electronics

radio, sound, communications and industrial applications of electron tubes · · · design, engineering, manufacture

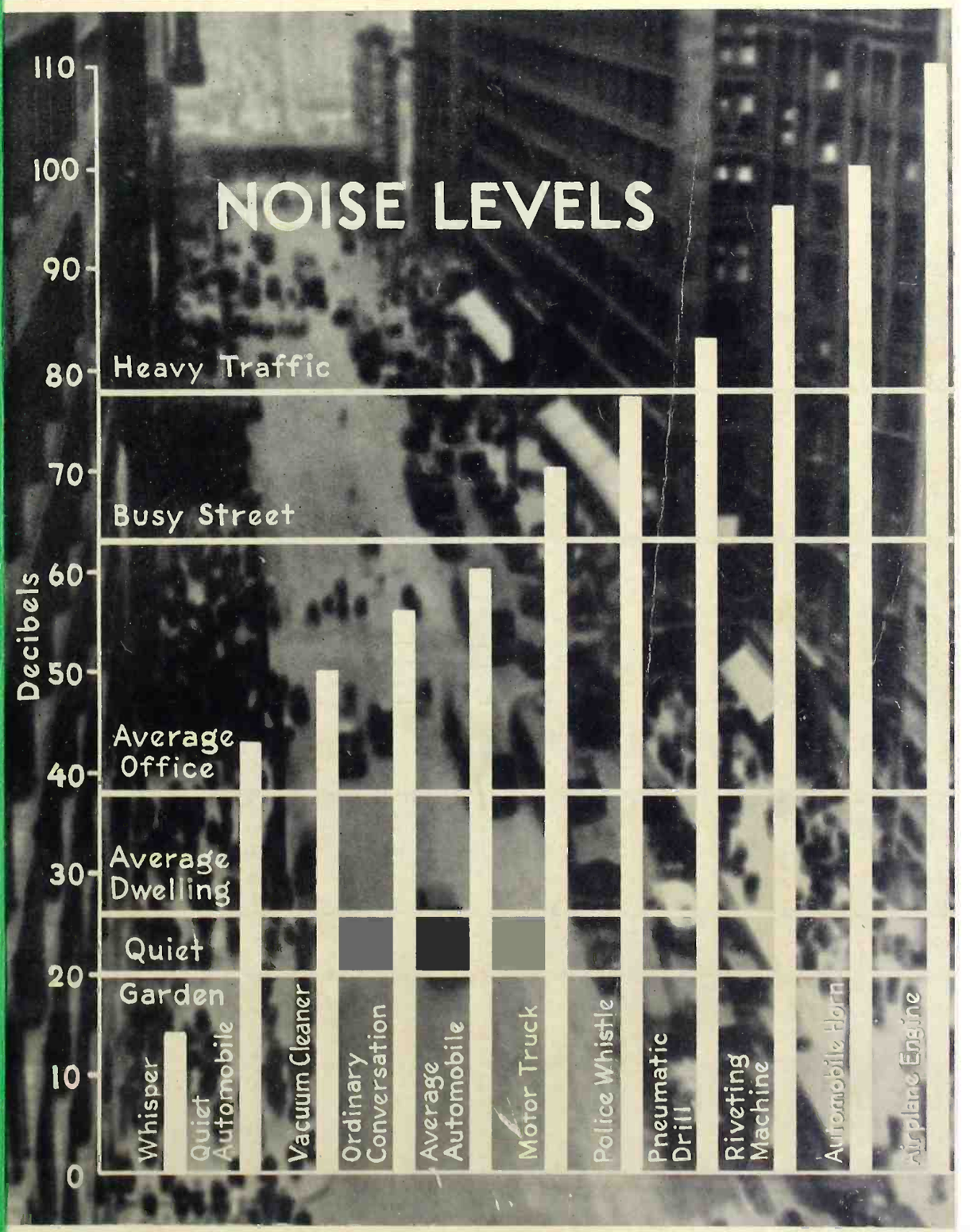
Noise meters

Metal radio tubes

Seven-meter broadcasts

What price radio

Tube delay relay



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April 1935

radio
sound pictures
telephony
broadcasting
telegraphy
counting
grading
carrier systems
beam transmission
photo cells
facsimile
electric recording
amplifiers
phonographs
measurements
receivers
therapeutics
traffic control
musical instruments
machine control
television
metering
analysis
aviation
metallurgy
beacons
compasses
automatic processing
crime detection
geophysics

Safeguard radio against politics

RECENT changes in the official set-up of the Federal Communications Commission at Washington, suggest that important revisions in the national radio structure are also contemplated. From such re-allocations, the present radio groups which have rendered yeoman service to broadcasting, may be expected to be less well off than before. New names and new call-letters will probably be appearing on the call-lists. And while all this is taking place, grievous technical injuries may be wrought by officials who have no understanding of radio principles, but very keen appreciation of political horse-trading.

THE next few months, therefore, may become a critical time for radio-engineering principles. Beginning May 15, the Commission will have before it at public hearings, all the wild-eyed and long-haired critics of the present system, who would reconstruct it without understanding the simplest facts about radio.

THIS is a time, therefore, when the sound engineering advice that Dr. Jolliffe and his Engineering Division have invariably given to the Commission, should have the support of every radio engineer and every radio executive. The successful business of every broadcaster, manufacturer, distributor, dealer and service-man depends upon having a proper broadcast structure. Washington politicians have never yet understood that radio principles are realities of nature, and that transgressions bring their inevitable penalties (though unfortunately not on the heads of the politicians!).

THE issue of good radio may again come before the Washington authorities this spring. Industry opinion will be needed to shape public opinion in support of *sound radio principles unswervingly enforced by the FCC.*

THE MOVEMENT FOR

Public consciousness aroused, here and abroad, for more silent machines and better acoustic control

IN MANY parts of the world, right now, there is a sudden consciousness of the evils of noise, accompanied by public and governmental movements to limit noise production or to abate its effects.

In London the sounding of auto horns is now forbidden at night. Extension of this ban to all built-up areas in Great Britain, during all of the 24 hours, has also been recommended by the British Minister of Transport.

In Rome, Premier Mussolini has decreed "silent days," when traffic moves in cemetery silence, even the policemen's whistles being stilled. Factories that create noise in the middle of the Imperial City have been ordered to insulate themselves as noise producers, or to move to the outskirts. Street-hawkers' cries have been prohibited both in the residential sections and in business streets.

New York City had a Noise Commission several years ago which compiled a complete report of noise evils in the metropolis, and awakened the local public to the possibilities of noise abatement.

The Noise Abatement League

Now, again, the activity of noise reduction in America is being taken up by a new League for Noise Abatement, with organization headquarters at 522 Fifth Avenue, New York City. Dr. Miller McClintock, Harvard Professor in the Erskine Chair of Street Traffic Research, is president of the new group, other members of which include such public-spirited citizens as Dr. Henry Goddard Leach, editor of *The Forum;* Dr. Harry Elmer Barnes; Mrs. Langdon W. Post; Rosamonde Gilder, author; Robert McLaughlin, architect; Quincy Howe, and R. W. Riis. Wide extension of this committee's membership is now under way.

The work of this Noise Abatement League's members has been largely that of calling public attention to the psychological and nervous injury done by noise. "Noise is the curse of our present civilization," they point out. "Needless noise destroys composure, comfort and efficiency."

"Noise elimination, already a science in itself, is building new industries and creating new employment to pull us out of the depression.

"New noiseless models of machines and other products make obsolete former noisy types, and rapidly outmode earlier equipment now in the customers' hands.

"Noise elimination, in line with other current efforts, is important to human well-being and the future richer life of the individual."

"Manufacturers are today critically examining their wares to see what can be done to make these products noise-proof and efficient," speakers for the league have declared. "Your competitor is probably doing this already, and you must follow suit or expect that the purchaser will discriminate in favor of equipment that recognizes the public's demand for noise abatement. Noisy machines must go, by verdict of public opinion."

Analyzing office noise. Dr. E. E. Free, treasurer of the Acoustic Society of America, demonstrates how the noise of a standard typewriter can be measured by his portable noise-meter, for comparison with silent typewriter model

Noise in streets and public places

Offices, stores, restaurants and public gathering places need acoustic treatment to suppress the reverberation that puts such a terrific strain on the nerves of all inside. Acoustic materials now on the market permit noise to be insulated and controlled practically at will. Sensitive electronic instruments—noise meters—are available and permit noise conditions to be accurately analyzed, so that efforts at noise abatement can be minutely compared for results. Noise control is a new popular trend which business men now recognize as a force that can obsolete old-model equipment.

Already silence is an important factor in automobile design. The new railroad trains are being built with a careful ear to silent operation. Even the door-slamming brakeman of mighty arm is now under ban from

NOISE ABATEMENT

New models and new materials, based on noise elimination, create new sales and new employment in many lines

headquarters, and self-opening and self-closing doors, photo-cell controlled, are being experimented with.

Street-car officials are specifying silent paving, and are turning to the new trolley-buses, the most silent of all public conveyances. A good deal of attention has been paid by the street-railway industry to keeping rail joints smooth by welding and grinding. Efforts have been made to reduce track noises by the use of mastic fillers along the rail. "Resilient" car wheels of various sorts have been developed and subjected to test. Steel car wheels have been bored and fitted with wood or rubber plugs. Helical gears, herring-bone gears and worm drives have been tried as substitutes for the old spur gears. Rubber cushions have been used extensively in car trucks to reduce vibration and noise. The so-called Electric Railway Presidents' Conference Committee car carries this idea further than any other yet built. Window glass has been set in rubber and various methods are used to eliminate body vibrations.

New models; new opportunities for employment

In offices, clicking typewriters, machine racket, buzzing messenger calls, telephone shouting, and jangled call bells, all take their toll of human nerve force. But acoustic materials are available for reducing noise and reverberation in building interiors, so that now offices, halls, restaurants and other public places can be silenced at will. Makers of office machines, typewriters, etc., are directing every effort toward silent operation of their products, and are capitalizing this in their advertising. Manufacturers and dealers are having it brought home to them that the public discriminates in favor of noiselessness. They are coming to learn that equipment which is fairly new in other respects, can be effectively outmoded and made obsolete as soon as a *silent* substitute comes along.

The new move in industry and business is now to reduce noise, to lift the oppressive stumbling-block to human efficiency, comfort and composure, and to create thereby new models and new opportunities for sales and employment, as we emerge from the depression.

The silencing of appliances for the home offers another large field for improvement. The wailing shriek of the electric vacuum cleaner can and should be muzzled and muted, in the interest of household tranquillity. The rattlety-bang of most home clothes-washers needs noise-abatement engineering. The roar of old-time dishwashers after dinner, has unsettled many a digestion. The noise of oil-burners, cheap electric clocks, water pumps, and other motor-driven appliances still leaves room for improvement.

In home radio sets we have now reached a point where, for the comfort of the household, loudspeakers should be supplemented with plug-in jacks for head-phone attachment. Headphone listening would also be a boon for broadcast reception in homes where there are two or more radio sets, or where only one person in a home circle is interested in a particular program.

The general problem of noise abatement is therefore threefold.

First, the production of noise should be limited so far as possible, by all the ingenuities of the engineer and acoustic expert. Noise should be *eradicated at the source* where feasible.

Second, noise should be prevented from reverberating and echoing, which tends to augment the irritation of the original noise, even if of low intensity.

And third, in some cases acoustic insulation may have to be set up to keep unwanted noise out of a given enclosure, so that those within may enjoy relative silence or the undisturbed hearing of desired musical or sound effects.

Measuring noise in city streets. S. K. Wolf and W. J. Brown of Electrical Research Products, Inc., show that Madison Avenue street-cars in New York produced 85 decibels. Replaced by buses, the street-noise level fell to 65 decibels

NOISE MEASUREMENT METHODS

A review of instruments and methods used in determining the cause and extent of industrial noise

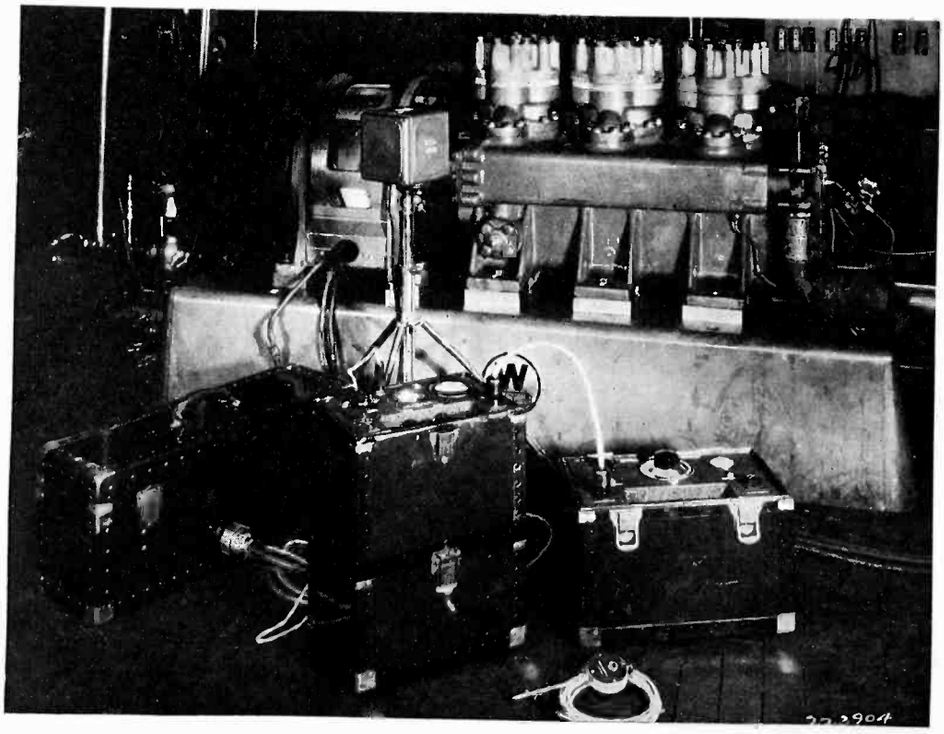
When an industrial organization buys a noise meter for design and production control, its use is turned over to the most logical man on the engineering staff, usually an electrical engineer with electronic training. This man usually has no appreciation of the physics of sound; he may never have considered sound reflections or standing waves, and he certainly has no appreciation of the finer points of acoustic control. It is small wonder under these circumstances that a great deal of confusion has attended many attempts to control industrial noise. When a noise meter fails to reveal the source of trouble in a noisy piece of machinery, the production engineer is more apt to blame the meter than the man using it; usually the latter is to blame.

Since noise measurements for industrial, civil, and architectural purposes must rest largely in the hands of the electronically trained engineer, it is important that he consider the different types of instruments available for use, the differences and limitations of each and the pitfalls which attend their practical use.

The first fact to consider is the difference between hearing a sound and measuring it with a meter. Sound affects the ear in a very complex way, whereas the response of a measuring device must be made relatively simple if it is to be operative under practical conditions. Hence there has arisen a difference of opinion as to how sound measurements should be carried out, i.e. by the subjective evaluation of the noise by the ear, or by the objective measurement of some important aspect of the noise by a meter. In general the two methods do not lead to the same results, and the type of measurement which leads to the truest evaluation of the loudness of the noise will differ according to the problem at hand. At present, the American acoustic engineers are inclined to favor the objective type of measurement, for reasons given below, while the British prefer the subjective method. Since both methods are used, sometimes in conjunction with one another, they both should be understood by the engineer who is confronted with a sound measuring problem.

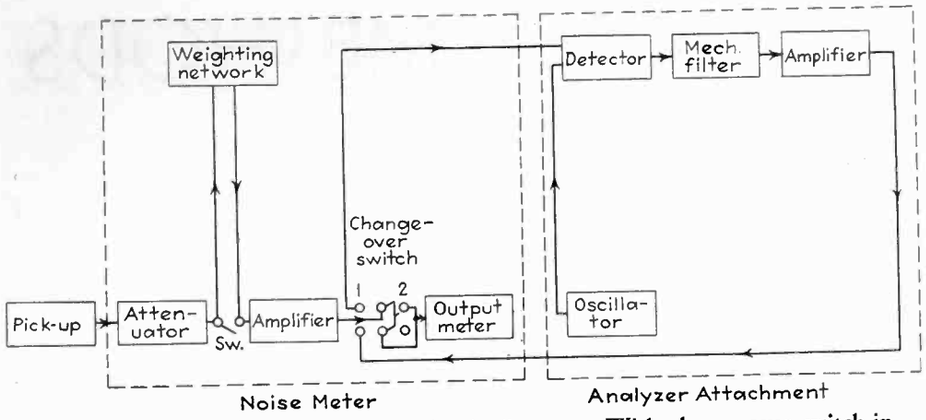
The subjective method makes use of a direct comparison between the noise to be measured and some standard, as compared by the ears of one or more observers. A simple tuning fork may be used. If the fork be sounded to a given intensity, and held at a given distance from the ear, the time required for it to become inaudible is an inverse measure of the noise level surrounding the observer. A ticking watch may be used in the same way. While these simple methods give no indication as to the absolute noise level unless careful calibrations are undertaken, they can be used to indicate relative level with good accuracy, especially if used by an experienced observer.

A more advanced type of subjective noise meter (or audiometer) has recently been described by B. G. Churcher.[1] The observer wears a single close-fitting earphone in which he hears a pure sine-wave tone (800 cycles per second in this case), whose intensity can be varied from the threshold of hearing to 112 db above threshold. Through the other ear he hears the noise to be measured. By adjusting the level of the tone in the earphone to a value distinctly higher and distinctly lower than the noise, and by the use of successive trials the loudness of the tone and the loudness of the noise source can be balanced in the ears of the observer. The test is then repeated with the earphone on the other ear, and the mean of the two results taken as the final value of the noise level. The attenuator control of the 800 cycle tone must be carefully calibrated, of course, in db above the zero reference. Using several different observers with this audiometer, the author reports agreement within 2 db at 100 db level, and within 6 db at 50 db level. This is remarkable accuracy for the audiometric method, and is considerably



The Westinghouse noise meter and wave analyzer set up for the measurement of noise produced by a Diesel power plant. The vibration pick-up is shown in the foreground

[1]Noise measurement for engineering purposes, by B. G. Churcher, *Electrical Engineering*, January, 1935, page 55.



A typical noise meter and analyzer circuit diagram. With change-over switch in position 1, the noise can be analyzed. In position 2, total noise is measured

better than the results which have been obtained by American observers using essentially the same methods.

These subjective methods are open to considerable criticism from several points of view: They represent results based on the ear, which is widely variable in its response. It responds differently from hour to hour in the same individual, it responds differently to different kinds of noise, and the variation between different individuals is sometimes as great as 40 db. Hence, while it is true that all noise measurements must ultimately be interpreted *in terms of* the effect of the noise on the average, normal ear, it is not true that measurements can always be made successfully *by means of* the average, normal ear, because an average, normal ear is hard to find and hard to keep in condition. Faced with the fact that the accuracy of the subjective methods seemed limited to 10 db, with 25 db as average error, American acoustic specialists have turned to the objective type of measurement, in which the ear plays no direct part.

The objective methods of measurement

The objective (or acoustiometric) noise measurement devices differ considerably in their refinements, but essentially they contain four elements: (1) a sound translating device, such as a microphone or vibration pickup; (2) an attenuator for decreasing the output of the microphone or pickup to the required input level of the following amplifier; (3) an audio frequency amplifier whose response may be flat over the entire audible range or may be peaked in a certain range by the use of filters or transformers; and (4) an indicating meter, usually of the square-law or logarithmic type, calibrated in db, or which is connected to the output of the amplifier.

The simplest type of noise meter contains just these four elements; it measures total sound energy, but makes no distinction between the different frequency components of the noise. It is perhaps the most generally useful type of meter for general industrial applications, particularly for production control purposes. It can be used to compare the relative intensities of two noises of the same kind, for example that of a production sample as against the production standard. It is far less reliable for comparing two noises of different character, and it may indicate very misleading results if used on pure tones.

The type of microphone used is usually one of two types: the magnetic type or the condenser type. Of the two the magnetic type is the more rugged and the cheaper, and is usually used in the general industrial meter. The frequency response of the magnetic microphone is not flat, but with the use of corrective filters can be made so, or can be peaked to follow the ear response, as explained below. The condenser microphone is not flat, but with the use of corrective filters can be made so, or can be peaked to follow the ear response, as explained below. The condenser microphone is suited to accurate measurement; it can be provided with flat response from 60 to 10,000 cycles, and it is considered non-directional to a high degree. It is a relatively fragile instrument, however, it must be provided with a head amplifier, and is subject to calibration changes with temperature and humidity. Carbon microphones are not used because their response changes with use, and ribbon type microphones are usually too highly directional.

The ideal system uses a flat-response microphone, since then any kind of response may be given to it in the following circuit. In general the over-all meter response is purposely peaked in the middle range of audio frequencies. This is a concession to the subjective point of view; that is, the meter response is made to approach that of the human ear by having its response peaked so that it is most sensitive to those frequencies which most strongly affect the ear. This frequency "weighting" as it is called, is usually accomplished by a filter network, although a simple transformer is sometimes used. Meters provided with this weighting arrangement give indications more nearly analagous to the ear response. For example: the 3,000-cycle commutator whine of a series motor may

A typical noise meter intended for industrial use, developed by General Radio. The circular opening admits the sound to a magnetic microphone, the amplified output of which is indicated on the db meter

Pricing radios by formula

—an empirical method of determining minimum list prices

LIST prices of radio receivers have never been determined in manners which are either scientific or economic. For example, the cost of making and selling the receiver often plays but a minor role in the process of setting up the price which the consumer must pay. Too often the discovery that a competitor has on the market a similar receiver has been the controlling factor in fixing the price, even though it may be so low that a loss instead of a profit results. In such haphazard methods both the public and the industry suffer.

A most interesting attempt to work out a more sensible and elegant way to determine list prices has been evolved by the Hazeltine Service Corporation. This group has produced a formula of several forms into which are fitted the factors which should determine the "potential performance" of any receiver. From this formula the minimum list price can be found. General changes of costs can be taken care of, whenever required, by appropriate alteration of the constants in the formulas.

"Potential performance" and price formulas

For each type of receiver, as indicated below, there is a fundamental formula leading to a numerical quantity which gives the potential performance of that type of receiver. This quantity is called "S". From it the minimum list price may be determined. These formulas, and the method of using them follow:

S (for home radio) $= E + I + A\sqrt{P}$

S (for auto radio) $= E + I + W\sqrt{P}$

S (for chassis less tubes, etc., as noted below) $= E + I + 4.2\sqrt{PU}$

After the quantity S, has been determined the minimum price is found as follows:

Min. list price—For AC, AC-DC, and auto radios $= 0.15S + 0.0012S^2$

Min. list price—Battery, DC line, and remote control radios $= 0.25S + 0.0014S^2$

Min. list price—Chassis less loud speaker, cabinet, or tubes $= 0.75S + 0.0006S^2$

Min. list price—Chassis less cabinet and tubes $= 0.75S + 0.0006S^2 + 3.4K$

Min. list price—Chassis less cabinet and loud speaker $= 0.75S + 0.0006S^2 + 3.4L$

Min. list price—Chassis less cabinet $= 0.75S + 0.0006S^2 + 3.4M$

The quantities in the above equations are defined as follows:

E = total number of electrodes in all tubes of the receiver

I = total number of impedances in the receiver

A = effective baffle area of the receiver (square feet)

P = power delivered by the output tubes (watts)

W = weight of complete receiver including accessories (pounds)

U = weight of chassis without cabinet, speaker or tubes (pounds)

K = average wholesale price for loud speakers of type used in chassis

L = average wholesale price of tubes in chassis

M = K + L

These quantities are determined in more detail as follows: the number of tube electrodes includes all elements brought out to pins, so that a 2A5 counts as 5 electrodes, a 6A7 as 7 electrodes, etc. Impedances rated as single units are as follows: a resistor, a condenser, a choke coil, etc. A transformer would rate as two impedances, as would a tapped inductance or winding. Triple impedances would be a potentiometer with a fixed and an adjustable tap, or a condenser block with three sections, etc.

The baffle area is determined by multiplying the baffle height by the baffle width. The height is defined as equal to the net height of the set (which is height less legs, if any), plus twice the depth of the set; the width is the width of the cabinet plus twice the depth. The power output is the rating of the tubes as supplied by the manufacturer of the tubes which are considered as operating at the maximum voltages, or at the maximum available voltages (i.e. 115 volts in a universal set). Under weight, the storage battery, ignition suppressors, generator filter condensers are not included.

How the formula works

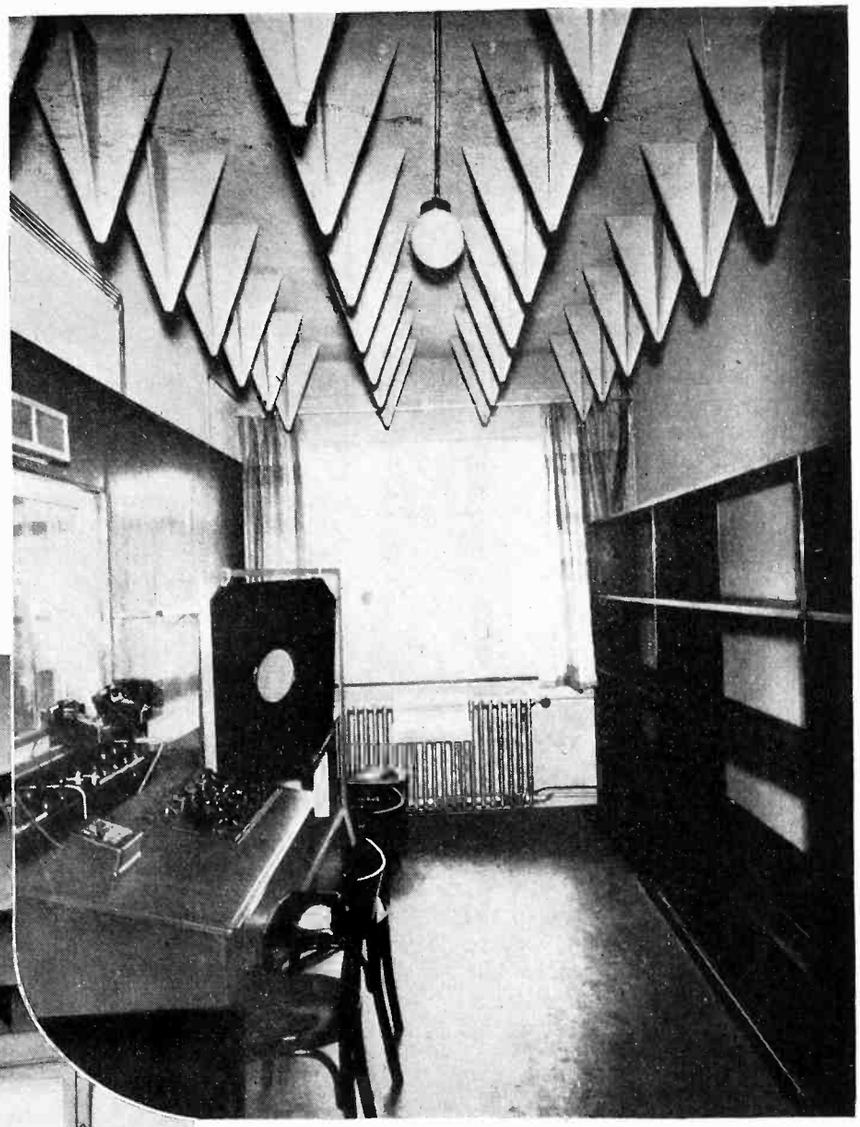
As an example consider a multi-band receiver of 7 tubes consisting of three 78's, one 6A7, one 85, one 42 and one 80. This receiver was in a cabinet with a gross height of 38 inches which stood on legs 9 inches high. This gives an effective height of 29 inches; the cabinet depth was 12 inches, its width was 25 inches. Thus the baffle area was 2600 square inches or 18.06 square feet. Impedances numbered 130. The square root of the power output was 1.73. Adding up the various factors, including 39 electrodes for the tubes gave a figure, S, of 200.2. This was a home radio receiver. The proper formula, gave a minimum selling price of $78.15.

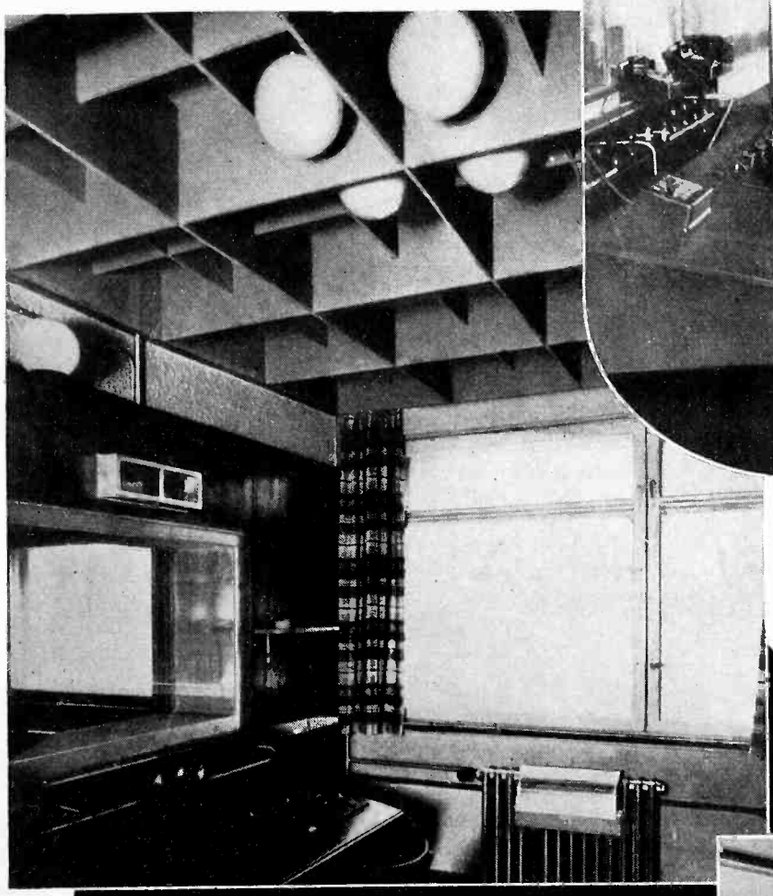
It will be seen that a reasonable minimum price was found. In fact it is more than an intellectual pastime to apply the formula to a complete line since it will show up the sets that are designed merely to be advertised, but rarely offered for sale, e.g. "come-on" merchandise to get the customer into the store, there to be sold a more expensive receiver.

However looked at, this empirical method of developing a scientific pricing system seems to be the first genuine attempt to fix minimum list prices upon basis of the potential performance of the receiver. Good engineering in such a system would rate a higher place; receivers tricked up with many tubes and parts, operating at low efficiency would demand a higher price than a smaller more efficient set—and many apparent bargains would be revealed in their true light.

NOVEL ACOUSTICS OF KÖNIGSBERG STUDIOS

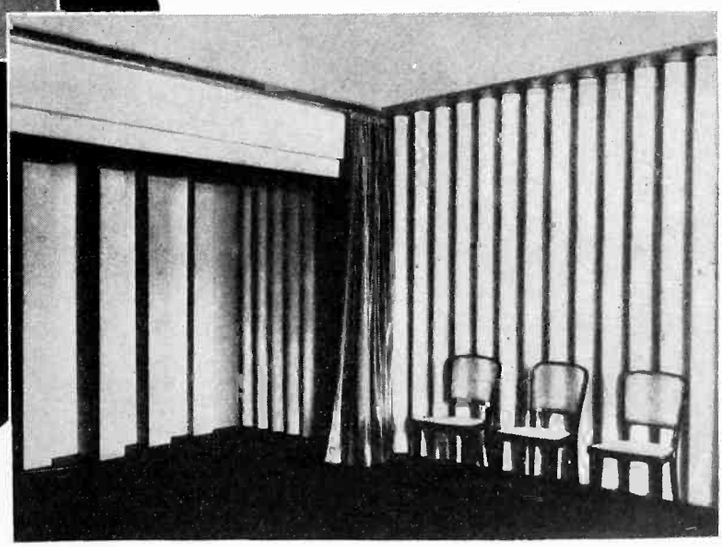
In Germany's newest broadcast station acoustic treatment takes new forms. In the control room pictured below, an acoustic "boxed ceiling" is provided

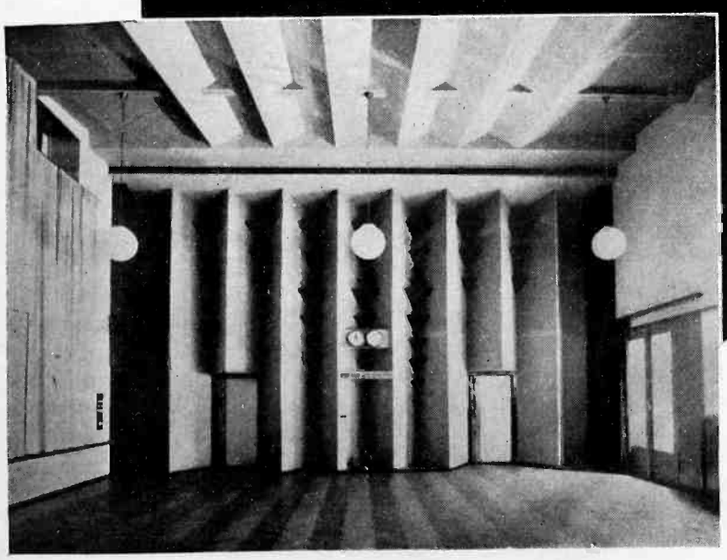




Another acoustic ceiling design is made up of the thirty-two cone "stalactites" in the receiving room pictured above

The floors of the studios below are built partly "floating." Walls are erected at oblique angles to reduce sound reflections, and sound waves within the rooms are broken up by wavy panels of eternit plates





An old German proverb—"Everything sounds, even silence" —has been employed decoratively in one of the large studios

HIGH LIGHTS ON ELECTRONIC

Night-club lighting to match milady's dress

THE FAMOUS Rainbow Room atop the 65-story RCA Building in Radio City, New York, is equipped with an electronic color organ, by which, as the organist plays, colors change in the dome overhead. These changes are created not by action of the organ, organist, or other human hands, but by the tones of the music itself. Harmonies of sound are thus reflected in harmonies of color, and a symphony of sound becomes a harmony in hues. Music receives a second dimension. As a melody is heard, its counterpart in color is reflected.

A microphone relays the music to the color organ, and through filters the tones are separated. To the lowest notes, one thyratron control responds; higher tones operate other electronic relays. Volume of tone also is registered. Each separate control energizes groups of colored bulbs concealed in the rim of the white dome over the revolving dance floor. Low notes bring forth red, middle register blue, and green, and high notes amber. The result is "a musical rainbow of musical moods in color."

E. B. Kirk, consulting illuminating engineer on the color-control system of the Rainbow Room lighting, has now proposed an additional novelty for the edification of the smartly-attired guests who visit this famous night-club. At the entrance doorway he would place the lens of a color-matcher, the photo-cells of which, through appropriate filters, would control the thyratron relays of the various color groups of lamps. A woman entering the Rainbow Room with her escort would be asked to stop a moment in front of the color-matcher, and immediately the central dome would automatically light up with the exact shade and tint of her gown, as a pretty compliment to the newcomer.

✦

Photo-cell steers ship

THE Photo-electric Pilot Corporation of Tacoma, Wash., is developing automatic steering apparatus for ships which employs a magnetic compass, the movement of which affects a light-beam and photo-cell to operate the steering gear through amplifier equipment. According to C. L. Hill of the company, the device serves to keep a vessel automatically on a predetermined course, and has been used on private and commercial craft along the Pacific Coast, with a high degree of success.

Facsimile messages as aids to industry

THE ULTIMATE possibility of flashing entire pages of hand written or typewritten letters by radio facsimile, instead of by the Morse code, is discussed in the 1935 report of the Radio Corporation of America, just sent to stockholders.

The report reveals that substantial progress has been made in the last year in this high-speed radio facsimile. It is expected that a high-speed, ultra-short wave facsimile circuit between New York and Philadelphia will be placed in service in the present year.

The implications in this new method are so stirring to the imagination that the report sounds a note of caution by stating that the translation of these developments into practical public services presents a number of complex financial, commercial and operating problems.

"Progress in facsimile transmission," the RCA report states definitely, "has reached a stage where communication by the square inch, instead of the traditional Morse code methods of dots and dashes on a word basis, has been achieved and demonstrated on an experimental basis. This development promises new point-to-point communication services, and new broadcast services to the home, of pictures, printed matter and other visual material."

David Sarnoff, President of the Radio Corporation, in commenting on high-speed facsimile says:

"Today we see radio stepping into a new field of expansion—micro-wave facsimile. And I believe the day is not so far distant when radio will dip into the mail bag. If a letter is worth the time required for dictation, for the stenographer to write, for rereading by the sender, then the stamp and, let us say, a month for arrival in Australia, then it is worth a little more to flash it across the world for quick delivery and an answer. I believe thousands of facsimile letters and messages will fly between cities and from country to country by facsimile radio."

Not only can simple messages be transmitted by facsimile, instead of by the spelling out of words, but almost every kind of specialized communication can be flashed through the air and put in the recipient's hands in exactly the same form in which it left the transmitting office. A question about an architect's plans can be cleared up without possibility of error simply by sending a facsimile of the drawing. The authenticity of a signature can be determined in the same way. Police officials can get instant action on fingerprints and photographs from distant cities.

WOR'S SPARE TUBES DISPLAYED TO VISITORS

This display rack contains (left to right) 4 250-watt modulators (Western Electric type 212-E), 11 35 kw. r-f amplifiers (W. E. 232-A), and 7 10-amp. mercury rectifiers (W. E. 266-A), spares for the new 50-kw. WOR transmitter at Carteret, N. J.

DEVICES IN INDUSTRY + +

WCAU'S "Photona" organ

EXPERIMENTAL work has been carried on for the past two years in the laboratories of the WCAU Broadcasting Company, Philadelphia, upon a new instrument for producing electrical tones. Tests were conducted with several types of sound production—moving film, rotating disks, etc.—and it was finally determined that the present instrument was the most suitable.

The "Photona," as it is called, has been constructed under patents held by Ivan Eremeeff and the tones are produced by means of rotating disks inserted between a light source and a photo-electric cell. The output of the cells is fed to a system of amplification capable of high-fidelity response and to loud-speakers which are capable of both high fidelity reproduction and of handling a wide dynamic range. The entire rotating mechanism is driven by a single synchronous motor and the speed of the disks is governed by the size of the driving pulleys. The instrument is entirely AC operated, the average demand from the AC mains being 350 watts. This load, of course, will vary with the number of light sources used.

There are twelve of the rotating disk shutters. The sections cut from the periphery of the disk vary in depth and are arranged to admit light from the proper light sources. The diameter of each disk pulley is determined mathematically by the number of sections cut from it and by the speed of rotation. The light sources, of which there are nine hundred, are standard six volt lamps, lighted from AC through a step-down transformer.

There are two manuals, each comprising six octaves. The keys in these two manuals are used as switches to light the filaments of the lamps desired. There are two banks of stops, one of which is used to insert harmonics or sub-harmonics in any predetermined ratio to the fundamental and the other is used for striking chords from a single key.

The tremolo may be either foot- or hand-operated and varies the speed of the driving belt. This is done by working the belt back and forth across a cone-shaped pulley. The vibrato thus accomplished is a variation in pitch and not in intensity. The volume control is a special potentiometer which is varied by means of a foot-pedal.

The output of the photo-electric cells is transformer coupled to the input of a standard preamplifier and thence through a voltage and power amplifier to the loud-speaker assembly. It may also, if desired, be fed directly through the microphone receptacle, into the standard speech input equipment.

The tuning of the organ is dependent entirely upon the speed of rotation of the disks. When once properly tuned, it will, therefore, remain in tune indefinitely and is also subject to no temperature variation. The completed Photona is sufficiently small to pass through an ordinary studio door, and be wheeled from one studio to another.

+

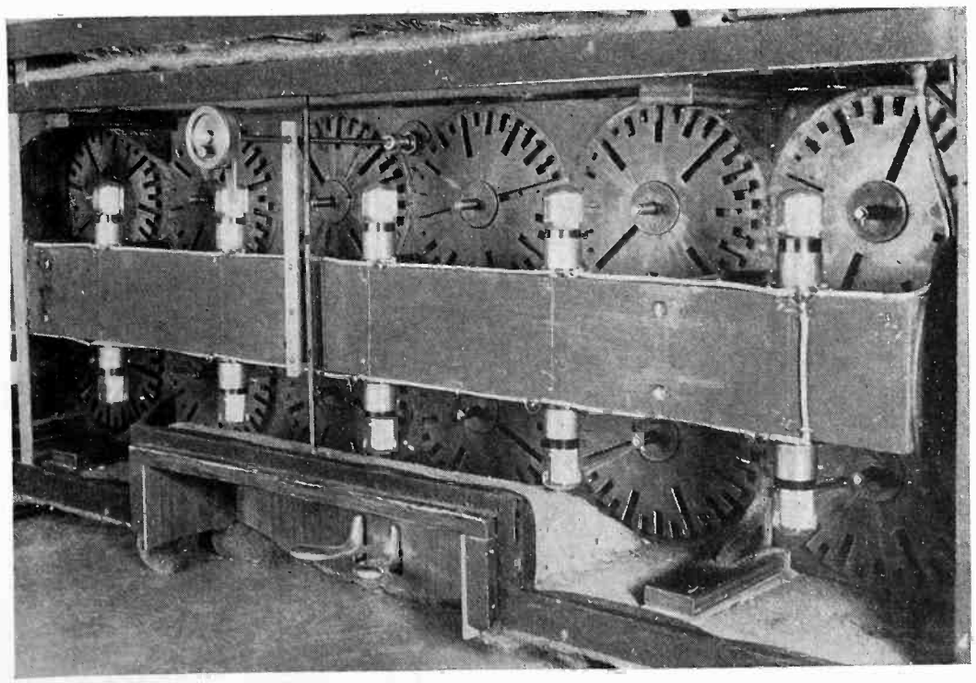
Locating watermarks in paper

THE PROBLEM of accurately locating a watermark in the center of a sheet of paper which has always been difficult of solution, has recently been solved by the use of a photo-electric cell marker, now in use by the Parsons Paper Company, of Holyoke, Mass. The former method of localizing watermarks in a roll of paper consisted of setting the cutting knife in direct relation to one watermark on the roll and then carefully watching the operation of the machine to see that the sheet of paper did not creep ahead of the knife or fall behind. The use of the photo-electric cell to do the watching has reduced the errors in localizing watermarks to a negligibly small amount.

The mechanics of the new method go something like this: A series of "signal spots" which may be light or dark spots on the paper or holes in the paper are worked on to one edge or selvage of the paper web. In some cases the watermark itself is used as the signal spot. These signal spots are placed in exact relation to the watermarks. Thus even though the paper should expand or contract to changes in atmospheric moisture, the signal spots will always maintain their proper position with respect to the watermarking in the paper.

Bolted on to the cutter frame and perched just above the edge of the roll containing the signal spot is a photo-electric cell. The beam of light which enters this cell is flashed as it goes through the hole. In each case as the signal spot alters the light entering the photo cell a magnetic contact operated by the cell controls the cutting edge. Four 22-in. rolls are thus cut simultaneously. In this way the watermark performs its own cutting. Special papers such as those used by banks, insurance companies and corporations may thus be accurately marked for greater protection against forging.

NEW PHOTOCELL ORGAN FOR WCAU'S STUDIOS



A front view of the WCAU Photona, showing the tone-shutter disks in complete detail. These disks revolve, and as the lights are switched on by the keys, the light beams flash through the shutters to the photo-electric cells and produce the tones of the instrument

Thermionic delay relays for cathode protection

By L. D. MILES *Vacuum Tube Engineering Dept.*
and
M. M. MORACK *Power Rectifier Engineering Dept.*
General Electric Company, Schenectady, N. Y.

WHEN a vapor tube of the hot cathode type is placed in operation by accident or inadvertence before the cathode has reached operating temperature, damage may be done to both the tube and the circuit in which it operates. To prevent this damage, cathodes must have ample heating time to insure operating emission current before the tube is placed in service. Accordingly vapor tubes are given two ratings, an initial preheating period and a reheating period after power interruptions.

It is obvious that the shorter interruptions require less time for reheating due to the heat storage in the cathode. Protective relay devices should, therefore, be judged by their ability to protect under all operating conditions and by whether they conserve all operating time compatible with safety by appropriate reheating characteristics and by responding to voltage changes.

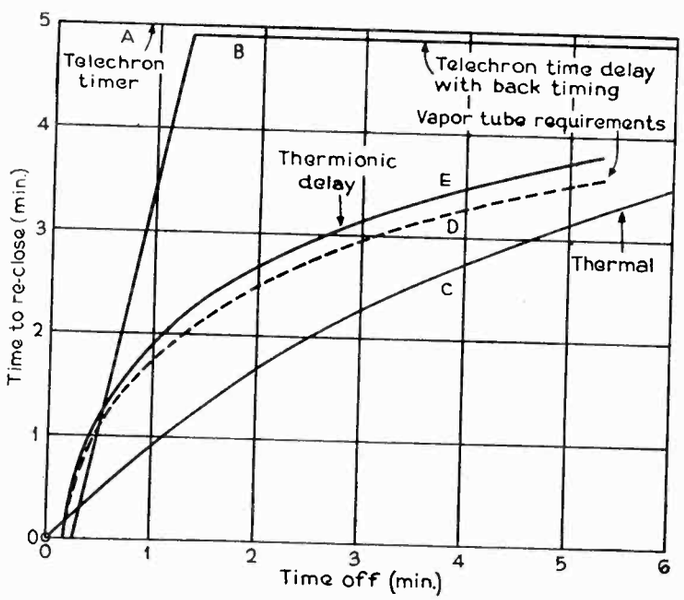


Fig. 1. Comparison of the re-closing characteristics of thermal, mechanical, and thermionic types of relay with the reheating characteristic of a vapor tube

The time delay for heating or reheating must be accomplished by keeping the tube non-conducting either by grid control or by holding the anode circuit open until maximum emission current is available. The former is accomplished by a bias arrangement or a phase shift scheme, while the latter uses anode contactors operated by a time delay relay. Time delay relays used with the above methods of control may be classified in the order of increasing desirability as follows:

1. Thermal timers
2. Mechanical timers
3. Thermionic timers

Reclosing characteristics of these three types of relay are given in Fig. 1. It will be seen that the mechanical timers (using the telechron clock with or without back timing) overprotect for outages of more than one half minute, that is, they keep the tube out of service for longer than the necessary reheating period. In addition, mechanical timers do not respond to voltage variations. The thermal types of relay are likewise difficult to match to the reheating characteristics of the tube, and difficult to insulate against the effects of ambient temperature. The thermionic type of relay, on the other hand, matches the heating characteristic closely and is sensitive to voltage changes.

Before considering the thermionic delay relay, it will be well to review the phenomenon in vapor and in high vacuum tubes. Conditions in high vacuum tubes are vastly different because no positive ions exist. The inter-

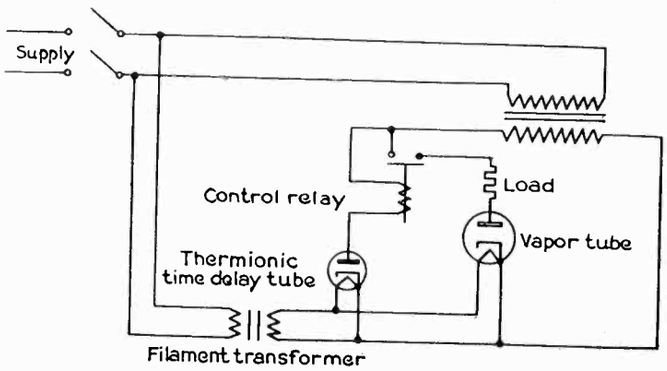


Fig. 2. Typical circuit diagram showing use of thermionic relay for cathode protection

electrode space contains only electrons which are drawn to the anode as cathode emission increases. The presence of electrons makes the space between the anode and cathode negative, neutralizing the effect of anode potential at the cathode and limiting electron current drawn by the anode. Then too, there are no positive ions to bombard the cathode. It is thus apparent that no deleterious effect is caused by operating a high vacuum tube with a deficiency of emission.

It follows then that a most effective time delay device for vapor tube cathode protection would be a vacuum tube with heating and cooling characteristics similar to the vapor tube it is desired to protect. The plate current of the vacuum tube could operate a relay in a way that the vapor tube is placed in operation after a minimum safe heating time. Particularly would this be desirable because the heating and cooling characteristics of the control cathode would match similar characteristics of the vapor tube cathode, and reheating periods after brief power failure or shutdown would be of the right duration in all cases.

The thermionic time delay is essentially a high vacuum diode having a cathode of similar heating and cooling characteristics to the vapor tube it is desired to protect.

However, instead of using an exactly similar cathode, one of similar characteristics but smaller size and correspondingly low power consumption is used. Vapor tubes such as the FG-57 must have available 15 amperes peak emission, while the control tube operates a relay readily with 100 to 150 milliampares total current, but requires a similar period of five minutes to attain this emission. Accordingly, it is smaller in size, cheaper to build and requires less power to operate. Fig. 3 shows three electronic delay tubes for initial delay periods of 5, 10, and 30 minutes respectively.

Thermionic time delay relay

A simple method of connecting a control tube with its relay to protect automatically a vapor tube cathode is shown in Fig. 2. The heaters of the control and vapor tubes are shown connected in parallel. To be generally applicable, the relay unit must operate from a 60 cycle, 110 volt supply. According, the mechanical control relay used in this connection must operate on half wave pulses of current which increase as the control tube heats.

It is necessary, then, to construct a relay which will operate on these pulses without chattering. This is done by winding the coil on a heavy copper core, which represents a high impedance to the alternating component of current, and lowers the ratio of peak to average current.

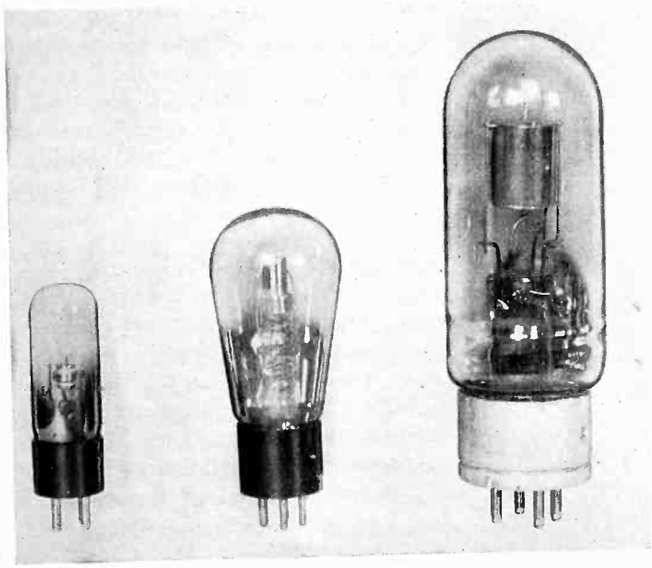


Fig. 3. Three types of thermionic relay tubes, for 5, 10, and 30 minute characteristics

With such a coil the relay operates smoothly and without chattering. A complete relay unit, for operation from the supply bus, is shown in Fig. 4. The equipment comprises only a small filament transformer, a relay and a tube mounting.

Probably the most important characteristic of thermionic delay relays is that the reheating period is proportional to the time off, and service is restored in less than the initial heating period, even for power failures or shutdowns of considerable duration. Another important feature is the ability to follow changes in voltage.

In the past, for lack of voltage sensitive relays, minimum and preheating periods have been specified for all vapor tube cathodes. Actually a different period exists for each heater voltage, and unless a delay relay is voltage-sensitive, it must be slow enough for under-voltage conditions and prolong most outages needlessly by 25 to 50%. The heating or reheating period of a control tube is governed by voltage during the heating time, just

Fig. 4. Complete delay timer with thermionic tube in place

as the vapor tube cathode. Accordingly, the thermionic relay will establish service when, and only when, proper temperature is reached as dictated by heater voltages. The advantages of the thermionic time delay relay can best be understood by comparison of its characteristics with those of other types of relays as shown in Fig. 1.

Applications

The thermionic time delay relay is designed to replace the mechanical or thermal timers in circuits controlling power tubes. There are numerous applications but, for purposes of illustration, consider a typical circuit for cathode protection of an automatic phanotron rectifier in which a time delay relay of the mechanical type is used to protect a rectifier through the control of an oil circuit breaker. In this arrangement the oil switch cannot be closed or reclosed after a power failure until the cathodes have attained proper operating temperature. By substitution of the thermionic relay the durations of interruptions will be shortened due to the fact that the circuit can be closed as soon as safe conditions obtain, instead of waiting for a fixed interval without allowing for voltage conditions.

If mechanical types of relays are used where voltage is held within 1% variation, and where prolonged heating periods after brief shutdowns are not inconvenient, then the mechanical type of relay is eminently satisfactory. In the usual installations, voltage fluctuations of several percent occur, and it is desired to establish service as soon as possible after interruptions. In such service a thermionic delay relay should be used.

REDUCING OUTAGE TIME IN VAPOR TUBES

Gas rectifier tubes are often kept out of service for needlessly long periods by the use of improperly designed cathode protection relays. A thermionic relay having the same thermal characteristic as the cathode itself, and therefore capable of exacting the maximum continuity of service, is described in this article

+ + NOTES ON ELECTRON

Values of Q for various component parts

AT THE fall meeting of the Institute of Radio Engineers, held in Rochester, Mr. C. J. Franks of the Boonton Radio Corporation described an instrument for measuring ratio of reactance to resistance (Q value) of various types of coils and condensers, at various frequencies. Mr. Franks has supplied us with the following table of typical values for such components as molded fixed condensers, gang variable condensers, air core and iron core coils, self-supporting transmitting coils, and the like. It is interesting to note that the air condensers having ceramic insulation may attain Q values as high as 8,000, whereas molded bakelite fixed condensers, which may go as low as 40, may be a serious limitation when used in conjunction with coils of higher Q.

The units measured were selected at random and do not represent either the maximum or minimum values to be found for that class of equipment.

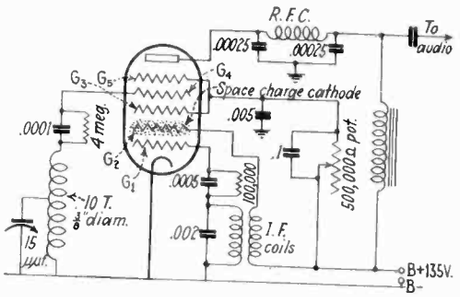
Item	*Freq. kcs.*	*Q*
100 mmfd. molded bakelite fixed condenser...	1,000	40
Typical receiver gang variable condenser with bakelite stator insulation	100	2,000
	1,000	700
	10,000	200
Same with ceramic stator insulation	100	8,000
	1,000	3,000
	10,000	1,000
Typical single-section litz-wound universal coil for 456 kc. I.F., in can	456	80
Same but with powdered-iron core	456	145
Broadcast band bank-wound litz solenoid $\frac{3}{4}$" diameter in $1\frac{3}{8}$" square shield can	1,000	110
Broadcast band universal-wound litz coil with iron core in same can.	1,000	185
Transmitter coil, $4\frac{1}{2}$" diameter and 5" long, 11 turns of $\frac{1}{4}$" copper tubing	5,000	650
Transmitter coil $1\frac{3}{4}$" diameter and $1\frac{3}{4}$" long, 12 turns of No. 10 wire	10,000	400
Receiver coil, 1" diameter and $\frac{5}{8}$" long, 5 turns of No. 14.....	30,000	270

Super-regeneration using the pentagrid converter

BY R. O. WILLIAMS,
Department of Conservation, Lansing, Michigan

THE PENTAGRID converter tubes are well suited to super-regenerative operation by using the triode section to modulate the electron stream at the interruption frequency. The triode section acts as the composite cathode for the pentode section which is connected in such a manner that feed-back takes place and the voltage on the screen grids 3 and 5 is controlled to regulate regeneration in the high frequency section. Audio impulses are taken off the plate and fed to the audio system in the same manner as is customary when coupling screen-grid tubes to audio stages.

In the circuit diagram it appears that there is no method of regeneration, since the entire high frequency circuit appears to be in series from the signal grid through grid leak and condenser and grid tank to ground. However, feed-back takes place by virtue of the fact the actual cathode for the H-F section is the space charge surrounding the anode grid (No. 2) and this "cathode" is located above ground and is a part of the capacitive reactance between grid No. 4 and grid No. 1, giving the same effect as connecting the cathode up from ground a turn or so on the grid coil. The capacities within the tube are such that the "phantom" cathode is correctly placed in the capacitive reactance without further "doctoring." This circuit is highly efficient and possesses the virtue of being non-radiating when adjusted for best signal sensitivity, thus eliminating shielding and lowering production cost.



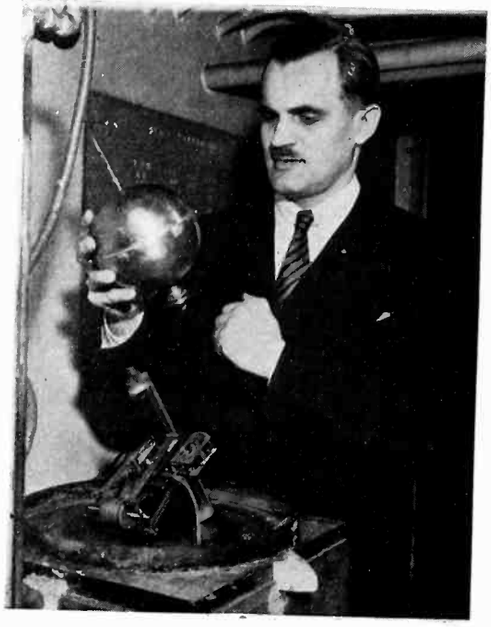
Adjusted correctly the received signal appears out of a relatively silent background, thus the hiss is not bothersome when the carrier goes off, and the sets can be left on for standby watch in a network.

The above circuit is founded upon the basic theory underlying super-regeneration which is well outlined in *Electronics* for February, 1934, page 43, column two.

EDITOR'S NOTE—In submitting the circuit described above, Mr. Williams states that in his work on communication apparatus for use in fire suppression, for communication between fire fighting crews and fire observation towers and headquarters, he has found no commercial circuits or sets which are entirely suited to these uses. He has had to develop his own apparatus. The advantages of the circuit shown are stated to be high sensitivity to weak signals, low hiss, good control of sensitivity, and no radiation at the point of greatest signal amplification.

✦

STRATOSPHERE RADIO



Prof. A. H. Compton prepares the cosmic ray meter equipped with automatic radio for a flight into upper atmosphere

✦

RMA Code for antenna and ground leads

THE Standards Section of the Radio Manufacturers Association has announced the adoption of a standard color coding for antenna and ground leads. The standard reads as follows: "When leads for antenna and ground connections are provided on the receiver, it shall be standard to color code the antenna lead light blue and the ground lead black. Special antenna connection leads shall be coded with combinations of light blue and black."

TUBES AND CIRCUITS + +

Graduate study in electronics at Columbia and M. I. T.

THE ADVANCED course in electronics which is offered in the Engineering School at Columbia University has recently been expanded to cover a full year. The first term deals with those aspects of electronics which are of interest chiefly to the electrical engineer, while the second term work is concerned entirely with communication electronics. Since the two terms may be taken separately, the latter portion is of particular interest to the communication engineer.

Subjects treated in the second half year include resistance and transformer coupled audio amplifiers, the output stage, push-pull and class B amplification, motor-boating, circuit noise, etc. Radio frequency amplification is also dealt with at length, as are such subjects as wave form distortion, cross-modulation, and the new feedback amplifiers. The theory of linear detectors is developed and consideration is given to exponential conductors and other non-linear circuit elements. Vacuum tube voltmeters and constant frequency oscillators are also included in the course.

In addition to providing a comprehensive survey of the field of communication the course also gives 3 points of credit toward the Master's Degree. The course is given on Thursday evenings, 7:15 to 9:15.

Four new courses have been added to the curriculum of graduate study at the Massachusetts Institute of Technology, Cambridge, Mass. These courses, which are given by the Electrical Engineering Department, are: Engineering Electronics, Super High-Voltage Engineering and Vacuum Electrostatic Machinery, Vibration Phenomena and Oscillations, and Mathematical Analysis by Mechanical Methods. Of these four the first two are of particular interest to electronic engineers. The high-voltage engineering course includes the new developments in the d-c transmission of power (See *Electronics*, February, 1935, p. 56).

✦

Over-voltage lamps in photography

MANY RADIO engineers are photographers as well; they should be interested in the following report from Nela Park as to why it is not feasible to use Photoflood lamps at greatly increased voltages to approximate the output of a Photoflash lamp.

The idea of using a Photoflood lamp with several hundred percent overload would be to avoid the necessity of packing around a number of flash bulbs; instead, a cheap transformer could be plugged into the socket to provide a Photoflood lamp with the voltage required to give the same output as the Photoflash lamp. But it will not work, says Nela Park.

"In the first place," say the experts, "the No. 20 Photoflash lamp gives out about 50,000 lumen seconds of light. The flash duration is approximately 1/50 second (90% of its light is emitted in this time). The No. 1 Photoflood lamp has a light output of 8,250 lumens and if burned for one second would give an exposure effect of 8,250 lumen seconds. Six lamps would make it 49,500 lumen seconds. In other words, the camera shutter would have to be opened one second to secure the same exposure as we would get from one Photoflash lamp with its 1/50 second flash.

"If we wanted to make the Photoflood picture with the shutter working at 1/50 second, 300 lamps would be required. 1/25 second is about as slow as you would want to make a "snap shot" picture, so we might get by with 150 lamps. We have found that when we put 130-133 volts on a No. 1 Photoflood lamp, it will burn out almost instantly, because at that voltage, the temperature of the filament is practically at the melting point of tungsten (3,655° K.). At 130 volts the light output of the Photoflood lamp is about 50 per cent greater than at 115 volts, thus our 150 lamps could be reduced to 100. Incidentally, this comparison does not consider the difference in the photographic quality of the light from the two lamps. The light of the flash lamp is whiter than that of the flood lamp even at 130 volts, making the ratio of the number of lamps even greater. Thus, it is apparent that we are really better off using Photoflash lamps on the basis of equal exposure for equal bulk of lamps."

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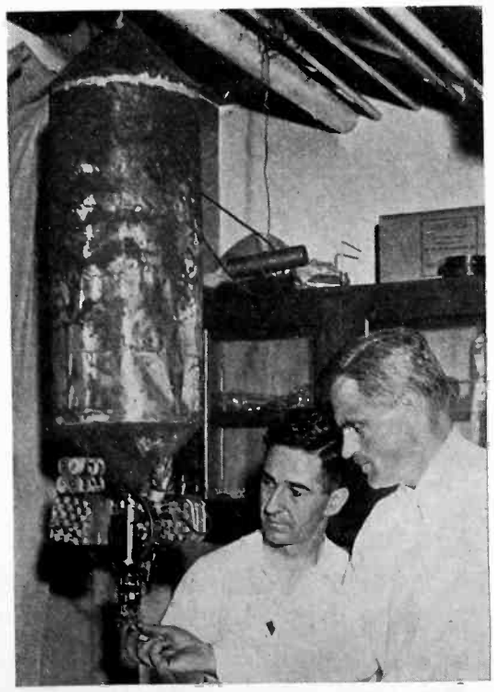
COSMIC RAY BALLOON



Ionization chamber with complete radio transmitter attached. Prof. J. M. Benade is assisting Dr. Compton

✦

High fidelity standards of the F.C.C.

A SET of tentative standards for reference use in considering high fidelity transmitting stations has been set up by the Engineering Department of the Federal Communications Commission. These standards will not be proposed as definite regulations until more experience has been gained but are designed to define the audio distortion, frequency range, noise level, volume range, of transmitters operating on high fidelity, experimental service: The total audio distortion shall not exceed 10 per cent at 95% modulation or 5 per cent at 85 per cent modulation throughout the range of modulating frequencies from 50 to 7,500 cycles. The audio frequency transmitting characteristic measured from microphone terminals to the antenna shall be flat within 2 decibels between 50 and 7,500 cycles. The transmitter is also required to be equipped with two cut-off filters, one cutting off at 8,500 cycles, the other at 5,500 cycles, the former to be in place at all times and the second to be used whenever the program transmission contains no desired signal above 5,000 cycles. Carrier hum and extraneous noise are to be at least 60 decibels below 100 per cent modulation, between 150 and 5,000 cycles, and at least 40 decibels down outside that range. The total volume range of carrier noise to 100 per cent modulation shall be 60 decibels.

It is also provided that a modulation meter be installed in the station for measuring modulation percentage from 40 to 110 per cent, accurate within 2 per cent. A modulation peak instrument is also necessary so that peaks above any set value from 75 to 100 per cent can be indicated and recorded if desired.

electronics

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Business men and Congress

ANY man who knows Washington will tell you that in the halls of Congress one influence is more potent than all others. It is "the word from back home"—from the voters, the electorate and constituents of each individual Representative and Senator.

With the present juncture in national affairs, with Congress leaning to radical ideas, business men should not leave the expression of their views to intermediates or even to "Washington representatives." It is time for sound responsible business thinking to make itself vocal in the Congressmen's own offices, as indicative of the sane opinion of the community back home.

The 28 states that require licenses for "engineers"

THE recent rapid development of licensing laws which make it illegal for any one to call himself an "engineer" without passing a state examination board, has been attracting the interest of radio engineers as well as members of the older engineering groups. The Institute of Radio Engineers has appointed a committee, headed by Arthur F. Van Dyck, to look into this whole matter of licensing as it affects radio men, and to advise radio engineers of their rights and responsibilities.

Meanwhile the licensing flood spreads. New Mexico has just passed a license law for engineers, becoming the 28th state to require engineers' licenses (if one includes Illinois whose licenses are limited to structural engineers). In addition, Hawaii, Porto Rico and the Philippines have license statutes. Bills are also now pending in 17 additional states. The complete list of states requiring licenses follows:

Arizona	Louisiana	Pennsylvania
Arkansas	Michigan	South Carolina
California	Minnesota	South Dakota
Colorado	Mississippi	Tennessee
Florida	New Jersey	Virginia
Idaho	New Mexico	West Virginia
Illinois	New York	Wisconsin
Indiana	North Carolina	Wyoming
Iowa	Ohio	
Kansas	Oregon	

What price radio sets?

A RATHER elegant method of determining the minimum list price of a radio set is described in this issue of *Electronics*. It is based on the supposition that certain tubes, components, baffle size, weight and other apparatus, when assembled, represent a certain "potential performance." What the engineers do with this assembled equipment is another matter.

The formula in this method was arrived at empirically by using the data on many commercial models of home and auto radio sets. The formula, in effect, sets up a norm of price and tends to show that a 5-tube table model of certain dimensions and parts, for example, is worth at least a certain number of dollars. The general use of such a formula would tend to offset the sales advantage secured by a manufacturer who has poor engineering but who—to make a set look good—pours into it everything but the office furniture—and then sells it at a low price.

Interference elimination?

THROUGH strange reasoning—and the insistence of the electrical groups involved in interference abatement—it is now proposed to put the activities of the new RMA Committee on Radio Interference under the American Standards Association! The ASA is an admirable body, and has accomplished some fine deliberative

results for American industry. Yet to apply the principles of "standards" to radio interference at this time, will prove elusive and delaying, we believe.

Indeed, accurate measurements or definite standards are the last thing to think about in this radio interference campaign. To clear up most of the interference which now besets our broadcast and short-wave channels, there is plenty of practical knowledge which needs only to be widely distributed among the public and radio people concerned.

We do not need further conferring or microvolt measurements, nearly so much as we need *action* in the direction of *public information.* The job right now calls for a few active expounders of present practical facts, to "take off their coats" and tell the public, by every means available—speeches, broadcasts, and printed matter—the simple remedies which will remove a large proportion of the listeners' radio troubles.

And it is high time to get this work going.

NEWS NOTES

Conventions Ahead—

Radio Union International, Washington, D. C., April 26.

Acoustic Society of America, Hotel Roosevelt, New York City, April 29-30.

Society of Motion Picture Engineers, Hollywood, Cal., May 20 to 24.

American Institute of Electrical Engineers, Ithaca, N. Y., June 24-28.

Institute of Radio Engineers, Hotel Statler, Detroit, Mich., July 1, 2, 3.

"Wired Radio" arrives at Cleveland—The Musak Corporation of Ohio, subsidiary of Wired Radio, Inc., and the North American utility interests, has begun program service over electric-light wires in the Lakeside Section of Cleveland. Three programs are supplied simultaneously, one of light music, one of classical selections, and one of special features. Wired-radio receivers are to be supplied at monthly rentals from $1.50 to $7 per set. Certain models have space-radio attachments. Wired-radio attachments can also be added to customers' regular space-radio sets. Music is now being supplied from recordings produced by the Associated Music Publishers, New York. T. J. Smith is general manager of Musak, and Waddill Catchings is chairman of the board.

"URSI" at Washington, April 26—Meeting with the Institute of Radio Engineers, the American Section, International Scientific Radio Union, will hold two sessions at the National Academy of Sciences Building, 2101 Constitution Ave., Washington, D. C., April 26, beginning at 10 a.m. and 2 p.m. The following papers are listed:

The London General Assembly of URSI. By Dr. J. H. Dellinger, Bureau of Standards.

Ultra Short-Wave Transmission Phenomena. By C. R. Englund, A. B. Crawford and W. W. Mumford, Bell Telephone Laboratories.

Ultra-High-Frequency Transmitting Antenna in Close Proximity to Ground. By H. Diamond and F. W. Dunmore, National Bureau of Standards.

Graphical Analysis of a 10,000-Hour Kennelly-Heaviside Layer Record. By Harry Rowe Mimno, Harvard University.

Ionosphere Measurements in the Southern Hemisphere. By L. V. Berkner, H. W. Wells and S. L. Seaton, Carnegie Institution of Washington.

Ultra-High-Frequency Signals over Long Indirect Paths. By Ross A. Hull, American Radio Relay League.

Terrestrial Magnetism and World-Wide Short-Wave Communications. By Henry E. Hallborg, RCA Communications, Inc.

Radio Propagation over Spherical Earth. By C. R. Burrows, Bell Telephone Laboratories.

Direction Finding of Atmospherics. By John T. Henderson, National Research Council of Canada.

Theory of Vertical Plane Radiation Characteristics of High Vertical Radiators. By K. A. MacKinnon, Canadian Radio Broadcasting Commission.

Low-Loss Inductances. By F. E. Terman, Stanford University.

High-Frequency Impedance of Networks Simulating Lines. By W. L. Barrow, Massachusetts Institute of Technology.

Low-Voltage Cathode-Ray Tube for Oscillographic Radio Measurements. By L. E. Swedlund, Westinghouse Electric and Manufacturing Company.

Detection of Frequency Modulated Waves. By J. G. Chaffee, Bell Telephone Laboratories.

Modulation Meter. By H. N. Kozanowski, Westinghouse Electric and Manufacturing Company.

Transmitter-Key Clicks and Their Suppression. By A. Hoyt Taylor and L. C. Young, U. S. Naval Research Laboratory.

Grid Dissipation as Limiting Factor in Vacuum Tube Operation. By I. E. Mouromtseff and H. N. Kozanowski, Westinghouse Electric and Manufacturing Company.

Application of Secondary Emission. By K. V. Zworykin, RCA-Victor Company, Inc.

Design of Networks for Distortion Correction. By E. A. Guillemin, Massachusetts Institute of Technology.

Directive Antenna of Station KYW. By R. N. Harmon, Westinghouse Electric and Manufacturing Company.

Industrial High-Frequency Generators Using Vacuum Tubes. By H. V. Noble, Westinghouse Electric and Manufacturing Company.

BROADCASTING SOUND-ON-FILM

Station KFWB, Hollywood, Cal., has arranged this sound-picture projector element as a pick-up for broadcasting transcriptions from sound-on-film recordings. Music and voices from standard feature films are being broadcast. United Research Laboratories adapted the machine for the Warner Brothers station

A REVIEW OF THE ELECTRONIC ART HERE AND ABROAD

Cross-talk frequencies

[K. WILHELM, Telefunken Laboratory.] When two radio waves $A \sin p_1 t$ and $B \sin p_2 t$ fall upon the grid of a vacuum tube, the plate current change i of which is given as a function of grid voltage change e by the expression

$$i = ge + \frac{k}{2}e^2 + \frac{u}{6}e^3 + \frac{v}{24}e^4 \text{ etc.}$$

the amplitude of the overtones produced can be readily calculated and arranged in the form of a table giving all the components of the output current. The fourth line, for instance, shows that the double frequency $2p_1$ is present as

$$-\cos 2p_1 t\left[\frac{k}{4}A^2 + \frac{v}{192}(4A^4 + 12A^2B^2) + \ldots\right]$$

and the fundamental frequency p_1 as

$$\sin p_1 t\left[gA + \frac{u}{24}(3A^3 + 6AB^2) + \frac{W}{1920}(10A^5 + 60A^3B^2 + 30AB^4)\right]$$

that is, the amplitude depends in both cases on both waves, and whenever the

			g	k/4	u/24	v/192	w/1920
			A B	A^2 AB B^2	A^3 A^2B AB^2 B^3	A^4 A^3B A^2B^2 AB^3 B^4	A^5 A^4B A^3B^2 A^2B^3 AB^4 B^5
+		0		1 1	3 12 3		
+	sin	p_1	1		3 6		10 60 30
+		p_2	1		6 3		30 60 10
−		$2p_1$		1	4 12		
∓	cos	$p_1 \pm p_2$		2	12 12		
−		$2p_2$		1	12 4		
−		$3p_1$			1		5 20
∓	sin	$2p_1 \pm p_2$			3		20 30
−		$p_1 \pm 2p_2$			3		30 20
−		$3p_2$			1		20 5
+		$4p_1$				1	
±		$3p_1 \pm p_2$				4	
+	cos	$2p_1 \pm 2p_2$				6	
±		$p_1 \pm 3p_2$				4	
+		$4p_2$				1	

amplitude of the second wave fluctuates the changes will be impressed upon the first wave and vice versa.

In the case of modulated waves at the receiver:

$$A = A_0(1 + M_1 \sin p_1 t)$$

$$B = B_0(1 + M_2 \sin p_2 t)$$

and the resultant wave is proportional to gA_0M_1 and to $uA_0B_0^2\ M_2/2$, so that the ratio for cross-talk is about

$$C = \frac{M_2}{M_1}\frac{u}{2g}B_0^2$$

The modulation factor cannot be changed, but tubes giving low values of $u/2g$ should be chosen, while B_0^2 can be reduced by good selectivity. In order to keep $u/2g$ low it becomes necessary to apply to the grid not more than one-fifth of the voltage which the tube could handle without producing distortion. (The symbol u is the third derivative of the characteristics.)—*Telefunken-röhre* 1 No. 3: 93-102. 1935.

✦

Booster apparatus for the people's receiver

THE GERMAN PEOPLE'S RECEIVER "volks empfänger" VE 301, has attracted nearly a million new subscribers to the broadcasting service in Germany since its introduction to the public (see *Electronics* for October, 1934, p. 306, for a description of this receiver). According to the Electrical Foreign Trade Notes of the Department of Commerce, a "booster" has been made available to convert this simple receiver to one capable of receiving distant stations. Although the apparatus is not procurable in complete form it can be assembled by the set owner for less than one-half the cost of the receiver itself. The booster consists of a tuned R-F stage, using a screen grid tube. An appreciable improvement both in sensitiveness and selectivity is reported. ["Helios" Jan. 1935]

✦

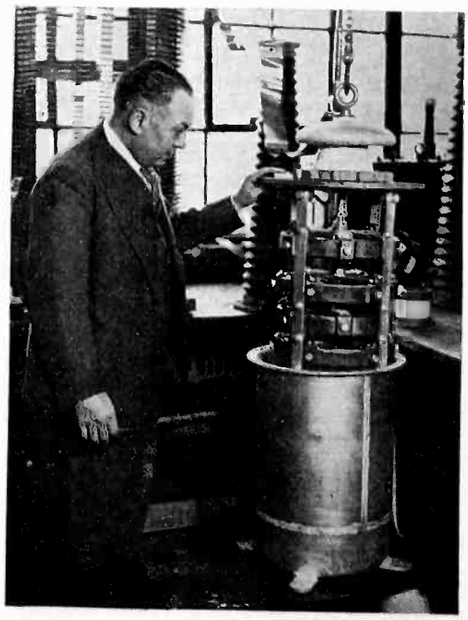
150-Ampere condensers for broadcast station

SEVERAL of the largest mica dielectric fixed condensers ever constructed have been built by the Cornell-Dubilier Corp., of New York for the use of a chain of high powered broadcast stations. The condensers are oil filled mica units and have a capacitance of .02 mfd., with a power factor of only 0.008 per cent. Each is rated at 150 amperes for radio frequency current or continuous operating voltage as high as 15,000 volts.

Each capacitor is made up of four rings of condenser units, each ring having six radio spokes of specially tested and impregnated mica unit capacitors. The spokes of each ring are staggered so that the cooling oil which fills the case may circulate freely. A horn gap is provided to protect the capacitor from voltage surges.

The "Brunet 534" a new French superhet

[P. BESSON] Brunet, well known in earlier days as a parts supplier, is bringing his first type of commercial receiver upon the market. It is a standard superheterodyne for three separate bands: 2000 to 900 m., 600 to 200 m., and 50 to 20 m. The first stage contains a variable-mu pentode for amplifying the signal (disconnected for the shortest waves), a frequency changer stage using an octode (as do most of the French receivers) a diode detector, a first A-F amplifier using a pentode placed with the diode in the same bulb, and a second A-F stage using a directly heated pentode. The intermediate frequency is 406 kc. The transformers, wound with stranded wire, have a low resistance, not over 10 ohms. The automatic volume control is of the customary type, acting over three circuits with different time constants upon the control grid of the r-f amplifier, the octode and the intermediate amplifier. A volume control is provided in the audio stage in the form of a logarithmic potentiometer of 800,000 ohms. A similar potentiometer with 2220 $\mu\mu$f. across it serves as tone control. Quiet tuning is accomplished by a switch which in its first position short-circuits the loudspeaker, illuminates the scale and inserts a milliammeter, and in the second position puts the loudspeaker into operation.—*Onde el.* 14 (No. 157): 50-63. 1935.

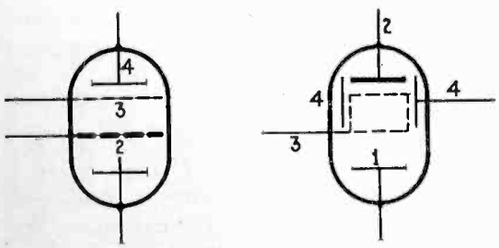


Wm. Dubilier and high-powered condenser

Cold cathode amplifying tubes

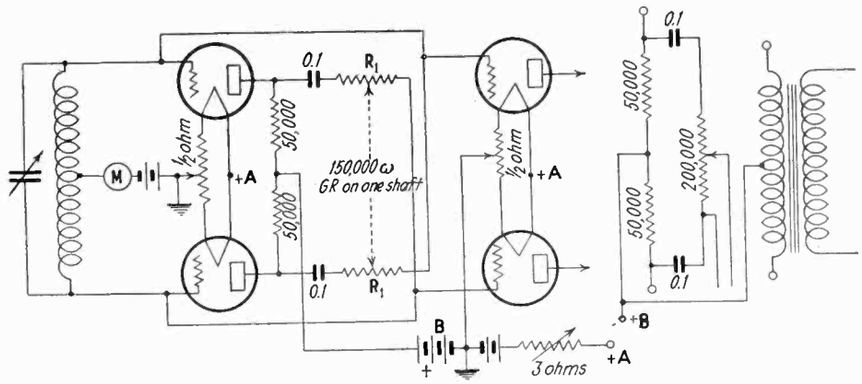
[FRITZ SCHRÖTER, Telefunken Laboratory.] Two main types of cold cathode tubes have been developed, the head-on tube (Nienhold, Germ. Pat. 319,806, Dec. 7, 1916) and Schottky's wall glow-tube amplifier. In the head-on tube (see figure) the electrons are produced together with ions in an auxiliary discharge between the cold cathode and a grid ("2" in the figure) as the positive electrode, parallel to the cathode; they travel in a straight line through this grid, which thus becomes the cathode for the amplifier proper, and through the control grid 3 to the plate 4. In the wall amplifier, the auxiliary discharge occupies the entire length of the tube and acts as the emitter, the electrons diffusing from this ionized space toward the wall where they are acted upon by a cylindrical control grid 3 and plate 4 surrounding the discharge column. For audio work a tube has been developed using a low voltage cathode of barium-coated nickel or an alkali metal and adding more grids (*Electronics,* Dec., 1931). Marx has given a complete theory. Lübcke has obtained wall type amplifiers giving 0.5 A. per volt intended as output tubes for giant loudspeakers. Seibt and Bley and Hund (*Electronics,* Jan., 1933) use a similar system: the positive electrode of the auxiliary discharge (or discharges) forms a screen, preventing fast electrons from entering the amplifying space which they can only reach by diffusion around the edges of the screen. The published articles fail to give a clear picture of the performance of this more recent type of tube.

The cold electrode amplifier as built in the laboratory gives high mutual conductance with low internal resistance, space charges being neutralized by positive ions. The auxiliary discharge,



Head-on and wall type gas tubes

however, requires about 100 volts and is about five times less efficient as a source of electrons than an oxide cathode which furnishes 50 mA. per watt, or more. The author, well known for his work on new uses of gas discharge tubes, holds that it is practically impossible to produce uniform tubes, and that on account of the low plate voltage at which the amplifier proper must be operated in order to prevent ionization, there is at present no sign that cold cathode amplifiers will displace vacuum tubes in radio receivers. —*Telefunken-Röhre* 1. No. 3: 103-112, 1935.



Low distortion 400-cycle oscillator

AN AMPLIFIER with a total harmonic distortion of less than 0.3 percent has been developed by Professor D. E. Noble, Connecticut State College. The circuit shown in the figure is stated to have the following advantages, by Professor Noble:

1. Total harmonic distortion (arithmetical sum) at 400 cycles measured with a General Radio distortion-factor meter, less than 0.3 per cent.
2. Air-core inductance (No. 20 D.C.C. paraffin boiled wound in four pies) high Q circuit.
3. Direct coupling of grids arranged with filament drop resistors to provide greater negative bias at amplifier tube grids than at oscillator tube grids.
4. Filament potentiometer arranged for grid voltage change to balance plate current in tube pairs.
5. Stable oscillator circuit.
6. Feed-back control to adjust oscillator grid current to minimum.
7. Three pole double throw switch to connect additional coils for range change.
8. Switch for either transformer or resistance output.
9. Range 100 to 50,000 cycles with two air core coils.

For operation from d.c., 112-A type tubes are used; on a.c. 57 type tubes are employed. In operation R_1 is adusted for minimum grid current. The ½ ohm resistors are to balance the current in oscillator and amplifier tubes.

RECOMMENDED BOOKS ON NOISE AND ACOUSTIC MEASUREMENT

CITY NOISE—by the Noise Abatement Commission, Department of Health, New York City. Report of the 1929 City Noise Survey.

SPEECH AND HEARING—by Harvey Fletcher. D. Van Nostrand Co., Inc., New York (1929). A standard reference on the subjective aspects of sound; with much source material.

INTRODUCTORY ACOUSTICS—by G. W. Stewart. D. Van Nostrand Co., Inc. New York (1934). A text requiring no previous knowledge of physics. Non-mathematical treatment.

APPLIED ACOUSTICS—by H. F. Olson and Frank Massa. P. Blakiston's Son and Co., Philadelphia (1934). A complete and mathematical treatment of the subject. Good chapters on loudspeakers, microphones, telephone receivers, etc.

MODERN ACOUSTICS—by A. H. Davis. The MacMillan Co. New York (1935).

JOURNAL OF THE A.S.A.—Articles on contemporary developments. Standard source reference.

SOUND, SPEECH AND HEARING—Chapters II and III in Electrical Communication by Arthur L. Albert. John Wiley and Sons, Inc. New York (1934). Compact presentation of important fundamentals.

ARCHITECTURAL ACOUSTICS

ACOUSTICS OF BUILDINGS—by F. R. Watson. John Wiley and Sons, Inc. New York (1930).

ARCHITECTURAL ACOUSTICS—by V. O. Knudsen. John Wiley and Sons, Inc. (1932.)

ACOUSTICS AND ARCHITECTURE—by Paul E. Sabine. McGraw-Hill Book Co., Inc. (1932.)

Telephoning to Ireland on five meters

ACCORDING to the *Electrician* of February 22, 1935, the success of the ultra-short wave wireless telephone link between Great Britain and Ireland, which was put into operation at the end of 1934, has justified the extension of this service from six to fifteen channels. In the new nine-channel system the nine conversations will be transmitted and received by a single transmitter and receiver for each channel. Standard Telephones and Cables are in charge of the work.

✦

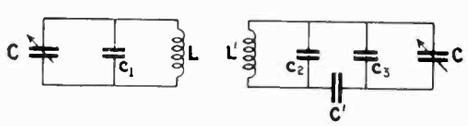
German literature

THE most recent number (December, 1934) of *Telefunken Zeitung,* the house organ of the Telefunken concern, contains the following articles:

✦

The tracking problem in superheterodynes

[W. KAUTER, Telefunken Laboratory, Berlin.] The problem is to maintain the difference *(F-f)* between the local oscillator and the broadcast frequency to which the set is tuned by turning the gang condenser on which the R.F. and the local oscillator circuit depend. The solution adopted is to reduce the capacitance of the section of the gang condenser to which the oscillator is connected by inserting the fixed condenser C', to use a smaller inductance L' in the oscillator circuit, and to destroy the equality of the gang sections by giving slightly different settings to the small adjusting condensers provided for matching. The problem of tracking is not completely solved in this way, but the choice of the three variables just mentioned makes it possible to obtain the desired difference *(F-f)* accurately at three wavelengths in the broadcast band f_1 (low), f_2, and f_3 (high), where $f_2^2 = f_1 f_3$ or for the three corresponding oscillator frequencies F_1, F_2 and F_3.



Input and oscillator circuits

In the circuit described (see figure) the deviation of the intermediate frequency from the desired value is at the signal frequency f given by

$$d = \frac{f_2\sqrt{L/L'}}{\sqrt{\dfrac{1 + af^2/f_2^2}{b + f^2/f_2^2} + c}} - F$$

provided c' is larger than c_3, and where

$$a = \frac{c_3 - c_1}{c_2};\quad b = \frac{c_2}{c'};\text{ and } c = \frac{c_1}{c_2}$$

c_1, c_2 and c_3 being the settings of the gang condenser in the input or R.F. circuit for the three frequencies f_1, f_2, f_3. The difference d is required to vanish at f_1, f_2 and f_3 so that three equations are obtained from which a, b, and c can be drawn.

$$b = \sqrt{\frac{n^2}{4m^2} + \frac{p}{m}} - \frac{n}{2m}$$

where

$$m = \frac{f_3^2 - f_2^2}{F_1^2} + \frac{f_2^2 - f_1^2}{F_3^2} - \frac{f_3^2 - f_1^2}{F_2^2}$$

$$n = (f_3^2 - f_1^2)\left(\frac{1}{F_3^2} + \frac{1}{F_1^2} - \frac{1}{F_2^2}\right)$$

$$p = \frac{f_3^2 - f_1^2}{F_2^2} - \frac{f_3^2 - f_2^2}{F_3^2} - \frac{f_2^2 - f_1^2}{F_1^2}$$

Moreover $C' = \dfrac{C_3}{b}\dfrac{f_1}{f_3}$

$$f_2^2(1+b)\frac{L}{L'} = \left[\frac{F_2^2 F_3^2}{F_3^2 - F_2^2}\frac{1}{1 + f_1/f_3}\right] - \left[\frac{F_2^2 F_1^2}{F_2^2 - F_1^2}\frac{1}{1 + f_3/f_1}\right]$$

$$L = \tfrac{1}{4}\pi^2 f_1^2 C_3$$

For instance, for an intermediate frequency of $n = 200$ kc., f_1 being chosen as 500 kc., f_3 as 1,500 kc., f_2 hence 866 kc., $F_2 = 1{,}066$ kc., the following values are obtained ($m = 1.472$, $n = 1.259$, $p = 0.223$):

$b = 0.151$
$C' = 1086\ \mu\mu f.$
$L/L' = 1.375$
$L' = 0.148\ \mu h.$
$c_2 = 6.7\ \mu\mu f.$ if $c_1 = c_3$

The greatest tracking error is about 5 kc.—*El. Nachr. Tech.,* 12 No. 1: 31-33. 1935.

BOOK REVIEWS

25 Years of Radio

Radio Club of America, 25th Anniversary Year Book, 1934. Available at the Club headquarters, 11 West 42nd St. (Price $1.00 to members, $1.50 to non-members.)

JANUARY 2, 1909 the Junior Aero Club of U. S. met at the Hotel Ansonia at the instance of W. E. D. Stokes, Jr. to consider a new hobby, radio. The members of this group, now the Radio Club of America, were of gentle age—Mr. Stokes was then 12. Today these boys are grown but their interest in wireless survives. The history of their club is the history of radio in America.

In the Year Book will be found photos of Louis Pacent and Harry Sadenwater listening for signals from Europe, Armstrong's regenerative apparatus, radio stations of E. V. Amy and others, Harry Houck's home-made loose coupler, station 1BCG which pumped 200 meter signals to Europe and caused M. I. Pupin and David Sarnoff to go to Greenwich, Connecticut, to see what "the boys are doing."

The entire book brings back memories of the old and glamorous days. Evidently the committee, under George Burghard, is still amateur at heart. In the Book is a history of each of the several hundred members.

Radio Communication, Part 1: History and Development

By W. T. O'Dea, B.Sc., A.M.I.E.E., published by His Majesty's Stationery Office, Adastral House, London, 95 pp., price 2s. 6d. net.

PUBLISHED AS a handbook for the engineering collections of the Science Museum at South Kensington, this book contains a wealth of information on the history of the radio art. Illustrations of early types of apparatus contained in the Museum's collection are included in the book, and add greatly to its interest. Chapters on the discovery of electromagnetic waves and on their early applications in wireless telegraphy are followed by the development of the thermionic valve, wireless telephony and television. A chapter called "Miscellaneous Developments" describes microphones, loud speakers, the measurement of wavelength and frequency and kindred subjects. There are 58 illustrations. While written from the British point of view this book is highly illuminating as a background for the American industry.

Gasentladungstabellen

By M. Knoll, F. Ollendorf, R. Rompe and A. Roggendorf. (Eight chapters, 171 pages, 196 graphs, Julius Springer, Berlin, 1935.)

THIS BOOK is in itself proof that the science and technique of gas discharge have left the empirical state and have entered upon a new and final phase where the theoretical discussion as well as the design of gas discharge devices is subjected to the same quantitative treatment as the conventional vacuum tube.

The authors deserve the gratitude of scientist and engineer alike for their pioneering work of compilation, critical survey and excellent presentation of quantitative information on gas discharge, which is scattered in periodical scientific publications to the extent of being frequently inaccessible to the average worker.

The formulae, tables and graphs of this book are carefully selected and properly presented in the most concise manner. They are a valuable source of dependable *numerical* information for both the vacuum tube engineer and the physicist.

The three authors, Knoll, Ollendorf and Rompe, are scientists of renown. Ollendorf's two books, *"The Foundations of High-Frequency Engineering,"* and *"The Potential Fields of Electrical Engineering"* are classics.

The first chapter deals with the physics of the individual neutral and charged particle. Atoms and molecules, electrons, ions and photons are treated. The subject matter presented in the section "Electrons" may serve as an example for the clear, concise and fundamental manner in which the book is written: Ten pages of formulae, graphs and numerical values pertain to the constants and dynamics of the electron, the rules governing the transfer to and the release of energy from the electron, the movement of electrons in a magnetic field, the mass and the impulse of fast electrons including data on the De Broglie wave of the electron in general and as a function of the volt velocity, the slow acceleration of the electron and the ratio of the volt velocity of the electron to the velocity of light.

The second chapter refers to the statistical theory of gas discharge. The universal constants and numerical relations are rendered in seven paragraphs: Kinetic gas-theory; Kinetics of charged carriers; Ionization, excitation and recombination in gases; Ionization and recombination at the boundary of the surface of a solid and gases; Discharges without appreciable space charge; Discharges with space charge and finally the Plasma.

High vacuum tubes, ionic tubes and discharges in air at atmospheric pressure as "particular types of discharge" form the substance of chapter three. Chapter four contains information regarding the raw materials employed in the construction of discharge devices and chapter five is a compilation of useful data for the design of high vacuum exhaust systems. The following chapters give definitions of the phenomena of gas discharge, lists of the important constants and tables regarding the relation of the electrostatic to the electromagnetic system, etc., and finally a condensed but perfectly intelligible collection of the most frequently employed mathematical tools partly in formulate form and to a larger extent in graphs and elaborate numerical tables.

The type and the printing of the book are well done on good quality paper.—H. J. MILLER.

✦

X-rays in Theory and Experiment

By Profs. Arthur H. Compton and Samuel K. Allison. Published by D. Van Nostrand Co.

"X-RAYS AND ELECTRONS," by Professor Compton, published nine years ago, stood for a number of years almost alone as a textbook and reference book on the physics of x-rays. The steady advance in knowledge of the nature of x-rays which has been made by the research laboratories of various universities has led to a complete revision and modernization of the first edition.

The association of Professor Allison with Professor Compton in the preparation of the new edition is particularly fortunate, since the fields of specialization of the two men are complementary. Professor Compton has done most of his work in the subject of scattering of x-ray while Professor Allison is well known for his contributions to x-ray spectroscopy.

The point of view of the book is entirely one of considering the ultimate nature of x-rays, and the application of x-rays to certain basic physical research, such as the atomic structure of gases, crystals, and other substances. The more common applications of x-rays for medical and industrial purposes and the practical problems in the manufacture of x-ray equipment are outside the scope of the book.

Typical chapters are "The Discovery and Properties of X-rays," "The Scattering of X-rays," "The Study of Crystal Structure by Means of X-rays," "The Intensity of Reflection of X-rays from Crystals," "Phenomena Associated with the Ejection of Photo-electrons by X-rays," "The Interpretation of X-ray Spectra," and "Accurate Methods of X-ray Wave-length Measurement." Extensive tables of spectral wave lengths, absorption coefficients, etc., are given.

The book is not to be recommended for the general scientific reader because of the complexity of the subject and the considerable amount of mathematics used. There is every reason to suppose, however, that it will be for several years to come the outstanding book in its field, and will be of inestimable value to the research man and the graduate student in the field of x-ray physics, and will find use in the hands of technical men engaged in the furtherance of applications of x-rays to medical and other fields of technology.—VICTOR J. ANDREW.

✦

Physical Basis of Things

By John A. Eldridge, Professor of Physics, University of Iowa, First Edition. McGraw-Hill Book Company, Inc., New York. (400 Plus IX Pages. Price $3.75.)

WRITTEN AS one of the International Series in Physics, this book presents a bird's-eye view of both modern and classical physics. The style of writing, while simple and direct, should not mislead the reader into believing the book to be a popular treatment of the subject. The book closely parallels in subject matter the popular "Nature of the Physical World," by A. S. Eddington but it deals less with the metaphysical implications of the subject.

Professor Eldridge states in his preface that "this book is intended for students who have had a course in general physics," that is, for the average college sophomore with general preparation in this subject. Since the book is intended for this type of study, no serious mathematical demonstrations can be included in it. Instead, the author has been very successful in reducing the more complex ideas, such as relativity and the quantum theory, to terms capable of being understood by the non-mathematical reader.

It should not be believed, however, that the discussion can be understood without serious thought, since modern physics is not as yet capable of complete simplification for the lay reader. The book contains an enormous amount of information, most of which is concerned with the bases of the theories of chemistry and physics. As such it is an excellent review for specialists whose specialized studies may have left them with no real understanding of the underlying fundamentals of the sister sciences.

+ NEW PRODUCTS

THE MANUFACTURERS OFFER

Transmitter coil forms

A THREADED coil form made of Insulex, suitable for amateur transmitting purposes, has been brought out by the Insuline Corporation of America, 25 Park Place, New York, N. Y. The form is 2½ inches in diameter and 5 inches long, and accommodates 26 turns of any size wire up to No. 10 with a spacing between centers of .143 inch. Two rows of holes along the length of the form permit the ends of the winding to be pulled through inside.

This new form is especially suited for 20-, 40- and 80-meter oscillator or amplifier tank coils. Insulex is a specially impregnated molded ceramic of low dielectric loss.

The form may be mounted permanently by means of small standoff insulators or fitted with banana type plugs for interchangeable service in multiband transmitters. Without supporting legs, the new Insuline transmitting coil form lists for $1.50; with legs and hardware for $2.00, less the usual discounts.—*Electronics.*

✦

Laminated contact button

A STEEL-BACKED silver contact button is offered by the General Plate Company, manufacturers of thermostatic bimetal and other laminated metals. It is stated that these laminated buttons cost far less and actually wear longer than solid silver. They can be furnished with suitable projection areas on the back which facilitate spot welding the buttons to support members of steel, brass or copper and reduce assembly time and costs. It is further stated that this type of button does not lose its shape even when contacts vibrate and pound together. They are made with flat or dome contact faces, in all sizes and are suitable for use in relays, vibrators, etc. Descriptive literature and samples may be obtained from the makers, the General Plate Company, 44 Forest Street, Attleboro, Mass.—*Electronics.*

✦

Tubular condensers

NEWLY designed paper dielectric tubular condensers have been made available by the Tobe Deutschmann Corporation, Canton, Mass., through its wholesale parts distributors. Features of this new series of condensers are:

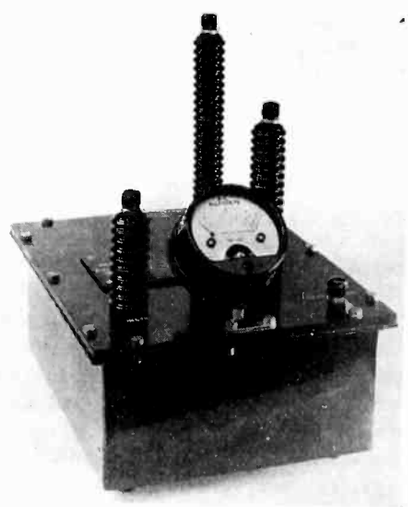
1. Metal end disks are soldered to the condenser terminals to provide a path for quick radiation of solder iron heat.
2. Dual impregnation of the entire condenser assembly to prevent moisture absorption.
3. Extra heavy double tinned wire lead terminals.
4. The outside foil terminal is plainly marked. (It is important in short-wave use that this terminal be at ground potential.)
5. Extremely compact physical sizes.

It is claimed by the manufacturer that the new condensers are priced low consistent with high quality of materials used, true voltage ratings, and the care taken in manufacture.—*Electronics.*

✦

Electrostatic voltmeters

A SERIES of high voltage electrostatic voltmeters for voltages as high as 18,000 volts a.c. is offered for sale by Ferranti Electric, Inc., 130 West 42nd St., New York. The instruments draw no current, have full scale ranges from 150 to 18,000 volts, and are protected from overvoltage. The readings of the meters are independent of wave form,



frequency and temperature. Mountings can be provided for flush mounting, projecting, portable or desk mountings, with dials of 2½, 3¼ or 4 in. in diameter. The instruments are claimed by the manufacturer to be suited particularly for making measurements in high impedance circuits and for measuring voltages on cathode ray tubes, photo cells and the like.—*Electronics.*

Low loss insulation material

A LOW-LOSS insulation material known as Mycalex, manufactured by the Mycalex Corporation of America, 101 West 31st Street, New York, N. Y., is especially designed for use wherever strong and efficient insulating material is necessary. The material is made of India mica ground and mixed with ground glass, and pressed together with a binding agent under extremely high pressure. The compression strength runs as high as 25,000 lb. per sq.in., while the tensile strength runs as high as 7,300 lb per sq.in. The material begins to soften between 450 and 500 deg. C. Its electrical properties are as follows: Dielectric strength from 240 to 420 volts per mil., depending upon the thickness. The dielectric constant at 15 deg. C. and 1,000 cycles is 6.1. The power factor varies from .003 to .005 according to the frequency.—*Electronics.*

✦

Copper oxide rectifiers

A COMPLETE line of copper oxide rectifiers, ranging from large sizes suitable for charging batteries and operating telephone or signal systems to small meter type rectifiers, is offered by the B-L Electric Manufacturing Co., 19th & Washington Avenue, St. Louis, Mo. These units are completely described in a bulletin issued by the manufacturer which is available upon request. Three types are available: for full wave rectification, half wave rectification and for three-phase use. Among the advantages claimed by the manufacturer are high uniformity, mechanical ruggedness, and freedom from radio interference noise. A wide range of mounting styles is available to meet the needs of various applications. Prices range from as low as $2.70 for a small 200 milliampere type, to $480 for a 9 ampere type.—*Electronics.*

✦

Kit volt-ohm-milliammeter

THE TRIPLETT ELECTRICAL INSTRUMENT CO., of Bluffton, Ohio, has announced that its No. 1200 volt-ohm-milliammeter is now available in kit form and is designed for use with built-

in shop equipment. This announcement will be of interest to those who desire to build their own instruments, or who want instruments to meet special space and installation requirements.

The 1200 volt-ohm-milliammeter in kit form is identically the same as the Master Model, except that it does not have the panel, the adjustable feature on the meter, the batteries or case—but does have index marking. It is furnished complete with all shunts, resistors, condensers, coils, drilling template, blueprints and instructions.—*Electronics.*

✦

Oil-filled transmitting condensers

UNITS OF A new line of oil-filled, oil-impregnated transmitting condensers, announced by the Aerovox Corporation, Brooklyn, N. Y., are available in round and rectangular metal cans, with high-tension insulator post terminals. Wound with pure linen paper, these condensers are guarded against deterioration even at high operating temperatures. Linen paper dielectric also provides necessary strength for the tightly-wound sections. Finished sections are thoroughly impregnated in high-grade oil, placed in can and surrounded by protective oil bath not only for higher insulation value and long life, but also for proper expansion-contraction properties whereby an oil circulation is set up through the section for cooling purposes. Containers are hermetically sealed for complete protection against moisture and leakage.

Round can type includes special reinforcement in winding process, relieving undue strain. Rectangular seamed can type has clamped section for constant pressure in order to avoid plate fluttering.—*Electronics.*

✦

Multi-prong cable connectors

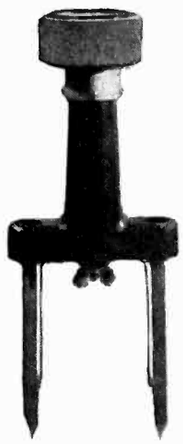
THE AMERICAN Phenolic Corporation, 500 South Throop Street, Chicago, announces a line of unique cable plugs. The base is moulded bakelite and the cap is drawn of steel with a self-locking catch so that they will snap into place with little effort. The contacts are exceptionally efficient. Amphenol plugs are available in all sizes from 4 to 7 prongs.

For use with these plugs are connectors. They are drawn steel shells which slip over the cable, and when the male and female plugs have been pushed together, the two metal shells of the plug connector are screwed together so that there is no danger of the plug pulling apart accidentally. These plugs are adapted for auto radio, microphone connections, public address installations and wherever a semi-permanent, dependable connection must be made.—*Electronics.*

Battery-cell tester

A NEW Tungar battery-cell tester, listing at $5.95 and featuring a special switch which permits the instrument to be used either for the usual high-rate-discharge tests or for open-circuit tests, has been announced by the General Electric Company's Merchandise Department, Bridgeport, Conn.

The body of the new cell tester is formed by a molded prod-handle shaped to fit the hand of the operator. A large, easily read meter, located at the top of the handle, has been imbedded in a wide rubber guard which protects it against shocks that might impair its accuracy. Besides having the usual voltage scale, it is marked with special subdivisions which simplify battery-test readings. The special switch, which makes the instrument a double-purpose tester, is of the thumb-screw type and is located between the two cadmium-plated battery prods.



By means of the switch, readings for both high-rate-discharge and open-circuit tests may be obtained from the same meter. Thus the instrument may be quickly converted to test the battery when the latter is either in or out of the car, or on the charging line.—*Electronics.*

✦

Universal power transformers

A UNIVERSAL power transformer, suitable for use in all radio receivers manufactured from 1927 on, has been announced by the RCA Victor Company, Camden, N. J. Known as the Fitzall Universal Power Transformers, four types are provided which accommodate all requirements from 12-tube receivers down to 4-tube midget types. Slot positions are provided in as many places as possible, with windings to meet the many requirements of different receiver types. Model 9551 for 10- to 12-tube sets lists at $6. Model 9552 for all class B sets lists at $6.50, while model 9553 for 5- to 9-tube sets lists at $4.75.—*Electronics.*

Fluorescent materials

AS UNITED STATES agents for the J. D. Riedel-E. de Haen A. G., the American firm of Pfaltz & Bauer, Inc., 300 Pearl St., New York, announce that they can supply barium azide, strontium azide and sodium azide, fluorescent materials of value in cathode ray oscillograph manufacture.—*Electronics.*

✦

Metal inlays as conductors

A NEW space-saving idea in construction of X-ray and other apparatus has been developed by the Waite & Bartlett X-Ray Manufacturing Company of Cleveland, Ohio, which is using Formica sheet in which a metal inlay has been pressed as a combined conductor and insulator.

This is used as a means of conveying current to a moving film holder on an X-ray table. This eliminates wires on which the constant movement would cause wear and eventually trouble. It is a compact construction and good-looking. The same idea is an important space-saver in the adjusting and tuning devices used on X-ray equipment.

The material is made by pressing a thin sheet of metal into the Formica when the latter is being cured in the laminating press. The Formica Insulation Company, Cincinnati, Ohio, supplies this material.—*Electronics.*

✦

Concentric transmission line

TWO SIZES of concentric cable transmission line suitable for use in broadcast antennas up to and including 50,000 watts are manufactured by Doolittle & Falknor, Inc., 1306 West Seventy-fourth Street, Chicago, Ill. Type C1, suitable for 1,000-watt transmitters, consists of an outer conductor of copper $\frac{3}{8}$ in. in diameter and an inner conductor provided with isolantite insulators for proper spacing. The impedance of this line is 81 ohms, while the loss per thousand feet measures from .6 db. at 500 kc. to 3.7 db. at 20 megacycles. The type C2 is suitable for transmitters up to and including 50,000 watts power. The outer conductor is a copper tube 2 in. in diameter, and the impedance is 125 ohms. These cables may be coiled up for shipment. Type C1 may be bent in a radius of 8 in., while type C2 can be supplied in coils of not less than 3 ft. radius. Antenna coupling units are also available. The cable lists at 50 cents per foot in small quantities.—*Electronics.*

R-f iron core inductances

RADIO FREQUENCY transformers having iron cores, and suitable for intermediate frequency or radio frequency interstage coupling use, are being manufactured by the Aladdin Radio Industries, Inc., 4049 Diversey Avenue, Chicago, Ill. The iron core permits a given inductance to be installed in a very much smaller space, and with the use of fewer turns of wire. The use of "poly-iron," the core material, adds to the efficiency of the radio frequency circuit, and at the same time improves the selectivity, since the number of turns in the winding is reduced. Complete intermediate frequency transformers with trimmer condensers and a coupling unit and radio frequency interstage couplers, are manufactured by this company.—*Electronics.*

✦

Cathode ray tubes for high frequency work

A SERIES of cathode ray oscillograph tubes, especially designed for use at frequencies as high as 100 megacycles has been announced by the Allen B. Dumont Laboratories, Upper Montclair, N. J. Four types are offered ranging from a 3-in. screen to a 9-in. screen, and listing from $17.50 to $85. Each is provided with a short-persistence screen material and with an indirectly heated cathode. A 1,500-volt supply is required for the small sizes, while 3,000 volts is necessary for the 9-in. type. The sensitivity ranges from .38 mm. per volt for the 3-in. size to .85 mm. per volt for the 9-in. type. These tubes are interchangeable with mechanically and electrically standard oscillograph tubes of other manufacturers.—*Electronics.*

✦

Cathode-ray oscillograph

A CATHODE RAY oscillograph for use in audio frequency measurements, oscillator calibration, and for general service work is offered by the United Sound Engineering Company, 2233 University Avenue, St. Paul, Minn. The screen size is 3 in. and the sensitivity approximately 70 volts d.c. per inch. The linear sweep circuits provided are adjustable from 60 to 8,000 cycles per second and a 60-cycle sinusoidal sweep is also provided. The input impedance is approximately 5 megohms. Besides the cathode ray tube three other tubes are required. The list price less tubes is $77, complete with carrying case 15x11x5 in. suitable for portable use.—*Electronics.*

Washers and stampings for radio use

A COMPLETE line of over 19,000 types of washers, stampings and miscellaneous assembly parts, many of which are suitable for use in radio receiver production, is offered by the Wrought Washer Manufacturing Co., 2100 South Bay Street, Milwaukee, Wis. This large variety of types and sizes, it is claimed by the manufacturer, makes it unnecessary for manufacturers to set up special tools for producing parts of this type. A handbook describing the complete line is available to radio manufacturers on request.—*Electronics.*

✦

Vibration-proof fuses

DESIGNED TO fill the need for a high strength fuse, capable of withstanding severe vibration, "anti-vibration" Littelfuses are being introduced by the Littelfuse Laboratories, 4507 Ravenswood Avenue, Chicago, Ill.

They are made in low and high voltage types and are designed for airships and aircraft radio transmitters, railway signal work, bus transportation, power supply circuits, alarm systems, etc.

The low-voltage elements are punched from tempered zinc and notched out to provide a place for fusion. A reinforcing rib runs the entire length of the element, and the sides are provided with supporting fins which fit snugly into the glass tube, thus preventing the element from vibrating as a separate unit. The most important anti-vibration feature, however, is a 90° twist given the element in the center. This simple expedient increases the stiffness of the element almost three times, increases the natural period of vibration four times, and brings it far above any period of vibration encountered in service and eliminates the possibility of sympathetic vibration. Cements for attaching the end caps have been eliminated. By a new method, the end caps, glass tube, and fuse element are locked together with a special solder.—*Electronics.*

✦

Airplane type dials

A SERIES of tuning dials and instructions suitable for use in radio receiver production has been announced by the DeJur-Amsco Corp., 95 Morton Street, New York City. The line comprises many sizes both of the friction and gear drive type and includes several band spread pointer arrangements. For multi-band receivers a planetary type is provided so that several speeds are available. The normal speed ratio of 12½ to 1 can be increased to a slow speed ratio of 65 to 1. The complete specifications of these tuning devices are included in Bulletin No. 35, issued by the manufacturer.—*Electronics.*

✦

Crystal microphone

A NEW CRYSTAL microphone for general broadcast and high-quality public address service is announced by the Gates Radio & Supply Company of Quincy, Illinois. This microphone incorporates a genuine Brush sound unit of latest design, with frequency response uniform from 30 to 10,000 cycles.

The microphone is supplied complete with pre-amplifier, which incorporates a pair of 6C6 tubes and the output impedance is 200 ohms. It is supplied with 20-foot cable, plug and socket, and requires 6 volts A supply and 180 volts B supply. It is beautifully finished in baked black lacquer with fittings of nickel and highly polished.—*Electronics.*

✦

Adjustable pick-up arm

THE ENGINEERING DEPARTMENT of the Universal Microphone Co., Inglewood, California, has devised a new adjustable arm for its combination pick-up and recorder. The adjustable feature is provided so that 12- and 16-in. records may both be accommodated with the proper radius for good reproduction. A counterweight is also provided to allow for adjustment of needle pressure upon the records at various lengths. The adjustment allows the maximum length to be used in any installation, and also makes it possible to change the length of the arm after the installation is made. —*Electronics.*

✦

Non-inductive power resistors

A SERIES of power resistors for use in radio frequency applications has been developed by the Ward Leonard Electric Co., Mount Vernon, N. Y. The inductance of these units is negligible at frequencies as high as 1,000 kilocycles and the distributed capacity is negligible at frequencies up to 5 megacycles. The resistance values range from .64 ohms to 10,000 ohms. Two sizes are provided, one 2 in. long, the other 4 in. long, the list prices being $.75 and $1.00 respectively.—*Electronics.*

U. S. PATENTS
IN THE FIELD OF ELECTRONICS

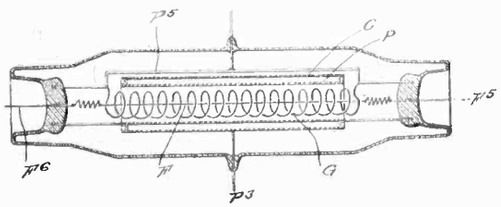
Electron tubes

Tube construction. W. R. Bullimore and L. H. Bedford, assigned to A. C. Cossor, Ltd. No. 1,973,606.

Tube construction. Ernst Lubcke, Siemens & Halske. No. 1,979,392.

Electron stream circuit. Circuit for using an electron or cathode ray stream type of energy in an oscillating circuit. E. L. Koch. No. 1,980,728.

Short wave tube. Barkhausen-Kurz oscillator composed of cathode, grid, anode and a metallic member disposed



about the anode connected to the anode but independent of cathode and grid. I. J. Saxl, Radio Receptor. No. 1,988,398.

Magnetron. A tube of split-anode type. B. S. Gossling and E. C. S. Megaw, London. No. 1,976,778.

Electron emitter. Nickel-cobalt alloy including measurable amounts of barium and chromium, with the nickel-cobalt metal constituting about 90 per cent of the alloy. D. W. Randolph, assigned to General Motors Corp. No. 1,976,295.

Graphite electrodes. An amorphous carbon body subjected to the action of a high frequency field in an oxidizing gaseous atmosphere and the action continued until substantially all amorphous carbon is removed. C. P. Marsden and C. M. Wheeler, Hygrade Sylvania. No. 1,982,821.

Life meter. An electric clock and a counter showing the number of hours a tube has been in service. L. A. Gebhard and G. E. Jacobson, Washington. No. 1,981,860.

Distance measuring, altimeters, aviation guides, etc.

Distance finder. A system for measuring distance by radiating a continuously vibrating wave to a reflecting surface, modulating it at a varying frequency, receiving this modulated wave at a known distance directly from the transmitter and after reflection by means of a circuit responsive only to a wave intensity of substantially the combination of the direct and reflected waves at synchronism of the peaks of the modulated wave, and an indicator operated by said circuit and a scale for measuring the distance between the radiating and reflecting surface. R. W. Hart, Submarine Signal Co. No. 1,993,326.

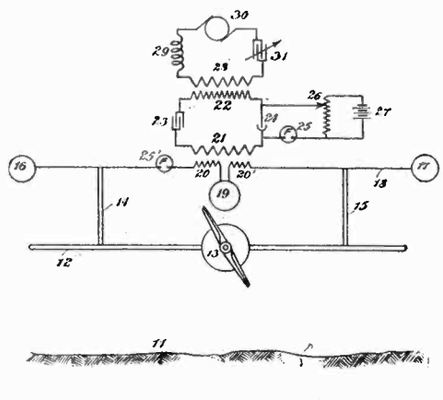
Direction finder. A system including directive and non-directive antennas, an oscillator producing several low frequency oscillations having a fundamental frequency and an even harmonic; the directive antenna signals are modulated with one of the low frequency oscillations; means for combining and demodulating oscillations from the antennas and for combining the demodulated oscillations with the other of said low frequency oscillations to produce a direct current whenever said directive antenna is in a position other than a null position with respect to a transmitting station, said direct current being variable dependent upon the position of the directive antenna. L. A. Taylor, G. E. Co. No. 1,991,473.

Radio beacon. Patent No. 1,992,197 to H. Diamond, and 1,992,927, F. W. Dunmore, on apparatus for radio beacon courses.

Direction finding system. In a radio receiver a means for producing an electromotive force having an asymmetrical wave form dependent upon received radio waves, a non-linear resistance, and means to impress said asymmetrical wave on the resistance to produce a unidirectional e-m-f having a polarity dependent upon the asymmetry of the wave form produced. H. P. Thomas, G. E. Co. No. 1,991,476.

Radio beacon. Patents No. 1,991,474 and 1,991,475 to L. A. Taylor, G. E. Co., on a radio beacon and a direction-finding system, respectively. See also 1,991,443 to H. I. Becker, G. E. Co., on radio direction-finding system.

Height indicator. Apparatus for determining the distance of an aircraft from the earth, comprising a pair of oscillatory circuits arranged upon the aircraft in influencing relation to each other, means for bringing said circuits into resonance with each other, capacity elements in one circuit which will be



influenced by any change in distance between the aircraft and the earth and cause the oscillatory circuits to become non-resonant and produce a beat note, with means for measuring the beat note to calculate the change of capacity to measure the distance. R. A. Fessenden, Chestnut Hill, Mass. Application Jan. 18, 1922, 1 claim. No. 1,991,892.

Measuring time intervals. A system for measuring the time interval between the happening of two events by using receiving indicators receptive to each event and several oscillating systems operated by separate receivers with a compensator for measuring the phase difference between the oscillating systems. Willy Kunze, Submarine Signal Co. No. 1,991,396.

Course and distance indicator. A system for application in a dirigible craft. Application Feb. 16, 1927, W. G. Gerlach, Oakland, Calif. No. 1,991,665.

Power control

The following patents involve the use of electron tubes in power control and distribution: No. 1,985,044, F. W. Lyle, WE&M Co., illumination control system. No. 1,988,349, J. E. Beggs, G. E. Co., photo-electric control system. No. 1,988,609, A. H. Reeves, W. E. Co., synchronizing system. No. 1,988,947, Helmut Hintze, G. E. Co., combination of d-c and a-c circuits with tube apparatus for interconnecting them. No. 1,989,187, A. S. Fitz Gerald, Wynnewood, Pa., a remote control system. No. 1,989,500 and No. 1,989,501, C. G. Suits, G. E. Co., control method. No. 1,990,261, H. E. Young, power factor controller. No. 1,990,366, M. E. Bivens, G. E. Co., power conversion apparatus. No. 1,990,428, H. J. de Bellescize, Paris, synchronizing system. No. 1,990,758, and No. 1,990,759, C. W. Stone, G. E. Co., power transmission and distribution. No. 1,991,066, S. A. Staege, WE&M Co., a speed-regulating system for d-c motors. See also No. 1,991,067 and No. 1,991,088. No. 1,993,581, E. F. W. Alexanderson, G. E. Co., operation of a-c motors from a d-c source.

Electron tube applications

Power control. No. 1,982,329 to P. E. Stogoff, WE&M Co.; No. 1,986,112 to F. G. Logan, Ward Leonard Electric Co.; No. 1,986,622 to B. A. Case, G.E. Co.; No. 1,988,294 to Emil Blaich, G.E. Co.; No. 1,988,271 to A. S. Fitz Gerald, G.E. Co.

Traffic control. Patents No. 1,986,679 to L. V. Lewis; No. 1,987,730 to A. M. Cravath; and No. 1,987,758 to A. J. Sorensen, all for the Union Switch & Signal Co.

Loss metering circuit. Measuring effective a-c resistance by converting d-c power into oscillating power, subjecting the sample whose resistance is to be measured to the oscillations, evaluating the resistance from the increase in d-c power required to maintain oscillations in the sample. F. E. Terman, Stanford University, Calif. No. 1,976,904.

Reverberation meter test. Direct current discharge of a condenser through a resistance is modulated, it actuates the reverberation meter, and the time interval required for the modulated voltage to fall from one value to another is determined. C. H. Rumpel, B.T.L., Inc. No. 1,984,995.

Grid-glow tube control. Method using a photo tube. L. R. Quarles, WE&M Co. No. 1,984,987.

Photometer. Method of determining the intensity of light rays photo-electrically. H. H. Geffcken and H. R. Richter, Radio Patents Corp. No. 1,985,085.

Flaw detector. Thermionic apparatus for detecting defects in an electrical conductor. D. W. Dana, G.E. Vapor Lamp Co. No. 1,984,465.

Winding indicator. Photo-electric method of indicating the winding or unwinding condition of rolled material. J. E. Soons, Hoffman-Soons Electrical & Engineering Corp. No. 1,988,255.

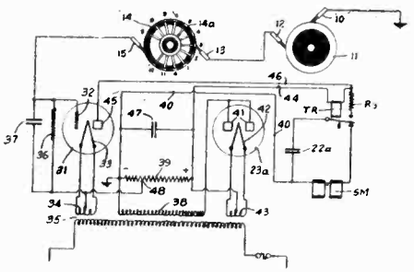
Photometric apparatus. Photo-electric method using polarized light. A. C. Hardy, G.E. Co. No. 1,987,441.

Position indicator. Geophysical prospecting method of determining position of a discontinuity in a wave propagating medium. Frank Rieber, Berkeley, Calif. No. 1,988,020.

Altimeter. Reflecting radiated waves from an object to determine its distance from a surface. No. 1,987,587 and 1,987,588 to F. H. Drake, R.C.A.

Sorting machine. Tube apparatus in which a sorting brush discharges a condenser. G. Lowkrantz, International Business Machines Corp. No. 1,982,216.

Sorting machine. Testing and rejecting device depending on variations in



flux lines. A. J. Moore, G.E. Co. No. 1,983,388.

Flaw detector. An amplifier is used to check flaws in boiler welds. H. C. Drake, Sperry Products, Inc. No. 1,978,252.

Web detector. A safety device for high speed printing presses comprising a phototube. M. D. McFarlane, New York. No. 1,978,589.

Remote control system. Method of operating street lighting system by a remote control system. H. E. Butler, G.E. Co. No. 1,982,368.

Traffic control. A supersonic air wave system. R. C. Hitchcock, WE&M Co. No. 1,982,341.

Remote recorder. A light sensitive method for controlling recorders. C. H. Wilson and C. J. Brown, Foxboro Co. No. 1,982,185.

Automobile lighting system. Phototube method of controlling the lights on a vehicle. C. H. Braselton, New York, N. Y. No. 1,981,985.

Control system. Synchronizing light and sound effects. E. B. Patterson, R.C.A. No. 1,977,997. 24 claims.

Voltage control. Means for maintaining a constant output current from an input current of varying voltage. H. C. Grant, Walter Kidde & Co. No. 1,967,303.

Patent decisions

A recent decision of the United States District Court, Southern District of New York, is of considerable importance to those interested in any phase of electrical amplification.

Several broad claims in the Langmuir patent 1,313,094 were declared valid and infringed. They refer to the use of vacuum tubes in cascade, the first tube being especially sensitive to changes of grid voltage and the second tube being less sensitive to changes of grid voltage than the first tube but adapted to control a greater amount of energy than the first tube.

These claims are functional and do not specify how the second tube is adapted to control a greater amount of energy than the first tube nor do they explain how the first tube is made more sensitive to changes of grid voltage. It is disclosed in the specification that the spacing of the grid wire of the second tube is greater than the spacing of the grid wire of the first tube causing the first tube to be especially sensitive to changes of grid voltage and causing the second tube to control a greater amount of energy but being less sensitive to changes of grid voltage.

Although the court ruled that the claims were to be construed in connection with the specification it did not state specifically how the claims were to be interpreted. Due to the very general wording of the claims it is extremely difficult to determine when and where infringement occurs.

The tubes may be physically identical but due to the difference in applied static potentials the voltage amplification of the first tube can be greater than the voltage amplification of the second. The second tube necessarily controls a greater amount of energy than the first if amplification is obtained.

Even when the interpretation is confined to differences in construction between the two tubes, the claims involve a number of parameters not referred to in the specification. The magnitude of the elements, their disposition and their physical structure, the temperature of the filament and any factor affecting the ability of the tubes to dissipate heat are all parameters which affect the voltage amplification or the amount of energy that the tube can control.

If the interpretation of the claims is confined strictly to the disclosure, infringement only occurs when the grid spacing of the second tube is greater than that of the first tube. Since an additional claim covers this particular change in construction the general claims would then appear to be unnecessary. Under this limited interpretation infringement could be avoided by using voltage tubes and power tubes of the same grid wire spacing.

Prior art

The use of voltage and power tubes is almost imperative in the design of high efficiency cascade amplifiers. It is quite obvious that it is unnecessary to use power tubes in the early stages of amplification where the energy controlled is extremely small. The obvious use of small voltage tubes in the early stages results in economy of cost and space as well as improved efficiency.

In an attempt to prove these claims invalid, the defendants cited two patents which were prior to the patent in suit: De Forest, 1,375,447, and Von Lieben *et al* French patent of addition 13,726.

The De Forest patent shows cascade amplification in which the first tube has a single grid and a single plate and the second tube has a double grid and a double plate. If the plate currents in the three instances were approximately equal the second tube could be considered as adapted to control a greater amount of energy than the first tube. However the first tube is not more sensitive to changes of grid voltage than the second tube.

The French patent shows cascade amplification in which the first tube is small and the second tube is large. The size of the second tube is increased to permit it to control a greater amount of energy than the first tube. There is no mention of the smaller tube being more sensitive to changes of grid voltage than the second tube.

Several claims in the Langmuir patent 1,297,188 were also declared valid and infringed by the same court. These claims pertained to the use of a non-inductive resistance in coupling tubes in cascade amplification. These are necessarily claims of degree in that it is impossible to obtain a resistance entirely free from capacity or inductive reactance. There is no definite point at which a non-inductive resistance becomes an impedance if we consider the reactance to be increased in small increments. What might be considered a a non-inductive resistance at one frequency could be designated as an impendance or reactance at another frequency due to the increase in the reactance with the frequency.

Neither the specifications nor the claims specify what percentage reactance is allowable in the non-inductive resistance. Therefore when using impedance coupling it is impossible to determine what percentage resistance is necessary to constitute infringement.

The defendants attempted to prove the claims invalid citing the De Forest patent 1,375,447 and the French patent of addition 13,726. The De Forest patent shows cascade amplification in which transformer coupling and coupling by means of an inductive coil are used. Neither the claims nor the specification of this patent refer to non-inductive resistance coupling. However no mention is made of confining the resistance of the reactance coil to any definite percentage.

The French patent of addition 13,726 discloses cascade amplification in which the tubes are coupled by transformers. It also shows resistance coupling in that the static potentials applied to the grids and plates are obtained from a potentiometer.

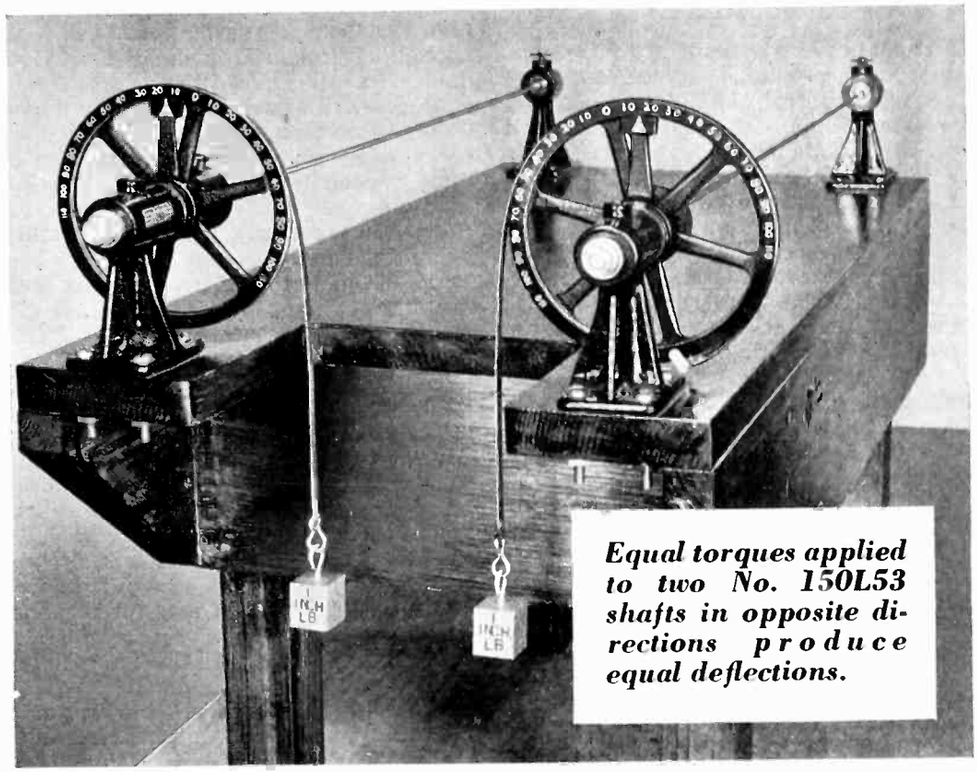
The defendants showed that all forms of coupling, including non-inductive resistance coupling were old prior to the invention of the vacuum tube. They also showed that coupling had been used to connect tubes in cascade. They claimed it to be no invention to choose a well known form of coupling and apply it to a previously discovered use.

Neither the specification nor the claims of the patent in suit cite any advantage of non-inductive resistance coupling in cascade amplification over the transformer and reactance coupling. For the particular purpose disclosed, receiving wireless telegraphy signals, resistance coupling not only proved to be no advantage, it was unsatisfactory.

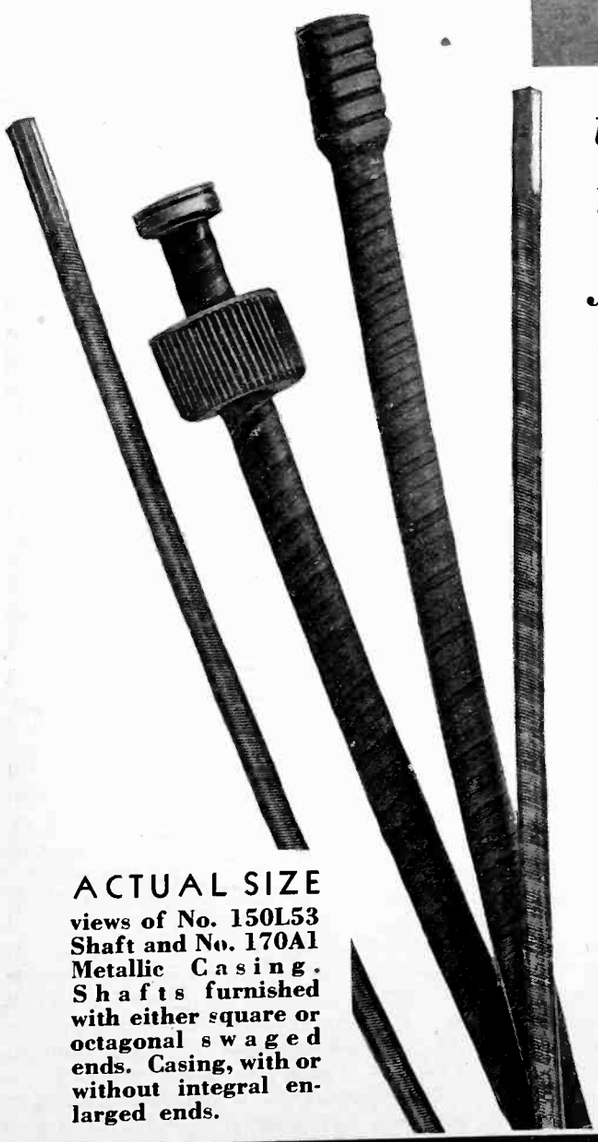
Equal torsional deflection for either direction of rotation

is a feature of

S. S. WHITE REMOTE CONTROL FLEXIBLE SHAFT No. 150L53..



Equal torques applied to two No. 150L53 shafts in opposite directions produce equal deflections.



ACTUAL SIZE views of No. 150L53 Shaft and No. 170A1 Metallic Casing. Shafts furnished with either square or octagonal swaged ends. Casing, with or without integral enlarged ends.

that's one reason why this shaft is superior to conventional flexible shafts for REMOTE CONTROL *of* RADIOS . . . .

Flexible shafts have what is known as a "winding" direction of rotation and an "unwinding" direction. Torsional deflection under load in conventional shafts, is considerably greater when they are turned in the unwinding direction.

But in the No. 150L53 Shaft this difference has been eliminated by radical changes in the number of layers of wire, in the size and number of wires in each layer and in the method of winding.

Also by this special construction, deflection has been reduced to such an insignificant amount that, when the shaft is properly applied, tuning is as smooth and sensitive as with a direct connection. There is no distinguishable difference. Yet ample flexibility has been retained for operation in curves of small radius.

Full details about the shaft, and the special small outside diameter flexible casing designed to go with it, will be furnished on request.

NRA MEMBER WE DO OUR PART

The S. S. WHITE Dental Mfg. Co.
INDUSTRIAL DIVISION
Knickerbocker Building New York, N. Y.

BRITISH PATENTS

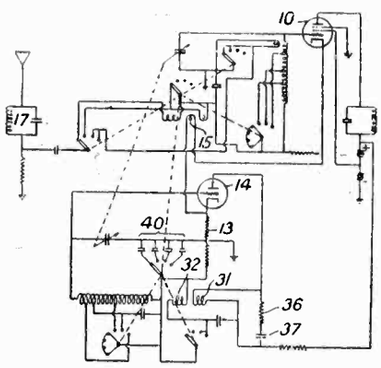
British patents are important to American readers because these disclosures often forecast corresponding U. S. patents which may not be issued until a year later.

Radio circuits

Automatic volume control. A system for producing quiet, delayed a-v-c in which the control potential is derived from two oppositely acting rectifier systems, each including a resistance traversed by a current which is the resultant of two opposed potentials, one of which is proportional to the amplitude of the received carrier wave, the other being fixed. Westinghouse Brake Co. No. 417,608.

Push-pull circuit. A pair of tubes in quiescent push-pull are fed from a source of anode supply, for example, an eliminator, which has across it an additional tube whose impedance is controlled by a portion of the signal input so that the total load on the anode source is constant. Marconi Co. No. 419,073.

Multi-band receiver. In a superheterodyne operating over more than one band, the frequency range of the oscillator is minimized by tuning to a frequency higher than the signal in the lower frequency band and to a frequency



lower than the signal in the higher frequency band. Hazeltine Corp. No. 419,795.

High frequency receiver. A tube operating on the Barkhauzen-Kurz principle, inserted at a current loop in the associated resonance circuit, damping due to the low resistance of the tube being reduced by feed back. Telefunken. No. 417,627.

Super-regenerator. A super-regenerative receiver is used in conjunction with a transmitter which sends a carrier interrupted at 100 cycles per second for the purpose of operating a calling-device. G. Monteavaro. No. 417,725.

Interference elimination. A receiving relay is operated by the a-c component of plate current, the d-c component being considerably varied by an interfering signal and is used to control an attenuating network to prevent operation of the receiver by the interfering signal. The receiver is applied in a telephone system to respond to a signal of definite frequency but not to respond to speed. The attentuation may be increased automatically by excessive levels of desired signals. L. E. Ryall. No. 418,442.

Super-regenerative receiver. A relay is operated in response to interrupted high frequency oscillations. N. H. Clough, Wireless Telephone Co., London. No. 418,525.

Modulation system. Amplitude modulation of a carrier wave is effected by combining two phase-modulated waves after oppositely displacing their phases. Marconi Co. No. 418,596.

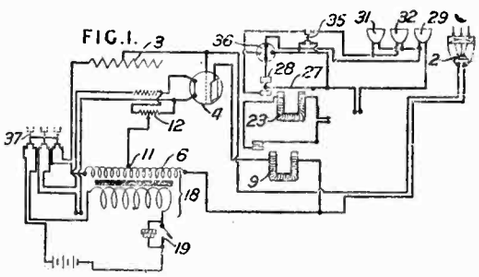
Antenna system. To prevent fading, a multiple aerial system comprises elements designed to radiate or receive horizontally-polarized waves, and other elements which radiate or receive vertically-polarized waves so as to produce a circular field, with no zero "pick-up." A. J. Carpentier, France. No. 419,433.

Receiving system. An omni-directional receiving system for reducing the effects of locally-produced disturbances, made up of several angularly disposed loop aerials, balanced electrostatic shielding surrounding the aerials and means for combining the outputs in such relative phase that the receiver responds equally to similar signals received from any direction. Marconi Co. No. 419,783.

Push-pull circuit. The input to a push-pull amplifier is obtained from an amplifier tube with two output electrodes, means being provided to maintain the output current constant. H. A. Wheeler, Hazeltine Corp. No. 419,784.

Automatic volume control. A-v-c potentials are applied to at least one of the electrodes of a multigrid of the type in which a "virtual cathode" exists on or between two of the grids by virtue of the external connections which are arranged so that the tube electrodes act as an amplifier and an oscillator. E. K. Cole. No. 419,885.

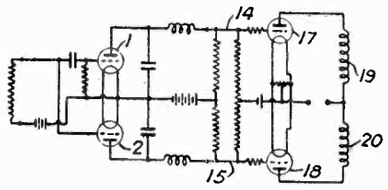
Power supply. A tube controlling a relay is supplied with a-c from the secondary of a transformer, the primary of which is energized with interrupted



d-c. The device is fitted to an automobile and the interrupter may be driven from the engine or may be the usual ignition interrupter. S. Vasilache, Paris. No. 419,236.

Negative characteristic circuit. A two-grid tube has the inner grid held at a substantial negative voltage, while another electrode, such as the second grid, exhibits secondary emission with the result that the current of this electrode has a negative characteristic and its current always flows against the applied positive voltage. The high negative bias cuts off any current to the outer electrodes until the second grid is given a positive voltage high enough to cause it to lose more electrons than it receives. A parallel-tuned circuit can be sustained in oscillation even if the circuit is considerably damped. The circuit may be used as an amplifier with the input applied to the grid of the triode tube, the plate circuit of which includes the negative resistance device. By matching the positive resistance characteristic of the triode with the negative resistance characteristic of the other tube, high current and voltage changes in the plate circuit result from small input voltages. Telefunken. No. 419,970.

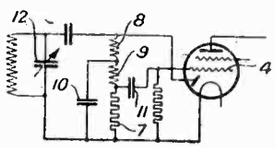
Detector circuit. Two tubes, one acting as a grid leak and the other as plate bend detector have their output circuits



coupled so that the sign of the voltage difference between points 14 and 15 depends on the magnitude of the alternating voltage applied to their input. G. E. Co. No. 419,978.

Modulation system. In a radio transmitter, the modulating voltage is applied in the same phase to several carrier-wave amplifiers of increasing power-handling capacity. No. 420,019.

Detector circuit. The input to a detector, particularly the rectifying part



of a diode-triode, comprises a resistance in series with two equal but oppositely-wound chokes. This prevents damping of the input circuit. Philips. No. 420,476.

Tuning indicator. A tubular gas-filled envelope with an anode near one end and a high resistance cathode extending the length of the envelope, the cathode current lead being connected to the cathode at the end remote from the anode and the cathode resistance being such that when the cathode is covered with a uniform glow the potential gradient along it is the same as that in the surrounding gas column. In one form, the anode is a short nickel wire while the cathode consists of a fine wire wound helically round a glass tube having its end taken out from the top inside the tube. The resistance of the wire is of the order of 250 to 5,000 ohms per inch, and the material may be iron, tungsten or Nichrome. The wire may be covered with a mixture of barium azide and ½ per cent of caesium azide. The filling may comprise neon, helium, argon, or mercury vapor, or neon containing 0.4 per cent of argon at a pressure of between 10 and 40 mms. British Thomson-Houston Co. No. 420,497.

Modulation system. Phase modulation is effected in a circuit by employing a long-line as a resonant grid circuit for a self-oscillating pair of tubes. Marconi Co. No. 420,574.