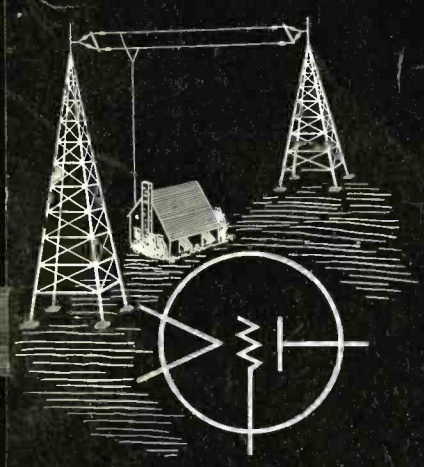
JULY, 1933

Radio Engineering



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MIXER CIRCUITS
By H. H. Scott

CABINET DESIGN
By Jan Streng

VOL. XIII, NO. 7 JULY, 1933

The Journal of the Radio and Allied Industries

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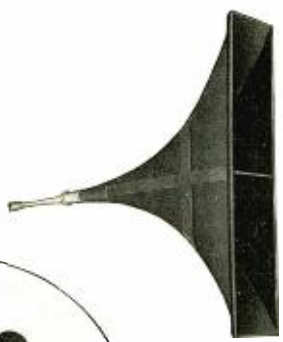

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RACON ELECTRIC CO. INC. 52 East 19th Street, New York City
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C. T. S. Co. No. 600 SERIES

A NEW VOLUME CONTROL TO MEET SPECIAL REQUIREMENTS

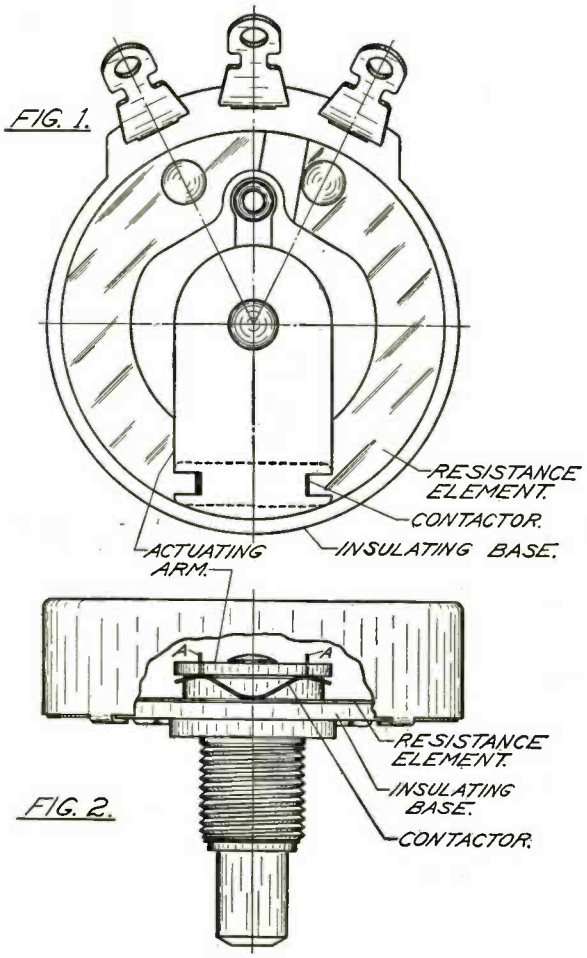

FIG. 1.

FIG. 2.

PATENTS PENDING

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

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

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

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

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

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

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

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

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

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

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

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RADIO ENGINEERING

Reg. U. S. Patent Office

MEMBER AUDIT BUREAU OF CIRCULATIONS

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Vol. XIII JULY, 1933 Number 7

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MORE POWER—FEWER STATIONS

IT is reported that numbers of stations are merging their facilities. Large stations are taking over small ones. A number of station owners with the necessary resources are acquiring additional station properties.

In cases where a number of stations are serving the same audience, certain interests are gradually acquiring control over the majority or all of the competing stations.

The present trend in the broadcast station field seems to have set definitely in the direction of increased power and a smaller number of stations.

BRYAN S. DAVIS *President*

JAS. A. WALKER *Secretary*

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Both are MONEY-SAVING Self-tapping Screws . . . but on some assemblies the Hex Head saves more

Now the Hex Head Self-tapping Cap Screw is a *Standard* . . . and is no higher in price than the slotted head Self-tapping Screws

RADIO manufacturers agree that no other fastening device can equal Parker-Kalon Hardened Self-tapping Sheet Metal Screws for assembly speed and economy with great security. But some prefer to drive these unique Screws with a screwdriver, and others find that a wrench works faster. Now, both can have the head style that best suits individual preferences or requirements.

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On assemblies where a HEX HEAD will afford greater speed . . . eliminate difficulty and loss of time caused by screwdriver blades slipping out of the slots . . . or prevent damage to screw heads . . . the Parker-Kalon Hex Head Self-tapping Cap Screw will save more than a slotted head Self-tapping Screw.

It will pay you to try it. You may find decided advantages, and remember—the HEX HEAD now costs no more than the slotted head Screws. To obtain free samples of Hex Head Self-tapping Cap Screws for trial on your own work, just mail the coupon below with a brief description of your assemblies.

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HARDENED HEX HEAD SELF-TAPPING
CAP SCREWS
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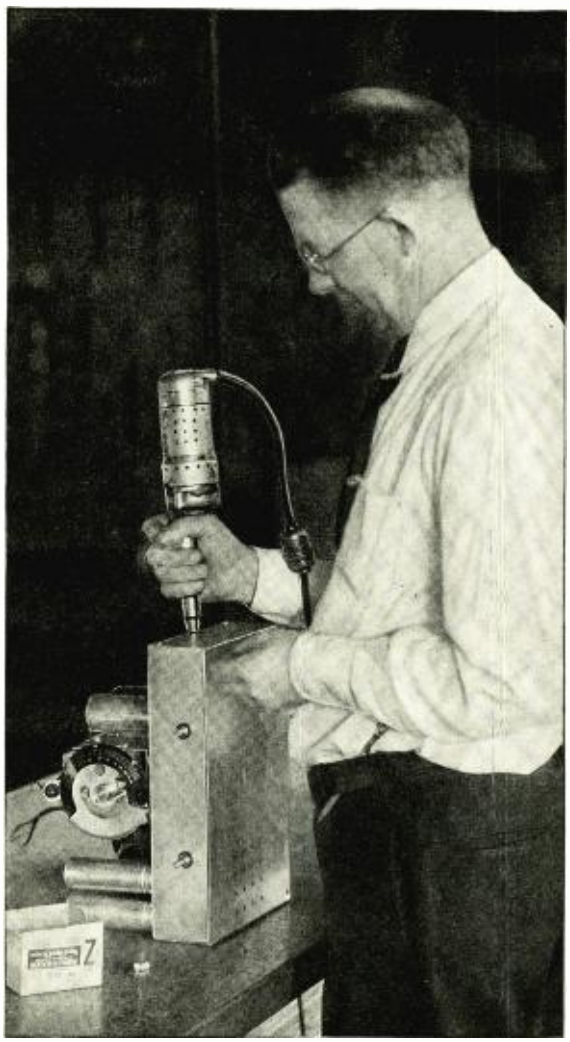

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Send free samples of Hex Head Self-tapping Cap Screws. See attached description of assemblies for which I wish to try them.

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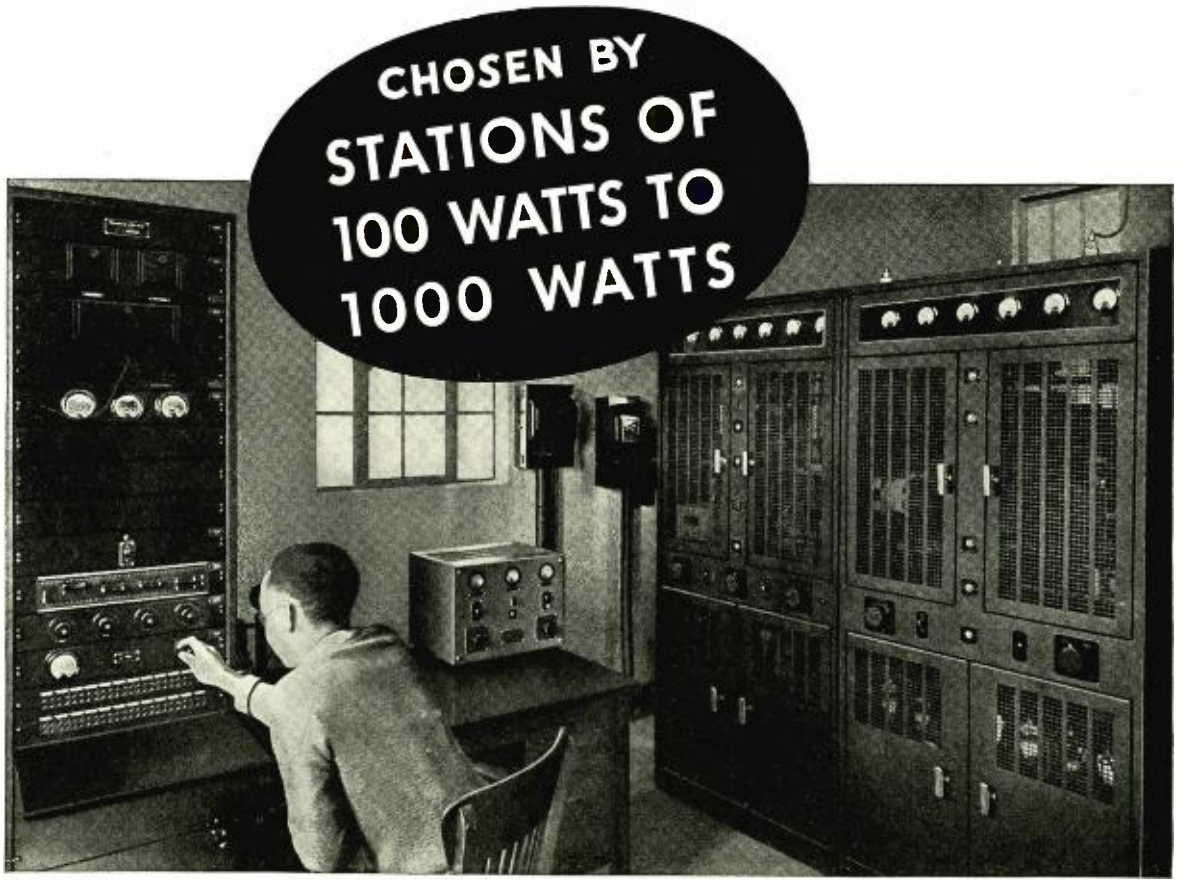

Western Electric 9 type Speech Input Equipment (left), 1A Frequency Monitoring Unit (on desk), 12A Transmitter and 71A Amplifier (right) as installed in Station KFAC (1000 watts) at Los Angeles.

...for quality, compactness, efficiency and economy!

Some 30 stations*—ranging in power output from 100 to 1000 watts—are now using Western Electric 12A Radio Broadcasting Transmitters. For power higher than 100 watts, the 12A is used as driver for the 71A Amplifier. This combination delivers 250 or 500 or 1000 watts depending upon tubes used in the output stage.

Notable features are: unusual frequency stability—fidelity of transmission—100% grid bias modulation. No rotating machinery—all transformers, rectifiers and control apparatus built in—apparatus fully enclosed, all high voltages eliminated when any door is open. All tubes radiation cooled.

Designed for easy installation, this equipment is extremely compact—each cabinet requires only 25″ x 36″ floor space. Connections are made directly to power supply mains. Push button control simplifies operation.

When A. C. operated single rack 9 type Speech Input Equipment is added—of which the Moving Coil Microphone is a part—no more modern or efficient broadcasting installation for its power is available.

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Graybar Building, New York, N. Y.
Gentlemen: Please send me full information on the Western Electric 12A Radio Transmitter, 71A Amplifier, and 9 type Speech Input Equipment.

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Over 200—or more than ⅓ of the number of broadcasting stations in the United States—are Western Electric equipped.

Western Electric

RADIO TELEPHONE BROADCASTING EQUIPMENT

Distributed by GRAYBAR *Electric Company*

RADIO ENGINEERING

FOR JULY, 1933

RADIO INDUSTRIAL CODE

AS this issue goes to press the first draft of the Industrial Code is being released for discussion by the RMA committee, headed by W. Roy McCanne. The adoption of this industrial code, either in the form in which it is released by the committee or in some revised form, is an urgent necessity.

On July 6 Donald R. Richberg, general counsel of the National Recovery Administration, stated as follows concerning provisions of the National Industrial Recovery Act:

"In his statement of June 16 the President said that this law is a challenge to industry and labor. That challenge must be met in the next sixty days. If the organized groups of either management or labor fail to meet that challenge they will be indicted for incompetence by the suffering millions who are now giving to industrial leadership one more chance—perhaps the last —to justify its authority.

"There is no choice presented to American business between intelligently planned and controlled industrial operations and a return to the gold-plated anarchy that masqueraded as 'rugged individualism.' There is only the choice presented between public and private election of the directors of industry. If the privately elected boards of directors and privately chosen managers of industry undertake their task and fulfill their responsibility they will end all talk of dictatorships and governmental control of business. But if they hold back and waste these precious hours, if they take counsel with prejudice and doubt, if they fumble their great opportunity, they may suddenly find that it has gone forever."

There is probably no industry in the country which has more complexities than radio. It is a decidedly individualistic industry. Its products are extremely varied including as they do the scores of components used in the manufacture of radio receivers, sound equipment, recording devices, broadcasting and communication equipment, tubes and other accessories.

There seems to be in many quarters a sort of hopeful expectation that the Code Committee next week will make a few magic passes and produce some miracle of cooperative planning to which we can all happily subscribe without further worry or consideration. It is, however, going to be extremely difficult to develop a code which will meet with the approval of the conflicting factors in this broad field.

Of course, it is self-evident that the question of labor —including a minimum wage scale and a spread of employment—is of paramount consideration. No code will be acceptable without these provisions. We further believe that a rigid licensing provision is going to be necessary. This licensing provision can effectively be handled through the facilities of the RMA.

Regardless of differences of opinion it must be recognized that quick action is essential even though individual sacrifices have to be made in some cases. It behooves all factors in the industry to approach the matter in a cooperative spirit, subordinating selfish interests to the end that the direction of the radio industry may remain in the hands of those who have created and builded it.

At the present time many of the units in the industry are increasing production schedules. In so far as this increased production is a reflection of the increased consumer demand which is already evident, and of the legitimate increased distributor and dealer commitments, it is a decidedly wholesome and impressive development. On the other hand those companies, if any, who are rushing into production in an effort to circumvent the provisions of the NIRA are contributing to a disturbance which will probably be more serious in its effects upon our own industry than upon many others.

The effort now being made to restore purchasing power is of particular importance to radio. It is entirely conceivable that industries supplying food, clothing, heating and housing to an unemployed army estimated at twelve million are still effectively transacting business with these twelve million. It is extremely doubtful, however, if relief funds ever find their way into the purchase of radio receivers. It behooves the radio industry to cooperate and to refrain from any upsetting orgy of speculative production during the next few weeks, if for no other reason than the selfish one of increased radio markets.

We believe that any manufacturer who mistakenly rushes into speculative production today will find that he is unable to dump an accumulated inventory at the end of a few months and that this speculative production will react most forcibly upon himself.

There is plenty of room and need for increased production schedules in many cases. The next few months will see many improvements and the adding of many new sales points to existing lines. But let's produce for a normal demand, and be sure that we aren't building up inventories which run into the wall of obsolescence and which in all probability will have to be written off.

If there ever was a time to quote the old adage, "Hang Together or Hang Separately," that time is today.

CLASS B AUDIO AMPLIFIER AS A

By Loy E. Barton
Engineering Department, RCA Victor Company,

◆

THE service range of a broadcast station depends upon the amplitude of the current in the antenna and the percentage variation of this current in response to the audio signal picked up by the microphone. The fidelity of the signal transmitted depends upon the ability of the transmitter to cause a variation in antenna current or to modulate the antenna current in such a manner that the demodulated signal from the transmitter is an exact reproduction of the signal picked up by the microphone. Since percentage modulation is the actual percentage variation of the antenna current, this variation of current requires additional power which is transmitted as sideband power. This sideband power amounts to 50 per cent of the non-modulated antenna power at 100 per cent modulation.

From the above facts it is evident that the apparatus for modulating the antenna current must be capable of transmitting power of the same general order of magnitude as the apparatus or system supplying the normal antenna current. There are various systems that may be used to supply the normal antenna current and associated with the system various means may be used for modulating the current.

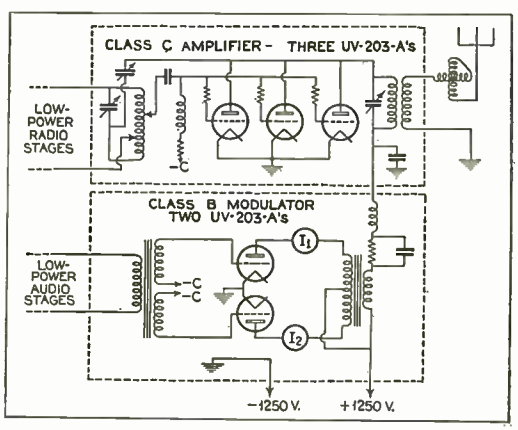
At the present time low first cost and low operating costs are very important factors to consider in the installation of a new transmitter. To meet the above two important factors of cost, the class B audio amplifier used to plate modulate a class C radio-frequency amplifier is gaining much favor. The trend toward the above system for transmitters is warranted because of economy alone, but contrary to the usual result of reducing costs, actual advantages are obtained, such as increased reliability of the transmitter, ease of operation, and increased fidelity of the transmitted signal.

Early Types of Broadcast Transmitters

To better understand the desirable features of the above type of transmitter, the following brief descriptions of some of the most common types of broadcast transmitters are given. The various types are discussed in a more or less chronological order to indicate the reasons for changing to other types of transmitters.

The first type of broadcast transmitter that was used extensively was the self-excited oscillating tube system which supplied power directly to the antenna. The usual means for modulation was known as constant current modulation which consisted of a tube (usually the same type as the oscillator) directly connected to the plate circuit of the oscillator as a class A audio amplifier. The plate current to the oscillator and modulator was supplied through a common reactor which was the means of coupling the class A audio amplifier to the plate circuit of the oscillator. This form of coupling the modulator to the oscillator had a coupling impedance ratio of one, so that the class A amplifier usually worked into an impedance much too low for minimum distortion or maximum output. Therefore, the maximum percentage modulation in these early transmitters was perhaps 15 to 30 per cent and the frequency of the oscillator was not particularly constant and was subject to wobble with modulation. However, the wobble could and was corrected by using a master oscillator to permit the output tubes to operate as a driven or separately excited oscillator as the radio-frequency output system. The crystal controlled oscillator soon replaced the master oscillator which resulted in good frequency stability. The separately excited oscillator is usually known as the class C amplifier and has higher efficiency than any other type of tube amplifier.

It was very desirable to use the highly efficient class C radio-frequency amplifier for the output system because of its inherent reliability and economy of operation so that a bank of modulator tubes was used in parallel in the above constant current modulation system to obtain higher percentage modulation. Special low impedance tubes designed for modulator service were built with the idea of increasing the percentage modulation without using an excessive number of modulator tubes. However, under no condition could 100 per cent modulation be reached with the same plate voltage applied to the plates of the modulators as was applied to the class C amplifier. Later a system was used which permitted a higher plate voltage on the modulators than was used on the class C amplifier to permit higher per-



Arrangement of the modulator system for a 250-w. class C amplifier. (Fig. 1)

MODULATOR FOR BROADCASTING STATIONS

A new type 250-w. transmitter using class B modulators at WFBC, Greenville, S. C. (Fig. 2)

centage modulation. Still later, a transformer was considered for more favorable coupling of the modulator tubes to the plate circuit of the class C amplifier but under the most favorable conditions 6 to 10 times as many tubes were needed for modulators as for the class C amplifier if 100 per cent modulation was to be reached. Therefore, it is appreciated that the modulator was the chief obstacle to using the highly efficient class C amplifier. The class B audio amplifier has proved to be the answer for the modulator and will be discussed later.

Present Type of Transmitter

Because of the high cost and the difficulty with the early modulators, the linear radio-frequency amplifier was developed. The purpose of this development was to permit 100 per cent modulation of a low power class C amplifier by using the modulator tube as a class A amplifier coupled to the class C amplifier in such a way as to obtain essentially 100 per cent modulation. One of the methods mentioned above for modulation was commonly employed which usually consisted of a large modulator tube used to modulate a much smaller tube operating as a class C amplifier at a much reduced plate voltage. The output of the modulated low power class C amplifier was used to excite the grid circuits of larger amplifiers operating as class B radio or linear amplifiers.

The class B radio or linear amplifier is an amplifier in which the tubes are biased to essentially plate current cut-off with tuned plate or output circuits and the output current and voltage are proportional to the input radio-frequency voltage. Since the input voltage from the modulated class C amplifier varies 100 per cent above and below the normal carrier value for 100 per cent modulation, the linear power amplifier must have sufficient power capability to permit a similar variation in its output current or voltage. The peak current or voltage output of the linear amplifier is approximately equal to the normal carrier output of the class C amplifier so that the carrier output of the linear amplifier is one-half the current or voltage output of the class C amplifier, or in terms of power, the linear amplifier carrier output is one-fourth that of the class C amplifier. Therefore, four times as many tubes are required for a linear amplifier as are required for a class C amplifier for equal power outputs. It is obvious that one larger tube may be used instead of four tubes, but the ratio of 4 to 1 in power handling ability must be met.

A typical layout of a present-day broadcast transmitter, using a linear output amplifier, has a crystal controlled radio-frequency oscillator, the voltage from which is amplified and excites a lower power class C amplifier. A separate audio amplifier or speech amplifier, including the modulator, amplifies the audio signal and is applied to the plate circuit of the low power class C amplifier for modulation. A linear amplifier follows the modulated radio-frequency amplifier and is excited by the modulated signal. This linear amplifier in turn is used to excite larger linear amplifiers until the output power is the desired value. The last linear amplifier is coupled to the antenna. In the case of 100 to 1000 watt stations, the first linear amplifier may be coupled to the antenna.

The linear amplifier system for broadcast transmitters has been in general use and, until more efficient modulators were devised, was the only practical system to obtain large powers with 100 percent modulation.

Another system that has been advocated and used to some extent is known as grid-modulated linear amplifier. This system differs from the above system in that the audio signal is applied with the radio signal to the input circuit of the first linear amplifier. The audio signal is applied in series with the bias for this first linear amplifier. This method of modulation requires somewhat less audio power for modulation than is required for plate modulation of the class C amplifier used to excite the first linear amplifier. However, the actual saving in audio power is not as high as might be expected because the varying grid current to linear amplifier must be supplied with little distortion. This varying grid current requires a comparatively large audio amplifier, unless the linear amplifier is operated entirely in the negative grid region so that no grid current is required. However, in this case the output

of the first linear stage is limited so that little is gained by grid modulation.

The bias requirements in the two linear amplifier systems mentioned are equally critical for minimum distortion and the carrier power output is limited in each case to 25 per cent of the class C rating of the tube used.

Class B Modulated Transmitter

As previously indicated the class C amplifier output system has a higher efficiency than any other system and requires fewer or smaller tubes for a given output. The class B audio amplifier also has high efficiency and several times the power output of the class A amplifier, so that its use for modulating the plate circuit of the class C amplifier is very desirable. This system for modulation was successfully used at the University of Arkansas several years ago and the results of the development reported in a bulletin.[1]

The class B audio amplifier is an amplifer in which two tubes are connected in a push-pull manner and biased to essentially plate current cut-off in much the same manner as the bias for the linear amplifier, except that the bias is somewhat more critical for minimum distortion at low output levels. The grids of the tubes are usually driven positive and since only one tube works at a time and the output of the amplifier is aperiodic two tubes must be used in a push-pull relation to prevent distortion. Further details on the class B audio amplifier may be had by referring to early articles on the subject.[2]

The typical layout of a transmitter using the class B audio amplifier to modulate a class C output system consists of: (1) a radio frequency amplifier channel to amplify the voltage from the crystal controlled radio-frequency oscillator to the desired power level, the last stage being coupled directly to the antenna; (2) an audio-frequency channel. the last stage of which is the class B audio amplifier, which supplies its power to the plate circuit of the final class C amplifier for plate modulation.

The general schematic layout of the system for a typical 250-watt station is shown in Fig. 1. It will be noted that the radio-frequency channel is entirely independent of the audio-frequency channel except at the output end of each system. The radio-frequency channel may be a partially self-biased class C amplifier including the output stage which permits a system that requires practically no attention as long as the crystal oscillator continues to function and there are no defective tubes. The power output is proportional to plate voltage once the initial tuning adjustments are made, so that little difficulty is experienced in maintaining a uniform power in the antenna and no critical adjustments are necessary to prevent distortion in the radio-frequency channel.

The audio-frequency channel consists of the usual voltage amplifier with a gain sufficient to amplify the signal to the desired value. The class A output stage of the speech amplifier is so designed that it will drive the class B tubes to their full output without appreciable distortion. The only operating precaution necessary for the class B amplifier in a well-designed system is to maintain a reasonably accurate adjustment of bias if the modulator tubes should change during life, or if new tubes replace the older ones. However, this bias adjustment is made by observing the meters in the individual plate leads of each tube so that the adjustment becomes quite simple and easily checked at any time. It will be seen that the percentage modulation is controlled entirely by the speech amplifier gain control. In the case of a linear amplifier, the circuit adjustments become critical as to initial adjustment and maintenance if high degrees of modulation are desired.

Comparative Costs of the Transmitters

Some idea as to the relative cost of the two types of transmitter may be had by considering the transmitter as shown in Fig. 1. The radio-frequency channel up to the class C amplifier and the speech amplifier, exclusive of the class B stage, will probably cost about the same for either the class B class C system or the linear system. The modulator and output system in Fig. 1 requires five UV-203A tubes which are relatively inexpensive and the plate supply voltage is low, which is relatively low in first cost.

The output system for a linear amplifier for 250 watts output would require at least one 851 type tube, two 849 type tubes or three 204A type tubes, with perhaps the equivalent of one or two 203A type tubes in the modulated system used to excite the output linear amplifier. From the cost of the tubes alone it is seen that the tubes for the linear amplifier system cost 3 to 4 times as much as the tubes for the class B class C type of transmitter. Since tube replacement is an important item in maintenance, the reduction of tube costs is appreciated by the station owner. Another item of cost for the 250-watt linear amplifier system is that the initial cost of the necessary 2000 or 2500 volt plate supply will be greater than the 1000 volt plate supply for the new system.

Another point of economy in favor of the new system is that the plate power required for the modulator and radio-frequency output amplifier is appoximately 30 to 50 per cent lower than the power requirements for the linear amplifier system. Since the cost of power is an operating expense, any saving is appreciated. The space required by the new system is less than for the linear system and, for larger installations, may become quite important. The compactness of a new type 250-watt transmitter may be seen in Fig. 2.

The above economy in first cost and maintenance, coupled with more reliable operation and less chance for distortion, was made possible by using the class B audio amplifier to plate modulate the highly efficient class C radio-frequency amplifier. Since the class B audio amplifier has an efficiency higher than any other known audio amplifier, and the class C amplifier has a higher efficiency than any other known radio-frequency amplifier, it is obvious that the combination of the two amplifiers will deliver power into an antenna with a higher efficiency than any other present type of transmitter.

The trend toward the use of a class B audio amplifier for plate modulation of broadcast stations is also indicated by the fact that the new 500,000-watt WLW station at Cincinnati, Ohio, will use a class B audio amplifier to deliver approximately 400,000 watts of audio power for modulation purposes. Experience with the operation of tubes as class B audio amplifiers, coupled with experience in the design of large audio-frequency transformers for use in the system, have indicated that the class B audio-frequency modulator is the most practical and economical system to use in what is to be the world's largest broadcast station.

References

[1]*Loy E. Barton: "A Modulation Transformer for Broadcasting Stations," University of Arkansas Experimental Station Bulletin No. 8.*

[2]*Loy E. Barton: "High Audio Power from Relatively Small Tubes," Proc. I.R.E., July, 1931. "Class B Push-Pull Modulator," QST, November, 1931.*

Lamb and Grammer: "High-Power Performance from the Small 'Phone Transmitter," QST, December, 1931.

DESIGNING A MIDGET CABINET

The Colonial Compact, the designing of which is described

By
Jan Streng
Industrial Artist, New York City

◆

YOUNG as the radio industry is, some of its habits are very old-fashioned and are extremely hard to break. One of these is its misconception of the place radio occupies in the home today. Is it furniture, or, like an electric clock or lamp, an accessory?

Obviously, to one whose vision has not been limited by a too intimate connection with radio's history, in its latest development it is decidedly not furniture. When radio was large and cumbersome, putting it in a piece of furniture was the easiest solution. But now that radio has followed the evolution of the timepiece through the massive Grandfather Clock period to the present small electric device—now that miraculous performance can be built into a space the size of a cigar-box—we see that radio has evolved into, and will remain, an accessory.

In planning the Colonial Compact cabinet, I was given but two limitations and one major objective. The limitations were the fixed size of the chassis and speaker, having decided on a five-tube superheterodyne, all-wave circuit, and the necessity for adequate ventilation. The objective was to make a set which would sell to all classes on sight, which would appeal to a market not reached by current types, and which would get wider distribution in such channels as the better department stores and shops.

Comparison

Since it was planned to retail the set at thirty dollars, somewhat higher than the average compact price, it was evident that it would have to look different and more intrinsically valuable than the others. Comparison showed that many of the compacts had seen the value of a molded plastic case, from the standpoint of permanence of finish, cost and ease of assembly, but for some unknown reason—probably still the furniture complex—their designers had tried to disguise the fact that they were molded by using walnut or mahogany molding compound. The net result of this dishonesty was that no one was fooled, the case looked like a cheap substitute for real wood, and the inherent beauty of plastic material was lost. The writer was somewhat amazed by the reasoning back of this.

Obviously, then, Colonial's opportunity lay in merely being sensible about plastic materials. The sales results of our brother industry, electric clock manufacture, was proof of our logic for when Hammond brought out the Junior electric in a smart black molded case, it sold amazingly well when the average Gothic walnut molded clock was gasping in the chain stores. And already walnut molded compact radios were beginning to suffer seriously from a retail price decline, attributable largely to their cheap look and the highly competitive state brought about by their monotony of design.

The set illustrated here is the result of this reasoning. The fact that production facilities have been unable to keep up with orders—several large orders even being lost for this reason—seems to show that we were correct in our assumption that radio should divorce itself from furniture, and should be an honestly designed accessory. It also shows that plastic materials are inherently rich-looking, and have a "cheap substitute look" only when warped into imitations of other materials.

Contours

As for the contour of the cabinet, smooth geometric lines were sought, partly because of the lowered mold cost, and partly because they are easier on the eyes. In the average home, walls, floor, pictures, furniture, scarves, etc., all present agitated or designed surfaces somewhat tiring to the eye and affording no optic relief. Therefore, any smooth solid colored object placed in such a room becomes an oasis for fatigued eye muscles. That is the reasoning back of true Modern Design, and incidentally that is where the amateur modernist goes wrong when he agitates surfaces with triangles and other crazy modernistic impediments.

Contrast with the black cabinet was easily obtained by the use of diecast zinc ball-feet and handle, chromium-plated, as was the grille. Instead of the fussy, wandering grille-work ordinarily used a circle, the normal motif of the dial, was repeated three times, partly to follow natural eye movements most easily and partly because it is more symbolic of radio than non-geometric meanderings. Choice of the molding compound was based on minimum "waviness," and a special grade of black Durez was used. The vertical flutings on the sides, which optically minimized the depth of the cabinet and made it look lighter, taxed the fluxing power of the plastic in the mold, but adjustments in the material took care of this. By using a four-side-acting molding press, the cabinet was molded in one piece, permitting ventilation slots in the bottom, and delivering a finished cabinet to the manufacturers without assembly work.

A Rectifier System for Broadcast Speech Input Equipment Using the New—83

By C. Bradner Brown*

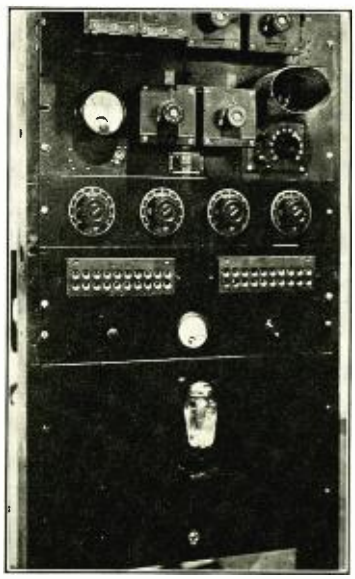


Fig. 2. Speech input equipment.

THE problems of plate voltage supply for speech input equipment which has taxed the ingenuity of the radio engineer seem to be solved with the introduction of the new mercury vapor rectifier, Type —83. This tube is of the mercury vapor atmosphere variety and operates by virtue of electrons released from ionization of this vapor. The characteristics of such a tube are entirely different from those of standard high vacuum rectifiers. The first current drawn through the tube is supplied from the electronic emission of the filament. These electrons collide with mercury vapor atoms, knocking loose some of the outer ring of planetary electrons which in turn are accelerated toward the plate causing even further ionization.

The voltage drop across such a tube is unstable as would be expected, and has a decidedly negative characteristic. That is, as the current increases the tube drop decreases, falling from 16 to 15 volts as the load increases. If a constant drop of 15 is used for calculating purposes, results of the proper order will be obtained. The type —83 is equipped with a coated filament of the oxide variety and heats up quickly enough to prevent damage to the filament emission power. It is not necessary therefore to arrange any type of time delay in the plate voltage circuit as is the case with the higher powered mercury vapor rectifiers. The —83 is fitted with a standard 4-prong base and should always be equipped with a socket making good contacts with the filament prongs. Failure to observe proper precautions in this matter will generally lead to contact voltage drops with correspondingly low filament current. This in turn will cause a high tube drop on account of the lower filament emission and ionization which will result in the ultimate destruction of the filament by positive bombardment.

For the same reason, the plate current rating should never be exceeded. However, there is but little chance of the latter occurring since the rating is sufficiently high for all practical purposes. The mercury vapor condenses on the cooler portions of the bulb, and for this reason the tube must be mounted in an upright position with the base down. This assures a plentiful supply of mercury for vaporization directly under the filaments. A circulation of the mercury vapor will be noticed, with the plate structures acting as chimneys. A dome type construction is employed, which allows the use of a mica support for the upper end of the plate structure making an exceptionally strong unit.

Returning to the problem of plate supply, it is at once apparent that the weak link in the chain previous to the design of the —83 was the rectifier tube. An average speech input system will easily draw in excess of 130 mills when all associated equipment, including condenser microphones, volume level indicators, and monitoring amplifiers are operated from a common power supply. An output of approximately 350 volts is necessary for operation of most standard amplifier equipment including the Western Electric 8-series amplifiers. Although the transformer and filter equipment for such a power supply is readily available, the rectifier problem has given rise to considerable thought on the part of the design engineer.

The voltage requirements are such that —80's in parallel cannot be relied upon for consistent service. Not only is failure a difficult matter to predict, but a forced shutdown would result which in the case of a broadcasting station or a public-address system might prove embarrassing. If 81's are considered, the current rating is exceeded by an amount which causes a high tube drop making for rapid deterioration of the filament. Not only this, but from an economic standpoint, allowing 100 per cent spares, the cost of tubes amounts to a figure which compares with the entire filter system.

The new Raytheon —83 is a full-wave rectifier having the following characteristics:

Filament voltage	5 volts
Filament current	2 amps.
R.M.S. volts per plate	500
Inverse peak voltage	1,400
Peak plate current	800 mills
Average plate current	250 mills

*Chief Engineer, Experimental Division, First National Television Corporation. Visual Broadcasting Station W9XAL.

It is at once apparent that an r.m.s. rating of 500 will allow a considerable factor of safety over 400 allowable under normal operation of an 80. The average current rating of 250 milliamperes will handle even the heaviest amplifier, and will even be found advantageous in small transmitters. For best results, a choke input of about 5 henrys is advisable as the current surge to a condenser fed filter circuit reaches high values during the first part of the charging cycle. This current surge, even with choke input, usually has a tendency to set up r-f. oscillations by shock excitation of the filter and associated equipment together with the usual distributed capacities found in all such circuits. A shielded transformer will generally be found necessary in order to prevent any such disturbances from reaching the power pack output. A small r-f. choke coil of a few millihenrys placed in the lead of each plate of the rectifier will generally eliminate most of the difficulty encountered from r-f. sources. In the W9XAL installation it was also found necessary to shield the tube, but this was entirely due to the proximity of the patching cord in the low level jack strip to the tube itself as was easily proved by removing all patch cords and listening to the amplifier output. It is probable that if not too close to the amplifier proper, little trouble will be experienced. In case it is decided to mount the power supply on the lower part of the relay rack carrying the amplifier equipment, the entire power supply should be shielded by a galvanized iron shield covering the back of the unit.

Fig. 1 shows the circuit used in the experimental power supply constructed at W9XAL in Kansas City. A double section 10-henry choke coil was used in parallel

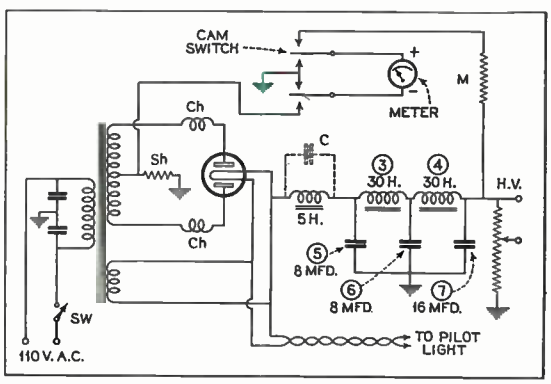


Fig. 1.

to obtain a 5-henry unit with the proper current carrying capacity. The experience of the author is that a well shielded unit must be used in this position to prevent noise from reaching the amplifier by direct induction. A small condenser C of from .05 to .1 may be used across this choke to absorb the shock input. This value is entirely experimental and apparently depends on the distributed capacity of the unit used as the input choke.

The small chokes Ch were wound on thread spools and consisted of some hundred turns of number 22 enamelled wire. Chokes 3 and 4 are 30-henry units with a current carrying capacity of 200 mills. Condensers 5 and 6 are two 8-mfd. sections of a three section electrolytic unit having a rating of 500 volts. The third section of 16-mfds. is used as the output capacity and is connected directly across the voltage divider which is a standard affair. The author used a heavy duty variable resistor of 40,000 ohms, the clips being set by trial when the amplifier was first tested.

Following the standard relay rack construction, the entire unit was mounted on a 3/16 inch aluminum panel. All units were fastened to the panel with 8/32 machine screws, tapped in holes drilled through the panel and filed off flat before the front panel was painted. This resulted in a smooth job, with the fastening screws barely detectable under the smooth lacquer coat which was put on with a spray gun after the job was finished. A front of panel socket was constructed from a couple of pieces of scrap aluminum, and a subpanel socket mounted from the underneath to hold the tube.

A small Weston type 506 voltmeter was dismantled and the series resistor removed. The meter was then mounted in the center of the indicator panel directly above the power pack. A double-throw cam switch was placed on the right and a pilot light on the left. The meter was arranged as shown in the diagram in Fig. 1 and fitted with proper resistors as shown in order to read either the current or voltage, depending on the position of the cam switch. These resistors were calibrated by loading the power supply during the regulation tests and comparing with an available standard.

Since the rectifier tube is operated well below its rating, little difficulty will be encountered in sudden failure. If the tube is tested once a week in the usual manner, i.e.: measurement of tube drop under normal load, and replaced whenever the drop exceeds the rated 15 volts the power supply need not be inspected other than in the routine of keeping the equipment in good shape. This unit has been in operation with a schedule of better than 6 hours a day for the past 3 months at station W9XAL, and the original —83 is still in use with every evidence of giving considerable longer service. In case an extremely low hum level is required, it will be found necessary to set up the power pack, operate the amplifier equipment and then trace down the noise, preferably with some form of vacuum tube voltmeter.

Fig. 2 shows the experimental construction as used to supply the Western Electric 8-C and its associated equipment including three condenser microphones in the studios of the First National Television Corporation on top the Power and Light Building in Kansas City, Mo. The regulation is extremely good, and no difficulty is encountered from power supply-motor boating even though the amplifiers are of the impedance coupled type. This type of power pack should be even more valuable in the case of the new class B amplifiers where exceptional regulation is required for good reproduction.

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Interesting developments in connection with the Radio Industrial Code will take place within the next thirty days. Last minute, up-to-date information on this vital subject will appear in the August issue of RADIO ENGINEERING. Watch for it.

The INSTALLATION at WHAM

TWO installations of the newest type Western Electric 50-kw. radio broadcasting transmitter have already been made, and one is at present under way. Those completed are WHAS, Louisville, Ky., and WHAM, Rochester, N.Y. That now nearing completion is WSB, Atlanta, Ga.

This type of transmitter, like all products of this manufacturer, is designed by Bell Telephone Laboratories. The circuit is based on the same fundamentals, such as the low power system of modulation, in which these two organizations pioneered in the early history of broadcasting and which reached such a high state of development in the first 50-kw. Western Electric transmitter that the entire industry has since followed the same pattern.

The new features incorporated in the latest type relate almost entirely to rectifiers, the control system, and certain simplifications of arrangements which result in improved operation, lower cost, and decreased building space required for installations.

The transmitter is arranged normally for delivering 50-kw. into the antenna. An adjustment is provided on the panel of the transmitter by which the power output can be varied between this value and 5-kw. continuously while the transmitter is in operation. If continuous operation over long periods at lower powers than 50 kw. is desired, equipment can be furnished to use less than the full complement of tubes in the last stage of amplification.

Each transmitter is provided with tuning and antenna coupling circuits which are arranged for the individual requirements of each installation in respect to power and frequency. This plan not only results in the most efficient use of apparatus but is one of the contributing factors in the low cost of the equipment.

The transmitter is arranged for transmission-line feed to the antenna, a system which removes the transmitter building from the immediate vicinity of the antenna. Thus the pattern of radiation about the antenna is not distorted by the presence of the building and the apparatus in the building is not subjected to the high fields which immediately surround the antenna.

All the radio-frequency circuits, except those associated with the last stage of amplification and the antenna tuning already mentioned, are adjustable to any carrier frequency between 500 and 1500 kc.

The new transmitter is equipped with two 700-A oscillators (one spare) which embody the latest developments in frequency control. The carrier frequency is maintained automatically to well within 50 c. p. s. of the assigned frequency.

The 700-A oscillator is a self-contained quartz crystal controlled oscillator having the constant temperature chamber for the crystal, the oscillator circuits and tube mounted together as a unit. This unit is arranged with sliding contacts on the bottom so that the complete assembly may be removed from the transmitter for calibration or inspection. These units are adjusted to the assigned frequency in the laboratory before shipment. Both crystals are kept heated all of the time and both oscillators are in operation while the transmitter is being used. The oscillators and the following buffer stage employ equipotential cathode type tubes.

Each oscillator obtains its heater current for the constant temperature chamber from a transformer through a three-element gas-filled tube. The mercury type thermostat in the crystal chamber controls the action of this tube providing close temperature regulation of the chamber even with a wide variation in ambient. This design has been given thorough laboratory and field tests over long periods of time and has been used successfully in common frequency broadcasting work.

Full modulation of the carrier wave obtains in the new 50-kw. radio transmitter and the distortion content of the modulated wave under this condition does not exceed 6 per cent. The importance of a high degree of modulation is now well understood and recognized as a necessary requirement to economical radio distribution. In the new transmitter the final stage of amplification is equipped with six tubes, each capable of delivering 35-kw. Thus ample margin is provided for full modulation as in a 50-kw. transmitter 200 kw. is required at the peaks of modulation.

Recognizing the need for the most economical use of vacuum tubes, six 35-kw. tubes are employed in the final stage of amplification in the transmitter instead of two 100-kw. tubes. The advantage of economical operation with two or four tubes in this stage is thereby secured if a temporary lower power assignment anticipates full power operation. Furthermore, while the Western Electric 100-kw. vacuum tube is designed for relatively rapid replacement, the smaller structure of the 35-kw. tube and its quick-change socket requires much less time off the air when tubes have to be replaced during broadcasting hours. Also, the investment in carrying tube replacements can be made lower by using the 35-kw. tubes.

Mercury-vapor rectifier tubes are used in the new transmitter for both the 1600-volt and the 17,000-volt rectifiers. After several years of experience with these tubes in the Laboratory, they have been included in broadcasting equipment with confidence that the operation of the rectifiers employing them will be entirely satisfactory. The mercury-vapor tubes in the new equipment are used at exceptionally conservative ratings to insure satisfactory and economical performance. Besides contributing largely to the low cost of this equipment, their use permits a simplification of apparatus.

The mercury-vapor rectifier tube possesses the inherent characteristic of gradually increasing its internal resistance as it ages. If operated beyond the limit of its useful life, this resistance rises to a limiting value and occasionally the tube arcs back. In the new Western Electric transmitter a testing circuit is built into the tube mounting which permits an accurate determination of the condition of the rectifier tubes before going on the air with the transmitter. Thus a periodic check-up can be made on each tube and a log kept which forecasts the proper time for removing old tubes from the circuit.

Transmitting room, Station WHAM. 5-kw. transmitter in the right foreground. —Courtesy, Western Electric Co.

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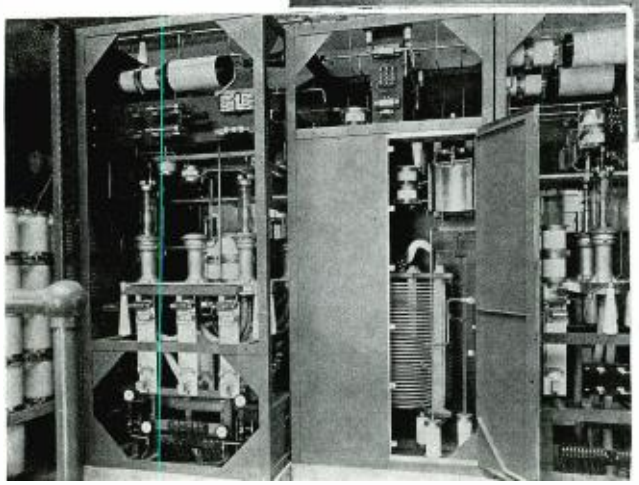

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Reading from left to right: Third power amplifier tuning unit; third power amplifier tube unit; second power amplifier tuning unit and second power amplifier tube unit—Station WHAM. —Courtesy, Western Electric Co.

Protection against overloads occurring in the rectifier is secured by the provision of a reverse current relay connected to each rectifier tube. If a rectifier tube should develop a fault, this relay functions to remove the high voltage almost instantaneously and operates a supervisory signal lamp for the operator's information. Particular emphasis is placed on the action of this relay because by virtue of its operation on reverse current, it provides more adequate protection than usually offered in rectifier circuits. By its action, the high voltage is removed before a serious overload occurs, rather than waiting for the overload to operate relays for opening the circuit.

The most modern developments in power control equipment are employed in this transmitter. All heavy primary wiring is confined to the equipment located in the basement of the transmitter building, and control wires only are brought to the main transmitter assembly. Supervisory signal lamps are mounted on the control panel which indicate at a glance the condition of all parts of the circuit when starting, operating or during overload conditions. These lamps are operated from a supply separate from that of the transmitter so that if the transmitter should be completely shut down by an action of the protective control circuit, the lamps will remain energized to indicate the cause.

Reclosing devices are used for automatically keeping the transmitter on the air. Occasionally a momentary surge condition occurring somewhere in the circuit will trip a protective device and shut down the transmitter. A new feature is provided in the latest equipment for automatically restoring the transmitter to the operating condition immediately. Should the shut-down be occasioned by a positive fault not of a momentary nature, the transmitter control system will function to protect the apparatus against the fault and indicate its location to the operator.

A recording clock is provided to permit cataloging the hours of operation of the transmitter.

The entire equipment is operated by circuits which are controlled from the panel of the transmitter. Under normal conditions, the operation of the transmitter is fully automatic. Pushing a single button sets the relay circuits in action and all starting operations occur in proper sequence.

Complete protection to personnel is provided in this transmitter by the use of dead front panels. The wire mesh fence enclosing the rear part of the main assembly prevents access to the high voltage apparatus except through a door equipped with safety switches. These switches function to remove all high voltage from the circuits and, in addition, ultimately ground the high voltage busses before the door can be opened. Entrance to the high voltage rectifier equipment in the basement is similarly protected.

The main portion of the transmitter consists of eight panels, each 7 feet 8 inches high and 42 inches wide, which are arranged in one continuous assembly for installation on the main floor of the transmitting station.

All other parts of the transmitter are intended for installation in the basement of the building. One room of the basement contains the transformers, tube unit and filtering apparatus for the high voltage rectifier. A door equipped with protective devices is furnished for the entrance to this enclosure. Elsewhere in the basement, but accessible while the transmitter is in operation, are the filament and grid bias motor-generator sets with their filters and the pumps associated with the water cooling system.

In a small building beneath the transmitting antenna, coils and condensers are mounted for coupling the antenna to the transmitter through a radio frequency transmission line.

The circuits of the new 50-kw. transmitter are made up essentially of the following major items.

1. A low power radio-frequency oscillator whose frequency is controlled accurately by a quartz crystal.
2. Five stages of radio-frequency amplification which progressively increase in power.
3. Tuned circuits for coupling these stages and for connecting the last stage to the antenna.
4. Two stages of audio-frequency amplification, the first of which is connected to the speech input equipment

(*Concluded on page* 19)

MIXER CIRCUITS

A MIXER circuit is an arrangement of volume controls for combining into one program, in any desired proportions, program elements on several channels. All of the multiple-microphone, transition, and fading effects, which contribute so much to program continuity, are obtained with mixer circuits.

For instance, separate microphones may be used for a soloist and for the accompanying orchestra, and the outputs combined to form a balanced whole. Similarly, separate microphones may be used to pick up the various sections of a large orchestra. Since the volume on each microphone channel can be regulated independently of the others, a method of controlling the balance between the various sections is obtained which, unlike the usual "tone control," does not impair the quality of the individual instruments. A mixer is also used to "fade down" a musical transmission so that announcements or advertising talks may be superimposed. All of these effects contribute a degree of smoothness to a broadcast program or recording which would otherwise be impossible.

The choice of a mixer circuit is determined mainly by the number of channels needed and by the impedance requirements of the system. If the mixer is to be used with equipment that is balanced to ground, this factor must be taken into consideration. Several representative types of mixer circuits are shown in Figs. I and II.

In designing a mixer, it is advisable to allow a separate channel for each available microphone, line, or transcription pickup, thus making it unnecessary to patch circuits while a program is in progress. The cost of an extra volume control is negligible compared with the consequences of even a single program interruption. The volume control used on each channel should have an impedance that matches approximately the equipment with which that channel is to be used. The three standard impedance ratings (50, 200, and 500 ohms) take care of practically all requirements. It is advisable, although not always necessary (see Fig. IIa), to have all of the channel controls alike and to use impedance-matching transformers to couple the mixer to any equipment having a different value of impedance.

When the channel controls are not all of the same impedance, the circuit should be so designed that, as in Fig. IIa, the attenuation is approximately equal on all channels.

The mixers shown in Figs. I and II have all proven very satisfactory. In the four-channel series-parallel type (Fig. IIb), the output impedance of the mixer is equal to the input impedance of each channel. In the series-type mixer (Fig. Ia, IIb, and IIc), the output impedance is equal to the sum of the channel impedances, which is frequently an advantage where low-impedance channels are used, since the input impedance of most speech amplifiers is 200 or 500 ohms.

In a series-type mixer of more than two channels, some channels must be above ground potential. Usually this is of no consequence if the equipment

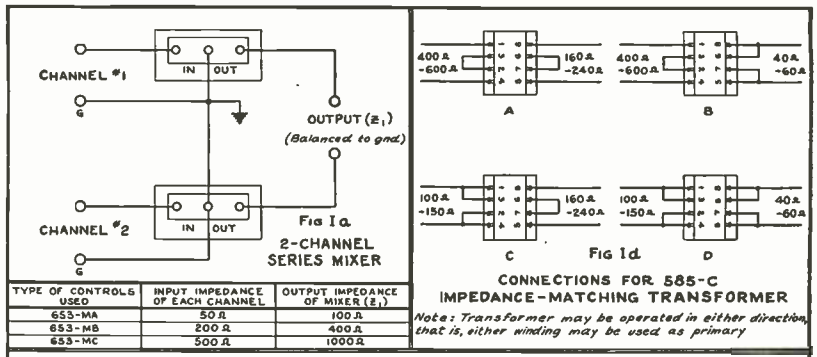

Fig Ia. 2-CHANNEL SERIES MIXER

TYPE OF CONTROLS USED	INPUT IMPEDANCE OF EACH CHANNEL	OUTPUT IMPEDANCE OF MIXER (Z_1)
653-MA	50Ω	100Ω
653-MB	200Ω	400Ω
653-MC	500Ω	1000Ω

Fig Id. CONNECTIONS FOR 585-C IMPEDANCE-MATCHING TRANSFORMER

Note: Transformer may be operated in either direction, that is, either winding may be used as primary

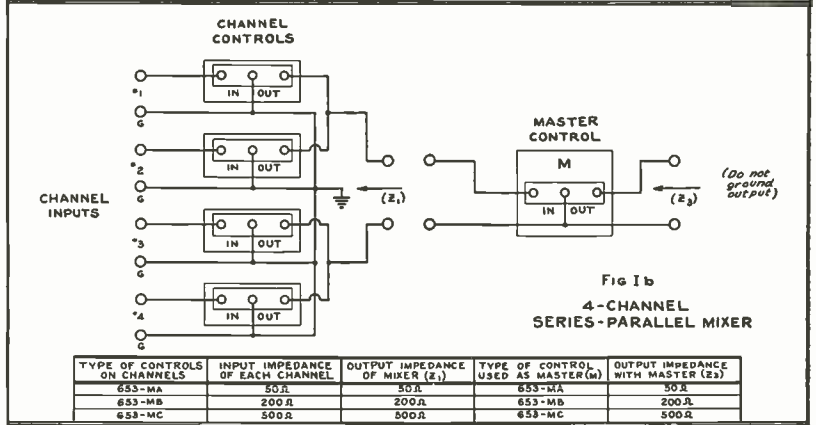

Fig Ib. 4-CHANNEL SERIES-PARALLEL MIXER

TYPE OF CONTROLS ON CHANNELS	INPUT IMPEDANCE OF EACH CHANNEL	OUTPUT IMPEDANCE OF MIXER (Z_1)	TYPE OF CONTROL USED AS MASTER(M)	OUTPUT IMPEDANCE WITH MASTER (Z_2)
653-MA	50Ω	50Ω	653-MA	50Ω
653-MB	200Ω	200Ω	653-MB	200Ω
653-MC	500Ω	500Ω	653-MC	500Ω

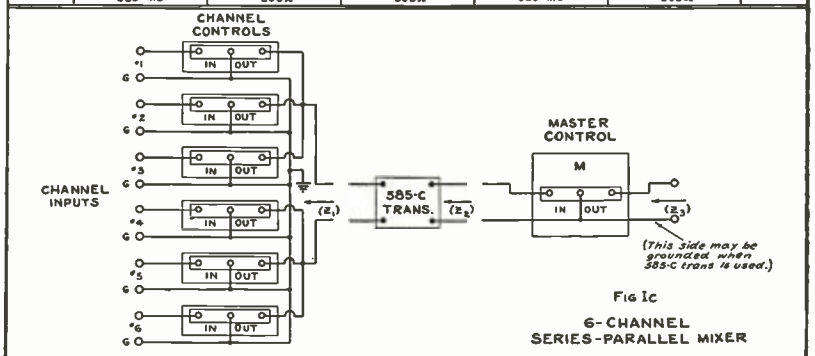

Fig Ic. 6-CHANNEL SERIES-PARALLEL MIXER

TYPE OF CONTROLS ON CHANNEL	INPUT IMPEDANCE OF EACH CHANNEL	OUTPUT IMPEDANCE OF MIXER (Z_1)	585-C CONNECTIONS (SEE FIG Ia)	Z_2	TYPE OF CONTROL USED AS MASTER (M)	OUTPUT IMPEDANCE WITH MASTER (Z_3)
653-MA	50Ω	33Ω	B (1-4 as SEC.)	500Ω	653-MC	500Ω
653-MB	200Ω	123Ω	C	200Ω	653-MB	200Ω
653-MC	500Ω	333Ω	NOT USED	—	653-MB	200Ω

FIGURE I CONVENTIONAL MIXER CIRCUITS

By H. H. SCOTT
General Radio Company

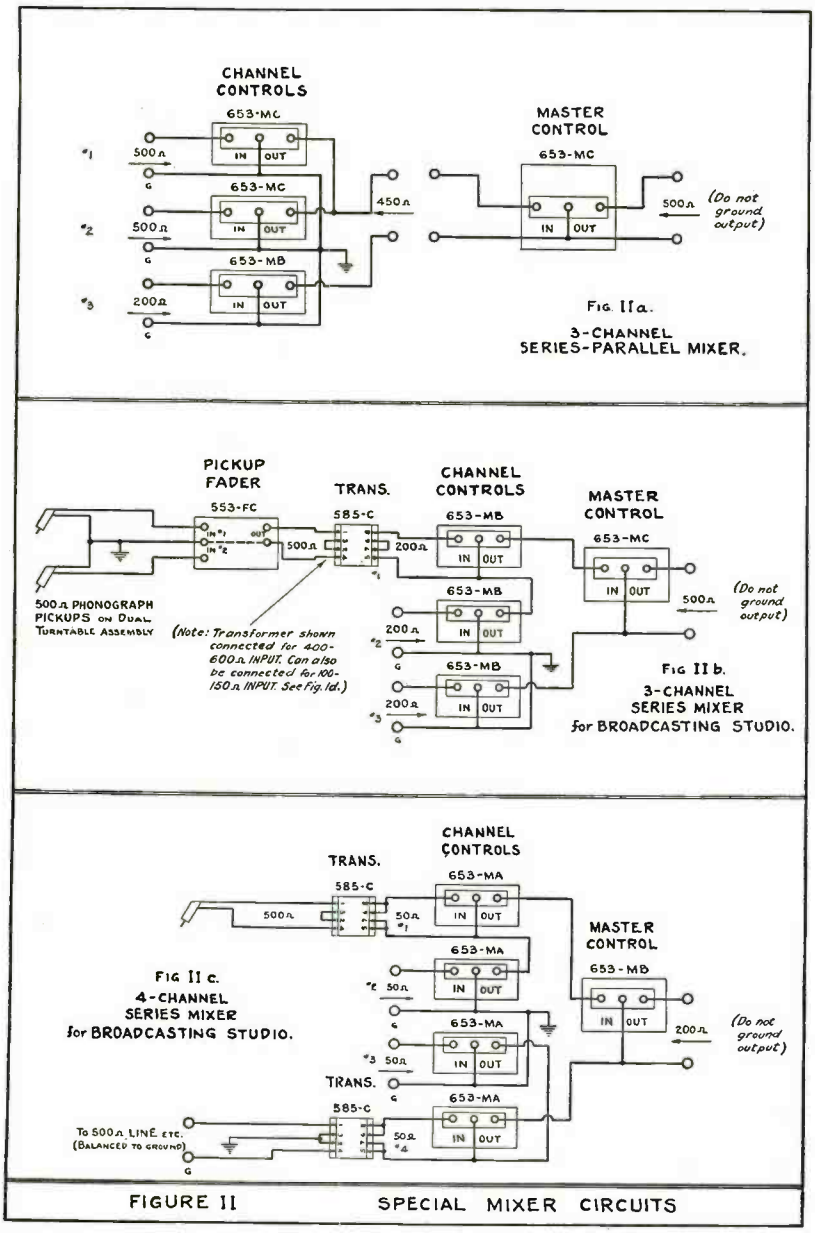

FIG. IIa. 3-CHANNEL SERIES-PARALLEL MIXER.

FIG. IIb. 3-CHANNEL SERIES MIXER for BROADCASTING STUDIO.

FIG. IIc. 4-CHANNEL SERIES MIXER for BROADCASTING STUDIO.

FIGURE II SPECIAL MIXER CIRCUITS

connected to these channels is not grounded and the leads are reasonably short. If any noise pickup or crosstalk due to this condition is encountered, however, it may be remedied by using impedance-matching or circuit-isolation transformers on these channels.

Fig. IIb and IIc show suggested uses for the above-ground channels in a series mixer. In these diagrams, channel No. 1 is equipped with a 500-ohm (or 125-ohm) transformer for coupling to the usual 500-ohm transcription equipment or program line. In Fig. IIb a fader is also shown for transferring from one pickup to another. In Fig IIc, channel No. 4 is also equipped with a 500-ohm transformer for coupling to the usual program transmission lines.

In the above cases the transformers are used both for circuit isolation and for impedance-matching. Transformers may, of course, be used equally well with the channels at ground potential in all of the mixers shown but are not necessary except for impedance-matching, balancing to ground, or keeping direct current out of the mixer.

Fig. Id shows how a transformer may be connected to give any one of four impedance ratios. It may be operated with either winding used as the primary, so this one transformer will perform most of the impedance-matching functions usually needed in mixers. It can also be used for circuit isolation purposes when coupling circuits at ground potential to circuits above ground potential and for coupling to 500- or 200-ohm balanced-to-ground circuits.

A 500-to-500-ohm transformer, with both windings center-tapped (for balance to ground, if desired) and with an electrostatic shield between the windings is used for isolating the two 500-ohm circuits. Similar transformers for operation at other impedances can also be supplied upon order.

Although a master control is not an absolute necessity, it is a decided convenience where the monitoring operator must manage more than two channels and where considerable ranges of gain must be covered.

In any well-designed mixer the volume on each channel can be adjusted without altering that on the other channels. This is most easily accomplished by using volume controls of the constant-impedance type. Minor changes in impedance will have no noticeable effects upon the operation of the mixer. It is also extremely advisable that the controls be so arranged that a low-attenuation resistance network is still in the circuit when the control is turned to the minimum-loss position. This eliminates the possibility of the mixer opening up if any of the associated equipment is disconnected while its channel control is in the ON position. Of course each control should be individually shielded to eliminate crosstalk and noise pickup within the mixer itself, and should cut off completely in the OFF position.

Because a mixer is followed by considerable amounts of amplification, only quiet volume controls can be used. The actual quantitative measurement of noise becomes increasingly more difficult as the noise level is reduced and actual figures should be liberally discounted. The determining factor in the selection of any volume control should be its actual performance in service and not mere claims of the manufacturer.

A current transformer for low radio frequencies

By L. B. Hilton*

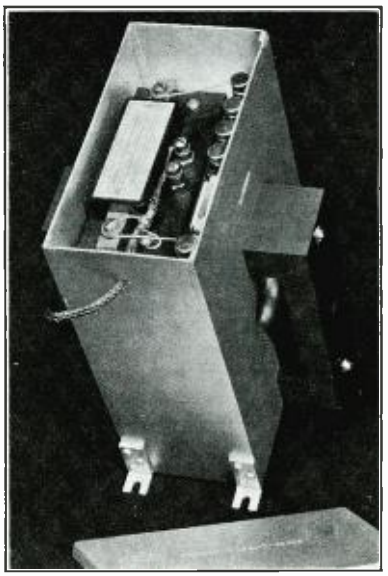

Fig. 1. The conductor carrying the current to be measured is passed through the center of the current transformer and held there by the insulating bridges at both sides. The heating element for the thermoammeter, in the upper part of the transformer, is connected to one of the four binding posts (upper right) for the desired current range.

THE development of radio-frequency circuits operating at high power levels has recently created a demand for apparatus suitable for the measurement of large currents at radio frequencies. In general the most convenient method of measuring large alternating currents is to use a current transformer, in which is induced a relatively small current whose value may be read on a small alternating-current ammeter. Current transformers for power frequencies have long been available and are in common use commercially. They have also been used in a few low-power applications at radio frequencies in the long-wave transatlantic radio telephone system. For high-power use at radio frequencies, however, it was necessary to develop a new type to measure high currents, with insulation suitable for the accompanying high potential to ground.

Such a transformer, designed for measurements at radio frequencies of the order of 60 kc., is shown in Fig. 1. It can be used to measure currents ranging from 10 to 500 amperes in conductors whose potential above ground may be as high as 10,000 volts. The conductor carrying the current to be measured is placed through the opening in the center of the apparatus, to act as the primary winding of the transformer.

The secondary windings are inside the apparatus proper and are arranged about the permalloy-dust cove in such a manner as to make possible the precise measurement of a wide range of currents with a single instrument. This is accomplished by designing the transformer secondary windings so as to provide four different current ranges for maximum currents of 500, 300, 100, and 50 amperes in the primary conductor. For each range, the transformer is designed so that the current from the transformer windings reaches a maximum of one ampere when the primary conductor current is the maximum for that current range.

To measure the current a thermoammeter with a range of zero to one ampere is connected to the secondary windings. The thermoammeter has two parts which may be widely separated, the thermocouple or "heating element" and the meter. A special compartment is provided in the top of the transformer to hold the thermocouple which can thus be connected easily to the transformer windings and yet kept completely shielded from any external high power circuits. By heating this element, a radio-frequency current of one ampere flowing through it causes a d-c. potential to be impressed on the meter which produces a full scale deflection. The typical calibration shown in Fig. 2 for a transformer of this type indicates the wide range of primary conductor currents which it can measure, and illustrates the overlapping of the different current ranges for greater precision of measurement. The instrument draws very little power for its operation—only a small fraction of a watt per ampere from the circuit.

A current transformer for either power or radio frequencies must have its secondary terminals short-circuited if the meter is disconnected. Failure to do this would cause an excessive rise in voltage at the transformer terminals which would create a dangerous condition and which might even destroy the transformer. In the new radio-frequency current transformer even this danger has been eliminated by providing a permanently connected protector[1] inside the transformer, which will prevent the building up of excessive secondary voltages in the transformer if the heating element should accidently be left disconnected.

Since the normal circuit potential between the conductor and ground may be as high as several thousand volts, alternating at radio frequencies, the conductor must be carefully insulated from the case to prevent breakdown and to avoid the possibility of corona formation, with consequent loss of energy and introduction of noise into the circuit. Fig. 1 shows how this transformer has been constructed to enable it to operate satisfactorily up to approximately 10,000 volts. Insulating bridges, located

*Engineer, Telephone Apparatus Development Department, Bell Laboratories.

[1] *Bell Laboratories Record, November, 1932, p. 80.*

well away from the opening, hold the conductor centered in the opening. No insulating materials other than air are permitted in the space between the conductor and the metal transformer case. For the highest voltages the inside surface of the transformer opening must be smoothed or polished to remove every irregularity and the outer surface of the conductor must also be smooth. Each end of the opening is smoothly flared on a large radius. The size of conductor fitting the bridges is the optimum for the transformer dimensions—a smaller conductor diameter reduces the potential at which corona forms, and a larger reduces the breakdown potential.

Before a current transformer was developed large radio-frequency currents were usually measured by means of high-current thermoammeters. The meter and the wires connecting it to the heating element were at the same radio-frequency potential as the heating element, and all had to be carefully insulated from ground. When the meter was located on the operating panel, glass windows had to be provided to protect the operating personnel from the high voltages.

Current transformers offer decided advantages over the directly connected thermoammeters previously used. One of the new transformers, with its single low-current meter, can measure as wide a range of currents as can be measured with several different thermoammeters, which are especially expensive in the larger sizes. The transformer may be placed anywhere in the circuit over existing conductors. This high insulation of the transformer permits the transformer case, meter and connecting cable to be grounded, thus simplifying the installation and providing maximum safety to the operator.

A number of these current transformers will be installed at various points in the antenna coupling circuits of the high-power amplifier in the proposed long-wave transatlantic radio transmitter. In these circuits they will operate at frequencies in the neighborhood of 60 kc.

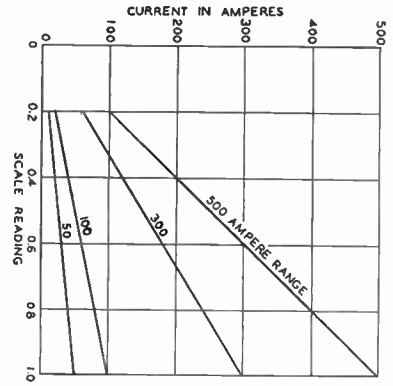

Fig. 2. By providing four current ranges in one current transformer, the instrument is given wide utility.

While the transformer, Fig. 1, is designed primarily for the the frequencies used in this transmitter, the design can be modified for much higher frequencies such as are used in high-power radio broadcast transmitters.

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PASSING OF DR. ARNOLD, LOSS TO RADIO

HAROLD DE FOREST ARNOLD, director of research of Bell Telephone Laboratories died early in the morning of July 10, of a heart attack. Dr. Arnold was born in Woodstock, Conn., on September 3, 1883, and received his undergraduate training at Wesleyan University in Connecticut. After further graduate work at the University of Chicago under Professor R. A. Millikan and a year as a professor at Mt. Allison University, he received the degree of Doctor of Philosophy from Chicago in 1911. Then entering the Research Laboratories of the Bell System he was one of the scientists who laid the foundation for what is now Bell Telephone Laboratories, Inc.

His contributions to knowledge have been in the field of telephone transmission, thermionics, and magnetics. In the field of thermionics he was one of the earliest scientific workers and was the first to appreciate the necessity for a high vacuum in the three element thermionic tube. Other contributions to this art were the development and application of methods for obtaining such a vacuum; recognition of the existence and the importance of the space charge effect of electrons in such a device and the calculation of the magnitude of this effect and methods for its adaptation to commercial purposes.

Dr. Arnold developed designs for vacuum tubes and methods for their manufacture so that tubes could be made to meet the telephonic requirements of reliability and ease of maintenance. This work included the development, under his immediate direction and at his suggestion, of an oxide coated filament as a source of electrons within this tube. He had charge of the adaptation of the tubes to the telephonic problem of long distance wire telephony and also of radio telephony. In recognition of these achievements, Dr. Arnold was awarded the John Scott Medal in 1928.

The stimulating guidance and personal contributions of Dr. Arnold were also responsible for the development in Bell Telephone Laboratories of the magnetic alloys, permalloy and perminvar. The first of these has an exceptionally high susceptibility to magnetism, many times that of the various materials previously available. In the form of a continuously applied loading to submarine telegraph cables, it has increased their message carrying capacity more than five-fold while its application to magnetic structures such as telephone receivers and transformers has been of great value in the undistorted transmission of sound. The alloy, perminvar, has the additional characteristic of being but little affected by superposed steady magnetizing forces so that it finds an important field of application in the cores of loading coils whose windings carry direct currents as well as the alternating currents of telephony.

As the research activities of the Bell System broadened his responsibilities were likewise broadened in scope with corresponding increase in staff for which work he has been responsible. Under his efficient direction, not to mention his very definite contribution of ideas, fundamental research work upon many phases of the communication art has been carried on. These have notably advanced the whole telephone art both wire and radio; they have made available new methods in land wire telegraphy; in submarine cable telegraphy they have furnished a new type of cable with appropriately modified methods of operation; they have given new methods of recording sounds, making possible improved phonograph records and making practical the so-called talking movie; and finally, not to extend the statement further, this work finds more or less direct application to the problem of those with impaired hearing.

During the World War, Dr. Arnold was commissioned a Captain in the Signal Corps and contributed effectively to the work in submarine detection.

Dr. Arnold was a member of Phi Beta Kappa, Sigma Xi, and Gamma Alpha Fraternities, and of the Franklin Institute, the American Chemical Society, and the American Association for the Advancement of Science. He was a Fellow of the American Institute of Electrical Engineers, of the American Physical Society, and of the Acoustical Society of America; a member of the last named society's Executive Council and its representative on the Governing Board of the American Institute of Physics.

STATEMENT

of

PHILIP G. LOUCKS
Managing Director
National Association of Broadcasters

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BUSINESS never again will be conducted as it was before the great depression. Unrestrained individualism is passing just as certainly as did unrestrained monopoly a quarter century ago. It has proved equally destructive.

The day when individual companies, through unrestrained cut-throat competion, could destroy the economic stability of a whole industry has passed. The business anarchist is doomed. Members of an industry must cooperate in the solution of common problems and in the improvement of trade standards and public service.

In the new business world a new importance is assigned to organized business groups. New responsibilities are placed upon trade organizations and these responsibilities can be met only through support of the industries they serve.

Recognizing the new obligations of trade organizations, the National Association of Broadcasters is speeding up the program which was approved at its last annual meeting. During the last several months the Association has established the Radio Program Foundation, a nonprofit corporation organized as a part of a campaign to rescue the broadcasters from its music copyright difficulties; the Association has established a business statistics service; a program interchange service; provided for a conference with agencies and advertisers for discussion of the station coverage problem; initiated a study into transmission conditions in all parts of the country; initiated a study of hours of work and wages; undertaken a study of the special representative and time broker problem; instituted a campaign for the elimination of unfair competition through rate-cutting; approved a standard order form for spot broadcasting; and took steps to institute a uniform system of cost accounting among stations. Many other minor phases of the program might be mentioned but these will tend to give some idea of the scope of the program now in progress.

Among the more important functions of the Association during the past several months has been its participation in meetings preparatory for the North American Radio Conference now in progress at Mexico City. Nearly a volume of technical data relating to the existing allocation and the characteristics of frequencies between 160 kc. and 1640 kc. was prepared for the benefit of the American delegation to Mexico City.

At the present time the Association is giving careful study to the status of broadcasting under the National Industrial Recovery Act. The broadcasters are eager to cooperate with General Johnson's administration but at the same time they are eager to avert possible conflict of authority between the administration and the Federal Radio Commission, which now licenses stations. In the meantime, however, the Association is busy gathering data on employment and general business which will prove of immense value in considering the status of broadcasting under the Recovery Act.

TRENDS IN BROADCAST ENGINEERING

By WILLIAM B. LODGE
Radio Engineer, C.B S.

IMPROVEMENTS in the technical side of broadcasting have been gradual and have often been the development of some small detail. There have been, however, several major improvements within the past year which should be interesting to the readers of RADIO ENGINEERING.

The most important of these has been in the field of antenna design. The practical application by WABC of the .58 wave vertical antenna has led to the general acknowledgment of the superiority of this type of radiating system. Greater efficiency and an increase of the fading-free service area have been the result of its use. There is another antenna problem which radio engineers have had to solve. That is the necessity of designing an antenna whose field strength pattern is highly directional. Within the past year WJSV, Alexandria, Va., has installed such an antenna with marked success. The high signal strength had caused interference at the Naval Laboratories directly across the Potomac from the transmitter. The field intensity at the Naval Laboratories was reduced to approximately 1 per cent of its former value. At the same time the signal in nearby Washington has actually been improved.

Another case in which a directional antenna was found necessary is that of WKRC in Cincinnati. Here, it was a question of either decreasing the power of the transmitter by one-half or employing such an antenna to prevent interference with stations in St. Louis and Buffalo operating on the same channel. Preliminary design shows that the interference will be better eliminated by the use of the directional antenna than by a reduction in the power, while the coverage in the local service area will not be impaired.

Another improvement to be noticed in broadcasting engineering, and one which the Columbia Broadcasting System is doing its best to further, is the increase of the volume range of the transmitted programs. The stations affiliated with the Columbia Broadcasting System have conducted a campaign to reduce the hum and extraneous noise from their equipment. As a result, the program engineers have been able to do less "compressing" of the program and still have the low passages audible. This has made a noticeable improvement in the fidelity of reproduction. At the same time, equipment whose frequency response was not of a satisfactory standard was either replaced or rebuilt.

Another interesting trend is the increased use of low powered portable transmitters in picking up programs from remote points. Broadcasts from boats, trains, airplanes, blimps, and automobiles, as well as from ground points, have been successfully produced.

The daily operation of a large broadcasting chain obviously leads to many small and detailed improvements. Their trend is toward a continuous improvement in program transmission and a smoothness of operation, which should be noticed by the radio audience.

AMALGAMATED BROADCASTING SYSTEM

JUST as the policies and practices of the Amalgamated Broadcasting System, third of the nation's radio networks, differ in some respects radically from previous concepts in the field so is it with Amalgamated's engineering setup, a series of surveys proves. These surveys were especially undertaken for RADIO ENGINEERING.

On the fourteenth floor of the new Amalgamated Broadcasting building—a 30-story buff-brick building at the northeast corner of Madison Avenue and 52nd Street in the heart of New York's so-called "Radio Row"—is revealed a studio setup thoroughly in keeping with advance promises made as to certain innovations and departures on Amalgamated's part. There are seven completely-equipped studios on this floor ranging from an assembly-hall studio to small "intimate" studios for individual broadcasts. One of these studios houses the largest pipe-organ regularly to be used in broadcasting and, so far as is known, the only built-in organ in any broadcast studio. Not only is this organ chamber, as are all seven studios, insulated with the most modern architectural and acoustic practice, but the chamber itself is isolated aerostatically. In other words the organ itself is not only insulated acoustically but its chamber is surrounded by an unimpeded stratum of air. This innovation is due to the consultation before Amalgamated's extensive building reconstruction begun, among Ralph W. Ahlschlager, the A. B. S. consulting architect; Frank Orth, A. B. S. chief engineer; President Ed Wynn, Vice-President Ota Gygi, and other Amalgamated officials.

Passing on to the strictly engineering aspects of Amalgamated's setup, some of the innovations of which have been jealously guarded, these facts were released by Chief Engineer Orth, his assistant, James J. Beloungy, formerly chief engineer of WEAF, and their aids especially for RADIO ENGINEERING.

The parent group of stations served from Amalgamated's headquarters comprises the so-called Atlantic Seaboard Network. This is as follows:

New York—WBNX-WCDA-WMSG, 250 w., 1350 kc. Trenton—WTNJ, 500 w., 1280 kc. Philadelphia—WPEN—250 w. daytime—100 w. night, 1500 kc. Wilmington—WDEL, 500 w. daytime, 250 w. night, 1120 kc. Baltimore—WCBM, 250 w. daytime, 100 w. night, 1370 kc. Washington—WOL, 100 w., 1310 kc.

These six stations are connected through the channel method. Each group of stations can comprise its own channel, on which the output of any one of five studios can be put, or any selective component or components of the six, within three seconds. It likewise is possible, through Amalgamated's own privately-designed setup to connect any combination of studios on any combination of outgoing channels at the same time!

Another interesting feature is that all studio circuits are so arranged that two-way conversation on loudspeakers between the control room and the studio can be used during rehearsals. Likewise the conventional telephone communication, which is such a psychological boon to busy directors when questionable talent is being auditioned, is in effect throughout.

The A. B. S. plant setup—its organ installation previously having been mentioned as one radical departure—has other revolutionary and tradition-dispelling aspects. The broadcast headquarters is the only network center extant, so far as is known, which is completely a-c. operated—no batteries are used whatsoever. In addition to Western Electric-built engineering equipment and specially-designed RCA microphones, many engineering short-cuts and innovations have been accomplished by Frank Orth, aided by his staff.

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THE INSTALLATION AT WHAM

(*Concluded from page* 13)

and the second of which modulates the carrier wave by plate circuit modulation at the output of the second radio frequency amplifier.

5. Two mercury-vapor rectifiers, one for supplying plate power to the radiation cooled tubes and the second for supplying the water cooled tubes.

6. A comprehensive automatic control and protective system.

As already indicated, these circuits are mounted principally in eight panel units which are complete within themselves and which are assembled together to form the main transmitter assembly. The employment of separate panel units facilitates manufacture, shipment and installation, permitting complete assembly and wiring before leaving the factory.

A simple and economical water-cooling system is employed for removing the heat generated by the high power amplifier tubes. In place of the large fan-cooled radiators previously used in the earlier transmitters, a heat interchanger has been inserted in the water system. The distilled water from the vacuum tube jacket is passed through the pipes of the interchanger. Water drawn from an outdoor spray pond is circulated on the other side of these pipes and a transfer of heat is effected. The heat interchanger is small and efficient and the pond with its spray furnishes a large cooling surface outdoors. Thus the space required indoors by the cooling system is reduced to a negligible factor.

Insulation between the vacuum tube jackets, which are at the same potential as the plates of the water-cooled tubes, and the pumps is provided by means of inserting runs of rubber hose in the piping system. These hoses, while selected particularly for the purpose, require replacement occasionally. To insure rapid and easy inspection and replacement, the hose is located in the basement of the building. Here the hose is not coiled on insulated forms, as is usually found in transmitting equipment employing water-cooled tubes, but mounted in straight runs on supporting insulators. The entire portion of the water-cooling system located indoors, therefore, has been arranged not only to occupy little space but to permit convenient operation and maintenance.

REQUIREMENTS OF A-F. SYSTEMS

By C. H. W. Nason

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RECENT developments in vacuum tube design permit high efficiencies of operation while researches in circuit methods have resulted in simplified design procedure permitting accurate prediction of operating characteristics. It is the double purpose of this article to set forth the basic requirements of a high quality channel and to describe the construction of an amplifier for their attainment. At some later date the basic design considerations will be detailed.

We know that the frequencies involved in music extend from approximately 16 cycles well out to 20,000. The high quality channel for normal requirements need not, however, have a frequency range greater than from 30 to 17,000 cycles. We may, therefore, get these limits for the gain-frequency characteristic of our amplifier.

The degree of harmonic distortion tolerable in any channel depends both upon the character of the distortional components and the high frequency limit of the channel. Exhaustive tests by the RCA Victor laboratories have led to the publication of the table given below. These will explain the reasons for the public acceptance of pentode and class B output systems in broadcast receivers.

	Single Sided		Push Pull	
Limit	Comparison	No. Comparison	Comparison	No. Comparison
14,000	5%	10%	3%	5%
8,000	5%	10%	5%	7%
5,000	5%	17%	>10%	>10%

Permissible distortion was determined as shown, with and without direct comparison with an undistorted channel having like cutoff. Note that the character of the distortion is a major factor since in the single-sided stage the even harmonics predominate while the third and higher order odd harmonics are predominant in the push-pull connection. The table fixes the permissible distortion in any channel beyond argument and is a valuable addition to the statistics of the art. There is still some doubt as to the degree of phase distortion (d/dw) allowable in a sound channel. It is a certainty that some impairment of quality results in long transmission circuits and must be compensated. Without data to the contrary, it is advisable to avoid sharp resonances, either intentional or otherwise in the design of amplifier systems save where applied as correctives. Even then it is advisable to avoid resonant systems where close design and performance checks cannot be made. This factor will be brought to a full mathematical conclusion in a future article.

The new 2A3 tube with its high cathode efficiency permits a plate efficiency of 50 per cent in the push-pull connection with proper load impedance and fixed bias values. This is nearly twice that attainable with normal triodes and compares more than favorably with pentode and class B output systems. With a plate to plate load of 3,000 ohms and a fixed bias of 62 volts a power output of 15 watts is attainable at 300 volts plate with but 2.5 per cent total distortion. In the complete channel the distortion of the penultimate or "driver" stage and of the voltage amplifiers must be held low. For this reason our channel employs a push-pull driver. A high voltage gain in the first stage has been attained through the use of the 77 tubes in a balanced resistance-coupled circuit. No harmonic cancellation is obtained, the balanced stage being merely for obtaining input to a push-pull system with resistance coupling.

But little popular attention has been paid the design of audio transformers from the standpoint of high quality other than to state the factors which govern high and low-frequency response. The use of a high permeability core material will not alone result in a high-quality transformer even though a flat frequency response is attained. The hysteresis of the core material results in the operation of the a-c. magnetizing force over a b/h curve having a loop of more or less open and deformed character. This results in a marked distortion of the output waveform. The core material employed in the Kenyon Laboratory standard transformers has been especially developed for high quality systems—a certain degree of permeability being sacrificed for a closed hysteresis loop-addition of sufficient copper, design of the individual transformers with a view to the d-c. magnetization and a-c. level involved. This results in a transformer series not limited in excellence to an improvement in low frequency response and decreased leakage reactance. Transformers for operation in push-pull and balanced circuits have special winding forms for identical characteristics of the two halves. The characteristics of a typical example of the line appear in Fig. 1. This gives a good idea of the excellence attained in frequency response, but cannot delineate the hidden factors just noted.

The power supply systems for the 2A3 tubes must have excellent regulation characteristics. This presupposes a power transformer of liberal design, an inductive filter input and sufficient capacitance to permit sustained passages at high levels without variation in output. Chokes must have adequate inductance, low resistance and must be

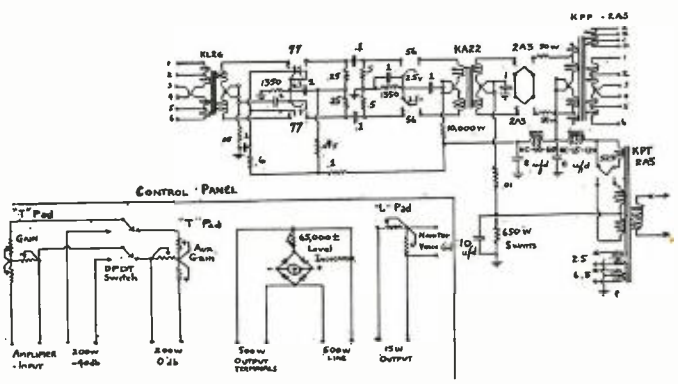

Fig. 1.

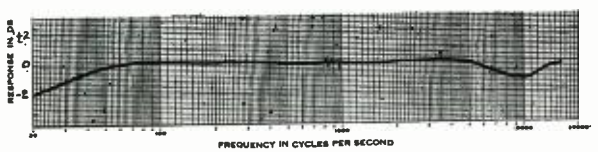

Fig. 2. Over-all frequency response of 2A3 amplifier.

designed with a view to fitness for the circuit in which they operate. This involves adequate air-gap despite the loss in initial inductance involved in a design having good regulation of inductance versus d-c.

The output capability of the amplifier shown is plus 34 db. with a total distortion of 5 per cent. The overall gain is 91 db. between 500-ohm circuits—slightly higher with 200-ohm input. The frequency characteristic is flat between 30 and 17,000 cycles, as shown by Fig. 2.

The KPP 2A output transformer is provided with taps to operate into lines of 500 ohms, 333 ohms, 250 ohms, 200 ohms, 125 ohms, 50 ohms, and into voice-coil circuits of 1.3, 3, 4.5, 7.5, and 15 ohms. The primary is tapped to provide operation with either fixed or "self" bias where loads of 3,000 ohms 5,000 ohms are required. The KL2G input transformer has the multiple line arrangement providing for the following impedance values: 17, 50, 125, 200, 250, 333, 500 ohms.

In reading the schematic circuit note that all resistors having values given as fractional megohms are of the 2-watt metallized type, while those given in ohms are of the 5-watt power type.

For convenient use of the amplifier in the laboratory or in the field the writer has constructed a control panel incorporating a simplified level indicator. The panel may be arranged to suit individual requirements. The level indicator is calibrated directly in decibels, sufficient accuracy being obtained for all normal purposes. A Triplett O-1 ma. d-c. meter is used in conjunction with an Erdi rectifier. This combination operates as a voltmeter in series with a 65,000-ohm resistor. This resistor must be adjusted to give a full scale reading at 86.5 volts (plus 34 db. in 500 watts)—calibration being made against any good meter at 60 cycles. The calibration points are as follows:

plus 34 db.	1 m.a.
32	.8
30	.64
28	.51
24	.325
20	.2
16	.13
12	.08
8	.05
6	.03

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I. R. E. CONVENTION

A NUMBER of interesting new developments were presented in Chicago during the annual convention of the Institute of Radio Engineers which was held on June 26-28 at the Hotel Sherman. Papers of interest to practically every one in the radio industry were included in the two dozen which comprised the technical portion of the program.

Among the more important papers was the presentation by Dr. Zworykin, of the RCA-Victor Company, on the "iconoscope," a non-mechanical scanning device which marks an important development in the progress of television.

B. J. Thompson and J. M. Rose, Jr., of the RCA Radiotron Company, outlined a development of miniature tubes and demonstrated their application in the generation and reception of signals in the centimeter region, sometimes referred to as dwarf waves. Radio-frequency amplifiers showing gains of approximately four per stage in the wavelength region of one hundred centimeters were discussed and demonstrated.

Electrical disturbances which presumably originate from a position in the solar system remote from the earth were discussed by K. G. Jansky, of the Bell Telephone Laboratories, and cover work which he has been doing for a number of months on the general problem of atmospherics.

Some interesting aspects of the influence of external design upon acceptance of radio broadcast receivers by the public was presented by H. L. Van Doren of Van Doren and Rideout, industrial designers. This is a subject in which the engineer is becoming increasingly involved.

The attendance at the meetings was the highest attained in the last few years and the banquet at which the Institute Medal of Honor and Morris Liebmann Memorial prize were presented was very well attended. Unfortunately neither recipient of these Institute awards could be present for the purpose and a representative of the English Consul accepted the Medal of Honor in behalf of Sir Ambrose Fleming. Similarly a representative of the German Consul was present to receive the Morris Liebmann Memorial prize which was bestowed upon Professor Heinrich Barkhausen.

Engineers active in the design and production of radio equipment were able to examine many new developments in component parts as well as test and measuring instruments which were displayed at the exhibition which has become a regular feature of these conventions.

Trips were made to the World's Fair which might well be described as a mixture of Coney Island and a liberal education in the arts and sciences. One could find there any type or variety of interest and the science group was particularly worth seeing. The high spots in the Communication Building were, perhaps, the A. T. and T. Company demonstration of high quality binaural reception and the RCA Victor cathode-ray oscillograph demonstration of the operation of a superheterodyne receiver.

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RADIO WHOLESALERS' ASSOCIATION

The Radio Wholesalers Association is now in a position to be of greater service to the distributing side of the radio industry than ever before.

The executive offices have been moved to 111 North Canal Street, Chicago, Illinois, and an active membership campaign is being conducted. The results of this campaign are already indicative of the wholesaler's realization of the need for organization.

The National Industrial Recovery Act has paved the way for an opportunity to be of direct benefit to the members of the association and to make it advisable for every radio wholesaler to participate in this movement. It affords an opportunity for the radio distributor to speak for himself through the medium of this organization in order to present a code of practices which are for the best interests of all concerned.

The Radio Wholesalers Association has created a special committee which is known as the National Industrial Recovery Act Radio Distributors Code of Practices Committee with Benjamin Gross, Gross Sales Inc., New York City, as chairman. The committee has already visited Washington in order to determine the best procedure to follow. They are in close contact with the similar committee of the Radio Manufacturers Association.

The association will be very glad to receive suggestions and recommendations from every distributor or local organization which they believe ought to be incorporated in the new code of practices. In this way the ideas of every section of the country can be carefully analyzed before making any definite and specific recommendations on the code to Washington.

In order that there might be no financial handicap placed upon radio distributors desiring membership, the dues have been greatly reduced for the period of 1933.

The major efforts of the association will be centered on the Industrial Recovery Act for the next few months at which time other activities will be developed and promoted for the best interests of the radio distributor.

Wholesalers seeking further information are requested to write immediately to H. G. Erstrom, executive vice-president, Radio Wholesalers' Association, 111 North Canal Street, Chicago, Illinois.

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

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

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Part XVIX

1885 (*Continued*)

(721) The Bishop Gutta Percha Company organized, taking over the business of Samuel C. Bishop, who had been manufacturing insulated wire since the year 1847.

1886 (722) Arthur C. Robbins, of Buffalo, N. Y., procures a patent for a printing telegraph system.

(723) The introduction of the typewriter by telegraphers, replacing pen and ink message copying, is becoming general in the larger telegraph offices.

(724) Oliver Lodge, in England, experiments with an electrical method of condensing smoke from the atmosphere.

(725) In Brooklyn, N. Y., street cars are lighted by electricity.

(726) The transatlantic cable rate is reduced (April 20) from forty to twelve cents per word in a rate war between the Mackay cable system and the Western Union Telegraph Company. (Later the rate was restored to twenty-five cents per word.)

(727) The Order of Railroad Telegraphers organized, June 9, at La Porte City, Iowa.

(728) The replacement of grounded toll telephone lines by metallic circuits begun in the United States and Canada.

(729) Franklin L. Pope is elected president of the American Institute of Electrical Engineers.

(730) Luther Stieringer obtains an American patent for an inclosed fuse element.

(731) The Westinghouse Electric and Manufacturing Company, East Pittsburgh, Penna., organized.

(732) The dry cell primary battery is introduced.

(733) The Edison machine works are moved from Menlo Park, N. J., to Schenectady, N. Y.

(734) Stephen H. Horgan, in the United States, and Mr. Glenn, in England, simultaneously invent a chart of squares by means of which pictures may be telegraphed.

(735) Magneto electric signals for railroad crossings are manufactured by the Switch and Signal Department of the Pennsylvania Steel Company, Steelton, Penna.

(736) In the interests of the United Lines Telegraph Company a suit is tried in the Supreme Court, New York, calling for $2,000,000 from the Western Union Telegraph Company, as damages for alleged illegal destruction of the former company's wires entering the company's offices in New York.

(737) Lucius J. Phelps is awarded the John Scott medal of the Franklin Institute for his inventions in telegraphic methods of communicating with moving trains.

(738) George Frederick Shaver invents a mechanical telephone exchange system, manufactured by the Consolidated Telephone Company, New York.

(739) M. Mercadier, in France, invents a system of wire signaling which he calls a RADIOPHONE. It is a tone system of telegraph signals transmitted through a telephone transmitter and received in a telephone receiver.

(740) The Postal Telegraph-Cable Company and the Canadian Pacific Railway Telegraphs, in Canada, make a twenty-five year agreement for exchange of traffic.

(741) An electric street railway system is planned for Pittsburgh, Penna.

(742) W. E. Irish invents a system of recording speech vibrations as received by telephone. The record consists of inked markings on a band of moving tape.

(743) The Postal Telegraph-Cable Company builds a line from San Francisco, Calif., to Port Moody, B. C., to connect with the Canadian Pacific Telegraph lines in Canada.

(744) The Edison Phonoplex system of induction telegraphy is introduced on several railroad lines. Samuel Insull has charge of the business.

(745) George C. Pyle, of Dayton, Ohio, procures patent No. 346,561 for an electric arc lamp for locomotive headlights.

(746) The North American Telegraph Company completes four copper wires between Minneapolis, Minn., and Chicago, August 22.

(747) A fusible cut-out for electric circuits is patented by Charles G. Perkins, of New York (Patent 348,048).

(748) Charles M. Hall, in America, discovers a process for the electrical production of aluminum.

(749) Hunnings' transmitter supercedes the Blake transmitter in the service of the Bell Telephone Company.

(750) Elihu Thomson procures a patent (No. 347,140) covering the invention of apparatus for electric welding.

(751) Charles McIntyre, of Newark, N. J., procures patent No. 347,625 covering the invention of a wire joint.

(752) The Central and South American Telegraph Company completes its cable connection to Nicaragua.

(753) William Preece, in England, reads an important paper before the British Association on the subject "Induction Between Wire and Wire."

(754) The Roberts-Brevoort Company, in the United States, introduces an improved form of dry-cell primary battery.

(755) Phillip Diehl, of Elizabeth, N. J., procures patent No. 350,668, for a small and powerful electric motor.

1887 (756) Joseph P. Davis is appointed consulting engineer of the Metropolitan Telephone and Telegraph Company, New York. Installation is begun of electrical subways for telegraph, telephone and electric light conduits.

(757) Tesla, in America, introduces the two-phase alternating-current motor commercially.

(758) Hertz, in Germany, shows that electromagnetic waves are practically identical with waves of light and heat.

(759) The Edison laboratory is moved from Menlo Park, N. J., to Orange, N. J.

(760) T. C. Martin is elected president of the American Institute of Electrical Engineers.

(761) The Phelps-Edison induction telegraph system is installed on the telegraph lines of the Lehigh Valley Railroad.

(*To be continued*)

NEWS OF THE INDUSTRY

RMA WILL LEAD A REBUILD RADIO PROSPERITY CAMPAIGN

A HIGHLY organized campaign to find a new prosperity for the radio industry will be staged this summer and fall under the leadership of the RMA. As announced by President Williams at the Membership Meeting, it will consist of two parts—an intensive sales drive during the month of September, and a week of special broadcasting from October 2 to 7, which will be known as Radio Progress Week. The organizing of the industry for cooperation in this program will begin immediately.

The business tide has turned. General prices are rising, and public gloom is changing to confidence and optimism. Men and women are now talking about the things they want to buy, and the spending will start soon. It is this reawakening market that this campaign is to capitalize.

There are now approximately six and three-quarter million homes using radio sets that are obsolete, and thirteen million homes that have no radio at all, but the radio industry cannot expect to sit back and let the returning prosperity pour new business into its lap. For every other industry is going to be out after these same dollars from the family budget. Automobiles, refrigerators, travel, clothes, and other strong personal appeals will be scrambling for attention.

So the radio industry is entering a season of better business with an intense competition to fight, and it is not a competition between radio manufacturers or radio distributors or dealers as in the past four years of sweat and tears. It will now be a competition with other industries that will be out energetically selling the home market. Therefore the radio industry must organize to throw its united strength into the market place, first and strongest.

Spectacular broadcasting will feature Radio Progress Week. People will be urged to get ready for this week of special broadcasting, and it will be a strong incentive right up until the end of September. After the week is over, it will still be a powerful selling argument because of the popular interest which will be aroused.

The prime objective, of course, will be to awaken a new popular enthusiasm for the present dependability of radio equipment, the perfection of its tone quality and control, and the scope artistry and excellence of modern programs. Intensified selling will create an added volume of business that would not mature without this urgent appeal. It will bring into active cooperation the two major branches of the radio industry, broadcasting and equipment. Manufacturers, distributors and dealers will be promoting the popularity of broadcasting to build up radio circulation. Networks, agencies and advertisers will be improving the appeal of broadcast to supply radio equipment sales.

The RMA is confident that if refrigerator dealers through local cooperation could sell a million household refrigerators in 1931, and 900,000 more in 1932, the radio industry can find a new prosperity in the market place this fall, if it will unite to sell radio against the field.

RCA RADIOTRON BULLETIN UL-6

RCA-Radiotron, Inc., of Harrison, N. J., has just released Bulletin UL-6 covering technical considerations of the reflex circuit. In general it covers theory and fundamentals with application notes dealing with specific circuits and other timely information.

◆

HOLYOKE APPOINTS NEW YORK REPRESENTATIVE

The Holyoke Company, Inc., 720 Main St., Holyoke, Mass., has opened a New York office at 205 E. 42nd Street, where Samuel Bialek will represent the company exclusively. The Holyoke Company is a manufacturer of insulated wire products for electrical and radio uses.

◆

"THE VERSATILE SERVICE OF BAKELITE RESINOID"

A brochure entitled "The Versatile Service of Bakelite Resinoid" has just been released by the Bakelite Corporation, Bound Brook, N. J.

The pamphlet sketches briefly the origin, manufacture and industrial applications of many types of Bakelite products created from the initial resinoid. Copies may be had upon request to the Bakelite Corporation.

◆

ARCTURUS MAY EXPORT SALES SHOW 25 PER CENT INCREASE

According to T. P. Feeney, export manager of the Arcturus Radio Tube Company, Newark, New Jersey, tube sales in dollars and cents volume for the month of May were 25 per cent ahead of the corresponding month last year.

TUBE MANUFACTURING ACTIVITIES NECESSITATES TRIP ABROAD

Victor H. Todd, president, Swedish Iron & Steel Corporation, sailed on July 6, 1933, on the *Ile de France* for an extended trip through Europe. He will visit the large radio tube manufacturers in England, France, Holland and Germany. Mr. Todd will also visit the works in Sweden where Svea metal is produced.

This trip has been made necessary by the widespread demand for Svea metal in wire, ribbon and other forms by a number of the large tube makers in Europe.

VICTOR H. TODD

KALKER TO HEAD SPRAGUE SALES

Harry Kalker, well known to the radio trade as sales manager of the International Resistance Company for a number of years, has been chosen to head the Sprague Sales Company, of North Adams, Mass., which will market through the jobbing trade condensers made for replacement purposes by the Sprague Specialties Company of that city. Mr. Kalker assumed his new duties on July 1 and will make his headquarters in North Adams where Sprague condensers have been manufactured for many years.

The new company will feature the Sprague "600" line of condensers. These are essentially the same units which the Sprague Specialties Company has been supplying to manufacturers for years, redesigned and styled for facility in replacement work. The line will be complete in every respect ranging from midgets to can and cardboard type dry electrolytes, automobile radio condensers and transmitting condensers.

Plans are now being made for an aggressive advertising and merchandising campaign. This will be based on a number of important new features incorporated in the Sprague "600" line.

◆

CROSLEY 80 PER CENT UP

More than 120 per cent more Crosley sets were built and sold during the five months ending June 1 than during the same period last year, and production during the first fifteen days of the month was 80 per cent greater than that for the entire month of June last year, according to a recent announcement by Powel Crosley, Jr., president of the Crosley Radio Corporation.

JOINT RADIO INDUSTRY COMMITTEE ON PUBLIC RELATIONS

The committees of the National Association of Broadcasters and the Institute of Radio Service Men to represent their respective associations on the Joint Radio Industry Committee on Public Relations have been named and preparations are being made to take the first steps in setting up a definite program. The Broadcasters' committee will consist of William S. Hedges, general manager of radio station KDKA, chairman; Henry A. Bellows, Washington, D. C., and Leo Fitzpatrick, Detroit, Mich. The Institute's committee consists of J. B. Durham, Chicago, chairman; L. Howard Sack, New York, and James E. Effer, Washington.

The work of conducting the committee's activities will be handled through the executive offices of the National Association of Broadcasters and the Institute of Radio Service Men in Washington, D. C., and Chicago, respectively. Other national associations are being invited to participate in the joint move and are expected to take an active part shortly.

◆

THE NEW PLANT OF THE SYNTHETIC MOULDED PRODUCTS, INC.

The opening of the new plant of the Synthetic Moulded Products, Inc., at Stonington, Connecticut, is announced through its president, O. W. Greene, Jr. This property is on the Boston Post Road, adjoining the tracks of the New York, New Haven and Hartford Railroad—conveniently located for either rail or truck shipment. The initial building is a modern brick structure, housing both office and manufacturing departments.

The machine equipment is new throughout and of the latest cost-reducing type. Eleven presses—varying in capacity from 50 to 320 tons—have been installed, and ten additional units are in order. The press equipment, when completed, will be adequate for the rapid and economical production of moulded parts of any size and in any quantity. The presses are supplemented by a battery of up-to-date pumps, accumulators and air compressors, all motor-driven. Steam is furnished by an oil-burning boiler.

◆

WESTINGHOUSE GIVES PAY INCREASE

Notice of an immediate raise in salaries and wages has been received in all offices, works and subsidiary companies of the Westinghouse Electric & Manufacturing Company.

The Westinghouse pay increase will add to the purchasing power of thousands of workers and will be effective in all sections of the country. Definite action such as this announced by President Merrick is further proof that electrical executives have assumed leadership in the nation-wide Industrial Recovery Program undertaken by President Roosevelt.

◆

GENERAL RADIO

The July, 1933, issue of "The General Radio Experimenter," published by the General Radio Company, of Cambridge, Mass., carries interesting material on cathode ray oscillographs; a new adjustable transformer, "Variac;" an electrolytic condenser testing bridge; wave analysis, and methods of securing small audio voltages. Copies may be had by communicating with the General Radio Company.

RADIOMARINE OFFICIAL SEES MARINE BUSINESS DEFINITELY ON UPGRADE

Orders on hand for new marine radio equipment give definite indication of an upswing of business in American shipping, according to Charles J. Pannill, executive vice-president of the Radiomarine Corporation of America.

Mr. Pannill pointed out that a substantial number of vessels are being recommissioned at this time, while others are placing contracts for apparatus and radiotelegraph service.

"Within the last week," Mr. Pannill said, "we have received contracts covering equipment and service for 5 ships of the Baltimore Mail Line and 2 ships of the Continental Steamship Company, as well as vessels owned by the Isle Royale Transportation Company, the Atlantic and Caribbean Steam Navigation Company and the Texas Company. We also have an order from the U. S. War Department to equip 12 seagoing dredges of the Corps of Engineers with radiotelegraph apparatus. Another order from the Pan American Airways is for furnishing radiotelegraph apparatus and a radio direction finder to the SS. Jelling which has been chartered by the Airways Company for survey work in connection with the proposed transatlantic air route.

"The company recently received from the Lykes Brothers steamship interests the largest single radio order ever awarded by a private American concern, covering 67 vessels."

◆

CRC TECHNICAL BULLETIN

A technical bulletin for engineers has just been issued by the Central Radio Corporation, Beloit, Wisc., covering general applications of the new CRC transformers and sockets. Copies may be had upon request to CRC.

◆

FAIRBANKS APPOINTED IRC SALES MANAGER

Effective July 1, Dan J. Fairbanks became sales manager of the International Resistance Company, 2100 Arch street, Philadelphia, Pa.

Mr. Fairbanks needs no introduction to to the radio trade. Coming with International Resistance Company in 1927, he was later appointed assistant sales manager. In this capacity he played a prominent part in building IRC products to their present outstanding position in the radio field.

Mr. Fairbanks will be ably assisted by Harry A. Ehle, a brother of the late Francis R. Ehle, former president of the company. Mr. Ehle has served as an executive in the IRC production department for a number of years.

Late in June, general offices of the International Resistance Company were combined with the IRC Engineering Department in spacious new quarters at 2100 Arch street, Philadelphia. Previous to this, the offices were located at 2006 Chestnut street.

◆

MAJESTIC PRODUCTION DOUBLED

Le Roi J. Williams, vice-president and general manager of Grigsby-Grunow Company, manufacturers of radio receivers and tubes, recently stated:

"Majestic radio shipments so far this June are already double those of all last June, and the production schedule is more than five times radio shipments for last June. Our radio production schedule for this month has not been equalled in June since 1929."

NEW PAMPHLET ON SOUND SYSTEMS AVAILABLE FOR SERVICEMEN

A very useful and interesting new 32-page pamphlet on sound systems has just been published by Federated Purchaser, Inc., 25 Park Place, New York City. Anyone interested in the installation or care of public-address systems may obtain a copy of this booklet gratis, upon request.

The booklet contains descriptions of numerous types of power amplifiers, ranging from a 30-watt double class A prime triple push-pull job to a simple low power amplifier.

The book is profusely illustrated and is full of facts and figures. Clear and concise explanations tell exactly what equipment is needed for different classes of public-address installations.

◆

TUBE DATA

The Raytheon Production Corporation, of Newton, Mass., has released a new tube chart covering all types of Raytheon tubes. Copies may be had upon request, either to the New York office at 30 E. 42nd St. or to Newton, Mass.

◆

STATEMENT BY W. R. G. BAKER, VICE-PRESIDENT OF THE RCA VICTOR CO.

"Through the medium of our employees' representation plan, the company has been asked to consider—prior to the establishment of a code for the radio industry—the increasing of rates for all hourly and piece-work employees.

"This matter has been given very serious consideration and I am pleased to advise that, subject to such modification as may be necessary upon the establishment of a code for the radio industry, a 10 per cent increase in wages for all hourly rated and piece-work employees will be effected July 24, which is the date we return to work after our vacation period. This wage increase will affect approximately 80 per cent of the employees of the RCA Victor Company."

◆

METAL CLAD TUBES

It is rumored that more than one tube manufacturer is investigating the possibilities of the new metal-clad tube construction, an example of which is the English Catkin. Apparently it is felt in some quarters that some adaptation of this method of construction may eventually come into use in this country.

Advantages claimed are a more rigid anchorage of the elements, with resultant breakage savings and decreased losses in shipment,—an angle which seems to be particularly interesting to the receiver manufacturers.

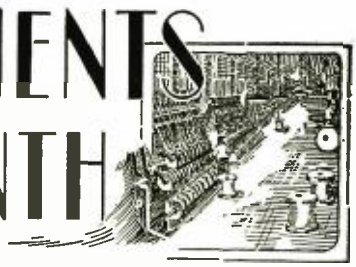
◆

KENYON 2A3 AMPLIFIER

The Kenyon Transformer Co., Inc., of 122 Cypress Ave., New York City announces that a complete constructional chassis layout is available on a Kenyon Laboratory Standard triple push-pull 2A3 amplifier that uses the following tubes: 2—57, 2—56, 2—2A3, 1—82, 1—83.

The completed amplifier has an extended linear response over a nine octave range. The gain at 1000 cycles is 97 db. The input line impedances available are 17, 50, 125, 250, 333 and 500 ohms. The output impedances available are 500, 333, 250, 125, 50, 15, 7.5, 4.5, 3 and 1.3 ohms.

NEW DEVELOPMENTS OF THE MONTH



NEW CABLE TYPE SUPPRESSOR

A decided improvement in cable type automobile radio suppressors has been announced by the International Resistance Co., 2100 Arch street, Philadelphia, Pa. This is known as the "MCA" improved cable end type suppressor and is designed to simplify what has heretofore been one of the most difficult suppressor installations. One end of the suppressor fits on the spark plug itself while the cable fastens on to the recessed screw in the other end for sure solid contact in the very center of the wire.

Besides being far superior to old style suppressors for general use, this new IRC

product is especially adapted for Fords and is ideally suited for installing where it is impossible to use the ordinary type of cable unit. The standard MCA suppressor is rated at 15,000 ohms while those adapted for Ford use are 50,000 ohms.

This new suppressor has the further advantage of new low resistance contact recently announced by IRC. Besides definitely removing the most common cause of suppressor failure—poor contact—this latter feature greatly improves noise suppression performance as well.

◆

3.2 RADIO?

A unique radio, following certain popular trends in design that have come into prominence since the re-legalization of beer, has been announced by R. K. Radio Laboratories, Inc., 6300 Northwest Highway, Chicago, Illinois.

The set is a 5-tube superheterodyne, using one 77, 78, 85, 43 and 25Z5 new

heater type tubes. Operates from either direct or alternating current, covers complete broadcast band, also gets police calls. The speaker, mounted in the cylindrical cask, is a full 5-inch dynamic.

NEW ZAPON FINISH

The tremendous popularity of suede and suede-like materials has led to the development of a revolutionary new finish by The Zapon Company, Stamford, Connecticut, a subsidiary of Atlas Powder Company. It is known as Sprayed Izarine Finish. Formerly the covering of any article with suede or imitation suede meant cutting and pasting innumerable pieces and then laboriously mounting them. Now a suede-like finish can be given to any surface by merely spraying a unique enamel and an equally unique Izarine powder with an air-gun.

The process, which is completely covered by patent applications, is simple, but research covering many years was necessary before it was perfected. The problem was to formulate an enamel that would remain wet long enough to leave time for the spraying on of the Izarine powder and yet dry rapidly thereafter without the need of baking or other artificial forcing.

Manufacturers in many different fields are negotiating with The Zapon Company for licenses to use this new finish.

◆

SOLAR CONDENSERS

Solar Manufacturing Corporation, 599-601 Broadway, New York City, is now manufacturing paper condensers in a department recently installed for this purpose. This department is equipped with automatic winding and impregnating machinery designed to take care of both standard and special types of paper-dielectric condensers. The complete Solar line now covers all fixed condensers used in the radio and allied industries, including wet

and dry electrolytic condensers, paper condensers, and molded mica condensers.

Solar also announces the appointment of Superior Sales Corporation, 1225 South Olive Street, Los Angeles, California, as sales representatives for the states of California, Nevada, Arizona. L. F. Schwamb is district manager.

◆

MUTER CANDOHMS

The Muter Company, 1255 S. Michigan Ave., Chicago, Ill., has recently released literature covering their complete line of Candohm resistors for use in the radio and communication fields. Copies will be sent to responsible organizations making letterhead requests.

THE RCA-19, CUNNINGHAM C-19

The RCA Radiotron Company, Inc., and E. T. Cunningham, Inc., have recently released to equipment manufacturers a Class B Twin Amplifier tube designed as Radiotron RCA-19 and Cunningham C-19, respectively.

The 19, like the types 53 and 79, combines in one bulb two triodes designed for Class B operation. It is intended for use in the output stage of battery-operated receivers and is capable of supplying approximately two watts of audio power.

CLASS B TWIN AMPLIFIER
TENTATIVE
RATING AND CHARACTERISTICS

RCA RADIOTRON RCA-19	CUNNINGHAM C-19	
Filament voltage (d-c)	2.0	v.
Filament current	0.26	amp.
Maximum overall length		4¼ in.
Maximum diameter		1-9/16 in.
Bulb		ST-12
Base (For connections, refer to Note 1)		Small 6-Pin

CLASS B POWER AMPLIFIER

Plate voltage			135†	v.
Dynamic peak plate current (per plate)			50†	ma.
Typical operation:				
Filament voltage	2.0	2.0	2.0	v.
Plate voltage	135	135	135	v.
Grid voltage	-6	-3	0	v.
Static plate current	1	4	10	ma.
Load resistance (plate to plate)	10000	10000	10000	ohms
Average power input*	95	130	170‡	milliwatts
Nominal power output	1.6	1.9	2.1	watts

*Applied between grids to give indicated values of power output.
†Max.
‡Approx.

Note 1:

Pin 1-Grid (Triode T_2) Pin 4-Filament
Pin 2-Plate (Triode T_2) Pin 5-Plate (Triode T_1)
Pin 3-Filament Pin 6-Grid (Triode T_1)
Pin numbers are according to RMA Standards.

THE Group Subscription Plan for RADIO ENGINEERING enables a group of engineers or department heads to subscribe at one-half the usual yearly rate.

The regular individual rate is $2.00 a year. In groups of 4 or more, the subscription rate is $1.00 a year. (In Canada and foreign countries $2.00.)

The engineering departments of hundreds of manufacturers in the radio and allied industries have used this Group Plan for years, in renewing their subscriptions to RADIO ENGINEERING.

Each subscriber should print his name and address clearly and state his occupation—whether an executive, engineer, department head, plant superintendent, or foreman, etc.

Remember this Group Plan when *Your* Subscription Expires

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PENTAGRID CONVERTER

The 1A6 is a multi-electrode type of vacuum tube designed primarily to perform simultaneously the function of a mixer tube and of an oscillator tube in superheterodyne circuits. Through its use, the independent control of each function is made possible within a single tube. The 1A6 is designed especially for use in battery-operated receivers. In such service, this tube replaces the two tubes required in conventional circuits and gives improved performance.

The action of this tube in converting a radio frequency to an intermediate frequency depends on independent control of the electron stream (1) by three electrodes (including the filament) connected in an oscillator circuit and (2) by a fourth electrode (a grid) to which the radio input is applied. As a result of this arrangement, it is apparent that the simultaneous control by these two groups of electrodes will produce variations in the electron stream between cathode and plate. Since the electron stream is the only connecting link between these two control-factors. this converter system may be said to be "electron coupled."

Pentagrid Converter
Tentative
Rating and Characteristics

RCA Radiotron	Cunningham
RCA-1A6	C-1A6
Filament voltage (d-c.)	2.0 v.
Filament current	0.060 amp.
Direct interelectrode capacitances (approx.):	
Grid No. 4 to Plate	0.25* μμf.
Grid No. 4 to Grid No. 2	0.2* μμf.
Grid No. 4 to Grid No. 1	0.1* μμf.
Grid No. 1 to Grid No. 2	0.8 μμf.
Grid No. 4 to all other electrodes (r-f. input)	10.5 μμf.
Grid No. 2 to all other electrodes (osc. output)	6 μμf.
Grid No. 1 to all other electrodes (osc. input)	5 μμf.
Plate to all other electrodes (mixer output)	9 μμf.
*With shield-can	
Overall length	4-9/32" to 4-17/32"
Maximum diameter	1-9/16"
Bulb	ST-12
Cap	Small metal
Base	Small 6-pin

Converter Service

Plate voltage		180 max. v.
Screen voltage (grids No. 3 and No. 5)		67.5 max. v.
Anode-Grid (grid No. 2)		135 max. v.
Control-Grid (grid No. 4)		—3 min. v.
Total cathode current		9 max. ma.
Typical operation:		
Filament voltage	2.0	2.0 v.
Plate voltage	135	180 v.
Screen voltage (grids No. 3 and No. 5)	67.5	67.5 v.
Anide-Grid (grid No. 2)	135	135 v.
Control-Grid (grid No. 4)	—3	—3 v.
Oscillator-Grid (grid No. 1 resistor	50,000	50,000 ohms
Plate current	1.2	1.3 ma.
Screen current	2.5	2.4 ma.
Anode-Grid current	2.3	2.3 ma.
Oscillator-Grid current.	0.2	0.2 ma.
Total cathode current..	6.2	6.2 ma.
Plate resistance	0.4	0.5 megohm
Conversion conductance**	275	300 micromhos
Conversion conductance at —22.5 volts on grid No. 4	4	4 micromhos

**Conversion conductance is defined as the ratio of the intermediate-frequency component of the mixer output current to the radio-frequency signal voltage applied to grid No. 4.

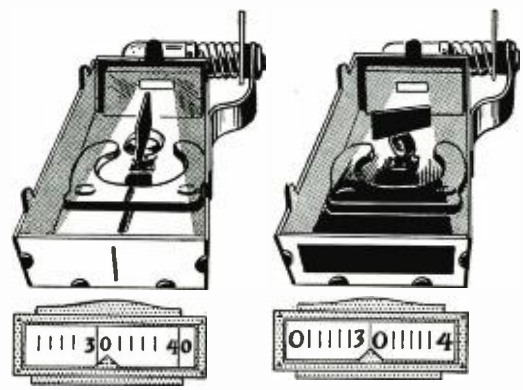
Federal Type F-307 mercury vapor rectifier.

WESTINGHOUSE SHADOW DIAL

Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa., has designed a tuning meter which gives an indication by means of a shadow effect on, or near, the station selector dial.

The meter consists of a light aluminum vane mounted on the instrument movement and arranged to intercept the light from a miniature lamp. This casts a shadow of the vane on the translucent dial and serves instead of the usual pointer. The best tuning adjustment is indicated by the narrowest shadow cast by the vane. The width of the shadow will vary with strengths of different stations, but for any given station it is very easy to watch the shadow and get the best effect.

It is interesting to note that the mechanism used is what is known as the "polarized vane type. This is perhaps the earliest form of direct-current instrument and was selected for this use on account of its extreme simplicity. It has no moving coils, springs or jewels; the entire moving element consisting only of three parts—the shaft, the iron vane and the shutter. The vane operates under the combined magnetic influence of a miniature permanent magnet and of a simple stationary coil.



Schematic diagram of the Westinghouse shadow tuning device. When the narrowest shadow is reached the set is perfectly tuned.

A NEW RECTIFIER TUBE

The Federal Telegraph Company, 200 Mount Pleasant Avenue, Newark, N. J., announces Type F-307 mercury vapor rectifying tube.

Main Use	Half wave rectifier
No. of electrodes	2
Filament voltage	5 v.
current	20 amp.
type	Oxide coated
heating time	60 seconds
Maximum peak current	5 amp.
Maximum peak inverse voltage	20,000 v.
Overall dimensions	
Maximum length	11 13/16 in.
Minimum length	14 1/8 in.
Maximum diameter	5 1/16 in.
Type base and cap	Standard
Mounting	Standard or F-476-1
Type of cooling	Air
Recommended operating ambient temperature range	0—50° C.

The above information by no means represents exact conditions of operation to be imposed for any particular situation. Tubes are used under many widely different conditions and consequently the manufacturer should be consulted for information regarding characteristics for design purposes.

Federal engineers have improved this type of mercury vapor tube by shielding it In the F-369-A the arc is confined within the shield which reduces bulb blackening and practically eliminates the effect of extraneous modulated and unmodulated high frequency fields.

A special filament core material insures permanency of the oxide coating and prevents flashing.

◆

TRIMM HEADSETS

The Trimm Radio Mfg. Company, 1528 Armitage Ave., Chicago, Ill., has recently made additions to their line of headsets for radio, aircraft and public-address use.

Particularly interesting is the new Trimm miniature featherweight earphone furnished in any resistance from 6 ohms to 2,000 ohms. The Trimm Company has recently released illustrated description of their entire line of headsets for every purpose.

◆

CRYSTALS

The Scientific Radio Service, 124 Jackson Ave., University Park, Hyattsville, Md., specializing in producing piezoelectric crystals exclusively since 1925, have available piezoelectric crystals for all radio and experimental purposes.

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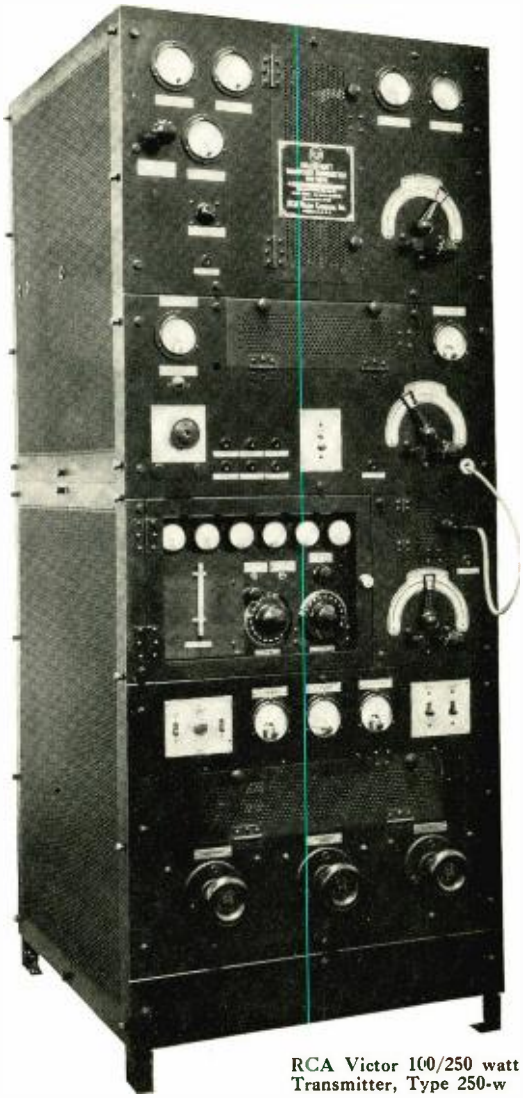
Low-cost operation of 100/250 watt stations



RCA Victor 100/250 watt
Transmitter, Type 250-w

Use of "CLASS B" modulators cuts tube cost in half

The outstanding advance in transmitter design during the last year has been the perfection and utilization of a "Class B" modulation system. This development has increased the efficiency of modulator tubes nearly ten-fold and, correspondingly, has reduced the required transmitter tube capacity by more than one-half. The saving in tube cost thus effected is particularly important in low-power stations where this cost is a relatively large item of operating expense.

The Type 250-W Transmitter is the only transmitter of standard manufacture in which this "Class B" modulation system is available. Moreover, this transmitter also offers a saving in first cost, for it has been designed to provide in one unit for 250 watt as well as 100 watt operation. The RADIOTRONS employed for 100 watts also provide for 250 watts. An additional amplifier unit is not necessary.

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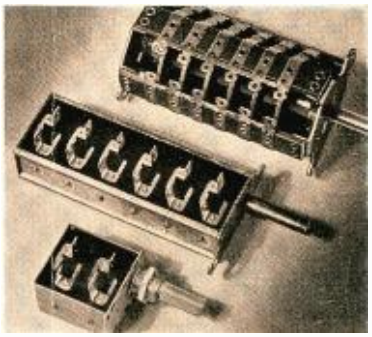

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