Eleventh Year of Service

RADIO ENGINEERING

Vol. XI AUGUST, 1931 No. 8

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NOISE GENERATION WITHIN RADIO RECEIVERS
By Rinaldo DeCola

USING SHORT-WAVE ADAPTERS AND CONVERTERS
By Clyde A. Randon

VACUUM TUBES AND THEIR APPLICATIONS
By W. C. White

PUSH-PULL ARRANGEMENTS OF UNUSUAL CHARACTER
By C. H. W. Nason

HOTEL RADIO TO PAY ITS WAY
By Earl Y. Poore

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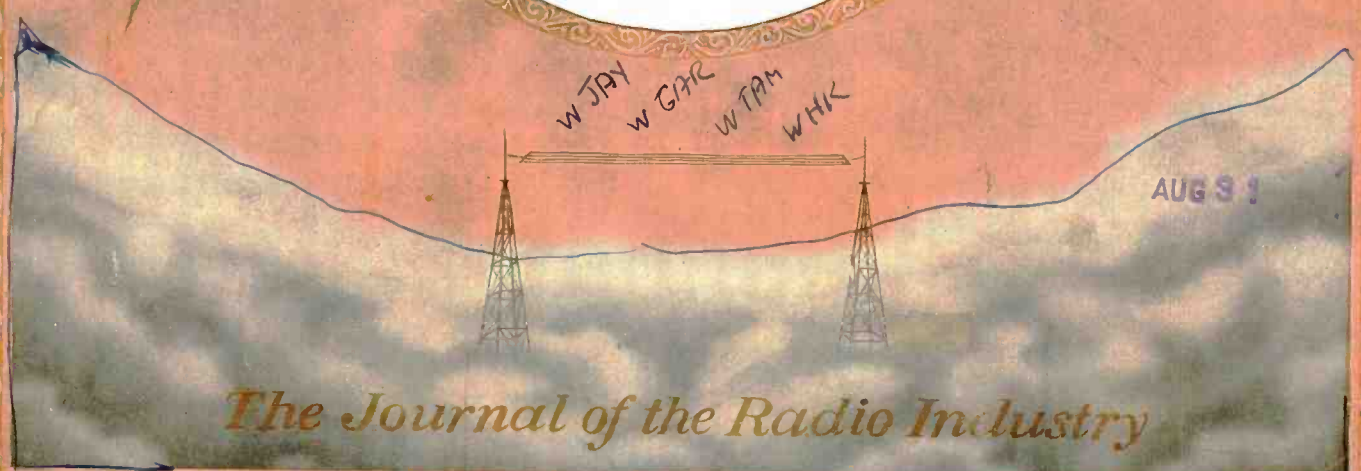
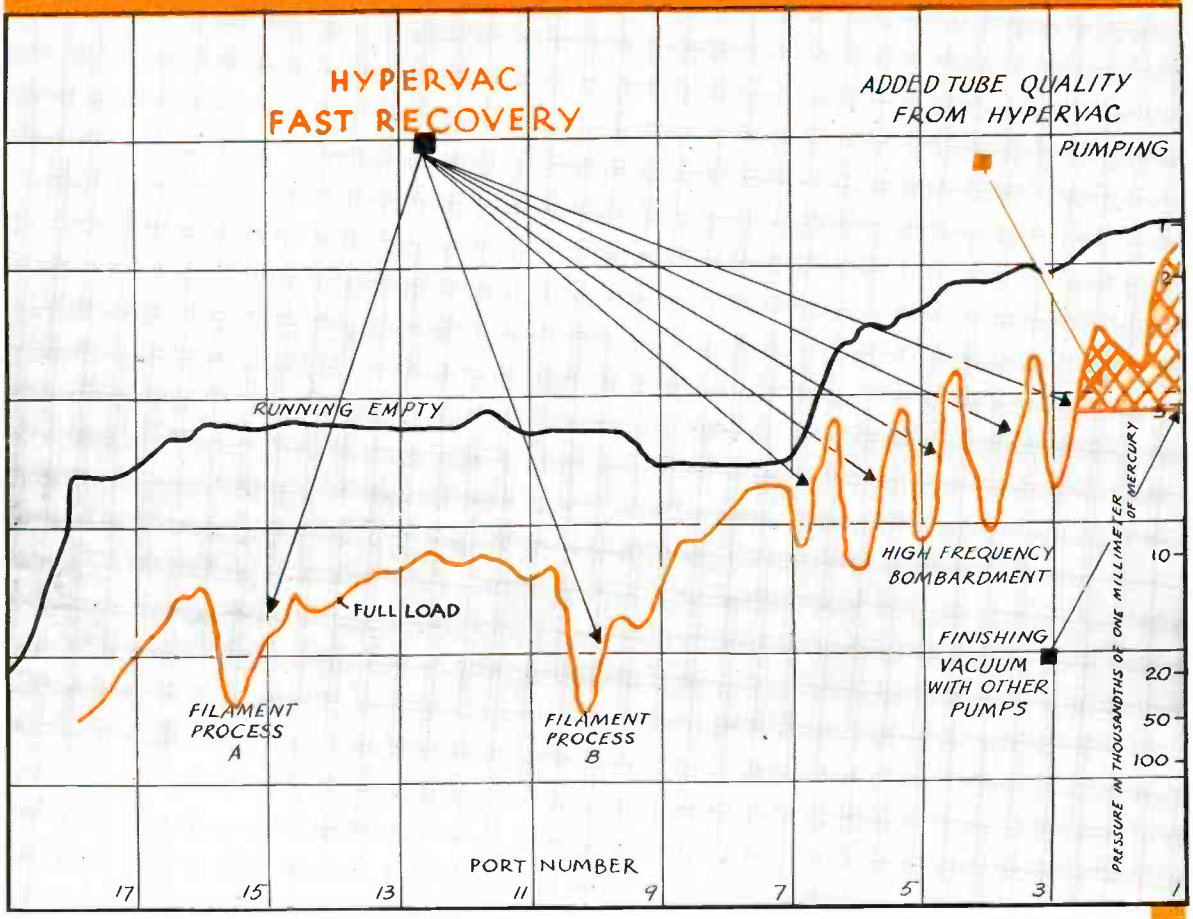


The Journal of the Radio Industry

How Cenco Hypervac Pumps *increase radio tube quality*

AS TOLD BY PRODUCTION CURVES AT ROGERS RADIO LTD.



IN PLANTS where accurate records of process efficiency are maintained, it is possible to identify the exact ways in which Cenco Hypervac pumps improve both product quality and product cost.

These graphs, taken from the records of screen grid tube production at Rogers Radio Limited, represent continuous port to port vacuum measurement, with and without load, on an automatic machine whose last eighteen positions are CENCO HYPERVAC pumped.. The unloaded curve marks the best vacuum allowed by the characteristics of the exhaust machine itself. The loaded curve approaches this in proportion to the efficiency with which the pumps remove gases as they are released from the load.

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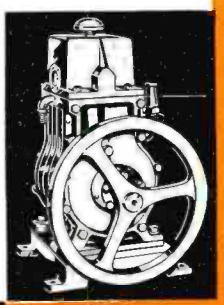

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THROUGHOUT the long series of events and stages of litigation which have led down to the present situation with regard to radio patents, the Radio Corporation of America may at least be credited with orderly procedure. With the idea established that large industrial organizations, in order to be on solid foundations, must be in strong patent positions, the policy of R. C. A. in this regard seemed logical, and protective to its own interests.

It was, of course, inescapable that as the industry expanded competitive interests, desirous of establishing themselves as manufacturers, should experience checks and interferences which were widely regarded as oppressive. Contract requirements insisted upon by R. C. A., no doubt, were restrictive in making it difficult for certain independent radio manufacturers to build up profitable volumes of business. That various concerns, perhaps only temporarily in radio, rode boldly upon the crest of the wave of protest made by legitimate independent establishments, on more than one occasion served to cloud the actual issues and mislead the public.

The deliberate, if slow, entry of the National Department of Justice into the controversy during recent months, served to bring forward for judicial review and consideration all of the matters in dispute between R. C. A. and other manufacturing units of the industry.

It is now probable that during the coming months modifications of policy will be worked out which will remove much of the obstruction which, legal or illegal, has kept the radio manufacturing industry in a turmoil for twenty years past.

BRYAN S. DAVIS, *President*
JAS. A. WALKER, *Secretary*

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Editorial

AUGUST, 1931

WELL DONE, MR. METCALF.

THE entire radio industry owes a debt of gratitude to Mr. Morris Metcalf, retiring president of the Radio Manufacturers Association, for the able manner in which he directed the organized efforts of the business during the past year.

In June, 1930, the radio sales outlook was dismal enough to worry the most sanguine go-getter. In addition to the declining demand for radio receivers due to the economic depression, there were many loose ends within the radio industry which needed selvaging. The morale of cooperation, or at least of fair dealing, between manufacturing units, had suffered grievously.

The president of the R. M. A. has no end of responsibility, but his authority is mainly that which may be exercised by an intelligent, courteous, conciliatory, but forceful personality. That Mr. Metcalf during his term as president held the organization in line and strengthened it was evidenced by the great gathering at Chicago in June—evidenced also in the smoothly functioning machine which kept watch on every detail of this large industrial gathering.

▲

PRODUCTION IN 1931

PRODUCTION of radio receivers this year indicates that hitherto neglected markets are being cultivated. Twenty manufacturers are turning out midget receivers designed to employ 2-volt tubes and to operate on the new, long life dry-cell batteries. These receivers will find service in many places where commercial a-c. power is not available, and in locations where the battery sets of earlier years failed because of short life of the batteries employed.

In the makeup of the 1931 receivers operating on house current almost every need and desire of prospective purchasers have been met. Receivers are on the market which fit into almost any available space. Almost every need of color and finish may be satisfied, and as to clarity and volume of reception all of the present day receivers made of dependable parts are superior to the sets passed over counters even a year ago.

Production, moreover, is well in hand. Most manufacturers of receivers have determined upon a general output which they believe can be marketed within a year, while at the same time the larger factories are in a position to enlarge production rapidly, should conditions improve sufficiently to stimulate the demand for receivers.

In our July rounds to the factories of receiver components manufacturers we visited plants where practically every work bench was manned and where there was not displayed much eagerness for additional orders at present. It is true that in some shops the misfortunes of the past still weigh heavily around Board rooms, slowing down noticeably initiative and exploitation.

A noticeable outcome of the times is that various manufacturing organizations have been relieved of much of the top heaviness which accumulated during the unusually good sales years. The best managed plants now appear to have under control a flexibility of organization and of production which is necessary for present market conditions, yet which will be promptly responsive to an improving market.

▲

CRASHING THE MIKE

IT is perhaps a concomitant of the newness of radio that an agreeable and popular technique of broadcasting has not yet evolved. The great American ambition to "make" the front page of a newspaper is losing out to a widespread desire to "crash the mike."

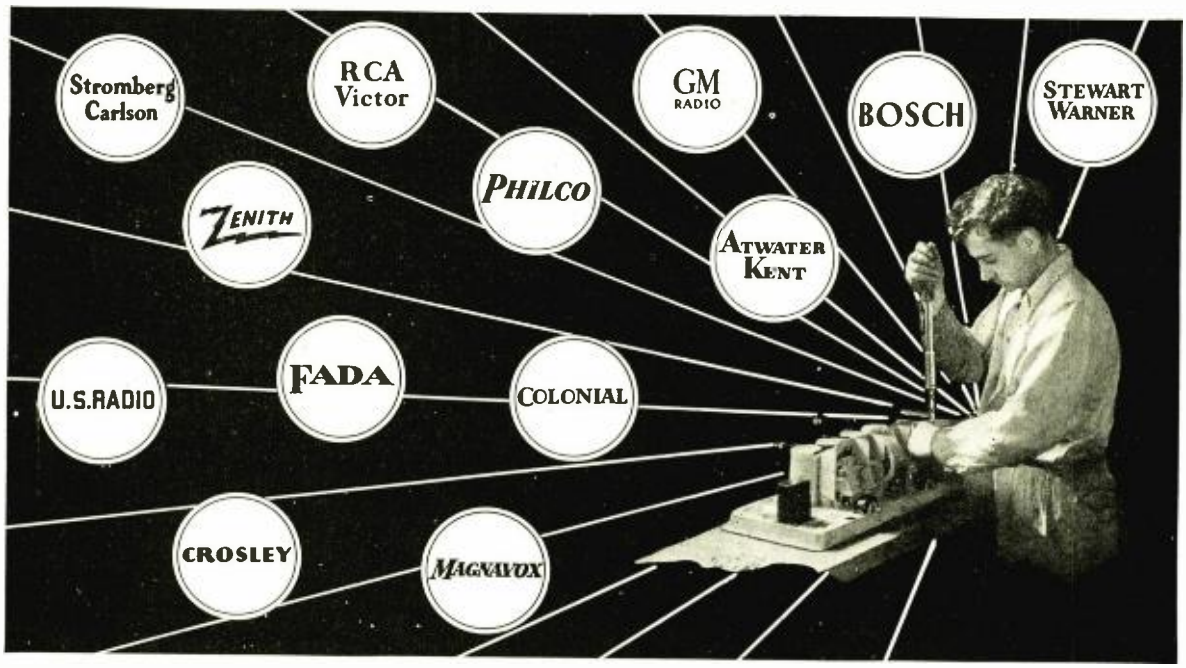
It has often been commented upon in recent months, by radio listeners, that it is a most singular thing should Mr. Graham McNamee hurriedly rush to the scene of a prize fight, a regatta or a disaster to broadcast the details to a waiting world, that at his elbow, or within hailing distance of the mike should instantly materialize the salesman for a glass wind-shield manufacturing concern, who, when stalling along is unavoidable, jumps to the task like a seasoned front pager.

It will require vigilance on the part of broadcasters to keep publicity seekers from ruining the broadcasting business.

Donald McNicol

Editor.

THE RADIO INDUSTRY DEMANDS ASSEMBLY SPEED, ECONOMY AND SECURITY



Leading manufacturers obtain all with Self-tapping Screws

Build fifty thousand sets in thirty days! Such an order is not unusual in a great radio manufacturing plant. Each improvement in radio design, every buying season, sends production skyrocketing overnight. Speed is the password of radio production. Speed to meet delivery schedules. Speed to meet cost schedules, too.

To attain rapid, uninterrupted work along the assembly line, leaders in the radio industry use Self-tapping Screws. By experience they know that these unique Screws offer the simplest, easiest way of making the many fastenings required in the assembly of each receiver. In a year's production of the Famous Philco Balanced Unit Radio, more than twenty-seven million tapping operations are eliminated by Self-tapping Screws. Radio assemblies made so much quicker and cheaper, are also stronger. Scientists have proved that fastenings made with Self-tapping Screws hold better than machine screws or bolts and nuts under tension, shear and vibration stresses.

Whether you produce ten or a thousand units a month . . . if your product requires metal assembly, Self-tapping Screws probably will reduce your fastening time and costs. Find out. Our Assembly Engineers will gladly and honestly tell you whether you can use Self-tapping Screws to advantage if you attach a description of one or more assemblies to the coupon below. You will find the two free booklets shown below worth careful reading ... be sure to get them.

Hardened Self-tapping Sheet Metal Screws

For joining and making fastenings to sheet metal up to six gouge; also aluminum, die castings, Bakelite, etc. Simply turn Screw into drilled, pierced or molded hole. It forms a thread in the material as it is turned in. Can be removed and replaced.

Type "U"—Hardened Metallic Drive Screws

This type of Self-tapping Screw is used for making permanent fastenings to iron, brass and aluminum castings, steel, Bakelite, Durez, etc. Just hammer the Screw into a drilled or molded hole. It forms a thread in the material as it is driven.

PARKER-KALON *Hardened* Self-tapping Screws

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Name and Co.----------

Address----------

Impressions and Expressions

By AUSTIN C. LESCARBOURA

WHEN PRICE TALKS

THE radio industry, which has never hesitated to talk price even in prosperous times, is busy these days establishing lower and still lower prices. Quality seems to have gone overboard, and everyone is buying on price. Which gives food for some radically new thoughts.

If we are in a price market, there is little to be gained by talking quality. Time and again the quality plea is pushed aside and the buyer decides on the price basis. While this situation is readily met by the smaller manufacturers with minimum overhead, no research staff, no advertising and no prestige to defend, it is proving more and more of a problem to the larger manufacturers.

There is just one way for the larger manufacturers to meet this price situation, and that is to play the same game without jeopardizing their regular line and good name. In other words, this is the time to introduce new brands geared to the price demand. One manufacturer after the other is going into a second and third brand, priced to meet the new day competition, depending on a sufficient sale to warrant the anticipated low production costs. In many instances the demand proves so great that the manufacturer in time is able to bring his regular brand down to the new low prices, gaining that much more acceptance by offering the quality brand.

Rather than jeopardize the quality brand, the second and third brands should be introduced, for it is only a question of time when the market will again be demanding quality.

▲

WANTED: TELEVISION SHOWMANSHIP

TELEVISION companies report a marked falling off in their sales during the past sixty days. This is most disappointing since television sales were mounting by leaps and bounds during March and April. Yet the matter is readily explained—and even remedied, if that is the desire of those concerned.

The crux of the trouble is that television broadcasters have failed to pay proper attention to programs. True, they have gone on a more or less regular schedule, which is the first step. Some have made a serious attempt at entertainment programs. During the past sixty days, however, there has been a definite falling off in whatever showmanship may have been developed in television broadcasting, and we are practically back to the transmitting of films and test pickups of little or no entertainment value.

Before television is definitely accepted by the public, with the resultant sale of television home equipment, we shall have to organize television entertainment. In this respect the problem is no different from the development of sound broadcasting, which did not take hold until real showmanship on a time-table basis came to take the place of radio telephone tests. Ultimately the regular sound broadcasters are certain to introduce the television supplement, flashing closeups of their favorites which may be tuned in as an optional feature by the broadcast audience. In the meanwhile, the television companies could do much to help their cause along by presenting some genuine entertainment. A little more showmanship would make a big difference in their balance sheet.

ADVERTISING

THE slashing of advertising schedules during these few months may seem justified on the basis of reducing expenses. Certainly it is the easiest way out for any management that must trim sail quickly to ride out the storm; but it may not be the best policy for an organization that intends remaining in business and getting started without delay when business in general picks up.

Advertising is nothing if it is not consistent and persistent. The radio industry has seen too much of the wild spurts and splashes of inexperienced advertisers, followed by complete silence. Today there are radio advertisers who, after spending fortunes in consistent and persistent advertising, are dropping out, presumably for a month or two, but actually for more than they contemplate. That there is no such thing as an advertising vacation does not seem to be appreciated by radio advertisers, for the most part quite immature in this as well as other business details.

No one can criticize the cutting down of an advertising appropriation to fit the available income. Space can be reduced. But to cut out all advertising—to drop out of sight for a time—is something quite different. It requires a disproportionate effort to restore interest and acceptance for a line that has dropped its advertising for a time.

Meanwhile, the radio press is not receiving the support to which it is entitled. Many radio consumer papers are suffering severely from the advertising vacation. They are being seriously impaired. The radio industry will some day be sorry that it did not support its press more wholeheartedly, when things move ahead once more.

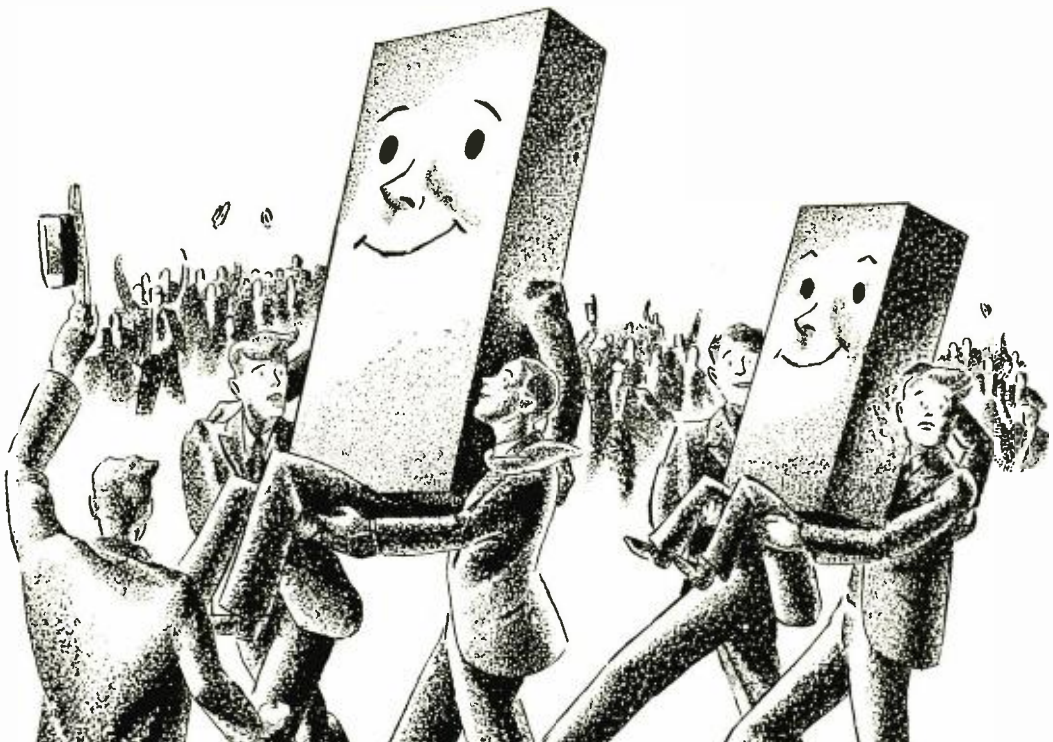
▲

PRODUCTION CONTROL

THERE is little danger of overproduction this radio season. The buying of components and raw materials is on a most conservative basis, and manufacturers for once are talking sane figures in place of the telephone numbers of not so long ago. Even the radio tube industry, notorious for its wild over-production schedules, seems to have declared a veritable moratorium on production in order that excess inventories might be cleaned up.

During the past thirty days, several large radio manufacturing organizations have closed up shop for several weeks. Many radio organizations have gone to a five-day week, in some instances reducing wages 10 per cent so as to effect an economy in the salaried end of the payroll. Some plants are working on a three-day week more or less regularly, staggering the workers so as to give maximum help to the largest number of workers. These measures are all justified under present conditions. They are not, however, a permanent cure of present-day conditions.

The radio industry must find new products to make in justifying its facilities and personnel. While it may be well to cut down on the working hours for the time being, there is one department that should be working harder than ever. That is the research and engineering department. It is imperative that this industry develop new products and new markets. More money should be spent than ever before for engineering talent. The battle for the future radio markets is now being fought silently but effectively behind the sealed doors of the laboratories.



Acceptance

TICKER tape showers and ballyhoo! All very well for the general mob. But practical, hard-headed men of science look for solid merit before they award any medals . . . Since its introduction last fall, Elkon's acceptance as standard equipment by 42 leading set manufacturers proves this new-type condenser a sound, worthwhile contribution to radio engineering . . . The new Elkon is the most efficient electrolytic condenser ever made—no free water*—nothing to leak, or freeze in shipment—most compact—mountable in any position—can optional but not necessary—only 4% power factor—highest voltage rating—long life—high filtering efficiency—in fact Elkon has practically the same characteristics as paper condensers—only *it costs less and is far less bulky!* And all of the above characteristics apply to our new Bi-pass condensers, too! . . . A request today will bring you your sample tomorrow. Complete information will be sent to all members of your technical staff. Just send their names.

*—water of crystallization, of course—but no *free* water.

ELKON CONDENSERS

ELKON DIVISION OF
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SUMMERILL SEAMLESS NICKEL TUBING

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any where—any time

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The scientific care used in making Summerill Seamless Nickel Tubing is carried through until it reaches you. It is packed in a sturdy box carefully made to insure the contents against all shocks in transport. It assures perfect condition of the tubing when it reaches you.

THE Peak Production demands of radio tube manufacturers have for years been met promptly and accurately by Summerill precision and protected shipping methods.

In the manufacture of the new pentode, variable-mu and other tube types—the background of Summerill experience and coöperation is again helping to maintain high standards of tube production—and tube performance.

Radio tube manufacturers recognize the advantages of the almost perfect uniformity, both chemically and mechanically, of Summerill tubing.

If you need tubing of this character—if guaranteed deliveries, no matter how large your requirements, would be helpful—write us.

Now is the time to contract for future needs.

LET US send you a sample for your engineering and production departments

The Summerill Tubing Co.

founded 1899

Bridgeport **Pennsylvania**

Philadelphia District

TUBING by SUMMERILL

LET'S GO

SEPTEMBER, *as usual, will see the stepping up of production schedules and a scurry of sales activities thruout the radio and associated fields. Increased activities in television manufacture and broadcasting have already commenced.*

AT THE NEW YORK RADIO AND ELECTRICAL SHOW *many new products will be exhibited. Sales charts will show an upward trend. The requirements of the industry for parts and materials will step up—as they always do during the autumn and winter.*

OVER 9,000 PAID SUBSCRIBERS *will scan the September Show Number of* RADIO ENGINEERING *for information about components, materials, instruments and their applications.*

YOUR ADVERTISING IN THE SEPTEMBER SHOW NUMBER OF RADIO ENGINEERING *(The Season-Opening Number) should tell the complete engineering story of your products.*

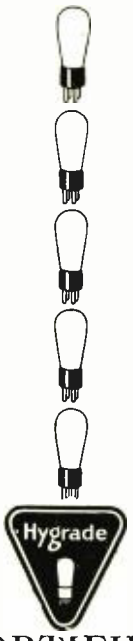
Note: Radio Engineering has the largest paid circulation of any radio industrial or electronic publication—over 40 per cent more than its closest competitor.

The per reader advertising rates are much lower than any competing radio or electronic publication

FORMS FOR THE SEPTEMBER SHOW NUMBER CLOSE AUGUST 25TH.

Quantity production
keeps down the cost

Rigid Inspection
keeps up the quality



FORTIFIED
CONSTRUCTION
(patent applied for)

HYGRADE Tubes combine the economy of mass production with the high quality only possible where standards of inspection are uniformly high.

The production of Hygrade Tubes has reached its present large proportions without any lowering of quality standards. Hygrade has moved into the ranks of the world's leading tube manufacturers and at the same time retained the uniformity and accuracy which has given such ready acceptance to Hygrade Tubes among radio set manufacturers.

New tubes, fresh from production and embodying the latest developments and improved construction .... no wonder Hygrade continues to grow in favor as the choice of the set manufacturer.

Strong tubes are better tubes. All Hygrade Radio Tubes are made better by the Hygrade method of fortifying (patent applied for) which renders it virtually impossible to break or injure the internal parts unless the bulb itself is smashed.

Jolts and jars, vibration, the rough handling of shipping cannot injure Hygrade Radio Tubes because the elements are held in positive, accurate space relation — fortified against breakage or distortion.

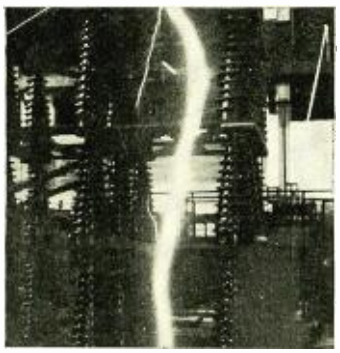
HYGRADE
RADIO TUBES

"Tubes You Can Trust"

A product of the Hygrade Lamp Division of Hygrade Sylvania Corporation, Salem, Massachusetts

Back of Textolite Laminated . . .

Years of Research

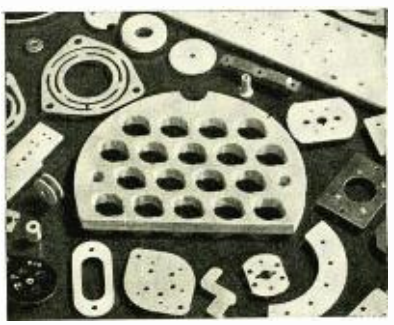


Years of insulation research are behind the G-E insulators that protect this G-E experimental "lightning generator" from a 15-foot bolt, 5,000,000 volt artificial lightning discharge

and Manufacturing Practice

Uniform durable insulation is vital to the satisfactory performance of the stationary armature for this G-E 30,000-kw. synchronous condenser

are behind Textolite Laminated



Proved service also characterizes these representative parts made from Textolite laminated

more than 40 YEARS

Experience with All Types of Insulations

For more than forty years, insulation has been a basic consideration of G-E engineering.

Generators — motors — high-tension cable — vacuum tubes — the reputation of these and every other G-E product would not be maintained without high quality insulation. For this reason, G-E engineers and research men have steadily worked and progressed toward ultimate excellence in insulation.

The long experience and extensive facilities of General Electric are back of Textolite laminated. It is especially appropriate for insulation needs in radio and electronic applications. Ask the G-E office in your vicinity about Textolite laminated, or inquire of the eastern or western fabricators.

General Fabricating Co.
37 East 18th St.
New York City

Electrical Insulation Corp.
308 W. Washington St.
Chicago, Ill.

831-5

GENERAL ELECTRIC

A Monument More Enduring Than Bronze

Exegi Monumentum
Aere Perennius

By Donald McNicol

THOSE men are happiest who throughout their lifetimes have a congenial hobby with which from day to day they may leaven the cares of a vocation or a profession.

There are those who are convinced that a man's hobby should provide a complete change of mental occupation from that of the day's work, but upon occasion there is evidence to show that much of delight and diversion have been gained by men who pursued hobbies related in some fashion to the particular tasks which occupied their gainful hours.

One can imagine a forester having the hobby of collecting specimens of wood; a deep sea mariner in his leisure hours carving out models of famous clippers, or a railroad man filling scrap-books with pictures of old locomotives. Hobbies of the nature of these would seem to be understandable and complete.

A philosopher or an essayist writing on hobbies of a high and inspiring nature has examples at hand to illustrate his theme: the example of Sir Francis Ronalds, and J. Latimer Clark, in England, and Mr. Chester H. Thordarson, in America. Ronalds and Clark throughout their lifetimes made extensive collections of published works on all phases of electrical research and development. About thirty years ago the Clark collection was purchased by S. S. Wheeler, of New York, and brought to America where it now constitutes a valuable section of the library in the Engineering Societies Building on Thirty-Ninth Street, New York.

The Thordarson collection of historical electrical books, transactions and pamphlets, magnificently housed in this scientist's library, in Chicago, has grown quietly but extensively through the years until today it is perhaps the most complete and richest private electrical library in America.

On numerous trips abroad Mr. Thordarson scoured the book marts and the attics of Europe for the purpose of adding to his great collection all procurable original source material. In this he succeeded to an extent that is a credit to persistence and to a clear knowledge of what to look for.

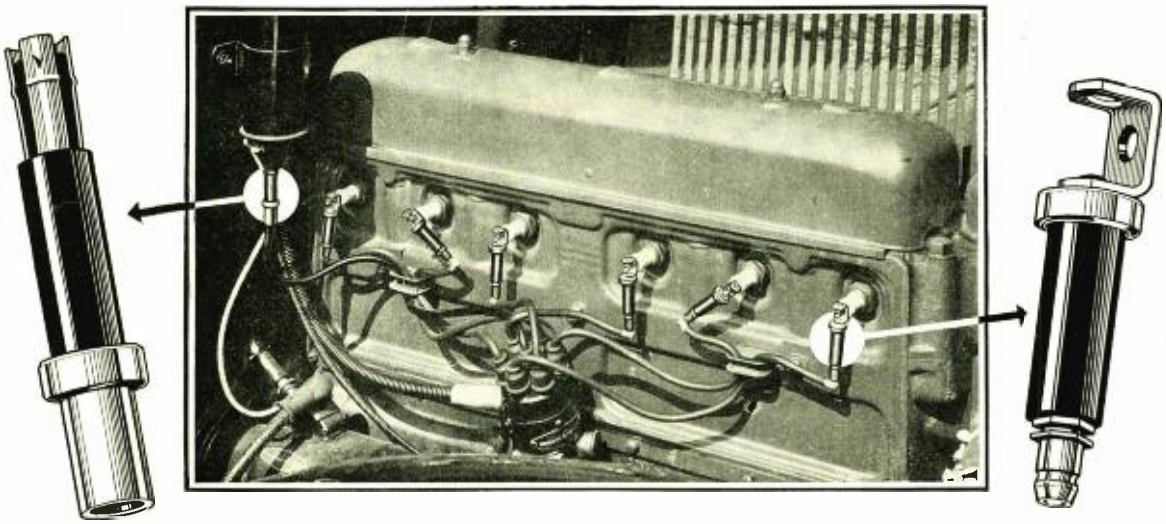
In this great private library furnished with magnificently carved tables, chairs and filing cases, repose original copies of most of the important publications on electricity from the beginning of the science to the present time.

Here the student may revel in the ruminations of Petrus Peregrinus (Pierre de Maricourt) who, prior to the year 1600, wrote about the lodestone magnet. Here an electrical student of the year 1931 may hold in his hands a copy of the first edition of William Gilbert's famous "De Magnete" published 331 years ago. He may even browse through the second and third editions of the same work. Or he may peer reverently into a copy of the volume by Galilei Galileo (1635) on the subject of the systema cosmicum, wherein Galileo discredits the idea of sympathetic magnetic telegraphy.

In this library may be traced to their very source and origin Francis Bacon's ideas of distinguishing between physics and metaphysics, and so on down through the centuries may be checked, step by step, each new foothold of advancing knowledge.

To those who know C. H. Thordarson intimately it requires no stretch of imagination to picture him of an evening alone seeking through these venerable tomes for the truth—the truth of scientific method and scientific discovery. That this American has been an outstanding success in scientific research and as a manufacturer is in no way difficult to understand when one contemplates the industry he has applied to the study of all that has gone before.

And, perhaps best of all, some day when he is in a position to luxuriate unmolested in the comfort of a hobby, the gentle peace of solitude, he will have at hand the finest of all diversions: a book—six thousand books.



Stop Interference on Radio-Equipped Cars With Bradley Suppressors

No Shielded Ignition Cable Needed

Bradley Suppressors are special solid molded resistors used by prominent car manufacturers to provide individual resistors for each spark plug and for the common cable to the distributor on radio-equipped cars.

They increase the resistance of the high tension ignition system and minimize the disturbing oscillations in the ignition circuit which interfere with the radio receiver in the car. When used with suitable by-pass condensers in other parts of the circuit, shielded ignition cables are unnecessary.

They do not affect the operation of the motor. The sturdy construction of Bradley Suppressors adapts them for the severe service in which they are used. Heat and moisture and age have no effect upon their performance. They are the last word for motor-car radio.

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Bradleyunits are solid molded resistors unaffected by temperature, moisture or age.

Their accurate calibration, great mechanical strength and performance make them ideal for providing correct C-bias, plate voltage, screen grid voltage and for use as grid-leaks and as fixed resistors in resistance-coupled circuits.

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The Bradleyometer is a potentiometer with approximately fifty solid resistance discs interleaved between metal discs.

The total number of discs can be arranged in accordance with any resistance-rotation curve.

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Type A. Single Bradleyometer

Type AA. Double Bradleyometer

Type AAA, Triple Bradleyometer

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RADIO ENGINEERING

Production, Administration, Engineering, Servicing

AUGUST, 1931

Noise generation within radio receivers‡

By Rinaldo de Cola

THE gradual but constant improvement in radio receivers since the advent of modern broadcasting has finally led the design engineer to a point where it is essential for him to thoroughly understand the factors determining the upper limit of merit for radio receivers.

In the case of selectivity and fidelity many excellent practical papers have been written on the design of appropriate circuits. However, the case of sensitivity, due to the limited sensitivity which could be obtained before the introduction of the screen-grid type amplifier, has not received much attention until quite recently. Limit in sensitivity is not imposed by any definite limit on the value of this characteristic, but is a relationship between the intensity of a received radio signal to the noises which arise within the set. Since in broadcast receivers programs are practically always for entertainment purposes, a relatively small amount of noise is sufficient to entirely destroy its entertainment value.

Since we are only interested in limitations imposed upon sensitivity from the fundamental structure of matter, noises due to static, motors, flashers, etc., are not within our scope, since they can, except for static, be successfully counteracted by proper legislation and care.

‡*A paper presented before Cleveland section I. R. E.*

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A theoretical discussion of radio receiver design as related to the employment of new type tubes.

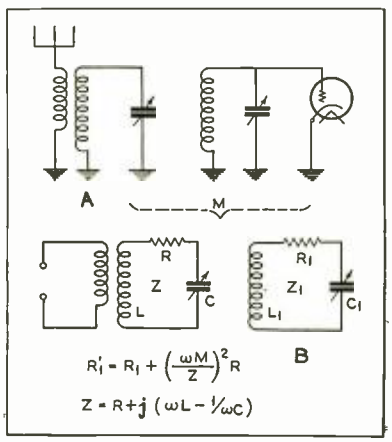

Fig. 1.

As will be pointed out later in greater detail, these noises are due to thermal agitation within conductors, shot effect in the space current of thermionic tubes, and to a lesser degree the secondary emission and ionization within vacuum tubes. The effects mentioned above will be treated separately under the following captions:

(1) Thermal agitation.
(2) Shot effect.
(3) Secondary emission and ionization.

The general theory of thermal agitation and shot effect has been thoroughly investigated both mathematically and experimentally by many physicists. Lately, however, these effects have been investigated with particular reference to radio receiver performance.

While to a certain degree the work of previous workers will be repeated for sake of continuity, this paper has been primarily prepared to point out some further limitations of present-day design in receivers and to suggest modifications to reduce its effects.

Thermal Agitation

Due to the fundamental concept of matter which holds that a conductor consists of practically numberless small particles in a state of ceaseless agitation, and because of the frequency of collisions between these particles which are normally disrupted and electrified due to collision, a small but measurable voltage is generated between any two points of the conductor. This effect is more pronounced the greater the temperature and electrical resistance of the conductor. The rate or time between individual collisions is not a constant, but represents a haphazard surging back and forth of electrified particles.

An analysis by means of Fourier's series for an elementary event, that is, the passage of a single electrified particle between collisions, shows that every conceivable frequency of voltage is generated, and that the amplitudes of these voltages are identical. If n, such events transpire in a unit of time, then the voltage is equal to n times that of a single event.

Since the noise generated within the grid coil of the first r-f. stage of an amplifier is subjected to the greatest amplification in traversing the remainder of the amplifier, its effect will predominate over the noises in the suc-

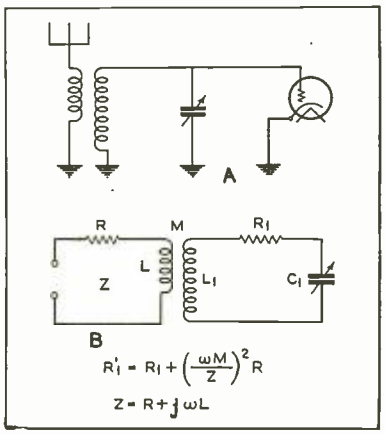

Fig. 2.

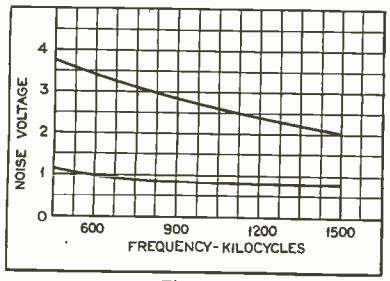

Fig. 3.

ceeding stages. Of course, the gain of this stage should be reasonably high. The mean square value of the voltage can be calculated by means of the equation developed by Schottky,

$$e^2 = \frac{2}{\pi} Kt \int_0^\alpha R \,|\, G \,|^2 \, d\omega \quad \ldots\ldots\ldots 1$$

where,

K, is a constant,

R, the effective value of resistance,

G, the gain of the amplifier,

and t, the temperature abs. deg. Kelvin. Normally, in even a very high-gain amplifier, the value of noise which can be heard as the familiar hiss is very small and hard to measure, unless a carrier voltage is impressed upon the system. Thus, it can be shown that the magnitude of the voltage due to the beating of various frequencies in the noise to produce the resonant frequency of the receiver is small compared with the noises beating with the carrier.

However, we are not primarily interested in the absolute value of noise, but only in the ratio of signal to noise appearing in the final output stage. Consequently we are desirous of transferring as much signal into the first-grid circuit from the antenna as possible, and to keep the value of noise as low as possible. In practice, using preselector circuits, in order to obtain optimum transfer between the two circuits, they are electrically aligned as closely as possible. To obtain fair selectivity, but mostly to reduce crosstalk, the optimum value of coupling is only sufficient to transfer about fifty per cent of the signal voltage into the adjacent grid circuit. Since the noises due to thermal agitation originate predominately in this circuit, this reduction in the transferred signal voltage is effective in reducing the ratio of signal to noise by about one-half. Although this factor is undoubtedly an important contributing factor to signal-noise ratio, another outstanding limitation of this arrangement can at once be recognized by an examination of Fig. 1-A which is shown in equivalent form in Fig. 1-B. A consideration of the expression for effective resistance R_1 shows that if fairly efficient circuit design is assumed the value of impedance Z is very low, approaching the value of R. in ideal cases, which consequently raises the effective value of resistance R_1 to a very high value. Since equation (1) shows that the effective resistance of a circuit is a contributing factor to noise, this effect should readily be evidenced by comparison to such a transfer system as shown in Figs. 2-A and 2-B. Because of the aperiodicity of this system the value of Z is always quite high, which limits the value of R_1. This comparison was subjected to experimental proof, and the results are shown graphically in Fig. 3. As can be seen in this graph, the ratio of noise in the two systems is approximately one-fourth.

The decrease in the value of noise for the higher frequencies for the curve marked Fig. 1-A is due to increasing values of transfer voltage in the preselector, which exceeded the value of 50 per cent which existed for frequencies below 1,000 kc. The arrangement shown in Fig. 4 was used to obtain the curves in Fig. 3. The procedure in this case was to impress by means of a standard signal generator, a radio-frequency signal modulated at ten per cent

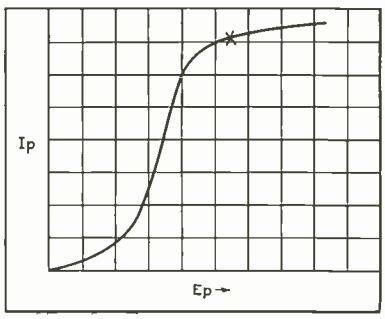

Fig. 5

upon the input of the r-f. amplifier sufficient to give a known deflection upon the vacuum-tube voltmeter connected at the output of the a-f. amplifier. The value of modulation was then reduced to zero, the carrier still remaining, and the voltage which still existed across the voltmeter was recorded as noise. To guard against error, this was checked at various times during the experiments, by disconnecting the signal generator entirely, which reduced the voltmeter reading substantially to zero.

Selectivity

To compensate for differences in overall selectivity of the two systems, and to exclude any hum which might be present in the output, a band-pass filter was inserted between the a-f. amplifier and the vacuum-tube voltmeter. It can be seen, of course, that the total value of noise was not recorded, but the noise *per frequency interval.*

To eliminate the noise arising from "shot effect" in this experiment, the tubes used in the r-f. amplifier were of the screen-grid 224 type operated at 2.6 volts filament and at 45 volts screen, and 180 volts plate. As will be shown later, operating these tubes at the voltages specified is effective in substantially eliminating this effect.

The criterion, therefore, in the minimization, since it is evident that total elimination is impossible, of thermal agitation is to eliminate the pre-selector system, and correct the difficulty of crosstalk, distortion, etc., by using the new type 235 or 251 exponential tube in place of the 224's. In the treatment of the shot effect which is to follow it will be shown that the new tubes, due to the varying grid pitch which gives the exponential effect a much higher value of electron action, are drawn from the cathode section adjacent to the section of greatest grid pitch. This results in a close approach to electronic saturation for this section of the cathode.

Shot Effect

The phenomena of the small shot or shot effect was originally investigated by Schottky. He showed that for conditions of voltage saturation with thermionic high-vacuum devices that the rate of electronic emission from the hot cathode varied from time to time, which consequently caused small fluctuations in the instantaneous value of space current. This effect can be analyzed by means of Fourier's series, which yields the same results regarding frequency distribution of energy and amplitude of waves as was indicated for thermal agitation. The difference between thermal agitation and shot effect is that the elementary effect of thermal agitation is the path of an electrified particle between collisions within a conductor, and in the case of shot effect it is the event of one single electron traversing the space from cathode to plate.

Since normal application of thermionic devices to radio uses necessitated the presence of space charge, the original equation of Schottky cannot be applied directly to phenomena within a radio tube. Why this is true can be readily appreciated by a study of Fig. 5.

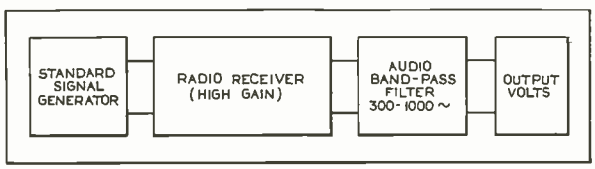

Fig. 4.

This graph shows a plot of plate current against plate voltage changes. For all points to the right of the point marked x, Schottky's equation can be used to calculate the shot effect. However, radio tubes are not operated nor used in this region of voltage saturation, but are normally operated at some point to the left of x, depending upon its particular function within the circuit.

It can be seen that since the phenomena of the shot effect is due to irregular emission from the cathode, if a reserve of electrons sufficient to supply the needs of the space current at all times can be maintained in the form of a common space charge in the vicinity of the cathode, that the effect of this space charge will be to smooth out the irregularities in emission from the cathode, since it acts as a reservoir supplying the needs of the space current.

It can be seen that, as long as the cathode is emitting more electrons than are required for the normal space current, the effects of irregular emission will be ironed out from the effect of the space charge which acts as a reserve store of electronic energy.

Magnitude of Shot Effect

Tests run upon tubes to measure the magnitude of shot effect show that the present type 224, and especially the newer type 235 and 251 screen-grid tubes, are deficient in this respect. The

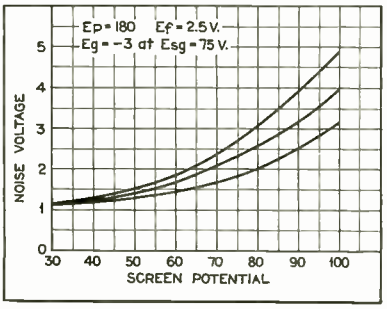

Fig. 7.

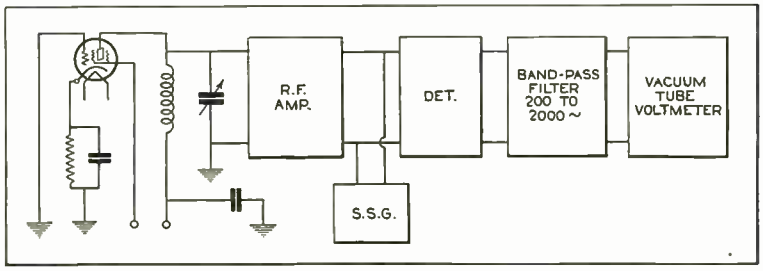

Fig. 6.

total emission from these tubes, although usually greater than the total space current, is not sufficiently prolific to properly smooth out the shot effect entirely. The experimental procedure in shown in Fig. 6. The setup was such that the plate voltage, grid bias, screen voltage, and heater voltage could be varied through wide limits for the tube under discussion.

To obtain a common reference point by which to judge the shot effect in various tubes, a 224 tube was first inserted in the set and operated with 180 volts on the plate, 45 volts screen, —3 volts on the control grid and 2.6 volts heater. It has been found that when these voltages are applied to an average 224 tube the shot effect can be reduced substantially to zero. The only remaining noise recorded by the voltmeter being the thermal effect in the tuned circuit LC. Fig. 7 shows the results on various types of screen tubes, plotting screen voltage against the noise voltage as read on a vacuum-tube voltmeter. It can be seen that the effect of voltage saturation in the 235 and 251 type tubes is considerably more pronounced than in the 224 tube. This effect is even worse than indicated by this figure since with the increased values of screen voltages the plate resistance was decreased, which tended to short out circuit LC, reducing the transfer voltage.

Changes in Tube Characteristics

A recent change in the specifications for the type 235 tube and the reduction of the normal plate current to 7.0 ma. will make the curve for this tube lie between the curves for 235 and 251. However, in spite of this change, it would seem necessary that tube manufacturers should be more liberal in the design of cathode emitters.

Even though the 235 tube is effective in diminishing the ratio of signal to noise from thermal agitation by elimination of the pre-selector, at least in t.r.f. circuits, this effect is somewhat counteracted by the increase in noise arising from the shot effect within this tube. However effectively this shot effect can be reduced depends directly upon the merits of the cathode as an emitter, and the operating voltages of the tubes.

Secondary Emission and Ionization

Ionization within a tube causes comparatively heavy positive carriers to be attracted to the space charge, which changes the density of the space charge due to recombination, resulting in a change in the instantaneous flow of space current. However, with the modern methods prevalent in the manufacture of radio tubes, noise due to ionization and secondary emission is negligible.

Measurement of secondary emission and ionization is quite difficult due to the very small voltage magnitude encountered in the normal operation of tubes. Amplifiers for the measurement of these effects must have a very high gain.

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Federal Radio Commission

THE Federal Radio Commission has issued general order No. 116:

1. On and after the effective date of this order and until one year from said date all radio broadcasting stations operating between 550 and 1500 kilocycles shall maintain the assigned frequency between the limits of 500 cycles per second above to 500 cycles per second below the assigned frequency.

2. On and after one year from the effective date of this order all radio broadcasting stations operating between 550 and 1500 kilocycles shall maintain the assigned frequency between the limits of 50 cycles per second above to 50 cycles per second below the assigned frequency and said stations are hereby required to make provision for the checking of the frequency of the emitted wave by means independent of the frequency control of the transmitter, said independent means having capability of the accuracy above mentioned.

3. On and after the effective date of this order the Commission will authorize the installation of new transmitting equipment in broadcasting stations or changes in the frequency control equipment at present licensed for operation only if such equipment is so designed that there is reasonable assurance that the transmitter is capable of maintaining the assigned frequency to the accuracy set forth in paragraph 2 above.

4. Each broadcasting station is hereby required to announce twice each day, at the beginning and end of its program, that it is broadcasting on a frequency of —— kilocycles, by authority of the Federal Radio Commission.

Using short-wave adapters and converters

By Clyde A. Randon

It is important to correctly understand the difference between a converter and an adapter, as these terms are applied to radio receivers.

BEFORE one discusses the subject of short-wave adapters and converters, it is well to define what is meant by "adapter" and "converter," in the best sense of these words. There is considerable confusion among laymen as to the distinction between an adapter and a converter. One often hears these two terms used interchangeably, while actually there is quite a difference between the two. The term "converter" should be applied only to devices which convert one frequency into another frequency. A converter may be used as the first detector of a superheterodyne arrangement. A short-wave converter is an electrical arrangement which changes short waves into long waves so that the short wave can be received on an ordinary broadcast receiver. The broadcast receiver itself functions as the intermediate-frequency amplifier of the superheterodyne. It is usually necessary that this intermediate-frequency amplifier should give considerable amplification for good loudspeaker reception. This requires that the intermediate-frequency amplifier shall consist of radio-frequency stages employing screen-grid tubes, usually.

Although in one sense a converter is also an adapter, it is better to confine the term converter to the short-wave superheterodyne arrangement. An adapter is an electrical arrangement for adapting an ordinary receiver for short-wave work. It is obvious that an adapter also can be used for adapting an ordinary broadcast receiver for long-wave work. An adapter is usually simply a short-wave detector and is sensitive to short wavelengths. No change in frequency takes place through an adapter. An adapter employs only the audio-frequency part of a broadcast receiver, while a converter also employs the radio-frequency stages of the receiver. In some broadcast receivers, the radio-frequency amplification is so low that one may just as well use an adapter instead of a converter, obtaining almost equal results. If properly adjusted, an adapter gives very satisfactory results, and it has the advantage of being considerably lower in first cost.

Adapter of Lower Cost

In view of the fact that an adapter is of much lower cost and will operate quite well with almost any type of receiver, if properly adjusted, it is well to point out the factors which usually give poor results when adapters are employed. The usual trouble with short-wave adapters is that they are not very sensitive. This, however, is also the case with short-wave receivers employing a small number of tubes. A properly adjusted adapter operated with a broadcast receiver having two good stages of audio-frequency amplification will give just as good results as the usual 3-tube receiver. However, the adapter must be carefully adjusted in order to insure good values at short waves. This article will consider the proper installation of short-wave adapters with common types of broadcast receivers in order to secure satisfactory results.

An adapter is really very easy to construct. The circuit of a simple adapter for use with a battery operated set, is shown in Fig. 1. Of course, the same circuit applies for a-c. sets. The only difference is that the connection from the tuning coil to filament is missing; this connection being made to the cathode of the a-c. tube instead. Normally, the rheostat, R2, shown in the diagram of Fig. 1, need not be used. However, if a tube having a lower filament voltage than those in the broadcast receiver itself is used, this rheostat is necessary. A rheostat also allows fine adjustment of the filament temperature of the detector tube which is usually not possible in the broadcast receiver itself. This rheostat is not necessary if an a-c. tube is used in the short-wave adapter..

Sensitivity

If it is desired to increase the sensitivity of the short-wave adapter, the circuit shown in Fig. 2 can be used. This arrangement gives one stage of screen-grid radio-frequency amplification ahead of the adapter, making it much more sensitive to distant stations and giving greater loudspeaker volume. The practical constructional data of Fig. 1 is as follows:

The antenna is of the usual size, say about 75 feet long. This value is, of course, not critical. Better results are secured from horizontal than vertical aerials, especially noticeable at short waves. The aerial condenser, C6, consists of two small copper plates about one inch square and separated 1/8 of an inch. These small plates should be mounted on a piece of bakelite and should be well away from the front of the panel, otherwise the set will have considerable hand capacity. C2 is a .00015 grid condenser, and R1 is a five megohm grid leak. C1 is a .00015 variable condenser, and C3 is a .00025 size. L1 and L2 are coils wound of No. 22 wire on UX tube bases. R2, if used, is a 20-ohm rheostat. This resistance value is sufficient so that one of the new 2-volt tubes may be employed if desired. At the point "X" shown in Fig. 1 a small choke consisting of 100 turns on a quarter inch diameter dowel can be used, if found necessary. The tube base for plug-in is an ordinary UX tube base. The leads run to the tube base as shown in Fig. 1. Flick the solder out of the tube base prongs with a soldering iron and run the leads to the ends of the prongs and solder in place. Then fill the base with a sealing compound such as sealing wax. The grid prong on the tube base is not used. To cover the 15 to 125 meter range, the

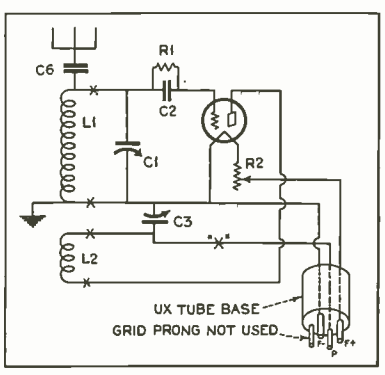

Fig. 1. Simple adapter for use with a battery operated receiver.

secondary and tickler coils should consist of 4 and 5, 9 and 5, and 18 and 6 turns, respectively.

In Fig. 2, the detector unit has, of course, the same constants as in Fig. 1. C6 is the same size as C6 of Fig. 1. C5 is a .00035 size. L4 is a plug-in-coil. To cover the same range as the detector coils, make three coils for L4 consisting of 4, 9, and 18 turns of No. 22 wire on a UX tube base. If a separate rheostat, R3, is used, this should be of a 20-ohm size. The coil L3 in the plate circuit of the radio-frequency amplifier stage should consist of about 100 turns of No. 36 wire closely wound on a piece of tubing two inches in diameter. This coil is coupled to coil L1 of the detector. If desired, L3 may be a short-wave choke coil. If L3 is a choke, couple the radio-frequency amplifier to the detector through a .00025 condenser C7. This will usually simplify connection because of the difficulty of coupling L1 and L3 if L1 is changed as it is for plug-in

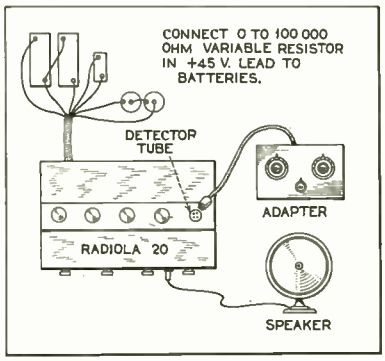

Fig. 3.

coils. The size of the coils given above for the radio-frequency amplifier will give considerable overlap between coils. However, this allows one to use either one of the two coils at the lower ranges. Better amplification is obtained when using the largest coil possible for a given wavelength. C4 may be as small as .006 mfd., but values as high as .5 mfd. are often specified. The grid circuit should be carefully shielded from the plate circuit.

This usually means that the coil L4 and the condenser C5 should be inside the shield can as well as the leads to the grid. Keep all leads short, especially those from the plate to the choke, and from the screen grid to the screen grid by-pass condenser C4. The plate voltages, shown in the diagram, will, of course, change slightly with different tubes. L3 must have a large number of turns, otherwise the screen-grid tube will only give a small amplification.

Use of New 2-Volt Tubes

Adapters are becoming more popular not only because of their increased sensitivity, but because of the new 2-volt battery tubes of low cost. Two-volt tubes are almost as cheap as 201-A's and they have the advantage that two dry cells, when used for filament supply, last a long time.

Another factor that will increase the use of adapters is the low cost of fine battery operated sets.

If an adapter has been constructed, it must be properly adjusted to the particular set with which it is to work. This important point has been neglected often, in the past. The usual adapter offered on the market is so designed that it will function with almost any type of broadcast receiver. An adapter employing fine parts, especially good coils, and short leads throughout, will give excellent results, provided it is properly connected to the broadcast receiver with which it is to be used. The results are really surprising when everything has been carefully designed.

Adjustment

When the usual adapter is connected to a broadcast receiver, it will be found that the regeneration is not very smooth. The regeneration control is, in reality, the sensitivity control. When the tube oscillates with a hum, a click, or, in general, not smoothly, the sensitivity is very greatly reduced. In order to smooth out the regeneration, the voltages applied to the detector must be carefully adjusted. The rheostat, R2, in Fig. 1, will often help. Suppose that we go through a typical example.

A common set on the market that many experimenters have purchased is the Radiola No. 20. This set will give excellent results when operated with a short-wave adapter. It is suggested that the 2-volt tubes be used in one of these sets. These tubes are very efficient and will give excellent results. One of the power type tubes should be used in the last stage. The general arrangement is shown in Fig. 3. If 2-volt tubes are used, two dry cells will furnish filament supply for the entire set. The complete connections are suggested in Fig. 3; further general information is given on the card tacked on the inside of the lid of the set. The detector tube (on the extreme right in the Radiola 20) is removed from the socket and plugged into the adapter. The rheostat on the Radiola 20 is then turned up as for normal operation, and the volume control is turned full to the right. The tuning controls on the Radiola 20 are not employed; the controls on the adapter now replace these. Move the tuning condenser, C1 (with the largest plug-in coil plugged into the coil socket of the adapter) while keeping the sensitivity control so that the tube "hisses." If it is found that the regeneration is

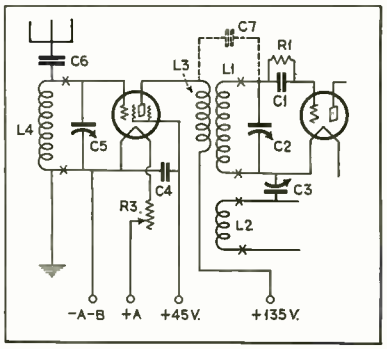

Fig. 2.

not smooth, the plate voltage applied to the adapter is probably too high.

In the arrangement tried by the writer, it was found necessary to connect a 0-100,000-ohm variable resistor in the plus 45-volt lead to the battery. This lead is plainly marked on the battery cable of the set. By adjusting the voltage on the detector, the regeneration can be made very smooth. Another thing that might help is to try various values of grid leaks in the adapter. It is usually not necessary to try different values of grid condensers because a .00015 size is usually correct.

Tuning In

To tune for foreign stations, look up the wavelength of the desired station and set the receiver to that wavelength by means of points on the dial which have been spotted from other stations having a known wavelength. The best way, however, is to use a wavemeter with the set. These may be either purchased or constructed.

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WIRELESS PROSECUTIONS IN GREAT BRITAIN

ON April 28, the Postmaster General stated that the number of prosecutions undertaken during the year ended March 31 last for the use of radio sets without licenses was 1,433, and the total amount of the fines imposed was £1,110. This compares with 1,029 prosecutions and fines of £1,194 for the year ended March 31, 1930. (The Electrical Review, London.)

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$5.02 A SHARE EARNED BY RADIO AND TELEVISION

Net income of the U. S. Radio and Television Corp., of Marion, Ind., amounting to $715,930, equivalent to $5.02 a share on 142,705 shares of no-par common outstanding, has been announced for the six months ended January 31. The half-year statement gave as current assets, $2,672,750, and liabilities $658,870. Cash on hand, $943,-868, and net fixed assets $470,761.

Vacuum tubes and their applications

By W. C. WHITE*

The extensive use of the high-vacuum tube in radio and communication work has resulted from certain remarkable characteristics of these tubes; the "thyratron" has been shown to possess certain other characteristics which mark it as being equally well suited to industrial uses.

VACUUM TUBES may be classified according to (1) number of electrodes (a two-electrode tube, being termed a diode, a three-electrode tube a triode, and so on, to include tetrode and pentode); (2) content of the bulb, which may be high vacuum, gas, or vapor; (3) nature of the fundamental electrode, the cathode, which may be thermionic, photoelectric, mercury-pool, or cold.

For convenience, practically any form of the many types of vacuum tubes can be classified by a combination of these three properties. For instance one sold under the trade name of "tungar" is a gas-content, hot-cathode diode. Screen-grid tubes used so much in modern radio are hot-cathode, high-vacuum tetrodes. The small tubes which are sold under the trade name of "thyratron" are hot-cathode, mercury-vapor triodes.

High-Vacuum Tubes

Fundamentally, the amount of current that can be carried through the vacuum in a hot-cathode, high-vacuum tube is dependent upon the electron emission and space charge effect. The electron emission is known to depend upon many contributing factors while the space-charge factor is controlled by simply introducing a grid into the tube with the proper voltage applied.

In a high-vacuum tube are embodied four features that singly or in combination make for a unique electrical device:

1. *Independence of frequency.* The speed of electrons is such that they will respond to frequencies of the order of several million cycles per second, so that for most purposes the tube has no limitations in this respect.

2. *Continuous control.* The electrons each carry such a small charge and are in such rapid motion that the current through the tube can follow accurately a very complicated waveform, as distinguished from the step-by-step action which occurs in most other electrical apparatus. This feature has made the high-vacuum tube useful in long distance telephony and radio broadcasting.

3. *Voltage control.* Relatively large amounts of current through the tube can be controlled by the grid voltage without furnishing any current to the grid. For example, the electricity generated by rubbing a fountain pen with a piece of cloth, when applied to the grid is sufficient to control relatively large amounts of power. This feature provides for the high amplification common to this type of tube.

4. *Rectification.* Current passes through the tube only when the cold electrode is positive with respect to the hot electrode.

From the point of view of these four factors, it may readily be seen why the high-vacuum tube is of such importance in radio. For industrial application, however, the high-vacuum tube has certain serious limitations, these being due mainly to high power loss within the tube. Part of this loss is represented by the power required to heat the cathode to the point at which electron emission will take place; this ranges from about 10 to 150 watts per ampere of current passed through the tube. Another limitation arises from the fact that from several hundred to about one thousand volts per ampere is required to force the current across the vacuum within the tube.

From these facts it will be seen that currents of more than a few amperes cannot be handled economically by means of this type of tube. Therefore, it is apparent that in the industrial field the most promising applications of the high-vacuum tube is in various control operations where the determining factor is the unique characteristics of the tube rather than its output.

The Thyratron

Next discussing the thyratron tube, its striking characteristics are the greatly decreased amount of power required to heat the cathode, and a marked reduction in the large voltage drop characteristic of the high-vacuum tube. This is brought about by the introduction of a slight amount of mercury gas or vapor into the bulb, the positively-charged vapor or gas molecules mingling with the electrons and neutralizing the space-charge. This neutralization of the space-charge makes possible a very different design of hot cathode; instead of utilizing what might be termed an open-type cathode permitting the electrons to leave the hot surface easily there may be used an enclosed-type cathode with just a few holes through which the stream of neutralized and negative ions may pass. This means that the heat may be kept within and conserved, whereas the electrons and positive ions may be allowed to travel to the anode. This is accomplished by surrounding the hot cathode with heat insulation and heat reflectors with only relatively small holes for the passage of the current. The resultant power loss is only about one watt per ampere of current through the tube contrasted with from 10 to 150 watts per ampere in the high-vacuum tube.

Also, neutralization of the space-charge eliminates the high voltage necessary to pass the current through the space; and instead of a large voltage increasing with the amount of current to be carried there is a constant-voltage drop of from 10 to 20 volts.

As a result a thyratron tube built to about the same physical size as the commonly-known UX-250 high-vacuum tube, and costing about the same amount to manufacture, will handle about 50 times as much current as the latter. It is apparent therefore, that the gaseous type of electrostatically-controlled tube is much better suited to the handling of relatively high currents common in the broad field of electrical engineering than is the controlled high-vacuum type.

Nevertheless, a thyratron tube has certain limitations; as stated, the high-vacuum type can handle currents up to a frequency of one million cycles per second, whereas the thyratron in its present form is limited to a few thousand cycles per second.

*General Electric Company, Schenectady, N. Y.

From a paper "Vacuum Tubes, Their Industrial Applications," presented informally at a meeting of the Schenectady Section of the A. I. E. E.—*Electrical Engineering.*

Station WHK introduces important refinements into radio transmitting

Insulated sectional towers contribute much to reduction of power losses

A CAREFUL survey of the range of radio station WHK, Cleveland, Ohio, revealed the fact that the field pattern was decidedly ragged in certain sections of the city. From this and other investigations it was quite apparent that the station, situated on the top floor of a Cleveland office building, surrounded on all sides by other skyscrapers and broadcasting on a power limit of 1,000 watts, was by no means operating at its highest efficiency. Moreover, a close inspection of the transmitting equipment indicated a considerable loss of power through the towers supporting the antenna. All the facts pointed to the necessity for radical changes if the station expected to maintain and improve its performance.

After considering the problem from all angles it was decided to petition the Radio Commission for permission to move the transmitting apparatus into the country where it would be possible to put in an effective ground system, and where there would be no interference from steel girdered buildings.

Fig. 1. Detail of ladder and lighting in WHK tower.

Permission was granted and accordingly a site on one of the highest hills, nine miles south of Cleveland, was chosen. While the studio remained downtown, the new station and towers were erected and new control boards, generators, etc., were installed. The results of the move were at once apparent, for with the same transmitting power of 1,000 watts, the field pattern assumed the shape of a circle, while at the same time the distance and volume were increased so that they frequently rivaled the signals of stations broadcasting with wattages running into five figures.

The power losses due to tower leakage which had been experienced in the downtown station led to a thorough study of this situation with the idea in mind of entirely eliminating them. To aid in this work engineers from the Barberton plant of the Ohio Brass Company were called in to consult with the station's engineers. Together these men, under the direction of E. L. Gove, chief engineer at WHK, and A. O. Austin, chief engineer of the Ohio Insulator Co., developed into an actuality the idea of the insulated sectionalized tower. While a number of stations have recently insulated their towers at the bases, this is the first time it has been found practicable to build the towers in sections, insulating the sections from each other by mounting specially designed insulators between them. The object of this design is to prevent the loss of radiation due to the neutralizing currents that flow out of phase in the ordinary uninsulated tower, and to prevent the tower itself from oscillating and causing interference from secondary radiation. Moreover, the towers themselves were designed to minimize the shunt capacity effect of one section to the other around the insulators.

It is of interest to note at this point that a current of 3½ amperes can be measured across the lowest insulator with sufficient voltage to operate two 75-watt lamps in series at about three-quarter brilliance.

Closing the gates on the towers changes the antenna current reading of the transmitter about one ampere, indicating a loss of about 20 per cent.

Jack-Knife Ladders

There are several other interesting features in connection with the towers. It was, of course, necessary to have ladder facilities running the full length of the towers. In order to maintain complete insulation, jack-knife sections were built into the ladders at the tower section points. These jack-knife sections were so designed that they could be left open while the station was in operation.

The aerial lights on the towers required by the Federal Radio Commission provided another interesting problem. Electricity was out of the question inasmuch as any wires along the legs of the towers would have destroyed the insulation. Consequently gas was chosen as the medium of illumination. The gas was piped through copper tubing along the leg of the tower. At the section points a special porcelain tube built into the insulator carried the gas through the insulator where another copper tube carried it up to the next section, and so on up to the top. In Fig. 1 this arrangement can be plainly seen.

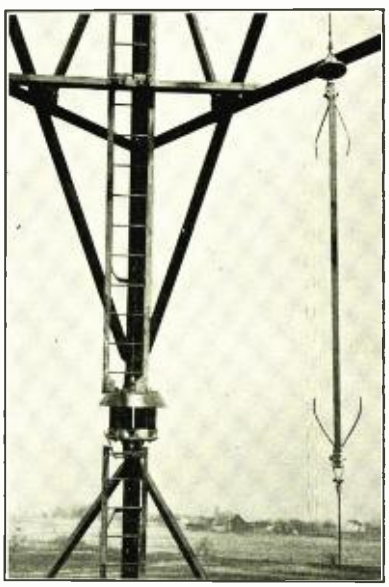

Fig. 2. Detail of hoist insulation in WHK tower.

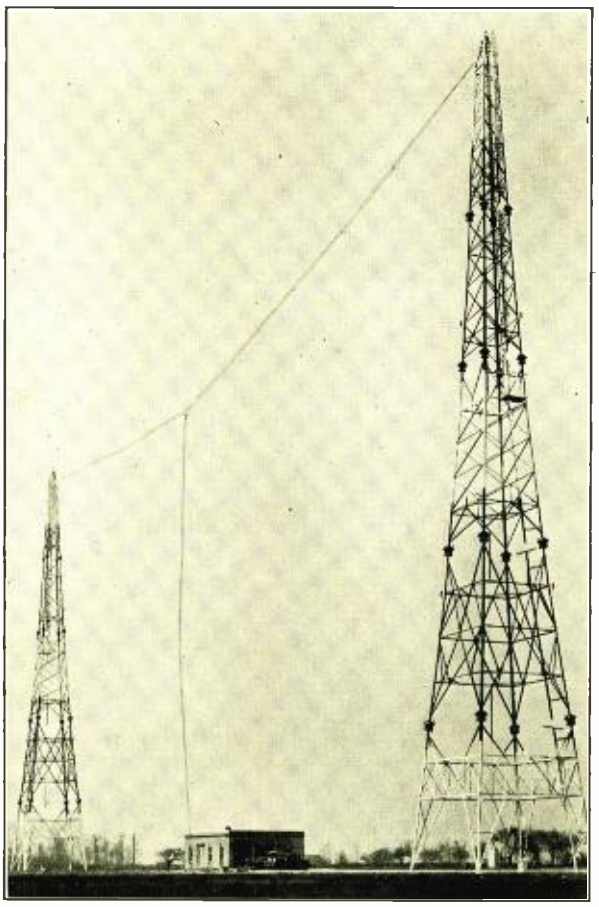

Fig. 3. General view of WHK sectionalized towers.

The Hoists

The hoists which are used to raise and lower the antenna are also insulated with wood strain insulators inserted at fifty-foot intervals along the steel cables. Since the insulators would not go through the blocks at the top of the towers, it was necessary to use inverted blocks so that a 50-foot pull at the ground would lower the antenna 185 feet. Quite a nice problem and rather uniquely solved.

Transmitter House

The transmitter house and ground system which have contributed much to the success of the station are also interesting. The transmitter house appears to be a one-story building, whereas it is really two stories with the first 8½ feet below the ground level. This construction was employed so as to bring the level of the transmitter down to the level of the ground system. The house itself is set in a copper cradle composed of strips from 5 to 14 inches wide. The cradle as well as the metal beams and metal lath used in the building were welded to the ground system. Very careful attention was paid to the ground system itself which covers about 5½ acres and in which over 20 miles of copper wire were plowed into the ground.

Apparently not the slightest detail was overlooked inasmuch as the lead-in bushing support in the side of the building was hewn from a solid stone ring. The bushing was then bolted to the ring so that no metal could possibly come in contact with any steel parts of the building.

With the completion of the present set-up, experiments were conducted to determine the efficiency of the station. The first test with 1,000 watts resulted in the signals being heard in New Zealand. While tower losses have been entirely eliminated, due principally to the insulated towers, a number of tests showed conclusively that extremely efficient broadcasting could be obtained with these towers, using a maximum power of 5,000 watts.

Previous to these numerous improvements, reports were received to the effect that radio listeners in the vicinity of Cleveland were unable to pick up WHK's signals. At the present time there are no reports of this nature coming into the station and it is apparent that the raggedness has been completely taken out of the field pattern.

The foregoing description of the new radio plant at WHK was procured from Mr. L. J. Ott and Mr. Deane S. Kintner. Mr. M. A. Howlett is manager of WHK.

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BOOK REVIEW

"PRINCIPLES OF ELECTRICITY." By Leigh Page, Ph.D., Professor of Mathematical Physics in Yale University, and Norman Ilsley Adams, Jr., Ph.D., Assistant Professor of Physics in Yale University. D. Van Nostrand Company, 250 Fourth Ave., New York. Price, $4.25.

This book meets a clearly defined need that has long existed for a book on electricity and magnetism to bridge the gap between elementary electricity and the modern treatment that requires wide knowledge of specialized phases of higher mathematics. This book requires no knowledge other than that of elementary physics and elementary calculus. In addition to a comprehensive treatment of the ordinary subject matter of electricity and magnetism, it provides an excellent up-to-date approach to the applications of circuit theory to networks, filters and lines. Moreover, there is an excellent introduction to the subjects of high frequency oscillations, radiation and electromagnetic waves.

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"THE THEORY AND PRACTICE OF RADIO FREQUENCY MEASUREMENTS. by E. B. Moullin. 486 pp. 289 illustrations. J. P. Lippincott, Philadelphia. 1931.

This excellent work is the second edition of a standard hankbook for the laboratory and textbook for advanced students in radio engineering. The entire field of the electromagnetic equations and of high frequency measurements is covered in an authoritative manner.

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"EXPERIMENTAL RADIO ENGINEERING." By John H. Morecroft. 345 pp. Illus. John Wiley and Sons, New York. Price, $3.50.

In this book Professor Morecroft aims specifically at the teaching of radio principles in the college laboratory. Fifty-one experiments are presented, each one of which is clearly covered by an analysis.

Push-pull arrangements of unusual character

By C. H. W. NASON

Observations on carrier suppression in radiophone operation

IT is believed that the use of a by-pass condenser across the biasing resistance in a push-pull circuit is not only unnecessary but is inadvisable, as the introduction of an out-of-phase second harmonic component in the grid circuit of the output stage might prove quite helpful. Push-pull circuits in general have received considerable mention in the engineering press but little has been said of the balanced modulator of Carson. No attempt will be made here to demonstrate at length the theoretical use of this device other than to mention its use in carrier current telephony and in the production of the carrier suppressed systems employed in transatlantic radiophone service.

In the elementary circuit shown in Fig. 1. it may be seen that there are two positions at which may be placed the input, and two at which the output may be taken. The normal procedure, based on knowledge of the grid modulator, would be so to place the carrier that it appears in opposite phase at the two grids and the modulation between the mid-point of the input transformer and ground in such a manner that the variations in grid voltage due to the modulation voltage are in phase. It is, of course, obvious that the procedure may be reversed. Note the following table where E is the carrier and e the modulation voltage.

Fig. 3.

Input			*Output*
e	E	Available at C	Available at D
A	A	0	e, E, 2e, 2E, E—e, E+e.
A	B	E, E—e, E+e	E, 2E, 2e.
B	A	e, E—e, E+e	E, 2E, 2e.
B	B	e, E	2e, 2E, E—e, E+e.

Since any of the combinations where the carrier E does not appear at one output point may be used in suppressing the carrier and obtaining the two side frequencies, there is no difficulty in obtaining the carrier suppressed condition. This is particularly true because in those circuits where E is not present the other frequencies besides E—e and E+e can readily be lost since transformers efficient for the two sidebands will be quite inefficient at the other frequencies present.

Modulation systems in which the carrier has been suppressed are now used to a considerable extent in certain types of film recording and may be of value in television. It is for those interested in this type of work that these notes have been prepared.

In the type "D" carrier current telephone installations it has been found possible to operate the Carson modulator in a self-oscillating condition. This is done by having the grids of the tubes in parallel insofar as the carrier is concerned but in push-pull with respect to the modulation. In the third case noted in the table it may be noted that the carrier is in the common grid return and the modulation in the push-pull input circuit. The output taken from a push-pull transformer at C contains the sidebands and the modulation frequency. By designing the output transformer so that it is efficient at the frequencies E—e and E+e a situation is created such that the amplification through the system for the frequency e is negligible. The sidebands alone are therefore transmitted. By designing an oscillator circuit with the two tubes in parallel as shown in Fig. 2, a transposition to the arrangement shown in Fig. 3 is simple. Here is an arrangement such as the third case in the table where it is not difficult to show that a strict equivalence exists between the self oscillating type and the type in which the sources and the modulator system are entirely separate.

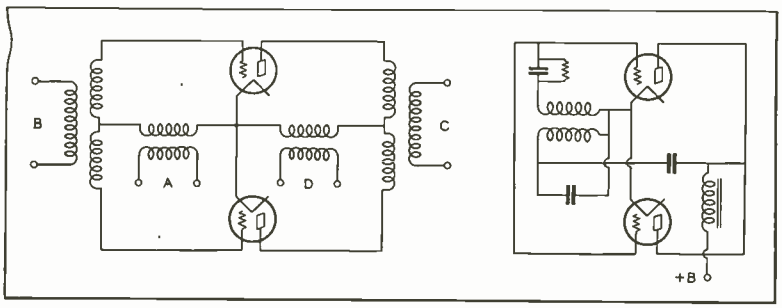
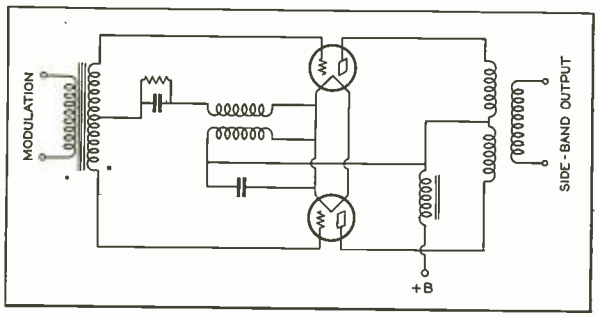


Fig. 1.
Two points of input, two points of output.

Fig. 2.
Oscillator with tubes in parallel.



GROSS RADIO SALES FOR 1930

According to Standard Statistics about half a million fewer radio receiving sets were sold in the United States last year than in 1929, the decline having amounted to about 14 per cent. Measured in dollars, the total sales volume was approximately 45 per cent below that of 1929, price declines having exaggerated the drop in unit sales. Including all products (sets, tubes, loudspeakers, batteries, etc.), aggregate 1930 sales of the industry amounted to $302,529,000, as compared with $525,000,000 in 1929, a loss of 40 per cent.

Radio power apparatus

By S. L. ABRAHAMS*

IN the progress of radio broadcasting the most prominent figure in the public mind has been the announcer. The great majority of those who "listen in" have probably given little or no thought to the mechanism whereby the announcer and performers are enabled to put on the air the programs which have now become a matter of course with the public.

More technical auditors, however, have looked behind the announcer and seen the transmitter whereby the programs are converted to the necessary electrical form for broadcasting through the well-known "ether." They have visualized the operator, who is very necessary to the success of the program, since he is responsible for the machinery and its functioning.

The operator in turn, both in broadcasting and in radio communication, has perhaps taken a somewhat matter-of-fact attitude with respect to the power supply for the transmitter. Such an attitude is not dissimilar to that taken by the average individual with respect to the functioning of the human heart, to which the power supply may rightly be compared. As long as the heart performs smoothly, its existence and importance are apt to be overlooked, but, if in any of a thousand possible ways something goes wrong, its existence is immediately called very prominently to our attention.

Early Machines

In the early days of radio communication, spark transmitters were used and the source of power was a 500-cycle generator. The transmitter was designed so that the spark-gap broke down once in each half cycle, resulting in a series of impulses having a frequency of 1,000 groups per second, which gave a very agreeable note in the receiver. The voltage for which the alternators were designed was 110 volts, this being transformed to 1,000 volts by a transformer having special characteristics required for the service. Usually the 500-cycle alternator was designed to have high synchronous impedance and poor regulation, in order to operate successfully under the periodic short circuit occurring when the spark-gap breaks down. The majority of such sets being used on shipboard, were driven by direct-current motors, excitation for the alternator being obtained from the motor supply line. For convenience and to save space, these equipments were usually made of the two bearing type. As the ether became more crowded with radio messages, it was necessary to find means of increasing the number of channels which could be utilized simultaneously without interference. The damped wave of the spark-gap transmitter became obsolescent, and the vacuum tube transmitter took its place.

With the advent of the vacuum tube, the demand for transmitter power supply became threefold, corresponding to the A, B, and C batteries of the vacuum tube receiver, namely, filament, plate, and grid supply. Each of these types of supply has special requirements which must be taken care of by the machine characteristics. In addition, still further specialization is involved on account of the demands of the various transmitter designers.

Filament Current

Filament supply sources may be either alternating or direct current. In a large number of transmitters used for telegraph communication only, it is quite common to use alternating current on the filaments. The supply may be obtained in one of several ways. When alternating-current supply is available, the line current may be used. If the line voltage is variable, a separate machine for filament supply is employed, either an alternator, or more commonly, a double current generator, supplying both direct current for excitation of the plate generator as noted below, together with other direct-current requirements for auxiliaries, etc., and alternating current for the filaments. An advantage of such a double-current machine lies in the fact that, when it is used, the motor-generator set is self-contained irrespective of the motor line supply, and, in fact, may be so designed as to provide for interchangeability of a-c. and d-c. driving motors. The double current generator may have a single armature winding with taps, in which case the ratio of alternating voltage to direct voltage will be the fixed value obtained in a rotary converter, namely, approximately 71% for single phase; or two separate windings may be used to obtain any desired ratio between a-c. and d-c. voltages. The latter arrangement has the advantage of eliminating the necessity of a transformer which is ordinarily required on the single-winding machine to transform the generated voltage to the value—usually considerably lower—required for lighting the filaments. In either case, the a-c. and d-c. output voltages cannot be varied independently, and the filament voltage is controlled by a rheostat in series with the filaments. Such a generator is usually designed to operate at full field without the use of a shunt field rheostat as described, and fairly wide limits can usually be tolerated on the d-c. voltage used on the auxiliaries or as an excitation source for other generators.

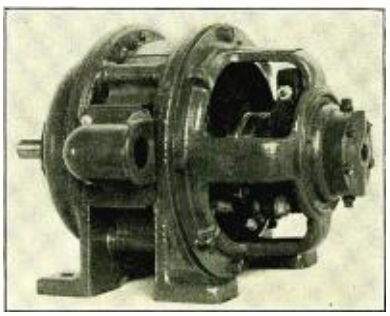


Fig. 1. .25 K VA-110 volt. 2500 r.p.m, 500 cycle alternator for filament supply.

Variation of Output

In certain instances, notably where independent variation of the a-c. output voltage is desired, a separate alternator is used for filament supply. Such an alternator is shown in Fig. 1. It is a single-phase machine of simple design, and since filament load has a high power-factor, quite good voltage regulation can be obtained. When the excitation for such an alternator is obtained from an exciter which, as part of the same motor-generator set, also

*General Electric Co.

This paper covers equipment used for supplying power to radio transmitters for communication and broadcasting. The requirements and characteristics of apparatus used for filament, plate and grid excitation are discussed and methods for meeting the specifications are described. Motor generators are compared with rectifiers and batteries and it is shown that the former have definite advantages except for very high voltage used for plate supply.

supplies auxiliaries and excitation for other units, the reaction of the pulsating armature reaction upon the field introduces a pulsation in the output of the exciter which in turn produces pulsations in the outputs of other machines excited from the same source. In some instances this has been found to be quite objectionable, necessitating action to eliminate this effect.

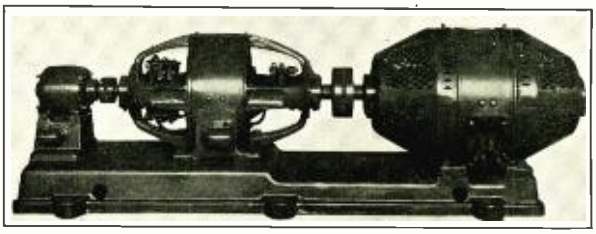


Fig. 2. 2000 volt plate generator and 125 volt bias generator driven by d-c. motor with slip rings for filament supply.

Machine Converter

When the line supply is d-c., the usual shipboard condition, alternating current for filament lighting is most commonly obtained by the use of slip rings on the driving motor, from which the necessary amount of volt-amperes are taken. In other words, the motor is functioning partly as a motor and partly as an inverted rotary converter (Fig. 2). Under these circumstances, the a-c. voltage is in direct ratio to the d-c. line voltage, and the filament voltage cannot be controlled except by a series rheostat. Furthermore, the a-c. voltage is subject to variation in direct ratio to any fluctuations in line voltage, and since such fluctuations and variations are apt to be quite common on shipboard, we have an inherent disadvantage in the use of this method for obtaining filament supply. Such a method is, however, very advantageous from the point of view of space saving, which is of prime importance aboard ship, so that it is very commonly used, the variations being compensated by manual control when of a gradual nature, and tolerated as unavoidable when rapid. Fortunately, rapid fluctuations are usually not of great amplitude, and the slower ones of greater magnitude occur when the supply source is a battery, and can, therefore. be cared for by series rheostat adjustment.

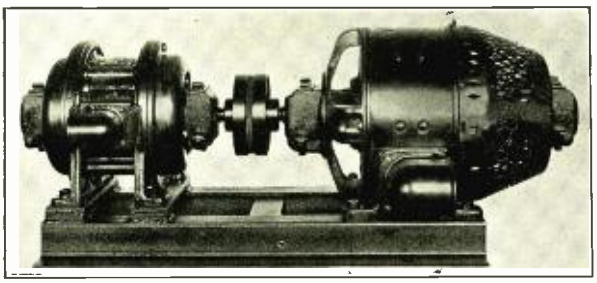


Fig. 3. 24 volt, 35 ampere filament generator set used on broadcasting transmitters.

On broadcasting transmitters, the common practice is to use direct current for filament supply. It is usually required that the characteristic of the voltage applied to the filaments shall be quite steady, that is, that the ripple or pulsations shall be kept to a minimum, since the ripple produces undesirable noises in the output of the transmitter. The elimination of the ripple is accomplished either by the inherent characteristics of the generator or by a filter, and sometimes by a combination of both. The degree to which the ripple must be reduced depends on the design of the transmitter; in some instances, one per cent is sufficiently low; in other cases, only a small fraction of one per cent can be tolerated. For the less exacting requirements, it is possible to incorporate features in the design of the generator which will easily meet the specifications, but when the greater refinement is required it is not possible to dispense with the filter. In the latter circumstances it is now the usual practice to depend upon the filter for smoothing out the voltage wave, and take what economy there may be in eliminating special features in the construction of the generator, since the reduction of ripple by special features in the generator requires increase in size of the machine.

The voltages used for filament excitation depend on the characteristics of the vacuum tubes employed. Common values cover a range from 7.5 to 33 volts. In order to allow for drop in the connections, generators are designed for output voltages two to three volts higher than the required filament voltage. Current requirements cover a wide range, depending on the number of tubes, as well as their design. Machines have been built having as high an output as 1,000 amperes. A typical set used on broadcasting transmitters is shown in Fig. 3.

It is usually required that it shall be possible to start the filament generator from standstill with the filaments directly connected across the machine and build up to full voltage within a few seconds. Since the cold filament is essentially a short circuit on the machine, this requirement is a severe one on a self-excited machine and is met by providing a suitable amount of series winding. As soon as the filaments begin to heat up, the resistance immediately increases to several times its initial value, so that the condition is only momentary. Since it is customary to furnish filament generators compound wound for purposes of voltage regulation, the build-up requirement is met without great difficulty. However, on generators having large current output, even compounding may not produce an entirely satisfactory result. The explanation will be seen when it is considered that the series field assists in two ways to enable building up under filament load—first, through the action of the series ampere-turns which counteract to a certain degree the effect of the armature reaction on the main field, and second, through the introduction of the resistance of the series field winding, which cuts down the armature current which tends to flow under the short-circuit condition of a cold filament load. In machines of high-current rating, the armature reaction is correspondingly high and at the same time the resistance of the series field is not of great assistance, being of the same order as the resistance of the cold filament. On transmitters requiring large filament currents, therefore, it is customary to use separately excited generators as a supply source.

Batteries, When Used

In general, filament supply for transmitters is obtained from rotating apparatus in one of the ways described above. Batteries are seldom used except as a stand-by source, or where the de-

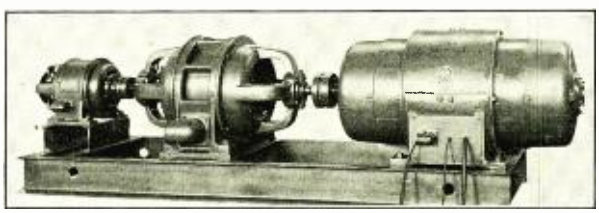


Fig. 4. Motor-generator set for plate supply on high power transmitter.

signer has some special reasons for applying them. In connection with receivers, however, the use of generators for filament supply is not as extensive. Of course, for broadcast receivers, the introduction of the a-c. tube is eliminating the need for batteries; and where direct current is used, the amount of current required is easily provided by a battery. The a-c. tube has created a demand for small devices to furnish power to alternating-current sets when operated in locations where only d-c. is available, such as certain metropolitan districts, farms, and the like. The commonest machine used for this purpose is an inverted rotary converter or a dynamotor; with the former a transformer may be required to obtain the correct a-c. voltage, but the latter may be designed to obtain any desired ratio of a-c. voltage to d-c. voltage. In certain instances, where a large number of receivers are to be supplied, a motor-

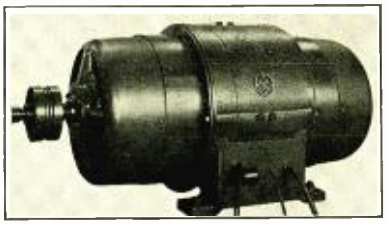


Fig. 5. 20 kw.. 8,000 volt d-c. generator for plate supply.

alternator set is used. It is desirable for best reception that the alternating wave be at least approximately sinusoidal, and free from harmonics. While the high power factor of the filament load is an aid to the design of the power source, the fact that the machine is of small capacity and is single phase complicates the problem of obtaining a good wave shape.

Power for Receivers

For commercial receivers a smooth filament supply is quite essential. Batteries are the logical thing to use for this application, but in the case of a large central receiving station such as communication companies operate, the filament current may be several hundred amperes, making a generator desirable if the correct characteristics can be obtained. Such machines have been built, in which the ripple has been so reduced

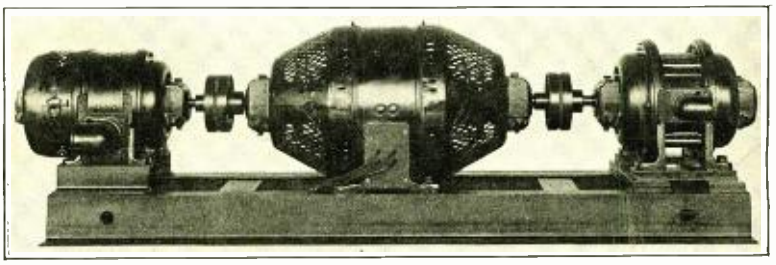


Fig. 6. Filament-plate motor generator for broadcasting transmitter.

that by using a comparatively simple filter, a current characteristic has been obtained which compares very favorably with that of a storage battery. The operation is also improved by floating the battery across the generator. In order to facilitate filtering, the generator is designed so that the frequency of the ripple shall be high. Another requirement of such a generator when used on commercial reception is that commutation shall be essentially sparkless. Long-distance traffic is very largely carried on short waves, and if receivers were supplied from a source which sparked, signals would be interfered with as if by very bad static. The problem of obtaining such wellnigh perfect commutation has been quite difficult, but machines are now in operation which meet every requirement of commercial reception.

Plate supply for transmitters is obtained either from rectifiers or from generators. In a few instances, batteries have been used, but the high voltages required make them commercially impractical. Voltage requirements vary with the output of the transmitter, design of tubes and the ideas of the designer. Voltage values cover a range from 800 volts or less on small transmitters, to 12,000 volts or more on large ones. Voltages over the entire range have been obtained by means of generators and also from rectifiers and the choice between the two is partly economic and partly a matter of personal preference. Prior to the introduction of the hot cathode tube rectifier, considerations of first cost, maintenance, regulation, efficiency and wave shape gave a decided advantage to motor generators, at least up to voltage values where the latter could be considered dependable. At present, the dividing line of voltage is probably much lower than before, and the choice is usually based on a study of the particular type of installation. Since the demand for small-output high-voltage generators was created by the vacuum tube, rapid strides have been made in the art of designing and building such machines, and many hundreds of generators have been supplied furnishing as high as 4,000 volts with complete reliability and satisfaction. A small number of machines for higher voltages—up to 15,000—have also been built and are operating satisfactorily, but there seems little doubt that in this field the modern rectifier is to be preferred to generators. A motor-generator set supplied in connection with a high-power transmitter is shown in Fig. 4; the plate generator (Fig. 5) is designed to furnish plate excitation at 8,000 volts.

Where only direct current is available, the generator is used in preference to the rectifier, other things being equal, since the latter requires an a-c. source which will have to be supplied. Furthermore, the generator has inherently a smooth wave which can be improved

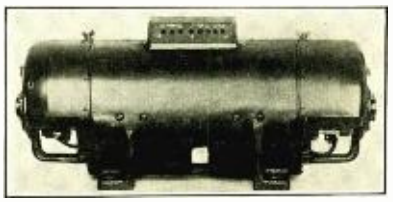


Fig. 7. 1200 volt plate supply with filament supply from slip rings on motor—designed for shipboard use.

if necessary by special design methods, whereas the rectifier must be filtered, and if the wave is required to be extremely smooth, the filter may become quite complicated. By compounding the generator any degree of desired regulation can be obtained. The rectifier has an inherent regulation which is comparatively high, especially on low voltages. and which can be improved only by somewhat complicated devices. The construction of small capacity high-voltage generators for radio work introduced to the designer many new problems. It has required the development of a technique for handling very small armature conductors. High volt-

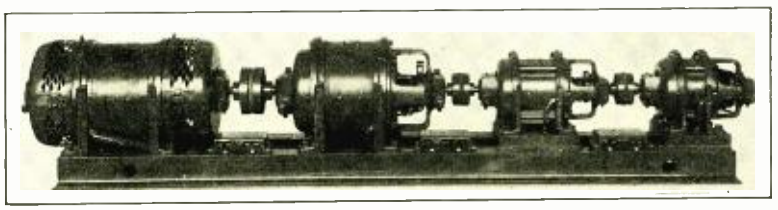


Fig. 8. Motor generators for carrier current transmitters.

ages, to be handled in small mechanical dimensions, have demanded effective methods of insulation which shall not require too much space, since, at best, the ratio of active material to slot space will be small. In handling voltages of 1,500 or more on a single machine, two commutators are ordinarily used, and problems of ventilation are thereby introduced. The matter of commutation on these machines is of sufficient interest to discuss in some detail. Where two commutators and two windings are used the most practical method is to put one winding connected to one of the commutators in the bottom of the armature slots, and the other winding in the top of the slots. This results in a very much greater self-induction for the bottom winding than the top winding, so that the amount of compensation required on the commutating field winding is very different for the two windings. Also it is the rule rather than the exception that the loads on the two commutators are not the same, since certain tubes in a transmitter will operate at the voltage of one commutator only, while others will require the voltage of both commutators in series. At times this unbalancing requirement may reach the extreme where the machine will be called upon to operate with load on one commutator only.

Further complication is introduced when the generator is to be used with a telegraph transmitter since the load on such a machine is of the so-called "keyed" type, that is, the load will be interrupted and again applied as the telegraph key is opened and closed. The frequency of opening and closing the generator armature circuit is, therefore, very rapid and also very abrupt due to the characteristics of the transmitter. An additional requirement is imposed on these machines on account of the fact that, in the event of failure of a vacuum tube which is the usual load, a short circuit is applied, which will persist until the protective devices have time to operate, and during that time the generator must be able to carry the short without distress or permanent injury. Such points have given the designer a rather nice problem to produce a machine which could be depended on to function satisfactorily and with absolute dependability under the great responsibility which is imposed upon it, and it is notable that the interruptions to radio communication because of failure of power sources is practically negligible.

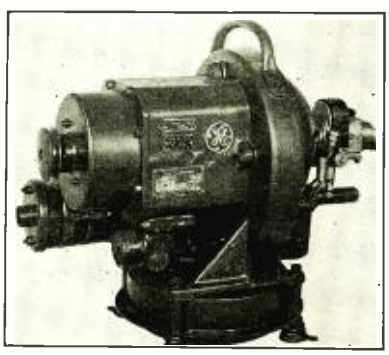


Fig. 10. Portable gasoline driven set for plate and filament supply.

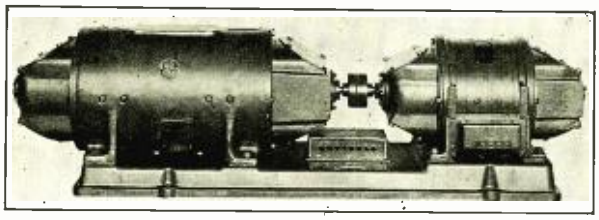


Fig. 9. Motor generator for shipboard use —operated from battery supply.

Separate Excitation

High-voltage generators are almost invariably separately excited. Since a low-voltage direct-current source is practically always available, either line supply if direct current, or filament supply, or power for auxiliaries, it is very undesirable to attempt to self-excite them with the resultant field coil of very small conductor and large number of turns which must be insulated for the high-armature voltage. In fact, where no low-voltage source is available, it is worthwhile to furnish a separate exciter. To be sure, the commutating field winding, as well as any series winding which may be required for compounding the generator, are in the high voltage armature circuit, but since it is customary to ground the negative side of the plate circuit these can be put on the ground side so that the voltage to ground is very small. As a matter of precaution, it is desirable to insulate all field windings for a high potential test to ground considerably greater than the usual "twice the voltage plus 1,000," which would be approximately 1,100 to 1,500 volts, and it is safest to apply the same ground test as for the armature for machines up to 2,000 volts output, and not less than 5,000 volts for machines of higher voltage.

For broadcast transmitters, the method of modulation used is almost invariably such that the load on the plate generator is constant. hence the requirements are not so difficult as for a telegraph transmitter. However, the load is quite apt to be more continuous. so that the heating of the generator must be within bounds. When used for continuous telegraph load, the armature copper loss will be on an average only half of what it would be under continuous telephone load, and it has been estimated that, for ordinary traffic the heating obtained is comparable with that corresponding to twenty minutes with locked key. In spite of this, the custom has been to be on the safe side when rating generators for telegraph load, and measure temperatures under conditions of so-called "locked key" corresponding to the maximum reading for "key down." The result is very low temperatures when operating under actual conditions, or, looking at it from another viewpoint, larger machines than the actual operating requirements warrant. A recent concession has permitted rating the machines on a two-hour locked-key basis, which is more nearly the operating condition. A combined plate and filament set much used on broadcasting transmitters is illustrated in Fig. 6.

Voltages for grid supply on transmitters vary from 125 up to 1,000 volts, varying with the plate voltage. Generators are very convenient and most commonly used for this application for the higher voltages, practices employed on plate generators may be followed, and for the lower voltages, it is frequently possible to modify standard equipment. The capacities required for grid bias are, of course, quite low, no problems of keying and the like enter in, and only infrequently are ripple or regulation a consideration. Quite often the grid generator is used for other purposes as well, such as excitation for other generators and as a supply for auxiliaries. As stated above, it may be part of a double-current generator which also supplies the filament. Since voltages—at least the lower ones—are not critical, grid generators are usually designed to operate without a field rheostat. For certain installations, it may be necessary to insulate the grid generator for voltages higher than it is actually supplying, since it is subject to high transient voltages whenever a tube fails by gassing, even though special means are usually included in the circuit for protection of the generator. Also in some cases, the grid generator may be forced to operate as a motor when used with tubes in a circuit which permits grid current to flow, and the designer will be required to take this into account.

Ship Installations

Since many installations of radio apparatus are for shipboard, mechanical and electrical features are required to provide for the conditions pertaining

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Measuring the power factor of electrolytic condensers ‡

IN the measurement of the power factor and capacity of electrolytic condensers certain precautions are necessary. The measurement of the capacity and power factor of a paper condenser is readily accomplished using an ordinary capacity bridge. On the bridge we actually determine the capacity and equivalent series resistances and from these values the power factor can be calculated.

In the case of electrolytic condensers we find that the power factor changes with frequency due to variations with frequency of the capacity and equivalent series resistance. Also the electrolytic condenser is designed for use only with pulsating d-c. and a polarizing voltage is therefore required to maintain the proper polarity of voltage across the condenser. This necessitates that the ordinary capacity bridge circuit be slightly altered for the testing of electrolytic condensers.

In the first place, since capacity and power factor vary with frequency, it is necessary that the condenser be measured at the frequency at which it is to be operated; in the case of filter circuits using full-wave rectification the source of tone for the bridge must be 120 cycles (assuming the condenser is to be used in a receiver designed for operation from 60-cycle supply). This immediately raises some difficulty. When a bridge is balanced at 1,000 cycles, a frequency to which the ear is very sensitive, it is possible to balance quite accurately though the source of tone contains a comparatively large amount of harmonic voltage. At 120 cycles, however, even a small amount of harmonic voltage may have a disastrous effect on the accuracy of the balance. Experiments carried on in our laboratory have indicated that the presence of harmonics may cause an apparent balance to be obtained at settings which give a power factor differing by as much as 50 per cent from the true value; this applies, of course, when balancing is done by means of telephones. By the use of some type of indicating instrument in place of the telephones a more accurate balance can be obtained, but the presence of harmonics still prevents one from obtaining a really accurate null indication. The solution is obvious—a low-pass filter circuit must be used between the oscillator and the bridge. The filter can be designed to pass 120 cycles and suppress all higher frequencies.

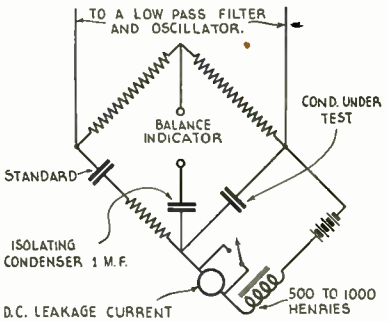

Fig. 2.

To permit the application of a polarizing voltage to the condenser while it is being tested in the bridge various circuit arrangements are possible. Two of the more generally used circuits are shown in Figs. 1 and 2. Of the two, the arrangement of Fig. 1 is probably preferable since the choke, through which the d-c. voltage is supplied, is directly across the bridge and therefore has no effect on the balance. In the case of the circuit of Fig. 2 the choke does not affect the bridge balance only if the choke has a reactance very much greater than the condenser reactance. In the case of Fig. 1 a 30-henry choke is sufficient; when placed directly across the condenser as in Fig. 2 an inductance of 500 to 1,000 henrys is desirable.

The low-pass filter should be designed to have a characteristic impedance approximately equal to the impedance of the bridge; in most cases the bridge impedance will be in the range from 100 to 500 ohms and the filter can therefore be designed to work into about 200 ohms. The proper values of inductance and capacity for use in the filter can be found as follows:

$$C = \frac{0.159}{fZ}$$

$$L = \frac{0.318Z}{f}$$

where Z is the impedance into and out of which the filter must work (for this work about 200 ohms is a good value.

- f is the cutoff frequency in cycles per second
- C is the capacity in farads at each end of the filter
- L is the inductance of the choke in henrys.

When the bridge has been balanced the capacity and equivalent series resistance of the condenser under test can be determined from the usual Wheatstone bridge formulas. A formula for power factor can be determined by considering the phase relations as shown in Fig. 3. The power factor is the in-phase component of the voltage divided by the total voltage.

$$\text{In-phase voltage} = E_r = IR$$

$$\text{Total voltage} = E_t = I\sqrt{R^2+\left(\frac{1}{\omega C}\right)^2}\,.$$

Therefore

$$\text{Power factor PF} = \frac{IR}{I\sqrt{R^2+\left(\frac{1}{\omega C}\right)^2}}$$

$$= \frac{R}{\sqrt{\frac{(R\omega C)^2+1}{(\omega C)^2}}}$$

$$= \frac{R\omega C}{\sqrt{(R\omega C)^2+1}}\,.$$

This formula is true under all condi-

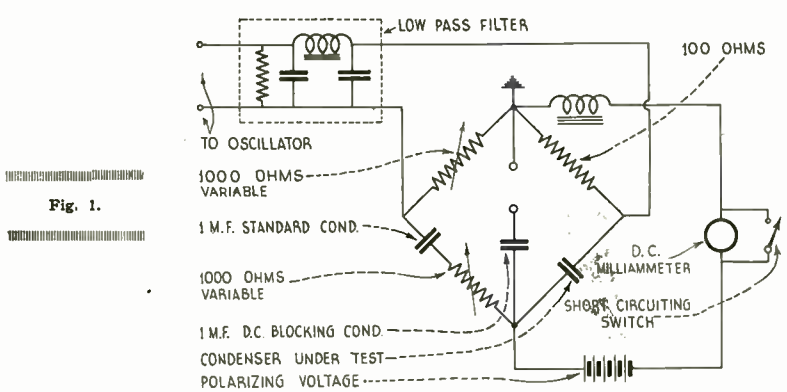

Fig. 1.

‡By the Engineering Department, Aerovox Wireless Corporation

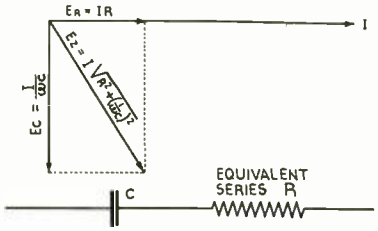

Fig. 3.

tions. Where the power factor is very low this formula can be simplified by remembering that, for small angles, the sines of ϕ are practically the same as the tangents of ϕ. Therefore for low power factors we can say:

$$\text{Power factor} = R\omega c.$$

This formula is satisfactory for determining power factors up to about 10 per cent; for larger power factors the accurate formula, equation (5), should be used. In all these formulas R is the equivalent series resistance, C is the capacity in farads and ω is 6.28 times the frequency.

A number of circuits have also been suggested for the rapid checking of the capacity of an electrolytic condenser. One of the commonest is shown in Fig. 4. The condenser under test is connected in series with a fixed paper condenser across the secondary of a step-down transformer; polarizing voltage is applied as shown. The fixed paper condenser serves to prevent short circuiting the d-c. voltage through the secondary of the transformer. The readings of the a-c. milliammeter can be plotted in terms of the capacity of the condenser under test (provided the a-c. voltage is kept constant) and the d-c. leakage current can be read on the d-c. milliammeter. The impedance of the circuit in terms of the two capacities and the power factor of the electrolytic condenser is

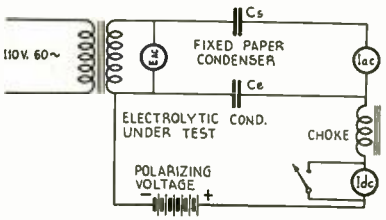

Fig. 4.

$$Z = \frac{1}{\omega}\sqrt{\frac{PF^2}{C_c^2} + \left(\frac{C_s + C_c}{C_s\, C_c}\right)^2}$$

so that the meter readings are really a function of both the capacity and resistance of the condenser under test. But since the total impedance varies but slightly with power factor this circuit does afford a reasonably accurate check on capacity and an accurate check on d-c. leakage. It is of course intended primarily for production testing of many condensers.

▲ ▲ ▲

Molybdenum—The Metal of Radio

TO say that the air or "ether" carries the radio broadcast wave is true, but it is a metal, sealed tight in tubes, which puts the wave "on the air" and then, in different tubes, recaptures it again, soon to be turned back into music, words—understandable sound.

In producing a vacuum tube the sciences of electricity, chemistry and physics unite. The tube is electrical both in principle and purpose. It is chemical in that it depends upon the emission of electrons from the filament or cathode, which necessitates the selection of materials which will emit the right amount of electrons under suitable conditions. It is mechanical, or physical, in that the elements in the tube must be spaced in relation to each other with almost microscopic accuracy, and must defy, or comply only to the very minimum with the physical law which says that metals must expand or grow soft when heated.

The reader, if he be an early radio fan, will recall that the first tubes were, at best, rather makeshift. It was by no means uncommon for a grid to soften, lean until it touched the plate or filament, and quietly render a six-dollar tube utterly useless.

For successful performance, a tube demands metals which will hold their form with little or no expansion or softening under extremely high temperatures. An additional requirement is that these same metals can easily be freed of occluded gases which otherwise would mar the performance of tubes. Vacuum tube metals must be good electrical conductors, chemically they must be as nearly inert as possible to active material thrown off by the filament or cathode, or to condensations from the flash. To further complicate matters, manufacturing efficiency demands metals easily worked, stamped or formed, and easily welded.

Tungsten and tantalum fulfill most of these conditions better than any other metals. But tantalum is considered rather expensive for low-price tubes, though its use is steadily increasing, while tungsten at ordinary temperatures is too brittle for some of the delicate forming operations.

The metal molybdenum, however, meets all requirements from a practical viewpoint and consequently is widely used either in a pure state or in alloys, for grids, plates and support members.

But it is not sufficient merely to say that molybdenum makes good radio tube parts any more than it is to say that steel makes good razor blades. Each statement should be qualified by the phrase, "under the right conditions."

Ordinarily, molybdenum is a stubborn, hard metal, almost as difficult as tungsten. But when refined to a high state of purity, molybdenum can be made workable and ductile, and in such condition, is easily formed and fastened.

Molybdenum has a high melting point and a very low vapor pressure. Like tungsten, molybdenum occurs in the oldest plutonic rocks, and its ore, molybdenite, is fairly well scattered over the world. The chief commercial sources are Australia, Norway, Canada, Japan and the United States. The largest known source of one has recently been discovered in the United States.

As an ore, molybdenum was known to the ancient Greeks who gave it its name, although they seem to have confused it with graphite. It was not isolated as a metal, however, until the successful experiments on a laboratory scale by Hjelm in 1790.

The commercial refining of molybdenum is quite similar to the refining process for tungsten. Impurities are refined out and finally the oxide is reduced to a powdered metal by heating in an atmosphere of hydrogen. The powdered metal is then pressed into bars and sintered, similar to the tungsten process already reviewed.

But the journey from a sintered ingot to a high quality pure sheet or wire which will meet the exacting specifications of manufacturers of vacuum tubes is long and arduous. To convert crystals into fibres requires careful working and annealing, all under the watchful eyes of trained metallurgists, specialists who are thoroughly acquainted with the properties and characteristics of this metal as well as the requirements of tube makers. Careful laboratory tests check every step in every process, and finally the metal is worked into ductile and pliable wire easily shaped into grids or support members, or carefully rolled into sheets easily stamped into plates.

The making of the wire is in itself an interesting process. First, the molybdenum ingot is swaged into rods of decreasing diameter, with careful heat treating between each operation, then drawn into wires of decreasing diameters. As with tungsten, some of these

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Standards of performance for commercial television receivers

By C. H. W. Nason

IN the past few years the standards for radio receivers for broadcast reception have been fairly well clarified and it must be said that settling this point has forced the development of commercial receivers to an unprecedented degree. This cannot be said of the commercial receivers available for television reception, regarding which little or no information can be had.

Taking as a basis a receiver designed for the reception of television signals from stations employing disc scanning with sixty apertures at twenty revolutions per second we may readily evolve certain standards on which to base comparisons. In the first place, we may assume that all stations will transmit a "positive" image—which is to say that maximum illumination at the scanned scene will correspond to maximum carrier amplitude. This assumption fixes the fact that with plate circuit detection an even number of low-frequency amplifying stages will be employed or that with grid-circuit detection this number will be odd. In cases where the stations transmit a negative image some means of reversing the phase of the signal as applied to the neon tube must be provided.

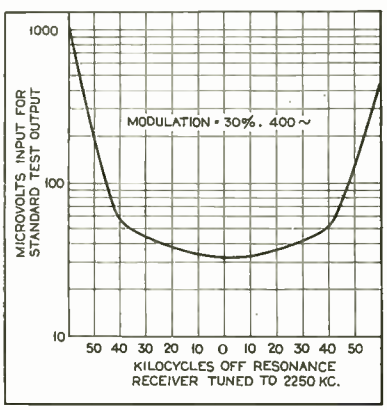

Fig. 2. Selectivity curve typical television receiver.

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Television Receiver Design as distinguished from radio sound receiver design.

Standard Output

It is difficult to set a standard for sensitivity until some fixed definition of "standard output" has been made. For the time being the standard for broadcast purposes is satisfactory for normal specifications. That is—.05 watt is a non-inductive resistance of such value that maximum power output per volt input for the type vacuum tube used is obtained. Under present circumstances it is not necessary nor desirable that a television receiver have as high a degree of sensitivity as is the practice with broadcast equipment. A sensitivity of about 30 microvolts should be more than ample. That is—30 microvolts in a standard antenna to provide normal test output.

Sensitivity tests may be based on a modulation of 30 per cent at 400 cycles as is standard with broadcast receivers. A sample sensitivity curve is shown in Fig. 1. The antenna used is the standard I.R.E. dummy antenna having an effective height of 4 meters.

While selectivity requirements in so far as the border beyond the highest modulation frequency required is concerned must be of a high order, the actual band passed must be in the neighborhood of 80 kc. wide. If a sharp cutoff beyond these limits is to obtain this demands the use of highly refined coupled circuit systems. Readings for the selectivity curves at various frequencies must be taken by recording the field intensity requisite for normal test output with the signal generator detuned from the resonant frequency of the tuned circuits by varying degrees as indicated in the curve, Fig. 2. Naturally as is the case in the broadcast receiver, a square conformation for the selectivity curve is the ideal.

Range Determined by Picture Frequency

The fidelity curve for the television receiver meets with certain restrictions

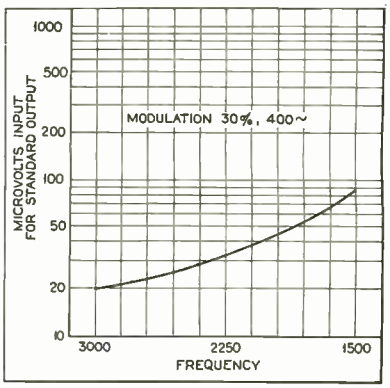

Fig. 1. Sensitivity characteristic television receiver.

which add to the problems of design. The overall fidelity of the channel must be flat within plus or minus 20 per cent over the entire range required. This range is determined by the picture frequency (20 per second) and by the amount of detail required. For a 60-line image, 72 elements wide, the upper limit is in the neighborhood of 40,000 cycles. While for obvious and some less obvious reasons a rising fidelity characteristic is desirable in a television receiver, this may not be gained by resonance effects in the low-frequency amplifier circuits. It may, however, if possible, be gained by correct design of the band selectors in the interstage coupling circuits. It has but recently been found that the intelligibility of telephonic conversations was affected by phase differences between the various speech frequencies transmitted. High quality telephone lines used in the wire transmission of radio program material are now equalized both for frequency and for phase. Phase discrepancies in the television circuit have a decided effect upon the received image and in the line dw must not vary from the linear by more than a fraction of a microsecond at the highest frequency involved. At the lower frequencies this divergence may be of the order of several milliseconds and if coupling between the stages may be improved at the low frequencies by resonance effects this is entirely permissible. There are,

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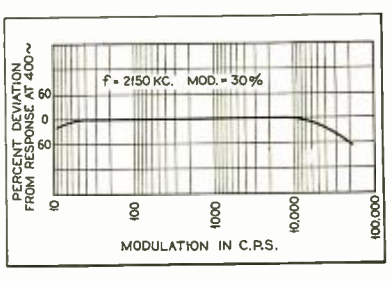


Fig. 3. Fidelity curve for television receiver.

Selective reception in the broadcast frequencies

By S. R. WINTERS

A VARIABLE arrangement for tuning the antenna circuit of a receiving set—insuring greater selectivity throughout the broadcast band of wavelengths—has been devised and patented by Lester L. Jones of Oradell, New Jersey, and Jacob Yolles of Brooklyn, New York. The inductance unit or tuning coil is constructed in sections having different values and the condenser includes a variable set of plates which are selectively and automatically associated with the various units of the inductance coil.

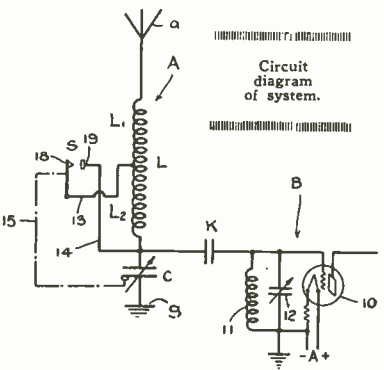
Thus, by this patented arrangement, different inductance values are employed for varying parts of the broadcast band of frequencies—that is, one inductance value is identified with the tuning condenser for one part of the broadcast range and another inductance value is associated with the tuning condenser for a different section of the broadcast band. This, we are told, means increased efficiency in radio reception in that sharper tuning is assured throughout the entire range of broadcast frequencies. At the same time, this antenna-tuning arrangement does not sacrifice simplicity of operation of a radio receiver since the one-dial-control feature is preserved.

The improved antenna circuit, as diagrammatically illustrated by the accompanying diagram, is shown connected to a tuned receiving set through a coupling condenser. Preferably, the latter is of very small electrostatic capacity, of the order of 3 micromicrofarads. The tube amplifying circuit consists of the usual vacuum tube, and an inductance unit and tuning condenser arranged in a resonant circuit—these elements being conventional with any amplifying system.

The antenna circuit proper consists of the usual pickup system, the antenna inductance unit and variable condenser arranged in series with the antenna and the ground connection. The inductance unit resolves itself into at least two sections, thus permitting of the patented tuning arrangement of using one inductance value for one part of the broadcast band and another inductance value for another section of the frequencies being received. The inductance L1, as shown in the circuit diagram, is about one-third of the value of the inductance L.

These two sections of the inductance are identified with the same variable condenser. This is accomplished by use of a switch, tapped by means of a conductor to the junction point of the two sections of inductance. Also this same conductor connects the inductances to the stator element of the variable condenser, the switch selectivity short-circuiting and closing the circuit of inductance section No. 2. To insure simplicity of control, this switch is controlled by the rotor element of the variable condenser through a connection, more fully disclosed in the circuit diagram. That is to say, during one-half of the rotation of the condenser the antenna is tuned through the smaller section of the inductance coil.

"In the use of this tuning apparatus," point out the inventors in explaining its behavior, "the operator first tunes to any desired station by the usual selector control found in tuned radio frequency sets, such as the three condensers customarily employed in present-day broadcast receivers. And then the operator increases the signal pickup with a concomitant increase of selectivity by a rotation of the antenna tuning condenser. This antenna tuning condenser is rotated by the operator through both halves of a revolution until the loudest signal is obtained; the different inductance values of the antenna being each automatically connected in circuit for the whole tuning range of the condenser during a complete or full revolution of the condenser rotor."



Circuit diagram of system.

Speaking of other methods to increase selectivity in receiving sets, the designers of this device—Messrs. Jones and Yolles—state:

"It has long been known that considerably more energy may be received from antenna systems when the antenna is series tuned to the frequency desired. The difficulty of arranging for convenient and easily operated series tuning means has been, however, largely

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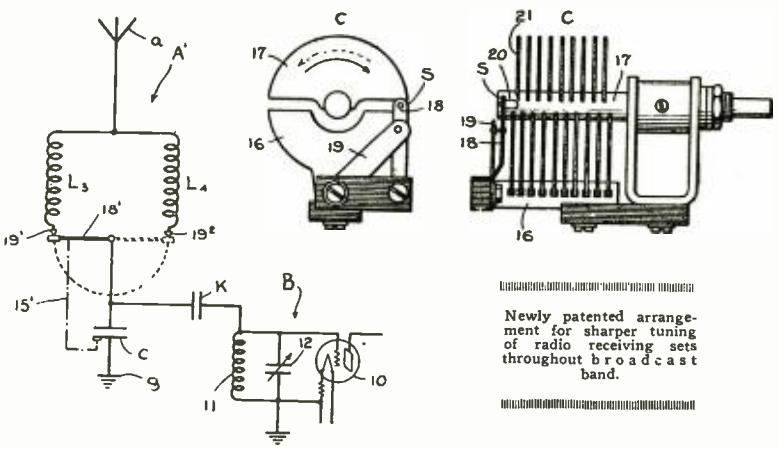

Newly patented arrangement for sharper tuning of radio receiving sets throughout broadcast band.

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An Antenna Tuning Arrangement Which Permits of Close Tuning

It's a price market!

By Austin C. Lescarboura

TWO years ago the basis of most of the buying in the purchasing departments of the radio industry was aimed at insuring a steady supply of component parts. The astute purchasing agent was more interested in whether the supplier could deliver parts continuously and certainly than in whether he could shade the price of his competitor a trifle. To insure a steady source of supply, it was the common practice to split up orders and so keep two or more suppliers constantly on tap regardless of whether or not the resulting price was slightly higher in consequence. With the advent of the price market to the consumer, together with the dumping and whatnot that has evolved during the last year or two, the whole attitude of the purchasing department has changed in its buying tactics. Forced to curtail and curtail some more, with the great worry shifted from "How can we meet the demand?" to "How can we meet the price?" we find the fraction of a cent the important factor in the sale of components, parts, and raw materials.

The large organization had the great advantage in the former attitude. Large plants well equipped with ample financing gave promise of stability and certainty of supply, while the small manufacturer was not encouraged because of the uncertainty of dealing with an unstable company. Today the very factors that gave the large company its preeminence are working to its disadvantage. A large plant running but part time, a well-rounded organization with but a small part of its potentialities used, adequate financing and big company organization are all factors that increase overhead, and high overhead today means high prices. High prices today mean no business. The executive of any large company must face and meet this problem of high overhead or he will find that the business that has been built up over a long period of service will go to competitors that he has not even considered as worthy of notice.

Inertia

This is the day of the small, shifty operator who can tack and be off in another direction while his large competitor is still trying to discover what is the matter with his market. There are few if any of the formerly high-powered organizations now showing a profit; and one by one they are waking to the fact that they must make drastic cuts if they are to remain in business at all. Just where can these cuts be made? What can the giant do to make himself mobile enough to meet the modern David with his garret plant and his price sling-shot?

In the matter of material cost the large company should have the advantage of large scale buying and organized engineering. In the matter of direct labor the giant should again have the advantage in line with machine production and well organized effort. But from that point on the puzzled executive board must make drastic changes if overhead is not to render useless all the aids to production economy.

First, there is the overhead traceable to over-financing. Too many companies are in the position of paying rent for many times the amount of money that has found its way into the coffers of the treasurer. Too many million dollar companies are paying interest on stock watered beyond all conscience. Legitimate refinancing to some sane valuation will be the salvation of many a company if the management is even slightly honest. In other words, there are too many outfits whose management lies in the hands of gamblers who would prefer to make their money selling stock than to make it selling merchandise. That burden is too heavy for a business to carry in the present market.

Now that the buying angle in radio has shifted from certainty of supply to price, what shall we do about it?

However, let us consign the over-financed companies to the oblivion which is perhaps inevitable, and take up the case of those honest companies who find themselves over-equipped and over-manned. In the boom times most of the large organizations over-expanded in the matter of equipment and housing. Too many high priced plants are nine-tenths shut down with the small operating part saddled with enormous shut-down expense that makes it impossible to meet the prices and still operate at a profit. The only way in which operators of this type can hope to survive is to scale down the overhead by jettisoning all surplus machinery and floor space at no matter what sacrifice, so that the remainder is not supporting a white elephant, or to find new products and other uses for that floor space and machinery. Unused machines are just as expensive as used ones from the standpoint of overhead, and they are a definite bar in the way of reduced prices. The taxes, insurance, depreciation, fixed charges and whatnot go on whether or not the machines operate, and at reduced schedules the cost of operation is ever so much higher per unit.

Drastic Readjustment

It is far better to scrap sixty per cent of the equipment and absorb the loss at one fell swoop than it is to let it string on and on until there is no business at any price and the sheriff liquidates the business. A thorough investigation will discover which of the inventory assets are really liabilities, and stoical pruning now may save a creditors' meeting later on. A high book value may look swell in a letter to the bond holders, but it looks like a bad pain when the salesman is trying to meet the competition of some small outfit that has been cutting the price all along the line.

We started out with over-financing and have reorganized to take care of that. We have sublet (if possible) or at any rate gotten rid of the excess factory floor space and sold or scrapped all that obsolete machinery that we have been carrying at about fifty times its value because it would give the statement an awful wallop to write it off. You know the sort of equipment we mean—those old d.-c. motors carried at nine hundred each when the most we could get for them in a swap would be fifteen dollars credit. Or those old mixers that were the pride of the plant when grandfather was the young blood of the business; they have been laying around for years now eating up space and money because no one had the nerve to throw them out. And over in the corner lies "Bascom's folly;" it cost forty thousand good cool smacks and was going to pay for itself within three years. It just never would work, and the darn thing has been boosting the overhead ever since. Every plant has them. They are the debris that results from growth. But they should be written off the books instead of being carried at ruinous prices and terrific overhead. In plain language, liquidate the book losses.

The Payroll

Just as we have space and machinery that is eating up the slight margin that modern buying leaves above expense, we have human liabilities that must be liquidated. We do not mean by human liabilities the poor wreckage that every factory maintains at pension wages; nor do we mean that any great saving can be profitably made in direct labor. The men in the plant, and the girls, are poor objects to begin on when we are seeking savings. The human lia-

bilities are the high-priced "fronts" that most large organizations took on during the boom times. One twenty-five thousand dollar a year vice-president will eat up the savings realized by the slashing of twenty-two laborers, and he doesn't earn it at present prices.

The average large operating staff is undermanned below and over-staffed above. There are too many high-priced men trying to justify their large incomes by slashing an already reduced direct-labor cost. Start your cutting at the top: the cuts are larger and apt to be more lucrative. The small price-cutting company is usually able to exist with one or, at most, two high-priced men. The large competitor must pull his superintendance item down to a place somewhat in proportion to that of his smaller rival.

All these cuts sound drastic, and they are. They are only to be used as a last resort. There is one place where real money can be spent to advantage before such drastic cuts are indicated. The research staff of any company corresponds to the new business department of the sales organization. It is the research department that holds out hope of new products that can utilize idle machinery and men. The wise manufacturer today is the manufacturer who is bending all his energies toward new products that will round out his production schedule and reduce the burden of overhead that destroys his chance of obtaining competitive business.

It is so easy to avoid thinking and to try to beat the competitor at the old game that both know only too well. The pioneer reaps profit in any line in any market. He has little competition since so few are equipped to lead while so many are equipped to follow. And it is in the field of research that the large powerful group can far outshine the weak competitor. The engineering department and research laboratory may look like an unnecessary expense, but they are the one place that every dollar expended will return many fold.

The alternatives are clear cut. Either develop new products to gain production, or cut the production equipment and organization to a size that can be operated at a profit. To muddle along in the vague hope that things must get better is to meet the fate that evolution has in store for all immobile organisms.

▲ ▲ ▲

Hotel radio to pay its way

By EARL Y. POORE*

Description of an actual installation of hotel radio which is paying a profit on the investment.

MR. A. TRAVELLER registered at the Hotel Hoffman in South Bend, Indiana at 2 p.m. He was assigned to room 414. The bellboy who accompanied him to his room came back to the room clerk's desk and received from the clerk a slip of paper. On this slip was written "Mr. Traveller, 414." The boy carried the slip to the switchboard operator, who then extended her left arm towards the switchboard at her side and touched the switch numbered "414." Then, turning her head slightly to the left, she spoke into her microphone.

At that same moment, in room 414, Mr. Traveller, who was now engaged in brushing his hair, heard a pleasant voice entering the room through a reproducer set into the wall greeting him in this fashion:—"Good afternoon, Mr. Traveller. We are glad to have you as a guest at the Hoffman. My voice is reaching you over equipment that has been installed for your pleasure, if you care to make use of it. On the wall of your room is a selector unit enabling you to turn on your favorite radio programs. If you would like to have radio in your room during your stay with us, just step to your telephone and say 'Radio.' A daily charge of 25 cents will be added to your bill. Again we welcome you."

Mr. Traveller did not like to miss the daily sports summary, and besides, there were several other favorite broadcasts to which he listened regularly whenever possible. Therefore, he promptly stepped to the phone, and said "Radio," and throughout the remainder of his two-day stay, enjoyed this added reminder of home comfort and convenience.

At about 6:30 that evening a telegram arrived for Mr. Traveller. A phone call to his room brought no response. The switchboard operator then touched the switches marked "Lobby, restaurant and elevators" and announced that a telegram for Mr. Traveller was at the desk. Mr. Traveller happened at that moment to be ascending to his floor in one of the elevators and thus heard the announcement.

Before retiring that night, Mr. Traveller, along with 29 other guests of the hotel, asked to be called at seven o'clock the following morning. At about three minutes before seven, the music of an appropriate phonograph record began softly to enter Room 414 (and 29 other rooms). Gradually the volume increased until Mr. Traveller, a sound sleeper, was awake. Then he heard a pleasant voice say: "Good morning. It is seven o'clock. A gentle rain is falling and the temperature is 56 degrees." A few minutes later his telephone rang and the call was thus verified, but Mr. Traveller was now wide awake and answered the phone promptly.

Showing telephone and selective call switchboard in Hotel Hoffman, South Bend, Indiana.

*Director of Research, Baritone Manufacturing Company.

A few facts regarding the equipment and the income derived from this system may be of interest.

A magnetic type reproducer is sunk in the wall of each room and covered with an appropriate grille. At convenient switch height in each room is a combination selector and volume control. This unit fits a single-gang switch box. Several reproducers are similarly installed in the ceiling of all the public spaces. The five receiving sets are located in the penthouse atop the elevator shaft. The telephone and selective call switchboards are so placed, that one operator cares for both without moving from her chair. Each switch on the master switchboard has three positions, and there is a switch for each room. In the center position, the room is cut off from all service. In one extreme position, five radio channels are released to that room. In the other extreme position, that room is connected with the operator's microphone and phonograph. Alongside the operator's chair are the microphone and the phonograph turntable.

The radio channels are entirely independent of the voice channel and each radio channel is independent of the others. The volume level and the quality throughout the building are automatically balanced and kept constant by specially designed features built into the system. Regardless of the number of rooms using any part of the service, the quality and volume level are not affected.

The Hoffman has 126 guest rooms. Table I shows the average daily income from radio revenue for the first quarter of 1931. It will be seen that South Bend is not a week-end city and that the best returns come from mid-week days (averages are figured to the nearest quarter-dollar). The entire cost of this radio and selective call system, including wiring, installation, and equipment, was $10,188.00. Table II shows the length of time that will be required to pay for the system on the basis of the income received during the first three months of 1931.

It will thus be seen that, on the basis of the experience gained during the first quarter of 1931, the Hotel Hoffmann will have paid for its radio from radio revenue alone in a period of a little more than three years.

The system here described is manufactured and installed by the Baritone Manufacturing Company.

TABLE I

Daily Income from Radio Rentals. (126 rooms)
Hotel Hoffman, South Bend, Indiana, January-March, 1931

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Average
January	$4.00	$9.25	$12.25	$11.75	$7.75	$6.00	$5.75	$8.00
February	4.25	7.75	10.00	11.00	10.50	8.50	9.00	8.75
March	8.00	10.75	14.50	15.00	14.00	8.75	6.00	10.75
Average	5.50	9.25	12.25	12.50	10.75	7.75	7.00	9.25

TABLE II

Length of Time Required for Covering Cost of Radio and Selective Call System from Radio Revenue Alone, on Basis of First Quarter of 1931.

IF EVERY DAY WERE LIKE:—

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
5 yrs., 3 mo.	3 yrs., 2 mo.	2 yrs., 4 mo.	2 yrs., 4 mo.	2 yrs., 10 mo.	3 yrs., 9 mo.	4 yrs., 2 mo.

AVERAGE
3 years and 2 months

▲ ▲ ▲

MOLYBDENUM—THE METAL OF RADIO

(*Concluded from page 29*)

operations must be carried out at white heat, and all heat treatment must be done in an atmosphere of pure hydrogen at closely held limits of temperature. Any impurities in the hydrogen would be picked up by the metal and any variation in temperature would greatly affect its workability.

For the small diameters, the wire is drawn through carefully drilled diamonds which are inspected almost hourly to be sure that exact diameters and perfect roundness are maintained. The sizes commonly used in vacuum tubes range from .005 inch to .001 inch, but for special purposes molybdenum wire has been drawn to .0004 inch diameter —less than one-sixth the diameter of a human hair!

Molybdenum has qualities highly desirable for use as plates, grids, or support members in vacuum tubes. It is 99.95 per cent pure, day in and day out, kept so by careful laboratory control. It is readily degassed and can be fastened without embrittlement to support rods. It is easily shaped and will maintain its shape without distortion at the relatively high temperatures attained in tube manufacture and operation.

By a process recently worked out ductile molybdenum rods up to 5/16 inch diameter are now obtainable. Rods of this size, used as support members in the giant tubes used in radio transmitting stations, formerly had to be worked hot, but they may now be formed cold at some saving in cost and greater uniformity of result.

For use both in tubes and incandescent lamps, several standard hardened molybdenum alloys are manufactured, each of which meets a particular requirement in tube or lamp manufacture. —*From the booklet Rare Metals, published by The Fansteel Products Co., Inc.*

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SELECTIVE RECEPTION IN THE BROADCAST FREQUENCIES

(*Concluded from page 31*)

instrumental in forcing the art to develop along other lines of producing simplified tuning equipment. The advantages of the series tuning antenna are, however, considerable, and recently attempts have been made to introduce the same into the broadcast receiving equipment; one such attempt comprising the introduction or use of a variometer or variable inductance in series with the antenna.

"This employment of variable inductance in series with the antenna is not entirely effective, however, on account of the difficulty of getting a sufficiently large range of variation with one variable, and particularly on account of the necessity of employing relatively high inductances imposed by the limitations of antenna characteristics. Antennas used for broadcast reception are usually poorly insulated and have a very considerable dielectric loss.

"In order to get a selective antenna circuit, therefore, it becomes necessary to reduce the antenna capacity considerably as by the insertion of a series condenser and to increase the inductance so as to impart 'stiffness' to the antenna. With such imposed constants the effect of poor insulation and dielectric loss is greatly reduced, as is already well known in the art, but these imposed constants make necessary the use of relatively high in-series inductance which is objectionable since the relatively large industances or variometers lack efficiency desirable for sharp tuning, particularly at the low wavelengths of the broadcast range."

Check This

WITH ANY RADIO ENGINEER

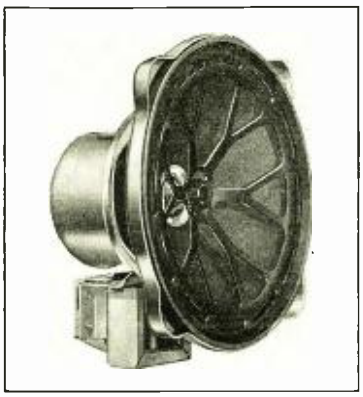
- In this series of advertisements, we have emphasized the superior qualities of Arcturus Blue Tubes. But such statements reflect partiality and may not be completely convincing to you. Very probably, you will want an outside check-up on Arcturus quality from some reliable source.
- Why not get the facts, yourself, from any radio engineer you know? Ask his opinion of Arcturus Tubes. Disregard any "sales talk" you may have heard, and make your decision on the basis of the technical acceptance of the *Blue* Tubes.
- We want you to get this kind of an outside opinion on Arcturus performance, because we know that most radio engineers appreciate Arcturus quality.
- Arcturus is now supplying tubes to America's leading set manufacturers. Their choice of tubes was made after careful competitive tests . . . and with the realization that the efficiency of their receivers must not be jeopardized by inferior tubes.
- We believe that a tube that has the official O.K. of well known manufacturers will be a good tube for you to use. We will be glad to furnish any data you may need about Arcturus Tubes, but if you want a quick and easy check on Arcturus quality, just ask any radio engineer.

ARCTURUS RADIO TUBE CO.
Newark, N. J.

ARCTURUS

"*The* TUBE *with the* LIFE-LIKE TONE"

COMPARE IT WITH YOUR PRESENT SPEAKER



THE NEW MAGNAVOX SYMPHONIC SPEAKER

MANY speakers have claimed tone perfection. The new Magnavox Symphonic Speaker has it! This great new reproducer over-accents neither the high nor low notes —it reproduces both in perfect harmony, without booming or shrilling. Only by hearing its true, melodious voice — only by examining its sturdier, shockproof construction — only by comparing it with speakers costing far more — can you appreciate what a revolutionary development in speaker construction this new Magnavox is. Just compare it with your present speaker! We will furnish a model, without obligation, to any radio manufacturer who desires to see, and hear, for himself.

Three models: No. 144 (7″ cone); No. 142 (8¾″ cone); No. 143 (10¾″ cone).

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SPEAKERS

THE PRODUCT OF TWENTY YEARS' PIONEER RESEARCH

The design of a complete television system

By C. E. HUFFMAN*

The technical information here given is of direct use to radio engineers who desire to master the elements of television.

THE television system about to be described is a partial answer to an outstanding problem.

That problem is to provide a means by which visual representations may be sent broadcast from one point and received at many others. Several methods might be used in solving this problem.

It is conceivable that some combinations of lenses or mirrors might be arranged whereby this broadcast could be effected by purely optical methods.

By purely optical methods we mean the linking of an observer with an observed object by light from that object directly and without the interposition of any auxiliary system of transmission.

It is understood, of course, that lenses or mirrors would only modify the direction of light and would therefore not introduce any new system.

A purely optical system would be dependent upon atmospheric conditions and its operation would presuppose the absence of intervening obstructions. Its many other limitations are quite evident and the broadcasting of visual presentations by optical means alone is obviously impractical.

It is necessary then for the practical solution of the problem to provide some auxiliary system interposed between the observer and the observed to effect visual broadcasting.

A system, electro-mechanical in nature, has been devised and today visual broadcasting is being effected by interposing that system between the observer and the observed.

A simple optical system includes a source of light, an object to be viewed, light given off by the object, an eye to intercept some of this light and a nervous system wherein would be created the sensation of seeing.

That is, in order to be seen an object must give off light. This light may emanate from the object itself or from another source and be reflected by the object. The object radiates this light, some of which reaches the eye of an observer. Entering the eye it falls upon thousands of sensitive nerve ends stimulating them to send pulses to the brain. The brain integrates these pulses into a sensation peculiar to that object and forms a vision of it.

A television system includes a light sensitive device and an electrical circuit interposed in the path of the light waves to convert them to electrical waves which may be transmitted with greater facility. It also includes a device for reconverting the electrical waves to light waves at the receiving end.

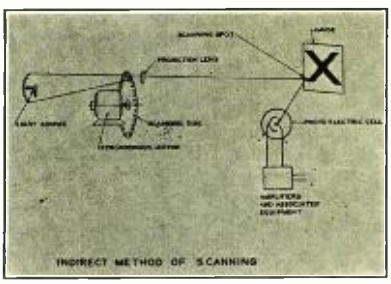

Fig. 3. One method of reduction of apparent brilliancy of light.

Photocell

A device called a photoelectric cell is placed in the path of the light from the object. This cell allows current to pass in proportion to the amount of light falling upon it. More light more current and vice versa. This current is amplified and transmitted to the other end of the circuit where it excites a lamp to give off light in proportion to that intercepted by the photoelectric cell. Now, it is evident that if the light from all parts of the object were allowed to strike the photocell at one time the lamp at the other end of the circuit would light with an intensity proportional to the overall brilliancy of the object. Therefore, no details of that object would be transmitted and it is necessary to scan the object a step at a time and view the light at the receiving end so that light from it reaches the eyes from the same angle as it would if the object were being viewed directly.

The explanation of how this is done has been given so often that it will not be gone into here.

The purpose of this paper is rather to describe the component parts of a television system and show their relation to each other.

Referring to Fig. 1 we have what is known as the direct method of scanning. Here the entire object to be viewed is illuminated by light which reflects into the photocell. A lens collects as much of this light as possible and passes it through a hole in the disc a unit at a time in rapid succession. The photocell delivers current to the amplifier in proportion to the amount of light reflected from the successive units.

As only a small part of the light thrown on the object reaches the hole in the disc, it is necessary that the object

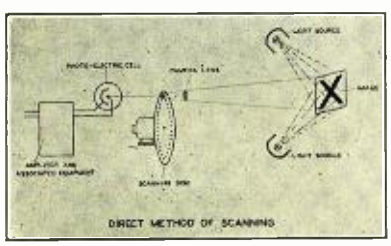

Fig. 1. Direct method of scanning.

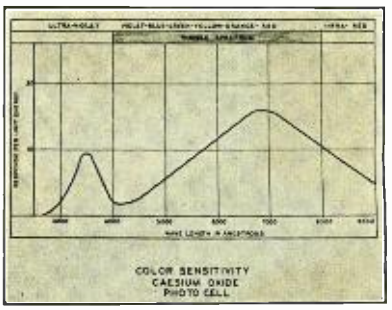

Fig. 2.

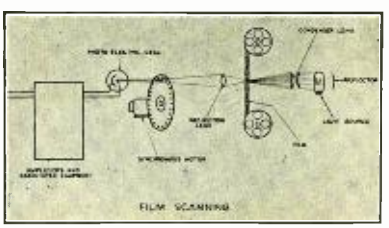

Fig. 4. Scanning motion picture type film.

†Presented before the Radio Club of America, April 8, 1931.

* Television Engineer, DeForest Radio Co.

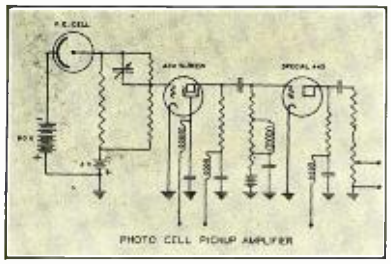

Fig. 5. Schematic of photocell amplifier.

be illuminated strongly over its entire surface.

As shown in Fig. 2 the photocells in use are sensitive to invisible light as well as visible and by the use of proper filters a subject being scanned is unaware of the intensity of light thrown upon him.

It is possible, however, to reduce the apparent brilliancy of visible light by the method shown in Fig. 3. In this method the scanning disc is placed between the light source and the object so that only a small portion of it is illuminated at one time. The illumination can therefore be much more intense without causing discomfort when a person is being scanned. Also the photocells may be placed closer to the object and thus pick up more reflected light.

Motion picture films are scanned as shown in Fig. 4. Here the light passes through the film to the scanning disc. The holes in the disc allow light from each unit area to affect the cell in succession as in the other methods.

The discs shown rotate at a speed of 1200 r.p.m. and scan the object 20 times

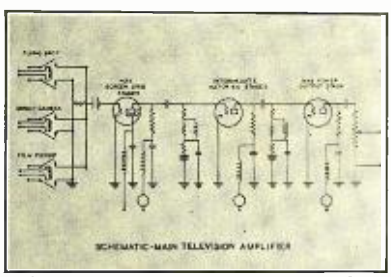

Fig. 6. Simplified schematic of amplifier.

per second. There are 60 holes around the circumference of the disc so that the picture at the receiving end appears as an image constructed with 60 lines.

Scanning at this speed will cause the photocell to release currents varying at a rate as high as 43,000 cycles per second.

Fig. 5 shows a schematic circuit of the amplifier associated with the photocell in each of the pickup scanners.

The network shown between the photocell and the grid of the first tube serves to equalize the response to varying rates of light fluctuation. The network shown at the grid of the second tube tends toward uniform transmission of the desired frequencies.

A special 445 type Audion is used in the output circuit so that signals are fed through a 75-ohm line to the main amplifier without undue attenuation at the higher frequencies.

Fig. 6 is a simplified schematic of the main amplifier which supplies signal to the modulator grids in the radio transmitter. Incoming lines remotely controlled by relay connect any of the photocell amplifiers to the input of this amplifier. One pickup may be faded out as the other is faded in.

Fig. 7 shows the frequency characteristic of the main amplifier. As shown the amplifier has an overall gain of 140 db. plus or minus 2 db. from 15 cycles to 80,000.

Fig. 8 is a schematic of a radio transmitter having 250-watts output. A crystal oscillator excites a radio-frequency amplifier through a screen-grid buffer stage. The output of the r-f.

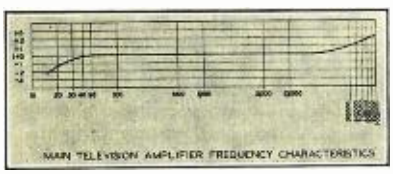

Fig. 7. Frequency characteristic of main amplifier.

amplifier is modulated by a water cooled modulator controlled by the output of the main picture amplifier just shown.

A separate speech amplifier may be connected to modulator grids for station announcements.

At W2XCD in Passaic sound is broadcast with the television programs over a standard deForest radiophone transmitter located adjacent to the television transmitter. No cross talk is experienced when these transmitters are operated simultaneously. The picture transmitter operates on a frequency of 2050 kc.; the sound on 1604 kc.

Changeover from one sound and picture pickup to another is effected by relays operated from a central control panel. Signal lights indicate in the studio and at the control panel just

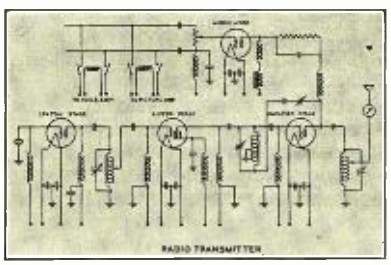

Fig. 8. Radio transmitter of 250 watts output.

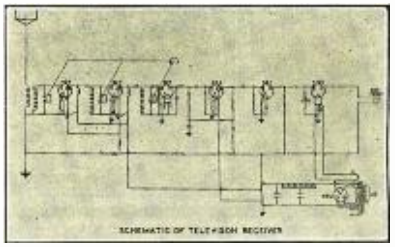

Fig. 9.

which pickup is connected with the transmitters and signal lights in the studio indicate when transmitters are on the air.

Monitor receivers for both picture and sound allow the quality of the transmission to be checked and adjusted from this control panel.

Fig. 9 shows the schematic circuit of the radio receiver used in picking up the picture transmissions. This consists essentially of four unit parts assembled as a whole.

The first is a power unit which provides power for all filament, plate and grid voltages as well as neon lamp current.

The second unit consists of two screen-grid audions operating between three tuned circuits to select and amplify the desired signals without discrimination against the side frequencies.

The third unit is a detector which recombines the carrier and side frequency to produce the picture frequencies at its

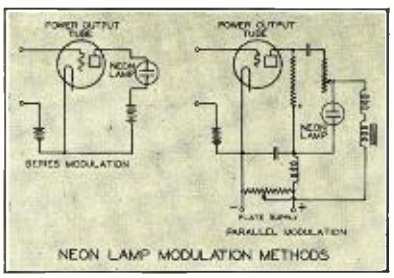

Fig. 10.

output.

The fourth unit is a resistance capacity coupled amplifier for building up the level of these frequencies sufficient to supply the picture reproducer or radiovisor.

No attenuation of picture frequencies occurs between 50 cycles and 20,000 cycles. At 20 cycles and at 50 kilocycles the attenuation is 4 db.

Fig. 10 shows two methods of connecting the output of the radio receiver to the neon lamp. The usual arrangement is to connect the neon lamp in the plate circuit.

A more desirable arrangement is to by-pass the plate current of the output tube through an impedance and operate the neon lamp in parallel, as shown.

Permanent Government Control of Philippine Radio Stations Urged

THE retention of Government control of the local radio service is advocated by the Department of Commerce and Communications as a new source of income for the Government. This decision has been reached by the Department of Commerce and Communications following the 6½ months trial that has been given to the Bureau of Posts. The trial has proved to the satisfaction of the Bureau that radio service under Government control can be operated and handled as efficiently as under private control with the advantage that the Government will gain a new source of income to finance the heavy expenses of the Government. The special appropriation voted out by the legislature for the operation of the 9 principal radio stations which were turned over by the Radio Corporation of the Philippines amounts to 245,000 pesos. (One Philippine peso equals 50 cents.) This amount covers the expenses for the maintenance of these stations until December, 1931.

The operation of these stations, which are located in Manila, Cebu, Iloilo, Zamboanga, Davao, Aparrl, Laong, Tacloban, Cagayan, and Oriental Misamisk, yielded an average monthly increase from tolls received amounting to 20,394 pesos. The monthly average collection from January 1 to September 15 from telegraph tolls, which include the radio service, was 76,741 pesos. This amount was increased to 97,135 pesos from September 16 to December 31 of last year. The Radio Corporation of the Philippines relinquished the operation of the 9 principal radio stations in favor of the Bureau of Posts last September 16. From September 16 to December 31, 1930, the Bureau of Posts increased their income from radio service by 71,379 pesos. Under the new improvements introduced by the Bureau of Posts, radio messages between Manila and Cebu require an average of 10 minutes. This time has been decreased to five minutes on many occasions. The same period is recorded for messages between Manila and Zamboanga. Another advantage in favor of Government control of the radio service is that the telegraph and cable service, which are also under the postal service, can be of assistance in case a radio station meets any difficulty in handling messages. This advantage cannot be found in the operation of private enterprises.

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STATISTICS OF CANADIAN PACIFIC TELEGRAPH SYSTEM

IN 1930, through 1,642 offices in Canada, the Canadian Pacific Telegraph System sent 5,761,694 paid messages and received 5,512,446. Cables sent totaled 340,408. Cables received totaled 313,854. At the close of the year, the total wire mileage, including carrier system, was 234,404 miles. The pole mileage was 17,718 miles, or a total of 708,720 poles. The total personnel of the telegraph department was 2,681 officers and employees. (Vice Consul Ralph Townsend, Montreal, Canada.)

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NATIONAL RADIO WEEK TO BE HELD IN SEPTEMBER

THE National Federation of Radio Associations, embracing all of the distributing side of the radio industry, has selected the week of September 21-27, coinciding with the Radio World's Fair in New York, to be observed throughout the nation as National Radio Week.

H. G. Erstrom, executive vice-president of the association, in commenting upon the event, stated:

"During National Radio Week in 1930, there were thirty-three chain programs dedicated to Radio. Over 200 broadcasting stations carried frequent announcements during the week concerning the event. Thirty-five metropolitan areas held gala demonstrations celebrating radio's tenth birthday and nearly one hundred newspapers ran special radio week supplements carrying radio news.

"This year we have laid more auspicious plans for the observance of radio's eleventh birthday. We intend to make the public more 'radio conscious' and to realize the vast influence radio has on the public life of our nation. The fact that well over nine million dollars are spent yearly to bring the best possible entertainment into the homes of the public should cause the listener to want to have the most up-to-date receiving sets in his home in order to fully appreciate the value of the programs that are rendered to him without charge."

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EXTENSION OF RADIO COMMUNICATION IN CHINA

WITH the completion in November, 1930, of the wireless stations installed at Shanghai under American auspices, direct communications were established between Shanghai and San Francisco and Shanghai and Berlin. A French installed station at Shanghai provided for direct communications between Shanghai and Paris. These stations are operated by the Chinese National Radio Administration in agreement with American, German and French companies. During the past few years, numerous radio stations have been installed in interior cities of China, primarily for the use of military authorities. At Mukden a station has been installed by Germans for communication with Germany and a second large station is being completed there, under American auspices, for communication with America. But the great majority of the installations in the interior of China are not sufficiently powerful to transmit other than local messages. The Mukden authorities have, however, provided a network of radio stations for communications in the three eastern provinces, hence functions independently of the China National Radio Administration.

Recently a notice appeared in the Shanghai press reading as follows: "By an order of the Ministry of Communications, all Government radio stations in the country will operate international services from May 15. The transmission of radio messages to or from foreign countries will, therefore, be extended to 15 additional cities."

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RADIO POWER APPARATUS

(*Concluded from page 27*)

thereto. This involves consideration of atmospheric conditions, temperature rises, and the like, and rotating machines must have ball bearings and be semi-enclosed and drip proof. Compactness is also desirable, as illustrated in Fig. 7, which shows a two-bearing set having a plate supply at 1,200 volts and slip rings on the motor for filament supply. It may be stated that, as a matter of precaution, all high-voltage machines should be equipped with some type of enclosure in order to prevent accidental contact with live parts of the machine. For land installations, of which broadcasting stations represent a considerable proportion, requirements are less rigorous, but it is probable that the economies which can be realized by taking advantage of the easier requirements will not warrant constructing two different lines of apparatus, at least so far as the specialized plate and filament machines are concerned.

Fig. 8 illustrates a motor generator used in connection with carrier-current transmitters. in which a small alternator furnishes filament current. Fig. 10 shows a three-unit, four-bearing outfit which provides sources of supply for filament, plate and grid. A small portable gasoline-driven set is shown in Fig. 10; this set supplies plate at 1,000 volts and filament at 12 volts direct current; it is totally enclosed and waterproof.

Transmission Channels for Television

A North American conference, held at Ottawa, Canada, in January, 1929, set aside the following frequencies for television assignments: 2,000 to 2,100 kilocycles; 2,100 to 2,200 kilocycles; 2,750 to 2,850 kilocycles; 2,850 to 2,950 kilocycles, with the additional frequency band 2,200 to 2,300 kilocycles, available for assignment in the United States, in such geographical regions as the South and Southwest, where such assignments would not interfere with the use of the same frequencies for other purposes in Canada or any other nation on the North American Continent, or in the West Indies. It will thus be seen that there are only four frequency bands, each 100 kilocycles wide, for general allocation in the United States.

The Federal Radio Commission has maintained a policy of permitting and encouraging the type of legitimate experimental research work in television, which will advance the art. For this reason, the present frequency assignments to television stations are made upon a purely experimental basis. All of these stations are subject to the provisions of General Order 64, covering experimental stations. This order requires the filing of regular quarterly reports showing the technical progress made by the station during the previous quarter, and definitely precludes the commercializing of the stations' transmissions. Since a large part of experimental television work can be conducted in the laboratory long before any need exists to conduct the transmissions on radio waves, and the actual radio transmission is in reality one of the more advanced stages of this development work, the Commission now requires a showing of laboratory research in television previously carried on by the applicant. Should very high frequencies prove useful for television a considerable step forward in the development of the art will have been made as the necessarily large band widths used in television can be more easily accommodated on these frequencies.

For example, assuming a 0.1 per cent frequency separation is in use, as recommended for the present by the first meeting of the International Technical Consulting Committee on Radio Communications at The Hague in the Fall of 1929, the band width at 2,000 kilocycles on a 9.1 per cent basis is only 2 kilocycles; in order to create a television channel of 100 kilocycles, 50 such channels are required.

The same percentage separation applied to the very high frequency end of the spectrum would give, at 60,000 kilocycles, a channel width of 60 kilocycles, 30 times as wide as the two-kilocycle channel in the 2,000 kilocycle-portion of the spectrum.

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Need for Radio Equipment in Australian Airplanes

ON March 21 the airplane Southern Cloud, flying in the Sydney-Melbourne mail and passenger route of the Australian National Airways Ltd. (A. N. A.) was lost in a storm with six passengers and two pilots. The report of the Air Accidents Investigation Committee regarding the loss of the plane recommended that a regulation requiring planes to carry two-way wireless and a qualified operator be placed in force as soon as practicable. Prior to the disaster, it was understood that Amalgamated Wireless Asia Limited had been experimenting with wireless sets in A. N. A. planes, but nothing had been done in the way of installing equipment because of the expense involved. Federal aviation authorities had also made plans for directional wireless stations at Richmond, N. S. W. and Laverton, Victoria, for the purpose of giving aviators their positions. Construction of these stations is now being expedited and it is probable that a third station will be erected at a point somewhere off the main route. It is reported that planes can be equipped with apparatus for about £150 while ground stations will cost between £400 and £500. A plane in the Western Airways Service between Adelaide and Perth recently carried an experimental set weighing about 29 pounds, including a battery, the set allowing the sending of messages for distances up to 1,000 miles. No definite move in the way of equipping passenger and mail planes with wireless sets has been made as yet outside of the erection of the directional wireless stations, but it is understood that serious consideration is being given to the installation of suitable equipment to minimize the possibilities of further disasters. (*Assistant Trade Commissioner H. P. Van Blarcom, Sydney, Australia.*)

PREDICTS EVERY POLICEMAN TO BE RADIO EQUIPPED

POLICE systems in which every man will be equipped with his own miniature radio receiver is foreseen as the logical development in steps now being taken by police organizations throughout the world in checking and preventing the commission of crime, according to a prominent official of E. T. Cunningham, Inc., who points to an experiment about to be tried in London, where every policeman will be equipped with a pocket radio set.

By means of these miniature receivers, this official explains, every policeman will be enabled to receive short-wave signals from the central police transmitting station informing him of crime happenings.

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ANGLO-BELGIAN CABLE

THE British Government is in negotiation with Belgium for the laying of a new telephone cable between St. Margaret's, in England, and La Panne, in Belgium. The British authorities foresee a considerable extension of traffic with the Continent, and wish to provide circuits for such distant countries as Turkey, Bulgaria, and Rumania. Amplifying stations will be erected on both the British and Belgian coasts and the cost will be shared by the two countries. According to present plans, the cable will be laid in 1932, and be put into service at the beginning of 1933.

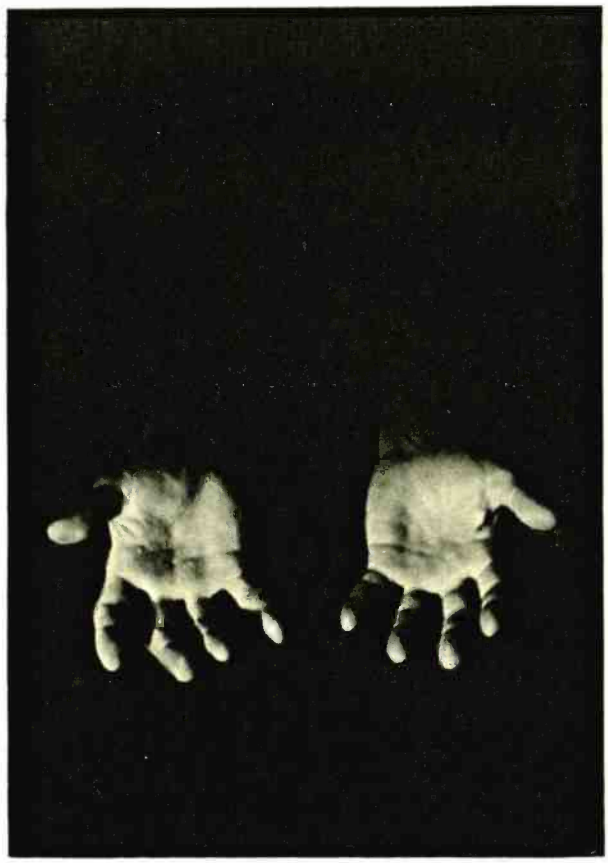
▲

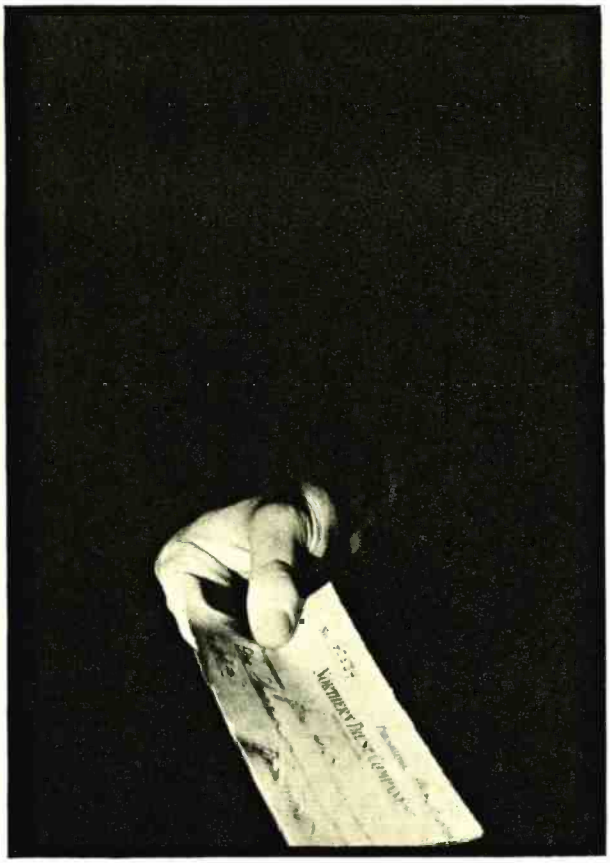
INCREASE IN NUMBER OF RADIO LICENSES ISSUED IN FINLAND

ACCORDING to the Radio License Department of the Postal and Telegraph Bureau, 106,000 radio licenses for the year 1931 had been issued before December 31, 1930, exclusive of the radio licenses issued in the rural districts. As the number of radio licenses issued for 1929 was 73,777, there is an increase of approximately 31,000 licenses in two years. (American Minister Edward E. Brodie, Helsingfors, Finland.)

ROCHESTER IN NOVEMBER

Extensive plans are afoot to make the Rochester, N. Y., Fall meeting of the Institute of Radio Engineers an outstanding success. Practically all of the exhibits' space has already been assigned. The meeting will be held at the Sagamore Hotel, on November 9 and 10, next.





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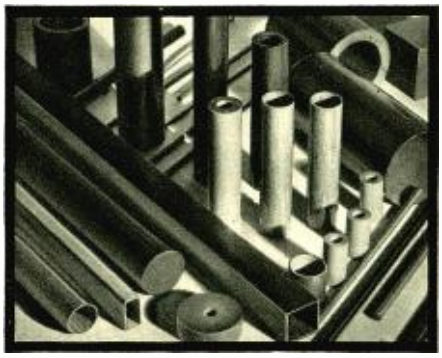
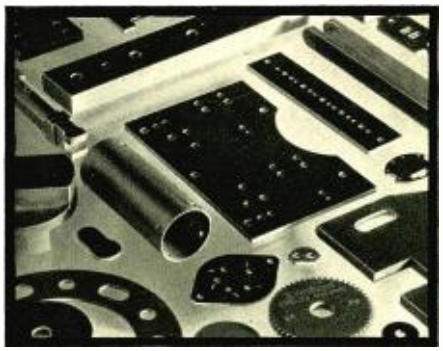


TUBES & RODS



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No matter what your requirements, you will find a grade of Synthane specially designed to meet them.

Special grades made at no additional cost. All standard grades of Synthane, listed according to N. E. M. A. standards, are ready for immediate shipment.

GRADE X. For General Use where low moisture absorption and good machining and electrical properties are required. Paper base. Will punch up to 1/32" cold, and when heated, to greater thicknesses. Machines readily. See "Sheets", "Tubes".

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GRADE XP. For Punching Operations. Paper base. Punches and shears cold up to 3/32"; punches and shears in thicker sizes depending on design of die and temperature of material. See "Sheets".

GRADE C. For Exceptional Structural and Impact Strength. Canvas base. Punches and machines readily. For use where high impact and transverse strength are required in connection with good insulating properties. See "Sheets", "Tubes", "Rods", "Gears".

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SHEETS. Size—36" square. Thickness—.010" upwards to 8". Color—Natural, Chocolate Brown and Black. Finish—Dull, High Gloss. Grades—X, XX, XXX, XP, C, L. Special as required.

TUBES. Length—36". Diameter—Inside diameter from 1/8" upwards. Outside diameter as required. Color—Natural and Black. Finish—Dull, High Gloss. Stocks—Round, Square, Rectangular. Grades—Wrapped X, C, L; Molded X, XX, C, L. Special as required.

RODS. Length—36". Diameter—1/8" upward. Color—Natural, Black. Finish—Dull, High Gloss. Stocks—Round, Square. Grades—Molded XX, C, L.

FABRICATED PARTS. Complete fabricated parts made to specifications in any of the above grades. Prompt deliveries to customers' requirements.

SYNTHANE STABILIZED GEAR STOCK for Silent Gears. Standard sheets 36" square. Thickness—upwards to 8". Easy to machine, strong, resilient and light. Gear blanks of any diameter in stock for immediate shipment.

SYNTHANE does not crack, break, dent, swell, warp, or cold flow. It has high dielectric strength, low moisture absorption, low surface leakage, good punching qualities, easy machineability, and high resistance to oils and chemicals. Genuine Bakelite resins, high-grade raw materials, specially designed machinery, controlled processes and supervised workmanship insure absolute uniformity of all Synthane products.

SYNTHANE

CORPORATION **OAKS · PENNA**

NEW YORK — CHICAGO — BOSTON — DAYTON — LOS ANGELES — SAN FRANCISCO

An electrical hair trigger

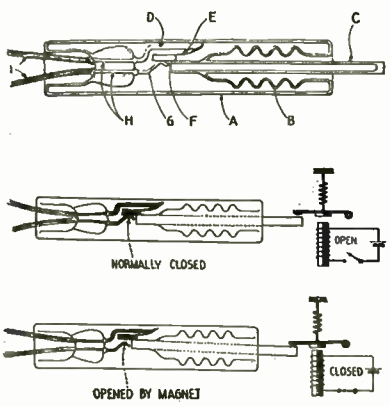
▲

Slightest mechanical or electromagnetic influence controls powerful electric current by means of novel vacuum contact.

▼

UNLEASHING two horsepower of energy when its stem is imperceptibly moved, the vacuum contact now introduced to the electrical and allied industries of America may truly be termed an electrical hair trigger. In potential application it may be likened to the vacuum tube amplifier, since it places a small amount of energy in complete control of thousands of times as much energy. Furthermore, it eliminates most of the complicated, cumbersome, costly and frequently troublesome array of apparatus heretofore required for the harnessing of electrical equipment to be controlled by delicate means. Properly applied, especially in conjunction with simplified light-sensitive cells, this device opens up startling possibilities limited solely by the fertility of ingenious minds.

The vacuum contact is a new and improved device for use wherever a positive, rapid and durable electrical contact is needed in circuits handling up to 6 amperes continuous load or 8 amperes intermittently, at potentials up to 220 volts. It can be operated by hand, by mechanical means, or again by an electromagnetic agency in conjunction with standard relays. This contact is especially well adapted for use in telegraph and telephone circuits, for railway switches and signals, for fire and burglar alarm systems, controller, advertising signs, rectifiers, electric ranges and various radio applications where a considerable wattage must be controlled by a minimum of energy. It operates in any position and is unaffected by movement or shaking.



Contact actuated by magnet to open circuit

The accompanying diagram presents the operating details of the vacuum contact. It will be noted that the principle is extremely simple.

It makes use of the elastic property of glass to cause the mechanical actuation of contacts sealed in vacuum. The bellows B, because of their shape and the tempering of the glass, are highly elastic. A slight movement of the stem or protruding rod C is communicated to the movable contact block E, causing it to separate from contact block G which is stationary. The spring E makes positive contact between the contacts when no pressure is applied to the stem. The contacts are maintained in the evacuated glass tube A. The leads are indicated at I.

The vacuum contact is a development of Siemens & Halske of Germany and has met with wide application in that country as well as in Great Britain. It is now being introduced in the United States for the first time by the Burgess Battery Company of New York and Chicago.

Operating in a vacuum, the vacuum contact is free from serious arcing and corroded contacts. It can handle its rated current as fast as 40 breaks per second. The makes and breaks are positive and clean, without hang-overs and chattering experienced with other forms of contacts, as proved by comparative oscillograph recordings. The vacuum contact requires a movement of only 0.02 inch at the end of its stem, which can be brought about by a force of less than 10 ounces, and usually but 6 ounces. The temperature rise at the rated current is extremely slight. The circuit is broken without arcing at less than 0.001 inch separation of the contact blocks. The small movement and slight force required for operation, lowers the total cost by the elimination of mechanical links. As for life, one of these contacts has been operated, at a rate of 10 times per second, 124,000,000 times, without breakdown.

There is no spark or arc, although on inductive loads a condenser is shunted across the contact. This device represents an ideal means of breaking heavy a-c. or d-c. currents with safety, rapidity and small force.

The normal action of the vacuum contact is with contact blocks in positive contact. A slight pressure on the stem breaks the circuit. However, this action can be reversed by mounting the contact with a pressure on the stem normally to break the circuit. Releasing the pressure will cause the circuit to close. Either method of control is practical. The ideal method of operating the vacuum contact is by means of a relay the armature of which is coupled to the end of the vacuum contact stem. The vacuum contact is clamped to the relay by suitable means.

With the early availability of an entirely new form of light-sensitive cell, the vacuum contact promises to play an important role in the light control of many electrical circuits. The vacuum contact makes possible the operation of powerful equipment by means of light control, with a minimum of equipment. The vacuum contact may be operated by a simple relay operating in the plate circuit of an amplifying tube fed by the output of the light-sensitive cell circuit, or again by a sensitive polarized relay actuated by the cell and in turn controlling the relay which operates the vacuum contact for controlling over a thousand watts if necessary.

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STANDARDS OF PERFORMANCE FOR COMMERCIAL TELEVISION RECEIVERS

(*Concluded from page* 30)

of course, ways in which a rising characteristic may be obtained through the use of resistances shunted by capacitances which have little or no effect upon the linear aspect of the line dw. There are also ways of operating the screen-grid tube or the pentode so that they become self-equalizing without resorting to resonant circuits.

The Detector Circuit

In discussing the fidelity characteristic of the television receiver too much stress cannot be laid upon the desirability for strict attention to the detector circuit. Recent developments in detector design lead the way toward detector arrangements which do not suffer from frequency restriction. The long favored "bias" or plate-circuit detectors *do not* fall into this latter classification. It might be noted, in view of the damping of the detector input circuit due to the use of detectors which habitually draw grid current, that it is entirely permissible to use regeneration so long as it does not exceed the magnitude necessary for balancing out the damping effect due to the detector. Regeneration properly applied to a band selector circuit will result in a considerable widening of the distance between the resonance peaks due to removal of the normal r-f. resistance from the circuits.

MACKAY RADIO AND TELEGRAPH COMPANY

Announcement was made in July by Clarence H. Mackay, president of the Mackay Radio and Telegraph Company, that the two Newark factories now controlled by his Company have been reopened and a considerable number of new employees will be engaged between now and September. These factories have been closed down for a short period, and were formerly operated by the Kolster Radio Corporation. The majority of this additional personnel, said Mr. Mackay, will be directly engaged in the manufacture of the new Kolster International radio broadcast receiver, which will be placed on the market early in August and will be the very last word in the art.

Trade response in the United States, South America and abroad has caused his Company to feel warranted in not only launching an aggressive campaign for this year's business, but also in providing substantial capital investment with the demand of the next several years in mind.

A large part of the personnel will be engaged in the manufacturing of the Kolster radio compass, and radiotelegraph communication equipment not only for the International system, but for installation on American merchant ships, which comprises the Mackay Radio marine services.

A separate department will be maintained for the manufacture of high powered vacuum tubes for transmitting purposes.

In addition to the manufacturing division a laboratory is being established in Newark, which will soon employ a large corps of engineers who will engage in development and research work in all branches of the radio art, and who will work closely with the laboratories of International Communications Laboratories.

▲

SYNTHANE OPENS CLEVELAND OFFICE

Synthane Corporation, Oaks, Pa., manufacturer of Synthane laminated Bakelite products has appointed J. W. Davis as its Ohio representative with offices at 1302 Ontario Street, Cleveland, Ohio.

The Synthane Corporation thus brings to this territory the same excellent technical service which it has already extended to manufacturers through its offices and representatives in New York, Chicago, Philadelphia, Los Angeles and San Francisco.

Synthane Corporation also maintains complete stocks of Synthane laminated gear material at its Cleveland Office, with adequate facilities for immediate delivery of full sheets or blanks.

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LOWER PRICES FOR IMPROVED BURTEX DIAPHRAGMS

Due to an improved yet more economical method of finishing Burtex or impregnated cloth diaphragms for loudspeakers, the Stevens Manufacturing Corporation of Newark, N. J., announces reduced prices.

"In the past," states Leslie Stevens, president of the Stevens organization, "we had to coat our Burtex diaphragms by hand with the aluminum or bronze lacquer, in order to obtain an airtight finish positively free from pinholes. Our elaborate spraying equipment had proved quite unsuitable for this purpose. The hand painting process represented a major item of cost in our labor.

"We have succeeded in developing a new finishing process whereby an attractive lacquer is applied to the diaphragms by dipping. A large number of diaphragms are dipped at one time and permitted to dry before the next coat is applied. Substantial reductions in our labor costs have been thus effected, and these reductions are being passed on to the buyer in the form of lower prices on Burtex diaphragms. Meanwhile, a better diaphragm with a more attractive finish, results from the new finishing process," concludes Mr. Stevens.

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ADVISE LAYMAN IN OBTAINING GREATEST SERVICE FROM RADIO TUBES

In a word of advice to the layman as to the best means for obtaining maximum service from the tubes in his receiver engineers of the E. T. Cunningham, Inc. offer the following:

First, be sure that the set if house current operated, is connected to a line, the voltage of which is that specified by the set manufacturer. In general it is advisable that the voltage be maintained within limits close to those designated by the manufacturer. If the voltage is consistently lower, operating inefficiency will result, and if too high the life of the tubes may be shortened through overload. Second, if a tube is to be removed from the set for any reason, it is advisable that the current to the set be turned off before such removal is made, otherwise excess voltage may be applied to the other tubes.

Third, it should be remembered that radio receiving tubes require reasonable care in handling. A severe jar or shock, while it may not break the glass bulb, may alter the position of the elements inside the bulb and thereby change the operating characteristics of the tube.

If these simple precautions are followed they conclude, the set owner may be reasonably assured that he will obtain both good service and good life if he uses tubes built to high standards of quality.

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SEVENTY PER CENT OF ALL RADIO SETS ARE NOW A-C. OPERATED

More than 70 per cent of all the radio sets in use today are electric and of this number approximately 67 per cent are operated by a-c., it was revealed by a survey just completed by the statistical department of the Arcturus Radio Tube Company of Newark.

"Four years ago when we pioneered the first a-c. tube there were not more than 100,000 alternating-current sets in the entire country," Arcturus officials said. The increased use of the a-c. sets is merely a trend of the times and a reflection of the manner in which the electric-line operated set has been perfected in recent years. Moreover, the mounting popularity of the electric set is seen in the industry as an important development as it indicates the manner in which the radio-using public is quick to adopt new types of sets so long as they are more efficient."

Arcturus officials also revealed that the sale of their blue a-c. tubes rose from a low of a few thousand tubes in the first month of their existence, to a peak of several million tubes per year. With the increased interest by the public in the new pentode and variable-mu tubes, which Arcturus pioneered, the company is now enjoying a consistent upturn in business.

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DR. ACHESON PASSES AWAY

Dr. Edward Goodrich Acheson, of St. Petersburg, Fla., internationally known scientist and inventor, founder of the Acheson Oildag Company and chairman of its board, died July 6th in New York City, after a brief illness.

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CABINET SIMPLIFIES HANDLING OF RESISTORS

To facilitate the handling of resistor units by jobbers, a jobber's stock all steel cabinet has just been issued by the International Resistance Company of Philadelphia, Pa. This metal cabinet has sixteen drawers, each drawer being divided into four compartments, thereby providing space for approximately 5,000 resistors of sixty-four different ranges. The cabinet is attractively finished in mahogany color and is an added attraction to any stockroom or shop.

The cabinet is furnished free of charge to any jobber with an order for at least 1,000 metallized resistors. If the order amounts to 500 units, the cabinet is billed at half the cost.

The cabinet has proved most popular with jobbers, since it answers the old question of where and how the many different sizes and styles of resistors may be stored for convenient handling, in meeting the requirements of dealers and servicemen.

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UTAH LOUDSPEAKERS ABROAD

The Utah Radio Products Company, of Chicago, has concluded an agreement with A. C. Cossor, Limited, of London, England, to manufacture and distribute Utah speakers and other Utah items in European countries, it is announced by H. C. Forster, vice-president of the Chicago company. The agreement was consummated by Mr. Forster with W. R. Bullimore, president of the English company, at the R.M.A. trade show in Chicago.

At the same time Mr. Forster announced that his company had signed contracts with several large American radio manufacturers to supply them with Utah speakers and other Utah products, including remote control units for automobile radios.

NEW OFFICERS OF HYGRADE SYLVANIA CORPORATION

The officers of the Hygrade Sylvania Corporation, successor to Hygrade Lamp Company of Salem, Massachusetts, Sylvania Products Company and Nilco Lamp Works Inc., of Emporium, Pennsylvania, manufacturers of incandescent lamps and radio tubes, have been elected as follows: Chairman of Board, Edward J. Poor; President, B. G. Erskine; Treasurer, Frank A. Poor; Vice Presidents, Walter E. Poor and Guy S. Felt; Clerk and Secretary, John S. Learoyd, Jr., Assistant Secretary, M. F. Balcom.

The directors are: E. J. Poor, B. G. Erskine, F. A. Poor, G. S. Felt, W. E. Poor, J. P. Hale and W. E. Erskine.

The selection of these officers assures the company, in addition to its more than usual financial strength and profitable present business, the actual guidance of a group of active "shirt sleeve" executives who as principal stockholders in the company, have a financial and personal interest in its success much beyond that of the usual hired executive.

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NEW PRICES ON DE FOREST TRANSMITTING TUBES

New net list prices have just been announced by the DeForest Radio Company of Passaic, N. J., covering DeForest transmitting audions. Increased production and a greatly enlarged market in this highly specialized field have made possible some striking downward price revisions, according to DeForest officials. The DeForest transmitting audion line covers every type from the 15-watt 510 type oscillator to the 10,000-watt water-cooled 507 type oscillator, including screen-grid tubes, mercury-vapor rectifiers, and ultra short-wave oscillators. A copy of the new price list may be had for the asking.

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PLANS FOR NEW JEFFERSON ELECTRIC PLANT

Announcement was made recently of what is claimed to be the largest industrial development in the Chicago area during 1931. Jefferson Electric Company purchased a 19-acre tract in Bellwood, a western suburb, on which it will erect at once a $550,000 manufacturing plant. This will house in one building two Chicago plants now at 15th and Laflin Streets and at Congress and Green Streets, and will care for the entire business with the exception of the Canadian subsidiary in Toronto. The company now employs approximately 1,800 and the new plant will have facilities for 3,000 workers.

The property fronts 700 feet on 25th avenue and 1,000 feet on Madison Street, extending from Madison Street 1,278 feet along the Indiana Harbor Belt railway to Jackson Street. In addition to being served by the Belt railway the new plant will have the Chicago, Aurora and Elgin railroad, the Chicago and Great Western and a freight line of the Chicago and Northwestern railroad.

Jefferson Electric Company of which J. A. Bennan is president, J. C. Daley, vice-president and treasurer, and A. E. Trenza, vice-president and general sales manager, was established twenty years ago and merged fifteen years later with the Chicago Fuse Manufacturing Company, which had been organized more than four decades ago. They have paid dividends every year without interruption since organization, it is stated.

The chief products manufactured include transformers such as are used for bells, signal systems, electrical toys, oil burners, radio receivers, and neon signs, as well as electrical fuses, automobile ignition coils, outlet boxes, switch boxes, and miscellaneous electrical products. The annual business approximates $5,000,000.

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PLASTIC INSULATION MATERIALS VARY IN TECHNICAL PROPERTIES

Oftentimes variations are not so apparent in comparative costs. It is perhaps true that factors other than mechanical or electrical characteristics must be considered, as for example, appearance, in the choice of a material such considerations must weigh lightly in making a decision on parts within the apparatus itself.

Most insulating parts, whether stamped from sheet, cut from rods, or tubes, or otherwise fabricated represent a rather inconsequential expense in relation to the entire assembly. Therefore, the shrewd radio engineer in designing his equipment will seek the greatest possible insulation protection against leaks and losses and the influence of atmospheric moisture.

The American Hard Rubber Company of 9 Mercer Street, New York, has specialized in electrical insulation almost from the very beginning of the electrical industry in America. They have for eighty years been recognized as experts in the production of hard rubber to meet definite engineering specifications.

The advent of radio brought new problems in insulation. With characteristic thoroughness the technical laboratories of this Company attacked these problems. As a result the special grades of hard rubber developed to meet these needs occupy an outstanding position in the industry.

▲

INFORMATION ABOUT PENTODES

There seems to be some misunderstanding among the trade in regard to what should be the appearance of the pentode type of tube. Customers write stating that the pentode type has the appearance of having gas, and in consequence there was some doubt as to the quality.

This phenomenon is not gas but a cathode ray bombardment of the glass, and is absolute proof of high quality.

This condition is caused by electrons passing through the grid either above or below the plate, receiving an accelerating energy from the plate but not being stopped by it, then striking the glass and causing the getter deposits on the glass to fluoresce wth a blue color.

This phenomenon is only present in tubes which are exceedingly gas free, as a slight trace of gas disperses the electrons in such a manner that their energy and path is not concentrated enough to produce this effect.

The phenomenon caused by the bombardment is proof of a gas free tube. It appears only on the surface of the glass and not throughout the bulb. The real gas glow is most in evidence immediately surrounding the plate, between the filament and plate, or sometimes filling the whole bulb volume.

The above information is supplied by the Cable Radio Tube Corporation, 230-242 North 9th Street, Brooklyn, N. Y.

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PERRYMAN ORDERS THREE TIMES 1930

Confirming the growing belief in the industry that the radio dealer is being rapidly brought to an appreciation of the fact that his widest margin of profit and most rapid turnover, lies in radio tubes, H. B. Foster, general manager of the Perryman Electric Company, announced recently that their back log of unfilled orders was three times that of last year, and that there is every possibility of this ratio increasing before September 1st.

The radio industry in general is realizing, pointed out Mr. Foster, that while the sale of new radio receiving sets for the home may fluctuate with business conditions, the sale of tubes for replacement purposes continues to increase every year, and is only affected by a drastic breakdown in general business conditions, and even then only for a limited time.

▲

REPLOGLE APPOINTED CHIEF ENGINEER OF DE FOREST

As part of its program of expanding engineering and production activities covering the most diversified line of radio and industrial products today, the DeForest Radio Company of Passaic, N. J., announces the appointment of D. E. Replogle as chief engineer.

For the past two years Mr. Replogle, familiarly known as "Rep" throughout the radio industry, has been Assistant to the President of the Jenkins Television Corporation, and in full charge of the engineering and production activities of that organization. Prior to that period he was identified with the Raytheon Manufacturing Corporation, heading its licensee engineering service and much of the research work. He has taken prominent part in the development of the broadcasting art during the past half decade, more recently turning to the television field in which he is a leading engineer and authority not only in development work but also in the evolution of television standards and practices. He is responsible for the first successful television broadcasting service of genuine entertainment value through Station W2XCR in New York City.

In his present position D. E. Replogle will head a staff of experienced engineers engaged in the further development and application of the DeForest line of products, which includes radio transmitters, transmitting tubes, special and industrial tubes, carrier current equipment, centralized radio systems and other items, quite in addition to a complete line of receiving tubes. He will also continue to guide the engineering activities of the Jenkins Television Corporation, whose products are manufactured by the DeForest Radio Company.

▲

CRC IN CANADA

The Central Radio Corporation, Beloit, Wisconsin, announces that it has been granted three Canadian patents on "CRC" sockets and contacts. Two of the patents particularly cover steel spring reinforced sockets and contacts.

"CRC" sockets are manufactured in Canada by Hale Brothers Limited, 6224 Chambord Street, Montreal, Quebec, and A. C. Simmonds, 218 Front Street East, Toronto, Ontario is sales agent for the eastern half of Canada.

▲

EGERT RADIO PLANT EXPANDS

Wireless Egert Engineering, Inc., has moved from 179 Greenwich Street to 179-181 Varick Street, New York. In the new and enlarged quarters the company is developing a line of standard electrical and radio instruments, including short wave transmitters and receivers.

The company is carrying on a growing business in industrial problems, such as geophysical exploration equipment, time saving devices, safety devices, heat control regulators, etc.

WHAT'S THE "DEAR PUBLIC" GOING TO BUY THIS SEASON?

8TH ANNUAL
RADIO-ELECTRICAL
WORLD'S FAIR
Madison Square Garden
New York, Sept. 21 to 26

9TH ANNUAL
CHICAGO
RADIO-ELECTRICAL
SHOW
Coliseum, Chicago
Oct. 19 to 25

That's what every radio jobber and dealer would like to know. No definite trends in models or circuits were established at the June trade show in Chicago but—there have been big developments since then, developments important to you and your business welfare. Everything new in radio and television will be shown for the first time at the

TWO NATIONAL RADIO-ELECTRICAL NEW YORK - EXPOSITIONS - CHICAGO

All leading manufacturers will display their newest merchandise at these two authoritative expositions which mark the opening of the radio buying season. Attend one of these shows. See what the manufacturers offer. Get the public's reaction. You can sense the buying trend and learn what's going to sell this season. Such information is well worth a trip to either of these two shows.

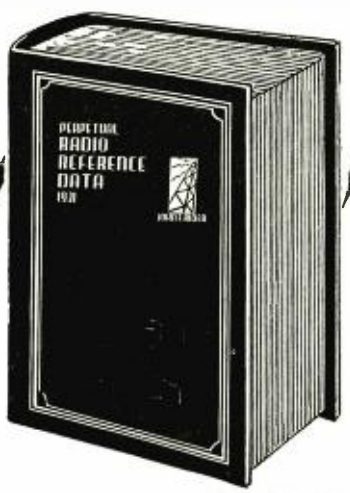
ELECTRICAL APPLIANCE DISPLAY

The foremost manufacturers of home electrical appliances will display and demonstrate their products at these two expositions. You will see just the merchandise you need to boost business and level out your year round sales curve.

Invitation credentials will be mailed to the trade about September 1st.

RADIO-ELECTRICAL WORLD'S FAIR
1904 Times Building, New York City

CHICAGO RADIO-ELECTRICAL SHOW
127 N. Dearborn Street, Chicago, Illinois



950 Pages of Accurate Radio Circuit Data

for Engineers, Radio Manufacturers, Research Laboratories, Technical Libraries, Technical Schools, Radio Schools

John F. Rider's PERPETUAL RADIO REFERENCE DATA is a whole radio circuit library in one great—loose leaf—volume. . . . This work has been adjudged the ***greatest compilation*** of radio circuit data ever attempted and produced for use in the radio industry.

In this loose leaf radio circuit library—acclaimed by many thousands—you will find more than 950 pages of accurate and authentic radio circuit information and more than 1,800 electrical diagrams, covering American broadcast receivers manufactured since 1919, Canadian broadcast receivers—test and set analyzer equipment—power amplifiers—eliminators and power units—short wave receivers—kit receivers.

In this comprehensive volume you will find electrical diagrams—chassis wiring diagrams—color coding of connecting wire—color coding of resistances—electrical values—voltage data—socket layouts—etc., information of value to the radio industry at large and to every individual in particular who at any time requires reference data pertaining to radio receivers or associated equipment.

We say without fear of contradiction that no volume devoted to a similar subject contains the wealth of information found in John F. Rider's PERPETUAL RADIO REFERENCE DATA. . . . The basic book is kept up to the minute by a regular MONTHLY SUPPLEMENTARY SERVICE for a very moderate fee.

If your work is of a technical nature and you desire actual reference data of practical value, you will find it in this book. We want you to understand that this is not a book on theory. Theory has been excluded. Every page contains vital practical reference information.

A panorama of its users covers the entire radio field from the student in the radio school to the legal department of the receiver manufacturer. If you have any interest in radio receiver design, this volume should be in your library. . . . The pages are 8½ x 11 inches. The drawings are clear and easy to read. . . . Everything is legible.

You are the sole judge of the merits of this book. If you think that it is not as represented or that you can do without the information contained therein, return the volume and get your money. . . . No quibbling. The book is guaranteed.

EASY PAYMENT PLAN

$2.98 DOWN

RADIO TREATISE CO., Inc.,
1440 Broadway,
New York City.

Enclosed find $2.98. Please ship postal charges collect John F. Rider's Perpetual Radio Reference Data. I will examine the book for 10 days. If it meets with my approval I promise to remit the balance of $2.00 during the next two months at the rate of $1.00 every 30 days, until the $2.00 has been paid. If I am not satisfied, I will return the book in 10 days and you will refund my $2.98. I am to be the sole judge.

Name .....
Address .....
City ..... State .....

NEW DEVELOPMENTS OF THE MONTH

NEW TUBES

In response to a growing demand for more efficient radio tubes, to be employed in battery operated receivers, especially those designed for broadcast reception aboard motor boats, the Perryman Electric Company presented on July 1, three new tubes. These tubes are known as types P236, P237 and P238, and have been especially designed to meet the requirements which motor boat, auto and portable radio receivers will place upon them.

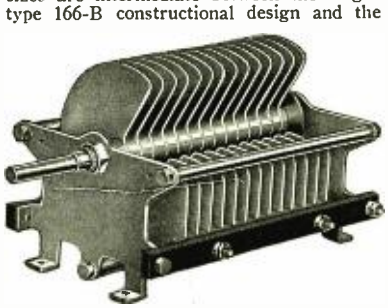
The P236 is a type of screen grid, the P238 a pentode amplifier and the third, the P237, a general purpose tube. These one quarter ampere tubes draw six volts and are of the indirect heater type. They have been ruggedly designed so that their construction will off-set the vibration which is inherent to most mediums using portable battery operated receivers.

Joseph D. R. Freed, president of the Perryman Electric Company, in making the announcement of the new tubes, pointed to the fact that over sixty per cent of the inboard motor boats now being shown at local yacht clubs and motor boat show rooms, feature special radio equipment and in most cases, built-in aerials.

▲

TRANSMITTING CONDENSERS

Suitable for amateur use and for medium powered commercial stations ahe new Cardwell type 16-B transmitting condensers are primarily intended to meet the requirements for moderately high voltages in a medium size condenser. The 16-B sizes are intermediate between the larger type 166-B constructional design and the



smaller T-183, T-199, etc., designs. To illustrate this point, the 300 mmfd. type 166-B Cardwell condenser having 23 plates. has a depth of 10¼ inches back of the panel. The 330 mmfd. type T-199 with 37 plates, has a depth of 6½ inches, while the new 16-B condenser with 315 mmfd. maximum capacity and 31 plates, has a depth of 9-9/32 inches.

▲

WIRE CLOTH

It is announced by the Newark Wire Cloth Co., 351-365 Verona Ave., Newark. N. J., manufacturers of wire cloth for every industrial purpose. that they have been granted patent No. 1,808,526 on "Sealedged" wire cloth which is now so much used in radio tubes.

AUDIO TRANSFORMERS

Having conquered the problems of distance, selectivity and all-electric operation —radio engineers have been directing major attention toward greater fidelity of reproduction.

New tubes with ample capacity to handle the greater energy of the low notes—new

speakers capable of reproducing faithfully the output of the receiver! Sangamo with 30 years' experience in precision manufacturing and unsurpassed facilities are marketing audio transformers and impedances which match the new tubes and speakers. Manufacturer and set builder are now able to get the full results which these tubes and speakers are capable of giving.

These transformers are made by The Sangamo Electric Company, Springfield, Ill.

▲

PORTABLE WESTON OSCILLATOR

The i-f. and r-f. oscillator recently announced by the Weston Electrical Instrument Corporation, Newark, N. J., is one of the most efficient and versatile radio testing devices available to radio servicemen.

It can be employed for the purpose of aligning intermediate-frequency stages, for aligning gang condensers, for determining the sensitivity of receivers, for checking radio-frequency coils and condensers and for making selectivity tests and checking the oscillator stage of superheterodynes.

The new Weston oscillator, known as model 590, has an intermediate-frequency range of from 110 to 200 kilocycles. Its broadcast range is from 550 to 1500 kc. Frequencies between 200 and 550 and above 1500 kc., may be obtained by means of harmonics.

A grid dip milliammeter on the panel of the oscillator also serves as a filament or plate voltmeter. being connected in either of the latter two circuits by means of push-button switches. Two '30-type tubes are employed, one in the oscillator and one to modulate the r-f., producing an audible note of 400 cycles with 30 per cent modulation. The output of the oscillator is controlled by an especially designed attenuator. A binding post on the lower edge of the panel which is connected through an adjustable coupling condenser, allows the grid clip meter to be used for determining the resonance point of any coil and condenser circuit within the range of the oscillator. The necessary dry batteries, consisting of a single 22½ volt "B" and four 1½ volt flashlight cells, are contained in a shielded compartment within the case of the instrument. A compartment is also provided for the model 571 Weston output meter—an important accessory to an oscillator.

▲

MICROPHONE STANDS

Microphone stands, formerly merely service instruments in the studio, have recently been designed with eye appeal to more accurately fit their surroundings.

With this in mind, the Samson Electric Company, Canton, Mass., has perfected four new microphone stands, finished in an attractive shade of light brown electroplated bronze.

These stands all follow the same general style and design. Stand Number 880 is for use on tables, desks and in general where the announcer or speaker is seated. Stand Number 881 is an adjustable table stand whose height may be regulated to suit the individual. Stand Number 882 is full length and may be used for speakers, orchestras, etc. Stand Number 883 is full length with two microphones thus insuring better coverage.

These new microphone stands are very attractive and will aid materially in completing the interior effects of the studio. They are strongly built and will withstand the hardest usage.

Further information may be obtained by writing the Samson Electric Company, Canton, Mass., exclusive distributors in the United States.

▲

RADIO CONTROL BOX

A manual control for regulating line voltage to radio sets or other devices. Made up of a rheostat installed in a black enameled metal box complete with recep-

tacle, wire, and plug for connecting. Will reduce high line pressures to proper voltage and avoid tube burn-outs. Has knob for adjusting desired voltage drop.

This control is manufactured by the Central Radio Laboratories, 16 Keefe Ave., Milwaukee, Wis.

MARK TIME SWITCHES

M. H. Rhodes, Inc., Hartford, Conn., is marketing a line of time switches for portable and wall controlled radio receivers.

This modern time switch may be mounted flush in the top or side of any radio cabinet by cutting a single hole. Type A, furnished

with either brass or bakelite plate, turns *off* the program in thirty minutes or less. List $2.50. Type AA furnished with bakelite plate, turns the program on *or* off in twelve hours or less. List $4.50.

▲

STOP NUTS

Elastic stop nuts, the locknut with a fibre collar, are now made for radio use as small as No. 3/48 of brass, duralumin or steel.

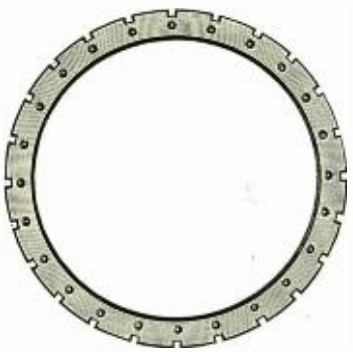
These nuts will stay tight at any position along the threaded length of the screw and, as a result, are frequently used by manufacturers to adjust the trimmers on condensers. In addition, the nuts are used for joining electrical connections in lieu of soldering or the standard nut lock washer combination.

These elastic stop nuts are manufactured by the A. G. A. Company, Elizabeth, N. J.

▲

ANTENNA SPREADER

Charles F. Jacobs, 270 Lafayette Street, New York, has on the market the Jacobs Antenna Spreader here illustrated. It may be used by transmitting stations of small



power and for receiving purposes. It lends itself to cage antenna and counterpoise construction.

▲

ELECTRIC CLOCKS

With so many homes "going Colonial" in their decorative appointments, the banjo clocks which have been added to the Sunbeam Eternatime line of electric clocks, made by the Chicago Flexible Shaft Company, Chicago, should find ready acceptance, because of their trim, clean-cut lines and beautiful finish.

They carry out the finest traditions of Colonial cabinet-making, and are fashioned of genuine mahogany combined with solid black walnut. The panel overlays are of oriental walnut and aspen, and the lyre-shaped grille is of solid black walnut.

▲

NEW 'BUILT-IN' POWER SWITCHES FOR CLAROSTAT VOLUME CONTROL

When the power switch was first combined with the volume control, this was done primarily to simplify the operation of the radio receiver through the elimination of an extra adjustment. The early designs of combined switch and variable resistor were bulky and none too certain in action. Improvements in the switch mechanism were gradually developed, but the combination device still retained the disadvantage of being somewhat of a makeshift.

Recently, however, the Clarostat Manufacturing Company has perfected a new type of "on" and "off," 110-volt line switch, which is built into the volume control. The mechanism is positive in action, being enclosed in a bakelite case and mounted so as to form an integral part of the control. The switch employed is approved by the Underwriters Laboratory for 1 ampere at 250 volts or 3 amperes at 125 volts.

The recently announced Clarostat model P5 graphite element volume controls are

now being equipped with the new type power switch. These combinations of volume control and switch are compact, being only 1¾" in diameter and ⅞" deep. The Clarostat model P18 wire wound volume controls are also being made with the new switch mechanism. These units have an outside diameter of 1⅝" and a depth of 1⅛" including the switch.

The new Clarostat combination units are especially well-adapted for use in midget sets, in automobile and aeroplane radio receivers, in portable sets and in fact, in all designs where space is at a premium. In addition to the much-desired feature of compactness, these new models retain all the recognized and distinctive advantages inherent in the design of Clarostat volume controls. The model P5 graphite element volume control utilizes a distinctly new positive rolling contact which eliminates erosion of the resistance element. Model P5 controls are available as rheostats or as potentiometers, either tapered or without taper, with insulated or grounded shafts and in all usual resistance values from 1000 ohms, up to and including one megohm.

▲

POWER FILTER UNIT

Manufacturers of telephones, intercommunicating systems, public address systems, talking picture equipment and other sound producing apparatus, who have sought some economical method of supplying noiseless, non-pulsating d.c. power from the ordinary a.c. line, will be interested in the power filter unit recently introduced by the Square D Company, Detroit, Milwaukee, and Peru, Indiana.

The power filter unit is not to be confused with ordinary rectifiers for keeping operating batteries charged. While the power filter unit can be used as the main source of d.c. power supply, with batteries

as a "standby," keeping the batteries fully charged and greatly reducing the maintenance cost of the batteries, it should be kept in mind that the power filter unit, without auxiliary equipment can supply clear, pure d.c. from an a.c. supply.

There are no moving parts in the power filter unit—the action is entirely electrical; therefore there is little or no depreciation and maintenance costs are largely elimiated.

To the manufacturers of telephones and all types of sound and signaling equipment, the power filter unit offers unique possibilities. It is noiseless, it has no hum and no moving parts, with tremendous condenser capacity, low impedance and the output voltage can be maintained within close limits. The power filter unit does away with the necessity of storage batteries and dry cells. It permits a.c. low voltage for ringing, besides pure d.c. for talking. It also avoids the necessity for special circuits and relays for cutting out the a.c. power supply when the system is in operation.

Although but recently introduced by the Square D Company the patented principle has been in use for the past several years.

Telephone, talking picture, intercommunicating and other sound and signal systems which have already been installed may also be equipped with the power filter unit.

Descriptive literature covering the Square D power filter unit is at the present time being published and requests for additional information will be supplied on request to the Power Filter Division, Square D Company, 6060 Rivard St., Detroit, Mich.

▲

DAMARIN REJOINS DUBILIER ORGANIZATION

After an absence of several years, Fred L. Damarin is once more with the Dubilier Condenser Corporation in the capacity of Western Sales Manager. Mr. Damarin makes his headquarters at 330 S. Wells Street, Chicago.

A little neglect may breed mischief:
for want of a nail the shoe was lost;
for want of a shoe the horse was lost;
for want of a horse the rider was lost.
—*Poor Richard's Almanac.*

For want of a nail

Lovely Period Cabinets . . . Copy Writers Superlatives . . . Expensive Engineering Talent . . . Modern Production Lines . . . Class "A" Tubes . . . Gigantic Advertising Appropriations . . . Well Planned Distribution . . . Quarterly Dividends . . . are ALL at the mercy of the proverbial "horse shoe nail."

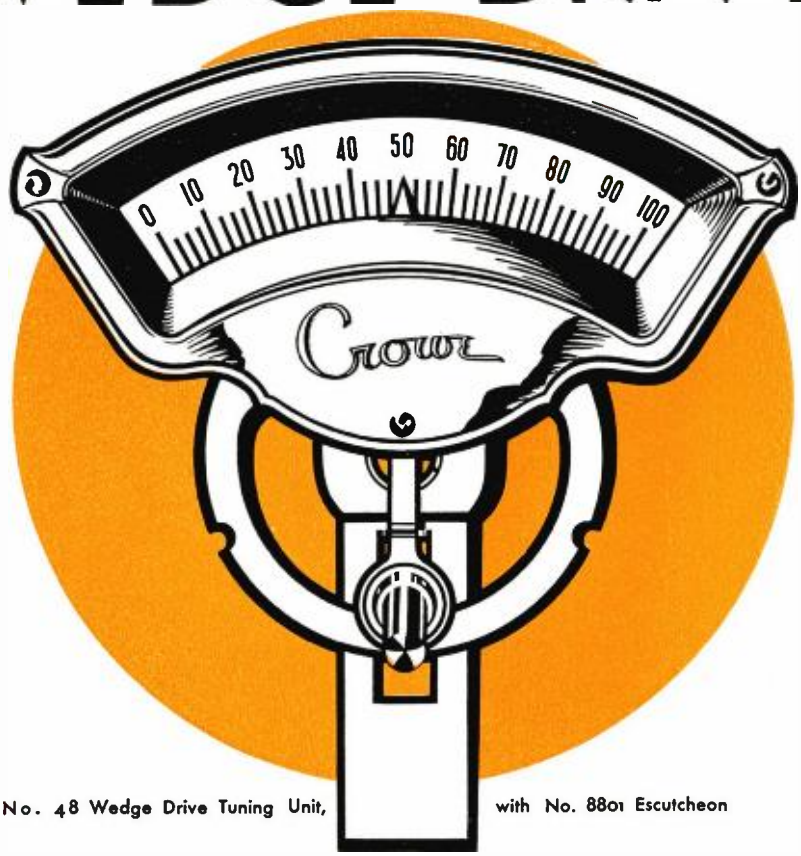
● In a section of the country almost devoid of set and apparatus manufacturers, the volume of sales of CRC Sockets increased to the point where we were curious as to where and how they were being used. Investigation showed that practically all of them were being used to replace other makes of sockets that had failed in service—through burning out or poor contact. "Penny Wise" set manufacturers had staked their reputation, and those of prominent tube manufacturers, on sockets not the mechanical or electrical equal of CRC Sockets. The difference in cost between poor sockets and CRC's was about one cent per set. • • • • • • • • Neglect of seemingly trivial details might very easily spell DISASTER. The foresighted manufacturer will test CRC Sockets in his laboratory—and make certain that his product will not "throw a shoe" at a crucial moment. • • • • Ask for samples—you'll get them—and *promptly*.

CENTRAL RADIO CORPORATION

Beloit, Wisconsin

Representatives—R. C. James & Co. . . . . Seattle, Washington
Paul R. Buehler . 406 Harris Building, Los Angeles
A. C. Simmons, 218 Front St., Toronto, Ontario, Can.

THE New WEDGE DRIVE



No. 48 Wedge Drive Tuning Unit, with No. 8801 Escutcheon

The No. 48 Wedge Drive Tuning Unit, shown above, is one of the newest developments by Crowe. Its remarkable smoothness and powerful action will appeal to the engineer who needs an efficient, compact unit at moderate cost. The bronze escutcheon shown with No. 48 is No. 8801.

Because of its 5 to 1 ratio, the wedge drive unit is especially well adapted for superheterodyne, short wave, or other accurate tuning. This new drive is available in several styles:

· Full Vision · · Full Vision with travelling light ·

· Several fan styles and other variations ·

These units, of which No. 48 is one, are ready for quick delivery with a generous selection of escutcheons to match. Write or wire for samples, describing your needs.

CROWE NAME PLATE & MANUFACTURING CO.

1742 GRACE STREET CHICAGO ILLINOIS

RESISTORS

The Ward Leonard Electric Company, Mount Vernon, N. Y., has issued bulletin No. 19 describing that company's new Ribflex Vitrohm resistors.

Ribflex resistance units consist of a metal alloy resistance ribbon, reflexed, wound on edge on a ceramic tube and banded at each end with heavy duty terminals. The entire unit is then covered with a fired-on vitreous enamel.

▲

ARCTURUS PRESENTS NEW SALES BUILDING IDEA TO TRADE

After very diligent tests among numerous radio dealers, the Arcturus Radio Tube Company, Newark, N. J., announces a new business-building merchandising idea for its dealers throughout the country.

The plan is based on the Arcturus tube tester. The Arcturus tube tester, in reality a silent tube salesman, has been designed to test every common type of tube including the new pentode and variable-mu tubes. The large meter on this board gives two readings, namely; the usual plate current measurement and the essential electron emission indication. Because of the display value of this tester, the dealer can very readily test tubes before the eyes of his customers and definitely point out to him the difference between good and bad tubes. When the latter are encountered, the test provides the dealer with excellent talking material on reasons why the customer should buy new replacement tubes.

On tests conducted it has been proved that dealers have very materially increased their tube sales and have gained new customers for other merchandise handled in their stores by the simple means of merchandising free tube-testing service to their customers and prospects.

▲

DECADE RESISTANCE BOXES

The interior view of the 900 series resistance box herewith illustrated discloses that positive, definite contacts are made from unit to unit along the resistance line of this instrument.

The box is made of cast aluminum and can be filled with suitable oil to the top of the switches in case loads in excess of one watt per step are to be employed.

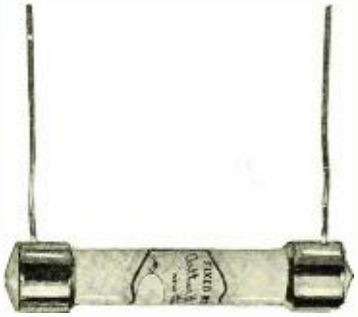
Cat. No.	Maximum Resistance		Dials	Price
935	1,100,000 ohms in	10,000 ohm steps	2	$100.00
945	11,000,000 ohms in	100,000 ohm steps	2	150.00
960	60,000,000 ohms in	1,000,000 ohm steps	2	350.00

Calibrated to an accuracy of .1 per cent.
Maximum voltage, 5,000 volts.
Dimensions, 5½"x7"x9".

The instrument is marketed by The Shallcross Mfg. Co., Collingdale, Penn.

3-WATT RESISTOR

The 3-watt metallized resistor here illustrated, manufactured by the Lynch Mfg. Co., Inc., 1775 Broadway, New York, is additional to the Lynch line of standard metallized resistors which now includes ratings of 1/3, ½, 1, 1½, 2 and 3-watts. It, too, employs the new Type "K" Fila-



ment (which possesses features hitherto unattained) and the cast metal end caps with molded in pigtails which insure positive electrical and mechanical connections. The special ceramic casing is of sturdy construction and maximum heat dissipation. It will withstand more than average shocks and jars as well as minimizes possibility of damage by crushing.

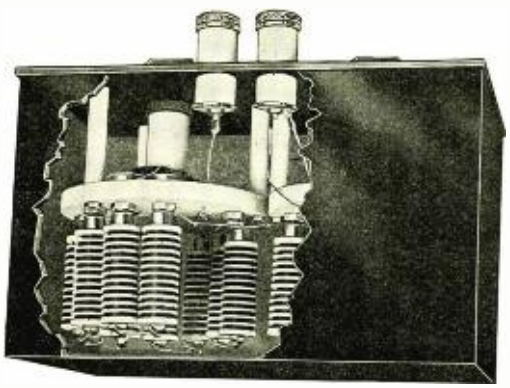
▲

HIPERNIK, A NEW MAGNETIC MATERIAL

The U. S. Patent Office has issued patents to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, for "Hipernik," a new metal possessing unusual magnetic properties. This strange-sounding, synthetic name is made up of the first syllable of the two words "high permeability," the valuable property the metal possesses, and three letters from the word "nickel," which is one of its important elements.

"Hipernik" is said to be the most magnetic metal ever discovered, being 160,000 times as magnetic as air. It is over thirty times as magnetic as ordinary open hearth steel or iron, which have a maximum magnetic permeability under 5,000, as the scientists express it.

Many of the uses to which the new metal may be applied are still under the observation of research engineers. Its use has greatly improved radio receivers and sound amplifying systems. Instrument transformers, too, have been made smaller and are most efficient and accurate when the transformer core is made of "Hipernik."



Interior view Shallcross 900 series resistance box.

INTERFERENCE SUPPRESSORS FOR AUTOMOBILE RADIO

The serious interference caused by spark coil, plugs and distributors, constituting the major problem in the operation of the usual automobile radio set, is now eliminated, according to the International Resistance Company of Philadelphia, Pa. The engineers of that organization have spent six months in intensive research and engineering development on the automobile radio interference problem, resulting in resistance units which offer a practical, simple and inexpensive solution.

The main point in suppressing radio interference set up by ignition equipment is to attack the trouble at the source. The new resistance units are designed to be applied at the potential sources of trouble. One unit connects to its respective spark plug, being inserted in circuit with the lead from the distributor. Another unit is inserted in the distributor cap so as to come between the distributor contact and the spark-plug lead. A third unit is in the form of a ceramic tube fitted with wood-screw terminals, so that it may be conveniently inserted in the main spark coil lead and in each spark-plug lead, which are cut for the purpose.

All units contain the new Type K metallized filament for the resistance element, fully protected by a heavy ceramic tubing, as well as cast metal ends with proper fittings for the connections required.

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BY-PASS CONDENSERS

The Kellogg Switchboard and Supply Co., 1066 West Adams St., Chicago, is fully equipped to quickly manufacture by-pass condensers of special capacities, and sizes of cans, to meet any special condition.

The condenser cans are fabricated from sheet metal and can be finished as specified.

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LITTLEFUSES

The Littlefuse Laboratories, 1772 Wilson Avenue, Chicago, Ills., has added a new unit to their line.

This, their N1039 Gryp-Connector, is designed primarily to provide an inexpensive and simple means of fusing the A and B circuits of automobile and battery sets without the use of an exposed cutout.

The connectors are made of tinned spring brass and a pull of about 5 lbs. is required to withdraw the Littlefuse. All metal parts are covered by a gum rubber sleeve, shown in shadow. The entire assembly hangs freely in the line supported by the

wires soldered to it. The overall length including Littlefuse is two inches.

Littlefuses are made in 1/100, 1/32, 1/16, ⅛, ¼, ⅜, ½, 1 and 2 amps. capacity, but the ⅛ amp. size has been found most suitable for protecting the B circuit of sets. It is most advisable to protect this circuit in using the new two volt tubes in which the filaments are usually placed in series. If a filament to grid or plate short should occur in one tube the others are burned out pronto. In some states also, battery circuits are legally required to be protected.

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