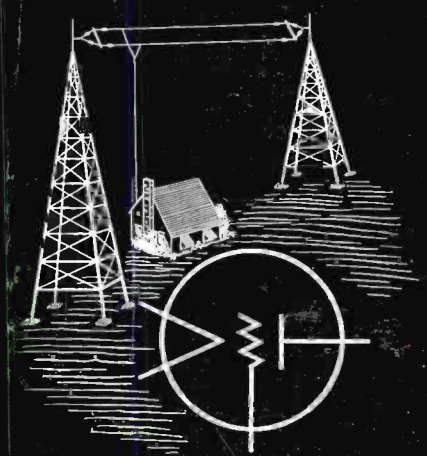
AUGUST, 1933

Radio Engineering



IN THIS ISSUE

OL. XIII, NO. 8 AUGUST, 1933

The Journal of the Radio and Allied Industries

C. T. S. Co. No. 600 SERIES

A NEW VOLUME CONTROL TO MEET SPECIAL REQUIREMENTS

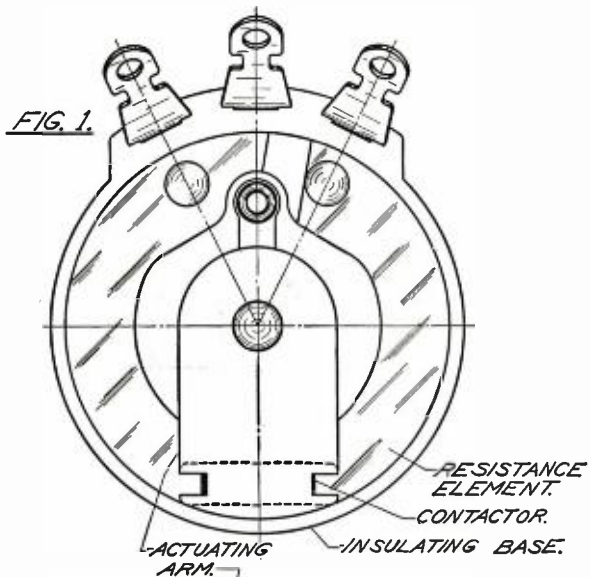


FIG. 1.

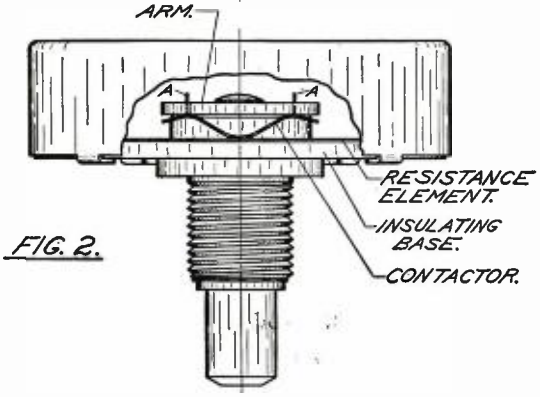


FIG. 2.

PATENTS PENDING

The above drawings of our new control show grounded shaft construction and for the sake of clarity the cover has not been shown on Fig. 1. The actuator arm and shaft are connected so that as the shaft is rotated the arm will swing over the resistance element. The contactor is interposed between the actuator arm and the resistance element, as shown plainly in Fig. 2, so that it exerts a light pressure on the resistance element and a corresponding pressure against the under side of the actuator arm.

This contactor is made of a very light spring-tempered metal and is so arranged that it will adapt its self to the normal surface of the resistance element, thus forming a radial *line contact*. The upright ears A on the contactor engage notches in the sides of the actuating arm to prevent radial or angular displacement of the contactor with respect to the actuating arm and to furnish a connection between the arm and the contactor so that the contactor will always be drawn, and not pushed, along the resistance element. The two end portions of the contactor that bear on the under side of the actuating arm are formed slightly convex to the arm surface so that a minimum amount of friction occurs at these points, thus allowing the actuating arm to slide freely over these surfaces to engage either one or the other of the upright contactor ears A to draw the shoe over the element.

Many automobile radio sets designed to have the volume regulated by remote means require a volume control that operates with a very low torque without sacrifice of quietness even when subjected to extreme vibration.

Some of the more important features of this new control are:

1 A narrow radial line contact extending across the face of the resistance element.

2 This resilient shoe insures intimate contact with the resistance element at all times. Its light weight and method of support make it practically unaffected by vibration.

3 The entire contact shoe is *drawn,* never pushed, across the surface of the resistance element. Smooth action is therefore an inherent quality.

4 More difficult resistance gradients are obtainable due to no noticeable shorting out of the high resistance sections by the contactor.

5 It operates with very low torque. A very necessary requisite for use with remote controls on automobile radio sets.

6 Low frictional component between the shoe and the resistance element gives extraordinarily long life with freedom from noise.

7 Full wiping contact keeps surfaces in good condition and automatically removes any foreign matter from the raceway.

8 Low minimum resistance with our terminals which are flush with the contacting surface of the resistance element.

9 Solder lug portion of terminals lock over projections on base and are unusually strong.

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Contents

Departments

AUTO RADIO TO BE STANDARD EQUIPMENT

ELSEWHERE in this issue is an announcement of the inclusion of radio receivers as standard equipment on the new Hudson-Essex line. We gather that other automobile manufacturers plan to adopt the same course and will include radio receivers as standard equipment in their 1934 models.

The automobile receiver market, which has increased by leaps and bounds throughout the past year despite the adverse economic conditions, promises to attain unprecedented proportions during the coming year.

BRYAN S. DAVIS *President*

JAS. A. WALKER *Secretary*

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A chronological history of electrical communication —telegraph, telephone and radio

◆

This history began with the January 1, 1932, issue of RADIO ENGINEERING. The items are numbered chronologically, beginning at 2000 B.C., and will be continued down to modern times. The history records important dates, discoveries, inventions, necrology and statistics, with numerous contemporary chronological tie-in references to events in associated scientific development. The material was compiled by Donald McNicol.

◆

Part XX

1887 (*Continued*)

(762) A public telephone line is opened for service between New York and Boston. (This line was built in 1884 for experimental purposes.)

(763) In the United States there are forty miles of electric railway in operation, and in Europe twenty miles.

(764) The Baltimore and Ohio Telegraph Company consolidates with the Western Union Telegraph Company. October.

(765) N. S. Keith constructs for the Pacific Power Company four dynamos, each 2,000 volts, 15 amperes.

(766) E. E. Blavier dies. (Born in France, 1826.)

(767) James F. Morrison and William Baxter, Jr., produce a practical series electric motor.

(768) The Anglo-American Telegraph Company adopts automatic transmission on its transatlantic cables.

(769) The gramophone invented by Emile Berliner. (Basis of the Victor Talking Machine.)

(770) James O'Connell, of Chicago, applies signaling lamps in the operation of central office telephone switchboards.

(771) Gustav Robert Kirchoff dies. (Born in Germany, 1824.)

1888 (772) A. E. Kennelly, senior electrician of the ships' staff, Eastern Telegraph Company, England, comes to America and is appointed electrician in the Edison laboratories at Orange, N. J.

(773) Pettingell, Andrews and Company, organized in Boston by F. E. Pettingell and D. A. Andrews.

(774) The Crocker-Wheeler Electric Company organized in New York.

(775) Ward Leonard installs a storage battery train lighting system on the Chicago and Milwaukee Railway.

(776) Edison's improved phonograph brought out, using a wax cylinder.

(777) The Van De Poele Company is absorbed by the Thomson-Houston Company.

(778) The Canadian Pacific Railway Telegraphs now have 5,210 miles of pole line, 17,826 miles of wire and 575 offices in Canada.

(779) Edward Weston is elected president of the American Institute of Electrical Engineers.

(780) The first extensive system of electric railway is installed, at Richmond, Va. Sprague seven and one-half h.p. motors are used on cars.

(781) The first central station lighting system in Chicago is placed in service, August 6, at 139 Adams Street. Two Edison 80 kilowatt bipolar dynamos installed.

(782) During the winter, New York, Philadelphia and Boston lose telegraph and telephone communication with each other and with interior cities, due to severe blizzards.

(783) Charles Cuttriss makes improvements in ocean cable signaling apparatus.

(784) M. B. Leonard presents a paper before the American Institute of Electrical Engineers, New York, entitled "Some Objections to the Overhead Conductor for Electric Railways."

(785) Sir Charles T. Bright dies. (Born in England 1832.)

(786) E. H. Lyons, engineer with the Bell Telephone Company, develops a telephone amplifying repeater.

(787) The first electric sign in Chicago is installed. This was used by the Iowa delegation to the National Republican Convention urging the nomination of Senator Allison for the Presidency.

(788) At Deptford, near London, England, Ferranti installs a central electric light station.

(789) O. B. Shallenberger is granted a U. S. patent for a method of obtaining two currents differing in phase, from a single phase current.

(790) Photoelectric effect is discovered.

1889 (791) At Deptford, England, Ferranti electric generators, alternating current, 1,200 kw., are installed.

(792) N. Tesla procures a U. S. patent covering the invention of a method of obtaining a-c. of different phases from a single phase current.

(793) Columbia University, New York, inaugurates a regular course in electrical engineering.

(794) W. C. L. Eglin arrives in the United States, from Scotland, joins the Edison Electric Light Company, Philadelphia.

(795) The Holtzer-Cabot Company organized, at Boston, by Charles W. Holtzer and George E. Cabot.

(796) The Kinetoscope, Edison's first moving picture machine, is brought out.

(797) A. S. Brown is appointed electrical engineer of the Western Union Telegraph Company, New York. (Remained in this position until March, 1892.)

(798) Raymond L. G. Plante dies. (Born in France 1834.)

(799) Elihu Thomson is elected president of the American Institute of Electrical Engineers.

(800) At Lynn, Mass., Elihu Thomson delivers an important lecture on "Alternating Currents and Electric Waves."

(801) Travelling electric cranes are installed at Philadelphia for use at the works of the Pencoyd Steel Company.

(802) James Prescott Joule dies. (Born in England 1818.)

1890 (803) Ferranti, in England, builds a high tension line operated at 10,000 volts and employing a paper-insulated concentric tubular conductor. The line is about twenty-five miles in length.

(804) The Edison Pearl Street station, New York, destroyed, in part, by fire.

(805) William A. Anthony is elected president of the American Institute of Electrical Engineers.

(806) Fire destroys the main operating room of the Western Union Telegraph Company at 195 Broadway, New York.

(807) Pickernell lays a dry core, lead covered cable in Philadelphia for telephone purposes.

(808) Telephone lines between New York and Philadelphia are equipped for simultaneous telegraph and telephone operation.

(809) A selenium relay is employed by Shelford Bidwell to operate a relay circuit.

(810) The Sprague Electric Railway and Motor Company is absorbed by the General Electric Company.

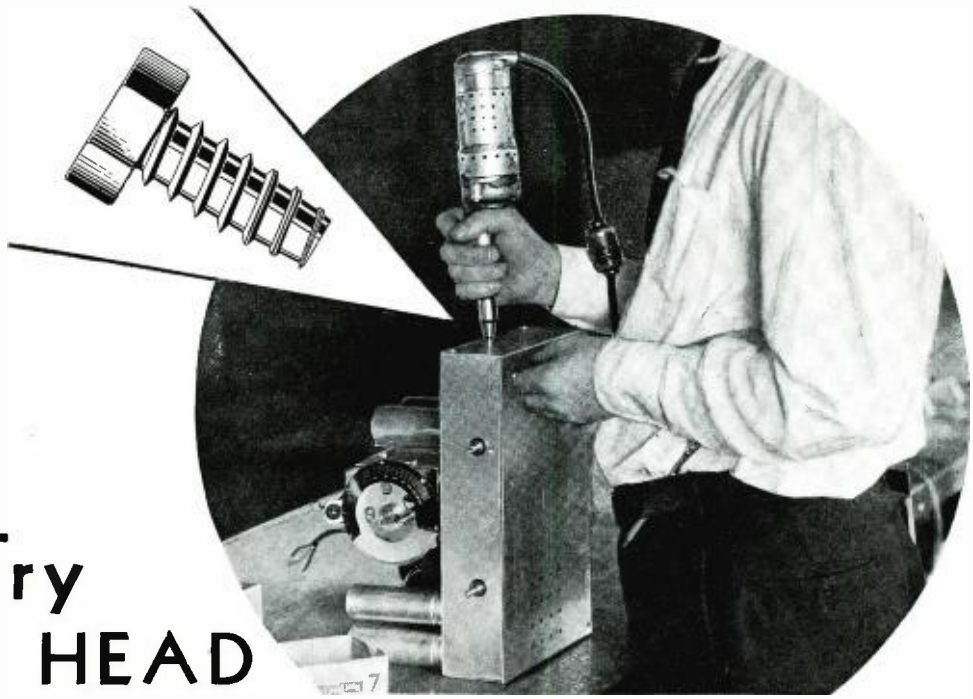
(811) Novak incandescent electric lamps are introduced, the bulbs contain bromine gas.

(812) In the *Electrical World* J. J. Carty describes the employment of 1,000 ohm bridging telephone bells.

(813) Canadian Electrical Association formed, in Canada.

A SUGGESTION . . .

that may speed up your assemblies



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Send free samples of Hex Head Self-tapping Cap Screws. See attached description of assemblies for which I wish to try them.

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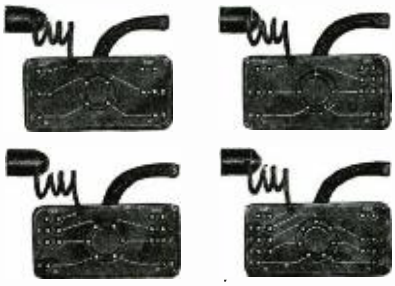

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RADIO ENGINEERING

FOR AUGUST, 1933

INCREASED RADIO MARKETS

ON July 29 the Radio Code was submitted to the National Administration. Its provisions are set forth in full elsewhere in this issue.

Briefly, the code provides for a minimum wage scale and a spread of employment which, it is estimated, will immediately create new jobs for at least 10,000 radio workers, with employment for additional thousands in sight during the fall months.

A uniform method of computing cost of production is being used as a basis for insuring the sale of all radio products at *no less* than the production cost—an end to price cutting and cut-throat competition.

We are entering an era, during which consideration of performance and merit will overweigh those of price. We are about to see a premium placed once more upon improved engineering, performance value and developmental activity. Largely expanding markets for good radio are in the immediate offing.

It is estimated that 5,000,000 men will be back at work on new jobs by early fall. It is entirely conceivable that a substantial proportion of these re-employed workers need radio tubes and receivers, and that within a few weeks or months they'll have the wherewithal to purchase them. The moves now under way to help the farmer may be summarized briefly as an effort to establish a standard of living upon the farm approximately equal to that in urban centers. We believe this means over the next two years a development of a much larger rural market for radio receivers than we have ever seen in the past.

Already at least one automobile manufacturer has announced that his new model cars will carry radio receivers as original equipment. Several other manufacturers are expected to follow suit. Sales of automobile radio during 1934 will far exceed anything which we have had in previous years.

Of course, obsolescence has played its part generally in developing a vast market for new and modern radio equipment. Along these lines, we believe that the present cigar-box radio should not be allowed to monopolize all of the attention of forward-looking manufacturers. Essentially, miniature radio is based upon economic conditions which dictated the lowest possible selling price. We believe that within the next two years there is going to again develop a substantial demand for a larger, self-contained unit giving better reception and occupying floor space rather than table or mantel-piece space. The small receiver has found a permanent place as a second or third set and in apartments or elsewhere, where floor space is limited.

We can't afford to forget that, just as we are looking to increased employment and larger buying power in other industries to furnish radio with larger markets, so too, are other industries depending in part upon the radio industry to increase their own markets. The chisel is being discarded but we have got to avoid the other extreme of too rapidly rising prices and overproduction.

Incidentally there are four important documents which will bear reading by all members of the industry. These documents are the National Industrial Recovery Act of June 13, 1933; NRA Bulletin No. 1 (President Roosevelt's statement); NRA Bulletin No. 2 (General Johnson's statement); NRA Bulletin No. 3 "The President's Re-employment Program." These four documents may be obtained by writing the U. S. Government Printing Office, Washington, D. C.

A REVIEW OF DEVELOPMENTS In Broadcast Receivers of 1933

By Edgar Messing and Monte Cohen*

◆

THE technical history of 1933 receivers is the story of the universal. The first of these sets that came unannounced on the market were four tube t.r.f. sets of the type shown schematically in Fig. 1. The 6.3 volt line of tubes was used with filaments connected in series. A permanently attached antenna cord was supplied. If the manufacturer thought his set was sensitive the cord was twenty feet long; if he thought the set could stand more pickup he made the cord thirty feet long.

The a-c.—d-c. feature was accomplished by employing a half-wave rectifier in series with one side of the power line. On a-c. this tube was a rectifier, on d-c. it was effectively a resistance. In order to minimize the voltage drop across the rectifier, mercury vapor tubes were used in some receivers. These, however, required r-f. filtering which cost money and took up space. Drops of the mercury also often shorted elements and caused many complaints in the field. For these reasons the 37 tube gradually superseded the mercury vapor tubes. With grid and plate connected together the 37 was well able to supply the small load required.

The outstanding characteristic of the little sets, however, was a physical one—heat. About forty watts was enclosed in a small cabinet whose ventilation was never good. Of the forty watts about thirty were dissipated in a six to ten inch resistor fastened to the chassis. On the first sets it was literally possible to fry eggs on the chassis plate. Wooden cabinets warped and peeled. Metal cabinets, which some manufacturers used in order to reduce costs radiated the heat somewhat better but were quite warm all over.

The metal cabinets were usually insulated from the chassis by simple fibre bushings. Since the chassis was often connected directly to one side of the line there were numerous possibilities for getting shocks. The majority of manufacturers, however, insulated the low side of the line from the chassis.

The immediate success of these early sets led to feverish activities on all sides. The sets lacked sensitivity, selectivity, quality reproduction and power output—in short they failed in all of the technical characteristics by which receivers are judged.

The component manufacturers brought forth 5 inch midget dynamic speakers, ¼ watt carbon resistors, roll type condensers half the previous sizes, small high gain coils, variable condensers that contained vernier drive mechanisms, and a whole new line of tubes designed to give superior performance.

The first superheterodynes came out—comprised of five tubes and using an intermediate frequency of 456 kc. The tubes used became practically standard for a-c.—d-c. sets. The 77's and 78's were the 6 volt companions to the 57's and 58's; the 43 was a 25 volt heater type tube that could be used with resistance coupling and deliver power outputs approximating one watt on this low voltage supply. The 25Z5 was a 25 volt heater type rectifier having separate cathodes and plates, and was advertised as the "voltage doubler" tube because, due to its two cathodes it could be employed in voltage doubling circuits.

A few manufacturers did employ voltage doubling circuits, but additional costs especially since: (1) bulky non-polarizing condensers were required; (2) the small margin of gain over what could be obtained with the usual circuits; (3) the necessity for a switch; (4) loss of gain on d-c. and (5) hum troubles, caused the early elimination of such circuits from commercial designs.

Fig. 2 shows the circuit that was most commonly used for the five tube supers. It will be noticed that the suppressor—grid type of tube is used in the composite oscillator detector. This type of oscillator, while resulting in slightly less translation gain than the usual circuit (wherein the tickler is put in the cathode circuit and the tank circuit made a part of the plate output load), was far more reliable and stable. Until the introduction of the 6A7, this circuit was used almost exclusively. The choke was placed in the negative leg of the filter unit so that maximum voltage could be applied to the plate of the output tube. The trouble ex-

*F. W. Sickles Company.

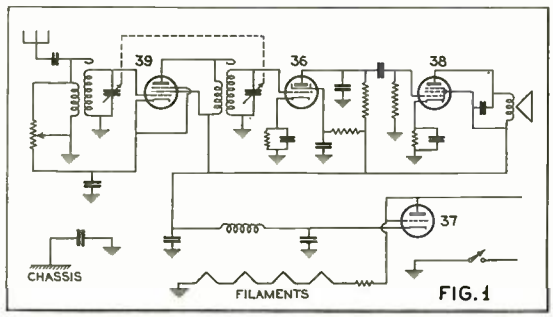


Fig. 1

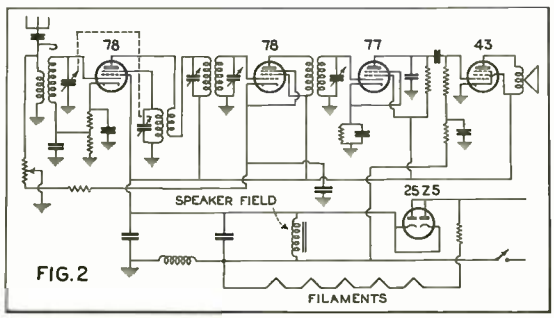


Fig. 2

perienced with modulation hum was easily cured by a simple r-f. filter across the line and proper arrangement of filaments. Large filter condensers were necessary to cut down hum since half wave rectification was used.

The higher voltage heaters of the 25Z5 and the 43 meant that the series dropping resistor had less power dissipated in it and could be made smaller. The "heat cord" was introduced—a line cord containing a resistor in the form of a third wire built into the cord. This took the heat out of the set and put it in the line cord where it was spread out over several feet and hence more readily dissipated. The 25 volt heater tubes, however, were dissipating about 7.5 watts apiece and were quite hot so that the cabinet had to be protected from them.

The sensitivity of good receivers of this type ran from 20 to 50 microvolts. The quality of reproduction was dependent on the choice of speaker and proper by-passing and was limited by the speaker size, power output, and inadequate and poor baffling.

The selectivity of these sets was not good—especially where single tuned i-f. units were used as coupling transformers. An i-f. of 456 kc., while giving comparatively good image selectivity, did not give good adjacent channel selectivity especially since in the desire for more gain. closely coupled i-f. transformers were used. The antenna coil, too, was designed for high gain and was closely coupled to the antenna. Since the antenna cords could be and were placed anywhere the wide variations caused noticeable detuning of the first circuit, with resultant loss of sensitivity and selectivity. Actual measurements on "typical" installations showed antenna capacities varying from 50 to 300 mmf. Standard practice for set testing and design was fixed at 100 mmf.

Tracking plate variable condensers were almost exclusively used because they were simpler to adjust in production, cheaper than the addition of a separate padder, and saved the valuable space the padder required.

To overcome the objection to the 456 kc. i-f. receiver, some two gang 175 kc. and three gang pre-selector 175 kc. receivers were built. The latter were acceptable, of course, and by careful coil design the pre-selector units were made to approach gains obtainable with ordinary antenna coils. The two gang sets, especially where no image rejector circuits were used, were utterly worthless in most localities though surprisingly acceptable in those localities where image interference was absent. Their adjacent channel selectivity was, of course, good and to the average listener these sets appeared more selective—especially since birdies and whistles could usually be explained away. One great fault of the 456 kc. i-f. was the direct pickup of commercial telegraph traffic on or about that frequency. This, especially in seaport towns was very annoying. Simple series traps tuned to the i-f., placed in parallel with the antenna primary eliminated this trouble with little loss in gain. Some designers unknowingly exaggerated the 456 kc. interference pickup by using high impedance primaries that resonated in the interference band.

The next step was the introduction of receivers capable of picking up police calls—which meant that the variable condenser ranges were adjusted so that the band reached 1700 kc., covering the police stations between 1700 and 1500 kc.

The big objection to these small sensitive receivers when used in localities where field strengths were high was their inability to correctly tune in stations. The average operator would turn the volume control up and tune throughout the broadcast band. Since the audio handling power was limited and there was no avc stations would "blurp" in and out and in again, which is double spot tuning due to overload. The next steps were the introduction of overload devices and avc systems. Fig. 3 shows a simple overload system that was quite effective in preventing double spot tuning. The detector grid going positive under the impulse of a large impressed signal draws grid current, which passing through R, biases back both the detector and i-f. tube's grid.

AVC systems could not be satisfactory because only the i-f. tube could be controlled. Six tube sets having a r-f. stage therefore appeared. The use of the complex diode tubes became universal where avc was desired. The diode detector helped ameliorate the double spot

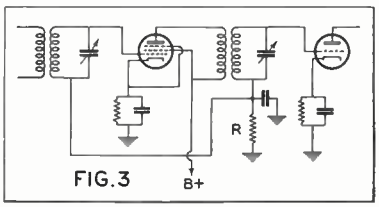
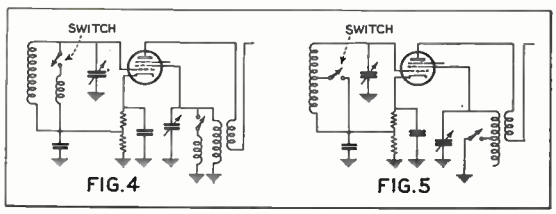


Fig. 3



Figs. 4 and 5

tuning effect even where avc was not used. The introduction of the now familiar 6A7 allowed control of the detector part of that tube and "dual automatic volume control" was advertised as a feature of five tube sets. There is still a question among many designers, however, whether the 6A7 will be satisfactory.

The next important feature that alert merchandisers seized on was the introduction of an additional reception band to cover the 2400 kc. police band and airport and amateur bands between 3500 and 1500 kc. A switch usually located on the rear panel of the set operated as shown either in Fig. 4 or Fig. 5. In Fig. 4 shorting coils are introduced by the switch in parallel with the main inductances. This system has the advantage of simplicity and ease of incorporation in sets designed for single band reception. Careful designers reported that the tapped system gave better selectivity and sensitivity, as would be expected.

Where the object was simply the ability to advertise police band reception no attempt at tracking signal and oscillator circuits was made. Series trimming for the short-wave band allowed for good tracking sensitivity. Good sensitivities for the short-wave band were values below 150 microvolts for five tube sets; better sensitivities were obtainable but the average was nearer 500. The 456 kc. i-f. again became prominent in these receivers because of the failure of 175 kc. to give any sort of acceptable image ratios on the high-frequency band. A compromise intermediate frequency of 262 kc. was also used. This had the advantage of better adjacent channel selectivity over 456 and better image ra-

(Concluded on page 20)

Stability problems of tuned r-f. and superheterodyne receivers

By S. W. Place*

EVER since the radio-frequency amplifier succeeded the familiar regenerative detector back in the early days of radio broadcasting, the radio engineer has had plenty to do.

Stabilizing a tuned radio-frequency or intermediate-frequency amplifier is not a difficult matter using screen-grid amplifier tubes, provided one is liberal in the use of shields and filters. Causes for instability in these amplifiers might be placed under two general headings; electrostatic feedback and electromagnetic feedback of the amplified energy from output to input of the amplifier.

Where sufficient energy is fed back into the input, the re-amplified energy would finally build the circuit energy up to a point where sustained oscillations could take place.

Let us examine some of the various possibilities of feedback. Electrostatic feedback may be caused by capacity coupling between control grids and their leads in adjacent stages, between plate and control grid leads of any one tube due to insufficient shielding; between antenna and control grid and leads of the second r-f. or following tubes in the r-f. amplifier, and between various unshielded parts of the different stages of the r-f. amplifier.

The obvious remedy for all of these causes of electrostatic feedback is, of course, more perfect shielding. The engineer may readily determine just how much shielding is necessary and desirable, this depending to a large extent upon the amount of amplification to be realized from the r-f. amplifier. More amplification with greater stability may be realized by amplifying at two different frequencies, as in a superhetrodyne receiver utilizing a stage or more of tuned r-f. amplification together with one or more stages of i-f. amplification.

Another cause for electrostatic feedback is through the medium of the power line, feedback occurring through some of the output energy of the amplifier getting into the power line through the filament leads, and also due to imperfect filtering. This r-f. energy being carried by the power line, is fed back into the antenna and re-amplified, thereby creating instability. The remedy for this condition is to place a small .01 mfd. condenser on each side of the line to ground.

*Engineer, Synthane Corporation.

Instability

As a cause of amplifier instability, electromagnetic feedback is far more troublesome. It may be caused by such a wide variety of conditions in the layout and design of the amplifier that frequently the engineer is at a loss to comprehend the root of the trouble. Whereas with the old neutrodyne receivers using triode tubes, it was sufficient to place the coils at an angle of zero coupling to each other, the greater amplification of the tetrode makes it imperative to shield each r-f. coil, so that no slight electromagnetic coupling may exist between any of the r-f. coils. Electromagnetic coupling may also be caused by feedback through unfiltered leads, or common conductors, in two or more stages of the amplifier. By proper use of chokes and by-pass condensers at the cathode, screen grid, and B plus terminals of each r-f. tube, we can be fairly sure of no trouble from this source. The audio detector plate circuit, being at the point of highest r-f. potential, must be particularly well filtered to prevent any r-f. energy from getting beyond it and affecting any part of the input circuit, either through common leads or by capacity coupling from the audio amplifier, power unit, or speaker wiring, to the antenna or input of the r-f. amplifier.

Filtering

It has been found that many of these chokes and by-passes can be eliminated in various parts of the circuit, other parts of the circuit requiring only a minimum amount of filtering such as would be provided with a choke of one or two millihenrys and a .01 mfd. condenser, or the condenser alone without the choke. Of course, the greater the amplification, the more need for better filtering. Generally, the screen grids of the amplifier may be connected together and by-passed with a common .01 to .1 mfd. condenser. Where two r-f. tubes are used, it will usually be sufficient to place a choke and by-pass in one of the cathode leads. With more than two r-f. tubes, more filtering of the cathode circuits becomes necessary. The same thing holds true for the plate circuit of the r-f. tubes that holds for the cathode circuits, and the by-passing of the plate return and cathode terminals of one r-f. tube is generally sufficient for a two-stage amplifier, while more filtering may be necessary for more than two stages. For filtering the output of the audio detector, a choke of 100 to 200 millihenrys or a 30,000 to 60,000 ohm resistor should be used, by-passed on each side by a .0001 or .0002 mfd. condenser. It is very essential that the audio detector tube is shielded as this is at the point of highest r-f. potential on the set, and hence most subject to the effects of electrostatic feedback into the input of the amplifier.

Another cause for magnetic coupling is the common return provided in the shaft of the variable condenser. To prevent the tuned circuit currents from returning through the common shaft, each coil return is generally connected back directly to the rotor of its own condenser, through spring connectors placed at each rotor. Magnetic coupling between shielded coils close together may take place through a common base in which there is not an individual shield under each coil shield, or where the shield itself is not of sufficient conductivity to do a 100 per cent shielding job.

Classifying instability problems under two general headings of those caused by electrostatic feedback, and those caused by electromagnetic feedback, we might

(*Concluded on page* 20)

PRACTICAL RADIO ENGINEERING

By
E. H. RIETZKE
President, Capitol Radio Engineering Institute

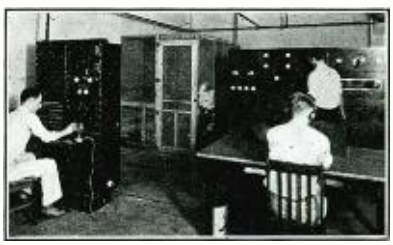
✦

IT is believed that the readers of RADIO ENGINEERING will be interested in some of the problems involved in the practical teaching of this subject and in the development of a school which specializes exclusively in the teaching of practical radio engineering. The Capitol Radio Engineering Institute, located at Washington, D. C., has for a number of years confined its instruction to experienced radiomen who are interested in taking up study of an advanced nature but who are not able to devote the time and money necessary for an engineering course at one of the universities.

The development of this course is interesting. Early in 1924 the writer, then in the U. S. Navy and attached to the flagship of the Battle Fleet in charge of fleet material, was ordered to the Naval Research Laboratory in Washington to work up a course of study in vacuum tube work suitable for the Navy's highest rated radiomen, Chief and First Class Radiomen. These radiomen were detailed to the school for a period of 22 weeks with two classes each year. How intensive the course of study was made is shown by the fact that over a period of several years an average of approximately 30 per cent of each class failed to make a passing average, although the minimum of radio experience of any student was about six years. This was due to the fact that insufficient time was allowed for the wide scope of the work that was required to be covered.

Knowing that no such course of study was available in the commercial field and that a definite demand existed the writer prepared this course in home study form and in 1927 organized the Institute with which he is now associated. When this course was announced it became extremely popular in the U. S. Navy, the naval radiomen studying it largely to insure their successful completion of the Navy's school at Washington without which they could not become eligible for promotion to Chief Radioman.

Realizing that one of the major problems in the development of a satisfactory course of instruction for commercial radiomen involved a very thorough understanding of the particular problems, the next two years were spent in a thorough analysis of commercial radio work, working conditions, apparatus used, design and development of circuits for all purposes, and the preparation of the essential information in the form of lesson material. Not until 1929 was this course actually announced to the commercial field, at which time an announcement was sent to all broadcasting stations. This practical study and analysis has never ceased and the course of instruction is continually in a state of revision and addition to keep up with the rapid developments taking place in radio.



A section of the transmitting room at the Capitol Radio Engineering Institute

In 1931 it was realized that many commercial radiomen who knew that they needed such advanced training were simply afraid they could not handle such a course, which starts right in with the essential mathematics and which assumes on the part of the student a somewhat extensive groundwork of fundamentals. To meet the needs of such men a special "introductory" course was prepared to precede the basic advanced engineering course. This "introductory" course enables the student to obtain a thorough review of fundamentals and to get into the habit of studying before reaching the mathematical work.

For the past five years there has been a continual demand for this same training in residence form. Many ship operators, servicemen, technicians, and others who, while they could appreciate the benefits of home study, felt the need for actual classroom instruction and practical work with modern transmitting and receiving apparatus and laboratory equipment. It was realized that with the depressed business conditions of the past several years the undertaking of such a venture at this time entailed considerable risk. However, the directors of the Capitol Radio Engineering Institute have felt extremely optimistic about the future in the field of radio for the man with better-than-average technical training. They have also felt that if such instruction is made sufficiently practical, if the equipment and facilities of the school are adequate to meet the needs of the really high class experienced radiomen, and if the course is actually intensive and is kept within the means of the prospective students, there will be a sufficient demand to make such an undertaking a success.

An entire year was spent in the selection of an enlarged instruction staff, selection, purchase and installation of equipment, development of the curriculum, etc. Two residence courses were decided on—a complete full-time one-year course running from September into June with eligible students limited to high school graduates and experienced radiomen—and a 10 weeks' summer post-graduate course which is available only to the home study graduates and students who have completed not less than 75 per cent of the home study course. The latter class started in June of this year with a full class, students coming from as far as Montana, Alabama, Minnesota, Iowa, and from ship operating positions. Registrations for the class starting in September were received as early as May.

The combined professional radio experience of the heads of the three technical departments of the Capitol Radio Engineering Institute totals fifty-one years. With this background of professional radio experience it was decided that every piece of equipment installed must be strictly up-to-date, completely workable and available for actual use by the student. A view of a portion of the equipment taken in the transmitting room is shown in the accompanying illustration. The complete broadcast transmitter is crystal controlled, modulated 100 per cent, and has a conservative carrier output of 200 watts. For working in the broadcast band it operates into a phantom antenna in the copper screened booth shown and actually goes on the air in the 160-meter amateur band with a personal call. The speech input equipment shown is of the latest type and includes two level indicators, a three stage and a four stage

amplifier (two individual amplifiers), three line equalizing circuits, a built in receiver for monitoring, six microphone mixer circuits, etc. Most of the equipment in this unit is General Radio. For communication purposes the Hammarlund Comet-Pro receiver is used. This is shown on the desk in the foreground.

Other equipment includes a complete broadcast studio at the other end of the building, a thoroughly equipped laboratory containing 90 feet of wired experimental tables, a classroom with individual student desks, a large blackboard and platform on which is mounted a wired demonstration table, and a projection machine for showing sound-on-film educational films.

Students attend class from 9 a. m. to 4:15 p. m. with one hour for lunch at noon. Only the number of students that can be given personal instruction is accepted for any one class. Home study students may start at any time and study as rapidly or as slowly as their individual situations permit. Of the approximately 1,200 home study students at present enrolled more than 97 per cent are professional radiomen, the other small percentage being made up of students and experimenters. The student body includes students in approximately 125 broadcasting stations in the United States with as many as six students at individual stations, in the radio organizations of all the leading air transport lines, in the radio divisions of the Army, Navy, Coast Guard, and Department of Commerce, and in radio service organizations, factories, and in almost all parts of the world such as Australia, China, Alaska, Venezuela, Egypt, Switzerland, and in many other countries.

From contacts with the radio industry, from observations over a number of years of the successful progress of radiomen who have had both practical experience and good technical training, and from the plain common-sense point of view, the writer feels very optimistic about the possible future in radio for the better-than-average man. The Capitol Radio Engineering Institute is operated for the benefit of the type of men who read RADIO ENGINEERING.

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Waxes and Compounds for Radio Components

By A. SAUNDERS

Technical Staff, Zophar Mills, Inc.

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THE application of insulating waxes has gone through some changes keeping pace with new radio designs and requirements. While waxes of relatively low melting points were satisfactory in the past, higher heat developed in modern amplifier and power supply units now demand the use of higher cold flow waxes.

For potting condensers or capacitors where low or no heat will prevail, waxes under 150° F. cold flow are satisfactory. If heat is to be encountered, plastic waxes, non-brittle in cold temperatures, with cold flows in a range between 160° to 180° F. in black or light colors will give good results. For topping and for sealing ends, such as cartridge or fibre tube case or box, a wax close to 200° F. cold flow is required. In some special cases it will be necessary to use sealing waxes with cold flows between 200° and 250° F. It must be borne in mind that high cold flow products have high viscosities requiring elevated pouring temperatures which in some cases, such as paraffined foil and paper, might change the final results of the complete assembled unit.

Oil, glycerine and acid-proof waxes of high cold flows are required for use in electrolytic condensers. For end sealing a light colored wax is preferable.

Use of certain types of chlorinated waxes is the best due to high dielectric strength for the impregnation of paper, but if the amount of paper and foil is not restricted by price, impregnation can be accomplished with waxes of 130° to 140° F. melting point.

For the satisfactory impregnation of the assembled and finished tube or cardboard box unit a wax light in color, of a transparent film to allow reading of printed matter and label, and of a cold flow not lower than 170° F. is desirable. The wax must allow for expansion and contraction, be tough, and must not, above all, crystallize due to the oxidation brought about by contact with the air. A wax of this type is desirable for the impregnation and water-proofing of resistance units.

For coil impregnation both low and high melting point waxes can be used according to requirements. In some cases varnishes are preferable.

Waxes of a melting point above 230° F. must be selected for sealing lightning arrestors such as used in connection with radio antennas.

For transformers of a low power a casing wax of 160° to 180° F. melting point is satisfactory. For audio transformers the low melting point waxes can be used. For large and high-power transformers plastic waxes, to prevent cracking under constant heating and cooling in operation of transformer, of best heat dissipating properties and of cold flows over 230° F., and higher, melting point must be used. In small transformers hard flint like waxes of over 230° F. melting point will give good results. These waxes must not develop moisture by usual oxidation or ozone formation, that would cause shorts or decrease efficiency of transformer. This is specially applicable to transformers operating large neon tube signs under use most of 24 hours daily.

Good varnishes must be selected for transformer coils and core plate impregnation, although some compounds have given better results for impregnation under vacuum. Thorough moisture proofness must be attained with good dielectric strength.

Waxes also find their use in the water-proofing and finishing of braided wire; in the manufacture of wet and dry batteries and in the manufacture of the many new parts which are continuously being developed.

AUDIO SYSTEM with the new 2B6 tube

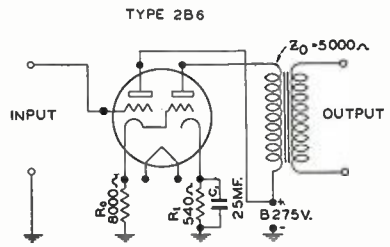
By Charles F. Stromeyer*

DURING the last few years there have been many attempts to popularize various audio output systems. The pentode was heralded as the successor to the triode, although its higher efficiency and sensitivity were obtained at the sacrifice of quality. However, with the cheapening of receivers, the pentode became a necessity. Then, Class B was introduced in battery receivers where it fulfilled a definite need. Later, when developed for a-c. operation, it did not meet with general success because of its cost and complications. The quality could hardly be considered as an improvement over the pentode unless particular expensive precautions were adopted. Push-pull Prime A was next in line, but this was an expensive system requiring an input transformer besides a driving tube.

Furthermore the last two mentionel systems required a minimum of three tubes not including the detector. Some system is needed which may be adopted for the smallest receiver to the largest, so that the basic problems in audio design may be standardized. This method should be free of complications and inexpensive. Also quality must not be compromised.

The confusing problem in determining an output tube's merit is the power rating on a basis of harmonic content. Until some other scheme is devised, the art will continue to use this method. However, it is misleading. For example, consider the pentode, whose "resistance-load" harmonic content may be nearly of the same order as a triode, yet qualitatively the rendition is poorer. Further consideration shows that the match between the pentode's internal impedance to its work load may be in the order of six to one, and that the generated harmonics rise very rapidly with increasing load. Then when coupled to an ordinary speaker, the transient harmonic term becomes seriously exaggerated, giving rise to inferior quality. This condition also arises, to a greater extent, in Class B. Carrying this thought still further, a word of caution might be helpful in applying the results of "permissible harmonics" shown by Massa.[1] This work shows values for permissible harmonics which represent the amplifier overall distortion. The load conditions are assumed to be ideal so that the transient term is minimized. Therefore, the values do not mean the mere rating of the output tube working into a resistance load. In short, the quality performance of an output tube must not be determined only by its power rating on a specified harmonic value, but by actual performance in the circuit used.

Reveclation Patents Holding Company.



STANDARD SINGLE TUBE CIRCUIT

Fig. 1

Since Class A triode output is conceded as the most desirable of known methods for perfect reception, it or its equivalent should be the goal of the development. The triode system, however, is not inexpensive, if relatively large power is to be obtained, due to the tube's low efficiency and sensitivity. The inception of the multifilamentary triode was an attempt to provide the result more efficiently. Unfortunately, its complicated filament structure makes the tube difficult to produce. A few tube producers are experimenting with a tube of similar characteristics but using three separate cathodes in parallel. Some improvement may be expected but the problem of obtaining uniform active coating surfaces from the separate cathodes is by no means a simple task. These improved triodes have two other objectionable features, first—the power falls rapidly with increasing load thereby causing a poor high frequency response, and second—the d-c resistance in the grid circuit must be relatively low which provides certain limitations in coupling to high impedance detector circuits.

The Arcturus Radio Tube Company has been working independently of this trend. The original triple-twin system was studied to ascertain if it was possible to maintain its high plate efficiency, and to reduce the components used in the circuit, and further to simplify the tube construction without losing its triode quality features. This was not only possible but other advantageous features were added. The new 2B6 tube characterizes the advancement for the a-c. application. Development on automobile types for a-c.-d-c. operation is now in progress. The same principles are involved so that general audio standardization may be expected by their adaptation.

The new 2B6 consists of two sets of triode elements mounted in tandem using a common heater but electrically separate cathodes. This structure is simple and

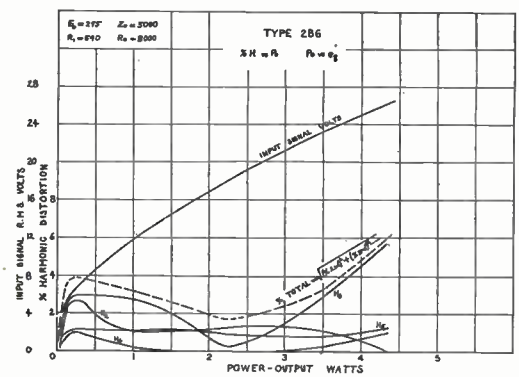


Fig. 2

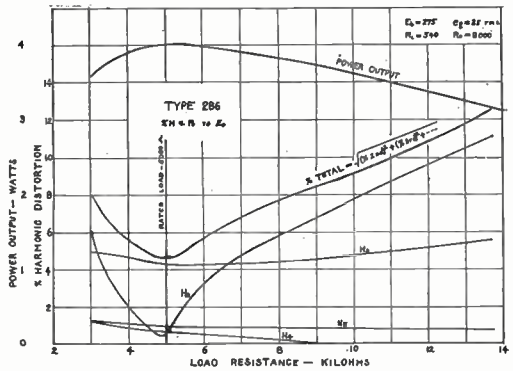


Fig. 3

less complicated than other popular tubes now in use. An examination of Fig. 1 will show the simplicity of the tube and circuit. The left-hand set of triode elements is the small input and the right-hand is the large output. Resistance Ro provides part of the first section's load and also the bias for its grid. (The complete load is the parallel combination of Ro and the grid impedance of the output section). Since its cathode is directly tied to the grid of the output section, the drop in Ro would put the output grid at a high positive bias. This is offset by the drop in R1. Consequently, the output grid bias is the difference between these two voltages, and it is normally 2.5 volts positive with respect to its cathode so that its grid conductance is appreciable. Therefore, the input current divides, part flowing through the output grid resistance and part through Ro. Degeneration in R1 is prevented by condenser C1. The large section of the tube delivers the output power. It operates at nearly the mid-point of its eg-ip characteristic. Since it uses the entire characteristic, its grid must be driven during part of the cycle. The input section performs this duty and provides a high input impedance as its grid does not draw current. The direct cathode coupling feature permits the delivery of grid power without the necessity of a step down transformer. The compensating theory of the input action for impressing a voltage across the grid impedance of the output section, independent of the grid impedance has been published[2], and, therefore, will not be treated here. It may be summarized as—the characteristics of the input section are arranged so that its internal impedance varies with the amplitude of the signal to maintain a constant ratio with its load. Hence, the developed voltage is not influenced by changes in its load value. In other words, the voltage impressed across the input of the second section is not affected by variations in the grid impedance of this section.

The output handling capacity of the 2B6 was decided upon after extensive consideration. One size of an a-c output tube for standard 250 plate volt operation adaptable for large midgets to the finest of consoles is desirable. Last year, some sets claimed the tremendous power

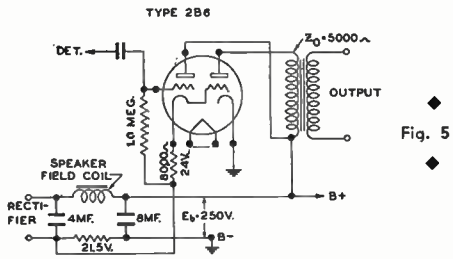


Fig. 5

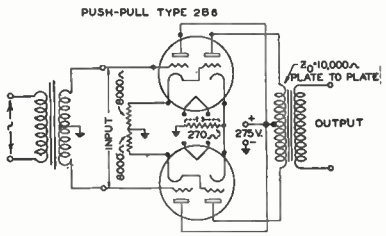


Fig. 4

output of 20 watts or more. This may be useful for advertising bally-hoo but from a practical consideration, almost none of these receivers employ sturdy enough cabinets to provide satisfactory baffles to minimize acoustical feedback to say nothing of the inability of the loudspeaker to handle such output. Probably, some eight watts of this output ceased to be real music and was nothing else but "noise" power. With this in mind, it is generally conceded that a good 10 watts of real usable power is sufficient for the better consoles. Thus a compromise was reached at a power rating of 4 watts for a single tube, which operation, should be ample for the larger midgets. Two tubes in push-pull would readily provide the 10 watts for consoles. The power rating was not the only point in question. The total anode current should not be much greater than types which the new tube is to replace, in order to utilize existing power pack components. Due to the system's high plate efficiency, the power rating was obtained at the low total value of 44 mils.

The curves in Fig. 2 show that 4 watts are obtained with a total harmonic of 5 per cent or less. A signal of 25 volts is required. Fig. 3 discloses the reasons why the tube has excellent performance. The optimum load impedance for maximum power is the same value as for minimum distortion. Hence the transient term of the speaker is minimized. Furthermore, this 5000 ohm load is almost perfectly matched to the plate impedance. The fall in power with increasing load beyond 5000 is not as steep as ordinary negative bias triodes. For example, with three times the rated load, the power is down only about 1.6 db. Thus the average speaker, whose impedance varies considerably with frequency will receive more nearly a constant power, regardless of the signal frequency. The only harmonic that climbs at any appreciable rate with increasing load is the second harmonic, but it rises slowly so that a buffer filter, across the output transformer, to make the load appear as a constant impedance device, is not necsssary. As the signal is reduced, the gradient of the power and harmonics curves decrease.

Excellent results are obtained in push-pull. The circuit is shown in Fig. 4. Due to the harmonic cancellation action of push-pull, the harmonics are considerably reduced. The evens nearly disappear and the odds[3], contrary to the erroneous general push-pull conception, are considerably reduced.

When first inspecting the tube's characteristics, it would appear that the input grid drew current because it is only biased to 24 volts while a peak signal of 35 volts is impressed for the rated power. Yet no power is required in the input circuit. This requires some explanation. With ground as a reference level, the voltage across Ro in Fig. 1 is in phase with the applied signal. Then the alternating voltage actually appearing across grid to cathode is the difference between these

(*Concluded on page 20*)

CODE OF FAIR COMPETITION for the RADIO MANUFACTURING INDUSTRY

As submitted by the Radio Manufacturers Association to the National Recovery Administration on July 29, 1933

Preamble

WHEREAS, radio consists of transmission and reception through the instrumentality of transmitter and receiving sets; and

WHEREAS, broadcasting by radio cannot be confined within state lines and has been determined by Courts of the United States to be interstate commerce, and radio receiving sets as an absolutely essential instrumentality of such interstate commerce; and

WHEREAS, various individuals, partnerships and corporations are engaged in the manufacture and sale of radio receiving and television sets and parts therefor for use throughout the United States and in foreign countries as such instrumentalities of interstate commerce; and

WHEREAS, under the National Industrial Recovery Act, the radio manufacturing industry is authorized to present a code of fair competition for the industry to the President for approval:

NOW, THEREFORE, to effectuate the policy declared by Congress in and pursuant to the provisions of such Act, the radio manufacturing industry through the Radio Manufacturers Association hereby adopts the following code of fair competition, subject to the approval of the President of the United States:

General Provisions

Administration and Definitions

The provisions of this code shall with the approval of the President be administered by the Radio Manufacturers Association. In order to effect such administration those persons who now are or those who from time to time may be elected to or appointed as the Executive Committee of the Radio Manufacturers Association shall constitute a Radio Emergency National Committee, hereinafter described, which shall be responsible for the administration of this code.

"Radio Manufacturing Industry" as defined herein shall include every person, firm, partnership, association and corporation who manufacture any of the following products:

(a) Radio receiving and television sets.

(b) Radio and television tubes, electronic tubes and valves.

(c) Parts, cabinets, accessories, including loud speakers, condensers and also sound distribution equipment.

"Radio products" as used herein shall consist of radio receiving sets and parts therefor and television receiving sets and parts therefor.

"Sound distribution equipment" as used herein shall consist of equipment for the distribution of sound originating from a radio receiving set or an electric phonograph or a microphone.

The term "cost of production" as used herein shall embrace cost of selling, advertising and administration and all other expenses of every kind and character which the manufacturer shall incur in the operation of his business, unless excluded or otherwise defined in separate chapters of this code applicable to radio products covered by such chapter.

The term "effective date" or equivalent term is herein defined as the tenth day after this code has been approved by the President of the United States.

Section 1: The provisions of this code shall not be used, interpreted or applied in such a manner as to—

(a) Permit or promote monopolies or monopolistic practices;

(b) Eliminate or oppress small enterprises or operate to discriminate against small enterprises.

Section 2: The President of the United States may from time to time cancel or modify any order, approval, license, rule or regulation issued under Title 1 of the National Industrial Recovery Act and this code is expressly made subject thereto as provided in Section 10 (b) of such Act.

Section 3: (a) Employees in the radio manufacturing industry affected hereby shall have the right to organize and bargain collectively through representatives of their own choosing and shall be free from the interference, restraint or coercion of employers of labor or their agents in the designation of such representatives or in self-organization or in other connected activities for the purpose of collective bargaining or other mutual aid or protection.

(b) No employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing or assisting a labor organization of his own choosing.

(c) Employers shall comply with the maximum hours of labor, the minimum rates of pay and other conditions of employment approved or prescribed by the President.

Section 4: (a) On and after the effective date employers shall not employ anyone under the age of 16 years.

(b) On and after the effective date the minimum wage that shall be paid by any employer to any employee engaged in the processing of the products of the radio manufacturing industry and in labor operations directly incident thereto shall be 40c per hour, unless the rate per hour for the same class of labor on July 15, 1929, was less than 40c in which case the rate per hour shall be not less than the rate per hour paid on July 15, 1929, and provided also that in no event shall the rate per hour be less than 30c per hour, and provided further that casual and incidental labor and learners may be paid not less than 80 per cent of such minimum wage, but the total amount paid to such casual and incidental labor and learners shall not exceed in any calendar month 5 per cent of the total wages paid to all process labor by such employer.

(c) On and after the effective date the minimum wage that shall be paid by any employer to all other employees, except commission sales people, shall be at the rate of $15 per week, provided, however, that office boys or girls, learners and casual employees may be paid not less than 80 per cent of such minimum wage but the total amount paid to such office boys or girls, learners and casual employees shall not exceed in any calendar month five per cent of the total amount paid by such employer to all employees covered by the provisions of this paragraph (c).

(d) The minimum rate of wages provided in this section shall apply to all employees in all localities unless the Administrator or his representative shall fix a lower rate for particular localities.

(e) Not later than ninety (90) days after the effective date the radio manufacturing industry shall report to the Administrator through the Radio Emergency National Committee the action taken by all employers in adjusting the hourly wage rates for all employees receiving more than the minimum rates provided in paragraph (b) of this section.

Section 5: On and after the effective date employers shall not operate on a schedule of hours—

(a) For employees engaged in the processing of products of the radio manufacturing industry, and in labor operations directly incident thereto, in excess of 36 hours per week.

(b) For all other employees, except executive, administrative, research, engineering and supervisory employees, and traveling and commission salespeople, in excess of 40 hours per week.

Provided, however, that these limitations shall not apply to those branches of the radio manufacturing industry in which seasonal or peak demand places an unusual and temporary burden upon such branches; in such cases such number of hours may be worked as are required by the necessities of the situation, but at the end of each calendar month every employer shall report to the Administrator through the Radio Emergency National Committee in such detail as may be required, the number of man hours worked in that month on account of seasonal or peak demand requirements, and the ratio which said man hours bear to the total number of man

hours of labor during said month; and

Provided, further, that these limitations shall not apply in cases of emergency, but at the end of each calendar month every employer shall report to the Administrator through the Radio Emergency National Committee hereinafter provided for, in such detail as may be required, the number of man hours worked in that month for emergency reasons and the ratio which said emergency man hours bear to the total number of man hours of labor during said month.

Section 6: No manufacturer shall sell or offer for sale radio products which have been made by labor in the factory of such manufacturer, receiving less than the standard minimum wage rate or more than the standard maximum hours of work or by labor in the factory of such manufacturer whereby persons under 16 years of age shall be employed or permitted to work as prescribed herein, except as to radio products manufactured or in process of manufacture prior to the date when this code shall become effective.

Section 7: To assure the payment of such minimum wages and the operation under such maximum hours above described and such other conditions of employment as may be approved or prescribed by the President and to effectuate the purposes of the National Industrial Recovery Act and to avoid further depletion and destruction of capital assets, it is deemed necessary and essential that each manufacturer be enabled to receive for his product a sum sufficient to compensate him therefor, and to relieve him from oppression of manufacturers of greater capital and the destruction of his business and cause unemployment by selling for less than the cost of production.

To accomplish these purposes, no manufacturer in the radio manufacturing industry, subject hereto shall sell any product for less than the cost of production as defined herein or as may be defined in separate chapters hereof as to manufacturers covered thereby unless exempted under such separate chapter.

Section 8: Each manufacturer may add to the cost of production as so defined, such amounts or percentages as he may deem advisable to constitute the net prices or list prices of his products, which prices shall be national and applicable whether sold within the state where such manufacturer is located or elsewhere, in order that the interstate commerce of such manufacturer shall not be unduly burdened or affected by intrastate sales.

Section 9: In determining such price no manufacturer shall discriminate between his various types of radio products in allocating overhead for production, selling, advertising and administration.

Section 10: No manufacturer shall include in any transaction other material or parts or services or labor at less than the regular prevailing price at which the party making the sale is at the time accustomed to sell such other material or parts or furnish such services or labor, or by granting any rebate or by permitting any over-shipments or making any concession or by doing anything whatsoever which directly or indirectly gives any purchaser more favorable terms than permitted herein and no manufacturer shall use any subsidiary company for such a purpose, the effect of which is to sell for less than the minimum prescribed herein.

Section 11: No manufacturer shall directly or indirectly give or permit to be given or offer to give money or anything of value to agents, employees or representatives of customers or prospective customers, or to agents, employees or representatives of competitors' customers or prospective customers, as an inducement to influence the employees or principals in the purchase or contract to purchase or sale or contract of sale of radio products covered hereunder from the maker of such gift or offer or to influence such employees or principals to refrain from dealing or contracting to deal with competitors.

Normal use of advertising or sales promotion materials and ordinary sales expense generally applied to all customers alike shall not be construed as prohibited under this section.

Section 12: No manufacturer shall use any of the following methods for the purpose of effecting or concealing price discrimination or for other purposes:

(a) Payment, allowance or acceptance of secret rebates, commissions, credits or discounts, whether in the form of money or otherwise.

(b) Understandings to do work or to furnish or receive material on terms other than those set forth in the contract or order between the parties.

(c) Failure to enforce collection in accordance with the terms of sale.

(d) Extend to certain purchasers special privileges including discriminating allowances for repairs, replacements or other services not extended to all buyers under like terms and conditions.

(e) Any secret understanding which is designed to give any special advantage to one customer as against another.

Section 13: No manufacturer shall:

(a) Sell or advertise for sale radio products by any means with the intent to deceive purchasers or prospective purchasers regarding their quality, substance or service feature.

(b) Mark or brand his radio products in any manner for the purpose or with the effect of misleading or deceiving purchasers as to the quality, grade and service thereof.

(c) Make, issue or mail any false invoice to conceal or misrepresent any sale or other transaction or any part thereof.

(d) Imitate or copy the design or trade mark of another manufacturer with intent to mislead or deceive and thereby secure undue benefit or advantage therefrom.

(e) Alter, deface or remove serial numbers or identification or trade marks on any other manufacturer's product.

(f) Disseminate false or misleading information relative to competitors' products, sales, prices, reputation, credit or financial standing, ability to perform work, or labor conditions among competitors' employees.

(g) Give any information acquired in confidence with the intent of giving or receiving any unfair advantage in competitive business transactions.

(h) Use untruthful, misleading or exaggerated statements regarding his radio products.

Section 14: Nothing herein contained shall be construed, interpreted or implied to authorize, sanction or permit any other person, firm, association or corporation to fix the net or list price which the manufacturer shall establish for the manufacturer's own products, except that no such net or list price or prices shall be made by which a manufacturer shall receive a net amount less than the cost of production if required in the separate chapter of this code applicable to such priced product.

Section 15: For the purposes of administration under this code by the Radio Emergency National Committee the radio industry or trade shall be divided into divisions, which are hereby established as follows:

1. Radio receiving and television set division.
2. Radio tube division.
3. Radio parts, cabinets and accessories division.
4. Radio loudspeaker division.
5. Sound distribution equipment division.
6. Fixed condenser division.

Other divisions may be established upon application of any group to the Radio Emergency National Committee, herein created, subject to the approval of such Committee. No code for such a new division may be adopted without the approval of the executive committee of established divisions.

Each division shall designate or establish its own administrative agency or agencies.

Each such division shall be independent and self-governing, and shall deal with all problems relating exclusively to that division.

Proposals in respect to matters affecting more than one division may be initiated by any division and shall be submitted for consideration to the Radio Emergency National Committee of the radio manufacturing industry and its determination shall be binding upon such division and all other divisions affected thereby.

Section 16: Each of the above divisions and any others which may subsequently be formed within the radio manufacturing industry or the Radio Manufacturers Association shall set up an executive committee for the purpose of administering through the Radio Emergency National Committee the general provisions of this code and the provisions of any chapter of this code which covers the operation of such division and adhere strictly thereto, hear any just complaints, consider proposals for amendments thereof and exceptions thereto, and otherwise to carry out, within the division, the purposes of the National Industrial Recovery Act and the provisions of this code.

Section 17: If a division as named above shall not agree upon a chapter of this code to cover such division to be submitted to the President, the Radio Emergency National Committee shall be empowered to draw such a code for such division and submit the same to the President for approval.

If at any time thereafter, the manufacturers of a division fail to conform to the provisions of the code as drawn by them or by the Radio Emergency National Committee, the Radio Emergency National Committee of the radio manufacturing industry is hereby empowered to administer such code as if such Radio Emergency National Committee were the executive committee of the division concerned.

Section 18: (a) Until otherwise determined under the provisions hereof, the executive committee of the Radio Receiving and Television Set Division shall consist of the persons from time to time constituting the executive committee of the Receiving Set Division of the Radio Manufacturers Association.

(b) Until otherwise determined under the provisions hereof, the executive committee of the Radio Tube Division shall consist of the persons from time to time constituting the Executive Committee of the Radio Tube Division of the Radio Manufacturers Association.

(c) Until otherwise determined under the provisions hereof, the executive committee of the Radio Parts, Cabinets and Accessories Division shall consist of the persons from time to time constituting the executive committee of the Parts, Cabinet and Accessory Division of the Radio Manufacturers Association.

(d) Until otherwise determined under the provisions hereof the executive committee of the Radio Loud Speaker Division and the executive committee of the Sound Distribution Equipment Division, shall consist of the persons from time to time constituting the executive committee of the Amplifier and Sound Equipment Division of the Radio Manufacturers Association.

(e) Until otherwise determined under the provisions hereof the executive committee of the Fixed Condenser Division shall consist of such persons as shall be elected or appointed by a majority of those covered by such division.

Section 19: Each of the above divisions and any other divisions which may subsequently be formed may formulate code provisions not inconsistent with the general provisions of this code, applicable to the business comprehended by such division, to form when approved a separate chapter of this code.

Section 20: The provisions of this code and the separate chapters of this code shall, upon approval by the President of the United States, be binding upon all manufacturers of radio products covered hereby.

Section 21: Until otherwise determined under the provisions hereof, the persons for the time being constituting the executive committee of the Radio Manufacturers Association which shall include the chairman of each division of such Association shall constitute the Radio Emergency National Committee.

Section 22: The Radio Emergency National Committee shall be the general planning and coordinating agency for the industry. It shall be empowered by the divisions to act for them exclusively in respect to all matters before the committee for consideration and within its jurisdiction. The committee shall have the powers and duties as provided herein, and in addition thereto, it shall

(a) From time to time require such reports from divisions to certified public accountants as in its judgment may be necessary for the administration and enforcement of the provisions of this code and every manufacturer shall comply by furnishing such reports promptly when requested upon which summaries shall be furnished to the Committee but not the individual reports.

(b) Upon the complaint of interested parties, or upon its own initiative to make such inquiry and investigation into the operation of the code as may be necessary and to make rules and regulations necessary for the administration and enforcement of this code.

(c) Have full power to enforce by appropriate action any provision of this code.

The decision of the Radio Emergency National Committee as to what is appropriate action shall be conclusive on all manufacturers of the radio industry subject to this code.

Section 23: The Radio Emergency National Committee shall adopt a uniform standard cost accounting system or systems for the radio manufacturing industry subject hereto and for each division thereof, recommended by certified public accountants of recognized standing selected by the executive committee of the division affected thereby, with the approval of the Radio Emergency National Committee. In each division for all purposes under this code each manufacturer's cost of production shall be established on the basis of such uniform system.

Section 24: Each division may adopt fair trade practice rules not inconsistent with this code relating to the practices peculiar to that division, subject to the approval of the Radio Emergency National Committee.

Section 25: In order to provide data necessary for the administration of the National Industrial Recovery Act, each member of the several divisions of the radio manufacturing industry affected thereby shall furnish to his division whenever requested and the Radio Emergency National Committee shall gather from each division statistical information from all members of the industry which may include:

(a) Capacity;

(b) Production, orders and shipments during the month;

(c) Inventory of finished merchandise on hand at the end of the month, including merchandise in the hands of distributors;

(d) Number of persons employed, wages, earnings and hours worked;

(e) Net or list prices in effect at the time the report is made for the various radio products covered hereby.

The Radio Emergency National Committee shall delegate the collection of this data to independent certified public accountants employed and selected by the Radio Manufacturers Association.

Such certified public accountants shall compute the totals and deliver the same to the Radio Emergency National Committee but shall not deliver the data received from individual manufacturers which shall be kept confidential by the accountants.

Section 26: Any or all of the provisions of this code not required by the National Industrial Recovery Act to be included herein may be amended, modified, cancelled or repealed, and new provisions added thereto, upon request of any person, firm or corporation, subject to the provisions hereof, if and when such changes and additions shall have been approved by the executive committee of the division affected thereby and by the Radio Emergency National Committee and by the President, pursuant to Section 10 (b) of the National Industrial Recovery Act.

A study of the trade practices of the radio manufacturing industry will be continued by the Board of Directors of the Radio Manufacturers Association with the intention of submitting from time to time additions to this code applicable to all employers in the radio manufacturing industry and supplemental codes applicable to one or more branches or subdivisions or product classifications of the radio manufacturing industry, such supplemental codes, however, to conform to and be consistent with the provisions of this code as now constituted or hereafter changed.

Section 27: Where the costs of executing contracts entered into in the radio manufacturing industry prior to the approval of this code by the President are increased as a result of the enactment of the National Industrial Recovery Act appropriate adjustments of such contracts would be just and equitable.

The Radio Emergency National Committee is hereby designated as an arbitration tribunal to assist in the determination of what adjustments would be just and equitable in cases where the parties are unable to reach such an adjustment, and a representative of the National Industrial Recovery Administration may sit as a member of such arbitration tribunal.

Section 28: Where any manufacturer subject to this code is engaged in manufacturing and selling radio products covered by more than one chapter of this code, such manufacturer shall be subject to the provisions of each such chapter as well as the general provisions hereof as to radio products covered by such chapter.

Section 29: Each manufacturer shall be bound only to a standard warranty, except as to sound distribution equipment, hereby adopted as follows:

Standard Warranty

The.....warrants each new radio product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of any unit of its manufacture which under normal installation. use and service, disclosed such defect, provided the unit is delivered by the owner to us intact for our examination, with all transportation charges prepaid to our factory, within 90 days from the date of sale to the consumer purchaser and provided that such examination discloses, in our judgment, that it is thus defective.

This warranty does not extend to any of our radio products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation or to use in violation of instructions furnished by us nor extend to units which have been repaired or altered outside our factory.

Any part of a unit approved for remedy or exchanged hereunder, will be remedied or exchanged without charge to the owner.

This warranty is in lieu of all other warranties, expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio products.

Section 30: Any violation of any general provision of this code and any violation of any provision of any chapter by any manufacturer subject thereto in any transaction in and affecting interstate commerce, shall be an unfair method of competition within the meaning of the National Industrial Recovery Act and subject to the penalties and remedies thereunder, except where such violation is caused by the performance of a bona fide existing contract in effect prior to the adoption of this code where costs have increased as a result of the enactment of the National Industrial Recovery Act.

Section 31: If any employer of labor in the radio manufacturing industry is also an employer of labor in any other industry, the provisions of this code shall apply to and affect only that part of his business which is included in the radio manufacturing industry.

CHAPTER I.

Relating to Manufacturers of Radio Receiving and Television Sets

Section 1: In addition to the general provisions of this code, each manufacturer of radio receiving and television sets shall be subject to the provisions of this Chapter I.

Section 2: For the purpose of this Chapter I, and of Section 7 of the general provisions of the code, "Cost of Production" for manufacturers of radio receiving and television sets shall be as defined herein.

When and as a uniform standard cost accounting system has been adopted for the Radio Receiving and Television Set Division, as set forth in Section 23 of the general provisions of this code, each manufacturing member of such division shall on the fifteenth of each January, April, July and October of each year, forward to the certified public accountants, selected by the division under Section 23 of the general provisions of this code, their costs as defined by such uniform standard cost accounting system.

The certified public accountants so appointed by the division shall classify the costs received by them into household, motorcar, and/or such other general classifications as may be necessary. They shall further classify the household set into AC, AC-DC, DC-110 volts and DC Battery and 32 volt farm sets, and they shall also classify them by number of tubes used. In the case of all sets, excepting motorcar, the actual cabinet cost shall not be included. The certified public accountants shall then, by dividing the total cost of all of each class of receiving sets sold during the preceding quarter by the number of such receiving sets so sold, compute the weighted average cost of production per set for each class of chassis (class having reference to the type of the set and to the number of tubes used). Such weighted average cost shall constitute the minimum chassis cost of production for each member of the Radio Receiving and Television Set Division for the succeeding three months period, such period beginning with the 15th of February, May, August and November of each year.

The word chassis as used herein shall embrace a complete chassis with tubes and one speaker but without cabinet.

In all cases, to the minimum chassis cost of production as above described, shall be added the actual cost of the cabinet and its shipping container in which the set is sold, and any additional equipment, such as more than one loud speaker or a phonograph or other additional equipment, the combination of these items being the manufacturer's cost of production for a complete radio receiver.

The uniform standard cost accounting system as adopted for the Radio Receiving and Television Set Division of the radio industry shall among other provisions contain the following:

(a) The cost of direct material and the cost of direct labor shall be the actual cost as experienced by the reporting manufacturer during the three months period being reported.

(b) The cost of all other items such as factory overhead, engineering overhead, sales, advertising, administration overhead and any other expenses involved in the manufacture and sale of radio receiving and television sets shall be a percentage of the direct labor (or a percentage of the total of both direct labor and direct material). This percentage shall be the actual percentage ratio between direct labor (or the total of both direct labor and direct material) and the total factory overhead, engineering overhead, sales, advertising and administration overhead experienced for the previous twelve months prior to the last day of the quarter being reported.

To cover the period prior to the adoption of the uniform standard cost accounting system as herein described certified public accountants selected by the Executive Committee of the Radio Receiving and Television Set Division shall secure from radio set manufacturers such past data as shall enable the Committee to promulgate temporary costs of pro duction for each class of chassis to be effective until the uniform standard cost accounting system has established costs of production under the procedure heretofore described. During this interim period the classes of chassis shall be as follows:

A-C. Household Receiver Chassis

4 Tube Chassis with Speaker and Tubes, without Cabinets.
5 Tube Chassis with Speaker and Tubes, without Cabinets.
6 Tube Chassis with Speaker and Tubes, without Cabinets.
7 Tube Chassis with Speaker and Tubes, without Cabinets.
8 Tube Chassis with Speaker and Tubes, without Cabinets.
9 Tube Chassis with Speaker and Tubes, without Cabinets.
10 Tube Chassis with Speaker and Tubes, without Cabinets.
11 Tube Chassis with Speaker and Tubes, without Cabinets.
12 Tube Chassis with Speaker and Tubes, without Cabinets.
13 Tube Chassis with Speaker and Tubes, without Cabinets.

A-C.—D-C. Household Receiver Chassis

4 Tube Chassis with Speaker and Tubes, without Cabinets.
5 Tube Chassis with Speaker and Tubes, without Cabinets.
6 Tube Chassis with Speaker and Tubes, without Cabinets.
7 Tube Chassis with Speaker and Tubes, without Cabinets.

D-C.—110 Volt Household Receiver Chassis

4 Tube Chassis with Speaker and Tubes, without Cabinets.
5 Tube Chassis with Speaker and Tubes, without Cabinets.
6 Tube Chassis with Speaker and Tubes, without Cabinets.
7 Tube Chassis with Speaker and Tubes, without Cabinets.
8 Tube Chassis with Speaker and Tubes, without Cabinets.
9 Tube Chassis with Speaker and Tubes, without Cabinets.
10 Tube Chassis with Speaker and Tubes, without Cabinets.
11 Tube Chassis with Speaker and Tubes, without Cabinets.
12 Tube Chassis with Speaker and Tubes, without Cabinets.

Battery Type Farm Receiver Chassis

5 Tube Chassis with Speaker, Tubes and Batteries, without Cabinets.
6 Tube Chassis with Speaker, Tubes and Batteries, without Cabinets.
7 Tube Chassis with Speaker, Tubes and Batteries, without Cabinets.
8 Tube Chassis with Speaker, Tubes and Batteries, without Cabinets.
9 Tube Chassis with Speaker, Tubes and Batteries, without Cabinets.
10 Tube Chassis with Speaker, Tubes and Batteries, without Cabinets.

32-Volt Farm Receiver Chassis

5 Tube Chassis with Speaker and Tubes, without Cabinets.
6 Tube Chassis with Speaker and Tubes, without Cabinets.
7 Tube Chassis with Speaker and Tubes, without Cabinets.
8 Tube Chassis with Speaker and Tubes, without Cabinets.
9 Tube Chassis with Speaker and Tubes, without Cabinets.
10 Tube Chassis with Speaker and Tubes, without Cabinets.

To each of these minimum chassis cost of production is to be added actual cost of cabinets to manufacturers for "cost of production" when chassis is installed in cabinets or when cabinets are delivered for or with chassis whether installed therein or not.

Automobile Receiver Chassis

4 Tube Chassis with Speaker and Tubes.
5 Tube Chassis with Speaker and Tubes.
6 Tube Chassis with Speaker and Tubes.
7 Tube Chassis with Speaker and Tubes.
8 Tube Chassis with Speaker and Tubes.

No manufacturer shall sell for money or other consideration any of such products above mentioned for less than the amount established herein or as may hereafter be established with the approval of the President as a part of this code.

When upon reasonable grounds or upon written complaint filed with the Radio Emergency National Committee which develops a reasonable doubt as to whether a manufacturer is selling his product or products at less than the cost of production as defined herein, the Radio Emergency National Committee on its own motion or upon such written complaint shall have authority to investigate the books and other records involved in the alleged or reported sales below cost of production and may cause the books of the manufacturer involved to be audited. If such audit should disclose that said manufacturer has actually sold his product or products below the cost of production as prescribed herein, the Radio Emergency National Committee with the approval of the Board of Directors of the Radio Manufacturers Association shall report the facts and its recommendation to the National Recovery Administration or the United States District Attorney of the district wherein the involved defendant is a resident or such other government agency as may best serve the purpose and deal effectively to attain the observation of the National Industrial Recovery Act and the radio manufacturing industry code as approved by the President of the United States.

Section 3: "Dropped" lines or surplus stocks, sometimes designated as "close-outs" of inventories which must be converted into cash for immediate needs may be sold for such prices as are necessary to move the merchandise into buyers' hands, but all such stocks must first be reported to the Executive Committee of the Radio Receiving and Television Set Division and such sale may be made only if approved by such Executive Committee.

Section 4: Each manufacturer shall be permitted without restraint or restriction whatsoever, to determine the amount and character of the radio products which he produces.

Section 5: (a) Each manufacturer shall after making his own provisions for manufacturing profit establish a national list price for his radio products whether sold within the state where such manufacturer is located or elsewhere in order that the interstate commerce of such manufacturer shall not be unduly burdened or affected by intrastate sales.

The national list prices so established and any and all changes from such list prices shall be published in circulars, bulletins. or trade publications and a copy thereof shall be mailed to the Radio Emergency National Committee.

(b) Each manufacturer shall also establish national discounts on classifications of the trade made by him, which discounts if a Uniform Standard Manufacturer-Distributor Agreement and/or a Uniform Standard Distributor-Dealer Agreement and/or a Uniform Standard-Manufacturer-Dealer Agreement is approved by the President shall conform thereto.

On and after the approval of this code the manufacturer's price to distributors or dealers shall absorb a freight allowance at the car load rate from the factory of the manufacturer to the city in which his distributor is located (where the manufacturer sells through distributors) or in which his dealer is located (where the manufacturer sells direct to dealers).

Section 6: For the purpose of classifying the trade, "distributors" shall be limited to persons, firms or corporations who maintain adequate warehouse stocks and a proper selling organization for selling direct to dealers and who actually sell broadly to dealers.

Section 7: Advertising and/or sales promotion allowances to dealers if given, shall not exceed in the aggregate three per cent (3%) of the net selling price. Discount allowances to dealers, based on total annual volume of purchases under uniform standard agreements, if given, shall not exceed an additional five per cent (5%) of the net selling price to dealers whose annual volume of purchases exceeds $25,000, nor ten per cent (10%) of the net selling price to dealers whose annual volume of purchases exceeds $100,000. Such allowances may be shared, but not duplicated, by the manufacturer and the distributor.

Section 8: Each manufacturer, if a Uniform Standard Manufacturer-Distributor Agreement and/or a Uniform Standard Distributor-Dealer Agreement and/or a Uniform Standard Manufacturer-Dealer Agreement for the radio manufacturing industry subject hereto, shall be approved by the President of the United States, shall use such contracts exclusively as the basis of his dealings with his Distributors and/or Dealers in order to effectuate the purposes and policy of the National Industrial Recovery Act.

Subject to the approval of the President, a uniform Standard Manufacturer-Distributor Agreement and a Uniform Standard Distributor-Dealer Agreement and a Uniform Standard Manufacturer-Dealer Agreement is hereby adopted, which agreements are annexed hereto and marked Exhibits "A," "B" and "C" respectively.

Section 9: Nothing in this chapter shall apply to radio receiving and/or television sets sold for export and actually exported and retained in foreign countries.

CHAPTER II.

Relating to Manufacturers of Radio Tubes

Section 1: In addition to the general provisions of the code each manufacturer of radio tubes shall be subject to the provisions of this Chapter II except as to cost of production provisions which shall not be applicable unless and except as embodied in this chapter.

Section 2: The term "radio tube manufacturing industry" as used herein is defined to mean the manufacture for sale of electronic tubes or valves. The term "person" as used herein shall include natural persons, partnerships, associations and corporations. The term "employer" as used herein shall include every person promoting, or actively engaged in, the manufacture for sale of the products of the radio tube manufacturing industry as herein defined.

Section 3: Until otherwise determined under the provisions hereof, the executive committee of the Radio Tube Division shall consist of the persons from time to time constituting the executive committee of the Tube Division of the Radio Manufacturers Association for administering, supervising and promoting the performance of the provisions of this chapter by the members of the radio tube manufacturing industry.

For the purpose of carrying out the provisions of the National Industrial Recovery Act and complying with the spirit thereof every employer in the radio tube manufacturing industry shall prepare and furnish to the executive committee not less than once in each year an earnings statement and balance sheet in a form approved by the Executive Committee or acceptable to any recognized stock exchange.

With a view to keeping the President of the United States and the Administrator informed as to the observance or non-observance of this chapter, and as to whether the radio tube manufacturing industry is taking appropriate steps to effectuate in all respects the declared policy of the National Industrial Recovery Act, each employer shall prepare and file with such person or organization as the Executive Committee may designate and at such times and in such manner as may be prescribed statistics of plant capacity, volume of production, volume of sales in units and dollars, orders received, unfilled orders, stocks on hand, inventory, both raw and finished, number of persons employed, wage rates. earnings, hours of work, and such other data or information as the Executive Committee may from time to time require.

Section 4: Except as otherwise provided in the National Industrial Recovery Act, all statistical data filed in accordance with the provisions of Section 3 shall be confidential and the data of one employer shall not be revealed to any other employer except that for the purpose of administering or enforcing the provisions of this Chapter, the Executive Committee, by their duly authorized representatives, shall have access to any and all statistical data that may be furnished in accordance with the provisions of this Chapter.

Section 5: Every employer shall use an accounting system which conforms to the principles of and is at least as detailed and complete as a uniform and standard method of accounting to be formulated or approved by the Executive Committee, and a costing system which conforms to the principles of and is at least as detailed and complete as a standard and uniform method of costing to be formulated or approved by the Executive Committee, with such variations therefrom as may be required by the individual conditions affecting any employer or group of employers and as may be approved by the Executive Committee of and made supplements to the said manual of accounting or method of costing.

Section 6: No employer shall sell or exchange any product of his manufacture at a price or upon such terms or conditions that will result in the customer paying for the goods received less than the cost to the seller, determined in accordance with the uniform and standard method of costing hereinabove prescribed, provided, however, that dropped lines, seconds, or inventories which must be converted into cash to meet emergency needs may be disposed of in such manner and on such terms and conditions as the Executive Committee may approve and as are necessary to move such product into buyers' hands, and provided further that selling below cost in order to meet existing competition on products of equivalent design, character, equality or specifications shall not be deemed a violation of this section if provision therefor is made in supplements hereafter prepared and approved.

Section 7: If the Executive Committee determines that with respect to any product or products of the radio tube manufacturing industry it has been the generally recognized practice to sell a specified product on the basis of printed net price lists, or price lists with discount sheets, and fixed terms of payment which are distributed to the trade, each manufacturer of such product shall within ten (10) days after notice of such determination file with the Executive Committee a net price list or a price list and discount sheet as the case may be, individually prepared by him, showing his current prices, or prices and discounts, and terms of payment, and the Executive Committee shall immediately send copies thereof to all known manufacturers of such specified product. Revised price lists, with or without discount sheets, may be filed from time to time thereafter with the Executive Committee by any manufacturer of such product, to become effective upon the date specified therein, but such revised price lists and discount sheets shall be filed with the Executive Committee ten days in advance of the effective date, unless the supervisory agency shall authorize a shorter period. Copies of revised price lists and discount sheets, with notice of the effective date specified, shall be immediately sent to all known manufacturers of such product, who thereupon may file, if they so desire, revisions of their price lists and/or discount sheets, which shall become effective upon the date when the revised price list or discount sheet first filed shall go into effect.

No employer shall sell directly or indirectly by any means whatsoever, any product of the radio tube industry covered by the provisions of this Chapter at a price lower or at discounts greater or on more favorable terms of payment than those provided in his current net price lists or price lists and discount sheets.

For a period of one year from the date of the adoption of this Chapter no new radio receiving tubes will be introduced, except for experimental purposes, by the radio tube industry without the approval of the Executive Committee.

Section 8: If formal complaint is made to the Executive Committee that the provisions of this Chapter have been violated by any employer, the Executive Committee shall investigate the facts and to that end may cause such examination or audit to be made as may be deemed necessary.

CHAPTER III.

Relating to Manufacturers of Parts, Cabinets and Accessories for Radio Receiving and Television Sets, Except Fixed Condensers

Section 1: In addition to the general provisions of this code, each manufacturer of parts, cabinets and accessories except fixed condensers for radio receiving and/or television sets, shall be subject to the provisions of this Chapter III, except as to cost of production provisions which shall not be applicable unless and except as embodied in this Chapter.

Section 2: For the purpose of this Chapter III and of Section 7 of the general provisions of the code "cost of production" for manufacturers of parts, cabinets and accessories except fixed condensers for radio receiving and/or television sets shall be as defined herein.

Section 3: For the purposes of this Chapter, parts, cabinets and accessories are classified as follows:

1. Audio and Power Coils and Wire.
2. Cabinets.
3. Variable Condensers.
4. Fixed Carbon Resistors.
5. Wire Wound Resistors.
6. Variable Resistors.
7. Sockets.
8. Instruments, Dials and Miscellaneous Parts.
9. Transformers and Chokes.

When a uniform standard cost accounting system has been adopted for the Parts, Cabinets and Accessories Division as set forth in Section 23 of the general provisions of this code, each manufacturing member of the division shall forthwith on the adoption of such system and thereafter on the 15th of each January, April, July and October of each year, forward to the certified public accountants selected by the division, their total costs as defined by such uniform standard cost accounting system.

The certified public accountants so appointed by the division shall classify the costs received by them into such general classifications as may be necessary.

The certified public accountants shall then compute an average total cost for all such products by classification and such average cost shall constitute the minimum cost of production as to each item so classified for each member of the Parts, Cabinets and Accessories Division for the succeeding three months' period, such period beginning with the 15th of February, May, August and November of each year.

Where standard or uniform systems of accounting are required under patent licenses, the licensors and licensees under such patents may use such accounting system in place of the accounting system provided for herein.

Inasmuch as complete data is not available upon which to determine cost of production and pending the determination of the certified public accountants, no cost of production as used in this code shall be established for the members of this division in the meantime.

Section 4: Each manufacturer shall be permitted without restraint or restriction whatsoever, to determine the amount and character of the radio products which he produces.

Section 5: So far as possible, after the adoption of this code and the determination of cost of production by certified

public accountants, each manufacturer shall, after making his own provisions for manufacturing profit, establish a national list or net price for his radio products, whether sold within the state where such manufacturer is located or elsewhere, in order that the interstate commerce of such manufacturers shall not be unduly burdened or affected by intrastate sales.

Section 6: No manufacturer shall claim or assert or attempt to recover damages against another manufacturer for delays or for failure to fill purchase orders for any cause resulting from strikes, fire, accidents or other causes beyond the control of such other manufacturer.

Section 7: Beginning with the approval of this code by the President, terms of payment on radio products of this division shall not exceed 2 per cent cash discount for payment in 10 days or 30 days net, except in special cases where 2 per cent cash discount may be allowed on invoices dated from the 1st to the 15th of the month if paid on the 25th of the same month and invoices from the 16th to the 31st of the month if paid on the 10th of the following month.

Section 8: No manufacturer shall permit any deductions from amounts due him on account of merchandise returned or allowance claimed for the purpose of price discrimination nor until after he has issued proper credit memorandum therefor.

Section 9: No manufacturer subject hereto shall make quantity contracts with buyers without obligation to take delivery of all quantities purchased for the purpose of making a special price nor shall any manufacturer make such quantity reduction as shall bring the net amount to such manufacturer less than the cost of production when and as established herein.

Section 10: "Dropped lines" or surplus stocks, sometimes designated as "Inventory close-outs," which must be converted into cash for immediate needs, may be sold for such prices as are necessary to move the merchandise into buyers' hands but all such stocks must first be reported to the executive committee of the Parts, Cabinets and Accessories Division and such sale may be made only if approved by such executive committee.

Section 11: No manufacturer shall furnish any free sample or samples of merchandise of a value in excess of five dollars.

CHAPTER IV.

Relating to Manufacturers of Radio Loudspeakers

Section 1: In addition to the general provisions of this code, each manufacturer of radio loudspeakers shall be subject to the provisions of this Chapter IV, except as to cost of production provisions which shall not be applicable unless and except as embodied in this Chapter.

Section 2: Each manufacturer shall be permitted without restraint or restriction whatsoever, to determine the amount and character of the radio products which he produces.

Section 3: Beginning with the approval of this code by the President, terms of payment on radio products of this division shall not exceed 2 per cent cash discount for payment in 10 days or 30 days net, except in special cases where 2 per cent cash discount may be allowed on invoices dated from the 1st to the 15th of the month if paid on the 25th of the same month and invoices from the 16th to the 31st of the month if paid on the 10th of the following month.

Section 4: No manufacturer shall permit any deductions from amounts due him on account of merchandise returned or allowance claimed for the purpose of price discrimination nor until after he has issued proper credit memorandum therefor.

CHAPTER V.

Relating to Manufacturers of Sound Distribution Equipment

Section 1: In addition to the general provisions of this code, each manufacturer of sound distribution equipment shall be subject to the provisions of this Chapter V, except as to cost of production provisions which shall not be applicable unless and except as embodied in this Chapter.

Section 2: For the purpose of this Chapter V and of Section 7 of the general provisions of the code, "cost of production" for manufacturers of sound distribution equipment shall be as defined herein.

Section 3: When a uniform standard cost accounting system has been adopted for the Sound Distribution Equipment Division as set forth in Section 23 of the general provisions of this code, the cost of production of each manufacturing member of the division shall constitute the minimum cost of production as to each item classified by the certified public accountants for each member of the Sound Distribution Division.

Inasmuch as complete data is not available upon which to determine cost of production pending the determination of the certified public accountants, no cost of production as used in this code shall be established for the members of this division in the meantime.

Section 4: Each manufacturer shall be permitted without restraint or restriction whatsoever to determine the amount and character of the sound distribution equipment which he produces.

Section 5: After the adoption of the uniform cost accounting system by certified public accountants, each manufacturer shall, after making his own provisions for manufacturing profit, establish a national list or net price for his radio products, whether sold within the state where such manufacturer is located or elsewhere, in order that the interstate commerce of such manufacturer shall not be unduly burdened or affected by intrastate sales.

CHAPTER VI

Relating to Manufacturers of Fixed Condensers

NOTE: To be submitted before hearing of administrator.

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I. R. S. M. "Rebuild Prosperity" Convention

PLANS for the "Rebuild Prosperity" Convention of the Institute of Radio Service Men, to be held at the Hotel Pennsylvania in New York City, October 2 to 4, are under way, according to an announcement received from the general headquarters office of the Institute in Chicago.

The three-day meeting, the first to be held on the east coast, will combine an exposition with the technical sessions, the displays being arranged in the Roof Garden which connects with the Salle Moderne where most of the technical meetings will be held.

The remarkable success of the first convention of the Institute held in Chicago last winter, at which time 52 exhibitors occupied the 62 booths that comprised the entire amount of space available, and which was attended by service men from all parts of the country, will, no doubt, have an important influence upon the forthcoming meeting.

The general office of the Institute has already received word from members in Boston, Albany, Rochester, Washington, and other centers that they expect to attend the New York convention, and a few of the members of the headquarters section, cognizant of the results of the Chicago convention are also making plans to be on hand during those three days.

A REVIEW OF THE DEVELOPMENTS IN BROADCAST RECEIVERS OF 1933

(*Concluded from page 7*)

tios than 175. It will probably be more emphasized next year.

De luxe midgets in the same cigar-box size cabinets appeared. The many who had confidently predicted the growth of the smaller sets back into the regular midget are still predicting the same metamorphosis. The six tube de luxe set still stays in the miniature midget size and is a modern receiver containing avc, undelayed, tone control, police band reception and tuning novelties. The "de luxe" feature, however, is usually in the cabinet.

Regular a-c. sets with transformers were also built into the miniature cabinets. The advantages of these receivers lay in the greater output obtainable with the higher voltages. The output when the 43 is used, is however, limited by the plate dissipation and grid emission of the tube so that the maximum plate voltage cannot be greatly in excess of that usually obtainable in a-c.—d-c. sets.

The close of the season saw some interesting novelties in the form of the midget receivers being used either as complete sets or as remote controls for larger sized speakers mounted in man-sized baffles across the room. The sets and speaker units may be bought separately. One manufacturer uses voltage quadrupling with two 25Z5's to supply the output tubes which drive the separate loudspeaker. This combination seems a real novelty that may prove interesting. Work is also being done to devise external means to go with the miniature midgets that have sold so as to make remote control combinations similar to the above.

◆

AUDIO SYSTEM WITH THE NEW 2B6 TUBE

(*Concluded from page 12*)

two voltages. For example, with 35 peak volts on the input circuit, the peak voltage developed across Ro is approximately 21 volts. The a-c voltage difference is 14 volts, but the d-c voltage difference is 24 volts which is more than sufficient to prevent grid current. The voltage across $Ro = \frac{G e_g}{G + 1}$ where the gain, G, is the actual amplification when degeneration is not present—that is, $G = \frac{\mu Z_0}{Z_0 + r_p}$. Therefore, this unrestricted degeneration makes the voltage transfer of the input section less than unity. If the signal is isolated from ground and coupled by a suitable cathode input condenser so that the signal is impressed between grid and cathode rather than grid to ground, degeneration is suppressed. Higher sensitivity is realized as only 10 volts are required for full power, although the harmonic content is somewhat higher. This high gain connection may be advantageous in small receivers where the speaker or cabinet design are responsible for certain quality limitations rather than the tube.

The components required in the circuit are few in number, but the usual by-pass condenser used in single tube operation represents an appreciable expense. The circuit in Fig. 5 has been devised for its elimination. The frequency characteristic is slightly better than that obtained from the circuit in Fig. 1 when the same power pack and filter was used in both tests, even though the by-pass condenser was increased to 50 mfd. The inherent hum of the 2B6 is so low that the slightly higher level introduced by the circuit in Fig. 5 is still a negligible factor. This particular filter arrangement has another interesting feature. The efficiency is improved as the voltage output is approximately 6 per cent higher.

There are several other practical features that should be mentioned. The 2B6 is absolutely stable as the circuit functions are free of regeneration and since no reaction exists in the coupling of the two sections, there is no phase displacement. The steady state power consumed by the tube is in excess of that taken under maximum excitation. Therefore, no complications are required in the power pack, so its design principles may be the same as used with any Class A system. A high d-c. resistance may be used in the input grid circuit as the transconductance of this section is relatively low, besides its physical size helps to minimize residual grid leakage or gas current.

In conclusion, the writer wishes to express his appreciation for the assistance of Messrs. J. I. Glauber and A. G. Campbell who collaborated in the solution of many of the probems encountered.

REFERENCES

(1) Frank Massa—Proc. I. R. E. p. 682, May, 1933.

(2) Charles F. Stromeyer—Proc. I. R. E. p. 1163, July, 1932.

(3) A number of investigations have shown this. Morecroft mentions same on p. 960, 2nd Ed.—"Principles of Radio Communication."

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STABILITY PROBLEMS OF TUNED R-F AND SUPERHETERODYNE RECEIVERS

(*Concluded from page 6*)

recognize either of the two types of instability by the symptoms.

Electrostatic feedback in the case of a tuned r-f. amplifier almost always makes the set oscillate at the high frequency end of the tuning range, the severity of the feedback determining over how much of the tuning range that oscillation will take place. If electrostatic feedback is the cause of oscillation, one can very often locate it and reduce it or cure it, by placing shields between various leads and parts of the circuit at different r-f. potentials. This way, one can soon determine which shields are important and which are not.

Electromagnetic feedback in the case of a tuned r-f. amplifier may make the set oscillate badly at almost any part of the dial, although it more often takes place anywhere from the middle of the frequency range down to the lowest frequency. The causes of electromagnetic feedback are harder to locate, and hence, to cure. The best way to start running down the condition of electromagnetic coupling through common leads, is by touching a small .1 mfd. capacity condenser from various points in the circuit to ground and noting whether the stability is improved in each case. Where improvement is shown, then further filtering by use of a choke and bypass together, will often clear up the instability entirely. In many cases, the search for causes of instability is more of a cut and try proposition, and previous experience alone, is often the main factor in clearing up these difficulties.

NEWS OF THE INDUSTRY

SYLVANIA BULLETINS

The Hygrade Sylvania Corporation, of Emporium, Pa., has just released a bulletin covering "Tubes for the Auto Receiver." This is a revision of former editions, listing practically every model manufactured with the proper complement of tubes for each.

Copies may be obtained by letterhead requests to the Hygrade Sylvania Corporation, Emporium, Pa.

The Electronics Department at Clifton, N. J., has also released a new Sylvania characteristic sheet for transmitting tubes, copies of which are now available.

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ACHESON SALARIES INCREASED

The Acheson Oildag Company, Port Huron, Mich., has announced an advance of 5 per cent in salaries to all employees of the company. This action is particularly interesting as the salaries of the employees throughout the depression years have never been reduced below the 1929 level; and this in spite of a 10 per cent cut effected in 1932.

As the scale of wages and salaries was well above the NRA blanket code requirements originally, "the 5 per cent increase merely denotes a desire on the management's part to restore to its employees as soon as possible the full 10 per cent," says H. A. Acheson, president of the company.

◆

SOLAR BOOKLET

The Solar Mfg. Co., 599-601 Broadway, New York City, has just released a 44-page booklet, cataloging and describing their line of wet and dry electrolytic condensers, paper condensers and mica condensers.

Letterhead requests directed to Solar will bring copies of this new booklet.

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NEW FEDERAL CATALOG

The Federal Telegraph Company, 200 Mt. Pleasant Ave., Newark, N. J., has recently released an attractive catalog covering their line of transmitting tubes. The catalog contains a large number of characteristic curves and other interesting material. Copies can be secured by letterhead requests to the Federal Company.

◆

WESTINGHOUSE INSTRUMENT TRANSFORMERS

A complete story of Westinghouse instrument transformers has recently been published by the Westinghouse Electric and Manufacturing Company in a 64-page catalog entitled *Westinghouse Instrument Transformers.* Technical information, ratio and phase angle curves, descriptive information and prices are included in this publication. Copies may be obtained from the company's nearest district office or direct from the advertising department, East Pittsburgh, Penna.

GENERAL PLASTICS

H. S. Spencer, advertising manager of General Plastics, Inc., North Tonawanda, N. Y., announces that a patent has been issued to Harry M. Dent, president of the company on a process of gluing wood veneers with an emulsion of synthetic resin to produce a compound lumber of greatly increased strength.

General Plastics, Inc., are well known as moulders of Durez, the moulding compound that is widely used in the manufacture of radio tube bases, sockets, midget set cabinets and knobs.

◆

DEVELOPMENT OF NEW TYPE TUBES SLACKENS

S. W. Muldowny, chairman of the tube committee of the RMA and chairman of the board of National Union Radio Corporation, stated in an interview recently that development of new types of tubes which set such a furious pace during the past year has definitely slowed down.

"I am sure this slackening in the production of new tube types will be good news to the entire radio trade," said Muldowny. "It is an indisputable fact that the development of new types of tubes, particularly those designed for special adaptations and dual purposes has had a great deal to do with the remarkable progress made in radio during the past year. This fact is self-evident in the expansion of new markets such as a-c.—d-c. compacts and automotive radio. Nevertheless, the introduction of so many types in such a short period of time not only put a severe strain on the tube manufacturer but worked great hardship on the trade.

S. W. MULDOWNY

"As chairman of the tube committee of the RMA, I am happy to announce that no new types are contemplated at present, and general opinion among leaders of the industry indicates that no need will appear in the immediate future for a type of tube which is not already in production."

AUSTRALIAN RADIO EXECUTIVE VISITS U. S.

Charles E. Forrest, managing director of International Radio Company, Ltd., of Sydney, N. S. W., Melbourne and Victoria, Australia and Auckland, New Zealand, invaded the United States early in July on a tour of inspection.

Caught in one of his serious moments, information was elicited that Mr. Forrest's Australian business in Jensen speakers, Sprague condensers, Ohiohm resistors and National Union radio tubes is booming.

Mr. Forrest explained that his American products were sold directly to makers of foreign receivers in addition to distributors and the regular retail trade, and attributes the success of his house to the consistent high quality of American-made radio parts in competition with foreign products.

◆

GOAT REPRESENTATIVES

Goat Radio Tube Parts, Inc., of Brooklyn, N. Y., who have recently introduced a new outer tube-shield, announce the appointment of two representatives handling this new item:

R. C. Veale, 125 Church Street, New York, N. Y., is representing them in the metropolitan area, and Fred Garner, of 43 East Ohio Street, Chicago, Ill., is covering the Chicago territory.

◆

REDUCES PRICES OF CRYSTALS

Scientific Radio Service, crystal specialists, of 124 Jackson Ave., Hyattsville, Maryland, have announced a general reduction in prices on their comprehensive crystal line. Scientific radio crystals have been for years standard equipment for broadcasting stations throughout the world.

◆

RADIO PROSPERITY WEEK

The Radio Prosperity Campaign is progressing rapidly. Already in 65 cities out of the 143 radio distributing points committees are in process of organizing local campaigns to cash in on the program. Among these are Portland, Maine, Boston, Hartford, Rochester, New York, Philadelphia, Baltimore, Buffalo, Pittsburgh, Cleveland, Detroit, Cincinnati, Chicago, Milwaukee, Minneapolis, Duluth, St. Louis, Kansas City, Salt Lake, San Francisco, New Orleans. In each case the local organization will plan not only for that city but for those neighboring communities that are served from that town. In other words, the country will be organized by the natural trading areas as they are covered in distributing radio merchandise.

AUTO RADIO FOR HUDSON AND ESSEX

Holding practically all hill-climbing records, and a wide range of cross-country and speed marks, the Essex Terraplane has taken a new step forward in the automobile industry.

For the first time in the history of automobile manufacture, the Terraplane Six and Eight new De Luxe Models will appear on the market with radio as standard equipment, the Grigsby-Grunow Company, makers of Majestic radios, have announced.

While all Hudson and Essex cars, as well as many other makes of cars, are wired for radio, installation of complete radios as standard equipment is a new feature in the motor industry.

It is the first time in history that a motor-car producer has attempted to make radio installation "on the line" in the motor-car factory a regular process in turning out motor-cars.

While wiring for radio requires little extra effort on the part of the automobile manufacturer, complete installation of radios and standard equipment, including the tuning and adjusting of radios, demanded new processes in the line assembly of motor-cars.

The radio equipment will be included in the quoted price of the Terraplane, F. O. B. Detroit.

◆

NICHROME

The Driver-Harris Company, of Harrison, N. J., has released a booklet covering Nichrome and other metals and alloys of their manufacture. The booklet deals with the applications of the various Driver-Harris products.

A mailing charge of 25 cents a copy is being made.

◆

PRECISE CERAMIC PRODUCTION NOW MATCHES RADIO REQUIREMENTS

The increasingly critical requirements of the radio art and industry with regard to dielectric, thermal, chemical and mechanical characteristics of tube components in particular are being matched by the ceramic specialist with utmost precision and control of all factors involved, according to the president of Henry L. Crowley & Company, West Orange, N. J.

"The critical radio requirements of today can be met only by exercising a degree of chemical and production control never dreamed of before by the ceramic manufacturer," states Mr. Crowley. "In our own experience we have found it imperative to go all the way back to the sources of raw materials so as to exercise rigid chemical control from the very start of the long and widely diversified production process. In fact, I believe we are the only ceramic manufacturers making our own ingredients. We buy the raw materials which are as pure and satisfactory as can be had on the open market, yet we break them down, remove the slight but vital impurities, filter and otherwise reduce such materials to their desired components, and then reconstruct the compounds under chemical control for maximum purity.

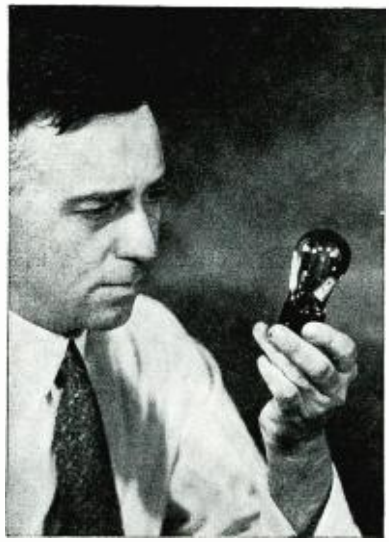
"Much new equipment has been installed in our plant for the various chemical processes, quite in addition to the fabrication machinery including extrusion and forming presses, cutting wheels, drill presses and lathes.

"This branch of the ceramic industry—an industry as old as civilization itself, by the way—has gone to entirely new standards of precision as the result of the demands of the radio art and industry, which we have had to meet."

WESTINGHOUSE GRANTED BASIC PATENTS ON A-C. TUBES

Westinghouse has been granted two basic patents on a-c. tubes.

These patents are No. 1,909,051 to Freeman and Wade, relating to the indirectly-heated cathode a-c. tube and No. 1,911,024 to Kimmel and Sutherlin, relating to the directly-heated cathode a-c. tube. The



LEE SUTHERLIN

Radio Corporation of America is now manufacturing these tubes under a license from Westinghouse.

It was the development of these two types of a-c. tubes by the Westinghouse research laboratories which made possible the change from battery-operated to a-c. receivers.

Of the four engineers involved in these patents, only Lee Sutherlin remains with Westinghouse. Freeman and Kimmel have died and Wade has left Westinghouse in the years that have passed since the patent applications were filed in Washington, in 1921 and 1926, on the patents recently granted by the Patent Office.

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NEW G. E. PHOTOTUBE

A new vacuum-type photoelectric tube has been announced by the General Electric Company. Designated as Type FJ-114, it is made in an automobile headlamp bulb and is fitted with the standard single-contact bayonet-type base, so that it is more easily mounted in crowded locations.

Vacuum-type phototubes are usually characterized by greater stability, and gaseous tubes by higher sensitivity. The new tube has about the same sensitivity as the usual gas tube and the stability of the usual vacuum phototube.

The activation process which produces high sensitivity is also responsible for an unusual increase of the infra-red sensitivity. Its limit extends so low that the tube responds to the heat from a body that is not even glowing in the dark (a wave length beyond 12,000 Angstroms, or a temperature of about 500° C. or 900° F.) With an automobile headlamp as the light source (2600° C., or 4700° F.) the new tubes give a five or six per cent response through a heat-transmitting filter; usual phototubes have a response of about 0.5 per cent.

An interesting detail of construction of the new tube is the method of joining the caesiated silver coating of the bulb (the cathode) to the contact in the base. A piece of 3-mil spring material fastened to the contact post presses a piece of platinum foil, a half mil thick and welded to the tip of the spring, so that it is held against the glass bulb. This platinum foil is fused to the glass, which has the same coefficient of expansion, by the tip of a flame applied to the outside of the bulb. Then, when the bulb has been coated with its mirror-like, light-sensitive, caesiated silver film, the connection is complete.

◆

SYLVANIA GRAPHITE ANODE TUBES

An innovation in transmitting tube structure is the graphite anode which is used in all Sylvania intermediate and high-powered air-cooled transmitting tubes. The graphite anode adds the following major advantages:

1. High plate dissipation without overheating. This is a direct result of the high thermal emissivity of graphite.
2. Lower operating temperature at the anode. This results in a lower operating temperature of the other electrodes, thereby preventing secondary and primary emission from the grid.
3. Uniformity of characteristics. The physical properties of graphite permit exact processing. Graphite does not warp under high temperatures and the mechanical dimensions of the anode remain constant. Proper relation between tube elements retained in this manner preserve the normal electrical charactristics of the tube.
4. Long life. Comparative freedom from gas is another important effect of the graphite anode and the high vacuum obtainable results in longer tube life.

A process developed in the laboratory of Hygrade Sylvania Corporation permits the treatment of carbon in such a manner that it is reduced to pure graphite with all amorphous carbon and other impurities removed.

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STATEMENT BY E. A. NICHOLAS, VICE-PRESIDENT, RCA VICTOR

Due to expanding business of recent months and the need for greater specialization in the merchandising of our various products, the following important organization changes have been made:

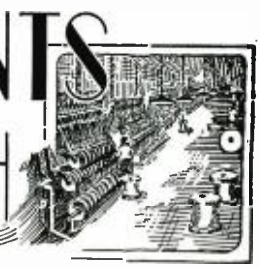
M. F. Burns, formerly division sales manager at Chicago, Illinois, for RCA Radiotron Company, Inc., and E. T. Cunningham, Inc., has been appointed merchandising manager of the RCA Victor Company, Inc., with headquarters at Camden, N. J. Among Mr. Burns' more important duties are the administering of sales policies and the supervising of trade relations.

E. J. Hendrickson has been appointed manager of manufacturers' sales, with headquarters in the Stotts Building, Detroit, Mich.

The growing activities in film, transcription and special recording has made necessary a separate division. Accordingly, C. Lloyd Egner will be manager of the recording division in charge of motion picture, transcription and special recordings.

Edward Wallerstein, formerly with the Brunswick Record Company, has been appointed manager of record sales. Mr. Wallerstein will have charge of all matters relating to recording, releases and the merchandising of standard records for use in the home.

NEW DEVELOPMENTS OF THE MONTH



LAMPKIN STATION FREQUENCY METER

To provide owners and operators of broadcast stations with a highly accurate means of measuring the station frequency, the G. F. Lampkin Laboratories, 146 W. McMillan St., Cincinnati, Ohio, have brought out the Type 102 station frequency meter.

The meter is essentially an instrument for transferring the Bureau of Standards 5,000 kc. transmission directly to the station frequency, without auxiliary apparatus or interpolating equipment.

Features of the instrument are: a

direct dial reading in cycles deviation from the assigned frequency, plus or minus and a guaranteed accuracy of 0.003 per cent. Repeated measurements made with the meter check Federal Radio Commission and high-class commercial laboratories within 3 to 15 cycles at 1,712 kc.; simple and foolproof in operation—only one adjustment standardizes the meter against the Bureau of Standards transmission; the instrument may be used with equal facility in the transmitter room or several miles away; requires power supply of 110-volts a-c and 6-volt filament battery; furnished for any transmitter frequency from 1,500 to 23,000 kc., with minor exceptions, and for maximum deviations of from one to two times the frequency tolerance allowed in the station license.

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NEW BEACON MODELS

The Beacon Microphone Co., 590 Sumner St., Akron, Ohio, has announced a line of new microphones ranging in price

from $32.75 to $46.20. They include floor stand models, suspension models and standard types.

SVEA METAL

During the past two months the new material Svea metal has come into quite widespread use. According to information received from the trade, the suppliers are now furnishing this material to seven tube manufacturers in this country, five abroad and sixteen makers of neon lights, or a total of 28 companies. The material is being used for plates (top, bottom and side) getter cups, eyelets, mica strappings and similar internal tube parts. Since the first of the year, some 50,000 pounds of metal have been used in all types of vacuum and gas tubes. Several new pamphlets giving detailed information regarding the application of this metal have been issued by the manufacturers and may be obtained without charge by application to the Swedish Iron & Steel Corporation, 17 Battery Place, New York City.

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EBY TRIMMING CONDENSERS

Available in a single or double assembly. The single assembly can be used in the intermediate-frequency transformer and adjusted from one side for each condenser which is respectively connected to the primary and the secondary of the transformer to be tuned. The single condenser is so arranged that several arrangements are possible.

The condensers are usable separately or in sets in connection with intermediate-frequency transformer assemblies and any

other place where trimming condensers are ordinarily used.

The single or double assembly can be made in any practical range that an engineer might require, the low range being 10 to 80 $\mu\mu$f and the high range 700 to 1,000 $\mu\mu$f. Any range between can be assembled in this job.

NEW ACID-PROOF MELTING COMPOUND

The Technical Products Company, of Pittsburgh, Pa., have announced a new melting and insulating compound known as Sauer-Eisen Melting Compound No. 49. This compound is the result of ten years' experiments in developing a substance which will resist hot acids and alkalis, and remain rigid above the boiling temperature. Technical Products Company are manufacturers of a varied line of industrial adhesives and cements, many of which have found extensive use in electrical assembling industry.

Probably the best known is Insa-Lute, a heat-resisting cement which is a non-conductor of electricity. It is largely used in cementing metal or mica to porcelain, for imbedding heater coils and similar assembling problems. Sauer-Eisen Plastic Porcelain is another product of the same company. It possesses the same electrical and adhesive properties as Insa-Lute, but is suitable for filling large openings or making thick joints. With the new melting compound added to their line, the Technical Products Company will be able to meet almost any problem in the field of industrial adhesives.

◆

SHALLCROSS WHEATSTONE BRIDGE

For all around resistance measurements, the most convenient instrument for measuring electrical resistance is the direct reading, easily operated, decade type of Wheatstone bridge. Such instruments are usually complicated and relatively expensive.

To meet the popular demand, the Shallcross No. 630 Wheatstone bridge shown in the illustration Fig. 1 was designed to combine the features of reasonable cost, ruggedness, wide range, portability and accuracy. This bridge is built around a highly sensitive but extremely robust Leeds & Northrup galvanometer. Extra binding posts are provided to permit the galvanometer and the resistance decades to be used independently for other work. Manufactured by the Shallcross Mfg. Co., Collingdale, Pa.

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Fig. 1 Shallcross Wheatstone bridge.

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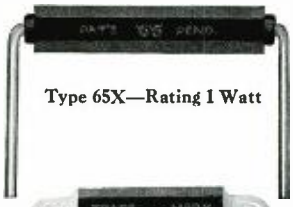
Type 16X—Rating 1 Watt

Type 25X—Rating ¾ Watt



Type 65X—Rating 1 Watt

Type 15X—Rating 1¼ Watt

S. S. White MOLDED RESISTORS

Type 40X—Rating ¾ Watt

Among the Users

General Electric
Westinghouse E. & M.
R. C. A. Photophone
R. C. A. Communications, Inc.
Radio Marine Corp. of America
Naval Research Laboratories
Pan American Airways, Inc.
International Broadcasting Equipment Co.
Automatic Signal Corp.
Carrier Microphone Co.
Leading University and Commercial Experimental Laboratories

Convincing Evidence of Superior Quality

When companies of the standing of those listed, elect to use S. S. WHITE Resistors, there can be no question of the superior merits of these units. Such preference provides the best possible evidence that these Resistors excel in the basic requirements; noiseless operation, mechanical strength and durability, accurate and permanent resistance value.

To makers and users of electronic and radio equipment who have had no experience with S. S. WHITE Resistors, a trial will quickly demonstrate their superiority. WRITE for descriptive circular and prices.

The S.S.WHITE Dental Mfg. Co.
INDUSTRIAL DIVISION
152-4 West 42nd Street New York, N. Y.

Resistance Ranges

Commercial Field

For the varied commercial purposes, Resistors are supplied in the standard range from 1,000 ohms to 10 megohms. Illustrations are actual size. Several other types, not illustrated, are available.

Laboratory and Experimental Field

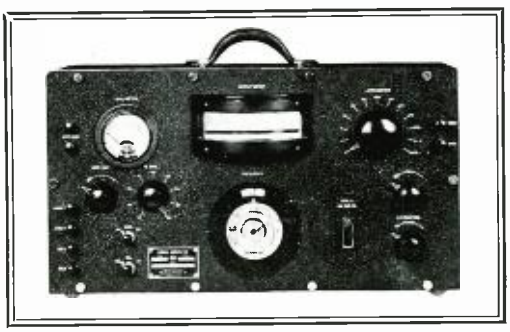
For this field, Resistors of the 65X Type are supplied from stock, from a comprehensive assortment of unusually high values ranging from 10 megohms to 1,000,000 megohms.

These high resistance units are commonly used with the FP54 Pliotron tube, and are adapted for other electronic applications requiring resistances above the standard range.

The characteristic *noiseless operation* of S. S. WHITE Resistors is of added importance in applications of this class.

LABORATORY APPARATUS

RCA VICTOR STANDARD SIGNAL GENERATOR—An instrument for taking performance data on radio receivers, radio frequency amplifiers and field strength measuring equipment. It's useful in measuring tube characteristics, resistance at radio frequencies, power factor, and is invaluable in the design of IF transformers, radio frequency amplifiers and in determining the characteristics of coupled circuits. Carrier frequency range 25 KC to 25,000 KC. A 400 cycle oscillator capable of modulation up to 80% is incorporated, and external modulation up to 7,000 cycles may be used. The design of the controls insures high accuracy of carrier frequency setting and resetability. A highly stabilized oscillator insures negligible harmonic content, constant output and maximum stability over long periods of time.



THE RCA VICTOR BEAT FREQUENCY OSCILLATOR—Especially developed for audio frequency use, and to obtain all characteristics of high quality loudspeakers, amplifiers and networks used in broadcast and sound picture laboratories. This instrument incorporates circuits which are conducive to low distortion, and is a typical high class product of "Radio Headquarters."

ENGINEERING PRODUCTS DIVISION

RCA Victor Company, Inc.

CAMDEN, N. J.
"RADIO HEADQUARTERS"

NEW FANSTEEL BALKITE BATTERY CHARGER

The new charger announced by the Fansteel Products Company, Inc., of North Chicago, Illinois, is small and compact—8 inches long, 7½ inches high, 5 inches deep—and comes ready to hang on the wall or place on the bench of the car owner's garage. Two cords are provided: one plugs into the car, the other goes into the electric light socket. No clips to bother with—car plug is polarized so it can not be connected backwards.

In speaking of its development, J. M. Troxel, president of Fansteel Products Company, Inc., said:

"The increased number of radios and other electrical accessories in automobiles are making it necessary for the automobile owner to pay more attention to the battery in his car. Free wheeling is also contributing to the need for watching one's battery because few people realize that when 'free wheeling' the battery is not being charged. We have as a result received many requests for a low-priced and convenient rectifier which would keep the car battery fully charged.

"Rectifiers are not a new development

with us," continued Mr. Troxel. "During the past ten years we have made well over a million Balkite and Fansteel battery chargers which are standard for radio, telegraph and telephone service all over the world. Here, as in the newly developed battery charger, we have employed the same reliable tantalum rectifier principle which has proven so successful."

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NEW ACRATONE 6-VOLT DYNAMIC REPRODUCER

The new Acratone speaker, recently developed by Federated Purchaser, 23 Park Place, New York, N. Y., consists of a special cone type "driver" unit model 735, combined with an exponential horn model 736, having a number of novel design improvements. The drive unit resembles the ordinary horn unit in so far as the field portion is concerned. To build up sufficient magnetic strength for handling the specified power, a large field coil is wound on a heavy iron core. The field is energized from a 6-volt d-c. source. Instead of employing the small-size metallic alloy diaphragm used in ordinary horn units, the Acratone reproducer uses a diaphragm somewhat similar to those used in cone-type speakers. This diaphragm is made of a special strong fibrous pulp material 6 inches in diameter. The voice-coil winding has an impedance of 15 ohms and will carry power up to 15 watts continuously and up to a 30-watt peak.

The model 736 horn sound projector is of the exponential type. Hence, the diaphragm is loaded up equally throughout the entire range of audible frequencies. The horn is made of a special composition which is entirely weatherproof. At the base of the horn, there is a housing for the driver unit, which fits securely against an internal baffle. The horn is supplied

with special brackets for mounting and with a weather-proof covering material for the bell. The horn is 3½ feet long and the bell dimensions are 28½ inches by 28½ inches.

The horn, with its small internal baffle, is equivalent to a straight baffle of approximately double size. As a horn, it loads the diaphragm of the driver unit with an air column and therefore prevents blasting. In addition, this new type of reproducer retains the "highs," so that they can be reproduced at the same time as the low notes. The horn makes the unit directional, instead of a non-directional one, thereby increasing the efficiency of the unit for a given area coverage.

◆

NEW IRC VOLTOHMMETER

The IRC Servicer for July announces the introduction of a new, small, light and durable IRC voltohmmeter that is a complete piece of test equipment covering voltage and resistance.

The basic meter is a Westinghouse 0-1 milliammeter and the range may be extended indefinitely by the addition of Precision wire-wound resistors. Another feature is the special vacuum relay which guards against accidental overloads. Suppose that, in testing with the scale connected from 0 to 30 volts, you accidentally touch the test lead across the 150-v. section. Instead of a costly burn-out as in ordinary meters, the vacuum relay will throw open and remain open as long as there is an overload. When the extra voltage is removed, the relay automatically closes and the meter is again ready for use.

A copy of *The IRC Servicer* will be sent free of charge upon request to the International Resistance Co., 2100 Arch Street, Philadelphia, Pa.

◆

NATIONAL UNION INTRODUCES FORM-FITTING TUBE SHIELDS

An important development in radio tube shielding is announced by National Union Radio Corporation, 400 Madison Ave., New York City. The new device consists of form-fitting metal jackets and grounding clip, easily applied to any type tube on which shielding seems necessary. Two styles are available so that all requirements for both straight-side and dome-type bulbs are provided for.

In summarizing the uses of the new shield, National Union draws attention to the fact that they can be used to replace spray-shield tubes; used where old tube shield can has been lost, stolen or damaged and used where present shielding is inadequate. They are further suggested for trial in noisy receivers and where non-vibrating shielding is desired.

While the tube shields are a National Union development, they are being manufactured by Goat Radio Tube Parts Company of Brooklyn, N. Y. They have been made available to the trade through National Union distributors, although sample sets are being offered, without charge, to experimental laboratories, technical schools, police department and air transportation companies.

◆

NEW RECTANGULAR SWITCHBOARD INSTRUMENTS

Among several points of advantage of a new line of rectangular switchboard instruments announced by the General Electric Company is the fact that the scale can be read at an angle with no error of parallax. Antiglare glass is another special feature. Others are magnetic damping, high torque, responsiveness, permanently constant characteristics, and availability in three styles of cases.

The line, designated as Types AD-6 and DD-6, include alternating-current voltmeters, ammeters, wattmeters, power-factor meters and frequency meters, and direct-

current ammeters and voltmeters. Special instruments also available include temperature meters and radio-frequency and rectifier-type instruments. Both surface and flush type cases are supplied. The surface type instruments are 6 inches high and 5½ inches wide, and four instruments may be mounted on a 24-inch panel; the flush type instruments are 7 inches high and 6½ inches wide. In addition, three-element ammeters and voltmeters, 12 inches high and 5½ inches wide, are available.

◆

MICROPHONE MANUFACTURER MOVES TO LARGER QUARTERS

After September 1, the Shure Brothers Company will occupy larger quarters at 215 West Huron St., Chicago, according to a statement by S. N. Shure, president of the company. Increased demand for microphone equipment necessitated the expansion.

The products of the company are principally used in broadcast stations, public-address systems, and sound recording studios. Renewed activity in these fields, influenced by improved conditions in general business, has been responsible for the large upturn in order volume. Many new products have been added to the Shure line during recent months in accordance with a definite research and development program.

WESTON ANNOUNCES NEW SELECTIVE ANALYZER

The new method of selective analysis with the Weston selective analyzer (Fig. 1) makes all necessary voltage, current and resistance readings, continuity and grid tests in any kind of a radio receiver. The tube socket readings are made through the medium of standard analyzer plugs. But instead of bringing the socket terminals through the plug to the inside of a complex instrument as is the case in older types of radio set testers and analyzers, they are brought to a small rectangular unit carrying a tube socket and a group of pin jacks. This small unit, known as model 666 socket selector, has two fixed pins on the under side which fit into corresponding blank pin jacks for mechanically mounting it on the multiple range volt-ohm-milliammeter, model 665.

At this writing four socket selectors are available, one each for 4, 5, 6 and 7 prong tubes and 4 jumper cords in red and black. (Fig. 2 shows the 7-prong model.) When one of these socket selectors, say, for instance, the one for 5 prongs, is plugged on to the volt-ohm-milliammeter, it then becomes a complete analyzer for sets employing 5-prong tubes regardless of their arrangement as to pin connections. In a similar manner, when the 4, 6 or 7 prong units are used, the analyzer is complete for testing 4, 6 and 7 prong tube sets respectively.

This unique combination is the result of very careful study to simplify for engineers and servicemen the operation of the analyzer and reduce its obsolescence. The physical separation of the tube socket, cord and plug from the instrument itself, simplifies the analyzer operation and reduces the instrument switching positions to a minimum which otherwise would require an almost impossible number of combinations, due to the complexity of the present tube situation, to say nothing of future expansions.

This selective analyzer will not become obsolete, should further changes take place in the arrangement of 4, 5, 6 or 7 prong tubes, as to their pin connections. If in ensuing years, new tubes should be developed, having more than 7 prongs, this combination can be readily brought up-to-date simply by securing a socket selector unit to suit.

Fig. 1

The instrument has an exceptionally broad list of ranges intended for the needs of tomorrow, as well as those of today. Since it reads directly in fundamentals of volts, milliamperes and resistance and since the ranges are so broad in scope, its obsolescence is reduced to a minimum.

To make readings at the tube sockets of the radio set, the proper socket selector

Fig. 2

should be plugged into the pin jacks provided for that purpose at the top of the instrument panel. Then insert the tube, in the selector unit, and the plug in the radio tube socket. The socket selector has on either side of its socket a group of pin jacks moulded in the Bakelite which are wired to the socket terminals as shown by white lines on the top of the unit. Pin jacks are also provided for the cap and for a ground lead to make measurements to the chassis itself. The jacks are marked with the new standard numbering system for the pins. To tie in with this numbering system a very complete chart (Fig. 3) is furnished showing the prong connections to the various electrodes on all tubes in use today.

The instrument has the following broad list of ranges: A-C and D-C volts 1,000-500-250-100-50-25-10-5-2.5-1, all with a sensitivity of 1,000 ohms per volt. The a-c. ranges are obtained through the use of a copper oxide full wave bridge type rectifier. The current ranges are 500-250-100-50-25-10-5-2.5-1 milliampere, d-c. only. The resistance ranges run up to 1,000.000 ohms with the lowest range indicating 1 ohm per division.

TUBE BASE CHART
FOR USE WITH
THE WESTON METHOD OF SELECTIVE ANALYSIS

Tube	Base	Tube	Base	Tube	Base	Tube	Base
1	4-7	38	5-2	68	5-2	2A6	6-4
1V	4-7	39	5-2	69	6-2	2A7	7-2
00A	4-1	40	4-1	71A	4-1	2B7	7-3
01A	4-1	41	6-3	75	6-4	5Z3	4-5
10	4-1	42	6-3	76	5-1	6A4	5-3
12A	4-1	43	6-3	77	6-1	6A7	7-2
14	5-2	44	5-2	78	6-1	6B7	7-3
15	5-2	45	4-1	79	6-5	6C6	6-1
17	5-1	46	5-4	80	4-5	6C7	6-4
18	6-3	47	5-3	81	4-6	6D6	6-1
19	6-6	48	6-3	82	4-5	6D7	5-2
20	4-1	49	5-4	83	4-5	6E7	5-2
22	4-2	50	4-1	84	5-5	6F7	7-5
24	5-2	51	5-2	85	6-4	6Z4	5-5
26	4-1	52	5-3	89	6-1	6Z5	6-8
27	5-1	53	7-4	90	6-2	12Z3	4-7
29	6-2	55	6-4	92	6-2	25Z5	6-7
30	4-1	56	5-1	95	6-3	LA	5-3
31	4-1	57	6-1	96	4-7	KR1	4-2
32	4-2	58	6-1	98	5-5	KR2	4-7
33	5-3	59	7-1	99	4-1	182B	4-1
34	4-2	64	5-2	1A6	6-9	183	4-1
35	5-2	65	5-2	2A3	4-1	485	5-1
36	5-2	67	5-1	2A5	6-3	864	4-1
37	5-1						

LOOKING DOWN ON TOP OF SOCKET

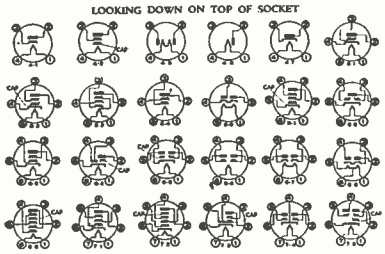


Fig. 3

CALLITE KULGRID WIRE

During the past year, the Callite Products Company, of Union City, New Jersey, has developed a new series of very useful composite wires having special properties, to meet the new requirements of the radio tube, neon sign and electrical industries. This new series of composite wires is made under special processes, patents applied for and pending, and is to be known as Kulgrid C, Kulgrid I and Kulgrid S.

Kulgrid C wire is a composite wire consisting of an inner core of special copper alloy perfectly bonded by special process to a nickel sleeve. This new Kulgrid wire is specially designed for use as lateral supports for grids, as well as grid wire proper. Because of its high heat conductivity and special surface treatment, this wire is particularly adaptable for use in grid construction, thus lowering the operating temperature of the grid assembly and reducing grid emission. This property is particularly advantageous in the construction of multi-grid tubes where grid emission is a factor.

Kulgrid I consists of a special iron alloy core perfectly bonded to a nickel sleeve.

Kulgrid S consists of a special steel alloy core perfectly bonded to a nickel sleeve.

All of the above types of Kulgrid wire can be furnished either hard drawn or soft annealed, having an elongation of 10 per cent to 20 per cent and a breaking strength of 1 to 1.45 kilograms based on a wire .005 inch in diameter. The above special wires have many useful applications, particularly in the manufacture of grids, grid posts and have non-corrosive, non-oxidizing properties. All of the three types of Kulgrid wire are weldable to each other, to nickel and other related metals.

◆

A PORTABLE OSCILLOGRAPH WITH UNIQUE FEATURES

An entirely new oscillograph, differing greatly from previous designs, has been developed by the Westinghouse Electric and Manufacturing Company using a new type of optical system and galvanometer. This new instrument may be used as conveniently as an ordinary voltmeter or ammeter, and has other characteristics which will extend the range of application of oscillographic instruments.

The instrument is entirely self-contained and may be operated from a 110-volt, 60-

cycle lighting circuit without auxiliary attachments. Its over-all dimensions are 8 inches by 11½ inches by 11 inches. Its total weight is approximately 18 pounds.

Terminals for the two galvanometers are located at the lower left and right-hand corners of the panel. Both galvanometers may be used for measurements of potentials up to 300 volts or currents up to 10 amperes without the use of external resistors.

INDEX TO ADVERTISERS

You are now faced with a New Era in Radio

If the new program is to bring success to YOU it must be upon the basis of alert, progressive policies.

The era of chiseling to a price is past. The question "What have you? now precedes "How much?"

If it means anything, it means that advanced design, engineering refinements and improved materials will pay dividends. It means a speeding up all along the line. It means active markets.

Are you keeping pace with the New Era?

•

Annual Component

and

Material Review

RADIO ENGINEERING for September will cover active supply sources for parts and materials used by the radio and allied industries.

There will be a wealth of information which will be of value to the executives, engineers and purchasing agents—information which will be used to select supply sources and allocate purchases.

Many reservations for September advertising space have already been received. Preferred Positions are in demand. Write or wire at once.

Advertising Forms Close September 5th

The paid circulation of RADIO ENGINEERING is approximately 5,000 A.B.C. This paid circulation for ten years has been larger than the paid circulation of competing publications.

In September 8,000 copies are being printed to provide for new subscribers, foreign distribution, and circulation which is climbing rapidly on the basis of increased activity and increased executive and engineering personnel.

RADIO ENGINEERING

19 EAST 47th STREET

NEW YORK CITY

Two Critical Life Tests that "double check" Allen-Bradley Suppressors

Type W Suppressor


Type X Suppressor


Type Y Suppressor


Type Z Suppressor

The Allen-Bradley radio laboratories conduct two types of life tests. One test is the "road test" in which a large group of spark plug resistors are operated on motor cars continuously under all conditions of service and weather.

To "double check" the road tests, continuous life tests are made on hundreds of spark plug resistors day after day, week after week, with the test equipment illustrated below. Under conditions equivalent to motor speed of 50 miles per hour, these resistors are tested at various ambient temperatures and battery voltages. No road trial is more severe than this exacting ordeal.

These long and critical tests have enabled Allen-Bradley engineers to produce spark plug resistors that—

1—Do not "open circuit" in service and cripple the engine.

2—Do not "drop" in resistance and fail as suppressors.

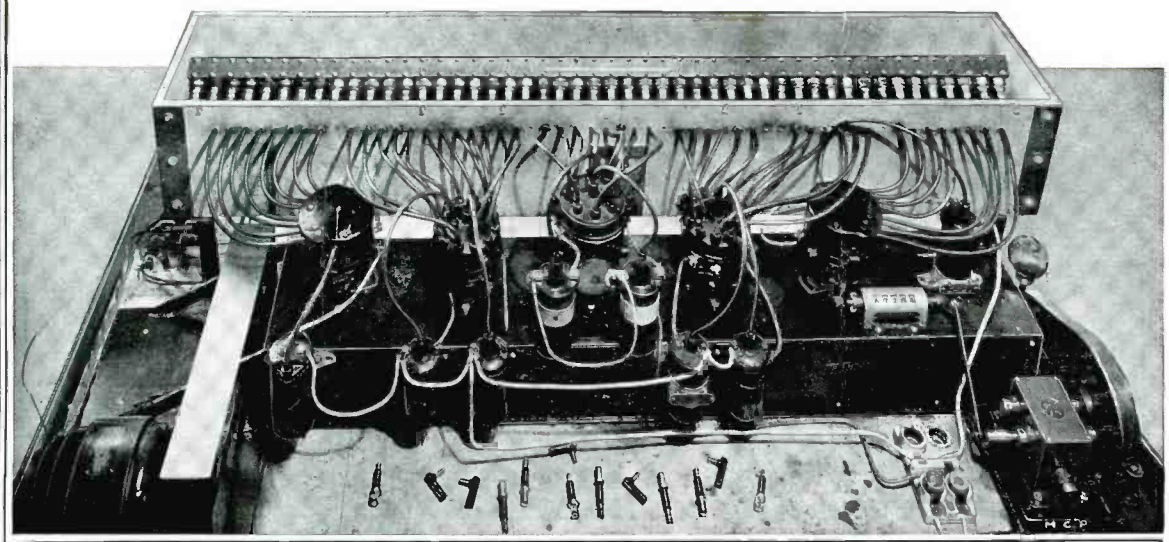
3—Do not have a "high voltage characteristic" which sharply decreases the suppressor resistance during each spark discharge and thus defeats the purpose of the suppressor.

4—Do not fail from exposure to oil and water.

5—Do not break due to car or engine vibration. The resistors are enclosed in rugged, non-arcing bakelite casings—not in brittle ceramic material.

The superiority of Allen-Bradley Spark Plug Resistors can be easily demonstrated. Our engineers will gladly supply data and performance curves on resistors for your requirements. Write us today.

Allen-Bradley Co.
126 W. Greenfield Ave., Milwaukee, Wis.



A-B

Allen-Bradley

SPARK PLUG RESISTORS