Radio Engineering

MARCH, 1936

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DESIGN • PRODUCTION • ENGINEERING

- Broadcast Receivers
- Auto-Radio Receivers
- Electric Phonographs
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- P-A Equipment
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- Tubes
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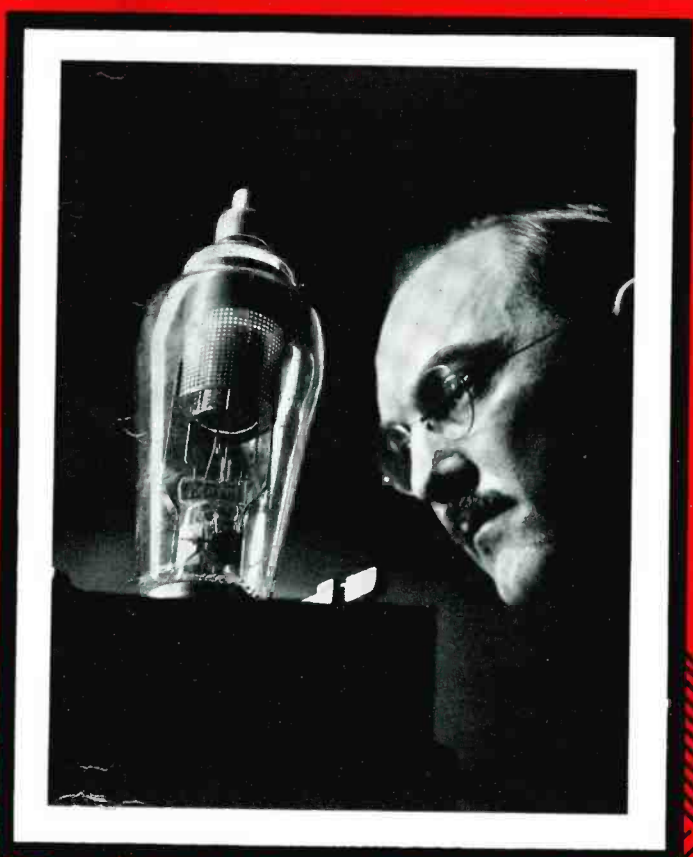

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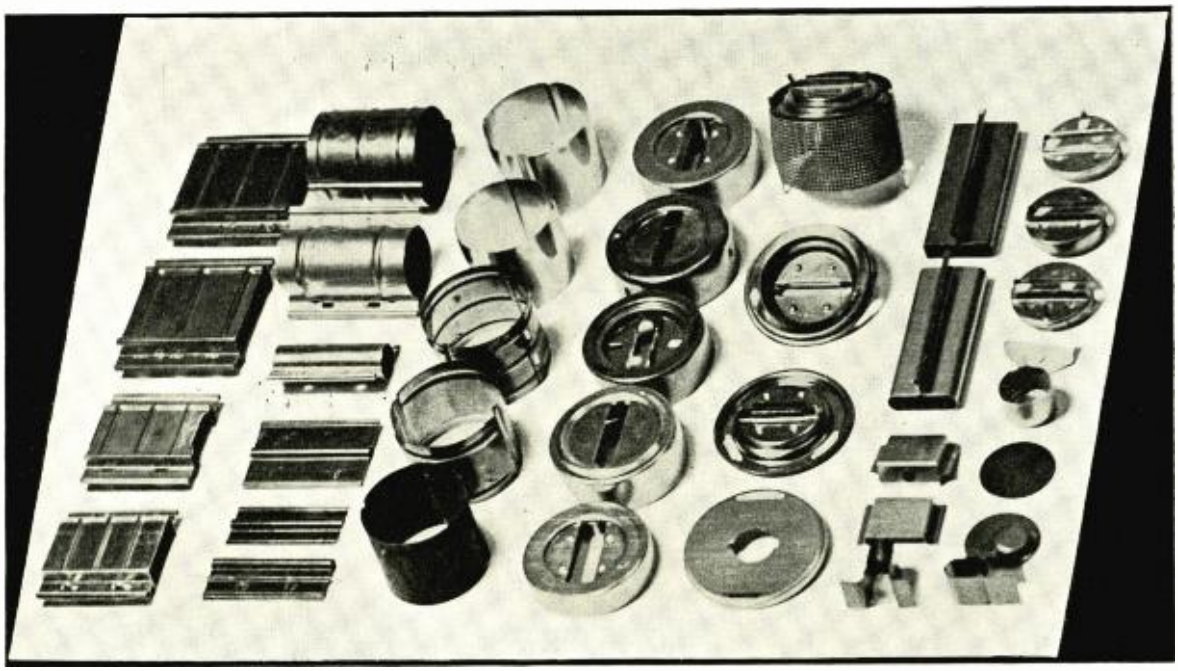
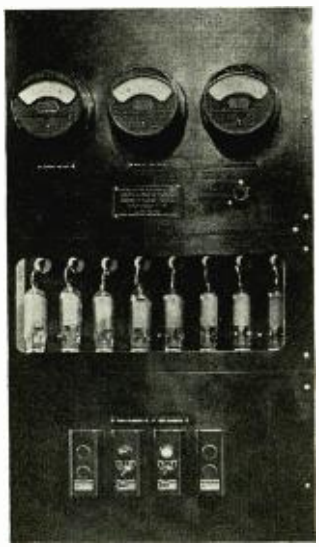
SVEA METAL TUBE PARTS



This *unretouched* photograph offers tangible proof of the clean working possibilities of SVEA METAL when used in internal radio tube parts.

Complete technical data upon request.



FOR TRANSMITTER AND RECTIFIER TUBES

The use of SVEA METAL in transmitting tubes, both power and rectifier, offers definite advantages worthy of serious consideration.

At the left are shown eight type 385A SVEA METAL tubes which have been giving satisfaction in one of the broadcasting stations in the Metropolitan area *under continuous operation for over two years!*

Swedish Iron & Steel Corporation

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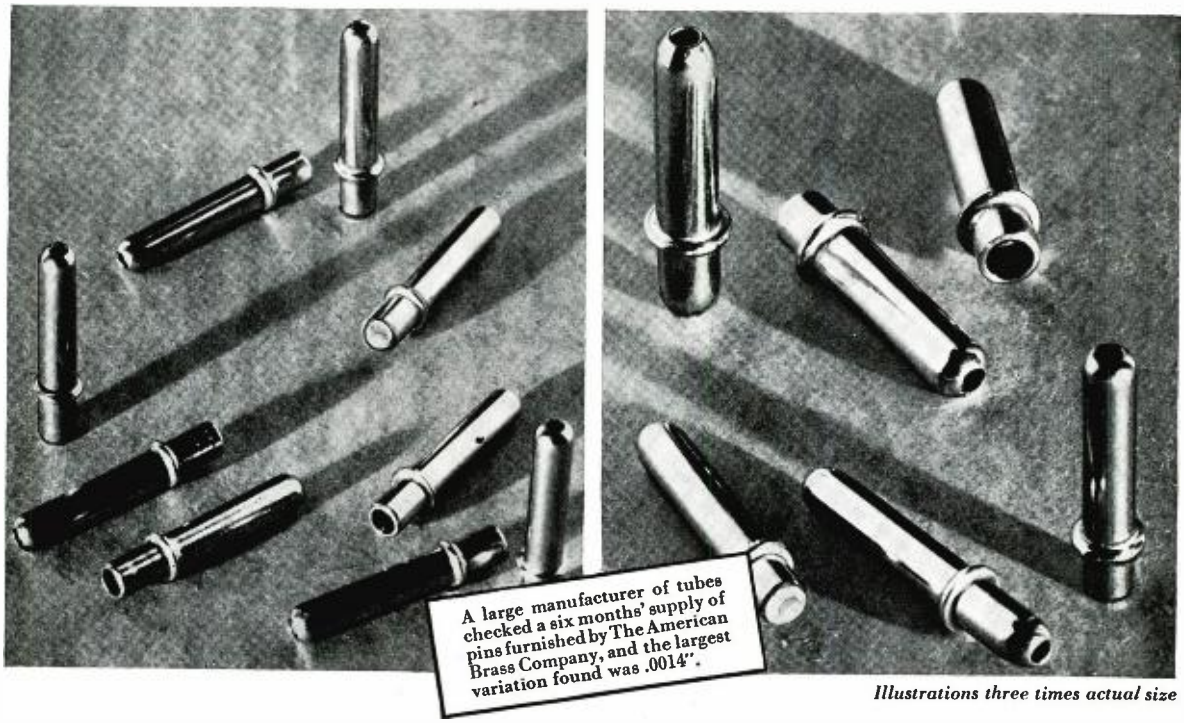
The *ideal* metal for internal electronic tube use.

SVEA METAL

RADIO PINS

Moulding-In · Plug · Staked

...for the new tubes ...for the old tubes



Illustrations three times actual size

The Waterbury Brass Goods Branch of The American Brass Company is prepared to furnish practically any quantity of vacuum tube pins—for the new type metal tubes; the glass tube with the new type base; or the old type glass tube.

These pins are *seamless,* concentric, and extremely accurate in size. They are plated, finished and cleaned by special methods and equipment that assure absolute cleanliness both inside and out. *Billions* of these uniformly accurate pins have been made in three types: Moulding-in Pins, Plug Pins and Staked Pins.

The Waterbury Brass Goods Corporation, as this division of The American Brass Company was formerly known, has long been a recognized source of supply for high quality copper and copper alloy radio parts, which include:

Plug and Socket Parts	Electrodes
Eyelets	Fuse Clips
Rivets	Sockets
Grommets	Screw Shells
Terminals	Condenser Shells
Contacts	Miscellaneous Stampings
Aerial Hardware	Shells, etc.

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from mine to consumer
REG. U.S. PAT. OFF.

Our Engineering Department will be glad to cooperate with manufacturers of electrical and radio equipment in designing new parts from the standpoint of economical production. Your inquiry or order will receive prompt and efficient attention.

WATERBURY BRASS GOODS BRANCH

The American Brass Company

General Offices: Waterbury, Connecticut

Editorial

COLD CATHODE TUBES

AS WE GO to press, the announcement of the cold cathode tube, called the "Multipactor" by its inventor, comes from a recent I. R. E. meeting.

True to form, the daily papers allotted no little space to this development and its possibilities. It is interesting to note that RADIO ENGINEERING carried two pages on this Farnsworth invention in the November 1934 issue.

Glancing back over that issue we find that the tube was used on a commercial radiotelegraph circuit between San Francisco and Honolulu, taking it out of the class of a laboratory "toy." Functioning of the tube, and its great stability, as a high-frequency oscillator were also discussed in detail.

• • •

FREQUENCY SPREAD

THERE SEEMS TO be a natural tendency on the part of many all-wave receiver design engineers to include as great a frequency range as possible in the least number of range steps.

There is a definite limit as to what can be accomplished in this respect without sacrificing tuning convenience, and this feature is of equal if not greater importance than frequency coverage. A point is finally reached where slow-speed tuning controls no longer serve the purpose; dial calibrations are so cramped and pointer movement is so slow that precise tuning is impossible.

The point is that the tendency to add just a bit more value to the receiver by extending the frequency range of one band only serves to destroy tuning convenience over the entire scale.

The average person can suffer along without an 18- or 20-megacycle channel—but the average person won't tolerate the inconvenience brought on by frequency condensation.

• • •

SILENT TUNING

THE NERVE-SHATTERING between-station noise of the unharnessed avc receiver is easily stilled if the set has some form of tuning indicator. It is quite an easy matter to retard the manual volume or sensitivity control, as the case may be, and tune by eye. All one has to do is watch the pretty needle or pretty shadow, and glance occasionally at the dial scale.

But if any engineer has the idea that the average listener is going to go through such a rigamarole—as simple as it may be—in order to enjoy silent tuning, he's barking up the wrong tree.

We know of a very nice park with the most beautiful, smooth winding paths that just cry out to be walked on—and the cops in this park are just about worn to a frazzle trying to keep the people from plowing shortcuts through the grass.

If you want to provide the feature of silent tuning to a receiver without resorting to squelch circuits, start thinking of some way whereby the listener won't have to fuss with something. If a tuning indicator is used, it might be done easily enough by adding a pressure switch to the tuning knob; that is, a switch that remains closed during the period the knob is being revolved. The switch could be made to kill the set completely, or could be tied in with a circuit with some lag to it so as to eliminate the plop on closing and the pop on opening.

The public has no use for any product that requires effort or thought to operate. If you remember that, you can't go far wrong.

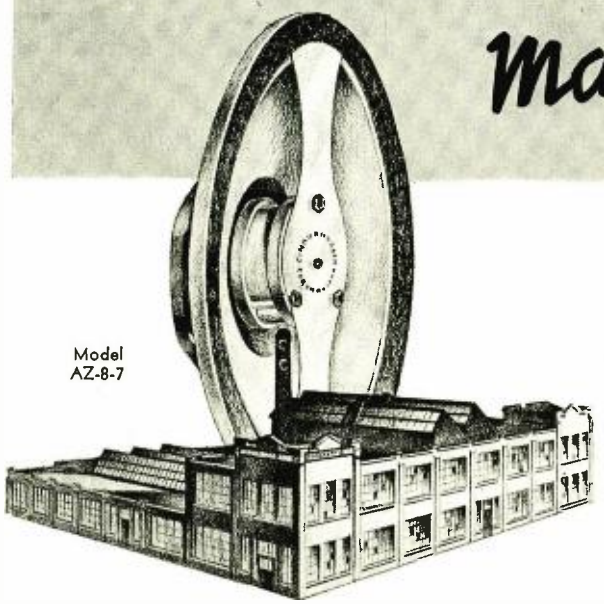
• • •

SKYSCRAPER RECEIVERS

THE PRESENT TYPE of radio receiver cabinet is designed so that it will support both the chassis and the loudspeaker. It seems about time someone gave thought to the idea of either having the chassis support the cabinet or using a "skyscraper" framework of angle metal for supporting the weight of the chassis, the speaker and the cabinet surfaces.

The advantage would lie in the possibility of using new surface materials for the cabinet, such as reinforced plastic sheets, etc., that would not be required as supporting mediums. Such an idea might simplify manufacturing procedure, and ultimately cut production costs.

The CINAUDAGRAPH Magic Magnet* SPEAKER



Model AZ-8-7

*"NIPERMAG"—the *"Magic Magnet,"* used exclusively in Cinaudagraph Speakers, should not be confused with other permanent magnet alloys now available on the American market. It is an exclusive Cinaudagraph product.

DESTINED TO REVOLUTIONIZE CONVENTIONAL SPEAKER CONCEPTS

In every detail its design, its construction, its materials, the *"Magic Magnet"* Speaker *is new.*

ENGINEERS listened. They were a hard-bitten gang as they sat within the sound-proof Cinaudagraph Laboratories—all fellows who had long since begun to take "New Developments" for granted.

NOW they listened with open mouths. The new Cinaudagraph Speaker was performing. They heard speaker history in the making.

WITHIN our walls we have kept our secret. Our personnel has had strict orders not to "spill" this thing that has been brewing in our laboratories until tests proved the product was finished.

NOW we are ready! This laboratory demonstration before a group of leading engineers and writers dramatizes the fact that the Cinaudagraph Speaker is "going places"! A new era in sound has begun.

● *It's New* in Cone Construction

A new polyfibrous material, developed and manufactured by Cinaudagraph exclusively, is presented for the first time in the *"Magic Magnet"* Speaker. Constructed so as to present a varying density of composition, this cone will transmit voice coil oscillations with uncanny fidelity. Shallow construction makes it particularly suitable for auto radios. Will fit into the smallest space conveniently. Overall speaker depth 2⅜" for model AZ-8-7.

● *It's New* in Magnetic Material

"NIPERMAG"—a permanent magnet alloy presented for the first time in American speakers by Cinaudagraph engineers, has been and is being used extensively with great success in Europe. The use of "NIPERMAG" reduces battery consumption, simplifies production assembly and makes humless reproduction possible in any application. It is the ideal speaker for farm receivers.

● *It's New* in Voice Coil Construction

A core of quartz silicate, a non-elastic, extremely dense mineral, is used in the construction of the voice coil. The voice coil is designed so as to transmit frequencies without losses or deviations and to operate under adverse climatic and temperature conditions.

● *It's New* in Spider Construction

A centering device, an exclusive Cinaudagraph development, consists of an interlaced net, the extreme flexibility of which makes a really low note obtainable.

● *It's New* in Baffle Construction

The Cinaudagraph *"Magic Magnet"* Speaker is designed to operate within an Infinite Baffle. This Infinite Baffle absorbs rear radiation, and allows only true, undistorted tones to emanate from the front of the speaker.

These five major engineering improvements contribute largely to the attainment of an extraordinarily flat frequency response of from 30 to 15,000 cycles. Extreme flexibility of the polyfibrous cone makes possible the production of speakers to individual frequency requirements.

Complete Details on the 8, 10, 12, and 18 Inch Models Will Be Supplied on Request

CINAUDAGRAPH CORPORATION

Speaker Division—Dept. E

STAMFORD, CONN.

HYDROGEN FURNACES FOR TUBE PARTS

Pre-Assembly Processes for Cleaning, Brazing, and De-Gassing Tube Parts

THE manufacture of vacuum tubes for radio use involves many complicated steps where process control must be maintained continually for the production of tubes having uniform characteristics and high quality. Exhaust or pumping naturally is of great importance in the production of good tubes. This step in the manufacture and the testing procedure are those most commonly thought of in connection with radio tube manufacture. There are other steps employed which are fully as important as exhaust and test, one being the preparation of metal parts prior to the assembly of the tubes. Hydrogen firing of vacuum tube parts has always been of major importance in tube manufacture and some phases of the hydrogen treatment process are pictured on these pages.

Most of the metal parts used in vacuum tube assembly are fabricated on machines requiring constant lubrication. As a result, parts are covered with a film of oil, a small part of which would be sufficient to ruin a finished tube. Parts which are made without the use of a lubricating medium are handled to a considerable extent during fabrication and these parts usually carry, on the surface, oils deposited there from fingertips of the operators.

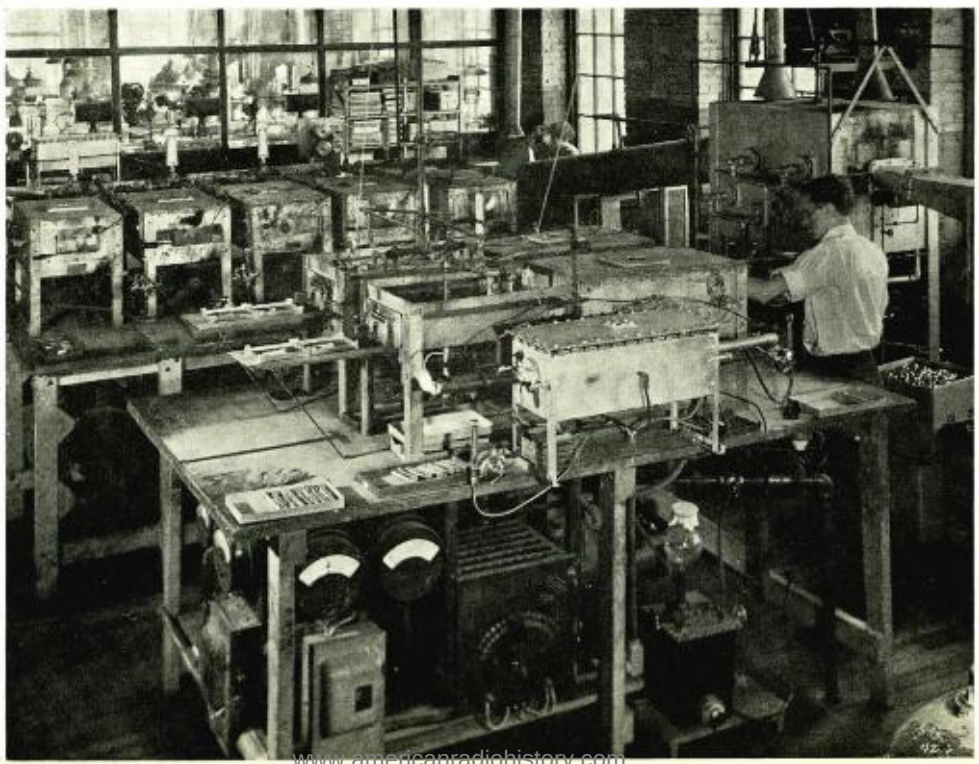
In addition to the necessity for obtaining a perfectly clean surface on all of the metal parts, residual gas contained within the metal must be driven off and replaced with gas which is neutral in its effect on the metal and the tube cathode or filament during that part of the exhaust cycle when some gas remains to be pumped out of the tubes. Hydrogen firing of these metal parts accomplishes the removal of residual gas, mostly nitrogen, very effectively.

The first step in cleaning preparation calls for a thorough washing of all parts in a good grease solvent. Some small parts, not suited to cleaning with solvent, are cleaned by washing in a boiling alkaline solution.

The actual hydrogen firing calls for a classification of the tube parts by wall thickness of the metal used. While the firing temperature may be approximately the same for different groups of parts, the time required for the individual part to reach the full baking temperature will depend entirely on the thickness of the metal. The usual time runs from three to five minutes in the furnace proper.

In Fig. 1 is shown a battery of hydrogen furnaces used principally for the treatment of grids and small parts. The entrance chamber opens at the free end of the large section of each furnace. This section contains the heating unit and the necessary insulation to maintain the furnace at a constant temperature. The small section shown extending from the large box-like body of the furnace is the cooling chamber which is water jacketed to provide rapid cooling. Hydrogen gas is introduced into both the heating and the cooling chambers with sufficient flow to drive out any air which might be present. Since air is not present in the furnace chambers no combustion takes place. The escaping hydrogen gas flows

Fig. 1. Battery of hydrogen atmosphere manual furnaces.



through a small hole in the door at one or both ends of the furnace and burns as it escapes.

In these small furnaces the tube parts, principally grids as mentioned before, are carried in trays made of nickel to withstand the high temperatures used. Each tray remains within the heating chamber from three to five minutes until the parts have reached the normal temperature, ordinarily from 900 to 1000 degrees C. During this heating time any grease or other substance on the surface of the metal vaporizes, and combining with the hydrogen, is carried away. Gases contained within the metal are driven off and the tray of parts is then pushed into the cooling chamber. The time in the cooling chamber must be sufficient, usually at least five minutes, to permit the metal parts to cool to a temperature at which there is no danger of oxidation on removal from the hydrogen atmosphere into the air.

Fig. 2 pictures a continuous feed hydrogen firing furnace used for cleaning large parts used in the manufacture of metal tubes. Parts are placed on the continuous conveyor belt and they are carried slowly through the heating and cooling chambers with results similar to those described for the smaller furnaces shown in Fig. 1.

Fig. 3 shows two hydrogen firing units used for brazing copper sealing rings to the Fernico eyelet welds in metal tube header plates. The Fernico eyelets in this case have a relatively thin wall compared with the header plate to which these are welded. While the weld shown on each eyelet might be a satisfactory vacuum seal, a vacuum is assured by brazing the entire seal with copper. Oxidation can not be permitted during this operation and therefore hydrogen as a gas neutral to the metal is used. The order of treatment is the same during this process as for regular hydrogen firing.

Fig. 4 shows equipment used by one manufacturer for the production of the necessary hydrogen gas through dissociation of ammonia. This type of equipment yields a high percentage of hydrogen of good quality. Other sources can be employed using any gas containing a fairly large amount of hydrogen.

The importance of control in the operation of these furnaces is extremely great. Temperature must be maintained within a very limited range, hydrogen flow must be sure and at a definite rate, and the water passing through the cooling chamber must be held at a temperature which will maintain the cooling chamber above room temperature by the correct amount. In Figs. 2 and 4, some of the control equipment used to maintain these values may be seen.

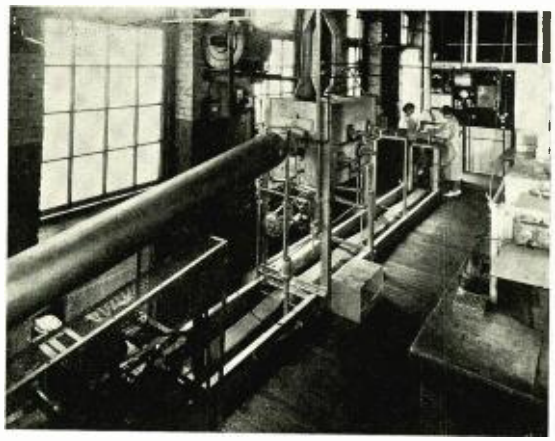


Fig. 2. Conveyor hydrogen furnace for cleaning and annealing metal parts.

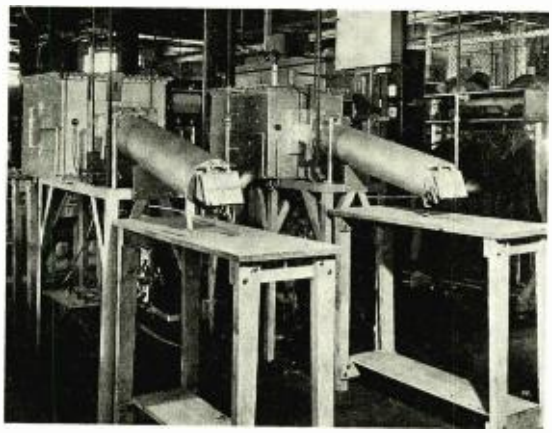


Fig. 3. Hydrogen atmosphere furnaces for brazing metal tubes.

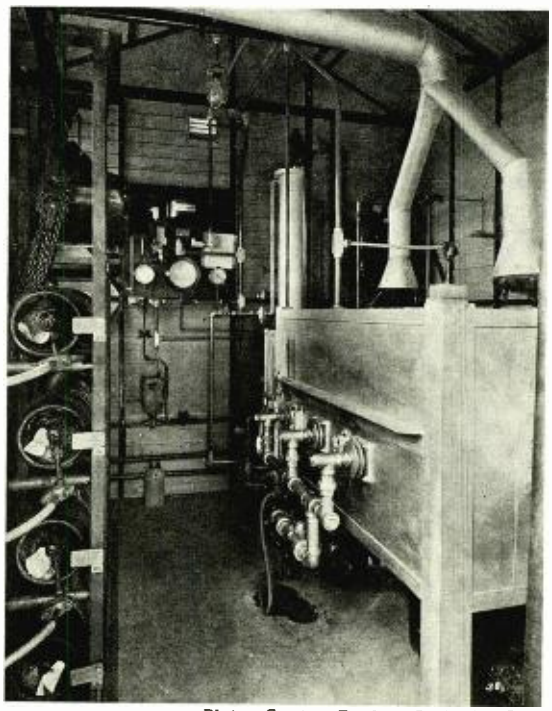


Fig. 4. Ammonia dissociator plant.

Photos. Courtesy Raytheon Production Corp.

OPERATION OF 6A8

Pointers on Tube Used as Mixer-Oscillator

Optimum performance of a superheterodyne receiver cannot be realized unless the mixer-oscillator section satisfies certain requirements. Unfortunately, however, these requirements usually conflict with other conditions for optimum performance. In practice, therefore, it is necessary to effect a suitable compromise. For example, the oscillator voltage of the 6A8 must be greater than a certain minimum value for reasonable mixer-stage gain. It has been found that this requirement immediately limits the frequency range which can be covered in a single band. Hence, a compromise between frequency coverage and mixer-stage gain must be reached. It is the purpose of this article to discuss some of the problems associated with the design of pentagrid-converter circuits and to present data on the operation of the 6A8, the all-metal pentagrid-converter tube, evolving from research in the laboratories of RCA Manufacturing Co.

A pentagrid converter produces an i-f component of plate current because of modulation in the electron stream of an r-f signal by an oscillator voltage applied to the No. 1 grid. The magnitude of the i-f component of plate current is equal to the product of the conversion conductance (g_c) of the tube and the r-f signal voltage when the load impedance is small compared to the internal resistance of the tube. Since the conversion conductance is a function of the oscillator voltage, the i-f component of plate current, and hence the mixer-stage gain, is dependent on the magnitude of the oscillator voltage.

Measurement of the oscillator voltage applied between oscillator grid and cathode of a mixer tube is often inconvenient and is sometimes subject to appreciable error. For these reasons, it is desirable to use the d-c oscillator-grid current as a measure of the oscillator voltage. For all practical purposes, therefore, a curve showing the relation between conversion conductance and d-c oscillator-grid current through a given resistance can be used to predict mixer-stage performance. This grid current may be measured by connecting a d-c milliammeter of proper range between the cathode and the low-potential terminal of the oscillator-grid resistance.

Effects of High Oscillator-Grid Currents

In the usual type of oscillator circuit, the oscillator voltage nearly always increases with frequency throughout any wave range of an all-wave receiver; this increase is due to the increasing impedance of the tuned circuit and to the increasing plate-grid feedback as the receiver is tuned to the high-frequency end of the band. Thus, if the oscillator-grid current is made high at the low-frequency end of a range, good mixer-stage gain throughout that band might be expected. However, experience has shown that the frequency range of the band may be seriously limited if the size of the tickler is increased in order to obtain high oscillator-grid current at the low-frequency end.

It has been found that the upper frequency limit of the range can be determined by the resonance frequency of the tickler coil and its associated shunt capacitance; this resonance frequency may lie within the theoretical tuning range of the band. When such a condition exists, the tickler determines the frequency of oscillation; this frequency remains fixed for any higher-frequency setting of the tuning condenser. Experience has shown that it is possible to obtain a tuning ratio of slightly more than 3 to 1 when the highest-frequency band tunes to approximately 18 megacycles and when the grid current throughout this frequency range is sufficient to insure good mixer-stage gain. In general, for frequencies higher than 18 megacycles this tuning ratio decreases, because the inductance of the tickler and the magnitude of the shunt capacitance do not change rapidly. A maximum oscillator-grid current for each operating condition is recommended. Currents in excess of these recommended values may seriously curtail the effective tuning ratio.

Another reason for limiting the size of the tickler is to prevent the oscillator from relaxing periodically. It has been found that, for the given values of oscillator-grid resistance and capacitance, relaxation effects may occur when the oscillator-grid current exceeds the maximum value recommended.

Oscillator-Grid Current Requirements

Curves of conversion conductance and cathode current (I_k) vs oscillator-grid current through 50,000 ohms (I_{c1}) for the 6A8 are shown in Figs. 1 to 4; these curves correspond to the four operating conditions normally encountered in practice. Consider Fig. 1, which pertains to 250-volt, fixed-bias operation. As the oscillator-grid current decreases, the cathode current rises; I_k eventually exceeds the rated maximum current of 14 ma. The high cathode current at small oscillator-grid currents is a result of the small negative bias on the oscillator-grid at low oscillator voltages.

The conversion conductance of the 6A8 varies with I_{c1}. The curve approaches flatness over a large range of oscillator-grid currents, but drops quite rapidly for small values of I_{c1}. Thus, when $I_{c1} = 120$ microamperes (0.12 milliampere), the cathode current is 14 milliamperes, the maximum rated value, and the conversion conductance is 350 micromhos.

It is evident from Fig. 1 that I_{c1} should not be less than 120 microamperes for the operating conditions specified in the figure. Oscillator-grid currents less than this minimum value will result in decreased tube life and low mixer-stage gain. The maximum oscillator-grid current recommended for this condition is 500 microamperes. Experience has shown that this current can be obtained without any of the undesirable effects mentioned previously.

Curves of g_c and I_k vs I_{c1} through 50,000 ohms for 250-volt, self-bias operation are shown in Fig. 2. In this case, the minimum value of oscillator-grid current (90 microamperes) is also determined by the rated maximum cathode current. This minimum is lower than that for fixed-bias operation, because of the effect of the self-biasing resistor in limiting the cathode current. The recommended maximum value of I_{c1} is 500 microamperes. These recommended minimum and maximum oscillator-grid currents can be obtained when the tuning ratio is approximately 3 to 1 and when the highest-frequency range tunes to about 18 megacycles. As with fixed-bias operation, the tuning ratio is reduced as the upper operating fre-

(*Continued on page* 12)

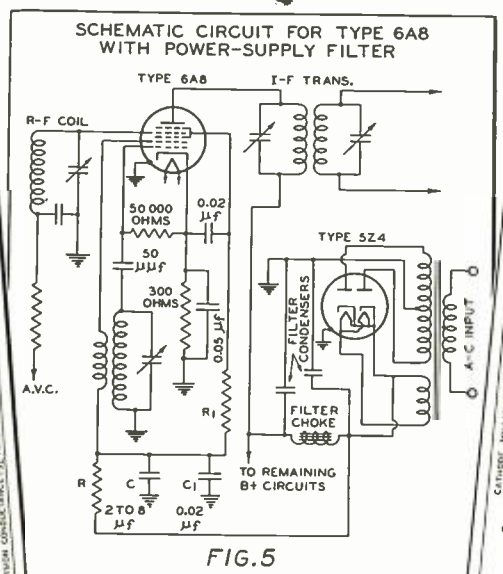


FIG. 5

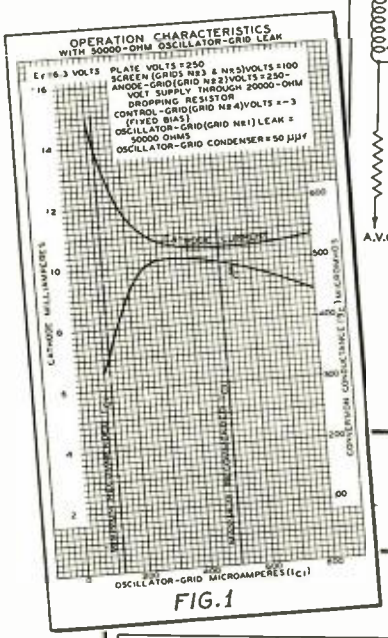


FIG. 1

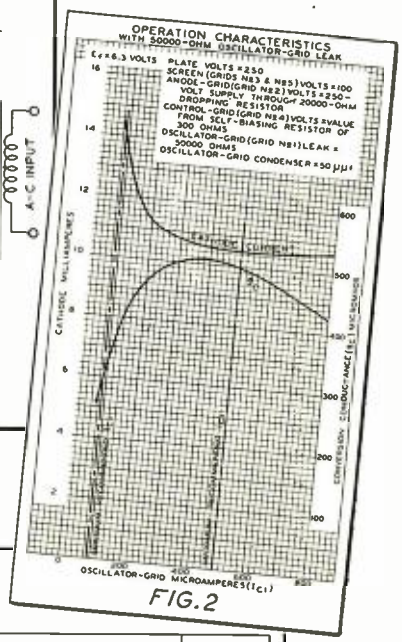


FIG. 2

SUMMARY TABLE

TYPICAL OPERATION OF THE 6A8

	100-VOLT CONDITIONS FOR			250-VOLT CONDITIONS FOR			
	Recommended MAXIMUM Osc.-Grid Cur.	Recommended MINIMUM Osc.-Grid Cur.		Recommended MAXIMUM Osc.-Grid Cur.	Recommended MINIMUM Osc.-Grid Cur.		
	Fixed- or Self-Bias (Figs. 3 & 4)	Fixed-Bias (Fig. 3)	Self-Bias (Fig. 4)	Fixed- or Self-Bias (Figs. 1 & 3)	Fixed-Bias (Fig. 1)	Self-Bias (Fig. 2)	
Plate Voltage	100	100	100	250	250	250	Volts
Screen Voltage	50	50	50	100 max.	100 max.	100 max.	Volts
Anode-Grid Voltage	100	100	100	250#	250#	250#	Volts
Control-Grid Voltage*	-1.5 min.	-1.5 min.	-1.5 min.	-3 min.	-3 min.	-3 min.	Volts
Oscillator-Grid Resistor	50000	50000	50000	50000	50000	50000	Ohms
Oscillator-Grid Condenser	50	50	50	50	50	50	μμf
Oscillator-Grid Current	0.25 max.	0.05 min.	0.05 min.	0.5 max.	0.12 min.	0.09 min.	Milliamperes
Plate Current	1.2	2.1	1.7	3.3	5.3	4.2	Milliamperes
Screen Current	1.5	2.1	2.0	3.2	4.2	4.7	Milliamperes
Anode-Grid Current	1.6	2.1	2.2	4.0	4.4	5.1	Milliamperes
Conversion Conductance	350	250	250	500	350	300	Micromhos
Grid Voltage (Approx.) for Conv. Cond. of 2 μmhos	-20	-20	-20	-45	-45	-45	Volts

* When self-bias is used, the self-bias resistor should have a value of 350 ohms for the 100-volt conditions, and 300 ohms for the 250-volt conditions.

\# This is an Anode-Grid Supply voltage applied through a 20000-ohm voltage-dropping resistor.

Note: Total Cathode Current = 14 Milliamperes Maximum, Anode-Grid Voltage = 200 Volts Maximum.

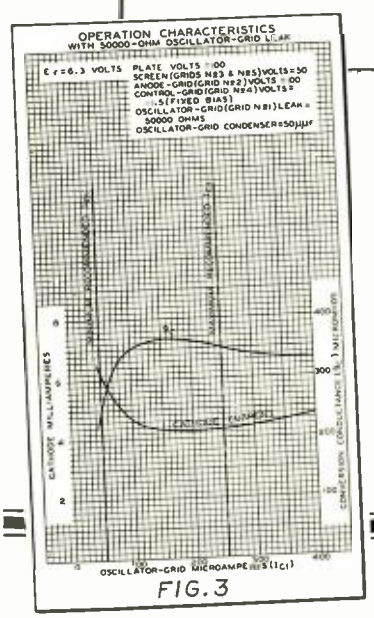


FIG. 3

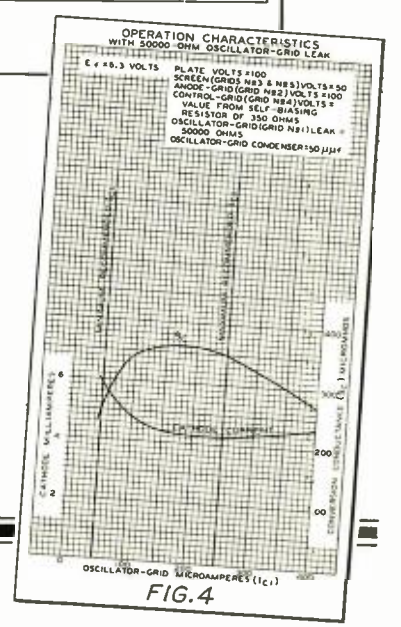


FIG. 4

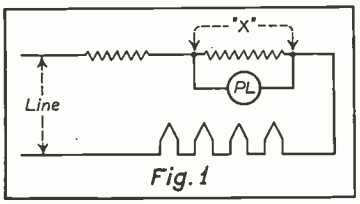


Fig. 1

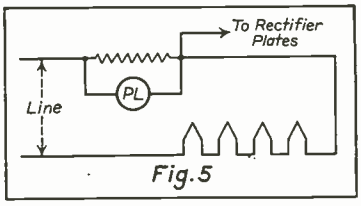


Fig. 5

BALLAST TUBES

Solving pilot lamp problems in a-c, d-c receivers

Among the many new problems presented with the advent of the a-c, d-c receiver, was the means of providing a source of voltage for pilot lamps. Due to the lack of suitable 110 volt lamps capable of operating directly off the power line, prevalent pilot lamps had to be used. Thus, lamps rated at 2.5 volts 500 ma were placed in series with the heaters. However, the meager illumination provided and the fact that failure of the lamp caused the receiver to be inoperative, led to the discarding of this method.

Fig. 1 shows the circuit generally employed today. Here, the necessary voltage is developed across resistor "X" and in case of lamp failure, the heater circuit is not opened. However, due to the fact that the initial current is considerably greater than the normal operating current, the value of resistor "X" is quite critical.

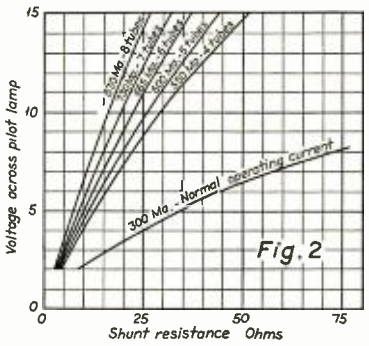
These high starting currents are encountered because the cold resistance of the heaters is considerably lower than the resistance at operating temperatures. In the case of the 25 volt heater, for instance, the hot-to-cold heater resistance ratio is approximately 7:1. The situation may be further aggravated by the use of voltage dropping resistors whose cold resistance is considerably lower than the resistance at operating currents.

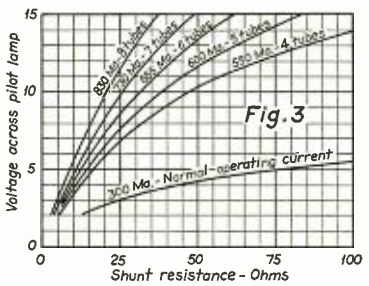
Lamp Characteristics

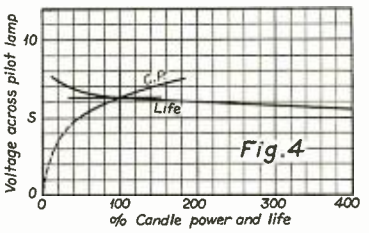
Figs. 2 and 3 (plotted from observed values) are a family of curves for the two lamps generally used, showing the effect of resistor "X" on the pilot lamp voltages. A study of these curves indicates that the initial voltage increases at a greater rate than the operating voltage for a given increase in the value of resistor "X". The starting currents given in the above curves were calculated on the assumption that two of the total number of tubes have 25 volt heaters. Thus, in cases where more than two such tubes are employed, the starting current will be considerably higher for the same total number of tubes.

Referring to the curves given for the No. 40 lamp, it is obvious that in order to operate the lamp at its rated voltage a shunt resistor of approximately 45 ohms is necessary. But this resistor will produce an initial voltage of approximately 14 volts or an over-voltage of 130% when the starting current is only 500 ma. This over-voltage will produce premature lamp failure.

This condition can be remedied by







using a shunt resistor whose original value is low enough to protect the lamp and whose final value is high enough to provide the recommended operating voltage with its resultant high illumination. Such resistors utilize the heat generated in the main resistor section for their operation. For this type of resistor, it is necessary that a minimum of 5 watts be dissipated in the main section of the line voltage dropping resistor. For a given resistor change, the maximum illumination for the same initial protection is had when the 6.3 volt 150 ma lamp is used.

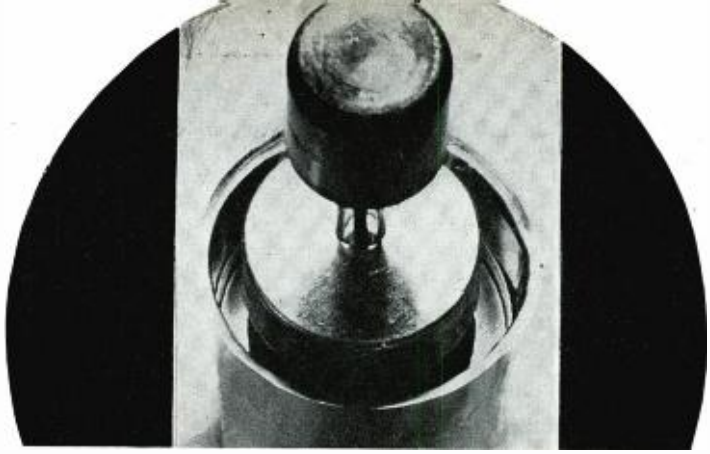
Curves shown in Fig. 4, compiled from data furnished by the General Electric Company, show the effect of over- and under-voltage on pilot lamp life and candle power. Such curves definitely show the need for initial protection.

Multi-tube receivers utilizing practically the entire line voltage for the series heaters, have abnormally high initial currents. It is obvious that no pilot lamp shunt is capable of providing both the necessary initial protection and desired illumination. For such cases a series lamp resistor of the order of 735 ohms, rated at 20 watts, is recommended. In this system the lamp is not subjected to a shock voltage. Here the 6.3 volt 150 milliampere lamp must be used to keep down the dissipated power.

Other Methods

An alternative is the use of a 110 volt medium screw (candelabra base) lamp, although this is not very popular because of large lamp size and its more or less special nature.

Another method of obtaining initial protection with a fixed shunt with unimpaired high operating value, particularly where the total plate and speaker current is 100 milliamperes or more, is shown in Fig. 5. This scheme depends upon the fact that plate current does not flow until the heaters have warmed up. Thus a lower value fixed resistor may be employed for the same operating voltage on the lamp.



United Electronics Company Mercury Vapor Rectifier.

POWER TUBE MANUFACTURING PROBLEMS

Discussing Ways and Means to Produce More Efficient Power Tubes at Lower Cost

L. L. McMaster, Jr.

The manufacture of power tubes, both transmitter and rectifier, offers certain problems not met in the high-speed production of less expensive receiving tube types. These problems, if not overcome, are very serious and far-reaching. The cost of life testing is an important factor, yet the manufacturer must have assurance that his product will give satisfactory life in operation.

With the increasing use of power tubes industrially and with television in sight, competition is becoming very keen and one way for a manufacturer to hold or increase business is through a reputation for *quality*. The cost to the consumer is too great to permit of any gamble with cut-price products. If, on the other hand, he is offered extra long life tubes it means a saving to him and increased business to the tube maker.

Rectifier Tube Life

Recent developments have indicated that the use of Svea Metal has given very satisfactory results with longer life the outstanding feature. Probably the most attractive application of this metal is in mercury type rectifiers. In broadcast station plate power rectification it has been said that high-vacuum types mean high power costs while mercury vapor tubes mean higher tube costs. This is only true when equal life is assumed. For example, the life of a high-vacuum type water-cooled rectifier may run from 6000 to 9000 hours, which is the life of the filament. A tube of the shielded cathode type, mercury vapor, such as the 869A, has shown that 15,000 to 20,000 hours of efficient operation are obtainable.

Among the factors influencing the life of such a rectifier tube are:

1. Occluded gas.
2. The elements which are liberated from the parts by heat.
3. Operating temperature.

It therefore follows that the parts must be free from occluded gas and those elements which, liberated from the part, tend to poison emission. Liberation of gas from the anode during exhaust is not usually difficult, although in the larger tubes degassing the metal supports is often a problem. It is here that the metal must not only be particularly gas free but able to give up surface gas at fairly low heats. The high thermal conductivity of Svea Metal makes such treatment possible without the necessity of bringing the entire piece up to normal bombarding temperature.

Emission Poisoning

Some materials which are porous and excellent radiators of heat offer certain disadvantages which may well be the cause of short life in tubes which were purchased on the reputation of the manufacturer. It has been found that these materials do not always give the same results but vary just often enough to cause difficulties at infrequent intervals. One lot of anodes may be excellent, whereas the next lot might, and often does, contain sulphur—not much, to be sure—but enough to poison emission, and it is not entirely removed during processing. For this reason Svea Metal has been adopted in many cases. Its absolute uniformity is a guarantee against such an occurrence and its adaptability to various methods of working and forming compensate for the fact that the radiating properties do not equal those of carbon surfaces—although superior to many metallic surfaces.

Operating temperatures depend to a large extent on distribution of heat within the parts so that radiation is more uniformly efficient. Rectifier anodes of Svea Metal are said to offer longer life due to lower operating temperatures with freedom from flashovers due to gas and ability to stand high peak plate currents.

Inasmuch as Svea Metal may be obtained in nearly any shape including wire of any diameter, rods in any size or length and tubing in any standard length and wall thickness, its application to power tubes is not limited to anodes, shields, etc. The wire is considerably stronger than nickel, and 12% lighter. It is far cheaper than molybdenum and much easier to form. These characteristics meet many of the requirements of an ideal tube material.

Metal Preparation

In preparing Svea Metal for use in power tubes the first consideration is temper. Unlike many materials, its temper cannot be judged by the "feel" or bending of the strip or wire. The temper range is very wide, the softest

being worked only with great difficulty, while the harder material may be deep drawn to a length eight times the diameter in six operations with no intermediate annealing. Any spinning operation may be done with ease and is frequently cheaper than die forming on small quantities of parts. Where mandrel forming is to be performed the material is often brought to the right temper by sandblasting the flat strip rather than the finished parts, the material hardening slightly in the process.

In receiving tubes it is a common practice to use either bright or oxidized metal. In transmitting tubes a sandblasted surface is used extensively. The procedure of sandblasting is probably the most critical in the entire process and calls for positive control by the engineering department. The surface of Svea Metal, being of soft texture and a much higher degree of purity than many other metals, is easily contaminated by any foreign material which it absorbs readily during the firing period. It is important, therefore, that the abrasive used on Svea Metal be free from any contaminating substances. If, for instance, the abrasive has been used on other metals such as copper, or brass, its use on Svea Metal will render the metal unfit for use in tubes. Carborundum, quartz or special sand may be used. Abrasives which have been used to sandblast glass may also be used with safety.

Washing and Firing

While washing may be done with a variety of solvents, those solvents which give off chlorine when in contact with hot iron (such as carbon tetrachloride) are not recommended unless the parts are *thoroughly* dried before firing. Even a furnace which has been contaminated in this manner will cause a spotty appearance on the parts when they are removed from the cooling chamber.

In hydrogen firing Svea Metal the tempertures may be allowed to run fairly high with no fear of blistering. The metal melts at 1535 degrees C, but firing above 1150 degrees C is neither necessary nor recommended as welding of the parts is likely to result. It is important that the cooling take place in hydrogen below the oxidation heat of the metal (200° C).

During the bombarding process temperatures as high as 1150° C. may be used if found necessary, though in the case of cathode shields 925° to 950° has been found to give the best results. During the breaking down of the cathode coating it is advisable to heat the parts only by radiation from the filament. In other words, bombard the parts well before coating breakdown and again after the breakdown is practically completed, the cathode temperature being not over 75% of normal operation during this process.

OPERATION OF THE 6A8

(*Continued from page* 8)

quency is increased. Thus, the same considerations regarding tickler-coil design obtain for self- as for fixed-bias operation.

Figs. 3 and 4 show the recommended minimum and maximum oscillator-grid currents through 50,000 ohms for 100-volt operation with both fixed- and self-bias conditions.

Receiver Testing In Production

When the i-f amplifier of receivers which use the pentagrid converter is aligned, the oscillator section of the tube should be in operation. During this test, it is common practice to apply a signal of intermediate frequency to the signal grid of the pentagrid converter and then adjust the i-f circuits for maximum gain. If the oscillator is not operating, the bias of the oscillator-grid is zero; consequently, the gain of the mixer stage as an amplifier is higher than that which can be obtained when the oscillator is operating. The i-f gains obtained with and without the oscillator in operation may lead to erroneous conclusions.

As pointed out previously, the gain of the mixer stage is a function of the oscillator-grid current. Therefore, when aligning the i-f circuits with the oscillator in operation, it is important that the settings of the gang condenser and the oscillator padding condensers should be approximately the same in all receivers. By observing this precaution, the tester is able to compare the i-f gain of any receiver with some standard under similar operating conditions.

It should be emphasized that there may be no definite relation between the gain of the 6A8 when it is operated as an amplifier and when it is operated as a converter. The gain of the 6A8 when it is used as a converter should be compared to a standard which is also used as a converter.

Blocking of Receiver

Some receivers seem to block, or motor-boat, when tuned to a strong high-frequency signal. In a number of cases, this has been traced to poor regulation of the oscillator-anode and screen voltage sources. The voltages for these electrodes are usually obtained from the low-voltage side of a filter choke, which may have a resistance of 1000 ohms or more. Variations in current through this choke, caused by tuning the receiver to a strong signal, change the voltage applied to the oscillator-anode and screen. This change in voltage shifts the frequency of the oscillator voltage; this shift becomes important at high radio frequencies. Hence, the oscillator detunes periodically at an audio-frequency rate and consequently produces modulation of the carrier amplitude.

Fig. 5 is a circuit which minimizes this effect. The oscillator-anode and screen voltages are applied through the resistance-capacity filter (R C); C_1 is a mica high-frequency by-pass condenser and R_1 is a screen voltage-dropping resistor. The values of R and R_1 depend on the voltage input to the filter. Since the filtering action is dependent on the time constant of R and C, not more than one tube (the pentagrid converter) should be supplied by this filter, as the value of R is inversely proportional to the current through it. In general, this circuit is not necessary on 100-volt operation, because the filter choke usually has a sufficiently low resistance to provide good regulation.

●

BOOK REVIEW

YOUR INVENTION, by Elmore B. Lyford, 210 pages, cloth covers, Published by Radio & Technical Publishing Co., New York, N. Y. Price $1.50.

This book will be of interest to those experimenters and inventors who always wonder if the latest of their discoveries is worth the expense of a patent. It cannot, and does not profess to be the final word either on patentability or procedure or law. However, the subject is covered with enough detail to clarify many of the obscure points about patents.

Mr. Lyford points out in his preface that he is not a patent attorney, and that he has no recommendations to make that will not stand the close scrutiny of the most ethical members of the legal profession. With this thought in mind the reader need have little hesitancy in following the author's advice—we suspect that an equivalent amount from an attorney would represent a real financial layout.

In addition to patents, the book covers copyrights and the exploitation of all protected material.

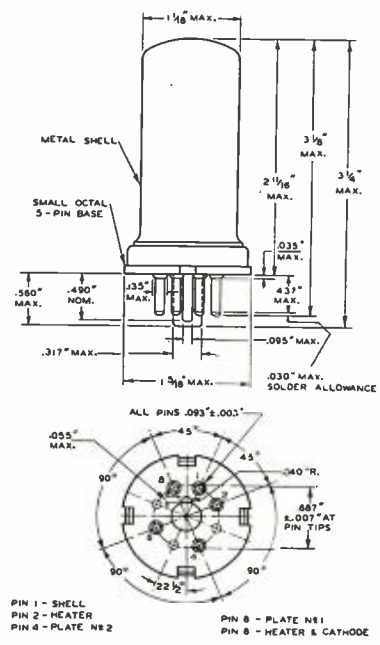
NEW TUBES

6R7 Diode-Triode—6G5 Tuning Indicator—Change in 5Z4 Size—New 2-Volt R-F Tubes

The 6R7 Metal Tube

The 6R7 tube, recently announced, provides, in a single envelope, twin diodes and a triode especially adapted for use in circuits where transformer coupling is to be employed. The plate resistance of the triode section is low enough so that the inductance of the primary of the coupling transformer can be made sufficiently high to insure good low-frequency response. This comparatively low plate resistance, along with a power output of 280 milliwatts, should make the 6R7 useful as the driver for push-pull A prime output stages.

Heater Voltage (A-C or D-C)	6.3 Volts
Heater Current	0.3 Ampere
Plate Voltage	250 Volts (max.)
Grid Voltage	—9 Volts
Plate Current	9 Milliamperes
Plate Resistance	8500 Ohms
Amplification Factor	16
Mutual Conductance	1900 Micromhos
Load Resistance	15000 Ohms
Power Output	280 Milliwatts
Maximum Overall Length	3-1/8"
Maximum Diameter	1-5/16"
Cap	Miniature
Base	Small Octal 7-Pin



New 5Z4 dimensions.

The information on the 6R7 was furnished by RCA Radiotron and the Raytheon Production Corporation.

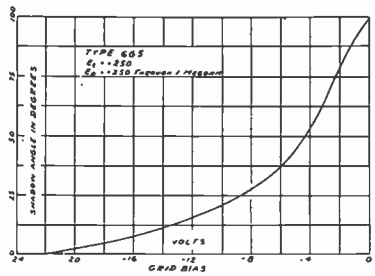
6G5 Tuning Indicator

The 6G5 is designed for use as a visual tuning indicator. In use, the end of the tube appears as a luminous disk with a sector cut out. The angle of the sector varies from 0° to 90° depending upon the applied voltages; it is this varying angle which indicates proper tuning.

The triode section of the 6G5 has a variable-mu characteristic which insures an appreciable movement of the shaded sector on weak signals and prevents overload on strong signals.

As is shown on the accompanying curve, zero shadow angle is reached with -22 volts on the triode grid. Receivers with avc systems capable of supplying a greater voltage than -22 should be provided with an appropriate voltage divider in the avc circuit to limit the voltage reaching the grid of the 6G5.

Care must be taken to eliminate practically all of the audio component of the avc voltage, otherwise the edges of the shadow will become indistinct on modulation peaks. Too great a time constant in the a-f filter must likewise be avoided since this would make the response quite sluggish.



Shadow Angle-Grid Voltage Curve of 6G5.

Heater Voltage (A-C or D-C)	6.3 Volts
Heater Current	0.3 Ampere
Plate Supply Voltage	250 Volts (max.)
Target Voltage	250 Volts (max.)
Series Triode Plate Resistor	1 Megohm
Triode Plate Current for Zero Grid Voltage	0.25 Milliampere
Triode Grid Voltage for 0° Shadow	—22 Volts (approx.)
Triode Grid Voltage for 90° Shadow	0 Volts (approx.)
Bulb	ST-12
Base	Small 6-Pin

The 6G5 details were made available by the National Union Laboratories.

Size of 5Z4 Changed

RCA Radiotron has announced a change in the dimensions of the 5Z4 rectifier. Although smaller in size, and with a metal shell instead of the former metal-cage construction, the electrical characteristics remain unchanged.

1A4 Super-Control R-F Pentode and 1B4 R-F Amplifier

	1A4	1B4
Filament Voltage (D-C) Volts	2.0	2.0
Filament Current Ampere	0.060	0.060
Plate Voltage (maximum) Volts	180	180
Screen Voltage (maximum) Volts	67.5	67.5
Grid Voltage (minimum) Volts	—3	—3
Plate Current Milliamperes	2.3	1.7
Screen Current (approx.) Milliamperes	0.7	0.4
Plate Resistance Ohms	960,000	1,200,000
Amplification Factor	720	780
Mutual Conductance Micromhos	750	650
Mutual Conductance (at —15 volts bias) Micromhos	15	....
Grid-Plate Capacitance (with shield) mmfd	0.007	0.007
Input Capacitance mmfd	4.6	4.6
Output Capacitance mmfd	11	11
Overall Length	4-9/32" to 4-17/32"	
Maximum Diameter	1-9/16"	
Bulb	ST-12	
Cap	Small Metal	
Base	Small 4-Pin	

Pin 1—Filament
Pin 2—Plate
Pin 3—Screen
Pin 4—Filament
Cap—Grid

The above characteristics are from RCA Radiotron.

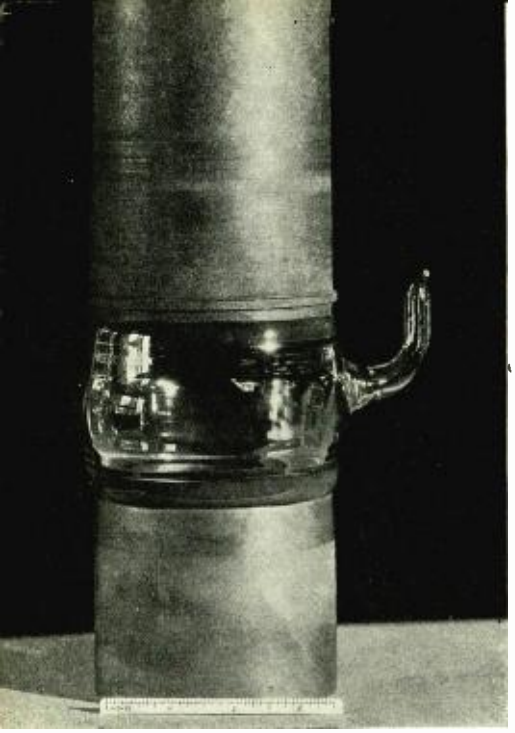


Fig. 2.

ADVANCES IN METAL-GLASS SEALS

From the very beginning of the electronics industry, the need for an effective vacuum-tight seal between metal and glass has been ever present. Platinum was the first metal used for this purpose, but was limited because of its high original cost and because it would seal only to ordinary lead glass which has a low melting point. The next improvement came with the development of a copper sheathed 42% nickel steel. Its use, however, is not general as copper is not resistant to mercury which is a common conducting vapor in many vacuum devices. Restrictions in the use of these metals were soon discovered as higher temperatures and larger size seals became necessary. This shift called for the use of hard glasses having low coefficients of expansion and, therefore, high resistance to thermal shock. High chromium iron alloys were found to fulfill some of the necessary requirements, but their use was confined to applications where temperature remained relatively low, as these metals would only seal into soft glass which, because of its high expansivity, has inadequate thermal resistance. Tungsten and molybdenum seal well into hard glasses with low temperature coefficients of expansion, but they are extremely difficult to machine and in most cases are practically prohibitive in price.

In order for a metal to effect a vacuum-tight seal with glass, two primary conditions must be fulfilled. First, the expansion of the metal and glass must be substantially the same under the temperature ranges encountered in the formation of the seal and the use of the finished unit. Where there is a large difference in the coefficient of expansion, stresses are set up which will cause the glass to crack when cooled to room temperature. However, this sameness of expansion is only necessary up to that point where the glass is substantially plastic.

Extensive experiments carried on under the direction of the Westinghouse Electric & Manufacturing Company Research Laboratories by Howard Scott have led to the development of a certain combination of iron-nickel-cobalt alloys that fulfills these conditions in relation to the characteristics of hard glasses. This patented alloy which contains approximately 29% nickel, 17% cobalt, 0.2% manganese and the balance iron, has been given the trade name "Kovar". The close resemblance between the two expansion curves of Kovar and hard glass is evident in Fig. 1. The expansivity of Kovar is reversible; i.e., the same on heating as on cooling. Table 1 gives these figures in comparison with that of hard clear sealing glass, a type of glass most suitable for sealing. The same figures are given for tungsten and molybdenum for comparison.

According to Scott, "Clear sealing glass into which Kovar has been sealed can be obtained at room temperature practically free from stress, since the contraction of both materials on cooling from a temperature near the strain point is practically the same."* The strain point is that point at which stresses in the glass will decay to an inappreciable value after exposure for fifteen hours. With Kovar and clear sealing glass, there is an absence of stresses up to the annealing point and with proper annealing a stress-free seal can be obtained. The annealing point is that point at which the same stresses will disappear after exposure for fifteen minutes. This factor is of great importance where quantity production and further assembling of the unit without delay for long cooling periods is desired.

The second primary factor necessary to effect a vacuum-tight glass to metal seal is that the glass must be "wet" by the metal when applied to it at a suitable temperature. "Wet" is a technical glass term which describes a condition present when an oxide film on the outside of the metal is formed during the heating and dissolves into the fused glass, making a perfect union. Care must be taken that oxidation in the process of "wetting" is not too extensive, for if the oxide film is too thick, the glass

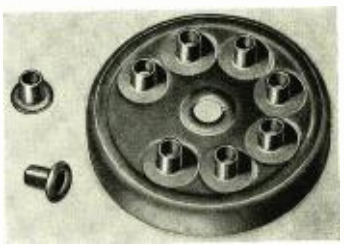


Fig. 3.

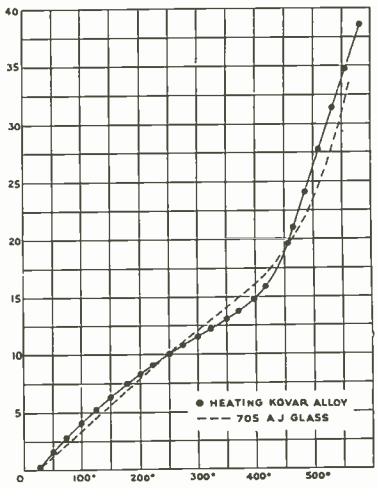


Fig. 1.

*"Recent Developments in Metals Sealing into Glass," Scott, H., Franklin Institute, 220:6 (1935)

Discussing Some Important Developments in the Art and Their Applications to Vacuum-Tube Manufacture

immediately around the metal has a tendency to become porous when cooling. In Kovar one function of the cobalt is to improve the fusibility of the oxide formed, thus effecting a good seal.

With Kovar it is not necessary to have a feather edge on a tubular shape such as is used in making Housekeeper seals. As a matter of fact, it is preferable to have a somewhat heavy rounded edge on the metal to minimize concentration of stress in the glass. Successful Kovar glass seals have been made using tubular shapes with a wall thickness as high as 1/8". An example of this is shown in Fig. 2. The Kovar tube in this illustration is 4 inches in diameter.

The procedure of making a seal between Kovar and clear sealing glass is not highly critical. The hot seal should be cooled to the annealing point, held there fifteen minutes, and then cooled to the strain point at a rate depending on the size and shape of the seal. Cooling from the strain point to room temperature can be quite rapid.

In evacuating metal tubes the necessary heat is not applied internally by induction as in the case of glass tubes, but externally on the bulb. Because it is conducted through the metal, high temperatures are generated inside which prohibit the use of soft glass seals around the lead-in wires. The use of Kovar eyelets in combination with hard glass has successfully overcome this problem and makes possible the production of metal tubes. Kovar eyelets are easily welded or brazed to steel headers. Because Kovar is easily formed, complete headers can be stamped from this material. Fig. 3 illustrates several eyelets and a complete header fabricated from Kovar.

The Stupakoff Laboratories have developed a combination Kovar-copper lead-in wire, consisting of a small piece of Kovar wire, of sufficient length to pass through the Kovar eyelet, where it is sealed in place with hard glass and butt-welded to a length of standard copper wire. Several Kovar-copper lead-in wires are illustrated in Fig. 4. The two wires at the left of this illustration are shown with glass sealed around the Kovar. Kovar-copper lead-in wires have the advantage over nickel-moly-nickel wires in that a better glass-to-metal seal is obtained with Kovar than moly, and in that cost studies show that the soldering of the lead-in wire to the base pins is accomplished much quicker and better with copper than with nickel. Nickel is used in the nickel-moly-nickel wires as moly cannot be welded to copper. The Kovar-copper wires are also more economical to manufacture as only one weld is necessary to join the two materials together as against two welds in the other type of tube lead-in wire. Fig. 5 shows a cross section of a metal tube with various components mounted in their respective positions.

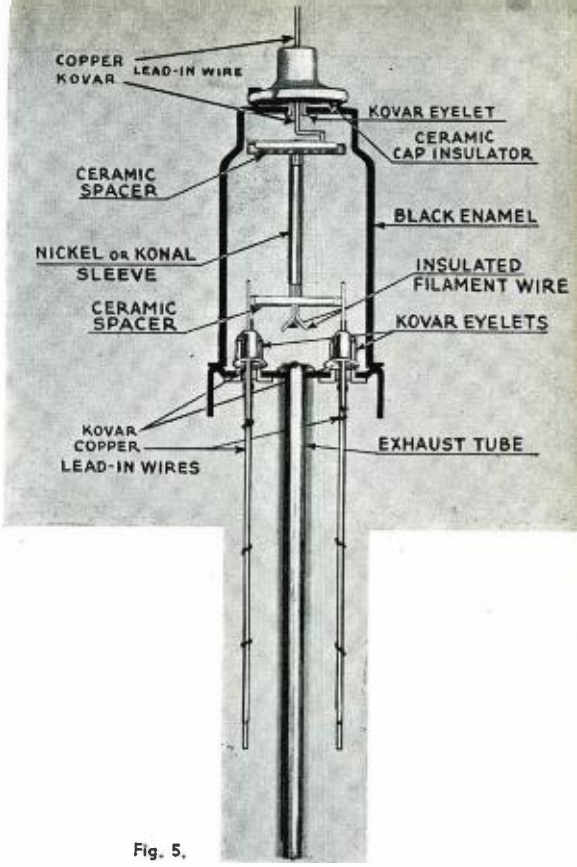


Fig. 5.

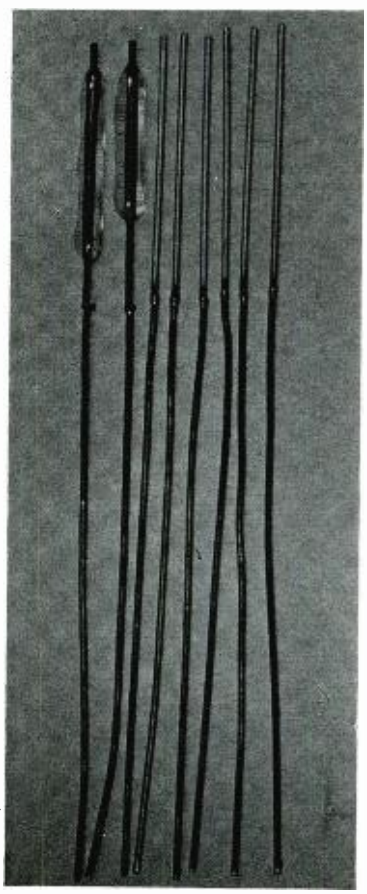


Fig. 4.

TABLE I

Material	Direction of Temp. Change	Expansivity 25 to 325°C.	Expansivity 25 to 470°C.
Clear Sealing Glass	Heating	4.2×10^{-6}/°C.	3.9×10^{-6}/°C.
Clear Sealing Glass	Cooling	4.4×10^{-6}/°C.	4.6×10^{-6}/°C.
Kovar Metal	Either	4.0×10^{-6}/°C.	5.1×10^{-6}/°C.
Tungsten Metal	Either	4.7×10^{-6}/°C.	4.8×10^{-6}/°C.
Molybdenum Metal	Either	5.5×10^{-6}/°C.	5.7×10^{-6}/°C.

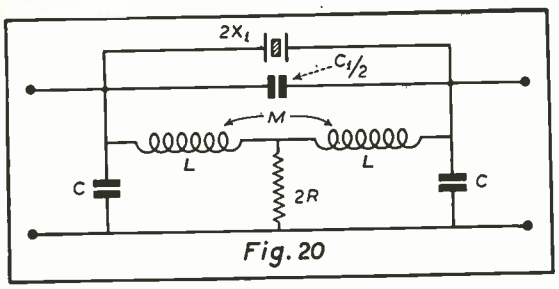


Fig. 20

CRYSTAL FILTER DESIGN . . . . . part 3

by W. W. Waltz

FOR an industry which claims leadership in research and all-around scientific progress, radio has been inexplicably inert to the possibilities of the broad-band crystal filter. Here are circuits whose details have been available—to those astute enough to realize their value—for nearly two years, but we still find even the most elaborate of the so-called high-fidelity receivers with amateurish and make-shift methods of i-f coupling variation.

Sideband Cutting

It has already been pointed out that superheterodyne receivers need r-f amplifier stages preceding the first detector for the purpose of eliminating or reducing image-frequency interference and other unwanted frequencies. Apparently it is of no interest to the circuit designer that so much sideband cutting can—and does!—take place in these r-f stages that to follow them with i-f stages of even moderately good response is just about the height of naivete. Granted that while there is no *entirely* satisfactory means of securing wide-band response through an r-f system, the fact still remains that some measure of good can be accomplished, the means for which are not unknown.[1] However, the usual lethargy has resulted in the shelving of this material.

It certainly cannot be said that receiver manufacturers are in any way responsible for the improvements in broadcast technique, although it might normally be expected that advances in the receiver manufacturing art should later reflect in better broadcasting. But, except for a few high-fidelity receivers—all with the variable i-f coupling for broad-band response—present-day models show no material advance over those of three and more years ago. Of course, the general public is responsible to a certain extent for this state of affairs; but, the public cannot be educated to higher tone quality by depending upon the broadcasters to make all of the improvements. Unless receivers can more or less faithfully reproduce the broadcast programs, there is obviously no use in further extending the audio range of transmitters. In other words, it is entirely on the shoulders of the receiver manufacturers to secure the interest of the public in quality reception.

Crystal-Coupled i-f

In the opinion of several engineers with whom this writer has discussed this problem, the answer lies in the adoption of crystal-coupled intermediate-frequency amplifiers; these, working with a constant bandwidth, would insure against the present objections of sideband trimming, so prevalent in i-f amplifiers coupled by the more conventional tuned-circuit transformers. The response curves of many i-f transformers exhibit a degree of asymmetry which can only result in the loss of highly essential sidebands. Just what is the effect on the symmetry of the response curve caused by variable coupling, or other means of obtaining a wide-band response, we are not prepared to say, but it is only reasonable to assume that none of these tends to "iron out" the irregularities.

The asymmetry of response of the tuned-circuit i-f coupling is not the only disadvantageous feature. Due to the Q of the coils, the cut-off frequencies are not distinct, and, in consequence, an essentially rectangular, flat-top curve is only remotely approached in practice. The net effect is that to secure the acute selectivity of a superheterodyne by means of coil and condenser combinations, necessitates the adjustment of these circuits in such a manner that most of the sidebands are irreparably attenuated. Engineers may jump to their own defense by claiming that, electrical circuits being what they are, nothing can be done about it. True enough, until crystal coupling became available!

Impedance Relations

We have mentioned, in Parts I and II of this series, the advantages deriving from the inherently high Q of crystals and how even the slight dissipation occasioned by the crystal may be nullified. Aside from the symmetrical response curve exhibited by crystal filters, the low-loss features result in a greatly increased ratio of the frequency of infinite (or maximum) attenuation to

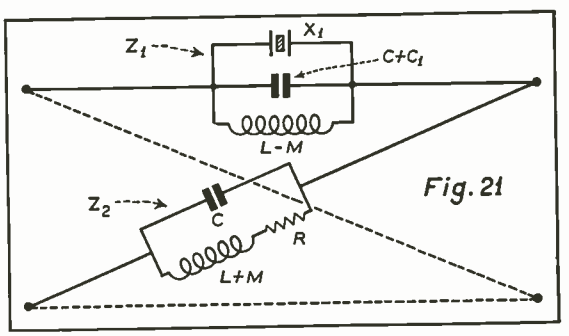


Fig. 21

[1]While the exact reference is not available, it seems that F. K. Vreeland published a paper on wide-band circuits in the I. R. E. Proceedings about 1928. In *Electronics* for September 1930, E. A. Uehling described a system of unusual interest; this was further developed—mathematically, at least—in the Radio Engineering Handbook (pages 158-159, 2nd edition, 1935).

CONTINUING THE DISCUSSION OF CRYSTAL FILTERS FOR HIGH-FIDELITY RECEIVERS

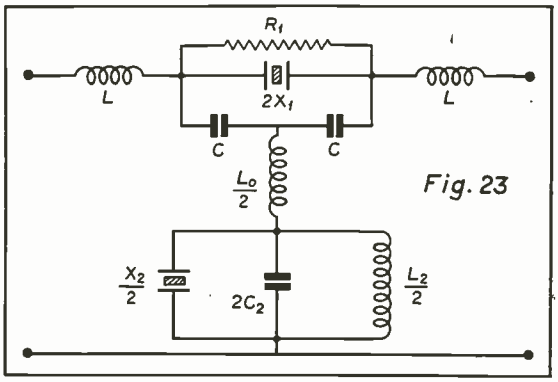


Fig. 23

the cut-off frequency—in other words, a response characteristic with steeply sloping sides. The "valley" between the peaks of maximum attenuation is due largely to the impedance characteristic of the crystal filter circuit—those familiar with the general theory of wave filters will appreciate that it is at these marginal frequencies where the difficulties due to improper impedance match are most pronounced. This can be explained further by recalling that in Part II we gave the conditions for the existence of a pass band in *any* filter, i. e., when the reactances of the two branches of a filter are of opposite sign, a pass band is indicated. This means simply that within a pass band the impedance of a filter network is a resistance, whereas, in the region(s) of attenuation, the impedance is reactive. However, to continue with the point regarding the "valley" of the crystal filter response characteristic, as shown by Fig. 17 of Part II, this "valley" is not especially pronounced; the slopes of the sides are gradual, and there is no sharply defined minimum point. Contrast with this the characteristic response of two coupled circuits such as are used in the conventional i-f transformer; here we find a decided V between the peaks representing the marginal frequencies.

In the discussion of design considerations given in Part II, we mentioned that in making the calculations for the filter network, Z, the filter impedance—which should be one of the known quantities—is taken to be about 80% of the impedance out of which, or into which, the filter is to work. This helps further to minimize the effects, discussed in the paragraph immediately above,

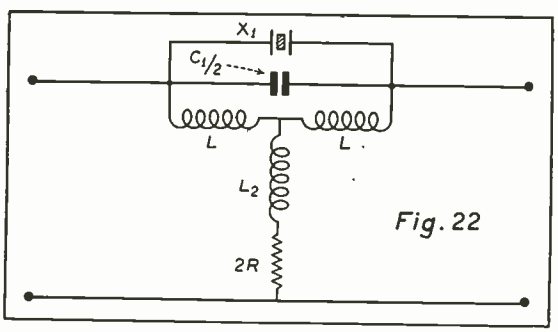


Fig. 22

of the shift from reactive-to-nonreactive-to-reactive impedance which occurs about the regions of cut-off frequencies. It should be pointed out here, too, that it is not only customary, but entirely permissible to consider that a filter is properly terminated when the impedance at one end of the network matches the impedance which it faces. This means that for crystal filters to work between tubes, we need consider only the plate impedance of the tube ahead of the filter. Since the plate impedance of a tube is quite generally known, this gives a satisfactory starting point for the design of the filter. And, as most present-day r-f tubes are of the pentode variety with an inherently great plate impedance, the possibility of obtaining a closer match between the tube and load is greatly enhanced by the crystal filter circuit.

Comparative Costs

Quite naturally, the question of comparative costs, as between a coupling unit employing a crystal and the usual i-f transformer, arises. We hasten to agree that there will be a difference—all in favor of the i-f transformer. But, if one is to have quality it must be paid for. It has been estimated by competent authority that the selling price of a receiver using a crystal filter need not be increased by more than $25 over the price of the same receiver built upon prevailing standards.[2]

The cutting and grinding of quartz plates has today become a production matter, perhaps not quite in the Ford sense of the word, but enough so to make the use of quartz crystal filters entirely feasible. The long, laborious grinding processes of a few years ago have been replaced by more accurate cutting to close limits, and a finish grinding to final dimensions. It should be remembered that the plates for filter use are finished to *dimensions* rather than to frequency, although checking the fundamental frequency of the finished plate—surely no more complicated than many other tests done under shop conditions and the stress of production schedules—is of no little importance.

It is perfectly obvious that the crystal filter in which the most interest—if any!—centers will be that section using the minimum of plates and associated circuit elements. This restricts the field to the bridged-T type which was described in Part II. The filter discussed (see Figs. 18 and 19 of Part II) employs two quartz plates, but the bridged-T type of filter can be further simplified so that a section requiring but one quartz plate is entirely feasible.

[2]We are indebted to Mr. W. A. Thomas of the Premier Crystal Laboratories, Inc., New York, N. Y., for supplying this estimate. As Mr. Thomas pointed out, there are many variables affecting this estimate; i.e., particular type of crystal filter selected, specified precision of adjustment, etc., but it is believed that the figure given represents about the maximum increase to be anticipated.

(To be continued)

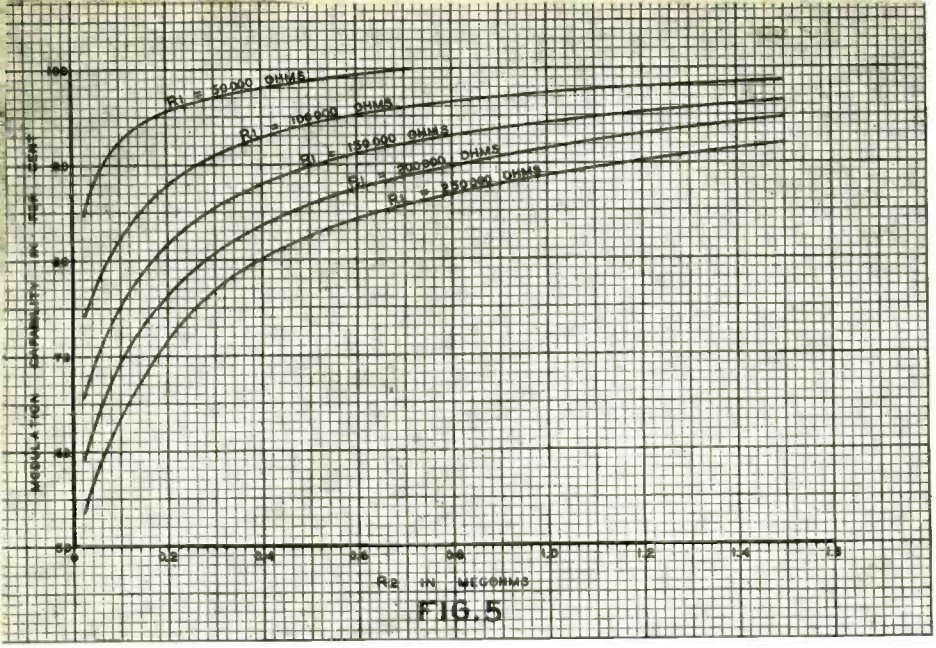


FIG. 5

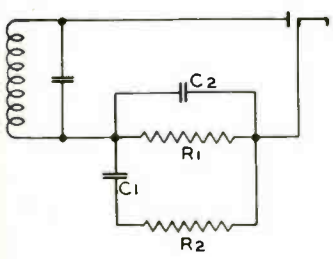


FIG. 1

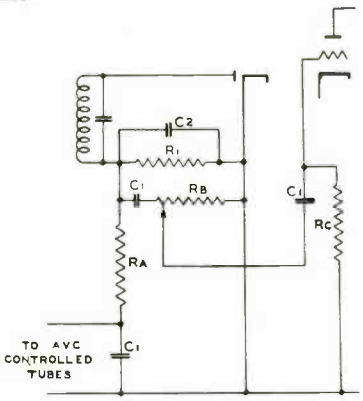


FIG. 2

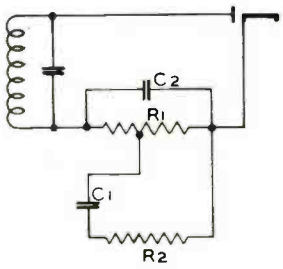


FIG. 3

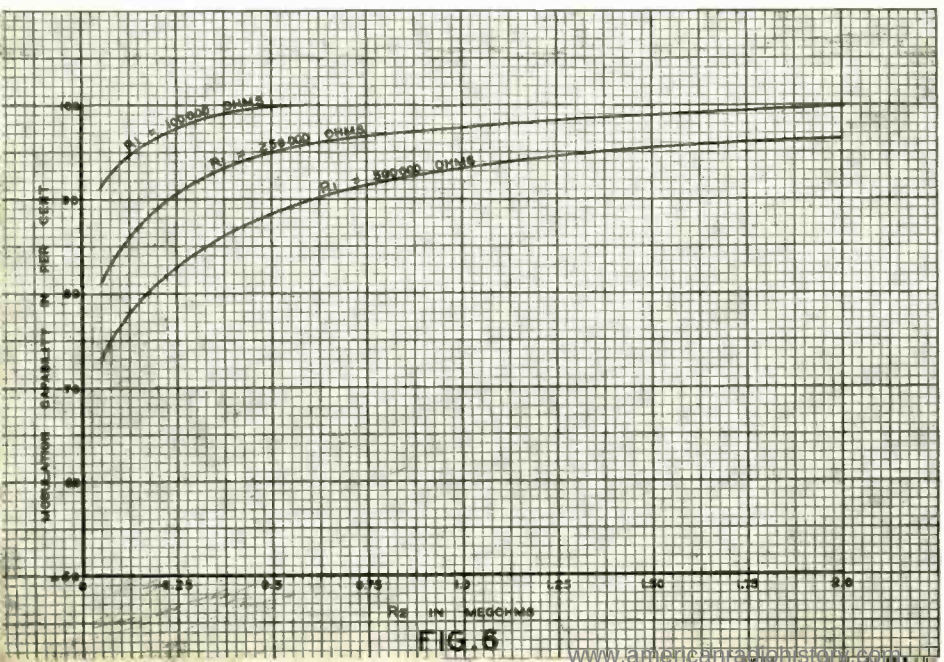


FIG. 6

IMPROVING DIODE DETECTOR PERFORMANCE

The realization of low distortion audio outputs from diode detectors subjected to high percentage modulated signals depends upon the magnitude of the ratio of the a-c and d-c output loads. The best condition is obtained when this ratio approaches unity. If the a-c load is appreciably lower than the d-c load then the ability of the diode to handle higher percentages of modulation is limited. In some cases where poor quality of audio output is obtained from a receiver, the difficulties are attributed to other portions of the receiver when the fault is in the diode detector design.

Load Effects

The accompanying curves show the effects of various ratios of a-c to d-c loads on distortion. The curves were plotted from data obtained by graphical methods involving the characteristics of a diode in a Type 6Q7 tube. As this type of diode is representative of those used in the Types 75, 85, 6B7, and other tubes used as diodes, the data shown are also applicable to those tubes. The diode characteristics were taken with conditions representing a generator (circuit feeding diode) impedance of about 100,000 ohms, which is considered a reasonable value for such circuits in ordinary receiver use. A signal of 30 volts peak was assumed as a representative value.

In the preparation of the data the conditions first considered were those where the diode load resistor R_1 (See Fig. 1) is a single unit and not tapped. The coupling capacitor C_1 is considered to be large enough to have a negligible reactance at audio frequencies. In cases where it is not, its reactance can be added vectorially to the value of R_2 and the resultant impedance considered as R_2 for a close approximation of the total loading. It must be remembered that if the total load has a substantial reactive component, the results differ from those of a pure resistive load as far as distortion is concerned. The value of R_2 is interpreted to be the resultant of all resistances in a-c circuits shunting the diode load R_1 where the condensers

C_3 are negligible in reactance. Fig. 2 shows a typical case of the several shunting resistances which give resultant R_2 composed of R_a, R_b and R_c in parallel. The r-f by-pass condenser is neglected because its value is normally so low that the effect on audio frequencies is not appreciable. Fig. 3 shows the general circuit for a tapped R_1. In this case R_2 is the resultant of the same components as shown in Fig. 2.

Modulation Capability

Fig. 4 shows the percentage modulation that the diode detector system will handle with the minimum inherent distortion when loaded with different ratios of R_2/R_1 as R_1 is varied. This property of the detector system is named for reference as "Modulation Capability."

Fig. 5 shows the same data on Modulation Capability plotted as a function of R_2 for different common values of R_1 to make information more readily usable.

Fig. 6 is similar to Fig 5, but gives the Modulation Capability of a detector system where R_1 is a tapped resistance so that R_2 is across only half of the d-c load. It is evident that this arrangement increases the Modulation Capability of the detector but sacrifices audio voltage available as a result of the tapped arrangement (Fig. 3).

It must be remembered that in addition to these data, which indicate that as low an R_1 as possible is desirable, that there are other factors acting in an opposite direction. When R_1 is reduced the distortion due to curvature of the diode characteristics is increased and the loading effect on the i-f transformer becomes greater. Therefore the design engineer must settle on a compromise that will give the best results for the circuit and receiver under consideration.

Harmonic Content

Fig. 7 indicates the total harmonic content (from the second to the fifth harmonic inclusive) of the audio output when a 100% modulated signal is applied to a diode detector loaded for various modulation capabilities. Fig. 8 gives spectrum plots of the harmonic content for three conditions of modulation capability when 100% modulated signals are applied. Fig. 7 and Fig. 8 are the results of mathematical calculations on the assumption that the distortion is the effect of cutting off a portion of one-half of the audio sine wave. The harmonic components given are those analyzed in the "cut-off portion." While this is not a rigorously correct assumption it is felt that this is probably a more accurate picture than could be obtained by measurement and it does give a good indication of the magnitude of the distortion involved when a diode is not properly loaded.

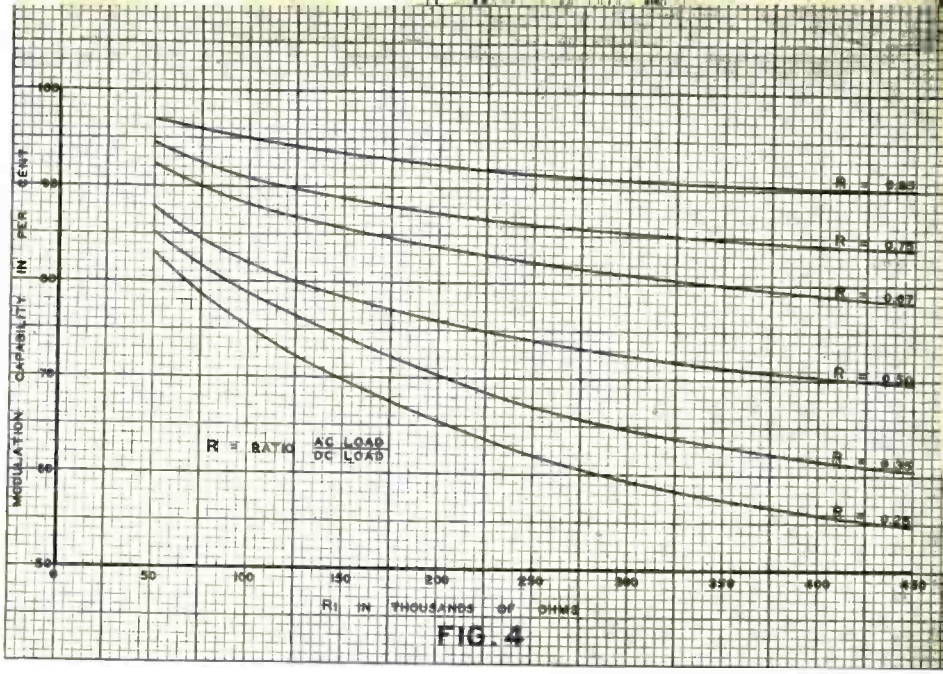


FIG. 4

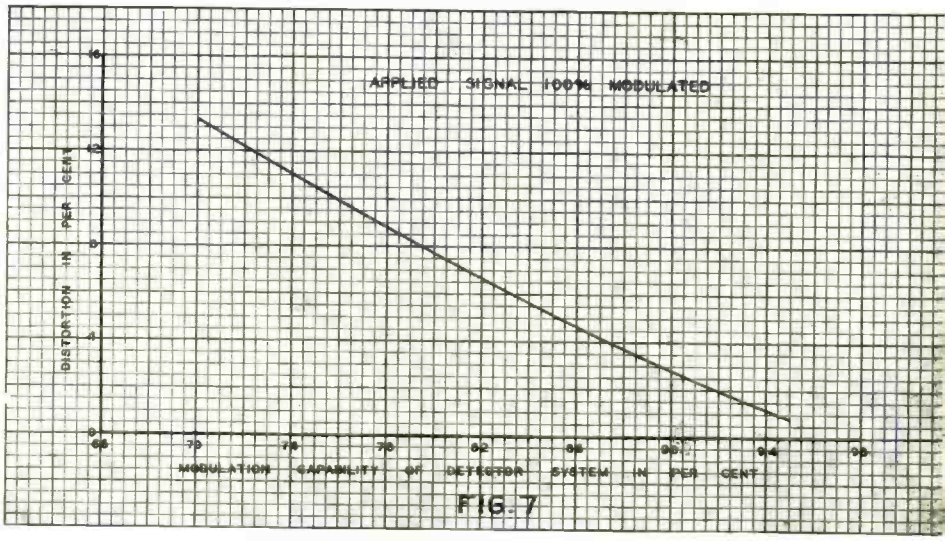


FIG. 7

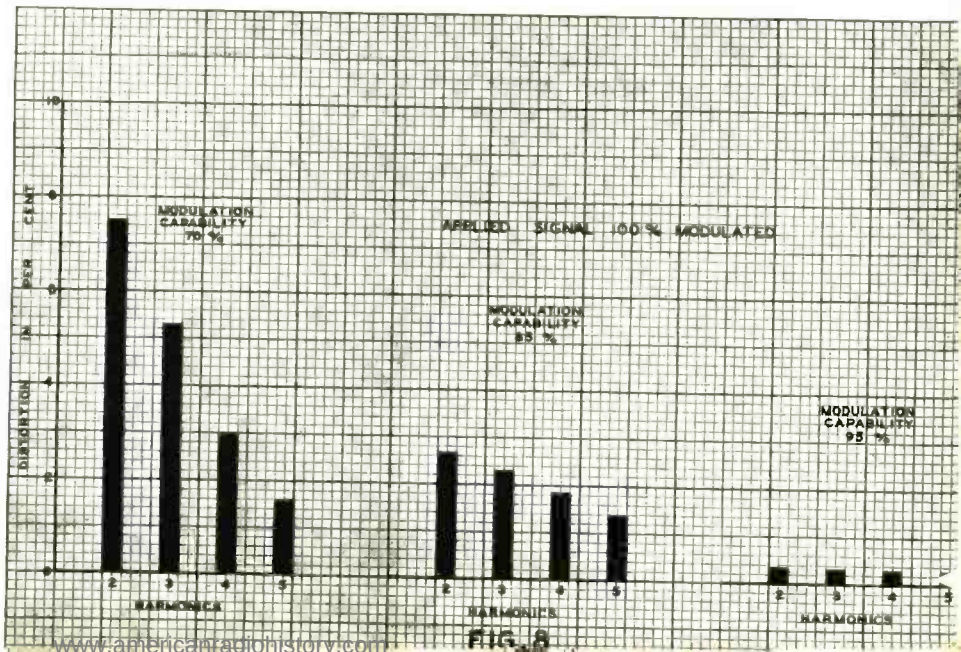
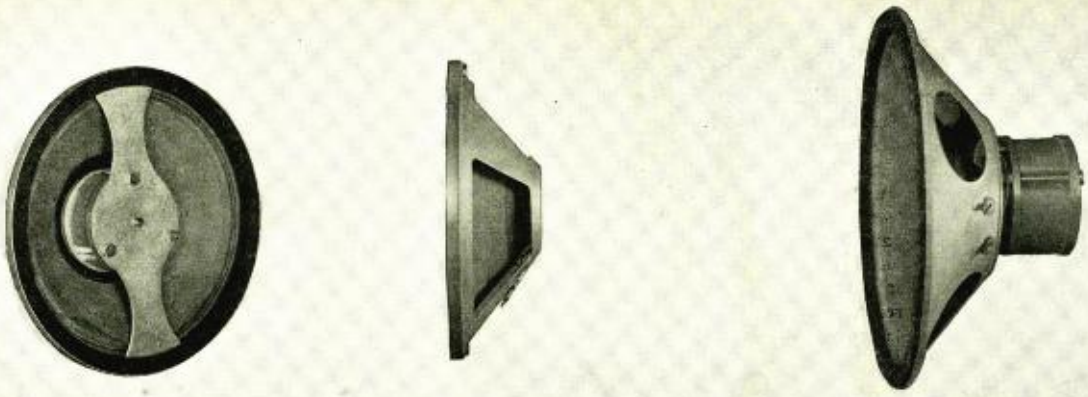


FIG. 8



THE "NIPERMAG" SPEAKER

Magnetic Alloy Introduced in This Country Is Basis of Unique Design

A MAGNETIC alloy for loudspeakers, "Nipermag," developed in England, was recently announced here.

"Nipermag" has been used extensively in England in the construction of permanent magnet speakers. It has been found to possess an exceptional degree of magnetic retentivity, thousands of speakers having been in service for well over a year with no perceptible decrease in magnetic strength.

"Nipermag" Alloy

The flux densities used will depend upon the size of the speaker. Densities as great as 16,000 lines per square centimeter are possible, although in typical designs somewhat less than this value is generally employed. For instance, an eight inch speaker may have a flux density of 7,000 lines per square centimeter, giving a total flux of 29,000 lines. A ten inch speaker may use a density of about 10,000 lines per square centimeter, a total of 40,000 lines. Total flux densities of upwards of 225,000 lines are obtained in larger models. Since it is the total flux density which determines the amount of actual "work" done by the speaker, these values should be of considerably more than academic interest to the designer.

Development work on a loudspeaker which uses "Nipermag" permanent magnets has been in progress at the plant of the Cinaudagraph Corporation. A large part of the research work has been concentrated upon materials for the cone diaphragm and the method of insuring against radial motion of the voice coil.

To begin with, the voice coil itself is wound on a form made of fused silica. The wall of the coil form is approximately 0.002 inch in thickness; this means that, with the wire in place on the form, the thickness of the voice coil and its form is only about 0.006 inch. An appreciable reduction in voice-coil weight is achieved.

The inelasticity of the quartz voice-coil form, and its rigid anchoring to the cone proper, insures the transmission to the cone of even the slightest motion of the voice coil, and, hence, the reproduction of the high frequencies of speech and music.

Cone Diaphragms

It is a well established fact that, at the higher frequencies, a cone diaphragm vibrates chiefly at the apex; as the frequency becomes lower, more and more of the surface of the cone is actuated until, at some comparatively low frequency, the cone functions as a piston. With this point in mind, the development work on the cone was devoted to a study of the means for coupling the various areas of the cone together, to eliminate, so far as possible, any abrupt change in the effective cone area with changing frequency.

The final result may best be described as a material which "shades" from one degree of density to another as the periphery of the cone is approached. It is said that the characteristic response of the cone can be controlled by proper design of this "shading."

Suspension

In order to prevent radial motion of the voice coil and to insure the axial freedom necessary for satisfactory low-frequency response, a new form of suspension was devised. In place of the conventional "spider," there is an interlaced net which effectively opposes radial thrust, while perfect freedom in the axial direction is said to be assured.

Baffles

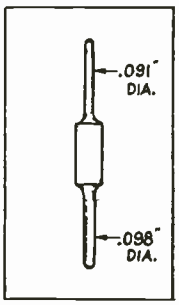
This particular type of speaker operates without benefit of the usual plane-surface baffle. The effect of an infinite baffle is obtained through enclosing the speaker in a box, or cabinet, the dimensions of which are determined from considerations of cone size, etc. Among the advantages claimed for this method of mounting may be mentioned: Absence of effects resulting from the interference of sound waves emanating from the front and the back of the diaphragm; ease of mounting in radio receiver cabinet and absence of cabinet resonance considerations.

Try this simple pin test and convince yourself of the **superiority** *of this socket—*

Type No. 39

1. ***Spring Resiliency*** . . . Insert into a contact, a pin .098 dia. representing an oversized tube prong. Then, insert, pin of .091 dia. representing an undersized tube prong. Note that firm even pressure is still maintained on the smaller diameter pin, proving that none of the original resiliency has been lost after spreading contacts.

2. ***Strong Grip*** . . . Insert a metal tube into socket; hold socket firmly in one hand and try to jar or snap the tube out of the socket. Note the strong grip contacts maintain on tube prongs.



3. ***Low Electrical Resistance*** . . . Withdraw tube from socket; examine the inside of the contacts. Note carefully the effect of the straight line wiping surfaces.

These 3 essential features, found exclusively in the FRANKLIN socket are the result of experience and knowledge gained from the limitations of previously designed sockets for new metal tubes.

the Franklin **Self-Locking** *Socket offers a new practical, economical and efficient method of assembling sockets to chassis—*

1. ***Practical*** . . . The Self-Locking feature is such that a ¼ turn to right locks socket securely to chassis. Although socket can be readily removed with a tool, there is no danger of it becoming loose in usage. A simple blanking die is all that is necessary for blanking out chassis to receive these sockets.

2. ***Efficient*** . . . The entire assembly of contacts are included in a circle of 1" diameter which makes it especially adaptable for small radio receivers where space saving is a factor. Despite its small size, it has a high breakdown voltage between contacts. This is indicated in the illustration, showing the contacts assembled into the Bakelite support. The soldering lug is bent over the prong portion preventing solder or rosin from flowing into the contact.

Type No. 37

3. ***Economical*** . . . Saves time in assembling sockets to chassis. Eliminates use of rivets and breakage caused by riveting. Sockets can be inserted into chassis in one position only, thereby insuring that contacts come in the same relative location for wiring at all times.

Albert W. Franklin Mfg. Corp., 137 Varick St., New York

All standard features found in type 39 sockets also included in type 37.

Technical Data Sheets covering complete line of Glass and Metal Tube Sockets sent upon request.

FRANKLIN

RMA NEWS

CONFERENCE ON INTERFERENCE

The first meeting of the new American Standards Association Sectional Committee on Radio-Electrical Coordination, under the sponsorship of the Radio Manufacturers Association, was held in New York City on February 19. The attendance of twenty-eight was composed of representatives of sixteen organizations. The meeting was conducted by Dr. W. R. G. Baker, chairman, assisted by Mr. L. C. F. Horle, vice chairman.

Mr. J. W. McNair, of the American Standards Association, discussed functions of a Sectional Committee. Dr. J. J. Smith detailed the work of the Joint Coordination Committee on Radio Reception of EEI, NEMA and RMA, which has been carrying on the coordination work for several years and expects to supply the Sectional Committee with the technical results of its work. Mr. P. J. Kent and Mr. L. C. F. Horle discussed the work of the Society of Automotive Engineers and Radio Manufacturers Association in investigating interference from ignition systems.

The obligations of the Sectional Committee in international work on reduction of radio interference were considered and action was taken to appoint a committee under the chairmanship of Dr. J. J. Smith, of Schenectady, to prepare recommendations for the International Radio Consulting Committee (C. C. I. R.), and, if desirable, to cooperate with the American Group of the International Electrotechnical Committee.

Chairman Baker asked all present to consider the necessity for additional technical committees and to bring recommendations to the next meeting.

Mr. H. O. Merriman of the Canadian Department of Marine discussed his work on interference reduction over a number of years and made several useful recommendations on procedure of the Committee.

JANUARY TAXES UP 51%

Collections in January, 1936, of the 5 per cent radio and phonograph excise taxes were $601,144.68, according to the latest official report of the U. S. Internal Revenue Bureau, an increase of 51 per cent over the collections of $398,177.40 in January, 1935. Payment of taxes in January which accrued on manufacturing prior thereto is apparently reflected in the official report for January.

The excise tax collections on mechanical refrigerators in January, 1936, were $210,143.58 as compared with $162,534.08 in January, 1935.

EMPLOYMENT INDICES FOR NOVEMBER 1935

The latest report on radio factory employment, for last November, of the U. S. Department of Labor, Bureau of Labor Statistics, recorded slight decreases during November in employment and payrolls, but an increase in the average hourly pay of radio workers. Employment in the radio industry, however, was far ahead of the general national average for all manufacturing industries. The number of radio companies reporting to the Bureau of Labor Statistics and the number of employees represented in the November, 1935, report were not detailed.

Radio factory employment in November, 1935, decreased 2.7 per cent from October, according to the last official report, but was 26.6 per cent higher than in November, 1934. However, radio factory employment during November, 1935, was 171.6 above the official three-year average of 1923-25, the radio index being 271.6 per cent, compared with 84.9 per cent general index for all manufacturing industries.

Radio factory payrolls during November, 1935, decreased 3.2 per cent compared with those of October, 1935, but were 36.7 per cent higher than November, 1934. They were also 79.8 per cent above the three-year official average of 1923-25.

Per capita weekly earnings in radio factories reported in November, 1935, were $20.52, a decrease of .5 per cent from October, 1935, but 8.3 per cent above November, 1934. The average per capita weekly earnings of $20.52 compares with a general average of $21.77 for all industries, and a general average of $24.47 for all manufacturers of durable goods.

Average hours worked per week in radio factories during November, 1935, were 39 hours, a decrease of 3.5 per cent from the previous month of October, 1935, but 15 per cent higher than average weekly hours for November, 1934.

Average hourly earnings of radio factory employees during November, 1935, were 52.7 cents, an increase of 3.1 per cent over those of October, 1935, but a decrease of 6 per cent compared with the average hourly earnings during November, 1934. The November average hourly earnings of 52.7 cents for radio factory employees compares with a general average of 56.7 cents for all manufacturing industries and 61.1 cents for all manufacturers of durable goods.

RMA EXPORT COMMITTEE REORGANIZED

With the appointment of Mr. S. T. Thompson of Long Island City, New York, as chairman of the RMA Export Committee, the work of promoting sales abroad of American radio will be pressed vigorously. Arthur T. Murray, of Springfield, Mass., chairman of the RMA Set Division, named Mr. Thompson to take charge of all export interests of the industry and the many problems abroad which are now before American manufacturers. Mr. Thompson, who succeeds Mr. E. G. Hefter of Chicago, former committee chairman, has had many years experience and active interest in the radio export field.

SWEDISH PATENT DECISION

From the Electrical Division of the U. S. Department of Commerce, the RMA has received advices of an important radio patent decision at Stockholm, Sweden, by the Swedish Court of Appeals. In the radio patent suit of "Telefunken Gesellschaft furdrahtlose telegraphie m. B. h. versus K. Broberg, Argenturer, Kurt Broberg," the decision was favorable to the defendant, Mr. Broberg. The Government advices are that the decision is important in opening of the Swedish radio market. Many Swedish importers and manufacturers had been sued by the Telefunken, Philips, and Marconi interests. However, in the Telefunken suit against the Broberk interests it is indicated that an appeal will be taken to the Swedish Supreme Court.

1935 RADIO EXPORTS SET NEW RECORD

A new peak for exports of radio apparatus from the U. S. was attained during 1935 with sales abroad of $25,454,188, compared with $24,856,592 in 1934, according to compilations by RMA of the official export statistics of the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce.

The new modern short-wave sets apparently figures in the 1935 increase in receiving set exports to $15,472,291, as compared with $15,338,143 of sets exported in 1934, while the number of units in set exports decreased from 612,084 in 1934 to $589,209 in 1935.

A decrease in tube exports, however, was recorded in 1935, slightly in units but materially in value. Tube units exported in 1935 were 6,588,060, compared to 6,682,083 in 1934. Dollar value of tubes exported in 1935 was $2,882,268, compared with $3,209,946 in 1934.

Increases in exports of radio parts, loudspeakers and transmitting apparatus also were recorded.

VIRGINIA PLANS POLICE RADIO

To carry out plans of Virginia authorities for establishment of a police radio system in the State, a bill has been introduced in the Virginia Legislature providing for appropriations and operation.

CANADIAN SALES IN 1935

The RMA, through the cooperation of the Canadian RMA, has received statistics on Canadian set sales for 1935, with a substantial increase over 1934 reported. Total list value of Canadian sales in 1935 was $18,062,853 as compared with $16,771,222 in 1934. The units sold in 1935 were 190,248 compared with 168,833 in 1934.

During the month of December, 1935, Canadian sales were 14,575 A. C. sets with a list value of $1,621,623; battery sets numbering 4,468 with a list value of $310,247, and 458 automobile sets valued at $31,367.

During 1935 the total Canadian sales of A. C. models was 137,742 at $14,157,083. In 1934 there were 132,190 A. C. sets sold. Sales of battery sets during 1935 totaled 39,073, valued at $3,034,221, a considerable increase over the 23,408 battery sets sold in 1934. Sales of automobile sets in 1935 were 13,433 valued at $871,548. This was a very slight increase over the 13,235 automobile sets sold in 1934.

News Of The Industry

STRYKER MOVES

C. E. Stryker, formerly Chief Engineer of the Fansteel Metallurgical Corporation, North Chicago, Ill., is now associated with McKinsey, Wellington & Company, management and consulting engineers; Mr. Stryker is at the Chicago office of that company, located at 135 South LaSalle Street.

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ERNEST H. VOGEL APPOINTED SALES MANAGER G-E RADIO DIVISION

Ernest H. Vogel was appointed sales manager of the General Electric Company's Radio Division, Bridgeport, Conn., effective February 1, it has been announced through R. J. Cordiner, manager of the division. For the past six years Mr. Vogel was associated with the RCA Manufacturing Company, Camden, N. J., having joined that organization in 1930 as advertising manager. He later was appointed radio sales manager, and was engaged in RCA sales activities until his recent resignation.

Mr. Vogel is widely known to the radio and music trades, having been identified with them throughout his business career. Prior to his connection with RCA, he was merchandise manager for the American Piano Company, where he specialized in retailing pianos and radios, and directed the retail advertising and merchandising of that organization's thirteen factory retail stores located in principal cities east of the Mississippi.

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CHANGES IN HYGRADE SYLVANIA TUBES SALES DEPARTMENT

Stanley N. Abbott, Sales Manager of Hygrade Sylvania Corporation has announced several changes in the management of the Sylvania Tube Renewal Sales Section, effective January 1, 1936.

Paul S. Ellison, in addition to his present work as Radio Tube Advertising Manager, becomes Sales Supervisor of the Eastern Division. He will retain headquarters in the New York office of the company.

R. P. Almy, formerly head of the sales department in the Emporium, Pa. plant, moves to headquarters in the Chicago office as Sales Supervisor of the middle west and western sales territories, with the exception of the Pacific Coast.

Chas. G. Pyle, to whom Mr. Ellison and Mr. Almy will report on all sales matters, carries the title of Assistant Sales Manager.

A. L. Milk, Assistant Advertising Manager, with headquarters in Emporium, will not only continue with his present responsibilities but will also be in charge of all the sales department activities formerly directed by Mr. Almy.

H. G. Kronenwetter becomes a member of the advertising department directly under Mr. Milk.

Before Mr. Almy left for Chicago, he was the guest of honor at a dinner held at the Sylvania Club in Emporium, where twenty-three of his associates gathered to wish him good fortune in his new work.

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NEW ADDRESS FOR TRIMM

Trimm Radio Manufacturing Company of Chicago, Illinois, have changed their address to 1770 W. Berteau Avenue, Chicago.

CORNELL-DUBILIER INCREASES PRODUCTION FACILITIES

In anticipation of a real spring auto radio season, the Cornell-Dubilier Corporation, 4377 Bronx Boulevard, New York, has materially increased its production facilities for the manufacture of spark suppressors and ignition interference filter condensers. One of the important additions to their production line has been the installation of a sixty-foot conveyer belt system.

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NEW REX PRODUCTS EASTERN OFFICE

The Detroit Rex Products Company, 13008 Hillview Ave., Detroit, Mich., manufacturers of Detrex solvent degreasers, Triad and Perm-A-Clor non-inflammable solvents, and a complete line of Triad Alkali cleaning compounds and enamel strippers, have moved the offices of their Eastern Sales Region to Room 816 Bush Terminal Sales Bldg., 130 West 42nd Street, New York City.

This Region, which is under the supervision of D. E. Williard, Eastern Sales Manager, consists of the New England states, the southeast corner of New York state, eastern half of Pennsylvania, New Jersey, Delaware and eastern Maryland. The various representatives covering this territory will work out of Boston, New Haven, New York City and Philadelphia.

By this division of the territory, the company is better able to service its accounts and render a consulting service on metal cleaning to the finishing industries. This arrangement is in line with the recent general expansion of the company's sales and engineering forces, and additions to its line of solvent degreasing machines.

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NEW KEN-RAD BULLETIN

A bulletin entitled "The Relation of Modulation Products with Multi-Tone Signal to Harmonic Distortion with Mono-Tone Signal in Audio Amplifier Analysis" is announced by the Ken-Rad Corporation, Owensboro, Kentucky. Those interested may obtain copies by writing to Ken-Rad at the address given.

•

NEW PLANT FOR SYLVANIA

The Hygrade Sylvania Corporation has announced the erection of a new plant at Salem, Mass. The new plant is to be devoted exclusively to the manufacture of radio tubes; its completion will release the facilities of the present Salem plant for the manufacture of incandescent lamps.

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RCA FIELD REORGANIZATION UNIFIES ALL SALES EFFORTS

Reorganization of the RCA Manufacturing Company field forces in order to unify the selling activities of its varied products and promote more efficient operation was announced by Mr. G. K. Throckmorton, Executive Vice-President.

The country has been divided into two major selling divisions, within which a number of district offices will administrate the sales and merchandising efforts for all of the Company's diversified products. Mr. M. F. Burns, formerly RCA Victor Merchandise Manager, will head this activity at the Camden, N. J. headquarters. Mr. John W. Griffin, who has had many years of radio selling and merchandising experience in the retail, wholesale and manufacturing phases of the business, has been appointed Manager of the Eastern Division. Mr. Henry C. Bonfig, former Sales Manager of the Grunow Corporation, and for many years a prominent radio wholesaler, has been appointed Manager of the Western Division.

Under the new arrangement, seven separate field forces which have been devoting themselves independently to the promotion of as many kinds of merchandise, most of which overlapped into the same fields, are consolidated under the direction of the district manager in each territory for the more efficient merchandising of all of the Company's products from a centralized control point which has full responsibility. To this end, the entire RCA Manufacturing Company field force has during the past year undergone an intensive training so that the personnel would be equally well informed about all of the Company's activities. The Commercial Managers for each product, at Camden, will continue to formulate plans and promotions which will be carried out by the district managers.

•

HAZELTINE PRESENTS POSSIBILITIES OF IMPROVEMENTS IN BROADCASTING

Professor Alan Hazeltine, noted radio scientist and president of the Institute of Radio Engineers, spoke recently at a meeting of the Emporium Section of the I. R. E. Mr. L. M. Price, chairman of the Toronto Section, Mr. W. C. Davison of the Radio Valve of Canada, and Dr. Hans Salinger, recently of the Heinrich Hertz Institute in Berlin, were also guests of the Emporium Section.

Professor Hazeltine's talk was a presentation of mathematical and theoretical speculations on a number of possibilities for improvement of broadcast transmission and reception. His talk was presented with slides to illustrate several different types of symmetrical and asymmetrical tube constructions whereby electron stream-control is had by both deflection and emission control.

In the second part of his paper, Professor Hazeltine touched on unusual modes of increasing the signal-to-noise-ratio. Possibilities of "compression-expansion" and "pre-distorting-restoring" modes of improving this ratio were pointed out. Amplitude modulation, frequency modulation and amplitude and frequency modulation were discussed.

Announcement was made of the establishment of an Annual Award donated by the Hygrade Sylvania Corporation to the individual of the Section, exclusive of the Executive Committee, who has done most to promote activities of the Section during the year. The award is to be a handsome desk set, carrying an engraved plaque suitable to the occasion of award.

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GENERAL PLASTIC BULLETIN

General Plastics are offering a new booklet explaining the advantages, physical properties and applications of Durez. A copy may be secured by writing to General Plastics, Inc., North Tonawanda, New York.

CORNISH WIRE TAKES LARGER QUARTERS

Cornish Wire Company, 30 Church Street, New York City, manufacturers of radio and electrical wires and aerial equipment, have just announced their removal to larger offices at the same location.

This move was necessitated by a greatly increased volume of business over previous years, and enlargement of the office personnel was, therefore, necessary.

Complete literature of the entire Corwico line will be mailed upon request.

•

BARNES JOINS UNIVERSAL

E. K. Barnes, recording supervisor at the Freeman Lang Sound Studios, Hollywood, has resigned and joins the staff of the Universal Microphone Co., Inglewood, Cal., as consulting recording engineer.

He was associated with KHJ in the early days around '25 when the station was owned by the Los Angeles *Times*. Later, under the Don Lee banner, he became daytime director of KHJ.

The past seven years he has been associated with the Lang sound enterprises in transcription activities.

Among the initial activities of Mr. Barnes with the new Universal affiliation will be the preparation of a booklet on practical wax recording which will be published in April. It will be fully illustrated with line drawings and photographs and will detail the entire process from the start to the finished transcription, and will contain full instructions for professional recorders.

•

WEBSTER-CHICAGO SOUND SYSTEMS LICENSED

The Webster Company, 3825 W. Lake St., Chicago, recently completed negotiations for a license to manufacture sound systems under patents of Electrical Research Products, Inc., subsidiary of Western Electric Company, Inc., and American Telephone and Telegraph Company. The Webster Company now manufactures a complete line of public address systems, sound equipment and accessories. A catalogue describing all of the items in their line is now available and can be obtained free on request.

•

NEWARK WIRE CLOTH APPOINTMENT

The Newark Wire Cloth Company, Newark, New Jersey, well-known manufacturers of high grade wire cloth and wire cloth products, announce that they have appointed Robert H. Brinton, 1640 Castle Court, Houston, Texas, as their Texas representative. Mr. Brinton's mail address is P.O. Box 1970, Houston.

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KASSON JOINS GARDINER METAL

Gardiner Metal Co., manufacturers of Flux Filled Solders, have appointed David M. Kasson & Co., 264 Canal St., New York City, N. Y., their eastern representative. The organization will contact the radio set and accessory manufacturers and the industrial trade in general.

Kasson & Company will also warehouse a stock of solder.

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INSULATION GUIDE BOOK

The latest edition of the Mitchell-Rand Guide Book may be obtained by addressing the Mitchell-Rand Insulation Company, 51 Murray Street, New York N. Y.

RCA TELEVISION FIELD TESTS

Proceeding on schedule, according to the plans announced by David Sarnoff, President of the Radio Corporation of America, at the annual meeting of May 7, 1935, the first field tests of television by RCA will begin in a month or two. That is revealed in the annual report of the Radio Corporation of America, being mailed to stockholders today.

It is emphasized that this experimental test does not mean a regular television service is at hand. This represents an essential pioneering stage to estimate and define its possibilities under actual working conditions. For the first time it is disclosed officially that the television transmitter will be on the Empire State Building, in New York City. Further details of progress toward working out the plans for the test are revealed in the following paragraphs from the RCA report:

"The New York area has been selected as the one in which the experimental field tests will be conducted. The television transmitter is located on the Empire State Building, and test receivers will be operated by technical personnel of the RCA organization throughout this area. The transmitter will be connected by radio with the television studio, now under construction in the NBC plant, RCA Building, in Radio City, New York. The installation is practically complete, and within a month or two the first tests should commence.

•

REPRESENTS BRUSH

Mr. C. B. Scott, Vice President and Sales Manager, The Brush Development Company, Cleveland, Ohio, manufacturer of crystal microphones, head phones, loudspeakers, oscilloscopes and vibration pickups, has announced the appointment of Mr. Gerald B. Miller to represent the company's lines in the southern California territory. Mr. Miller has his headquarters at 8208 Santa Monica Blvd., Los Angeles, California.

•

OXFORD MOVES

On March 1, the Oxford-Tartak Radio Corporation, manufacturers of Oxford Speakers and Accessories, moved in their new and enlarged plant at 915 W. Van Buren St., Chicago. They were previously located at 340 W. Huron St.

•

GENERAL ELECTRIC APPOINTMENTS

A. J. Gies, auditor of the merchandise divisions of the General Electric Appliance and Merchandise Department, Bridgeport, Conn., has been named Assistant to Vice-President C. E. Wilson, and will function as chairman of the newly formed credit and service committee.

C. E. Anderson, formerly assistant to Comptroller I. D. LeFevre, has been appointed auditor of the merchandise divisions of the Appliance and Merchandise Department.

Mr. Gies, formerly a railway official, went with the General Electric Company in 1918, and shortly thereafter was appointed auditor of disbursements. In 1924 he served as assistant to Vice-President C. E. Patterson in New York, and in 1926 was appointed auditor of the Merchandise Department at Bridgeport.

Mr. Anderson entered the employ of the General Electric Company in 1924. He became general assistant in the accounting statistics division in 1927, was placed in direct charge in 1929, and in 1932 was named assistant statistician. Later in the same year he was appointed auditor of disbursements, and in November, 1935, became assistant to the comptroller.

•

NEW CROWE CATALOG SHEET

Jobber's Bulletin No. 75 has been released by the Crowe Name Plate and Manufacturing Company, 1749 Grace Street, Chicago, Illinois. This catalog sheet lists newly-designed Crowe components for receivers, transmitters, sound equipment, experimental work and the like. Bulletin No. 75 may be obtained from the above organization.

•

NEW U. S. TARIFF RATES JUST ISSUED

The 1936 edition of the Custom House Guide, which has just been issued, is in effect practically a new tariff edition. Approximately 60,000 changes, by actual count, have been made in the volume since the 1935 edition, according to the publishers.

One-third of the imports and one-quarter of the exports of the United States are affected by the nine reciprocal trade agreements entered into between the United States and Cuba, Brazil, Belgium, Haiti, Sweden, Columbia, Canada, Honduras and the Netherlands for which the rates of duty on over 482 commodities, the growth, manufacture, or produce of 83 countries, have been included in this new edition. The new rate of duty appears opposite each article affected in the alphabetical import commodity schedule of 30,000 commodities.

•

WELDING DEMONSTRATIONS

A series of welding "clinics" to demonstrate the best methods for welding various non-ferrous metals and clad materials will be held in four West Coast cities during April. Included will be practical problems involving the latest methods of both electric and oxy-acetylene welding and brazing on Monel Metal, aluminum, nickel, copper, brass, bronze, Inconel, and Nickel-clad steel. steel.

The "clinics" will be conducted by welding engineers of The International Nickel Company. The Aluminum Company of America and The Revere Copper and Brass Company. They will be held as follows: April 3rd and 4th at Wilkinson Company, Limited, 190 West Second Avenue, Vancouver, B. C.; April 10th and 11th at Eagle Metals Company, 21 Spokane Street, Seattle, Washington; April 17th and 18th at Pacific Metals Company, Limited, 3100 Nineteenth Street, San Francisco, Calif.; and April 24th and 25th at Pacific Metals Company, Limited, 1400 South Alameda Street, Los Angeles, California.

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REISS AGENCY MOVES

Reiss Advertising is occupying new offices in the RKO Building, Radio City. The address is 1270 Sixth Avenue, New York, N. Y.

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ATLAS SOUND CORP.

Robert C. Reinhardt and Carl R. Blumenthal, formerly operating as the Macy Engineering Company, have become associated with the Atlas Sound Corporation as President and Secretary-Treasurer, respectively. The Atlas Sound Corporation, designers and manufacturers of sound reproducing equipment, is located at 1451 39th Street, Brooklyn, N. Y.

NEW PRODUCTS

UNIQUE CORD SET

The Holyoke Company of 720 Main Street, Holyoke, Mass. presents to the trade Cord Sets with the Gilbert Plug. Constructed of special composition, the cap mold is flattened to provide a fingergrip which assists in removing the cap from the receptacle. The plug is practically unbreakable—subject it to far more severe wear than it could receive in daily use—and it remains intact.

Attaching the plug to the cord requires no tools since the blades are screwless.

A patented spring action insures tight grip of blades to outlets.

These cord sets are obtainable in either rayon or "Posj" all rubber and are approved by both the National Board of Fire Underwriters and the I.E.S. Continuous or cut-to-length cord is also available. Samples on request.

•

TUBE PARTS CARD

The Stupakoff laboratories have recently published a small card on which are mounted various component parts used in metal tube manufacturing, consisting of ceramic insulators, insulated filament wires, Kovar eyelets, Kovar copper lead-in wires and exhaust tubes. Copies of this card may be secured by writing the Stupakoff Laboratories, 6627 Hamilton Avenue, Pittsburgh, Pa.

•

"RECORDING MICROSCOPE"

Radiotone Recording Co., 6103 Melrose Ave., Hollywood, Calif., announce a new low-priced microscope as an aid in instantaneous-recording work.

This microscope comes ready to fasten to the bed plate of any recording machine, equipped to pivot over the turntable and swing free when desired. A lamp properly placed gives good illumination of the record grooves and a .006-inch comparative scale

is incorporated in the lens system so that measurements may be taken of the work being done.

By use of this glass the operator will be able to discover the cause of various defects in recording such as "ghosts," high-surface noise and improperly modulated cuts.

AMERICAN TYPE AG CRYSTAL MICROPHONE

The American Microphone Company, Los Angeles, Calif., announces the introduction of an improved diaphragm-type crystal microphone. The features of this unit are unusually high output level, wide-angle pickup, and rugged construction it is stated.

This microphone is said to meet the demand for present-day requirements of a self-energizing microphone requiring no polarizing voltage. The unit is enclosed in a chromium-plated housing and is well protected against moisture and temperature changes.

•

NEW P-A AMPLIFIER

An amplifier suited to a wide variety of public address purposes is announced by the Lafayette Radio Manufacturing Company, New York, N. Y.

Thirty-five watts of output power (50 watts peak) are obtained with a gain of 122 decibels in a unit measuring 9½" x 9½" x 16½", which combines within itself, preamplifier, driver, and power amplifier. The same unit also includes a

mixer for two input channels, and serves as a power pack to provide forty watts of d-c power to loudspeaker fields.

This amplifier, coded as the Lafayette Model 254-A, is distributed exclusively by Wholesale Radio Service Co., Inc., 100 Sixth Avenue, New York, N. Y.

•

NEW BATTERIES

New 7½ volt and 9 volt Ignition batteries have recently been announced by the Burgess Battery Company—Freeport, Illinois. They are expected to enjoy a large demand from motor boat and gas engine owners who will appreciate the improvements over old style Uniplex batteries. A new type of construction provides a higher sustained voltage, which in turn results in a hotter spark. A weatherproof metal container completely encloses each battery. Portability has been increased by a reduction of 40% in weight and 30% in size—without the loss of any electrical capacity.

•

GRID-GLOW TUBE WITH BUILT-IN TIME DELAY

Important advances in gaseous discharge tube design have been made in the new Westinghouse KU-676 tube. This tube has two new features; a built-in time delay for protection of the cathode when starting the tube and a new cathode design resulting in a high ratio of crest to average current rating. High ratios of crest to average current rating are especially important for such applications as Ignition Control, Welding Timers; six-phase rectification and the like.

An outstanding feature of this tube is the structure of the cathode. The directly heated portion of the cathode is an edge-wound helix, which is closely surrounded by an indirectly heated portion of perforated metal coated only on the inside surface. The discharge is thus forced to pass through the perforations in the screen and then outward through the annular space between the screen and the first radiation shield. This construction has been developed with the object of electrostatically shielding the active surfaces of the cathode to such an extent that they are not subject to high field strengths and are also protected from excessive positive ion bombardment. These structural features thus lead to a more nearly "fool-proof" cathode with much longer life expectancy. In addition an extremely efficient cathode results.

The current rating of the KU-676 tube is 6.4 amperes average and 75 amperes crest while the cathode heating energy required is only 55 watts.

•

NEW BELL PRE-AMPLIFIER

Bell Sound Systems, Inc., 61 East Goodale Street, Columbus, Ohio, has just announced a new metal tube pre-amplifier, known as their Model L 5. It is a moderately priced pre-amplifier, with ample gain for adapting crystal or high-impedance ribbon type microphones to existing equipment which utilizes the carbon type microphone. It is an ideal unit for modernizing any p-a system, it is said.

Having metal tubes it is possible to ob-

tain a very low hum level and freedom from microphonics.

Model L 5 is a two-stage resistance coupled circuit, using two type 6F5 tubes and one type 5Z4 for rectifier. The overall gain is said to be 60 db. The unit is entirely a-c operated (110 volt 50-60 cycles). Input is of high impedance and output is 200 and 500 ohms.

The Model L 5 is provided with volume control and on-off power switch. Total shipping weight is twelve pounds and the overall size is, length, 11"; width, 4½"; and height, 5⅞".

For further details of the Model L 5, write to Bell Sound Systems, Inc. Complete details on any of Bell's full line of p-a equipment will also be supplied upon request.

Kadette receiver.

KADETTE BATTERY RECEIVER

The new Kadette Battery permanent dynamic Superheterodyne Model 400, just announced, is completely portable with aerial attached and batteries entirely self-contained, weighing approximately 25 lbs. It uses three ordinary 1½ volt ignition dry cells for "A" supply, giving approximately 300 hours of service. Three portable size B batteries are used, supplying 135 volts and giving extremely long life because of exceptionally low battery drain. Two distinct tuning ranges cover both Standard Broadcast and Short Wave. A superheterodyne circuit is employed, using the following tubes: one 1C6, one 34, one 1B5, and one 950.

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CINAUDAGRAPH SPEAKER

The Cinaudagraph Corporation, 110 Davenport Street, Stamford, Connecticut, is manufacturing a new line of 8, 10, 12, and 18 inch permanent magnet speakers, according to Harold W. Harwell. Mr. Harwell, who is well known for his work in the motion picture field, is Vice President and Director of Cinaudagraph.

•

KAY ANNOUNCES NEW UNIVERSAL REMOTE CONTROL

Kay Products of America, Inc., 560 DeKalb Ave., Brooklyn, N. Y., presents a new modern auto-radio remote control unit embodying "wrist-watch" finger control, full airplane dial calibrated in kilocycles, escutcheons with chromium knobs harmonizing with all car interiors.

This new Kay control permits easy custom-instrument panel installation of all makes and models of auto-sets without the necessity of cutting the dashboard or difficulties in fitting. There are no visible bolts or screws. Adapter couplings are supplied for all cables.

Kay controls are supplied in various gear ratios to fit any auto-radio receiver. Escutcheon plates supplied additionally matching the dash finish of all 1935-1936 cars.

Write to the manufacturer for complete illustrated catalog with prices listed.

•

UNIVERSAL "SUPERFINE" RECORD BLANKS

Superfine aluminum records of a special alloy heat treatment and a maximum of highly polished surface finish are finding a varied market among recorders for making records of speech, voice, music, languages and other uses, according to information from the Inglewood, Cal., factory of the Universal Microphone Company.

The Superfine records, whether with the Universal professional recording machine or its number 12 recorder, records with a minimum of groove or background noise.

The results of the initial research with aluminum records several years ago was not perfect. Far from it. But it has given rise to the popular conception, still existing in some quarters, that metal discs of all sorts are noisy and that good frequency response cannot be recorded on aluminum. Whereas, as a matter of fact, it is said, present-day experiments have practically perfected this type of radio disc.

Universal's Superfine line of blanks is not merely an aluminum disc. It is a composition coating of special alloy aluminum material that is not subject to deterioration from age. Speech, music and other programs or messages can be placed in storage and kept for years without frequency loss or the accumulation of background noise.

•

WIRT ALL-WOOD RESISTOR CABINET

This new resistor cabinet is made of Bass Wood, varnished and rubbed. It has six drawers with four compartments in each drawer, and all partitions are removable.

Wirt Co., 5221 Greene St., Philadelphia, Pa., is offering this cabinet free on the purchase of an assortment of Resistors.

•

SHURE CARBON MICROPHONES

A new series of inexpensive two-button carbon microphones with improved constructional features is announced by Shure Brothers, "Microphone Headquarters", 215 W. Huron Street, Chicago, U. S. A. The new series is suggested for low cost public address systems and similar applications.

•

NEW HEAVY-DUTY VIBRATORS

A new line of heavy-duty vibrators, designed especially for police-radio and transceiver work, has just been announced by Electronic Laboratories, Inc., of Indianapolis.

The outstanding feature of these new vibrators is their unusually large contact points, these being approximately twice the diameter of the contacts used in vibrators of the standard types, it is stated. These larger contacts, Electronic engineers advise, greatly increase the current-carrying capacity and life of the heavy-duty vibrators.

The non-synchronous models in Electronic's heavy-duty line are plug-in units on a four-prong base, while the synchronous types are on a standard five-prong base. However, any of the heavy-duty units will be built to order for police radios in which the vibrator base wiring is not standard.

•

NEW LAMACOID PRODUCT

The Mica Insulator Company, New York, N. Y., has developed a new product called Graphic Lamacoid. It incorporates designs, colors, printed matter and other reproductions into translucent or opaque sheets of Bakelite Laminated. The finished material retains the same general electrical and mechanical properties of regular Bakelite Laminated.

•

DIRECT-INDICATING AUDIO-FREQUENCY METER

A direct-indicating audio-frequency meter is a great convenience in many laboratory measurements, or in production and testing operations where a large number of measurements must be quickly made. In some cases, a continuous indication of the value of a varying frequency is required. To meet these requirements, the Type 834-A Electronic Frequency Meter has been developed. This instrument is of new design, is direct reading from 0 to 5,000 cycles per second, and operates from the a-c line.

The meter consists, essentially, of an amplifier, a gas-discharge-tube counter, and an indicator. The fundamental circuit design of the instrument was devised by Dr. F. V. Hunt in the Cruft Laboratory at Harvard University.

The instrument includes a one-stage amplifier, the gas-discharge-tube counter circuit, diode switching tube, frequency-indicating meter and power supply (with rectifier and voltage regulator).

The amplifier provides for satisfactory operation on signal inputs of three volts or less, and also provides a high-impedance input circuit (one megohm). By the arrangement of the amplifier circuit, provision is made for satisfactory operation over a wide range of signal input voltages, up to 200 volts, with no change in indication of frequency.

Five ranges are provided, each starting at 0 and extending to 200, 500, 1,000, 2,000, and 5,000 cycles. The desired range is selected by means of a multiplier switch mounted on the panel. Individual adjustments are provided for making the indication agree with the scale of the meter on each range.

The Type 834-A Electronic Frequency Meter is a product of the General Radio Company, 30 State St., Cambridge, Mass.

The Type 834-A Electronic Frequency Meter.

INDEX TO ADVERTISERS

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(Radio Engineering)

Bryan Davis Publishing Co., Inc.
19 East 47th Street
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IN THE SUPPORTING CAST

(Scene presented through the courtesy of Metro-Goldwyn-Mayer Pictures)

You'll find SYNTHANE laminated bakelite on the "cast" of materials for many products —not as the "star", perhaps, but playing a small though vital part in the performance.

The motion picture industry requires dependable insulation for equipment—and gets it with SYNTHANE laminated bakelite . . . Use Synthane in your products for the same reliable performance.

SYNTHANE LAMINATED BAKELITE
SHEETS • RODS • TUBES
FABRICATED PARTS

Send for Sample Book

SYNTHANE
CORPORATION OAKS · PENNA

Is your pulse strong and steady?

JUST as the human pulse is dependent on proper heart action, so the carrier frequency of your transmitter is dependent on the proper functioning of its crystal.

Crystals mounted in holders made of ISOLANTITE generate frequencies of greater amplitude and precision than where other insulating materials are employed.

Actual comparison in performance between crystals mounted in holders of ISOLANTITE and of organic materials has shown more than 75% increase in transmitter output where ISOLANTITE was employed.

Avoid frequency drift and assure increased output by insisting on ISOLANTITE crystal mountings. Isolantite, Inc., 233 Broadway, New York, N. Y. Factory at Belleville, N. J.

Isolantite
CERAMIC INSULATORS