the new receivers were equipped with a switch to turn off the power for the picture circuits and thus permit the reception of sound programs at reduced power consumption.

Considerable development work is being done on television pickup[14] and receiver picture tubes, and new types may be announced during the year. Other probable developments for 1940 include demonstration of large screen television of theatre size and television relay stations using frequencies in the vicinity of 500 mc.

• • • frequency modulation

Field tests[15] of the frequency-modulation system have shown that at least three distinct advantages can be obtained through its use:—high quality, static reduction and service area extension at ultra-high-frequencies. While f-m has had but little effect on radio business as yet, it is expected to gain considerable momentum rapidly during 1940. A number of new models of f-m receivers as well as combination a-m/f-m units will undoubtedly be introduced this year. It is also likely that special converters will be produced to permit the use of the audio portion of present a-m receivers.

Frequency modulation may also play an important part in aeronautical and police radio. Experiments are being conducted in this direction and more will be heard as to these applications later in the year. It is also interesting to note that the FCC has allocated the following bands for use by amateur stations for television and radiotelephone frequency - modulation transmission: 112,000-116,000 kc, 224,000-230,000 kc, and 400,000 kc. Special authorization has also been secured for a 1000-watt station, operating on 42.18 mc, to gather comparative data using a-m and f-m for both aural and facsimile programs. In addition, some consideration has been given to the possibility of using f-m for certain portions of television signals.

The FCC has recently given notice of an informal engineering hearing, to be held on February 28, for the purpose of determining, among other things the several merits of frequency modulation and amplitude modulation.

[14]"Television Pickup Tubes Using Low-Velocity Electron-Beam Scanning," by Albert Rose & Harley Iams, Proceedings of the IRE, Sept. 1939. p. 547.

[15]"Field Tests of Frequency—and Amplitude Modulation with Ultrahigh-Frequency Waves," by I. R. Weir. Parts I & II. G. E. Review, May 1939, p. 188, and June 1939. p. 270.

TELEVISION BROADCAST STATIONS*

(as of January 1, 1940)

Licensee and Location	Call Letters	Frequency (kc)	Power Visual	Power Aural	Emission
Columbia Broadcasting System, Inc. New York, N. Y.	W2XAB	42000-56000, 60000-86000	7½kw	7½kw	A3, A5
Allen B. Du Mont Laboratories, Inc. (area of New York, N. Y.)	W10XKT	156000-162000	50w	50w	A3, A5
Allen B. Du Mont Laboratories, Inc., Passaic, N. J.	W2XVT	42000-56000	50w	50w	A3, A5, Special (C. P. only)
First National Television, Inc., Kansas City, Mo.	W9XAL	42000-56000, 60000-86000	300w	150w	A3, A5
General Electric Co., Bridgeport, Conn.	W1XA	60000-86000	10kw	3kw	A3, A5 (C. P. only)
General Electric Co., Albany, N. Y.	W2XB	60000-86000	10kw	3kw	A3, A5 (C. P. only)
General Electric Co., Schenectady, N. Y.	W2XH	288000-294000	40w		A5
General Television Corporation, Boston, Mass.	W1XG	42000-56000, 60000-86000	500w		A5
Don Lee Broadcasting System, Los Angeles, Calif. C. P., T-Hollywood, Calif.	W6XAO	42000-56000, 60000-86000 C. P., 44000-50000 kc.	1kw	150w	A3, A5
Don Lee Broadcasting System (area of Los Angeles, Calif.)	W6XDU	321000-327000	6.5w		A5
National Broadcasting Co., Inc., New York, N. Y.	W2XBS	42000-56000, 60000-86000	12kw	15kw	A3, A5
National Broadcasting Co., Inc., Portable (Camden, New Jersey and New York, N. Y.)	W2XBT	92000 and 175000-180000	400w	100w	A1, A2, A3, A5
Philco Radio and Television Corp., Philadelphia, Pa.	W3XE	42000-56000, 60000-86000	10kw	10kw	A3, A5
Philco Radio and Television Corp., Philadelphia, Pa.	W3XP	204000-210000	15w		A5
Purdue University, West Lafayette, Ind.	W9XG	2000-2100	1½kw		A5
Radio Pictures Inc., Long Island City, N. Y.	W2XDR	42000-56000, 60000-86000	1kw	500w	A3, A5
RCA Mfg. Co., Inc., Portable (Camden, N. J.)	W3XAD	321000-327000	500w	500w	A3, A5
RCA Mfg. Co., Inc., Camden, N. J.	W3XEP	42000-56000, 60000-86000	30kw	30kw	A3, A5
State University of Iowa, Iowa City, Iowa	W9XK	2000-2100	100w		A5
State University of Iowa, Iowa City, Iowa	W9XUI	42000-56000, 60000-86000	100w		A5
Zenith Radio Corporation, Chicago, Ill.	W9XZV	42000-56000, 60000-86000	1kw	1kw	A3, A5

* COURTESY, NATIONAL ASSOCIATION OF BROADCASTERS.

Pending the outcome of this hearing, the Commission will grant applications for permission to carry out fundamental research which show satisfactory promise of being able to contribute substantially towards the development of aural broadcasting and applications filed by existing licensees to experiment with aural broadcasting on frequencies above 25,000 kc, provided the request to operate additional stations involves a program of experimentation directly related to the existing station. About 20 applications are pending action by the Commission for new stations desiring to use f-m. There are now 34 a-m stations and 20 f-m stations authorized by the FCC.

It is also interesting to note that various groups interested in frequency-modulation broadcasting have recently formed an organization known as F-M Broadcasters, Inc. This organization will present technical data and group recommendations at the February hearing. Some 43 groups were represented at the original hearing.

Increased experiments and operation with f-m and phase modulation as well as combinations thereof should better determine the service capabilities as well as public response to this type of transmission.

• • • facsimile

While facsimile has not reached a definite point of conclusion and for the time being seems likely to continue on an experimental basis, it should come into more prominence as the year progresses. Despite promising field tests, laboratory work is still being directed towards higher definition, increased speed and better synchronization.

The possibilities of using facsimile for home newspaper printing, police, aircraft, military and marine applications has often been mentioned in this publication. It is gratifying to note that experiments are being conducted along all these lines . . . as well as with f-m transmission.

It is likely that improved systems will shortly make their appearance in this country. Considerable work has been done here and abroad with wet electrolytic systems with favorable results.

Commercial wire facsimile will probably expand during the year. Circuits between New York City and Buffalo, and New York City and Chicago have been in operation for some time, while automatic telegraphic facsimile apparatus, for transmission of messages from hotels, etc., to the central office, was put into operation during 1939[16]. Excellent results are obtainable and both systems are meeting with good success.

It is also interesting to note that the frequencies 1715 to 2000 kc, 56,000 to 60,000 kc, 112,000 to 116,000 kc, 224,000 to 230,000 kc and 400,000 to 401,000 kc have been set aside for amateur facsimile experimenters.

• • • marine radio

This year will see increasing use of radio telephone equipment on small pleasure craft. For the most part these will be small, compact transmitter-receiver units which will permit contact with other craft, with land telephones and in emergency provide direct communication with the Coast Guard. Simple, foolproof operation will be featured for this type of equipment.

Direction finders are coming into more prominence. Also, some work has been done with u-h-f obstacle detectors. Experimental work will no doubt continue along the latter line. There should also be considerable gov-

[16]"The Automatic Telegraph," G. W. Janson, COMMUNICATIONS. April 1939, p. 12.

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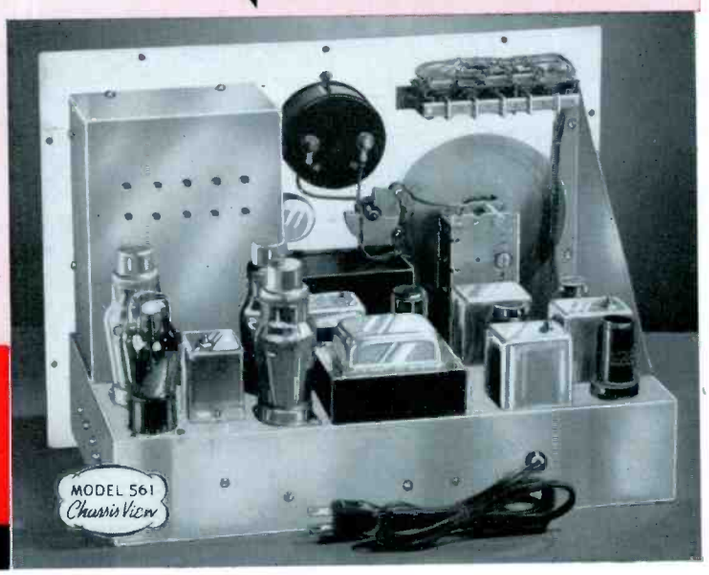

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ernment work during this year . . . especially in view of the naval expansion program.

• • • police radio

A development that will be watched with great interest is a two-way frequency-modulation short-wave system being designed by Daniel E. Noble for the Connecticut State Police. Surveys for the system were started last July and tests are now being conducted under the experimental police license W1XSP on 39.180 mc. A test f-m installation will be operated through the winter in the Hartford area to prove-out the system. Installation of 10 fixed transmitters, one for each patrol area, and 20 mobile two-way units will be made in the summer.

The possibilities of using facsimile for the transmission of various types of information, such as photos, maps, finger prints, etc., has often been mentioned, as has traffic control by means of u-h-f which would require suitable receiving equipment in all autos with the transmitters located at the various intersections. The use of aircraft equipped with radio apparatus for locating and directing traffic has already seen use. This latter method of traffic control is likely to gain prominence especially in large communities. However, airplanes operating in conjunction with motor cars and motorcycles should prove a great aid for state police and seems likely to be widely used in the not too distant future.

• • • recording

Better control, improvements in technique as well as in disc materials permits recording of frequencies from 50 to 9000 cycles. Simpler and better cutting heads, stylii, pickups and reproducing needles are now available at prices considerably lower than last year. The price of discs has also been reduced in some cases. This general reduction of prices has prompted several manufacturers to attempt simple low-price recorders with a view toward expanding the market for these devices. It is expected that the recorders will be placed on the market shortly, and if they find any success additional manufacturers will no doubt be prompted to get on the band wagon.

New fields which show promise for this year are home recording, and disc recorded sound for home made movies. As previously mentioned, it is also believed that several receiver manufacturers will introduce models which will permit the home recording of radio programs as well as events in the home. The use of portable sound recording and reproducing equipment to add sound to 8 and 16 mm. home movies is also attracting considerable interest[17].

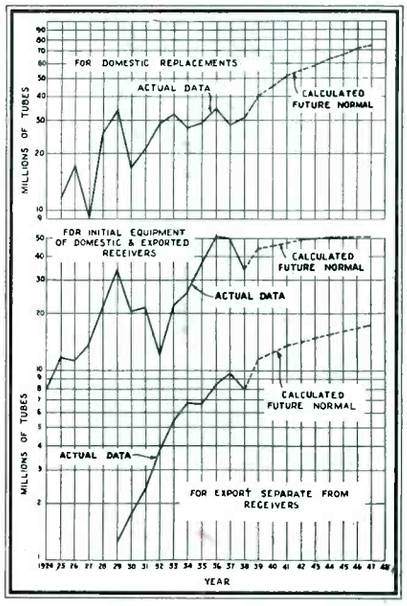

Fig. 3. The chart[2] predicts a continually expanding tube market for replacements, for initial equipment and for exports. It is based on actual data from 1924 to '38 and upon trends to 1947.

In broadcasting there is also a trend of interest. Many programs are recorded at the time they are broadcast and the recordings put on the air over other stations at a later, convenient time. Speeches, sporting events, etc., are also recorded and broadcast at a more convenient listening time. In all liklihood this use will expand.

• • • public address

Although unit sales for sets and tubes soared higher for 1939 than for any previous year, this was not true of public-address equipment in general. In spite of the comparatively large amount of p-a equipment purchased for the two World's Fairs[18] sales figures were below the high mark set in 1937. This, notwithstanding the fact that the new equipment is definitely superior, more compact and provides greater power output with less distortion. Systems have been streamlined and external appearance greatly enhanced as well.

We look forward, however, to a banner year during 1940 as other national election years have been in this field. Another cause for optimism is the possibility of increased applications, many suggested by those at the New York World's Fair[18]. The great popularity (and low price) of the universal 6 volt-110 volt mobile units should give this trend additional impetus.

One of the most remarkable of recent p-a developments has been a system which will perform a multiplicity of mechanical or electrical duties while delivering a recorded sound feature, perfectly synchronized. Several different methods of accomplishing the desired results have been used and will no doubt find additional application during 1940.

With the large number of low power consumption battery type tubes available there is a probability that the near future will see the development of portable dry-battery operated p-a systems for special purposes.

• • • test equipment

The multiplicity of tube types has lead to the revival of new-tube adaptor boxes to augment units now in the hands of dealers and Service Men. This seems to be the logical solution for those who have good instruments capable of testing all but a few of the very latest types.

There has been a growing tendency toward the use of signal tracing equipment during 1939 and manufacturers have been hard put to keep up with production. Service Men throughout the country have taken to the instrument and it seems as if it is marked first on their want list.

There should be a decided trend, in 1940, toward greater accuracy and stability in test instruments for the Service Man. This should be especially true of signal generators, where higher and more uniform output over the entire frequency range will probably be stressed. The use of some simple form of voltage stabilization in power-line operated equipment will also see application.

• • • materials

The international situation has had some effect on the supplies of certain raw materials. In the main, however, there appears to be no great concern over supplies, as the majority of the materials used for radio purposes are produced in this country. In some cases there have been increases in the price of imported materials, but as yet this has not been reflected seriously in the price of receiver and transmitter components.

Plastics, an ever-expanding field, is finding more radio uses today than ever before. Not only have some very excellent plastic insulating materials been developed, but its uses for knobs, dials, cabinets, terminal strips, and the like is ever increasing. This is especially true in radio cabinets where almost any color or color combination can be secured. With the possibility of new and smaller receivers being produced it is likely that plastic cabinets will be used for these units. One receiver manufacturer uses a molded plastic chassis

(*Continued on page* 32)

[17] "Syncrosound System," by Ralph C. Powell, COMMUNICATIONS, Nov. 1939, p. 12.
[18] "Public Address and the New York World's Fair," by S. Gordon Taylor, SERVICE, Oct. 1939, p. 463.

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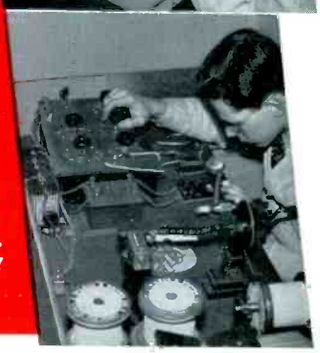

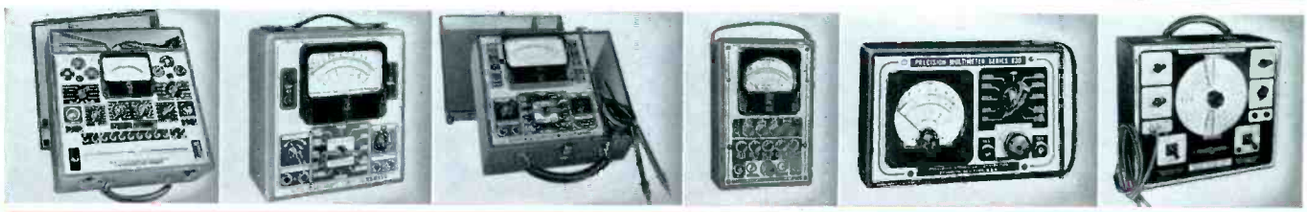

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A-C, D-C, BATTERY PORTABLE

G. E. HB412

(See Front Cover)

By HENRY HOWARD

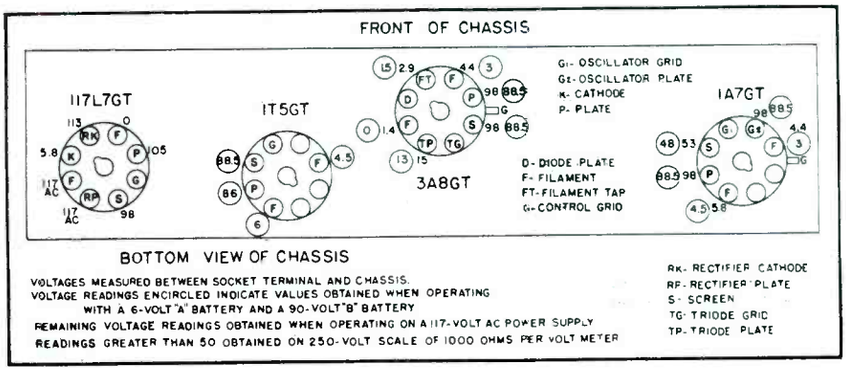
THE General Electric Model HB412 is a portable 4-tube superheterodyne designed to operate on battery power, on a-c or on d-c. Two of the tubes used are dual function types. Only three tubes are actually operating at one time. For battery power operation the 1A7GT converter-oscillator and the 3A8GT i-f-detector-audio-avc are used together with the 1T5GT battery power output tube. The latter is switched with a 117L7GT a-c, d-c power output rectifier tube when the set is connected to the power lines. The control grids of the two power tubes are in parallel. On battery operation, the 117L7GT is dead because of the absence of filament voltage while the 1T5GT is let out in the cold on a-c or d-c operation. The plates of the power tubes are connected to proper taps on the primary of the output transformer in order to properly match the different plate impedances of the power tubes to the speaker. The 117L7GT has a much lower plate impedance; hence, it must look into a much lower inductance in the transformer.

The set is housed in a wood case with fabric covering. A sliding front cover is used to protect the dial, grill and controls from the weather when not in use. On battery operation 250 hours of life may be obtained when operating the set four hours per day. An automatic power selector switch is an interesting and unusual feature, operating as follows: inside the small door on the left side of the cabinet is the power selector lever. To operate on batteries, the prongs on the power cord plug are inserted in the lever holes, and the plug pushed in until it wedges between the cabinet wall and the lever. The rest of the power cord is placed in the compartment and the door closed. To operate the set on an a-c or d-c power line merely remove the power cord plug from the compartment, this operation causing the selector lever to switch to line operation. A word of caution is posted—not to press the lever while the power cord is in convenience outlet. On d-c, of course, the polarity of the plug must be observed. On a-c operation it may be desirable to reverse the plug, leaving it in the position giving the least hum.

The filament supply for the converter and i-f detector-audio tube in power line operation is another interesting feature. The cathode current of the 117L7GT is employed to heat these filaments, giving a certain amount of voltage regulation and hum reduction. This voltage is usually wasted in a cathode resistor. A 27-ohm carbon resistor is in series with the filaments acting in the capacity of a buffer, or surge reducer when the set is switched on the line. Carbon is used because of its negative temperature coefficient, allowing a slightly greater resistance when switched on which gradually diminishes as the set warms up.

No resistance cord or separate resistor is needed in this set because of the 117-volt rectifier-power tube, representing a real step forward. Resistance-capacitance filters are used throughout; there are no chokes or speaker field coil. The speaker uses a permanent magnet of alnico.

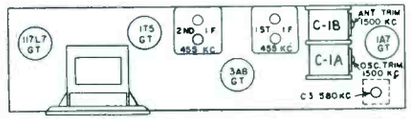
All of the tube types used in the G. E. HB412 have been introduced within the last few months. Voltages are given as found on the various tube prongs for both battery and line operation. In the former case they were measured with batteries in peak condition. Allowance must be made for older units.



This model is designed for loop operation exclusively and no provision is made for an antenna-ground connection. Avc is provided, as usual, but the arrangement is a bit unusual. In addition to the normal shunting resistor to control the amplitude of avc voltage, a 3.9-meg resistor is connected from the avc bus to the high side of the 1A7GT filament (plus 4.5 volts in the filament arrangement). This cuts the initial grid bias on the two tubes, providing greater sensitivity on weak signals; obviously, an important point in a loop receiver.

• • • alignment

Connect an output meter across the voice voil. Rotate the volume control



With the exception of the padder, all the trimmers may be reached from the top of the chassis.

to maximum. Set test oscillator to 455 k-c and apply signal to the control grid of the 3A8GT tube through a 0.05-mfd capacitor. Align the second i-f transformer trimmers. Next apply signal to the control grid of the 1A7GT through the same 0.05-mfd capacitor and align the first i-f transformer trimmers. Retouch the second i-f transformer trimmers while applying signal to the 1A7GT tube. Do not remove the grid leads from the tubes when applying the oscillator signal and keep the test oscillator output as low as a readable meter reading will permit.

Place a one turn coupling loop not closer than six inches from the receiver Beam-a-Scope. Apply a 1500-kc signal to the coupling loop. Set pointer to 1500 kc and align the oscillator trimmer (C-1A). Peak (C-1B) for maximum output. Change test signal to 580 kc and with pointer in region of 580 kc peak (C-3) while rocking the gang condenser. Retrim at 1500 kc.

The Beam-a-Scope leads should be dressed the same after the components are mounted in the cabinet as during alignment.

• • • specifications

Cabinet: Portable; leatherette covering.
Tuning: Manual; dial ratio, 5.5 to 1.
Range: 550 to 1600 kc.
I-f peak: 455 kc.
A-c or d-c power supply: 110 to 120 v, 25 to 60 c on a-c.
Power consumption: 25 watts.
Battery power supply: 6-v A supply and 90-v B supply.
Power output: Battery operation, 275 milliwatts; line operation, 2 watts (max.)
Speaker: 4-in, p-m; voice coil impedance, 3.5 ohms (400 c).
Over-all dimensions: 10½-in h, 13-in w, 5⅜-in d.

TUBES

(*Continued from page 12*)

which you service, bring the voltage down to the design maximum, based on a line voltage of 117. You can do this quite simply by inserting a resistor in series with the power transformer center tap and ground. Make sure that the resistor wattage rating is sufficient. Usually a value of the order of 500 to 1000 ohms will do the trick on most sets, with a wattage rating for the resistor of 20 or more, depending upon the receiver B-power consumption.

The maximum a-c voltage per plate for the 5Z4, at 117 volts line supply, is now 350 volts, just 50 volts lower than the previous absolute maximum, with condenser input. This same rating applies likewise to the 5Y3, 5Y4, and 5W4, formerly rated at 400 volts. The d-c output current rating for the 5Z4 remains at 125 ma, as does the 5Y3, while the 5Y4 and 5W4 have been boosted from 110 to 125 ma. The choke input design maximum a-c voltage for the 5T4 plates remains unchanged at 550 volts, but the d-c output current rating takes a 10 percent drop. For the 5U4G, both plate and d-c output current ratings are reduced 10 percent from their previous ratings of 500 volts, 250 ma to 450 volts, 225 ma.

The design maximum for the output plate voltage has been increased from 250 to 300, for the 6A8G, while the screen rating is maintained at 100 volts. However, the anode grid voltage design maximum has been brought down to 200 volts from its former 250-volt maximum. The same situation exists with regard to the 6D8G.

All ratings on the 6K8G have been substantially increased. The hexode plate and screen voltages are now 300 volts each, instead of 250, while the triode has been raised from 100 volts to a plate voltage of 125. For the 6L7, the previous absolute maximums for the plate and screen of 250 and 100 volts respectively have been increased to 300 and 150 volts for the corresponding elements.

Increased ratings on the new chart are shown for the 6C8G, 6F8G, 6K7, 6K7G, 6L7, 6L7G, 6U7, 6U7G and the 6W7G. In each case the plate voltage design maximum has been raised to 300 volts, where the previous absolute maximum was 250 volts. The 6SQ7 design maximum is 250 volts for the plate in place of the former 300-volt absolute maximum rating. This applies likewise to the 12SQ7.

[In conclusion, the writer wishes to express his appreciation to the various tube manufacturers for their cooperation in supplying the tube data, etc., upon which this article is based.]

LEARN TO SELL

(*Continued from page* 13)

charged. In other words justify your labor charges before you're asked to do it. And be sure that the price you quote on a job is a fair price. Make a profit, but remember that your customer will probably need a Service Man in the future. You want to be that man. Many Service Men ask housewives if there is any little extra favor they can do, such as wiring a lamp plug or checking a door bell. It only takes a couple of minutes to do it . . . but you make an impression that won't be forgotten.

We could discuss the advantages of service-salesmanship for hours, but discussing it isn't enough. You've got to make it work for you. And you'll be surprised how easy it is to acquire effective selling methods—they actually become a habit—and they do pay dividends. Aside from the profit angle, you'll find that the application of these thoughts in your daily contacts will make servicing a happier, more satisfying profession.

BOOK REVIEW

SERVICING BY SIGNAL TRACING, by John F. Rider, published by John F. Rider, Publisher, 404 *Fourth Avenue, New York City,* 1939, 360 *pages, price* $2.00.

A definite need in the service field has been a method for locating trouble in a receiver while it is operating for only then will certain ills show up. Moreover, such a method should be universal in scope, i.e., it should be applicable to simple t-r-f receivers as well as the most complicated multi-tube superheterodyne and the type of tubes in the receiver should make no difference. In this book the author describes such a testing system, which is based upon the signal, the one thing common to every receiver or piece of electronic equipment.

In his foreword the author states that it is essential that the user of the signal-tracing system be thoroughly familiar with the behavior of the signal in detectors, amplifiers, coupling devices, etc., and so has devoted the first seven chapters of the book to such descriptions. The remaining five chapters deal with the testing procedure itself and how it is applied to receivers, public-address systems, television and facsimile receivers, etc. A chapter is also devoted to signal-tracing instruments and how they are used.

Even if the Service Man does not adopt the signal tracing method in his work, he can learn, from this book, how the signal behaves in all types of circuits.

The book is recommended to all Service Men. L. M.

TRADE SHOW NEWS

The office of Radio Parts Manufacturers National Trade Show, Inc., reports that at the turn of the year contracts for 60 booths at the 1940 Show, to be held at the Stevens Hotel, in Chicago, had been received.

This heavy application for space exceeds that of any other year, in a like period of time, by 25 per cent, it is said.

CHASING SIGNALS

By J. E. WOOLLEY

SIGNAL chasing will probably become a regular routine in the better service shops before the end of 1940. Those who now own signal chasers will tell you without hesitation that it is the last instrument in their shops with

RCA Rider Chanalyst.

which they would part.

Call them what you will, among the many fancy trade names, there are signal chasers on the market that will fit practically any purse, and almost any one of them is better than none at all; however, the best one you can afford is the one to buy. Such an instrument is an investment that pays dividends, not merely a convenience or a luxury.

It is not the purpose of this article to give directions for use (because each instrument is accompanied with the manufacturer's instructions), but rather to show the possibilities of such instruments. Some Service Men haven't taken the subject of signal chasing seriously. Others have seen demonstrations but have no idea what they are missing by using older methods. Many seem to feel that this is just another gadget like the "oscillograph they bought which is in the back room collecting dust." The writer has made over a hundred demonstrations with various makes of chasers, and it is surprising to see the change in enthusiasm within five minutes after the demonstration has begun. The Service Man readily sees the possibilities in a simple instrument which he can learn to operate as easily as he can learn to use a new tube checker; it's just a matter of becoming familiar with the various controls.

Can anybody learn to chase signals accurately and speedily? No. The single requirement, however, is that he be familiar with radio circuits. There are three classes of men in this industry. First, there is the man who is well trained technically and practically, who is little short of an engineer. This man has already seen the possibilities of chasers and probably owns one. Second, there is the screwball, the man who can measure voltages and resistances and beyond that can hope, pray and try. This class of fellow has no business with a signal chaser. It would only add confusion to an already confused mind. The third class (the big class) is the man who, while far short of engineering ability, has the training and experience to know what is going on in a radio receiver. He is the man who needs a signal chaser and needs it badly.

Altogether too many receivers are returned to their owners repaired but not fixed. The average Service Man repairs the major complaint, checks the remaining voltages and tubes, aligns the set and returns it, overlooking many

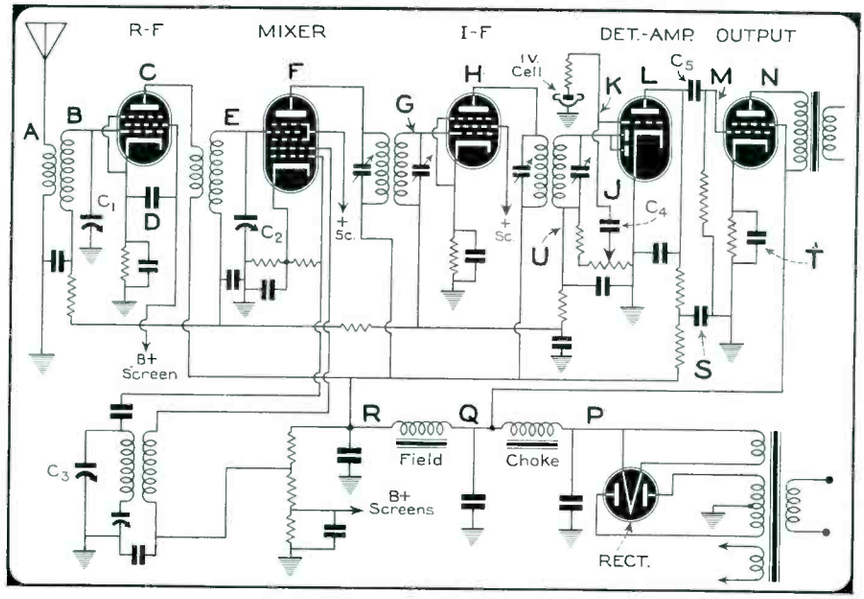
Supreme 560 Vedolyzer.

small items that would add to the customer's further enjoyment and to his own profit. After the major complaint is repaired, the owner of a chaser can go farther. He can check the gain per stage; find and eliminate dead spots; modulation hum; gassy tubes; and usually (not just occasionally) can find dozens of other annoying ailments that need attention. You will be amazed at the number of defective tubes that a chaser will find that were pronounced good by your expensive tube checker.

Before explaining the various special uses of a chaser let's look at the possibilities in weak or dead receivers. In Fig. 1 is a very simple six-tube super of common variety. We connect a signal generator at its antenna and ground post, and for simple calculation, let's feed 1000 kc into it. We can disable the set's voice coil so as not to be disturbed during our tests. Use as weak a signal as possible to keep the set's avc voltage low. Tune both set and chaser to 1000 kc and measure the signal at the antenna post (point A in the diagram). The antenna transformer is a step-up device, so when we move the probe from A to B, we have a moderate gain in signal. Likewise, when we move from B to C we should have a gain, and a much larger one because we are getting the advantage of the gain in the r-f tube. When we move from C to E, we also get a gain, but a small one in most cases, or possibly none at all, depending upon the type of receiver. Now, in moving the probe from E to F, the reader might expect a substantial gain until he stops to realize that the mixer tube is not working into the 1000 kc circuit and therefore we do well to keep the same signal intensity—in fact, a loss is usually experienced here.

Unless you are chasing some specific trouble, it is not necessary to take the time or trouble to check the oscillator circuit independently. At point F you can give the oscillator a sufficient check. With our probe fastened to F, it is only

Fig. 1. These instruments will check the progress of the signal through the receiver circuits.



Thomas A. White (left) and Hugh S. Knowles.

JENSEN PROMOTIONS

The Jensen Radio Manufacturing Co. have recently made the following announcement concerning their personnel. W. E. Maxson becomes president and general manager after serving the corporation for ten years as managing director. Hugh S. Knowles and Thos. A. White have been elected vice-presidents while continuing as chief engineer and sales manager, respectively. A. Leslie Oliver, after an eleven-year tenure as vice-president, becomes chairman of the board of directors. Other corporate officers remain in their capacities except for Peter L. Jensen, whose resignation as president and director was recently accepted.

SMITH JOINS JFD

Herman H. Smith has joined the JFD Manufacturing Co., 4111 Ft. Hamilton Parkway, Brooklyn, N. Y., in the capacity of sales manager. JFD manufactures dial drive cables, auto-radio remote control hardware, swaging tools, auto radio aerials, etc.

necessary to establish the presence of three useful signals (there are others which don't concern us); that is, the presence of the 1000 kc (although it may show a slight loss as compared with E), the local oscillator's beat, which is 1456 (for an i-f of 456) and the i-f itself. It is not necessary to reset the signal-generator. Keep 1000 kc coming in the antenna post throughout the entire procedure. For the mixer tube to feed a 456-kc signal to the i-f stage, it is necessary that the set's local oscillator beat 456 above the incoming signal. Therefore as you tune the dial on the chaser in 1456, the indicator will show the presence of this signal if the oscillator circuit is functioning. This is an unmodulated signal and will not be audible (in case your chaser has provisions for listening). The third frequency present at point F is of course the i-f of 456.

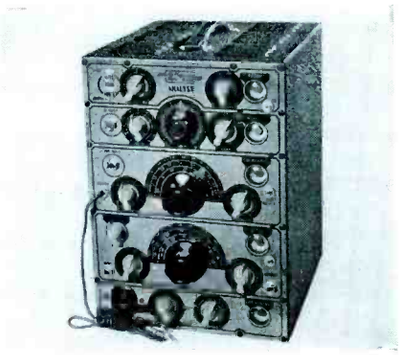
With the tracer dial set at 456 (1000 still coming in the antenna) we proceed through the i-f stage. From F to G we usually get an even signal. However, from G to H we should get a healthy sock. From H to J there is always a decided loss as would naturally be expected in a diode circuit. When we reach the diode plates we are through chasing the i-f signal and begin using the audio portion of our chaser (1000 kc still coming into the antenna post). From J to K there is bound to be a slight loss (only slight, however) because of the filter resistor and the condenser C4. (The sets' volume control is on full.) From K to L there should be a big gain. (What these gains or losses should be is clearly explained in the instructions that accompany the various instruments.) From L to M there should be about an even transfer of signal, as would be expected of resistance-coupled amplification. (Transformer coupling would show a gain.) From M to N there should be a considerable gain with a triode or a healthy sock with a pentode.

Now let's suppose that when moving the probe from G to H we did not experience the expected gain. We try a new tube in this socket, but find the gain still insufficient. It is not necessary to put away the chaser and get another instrument. Nearly all makes of chasers have a modern vacuum-tube voltmeter built into the instrument for use both internally or externally.

Chasing signals through a set is much faster than it sounds. The chasing explained in the last four paragraphs on the set shown in Fig. 1 was actually done in about three minutes. The Service Man who buys a chaser should first run through four or five operating sets and study the instructions furnished with his instrument to establish in his

mind just where gains or losses should occur in receivers and what the gain, if any, should be. By that time he should be able to take on the toughest jobs that might come in. This is no exaggeration. Learning to chase signals is just that easy.

What about a stubborn case of hum?



Meissner Analyst.

Hum often presents the toughest of problems with the cut-and-try or bridge-and-listen methods. It's one of the simplest with a chaser. With the audio portion, you can listen right in on the filter system at points P, Q and R (Fig. 1). But stubborn cases seldom originate there. The hum might develop at points S or T or it might be a bad tube (which checked good in a checker) or countless other places. All you have to do is probe and listen.

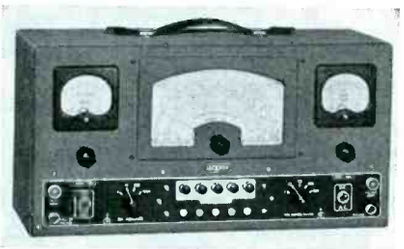
The same simplicity locates distortion. How many times have you guessed that the distortion was originating in some particular stage, and replaced all surrounding parts only to find you had been barking up the wrong tree? You don't have to be a smart guesser with a chaser. You hear where the distortion originates (on some instruments you also see it), and the rest is easy for the man who knows radio, especially with the aid of the vtvm. Furthermore, that oscilloscope you bought, largely for locating distortion, can now be dusted off and brought out into the front room because most chasers have provisions incorporated for truly using a scope to better advantage than ever before. Understand, a scope is not necessary for locating distortion, but you can use it if you choose.

Making estimates is made simple with a chaser. For instance, suppose a customer brings in a set like the one in Fig. 1, and you find no plate voltage at point H; other voltages normal. You are sure the second i-f primary is burned out and you give the customer a price on replacing the i-f transformer. A quick voltage analysis makes you think the rest of the set is normal, and the tube checker says it thinks the tubes are good. With a chaser you don't have to take this chance. You can chase the signal from A to G and be sure about that much, then feed an audio signal into J or U and check the rest of the set. (With some instruments you can tune the chaser to a broadcast signal and send the resulting audio signal into J and out the set's speaker.) You can also listen in at R and see if the hum level is satisfactory, you can see if the volume control is noisy and countless other tests that will occur to you, and when you give the customer his estimate, you will know it is sufficient to cover everything.

If you are one of these Service Men who permit the customer to hang over your shoulder, a chaser presents a splendid opportunity for showmanship. Showmanship is one thing sadly lacking in the service business and probably accounts to some extent for the poor prices the boys get for their work.

You may ask, "Isn't there anything that's hard to do with a chaser? This all sounds too good to be true." Yes, finding the cause of violent oscillation is a tough job with or without a chaser. The chief difficulty is that the offending stage frequently feeds back into an innocent stage and is misleading. However, a chaser will find the trouble in less time than the cut-and-try methods heretofore used. Poor grounds and

faulty condensers are the most common causes of oscillation, and it is obvious that poor grounds can be found easier on a non-disturbing instrument. As for condensers, the common practice of momentarily shunting a good condenser across the suspected one often adds other disturbing conditions, but with a chaser you can test a suspicious condenser without shunting or disturbing anything. First, you can listen at various points throughout the suspected portion of the receiver, seeing if the oscillation is audible. Second, you can see if the suspected condenser is actually by-passing. For instance, look at the by-pass at point D in Fig. 1. If it is not by-passing properly, there will be a weak signal on this screen.

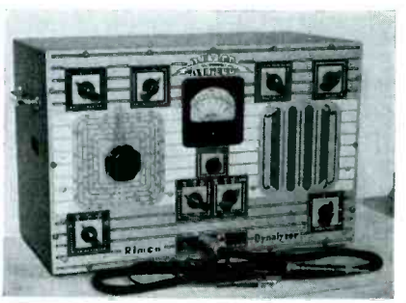


Jackson 660 Dynamic Signal Analyzer.

What about unusual circuits that are not found in the average radio set? No circuit is unusual or strange to signal chaser if you understand the circuit. Afc and squelch circuits are termed unusual by many Service Men and phase inversion is still a mystery to a few. So long as you can service these circuits by the horse-and-buggy methods, you can do it better and quicker by sleuthing the signal. Even sound equipment or wireless record players can be serviced better this new way. The important thing in service work is "Is the signal coming through, and, if so, is there the proper gain or loss at each progressive point?"

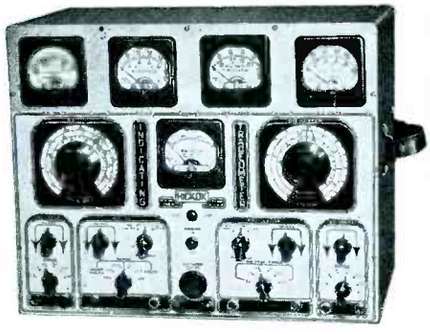
What about chasing noises, such as those made by noisy i-f's and audios? This is one of the simplest things possible, and is done in the same manner as checking hum and distortion. You simply take the probe from stage to stage, listen, and determine at which

Rimco Dynalyzer.



point the noise originates. The cause is then obvious. Some very tough cases of crackling noises have been found with chasers that would have been real headaches to find with the old "stumble-onto" method.

Service Men frequently inquire as to the possibilities of using chasers in alignment work. Once you do an alignment job with a chaser, you won't do it any other way. First, there is no other output device as convenient and sure as a vacuum-tube voltmeter. Second, check of the tracking of a gang condenser is very difficult with any other method. Most careful Service Men who follow manufacturers' instructions get a good job on the i-f's and usually on the 1400 kc trimming, but when they set the 600 kc padder by the familiar rocking method, they think the job is done, and done well. Some few, but very few, check themselves by seeing if the r-f sections will take a different adjustment at various points on the dial; others attempt to check with tuning wands and other gadgets. With a chaser you can align as heretofore, then go back and see if the two, three or four sections of the gang are really tracking all over the dial. For instance, go back again to Fig. 1. First you tune the over-all receiver to the test frequency. C3, the oscillator section, predominates and governs the dial reading. Now you can check sections C1 and C2 to see if they resonate at the exact same dial setting. We have all seen sets that won't track clear across, particularly some of the cheap stuff on the market, but the better receivers, the kind you want to do a good alignment job on, will usually track, and when they won't, there is a definite cause.



Hickok 155 Traceometer.

As stated before, a vtvm is built into most signal chasers, and this alone is worth a large percentage of the purchase price of the instrument. The meters we have used for years are gross liars; they seldom tell the truth. They were good in the battery days, passable in the t-r-f days, but today they cannot give us the reliability we require. The vtvm is the answer to modern voltage measuring problems. You can measure avc voltages even on the grids themselves without disturbance. You can read resistance-coupled plate voltages accurately and without disturbance. You can measure screen voltage on pentode linear detectors where usually a 2-meg resistor feeds the screen. You can use the vtvm as a resonance indicating device or for any voltage measurement use, either positive or negative without reversing prods. Most of the meters are the center zero type with a very wide-range zero set, which is useful in checking intermittents because it eliminates the memory factor. Once the maximum reading is obtained, the meter is adjusted back to zero so that the operator does not have to remember any numbers while awaiting the occurrence of the intermittent. One manufacturer has gone so far as to include ohmeter service. Another uses no physical meter for the vtvm feature. Instead, the scales are etched on the panel, and you read the voltage where the pointer stops when a 6E5 electronic eye comes to mesh.

The big question everybody asks is, "Will a chaser speed up the finding of intermittent trouble, and why don't manufacturers' instructions go into more details on this subject?" A chaser not only speeds up intermittent jobs,

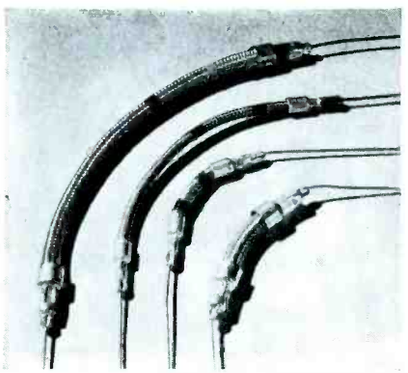
(*Continued on page* 34)

WE EXPECT . . .

(*Continued from page 20*)

base which includes sockets, trimming and padding condenser and insulated terminals. There is also a trend towards plastic cabinets in college colors, in fraternity and sorority colors, and for other specific groups.

Other interesting developments include a plastic material made from coffee beans, and a new plastic molding process using plaster of paris forms. This latter development might be used to produce samples more cheaply as well as for specific items where no large production is anticipated.



Illustration, courtesy Clarostat

Fibreglass is used as a covering for resistors and for wire.

Increasing use of the ultra-high-frequency channels will find more and more use for insulating material of either the polystyrene or ceramic types, depending upon the specific application. With more television, f-m and other high-frequency services being placed on the air the manufacturers of u-h-f insulators should be prepared for a very good year. Fiber glass insulation, announced about a year ago, is finding radio applications for insulated wire, resistor insulation, etc.

• • • tubes

Until the end of 1939 the trend in tubes was toward more tubes. Since January 1939 over 140 new types have been announced[7, 19]. However, for the new year one large manufacturer of sets and tubes has annouced the intention of standardizing on 36 types and concentrating production around these types. At least one set manufacturer has also announced a similar program. A survey of the tube manufacturers indicates that they would welcome standardization although there may be some disagreement as to just which types should be "preferred". If the original list of 36 were enlarged slightly, and some compromises made, there is every reason to believe that standardization will be accomplished within the next few months. Perhaps this will slow down the onslaught of unnecessary tube types.

Last year saw some definite steps toward standardization of tube prices. Inflated list prices have been brought down and a price structure established which is simple and based upon a sound relationship between manufacturing costs, distributor net prices and suggested list prices. At this time we can report general conformity all along the line. The new setup has done a lot toward stabilizing the tube industry.

Toward the end of 1938 and during the early part of 1939, single-ended, loktal, 1.4-volt and GT tube types made their debut. The singular advantages of each type have already been discussed on the pages of this magazine[19]. Let it suffice to say that the single-ended construction has eliminated the clumsy top grid-clip and thus presents much to manufacturing efficiency and to consumer convenience. The loktal tube, also single-ended, has a special base designed to permit easier removal and replacement of tubes in receivers and other electronic equipment. This is of particular advantage to receivers in that it aids them in obtaining Underwriter's Laboratories approval as well as the backing of various consumer groups.

The 1.4-volt tube series has given the set engineer the basis for the self-contained battery portables discussed earlier in this article. Miniature tubes, recently announced[7], should find application in vest-pocket portables and in equipment where extremely small size is of paramount importance such as in portable hearing aids and in airplane receivers.

Probably the most important technical development, relating to tubes, during the year was the announcement of a new basis for tube ratings[7, 20]. In the past receiver designers used the published absolute maximum ratings as design maximum values. In cases where the power source voltage varied greatly from the original design value, the possibility existed that the tubes would be subjected to overload and consequent loss of life and efficiency. The new ratings have been chosen to allow for such variation in power source voltages.

Unit sales of tubes for 1939 were close to 100 million according to reliable estimates[1]. These are based on actual sales (65 million) for the first ¾ of the year and an estimate (of approximately 35 million) for the last quarter.

Of the total 100 million, some 62 million were used in initial equipment and the remaining 38 million for replacements.

The greater number of sets now in

[19]"Tubes," by D. Bee, SERVICE, Feb. 1939, p. 62. Also, "New Tubes," SERVICE, March 1939, p. 133.

[20]RCA Application Note 105.

use over last year and the increased listening due to the European situation, and also because of the approaching presidential election, should make 1940 much better from a standpoint of unit sales. Fig. 3 shows the long time trends as predicted from existing data[2].

• • • condensers

For the past few years there has been considerable improvement in condensers which, strangely, has been followed by price reduction. By and large you can obtain more for your condenser dollar this year than ever before; this is true in spite of increased raw material costs.

As for the improvements . . . one manufacturer has a new line of wax-moulded tubular condensers which reduce moisture absorption. Another has introduced a 600-volt tubular which uses a treated cellulose derivative dielectric. Several manufacturers are specializing in fabricated plate type of electrolytics. Others are featuring etched foil types. In general all types of condensers have less leakage, higher voltage breakdown, less equivalent resistance, improved power factor, better by-pass action and a longer expected life. We hope that the cardboard types used in the cheaper midgets will also come in for some of these advantages especially the longer life expectancy.

Improvements have also been announced, during 1939, in small temperature compensating units, in silver-mica types and in various trimmers. These should add to the efficiency of all types of electronic equipment, especially u-h-f devices.

Even though the sales price of condensers was lower during 1939 than in 1938, the total dollar volume of business was somewhat better for 1939. The figures (actual for 9 months and estimated for the last quarter on the basis of between 9 and 10 million sets) are about $9,800,000.

• • • resistors

Even the smallest resistor has not been overlooked. Wire-wound resistors have new ceramic coatings which render them entirely waterproof. One manufacturer marks the coating with a unique spot which changes color when the resistor is subjected to an overload. Several other manufacturers are using fibreglass as insulation on resistors and on wire, adding considerably to the safety of all kinds of sets and equipment. Carbon composition resistors are better all around; they are smaller with better insulation.

It has been estimated (on the basis of between 9 and 10 million sets sold) that approximately 70 million resistors (of all types) were used for initial equipment alone in 1939—to say nothing of replacements.

Volume controls, too, are better, smaller and cheaper, with better tapers now available, and ranges are extended to as high as 20 meg. The old paper-ink surface is replaced with a fired-carbon coat on bakelite, which has a longer life with less noise.

• • • speakers

Speakers come in for their share of improvement with more and better permanent magnets. The trend toward the use of p-ms has been gradually increasing. In the current (1939-40) lines over 35% of the models offered feature p-m speakers. The introduction of the battery operated portable, no doubt, explains the apparent greatly increased trend toward p-ms in the 1938-39 and 1939-40 lines. We can, however, expect an even greater trend in this direction. P-m speakers offer several decided advantages in their favor. Their use in receiver design obviates the necessity of a hum-bucking coil and its attendant reduction of speaker efficiency. Because of the absence of the field coil voltage, the use of a p-m speaker permits the use of lower voltages on the rectifier, in a-c sets, and hence reduces the possibility of failure in transformers, filters and other components.

WHEN YOU CHANGE YOUR ADDRESS

Be sure to notify the Subscription Department of SERVICE at 19 E. Forty-seventh St., New York City, giving the old as well as the new address, and do this at least four weeks in advance. The Post Office Department does not forward magazines unless you pay additional postage, and we cannot duplicate copies mailed to the old address. We ask your cooperation.

CHASING SIGNALS

(*Continued from page* 31)

but removes the headache from the job because instead of haphazard guessing, you follow a sensible routine, and by the time you have run the routine, you have usually "got your man." As for the brief data given by instrument manufacturers, no iron clad rules can be written out to apply to each and every radio circuit in use. You have to use your head.

Supreme 562 Audolyzer.

It is seldom that an intermittent comes into the shop that you cannot, by inspection or a few licks, localize the trouble to one or two stages, but for the sake of discussing a real headache, let's assume that the set shown in Fig. 1 came in with a very stubborn intermittent, and that it was so critical that the slightest disturbance broke the intermittent; truly a job for a chaser. We have no idea in what part of the set the trouble is. Naturally the first thing to do is to find out whether the intermittent is ahead of, or behind the detector. There are many obvious ways to do this and one very simple way is to connect the vtvm at J or U in Fig. 1, tune in a station using the vtvm as a resonance indicating device, and await the intermittent. When it occurs, if the meter changed, it is r-f, i-f trouble. If the needle on the meter didn't change, it is audio trouble. If the trouble was in the r-f, i-f, the most logical second step is to connect the probe at F and establish presence of the three signals we mentioned before. Leaving the dial on the chaser set to one of these frequencies, we again await the intermittent. When it occurs, quickly reestablish the presence of the three signals. (The chaser will not disturb the set.) If the three are not all there, it is obvious where we should set the probe for our third check. If all three are there, the trouble lies between F and J, or more probably between G and J. One more hook-up, probably at H, will locate the offender exactly; thus you can see that by the time the intermittent has occurred three times, we have it located.

If the trouble had originally been shown as an audio defect instead of r-f, i-f, the chasing would be just as quick and even more simple. After moving from point J (or U), the second step (using the audio portion of the chaser) would be to connect the probe to K so as to include two habitual of-

fenders, the condenser C4 and the diode load resistor, which in this set is the volume control, another usual offender. For a third step, the best position for the probe is point M, because of C5, which is a frequent trouble maker. At the same time you make this audio check, the vtvm could be used externally (on most chasers) measuring voltage changes at suspected points.

A single channel chaser is much slower than a multi-channel job, and the tests described above can of course be speeded up with a larger instrument.

This question is frequently asked: "If I buy a chaser now, will it be obsolete in a short time and won't the later models have improvements?" No, it will not be obsolete so long as radio sets need service. As for improvements in later models, what article isn't improved from year to year? Suppose in 1923 you had decided not to buy a radio until the improving was all over. You would still be waiting today.

Many different ideas have been built around the basic signal chasing principle, and features found on one will be offset by other features on other chasers, so you should have no trouble finding a combination to suit your appeal.

Two of the instruments available are combination chasers and oscilloscopes. Three other makers have a section which checks the total wattage of the set under test.

Most chasers have provisions for listening to the signal being chased (whether the signal be r-f, i-f or audio; detection being provided within the instrument). Some have speakers; others use headphones. While phones are usually considered a nuisance, the speaker models have the single objection that it is often necessary, in careful work, to silence the set's speaker in order to avoid confusion. This can of course be accomplished at the voice coil.

Two makes of instruments have a system for sending the audio in two directions. First there is the usual way of picking off the signal with the probe and taking it into the instrument for visual and audible check. The other way is to tune in a station on the instrument's r-f, i-f channel, set the controls so that this signal is detected and amplified at a-f, and then feed that audio signal off the probe into the audio amplifier of the set under test. This latter system is not a necessity, but has many convenient uses.

Three of the instruments have separate portions known as the oscillator channel. (This is not a signal generator as many believe.) The chief advantage in this separate oscillator channel is in the extra test possible on intermittent jobs. The r-f, i-f channel will, as explained before, check the local oscillator in ordinary chasing work.

The r-f, i-f sections of these instruments usually consist of a two or three stage tuned r-f amplifier with a range switch making it possible to check all normal intermediate frequencies, the broadcast band, and the short waves down to about 19 meters. In most instances this coverage is continuous. Some manufacturers show gain and resonance with 6E5 tubes, or a meter, while others depend entirely on the vtvm and the operator's ear.

The test cables or probes vary with different makes. Some use four different plug-in probes; some use three and some two. One maker uses a single probe for most services (with a slight loss in sensitivity) and a second probe for use in checking two circuits at once. Another uses a single cable for everything, but provides different ends which fit onto a banana plug at the end of the cable. The reason for the different plug-in probes or plug-on ends used by different manufacturers is to insert the isolation element at the handle end of the probe. Generally speaking, a condenser of about 1 mfd is used for r-f work, a resistor of about 1 meg is used for the vtvm probe, whereas the a-f probe is usually wired straight through.

UTAH APPOINTMENT

The Utah Radio Products Co., of Chicago, have announced the association of Peter L. Jensen with the Utah organiza-

G. Hamilton Beasley

Peter L. Jensen

tion. Mr. Jensen will assume the duties of vice-president. The announcement was made by G. Hamilton Beasley, president of Utah.

TRANSFORMER ENCYCLOPEDIA

The new Thordarson Replacement Transformer Encyclopedia and Service Guide No. 352E is just off the press. It lists replacements for power transformers, filter chokes, audio transformers, and output transformers for thousands of receivers. The Service Guide covers timely technical and sales subjects for better servicing. This book can be obtained by writing directly to the Thordarson Electric Manufacturing Co., 500 W. Huron St., Chicago.

C-D CAPACITOR MANUAL

The Cornell-Dubilier "Capacitor Manual for Radio Servicing", a guide to the selection of standard C-D types for use as replacements in practically all existing receivers, is issued free to readers of SERVICE.

Set manufacturers' names appear alphabetically, and under each are listed the manufacturer's models. For each model the data given includes capacitor values in each circuit, working voltages, C-D standard capacitor types recommended for replacement, references to basic filter and bypass circuits (over 165 of which are given in the rear section of the manual), manufacturer's original parts numbers, and volume and page of the Rider Manual in which the complete schematic circuit can be found.

All recommended types are standard and are the correct and most economical types for each particular job, it is said.

The 256-page book is bound in an embossed paper cover printed in two colors and is of pocket size (5⅜ by 7⅝ in).

ERWOOD AMPLIFIER

Erwood Sound Equipment Co., 224 W. Huron St., Chicago, has announced a new amplifier with a power output rating of 28 watts. It is said that this amplifier has unusual overload capacity and the distortion at the rated output is less than 5%. Provision has been made for 2 microphones and a phonograph input. High and low frequency-characteristic controls are provided to adapt reproduction to the particular acoustical conditions encountered. All controls are mounted on an edge illuminated dial of plastic material. Output impedance is variable by means of a tapped switch located on the rear of the amplifier. Provision has also been made for use of a remote control to adjust the volume from some remote position.

AMPERITE MIKE PLUG

The new Amperite station-type plug is designed to eliminate breaking of the cable at the connector and to hold the cable firmly, it is said. Two screws which tighten a ½-in. bearing hold the cable firmly. A rubber sleeve reduces the strain on the cable at the connector. All Amperite microphones are now equipped with this station-type connector.

Additional information may be obtained directly from Amperite Co., 561 Broadway, New York City.

SPRAGUE KOOLOHMS

Sprague Products Co., North Adams, Mass., announce that their Koolohm wirewound resistors are now generally available at leading distributors.

These resistors feature a special type of insulation on the resistance wire which permits interleaved windings and eliminates the necessity of overall coating. Each Koolohm also has the Teledot wattage indicator, a Sprague feature, which consists of a red dot on the end of the unit that changes color when a 25% overload occurs.

CLARION AMPLIFIER

Clarion introduces a high-powered portable sound system designed to meet the requirements of all large indoor and outdoor public address installations. The amplifier delivers a rated output of 40 watts with a peak output of 62 watts, 4 microphone inputs with a gain of 128 db are provided as well as two phono inputs with 84 db gain, it is said. Simultaneous control and mixing of any five inputs is afforded as well as individual control of both bass and treble response by use of the tone equalizer feature. A master gain control, output meter, sloping face panel and speaker matching switch for variation of output impedance from 2 to 500 ohms are among its features.

The Model C483 system is complete in two modern aero-luggage carrying cases and consists of the amplifier, two heavy duty p-m speakers, choice of one of 5 microphones, floor stand and cables, connecting plugs and output meter.

Further information and technical specifications are available from Transformer Corp. of America, 69 Wooster St., New York City.

TURNER MICROPHONE

The Turner Co., Cedar Rapids, Iowa, is offering Model 33X, a streamlined satin-finished crystal microphone. It has an output level of —52 db and a frequency range of from 30 to 10,000 cycles, it is said. The unit is licensed under patents of the Brush Development Co.

A new 8-page Turner microphone catalog is now available. Write for it!

CA AUTO ANTENNA

Insuline Corp. of America, 30-30 Northern Blvd., Long Island City, N. Y., have announced buggy-whip antenna with underhood mounting brackets. The aerial is made of chrome plated Admiralty brass and is equipped with both underhood and alligator mounting brackets. Additional information may be obtained directly from Insuline.

CABLE-TYPE TRANSFORMER

A new cable-type microphone transformer, to match 35-50- and 200-250-ohm low impedance dynamic microphones or lines to high-impedance inputs is offered by Shure Brothers, 225 W. Huron St., Chicago.

This A86A transformer may be located anywhere within 25 ft. of the amplifier. The compact tubular case is magnetically shielded. Cast end covers are removable for access to the terminals. Compression fittings seal-in the microphone and amplifier cables. Removable rubber rings prevent marring the floor or furniture. A clamp fitting is provided for permanent mounting.

OHMITE TAPPED CORDOHMS

A new Cordohm, offered by Ohmite Mfg. Co., 4838 Flournoy St., Chicago, has a three conductor cable which furnishes 110 volts for the rectifier plate, plus a reduced voltage for the filament circuits and, in addition, has a fourth conductor to supply the pilot light voltage. Tapped Cordohms are available in a range of values for 4 or 5 tube sets. Bulletin 118 gives illustrative and descriptive information and is obtainable directly from Ohmite.

RADIO CITY TUBE TESTER

An improved Model 308 tube tester is announced by Radio City Products Co., 88 Park Pl., New York City. This new tester provides facilities for testing all tubes, including the 0Z4, loktal, single-end, bantam, miniature and high-voltage filament types, all ballast tubes (separate ballast tube chart included), pilot lamps

and Christmas-tree lamps. An additional test position is also provided for future tubes with new base arrangements.

Additional information may be obtained directly from Radio City Products.

RCA SIGNALYST

The RCA Signalyst has been announced by L. W. Teegarden, RCA tubes and equipment sales manager. The instrument is a companion to the Rider Chanalyst and

the Rider VoltOhmst recently acquired by RCA. It has a fundamental frequency range from 100 kc to 120 mc, on 10 bands. In addition, it is said to be accurate to within 1% scale calibration and stray leakage has been kept at a minimum. Hetrodyne detection is provided for calibration purposes. Maximum output voltage is 0.05 volts at low range and 1.3 volts at high range. A die-cast shielded attenuator provides direct reading of output voltage by means of a meter. The 90-in, 3-color dial scale is traversed by a pointer which has a 60 to 1 ratio between it and its driving knob. Plate and screen voltages for the instrument are regulated.

Additional information and prices are available directly from RCA Manufacturing Co., Inc., Camden, N. J.

AEROVOX MICA CONDENSERS

Bakelite-molded mica condensers provided with handy meter-mounting brackets, for the purpose of radio-frequency shunting of meter windings, are announced by Aerovox Corp., New Bedford, Mass. The heavy 3/16" thick brass brackets are mounted and connected to the popular series 1445-57 mica condensers. Long slots in the brackets permit attachment to the terminals of any of the standard panel-mounting meters.

NEW COMPANY

As of the first of the year the manufacture and sale of Cinaudagraph loud speakers has been transferred to a new company

Sam Baraf (left) and I. A. Mitchell

known as the United Teletone Corporation. This new organization, which is managed by I. A. Mitchell and S. L. Baraf, of United Transformer Corporation, will continue to manufacture Cinaudagraph speakers at the present plant with, as far as possible, the complete personnel of the present organization.

Index to Advertisers

Years ahead in Features & Design
the new RCP TUBE CHECKER

MODEL 308

MODEL 308 —Counter Type **$16.95**
MODEL 308P—Combination Portable-Counter Type **$18.95**

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In face of rising material and labor costs . . . with more new features than ever before—RCP can still offer a tube checker as advanced as this at a price lower than today's ordinary test instruments. And you know it s quality built *through* and *through* because it's a product of RCP. If you're thrifty minded . . . interested in quicker servicing . . . insurance against obsolescence, and years of guaranteed dependable operation, get all the facts about RCP Model 308. Check the features—compare the RCP values—prove to yourself "there's more value per dollar in RCP testers than in any other make." NOW mail coupon for full details.

SOME OF THE REALLY OUTSTANDING FEATURES OF THE MODEL 308

- ★ Tests all new miniature radio tubes. Checks pilot lights, headlights, etc.
- ★ Spare socket provides for future tube developments. No fear of obsolescence — RCP test equipment offers maximum useful life.
- ★ Tube selector switches facilitates rapid and accurate testing of every type tube. Makes possible quickest check of leakage and shorts on each individual element, while hot.
- ★ Noise test checks noisy and "hum" tubes not detected otherwise. Simply plug in speaker or headphones.
- ★ Line voltage indication directly on meter.
- ★ Neon test for shorts and leaks.
- ★ Load selector provides proper load as specified by RMA.
- ★ Individual check of sections of rectifiers and multipurpose tubes.
- ★ Tests all ballasts tubes — provides filament supply for all tubes up to 117 volts.
- ★ 25 watt smooth power control for 105 to 135 V. line control.
- ★ 3" square direct reading D'Arsonval meter 2% accurate.
- ★ Professional appearance. Black and maroon panel.

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Ranges up to 6000 volts and 1 billion ohms. Total of 12 ranges on direct reading master scales. **$18.85**

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An miniature, an AC-DC voltmeter, ohmmeter, milliammeter and d.b. meter. **$7.95**

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Pocket-size instrument with all the sensitivity, ranges and features of large, expensive testers **$12.90**

Universal Supertester 411

Measurements in ranges never before available in small instruments. Most comprehensive tester ever devised **$16.25**

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Dollar for dollar, feature for feature, the new RCA Signalyst is the best buy in Signal Generators. Its amazing range is greater than any test oscillator...Its accuracy and stability are the tops ...Stray signal leakage is kept at a minimum...AC operated with regulated power supply...It is beautiful to look at and simple to operate—truly a magnificent instrument you will be proud to own.

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