electronics

radio, sound, industrial applications of electron tubes + + + design, engineering, manufacture

Opportunities for photocell control of lighting

+

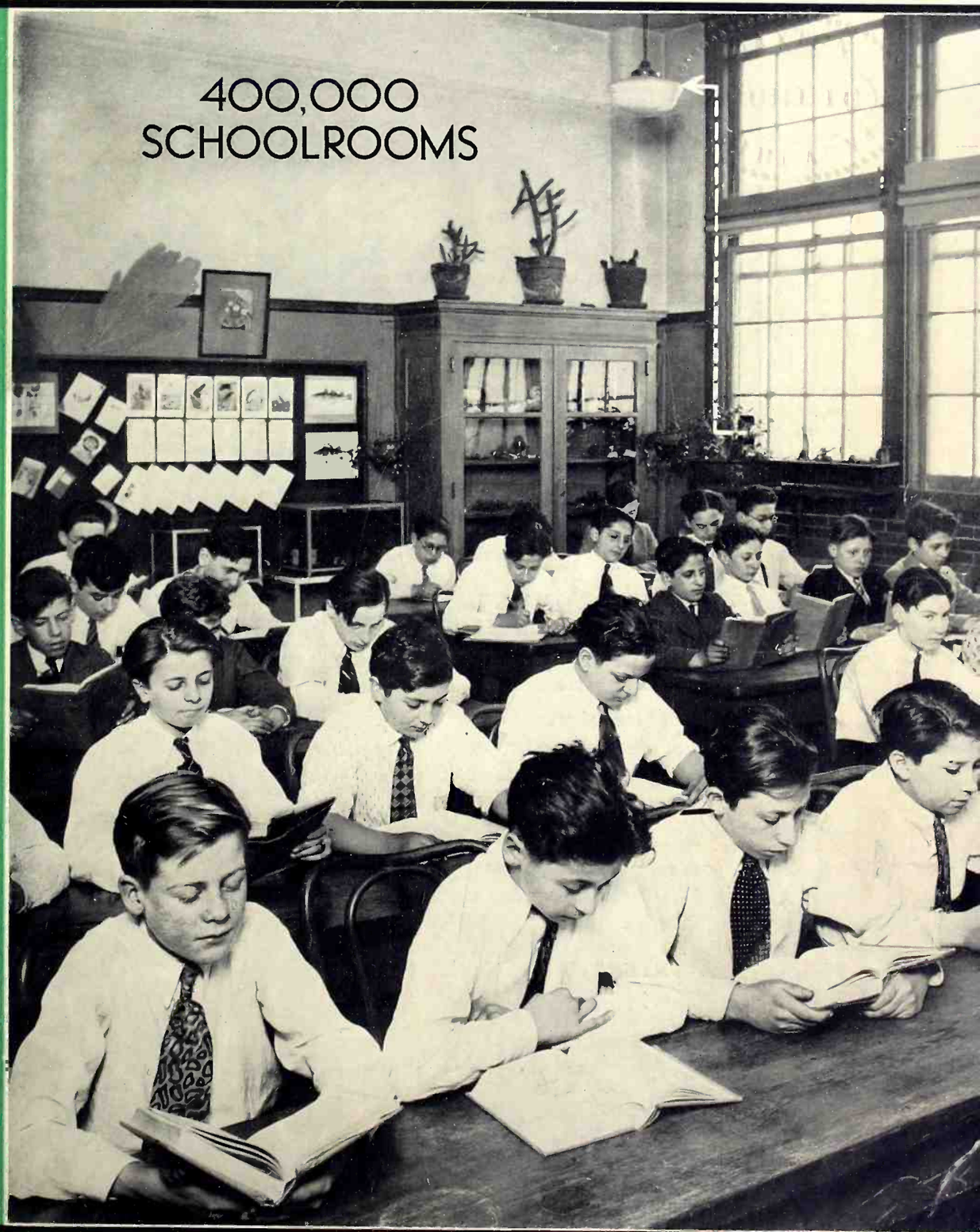
The "electric eye" in industry

+

Survey of 1932 radio sets

+

Television fidelity measurements



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OCTOBER 1931

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The BLUE *Radio Tube!*

ARCTURUS

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

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electronics

McGRAW-HILL PUBLISHING COMPANY, INC.

New York, October, 1931

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What would be accomplished by a voluntary

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

Pool of electronics patents

THOSE who have been through the long protracted patent litigation in radio have often asked themselves "Must all this agony be gone through once more in the broader field of electronics? Shall the new electronics art be faced with exhausting legal warfare which will slow down development and freeze progress — while humanity waits?"

OUT of each depression, economists tell us, some new invention or industry has always arisen to lead the world into new business activity. The automobile, for example, pulled us out of the slough of 1921.

If such is to be the way out of the present depression, then certainly on the horizon of 1931 there is no more promising prospect to perform such service, than the electronic tube with all its manifold applications.

BUT always over the brightest picture of electronic possibilities, hangs the spectre of patent infringement. It stalks at every engineering conference, be the company large or small.

If the owners of electronic patents could see the advantage of cross-licensing and exchanging patent privileges under a voluntary pooling plan that would stimulate both manufacture and profits, how far would the development of this art be pushed ahead?

Certainly, a voluntary patent pool would speed up electronic development at least five or ten years.

The public, the industry, the inventors would all be the gainers.

Electronics—science's latest, greatest gift to mankind—is straining at the leash, waiting to get underway.

A VOLUNTARY pool of electronics patents we believe, would start things rolling again, outside as well as inside the electrical and radio industries—restoring business, rebuilding confidence, and directly or indirectly creating jobs for hundreds of thousands now unemployed.

An electronics patent pool, maybe, is the key—or one of the keys—to the business puzzle of 1931.

THE "ELECTRIC EYE"

It counts, it records, it measures, it controls, it regulates, it detects

Places where light-sensitive devices can be installed

School rooms, (for light control)	400,000
Shops and factories (for light control)	200,000
Smoke-stacks (for smoke control)	100,000
Large electric signs	100,000
Machines to be safeguarded	100,000
Elevators	200,000
Restaurants, hotels	60,000
Offices (for light control)	300,000
Retail stores (for light control)	350,000
Counting operations	250,000
Color-matching operations	3,000
Sound-picture projectors	45,000
Air ports, aviation beacons	3,000
Street-lighting circuits	150,000

THE past year has seen a rapid increase in the number, diversity and ingenuity of application of light-sensitive devices. Suddenly electrical men and practical production superintendents seem to have come to realize the usefulness of this remarkable new tool,—the "electric eye"—in taking the place of human scrutiny and human drudgery in the performance of many routine tasks.

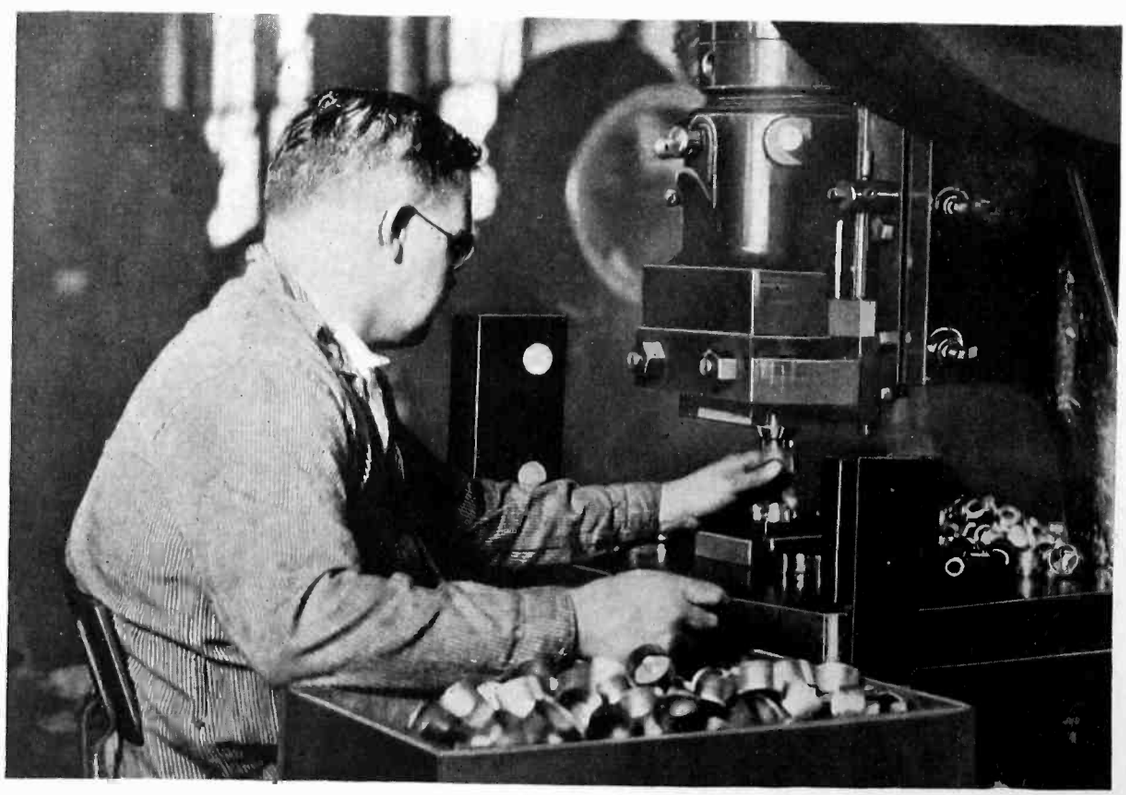
Daily, new uses are found for the photocell and the number of these applications already is so expanded that the "electric eye" bids fair to penetrate into every activity of industry and of everyday life. From the movies to the factory, from the race-track to the corner traffic light, from the laboratory to the kitchen, the photo-sensitive cell finds hundreds upon hundreds of uses.

Types of light-sensitive devices

Light-sensitive devices are of several different classes, based upon widely different physical phenomena, and each class has special characteristics which adapt it for particular uses. These different kinds of "electric eyes" may be listed as follows:

1. The photoelectric tube,—a vacuum or gaseous cell, with light-sensitive plate which emits electrons upon illumination. This stream of electron charges is then amplified by other tubes.
2. The selenium cell—the familiar element which changes its resistance with incident illumination, now, in its latest forms, sealed in vacuum-tight tubes.
3. Photo-voltaic cells, or batteries, which produce a change in current flow with changes in illumination.
4. Dry oxide plates (copper oxide, etc.) which produce comparatively large, low-voltage currents when illuminated.

Wherever a beam of light can be interrupted, modulated or controlled by some operation which is to be

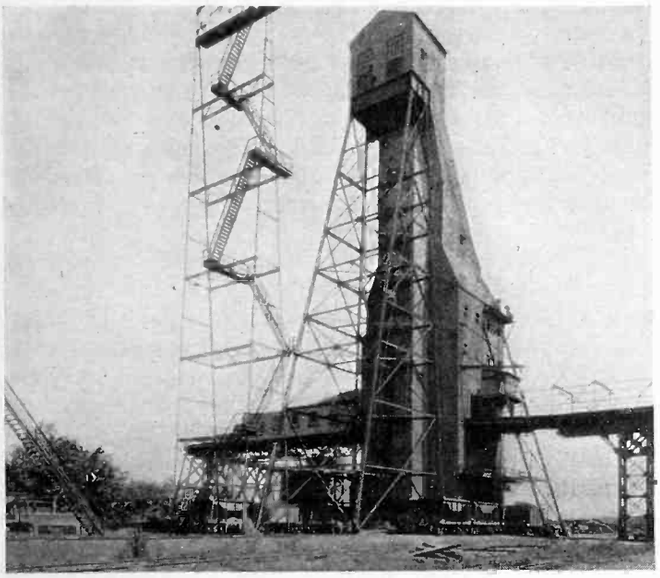


Safety-first with photocells

As long as the operator's hand remains in the danger zone of this punch press, the beam of light entering the photocell is intercepted, and the press will not operate. Photocells eliminate annoying mechanical guards which often irritate workers so that they are surreptitiously removed

NOW ENTERS INDUSTRY

It safeguards, it grades, it inspects, it engraves, it matches colors, it reproduces



Each time a larry comes up out of this mine pit, it intercepts a light beam and is automatically counted by the electric eye

counted, detected or reproduced, a light-sensitive cell of some of the types just described can be employed, and this can be done without interfering with the action to be recorded. For example, if the pendulum of a master clock is to drive other clocks without being itself loaded, a beam of light and a photo-cell will accurately record the master pendulum's swings without imposing on pendulum or train the slightest interference with its movement.

Counting production lines, traffic, etc.

As motors, refrigerators, automobiles or other manufactured articles, large or small, move along in a factory production line, the interrupted beam of light falling on a light-sensitive device will give an accurate count of the number turned out.

In the same way, autombile traffic in a tunnel can be counted. Photocells at the entrance and exit can even be arranged to work the counter mechanism in opposite directions so that the number *remaining* on the counter dial at any moment will represent *the number of cars in the tunnel*. The same principle has been applied in motion-picture theaters, to check up the ticket sellers, and to show, on an index in the manager's office, just how many people are in the theater at any time. Photocells are being successfully used to check the number of tickets sold on toll bridges.

One of the most important future uses of the "electric eye" in point of numbers, will be that of controlling interior illumination. For years we have automatically adjusted the temperature of our rooms by means of thermostats. Is it any less logical or less important to control the intensity of the lighting in workrooms, schoolrooms, etc., by means of a "light-o-stat" or light-sensitive cell?

In the average schoolroom, during the winter months, the natural illumination goes through wide changes, imposing extra burdens on little eyes. But with a photocell on guard, electric lights will be automatically switched on, each time the natural light falls below a predetermined value. Since there are 400,000 schoolrooms in schools having electric lights, the commercial opportunity for photocell control here is apparent.

Factories and machine shops offer another large field for automatic light control. Tests recently conducted by a large industrial company, show a saving of at least 50 per cent of the electricity required (chiefly wasted) in the ordinary hand-controlled shop lighting system. In these experiments, two sections of machine shops

At Macy's, New York City, the elevators are safeguarded by light beams across the threshold. As long as anyone is in doorway, door can't be closed or car started. Insurance companies reduce policies 10 per cent when such electric-eye protection is provided

doing similar work were equipped respectively with photo-electric and with manual control of lights.

Recording meters showed that while the "electric eye" switched on the lights as soon as the natural illumination fell below the predetermined level, it was often half an hour or more before the man in charge of the manual switches thought to turn on his lights—meanwhile his workmen suffered poor illumination. Later when the need for artificial lighting has passed, the photocell turned off the lights *immediately,* but under the same conditions the human monitor often let the lights run for hours during bright daylight, wasting electricity. In this way, the photocell control actually gave far better illumination to the workers, and at the expense of half as many kilowatt-hours.

Switching on electric signs, street lighting

Control of electric signs and street-lighting circuits is another field which is rapidly growing. Large signs, actuated by photocells, are automatically turned on when the sky becomes dark enough to make them effective, and this is done independently of the hour of the day, or the attention of human supervisors. One of the most valuable times to display electric signs is during the day when the sky is heavily overcast. The phototube can be set to turn on the sign for this service, and also to catch the exact point at dusk of evening, when the sign will begin to be effective,—the clockhour of which of course varies widely from night to night, with the condition of clouds and sunset.

For the control of street lights, already a number of photocell circuits have been put into service, and have given thorough satisfaction. From now on, it is likely that such control of the thousands of street-lighting circuits in the United States will grow rapidly.

Safety applications—elevator doors, shop machines

Safety uses of photoelectric devices comprise one of the most important general applications now in sight. Wherever human life or limb is likely to come into a danger zone, a beam of light can be so projected as to give warning, or to stop the machine. A punch-press operator can be protected by a beam of light across the front of his machine. As long as his hands are in the danger area, the motor is cut off and the punch press remains inoperative. As soon as his hands are removed, the press is instantly ready to strike. No cumbersome mechanical guards are needed—guards which interfere with the operatives and often gain their opposition even to the point of surreptitious removal.

Passenger elevators offer an impressive field for photoelectric safety work. Several large department stores have already equipped their cars with photocell safety switches, making it impossible for elevator operators to close doors or to start cars so long as any person is within the beam of light which shines across the car threshold.

Already the accident insurance companies are recognizing the reduced libility resulting from such installations, and are offering reductions of 10 per cent or more on customers' policies, where photocell safeguards are used. Such savings make it possible to finance the

COMMERCIAL APPLICATIONS OF PHOTO-CELLS:

Industrial Control

Steel mills, bar mills
Soaking-pit covers
Reversing rolls
Cut-off saws
Furnace temperatures
Adjusting water softeners
Paper machines
Registering printing, folding, cut-offs, etc.
Synchronizing conveyors
Chemical processes
Leveling elevators
Limit switches in mines, etc.
Controlling thickness of sinter beds
Smoke indicators in smoke stacks
Level controls
Adjusting movie screen
Opening doors
Operating valves, switches

Traffic Control

Railroad signals (European)
Street traffic lights
Elevator levelling
Elevator safety stops
Routing mail-bags and letters
Counting traffic
Speeding subway traffic
Checking up theatre patronage
Detecting dangerous gas in tunnels

Light Control

School-room lighting
Shops and factory lighting
Large electric signs
Flood lighting and decorative effects
Store lighting
Office lighting
Street lighting circuits
Air ports, aviation beacons
Light-houses, range lights, markers, etc.

Visual Reproduction

Facsimile recording, photographs, maps, newspapers, etc.
Television recording
Half-tone and line-cut manufacture
Electrotyping
Aiding blind to read ordinary print

Counting, Measuring

Production lines (motors, automobiles, refrigerators, etc.)
Traffic in tunnels, on bridges, etc.
People passing or entering (theatres, etc.)
Animals, livestock, etc.
Recording beats of master clock
Printing and engraving
Tabulating statistics, quantities
Measuring lamp candlepower
Timing races
Integrating irregular areas
Astronomical measurements
Color measurement
Turbidity measurement
Projectile velocities

Grading

Cigars
Tile
Beans, vegetables
Detecting missing labels
Inspecting tin-plate
Calipering small parts
Color comparison
Adjusting and headlights

Sound Production

Phonograph recording
Sound-picture recording
Sound-picture reproduction
Light-beam transmission
Light siren
Electric organ
Broadcast modulation
The "talking book"

Home Possibilities

Controlling uniform illumination in work rooms
Monitoring oil-burner pilot flame
Garage-door openers
Alarms against trespassers
Flood-lighting control

At the fall of darkness, a photocell turns on this sign. On dark overcast days it is also automatically lighted

installation of the "electric-eye" safety mechanism directly out of the savings effected.

Figures are given by the Otis Elevator Company which indicate that 200,000 elevators are now in operation in the United States, (excluding passenger-controlled units). As the average elevator installation serves a building of five or six stories, the total number of elevator doors to be protected reaches the surprising total of one million.

Photocells are now also being applied for leveling elevator cars at floors, for railway signalling, for automobile traffic signals, and for a host of traffic purposes.

Races are timed by photocells, the winner serving to interrupt a light beam which gives an accurate, incontestable record of the time elapsed, and may also be arranged to snap a photograph of the finish line at the instant of crossing, so that there can be no doubt about which contestant was first to cross the tape!

Uses in home yet undeveloped

While the home has been recognized as a vast field for the installation of electrical appliances and so of photoelectric devices, as yet few practical uses have been found.

For keeping an atuomatic eye on the pilot flame in oil-burner installations, phototube devices have been experimented with, but difficulty has been found in maintaining the glass lenses clear enough to make the light-sensitive devices of value.

Photoelectric garage door-openers are handy things for the home driveway and home garage in wet or cold weather. The driver has merely to turn his headlights on the secreted electric eye and presto, the door rolls open. But even such installations, practical as they are, will probably be confined to a relatively small proportion of the 19,000,000 homes now served with electricity.

The home still remains the great untouched market for photoelectric devices. Undoubtedly the day will come when the intensity of illumination will be controlled in certain rooms of the average home, just as the temperature is automatically controlled today. But this era is probably still far off. Meanwhile the inventor and manufacturer who can find a photocell application needed in every household, will have a ready-made market of 19,000,000 homes awaiting him.

Possible uses of the "electric eye" or photocell in industry, in commerce and everyday life are already legion. The further spread of these devices into all manner of applications will depend only upon the recognition of needs and uses for them, and on the ingenuity of engineers and practical production men in fitting these ubiquitous and all-useful electric eyes into the problems of the workaday world.

HEADLIGHTS OPEN GARAGE DOOR

This garage door, at the Greenwich, Conn., home of O. H. Caldwell, editor of *Electronics*, rolls open when the car headlights fall on the concealed "electric eye." So sensitive is this selenium bridge, that a flashlight will operate it at 50 feet. Other electric eyes concealed in stone walls about the place, operate a battery of 300-watt flood lights surrounding the house, and ring chimes whenever a visitor's car comes up the driveway

Survey of 1932 radio set trends

SURVEYS conducted by *Electronics* at the New York Radio Show, September 21-26 and by mail, indicate that radio manufacturers are at last making some effort to overcome the growing belief among the listening public that sets are becoming steadily worse, and that if one wants to buy a really good set he had better get a second-hand model of one or two years ago of any reputable manufacturers.

There were many four-tube sets selling around $40 or below that these sets are so palpably inexpensive and small and it is so evident that the user gets his money's worth that there is no attempt to compare them with larger and more expensive receivers. The very cheap set seems to be finding a niche of its own, not as a pretender to be all any receiver is, but simply as a compact, inexpensive radio. Casual conversation at the radio show indicated that major interest among the record crowds was directed toward the sets in the higher brackets.

There seems, then, to be not only an attempt on the part of the industry to slowly raise prices, but to make the difference between the $100-set and the $40-set so apparent that the customer can make his own choice. At the same time this interest on the part of the public, which probably has been burned too often by wild claims for cheap merchandise, in the larger, better toned, and more expensive sets cannot help but be healthy for the industry as a whole.

In another year or two it may be apparent to everyone that it is no longer cheaper to buy a new set than to buy new tubes for an old set. For the $100–$125 asked for many of this year's receivers the listener gets a vast amount for his money, greater value than ever before. He gets a superheterodyne of extreme selectivity, he gets pentode tubes (of dubious techincal value but of considerable sales appeal), he gets variable-mu tubes of evident worth when near local stations. Many of the sets in this price range are in cabinets large enough that the listener will get a few first-hand notes below 100 cycles; to enjoy the base viol he will no longer be dependent upon some lack of symmetry in his own physiological or mental acoustic apparatus.

Manufacturers have so reduced the process of putting together the components, so eliminated unnecessary expenditure of component money—by reducing factors of safety in many cases—and so reduced their chances of making a profit that the listener is bound to get receivers at little cost.

Special features are few

Attempt is displayed by some manufacturers to attract attention to their wares aside than by price wars. The addition of short-wave sets to standard consoles is one indication that ingenuity in appeal effort may in time become as apparent in the radio industry as in the automobile for example. Time may come when all radios will not look alike, sound alike, and sell for the same money.

Pentode tubes are everywhere, almost. So are variable-mu tubes; the superheterodyne is supreme. Many manufacturers use two pentodes, either in push-pull or in parallel and effect economies by so doing. A number of them have had engineering skill enough to overcome the disadvantage of the pentode, viz., harmonic distortion and over-emphasis of high notes. Whether the superheterodyne is an unmixed blessing or not is debatable—its superselectivity indicates a vicious slashing of high note response.

Television drew record attendance at the New York show. Demonstrations were given of the Sanabria large-screen system and, in hotels about, other sets ready for exploitation were shown. The Jenkins receiver, among others, attracted considerable attention. It uses a ground-glass screen. Such a receiver calls for considerable illumination—this may be the stumbling block even after the necessary increase in detail for satisfactory reception has been attained. At present much work is being done on the crater lamp type of light source.

At the present moment lack of something worthwhile to look at may be a greater deterrent to television set sales than evident lack of technical perfection. After all no salesman can be sanguine enough to expect the public to look in rapt attention for more than a few minutes at a two-foot screen filled with the head of some well-known singer. Close-ups, even in the movies, are only occasionally used.

Privately shown during the week of the show was a new power tube. This is really a combination of two tubes in the same bulb, one used to drive the other and to furnish its grid current. By such a method the second tube which furnishes the loudspeaker power can be used on the positive side of its grid characteristic without wave-form distortion. Such a tube is more difficult to make than a simpler tube, will cost more, provides another new tube for the industry to cope with, but has a higher efficiency than even the pentode. Its output impedance is low, it has a high amplification, and may do the work of two present tubes.

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THE editors of *Electronics* and *Radio Retailing* have compiled a complete analysis of the radio sets of this season. The survey, which is ready for distribution, gives prices of all models, dimensions, circuit, number and type of tubes, etc.

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Measurement of fidelity in television systems

By A. F. MURRAY
RCA Victor Company

A HIGH degree of standardization has been reached in the radio engineering profession for measuring the fidelity of sound reproduction from broadcast receivers. Similar standards are required in the rapidly developing art of television. In considering this problem we find that the same word—Fidelity—can be used both in connection with the excellence of sound reproduction and picture reproduction. During these early days of television development, picture fidelity is usually expessed by rather unscientific phrases such as "you can see the lines between the teeth" or "there was not sufficient detail to show the facial expression of the person televised." In other words, it is difficult for one television engineer to convey to another with exactness the degree of excellence of a television system because no technical measure of picture detail and gradations in picture shade is available.

The means used for this purpose at the television transmitter, W3XAD, of the Research Division, RCA Victor Company, Camden, are described in the paragraphs that follow.

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AS a preliminary step toward standardization of the measurement of television fidelity, the charts reproduced here were devised in the RCA Victor Research Laboratory of which Mr. Murray is division engineer. Associated with him in the development of television apparatus are Dr. V. K. Zworykin and R. D. Kell, both well known for their original work in this important field.

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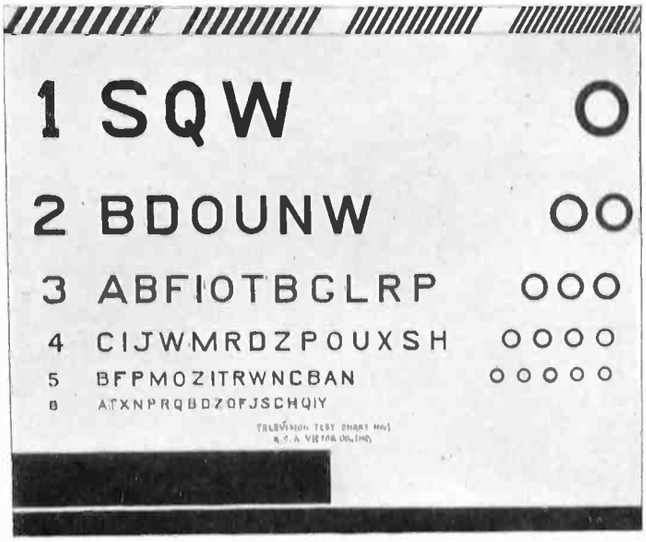


Definition chart to measure television fidelity

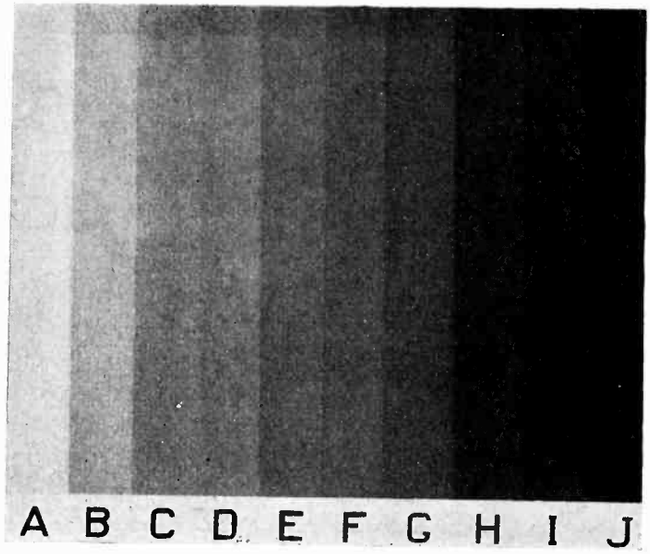
One of the requirements for measurement of the quality of a picture is that the effect of the observer's imagination must be eliminated. It is evident that the engineer must have a measure of precisely what he *sees* over a television system, not what his imagination indicates might be there. For the sake of reproducibility and uniformity of result the test object should not be moving, although motion in a picture (especially in a poor picture) considerably increases what the observer can see. As a measure of perception oculists use an eye-testing chart. Should not such a chart be the basis of tests of the degree of perception via television?

An analysis of the processes employed in the transmission of pictures at a distance—including scanning, amplifying, transmitting, receiving, detecting and reproducing—shows that the fidelity of the reproduced picture can be measured by such an eye-testing chart, having the usual lines of type progressively decreasing in height. But this is not sufficient; there must be included a test which demonstrates the ability of the system to reproduce varying shades from black to white, that is, ability to reproduce halftones. Most television workers are familiar with the geometric figures described and used by the Bell Laboratories in early telvision tests. Both the oculists' chart and the chart of varying shades were used by Dr. Alexanderson and Mr. Kell several years ago in their television research work at the General Electric Company, and it was Mr. Kell, now television development engineer with the RCA Victor Company, who suggested to the writer their use in measuring fidelity.

In preparing the chart shown in Fig. 1 the height of the top line of block letters was made great enough so that it is easily read on any television system. The height was calculated on the supposition that, to be recognizable, letters must be at least three scanning elements high. It will be noticed that each line is numbered so that the measure of excellence of the system being tested may be denoted by the number of the smallest line which it is possible to read.

A combination chart for convenience

After a special type of oculists' eye chart for television was laid out (in which the height of lines bear the relation of 1:2) it was evident that other test figures could be placed on the same sheet for convenience. Across the top of the sheet in Fig. 1 are groups of alternate white



Shade chart in which each shade bears a definite relation to adjacent shades

and black slanting bars. Reading from left to right the bars in each group are progressively narrower. The width of the bars in the first left-hand group is such that this group may be seen with good definition on a 48-line scanning system. The greater the horizontal definition afforded by the system the narrower the bars which can be distinctly reproduced.

The circles along the right-hand border are to test for distortion. These circles sometimes appear slightly elliptical when distortion exists in the scanning or reproducing equipment. The heavy black bar extending halfway across the bottom of the chart is for the purpose of indicating phase-shift in the transmitting and receiving system. Where serious phase-shift is present there will be no sharp line of demarkation between the white and black. The narrower black bar extending across the entire width of the chart tests the low frequency response of the system.

To test half-tones

In the early days of television, silhouettes were extensively used because it was difficult to reproduce halftone pictures. Most of the television systems today have no difficulty in securing halftones. It is possible, of course, to have good definition in a system which is capable of producing only black and white. Therefore, in order to measure the degree of merit of a television system it is necessary to use, in conjunction with the definition chart of Fig. 1, a second chart as illustrated in Fig. 2. This chart, which has ten shades varying from black to white, is televised and observers at the receiver pick out and record as many distinct shades as possible. The number of shades observed represents a measure of the fidelity with which the system reproduces halftones. Each of the shades on the chart is lettered for reference.

The chart shown in Fig. 1 is enlarged to 15 in. by 18 in. (5 to 6 ratio) and mounted on a suitable support in front of the scanner. The scanning field is adjusted to scan exacty this 15 in. by 18 in. area. The usual precautions regarding sharp focusing, etc. are observed. While the chart is being televised, the received image should be inspected by several independent observers to ascertain the number of the smallest line of type which can be read, for this is the measure of perception of the system under test. The reproduction of the slanting bars, the circles and the black bars should also be noted.

The halftone chart is enlarged to 15 in. by 18 in., televised and observed in the same manner. The most reliable results are obtained, of course, by averaging the results of various observers because there may be slight differences in the number of distinct shades reported by several observers at the same receiver.

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NEW BOOKS ON ELECTRONIC SUBJECTS

High frequency alternating currents

By Knox McIlwain and J. G. Brainerd; John Wiley & Sons, Inc. New York. 510 pages. Price $6.

This book gives the material presented by the authors for several years at the Moore School of Electrical Engineering at the University of Pennsylvania. There senior students in the school or first year men in the graduate school are apparently given a stiff ground course in high frequency.

It does not seek to give quantitative data on particular circuits or apparatus, it deals with broad general principles underlying the art. It is a book for students whether they are in college or in industry. These are a number of pertinent problems seeking to test the student's fundamental grasp of the text.

There are chapters on modulation, detection, filters, resonance phenomena, electro-mechanical systems, etc.

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Radio frequency electrical measurements

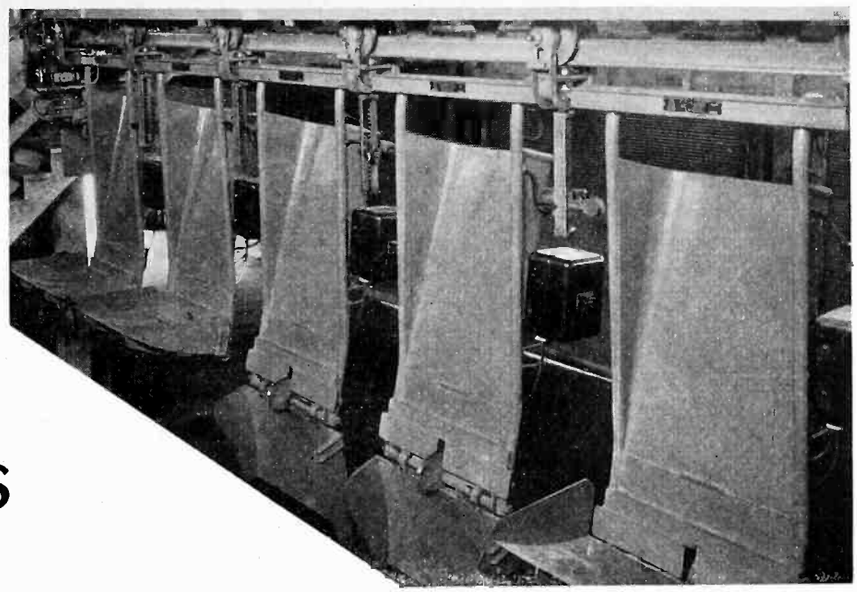
By Hugh A. Brown, University of Illinois, McGraw-Hill Book Company, Inc., New York, 380 pages. Price $4.00.

A MERITORIOUS BOOK, written by a professor of electrical engineering with long association in the field of high frequency, and designed to be used as a text for students, the volume has considerable value as a ready reference book for the practicing radio engineer. The measurement of such fundamental circuit constants as inductance, capacitance, resistance, frequency, and voltage, all at high frequency is adequately discussed with reference not only to the various methods in use but with considerable space devoted to the apparatus required, sources of error, precision attainable, and manipulation of the equipment.

The sections on precision of measurement attainable and sources of error could be called to the attention of many laboratory engineers who are inclined to accept too easily what their meters read when working at a million cycles or above. It is not uncommon even in this day of radio experimentation to find an engineer blithely using a resistance box to measure a few ohms at broadcast frequencies not realizing that the same meter indication would probably be noted even if the box were short circuited.

Measurement of percentage modulation, power detection characteristics, piezo-electric circuits, field strength, and of the numerous thermionic tube characteristics are but a few of the subjects treated.

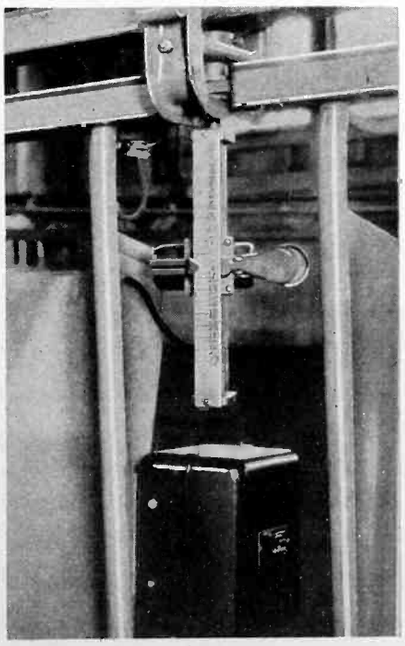
Routing mail by photocells

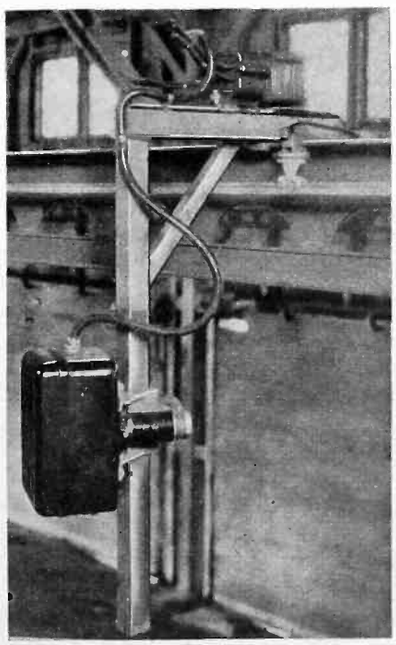


ABOVE
A mail "train," with some of the mail bag trays closed to hold the bags, and others open to show how bags are dropped at destination

BELOW
Light source at destination set to actuate photo-electric relay on conveyor. In this demonstration installation there were thirty-four possible destinations for the trays

ABOVE
Setting the photocells at proper levels corresponding to destinations of bags. Each level corresponds to an unloading platform. When the light is passed, the carrier opens

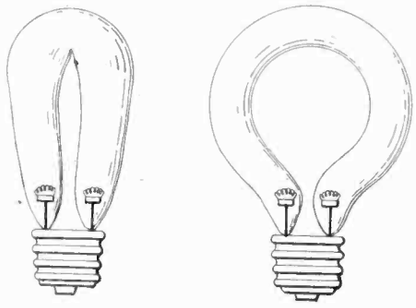




RIGHT
Photo-relay routing device on one of the conveyor trays, in Cincinnati demonstration made by the electric tramrail division of the Cleveland Crane & Engineering Company, for executives of railroad terminals

A cold-cathode 110-volt gaseous illuminant

Available in variety of colors, and in lampsocket forms



Two forms of the Spanner Germer-Doring gaseous lamp adapted for operation in standard lamp socket for 110 volts, a.c. or d.c.

IN Germany and England a new type of electric lamp has made its appearance which is believed to mark an important development in the art of illumination. It is a cold-cathode gaseous lamp which combines the advantages of the mercury-vapor lamp and of the neon tube, and which can be connected directly with any 110-volt socket. The inventors, Dr. H. J. Spanner, Edmund Germer, and U. W. Doring arrived in this country recently to demonstrate their new lamp which is already being introduced into Europe by the Philips and Osram companies which have purchased the rights there.

Wide interest has already been created in gaseous illuminants in the United States, by reason of their superior efficiency over incandescent-filament lamps. The lack of flexibility of the gaseous units, however, and their requirements of special voltages and mechanical forms has so far limited their applications as general commercial illuminants. Electrical engineers and electric utility companies are closely watching the new tubes of various types, expecting that the 1910 history of the tungsten lamp, with its three-fold output of light, may be repeated during the early 1930's by lamps of the gaseous type.

"The mercury-vapor lamp," said Dr. Spanner in demonstrating his lamp to the editors of *Electronics*, "is one of the most efficient known. But unfortunately it has marked disadvantages. In the first place it has a ghastly, greenish-blue color. Seen under it, the veins stand out in the hand like little purple rivers. The reason is, of course, that no red rays are emitted. Furthermore, the mercury vapor can be electrically excited to glow only with direct current. If alternating current is supplied, which is usually the case, special additional devices must be used.

"Neon lamps are also efficient, but are limited in their use. They operate only on alternating current, and usually at high voltage. The rare gases in the tube are excited by the electric current. Different gases, of course, give different colors."

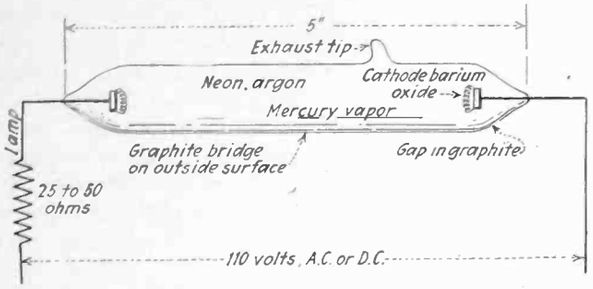
"What is wanted in the illuminant of the future," according to Dr. Spanner, "is a lamp which will have all the advantages of the mercury and neon lamps, which

THE FILAMENTLESS RADIO TUBE

SO many inquiries have reached the editor of *Electronics* as the result of the editorial on page 89 of our September issue, mentioning a new filamentless radio tube and a cold-cathode 110-volt gaseous lamp, that we have undertaken to get more complete details for readers.

The new illuminant is described on this page.

The new filamentless radio tube is the invention of Dr. August Hund, of the research laboratories of Wired Radio, Ampere, N. J., a subsidiary of the North American Company of 60 Broadway, New York City, which controls utility properties valued at $841,000,000. Clinton W. Hough is president of Wired Radio, H. D. Connick is vice-president, and R. D. Duncan, Jr., is chief engineer. These gentlemen have promised that a full description of the new tube will be available for the next issue of *Electronics*.



Section of new gaseous lamp, showing ballast and operating conditions. The high-resistance circuit painted on the outside of the glass, brings full operating voltage up to the gap near one cathode, facilitating ionization and quick starting

can be made to glow with any color, even if the desired color is an approximation of daylight, and which can be screwed directly into any socket."

Dr. Spanner points out that the incandescent filament lamp has already been developed as far as possible. It is limited by the temperature to which the tungsten filament can be electrically heated without causing the tungsten to evaporate and blacken the bulb. The future. he believes, belongs to a lamp which has no filament at all —one in which a gas is made to glow.

Barium oxide stimulates electron ejection

The Spanner-Germer-Doring lamp depends for its success largely on the use of barium oxide in the cathodes. When electrically excited, the oxide ejects quantities of electrons, and these, as they flash through the tube, tear off electrons from the atoms of the vapor or gas and convert them into ions. An ion glows when it reacquires lost electrons.

An alternating current, of course, swings back and forth. If the atoms of a mercury lamp are made to glow when the swing is one direction the light is extinguished when it swings back in the other. Hence undirectional current is needed for a mercury lamp, and hence, when alternating current is used, special devices must be installed to insure the maintenance of swings in one direction only.

The neon lamp, on the other hand, does not give a very intense light, and can be used only with alternating current. In New York, Chicago, and many other cities both direct and alternating current are supplied. What is wanted is a lamp which can be used anywhere with the standard voltages, without resorting to extraneous apparatus to change the character of the current or the voltage.

Can be made in lamp-socket forms

The Spanner-Germer-Doring lamp can be made not only in the usual long tube or in the intricate designs required to reproduce the effect of luminous handwriting, but also in the form of tubes curved back on themselves to produce a "bulb" which can be screwed into any household socket—something not possible before. Moreover mercury can be mixed with any desired element to produce light of almost any color. Thus a mixture of the vapors of mercury, zinc and sodium gives a light much like daylight. Cadmium gives a bluish light tinged with a little red. Such mixing of elements is not broadly new, but the flexibility is enormously increased with no marked loss in efficiency. The tubes shown in America have been of the dimensions illustrated in the diagram, but in Europe very much larger units, longer and of proportional cross section, employ currents of 3 to 5 amperes.

It takes a little time for a mercury or neon light to start. But these new lamps glow almost immediately after the current is switched on. This is facilitated by painting a conducting strip of graphite on the outside surface of the glass tube, ending in a gap near one of the cathodes. This imposes full operating voltage on the gap, stimulating ionization at the cathode, and insuring quick starting.

There is no liquid in the lamp, nothing that resembles the usual little pool of mercury. The tubes contain merely gas at very low pressures.

The new lamps are declared to be three to five times more efficient that the best filament-type incandescent electric lamps, which means that for the same amount of current three to five times as much light is obtained.

DEATH OF HARRY P. DAVIS

"Father of Radio Broadcasting"

Electronics Enthusiast

The whole field of radio and electronic development lost a far-visioned friend, in the death last month of Harry P. Davis, vice-president of the Westinghouse Electric & Manufacturing Company and chairman of the board of the National Broadcasting Company.

Starting as personal assistant to George Westinghouse, and later for years in charge of engineering and manufacturing for the Westinghouse company, Mr. Davis evinced a remarkable engineering grasp and openness of mind which always welcomed new ideas and radical new methods.

When Frank Conrad showed the possibilities of broadcasting, Vice-president Davis was quick to put executive approval back of its commercial development, and from then on he tirelessly pushed the expansion of the new art ever to higher powers and greater perfections.

He was no less enthusiastically interested in all electronic developments, and followed closely the penetration of electron-tube methods into all fields of power distribution and utilization. Around the Westinghouse plant, it was an axiom that any engineer with an idea or a problem would always find friendly encouragement from Mr. Davis.

Gracious, kindly, simple and unaffected, he was as delightful to meet, as his influence was wide in the affairs of electricity and radio.

The problem of pentode output fidelity

By LEONARD TULAUSKAS

Chief Engineer, Radio Division
United Air Cleaner Corporation

IT IS said that a prominent radio engineer on first observing the characteristic curves of the power pentode exclaimed, "Ah! 30 per cent distortion in a bottle." It is the purpose of this article to show that a pentode may be used in the output stage of an amplifier with very gratifying results not only as far as sensitivity and power output are concerned but also from the standpoint of fidelity. The first two qualities are inherent in the characteristics of the tube; the latter is achieved only through careful circuit design.

In Fig. 1 are shown the dynamic characteristics of the Arcturus PZ pentode. Note that the power output increases as the load resistance is increased from zero. While the efficiency of the system is greater with the higher load impedances, that point is of little consequence in the pentode where practically limitless power is available. If the plate load resistances were plotted for higher values in Fig. 1, it would be found that the total output would be a maximum at about 38,000 to 40,000 ohms which is in accordance with the performance of an electric alternator.

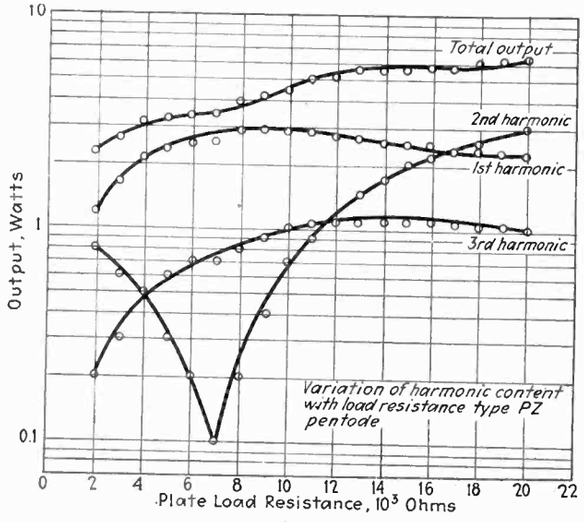


Fig. 1—Distortion characteristics of power pentode

Referring to Fig. 1 again, it will be seen that as the plate load resistance is gradually increased from zero, the second harmonic output decreases and reaches a very low value between 6,000 and 8,000 ohms. The third harmonic output varies quite differently and increases with the load resistance. If the load impedance is adjusted for least second harmonic distortion, then the third harmonic distortion is about 25 per cent and the second harmonic distortion only 4 per cent of the fundamental.

The pentode and dynamic speakers

It is customary practice to work the pentode into an electro-dynamic speaker through a suitable coupling transformer, usually of the step-down type. If the impedance of the moving coil is known, it is a simple matter to calculate the transformation ratio to secure the proper primary impedance into which the tube is to operate. Unfortunately, the speech coil changes in impedance several hundred per cent over the range of audio frequencies usually encountered in voice and music and consequently the correct load impedance is obtained only over a narrow band of frequencies. In Fig. 2, Curve *A* shows the increase in impedance with frequency of a Jensen type D-15 electro-dynamic speaker with an output transformer of 30:1 ratio. The peak at

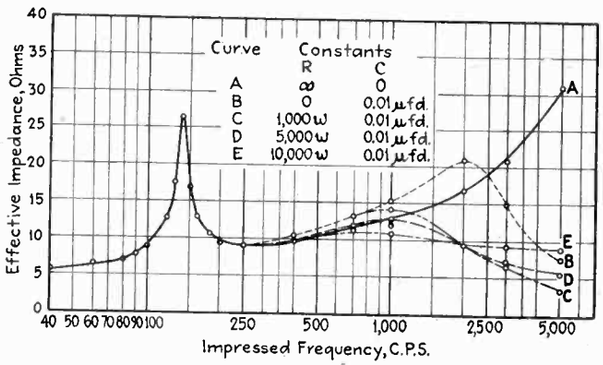


Fig. 2—Effect of compensating characteristic of pentode and dynamic speaker

140 cycles per second is caused by mechanical resonance of the speaker and can be shifted up or down by varying the weight of the cone, voice coil, or suspension.

To reduce the impedance at the higher frequencies, a capacity shunted across the primary of the output transformer naturally suggests itself. The impedance curve under such conditions with an 0.01 mfd. condenser is shown in Curve *B*, Fig. 2. While this is a great improvement, it is far from being satisfactory. It is a scheme which is used in practically all amplifiers employing a pentode and should be avoided unless the condenser is required as an r.f. by-pass to ground.

A device used by our European contemporaries to obtain a flatter impedance curve is that of shunting a resistor of two or three times the resistance of the voice coil across the latter. While this is a fairly satisfactory and inexpensive way of achieving the desired results, the losses in the resistor are considerable and as a consequence the acoustical output from the speaker is reduced very appreciably. The methods about to be suggested are much more effective, possess high efficiency, and can be adapted to any existing amplifier at small expense.

Referring back to the shunted capacity method, it is obvious that the change in reactance of the condenser alone is too great to produce the desired results. The next step is to devise a system whereby the change in shunt impedance is less pronounced as the frequency is changed. This can be accomplished by using a resistor in series with the condenser and then shunting the series combination across the primary of the output transformer. The effect of the resistor will be small at low

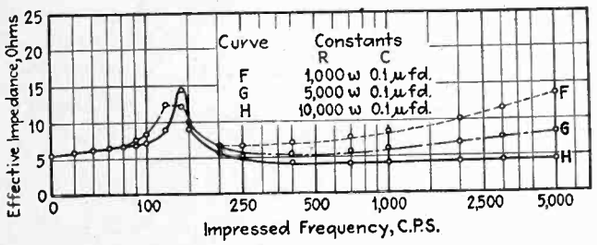


Fig. 3—Flattening of resonance peak of speaker and high frequency rise

frequencies and most pronounced at the frequencies at which the reactance of the condenser becomes negligible in comparison to the value of the resistor. In Fig. 2, Curve *C* indicates the impedance change with a shunt combination of an 0.01 mfd. condenser and a 1000-ohm series resistor. Retaining the same capacity and increasing the resistance to 5,000 ohms gave the characteristic shown in Curve *D* and when the resistance was increased to 10,000 ohms, Curve *E* resulted. Higher values of resistance were tried but obviously, their shunting effect is less and the curves approached that of *A* in configuration. Note that Curve *E* is reasonably flat and represents enormous improvement over Curve *B*.

As the reactance of the 0.01 mfd. condenser which was used is quite high at the resonant period of the speaker, the peak due to that mechanical resonance was not affected. The reactance of a 0.1 mfd. condenser at 140 cycles per second is 11,340 ohms which is sufficiently low to affect the low frequency resonance peak. In Fig. 3, Curve F shows the effect of the shunt combination of a 0.1 mfd. condenser and 1000 ohm series resistor. The small high frequency peak previously obtained in Curve E has completely vanished and the resonance peak itself greatly reduced. Curve G resulted from the same condenser and a 5000 ohm series resistor and Curve *H* indicates the effect of increasing the resistor to 10,000 ohms. On looking over this assortment of curves, G seems most satisfactory although H is somewhat flatter but its impedance in the middle of the audio spectrum is too low. That may be corrected by increasing the transformer ratio slightly which will displace the entire curve upward so that the greater part lies between 7000 and 8000 ohms. The proper transformer ratio with the Jensen type D-15 speaker was found to be 33:1. The impedance, with that transformer, decreased from 8000 ohms at 40 cycles to 7000 ohms at 5000 cycles.

There seems to be no simple method of removing the peak at the resonance frequency and, therefore, in selecting a speaker to be used with a pentode the resonant peak should be about 80 or 90 cycles per second where it is less likely to create discord. It is obvious that the resonant frequency should not be at 60 cycles per second or any multiple of it when the speaker is to be used with rectified 60 cycle power supply, as any small hum picked up by the pentode either magnetically or through the plate supply will be amplified enormously and cannot be removed without great difficulty.

It is common practice to use a tone control arrangement from anode to cathode of the pentode. As the usual tone control is not all the name implies but only a variable high-frequency attenuator, its only desirable function is to reduce the effect of high-pitched audio frequency disturbances and static which comes under the same classification. The tone control may consist of a 10,000 ohm variable resistor (preferably with an exponential taper) and a 0.1 mfd. condenser in series connected between plate and cathode of the pentode. With the tone control turned to maximum resistance, the circuit is compensated for the frequency characteristics of the speaker and is identical in performance to Curve H. However, when the tone control is turned towards the value of minimum resistance to attenuate the higher frequencies, the entire load impedance network is radically changed and the proper operating conditions for least harmonic distortion no longer obtain. From that standpoint, it is desirable that the tone control be placed in the detector plate circuit but from the angle of economy the first scheme is better.

There is another economical solution which has to do with hum reduction. If the pentode is operated directly out of a detector tube, the hum voltage in the anode circuit of the pentode is in the same phase as in the cathode circuit of the detector. If the detector cathode resistor is twenty thousand ohms or more, it may be tapped so that the a.c. impedance to ground from the tap will be 10,000 ohms. Consequently, if the 0.1 mfd. condenser is connected from the pentode anode to the tap on the cathode resistor, the same equalizing

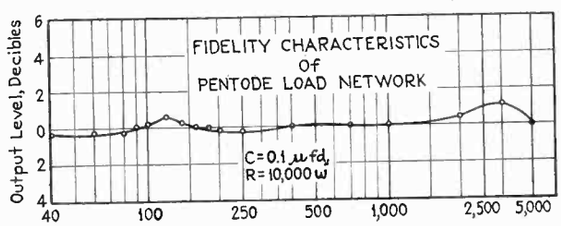


Fig. 4—Final result of applying correcting network to speaker-pentode combination

impedance network results with the addition that a small hum voltage is fed into the detector grid in opposite phase to that in the common anode supply and a reduction of hum naturally occurs.

Figure 4 indicates the fidelity characteristics of the constant impedance network. The maximum variation in output power is only one db. which represents highly satisfactory performance. Using such an amplifier, as well as one of the conventional type employing a type '45 tube in direct comparison, the acoustical output seemed precisely the same. In an adjoining room, it was impossible to state which amplifier was operating. The '45 tube was then operated with an average of 10 per cent second harmonic content whereupon the difference between the two amplifiers become well pronounced indicating that the 10 per cent second harmonic distortion was much more objectionable than 25 per cent third harmonic.

In conclusion, the writer wishes to acknowledge with thanks the assistance of Mr. George Lewis of the Arcturus Tube Company and Mr. Hugh Knowles of the Jensen Radio Company in supplying some of the data required for the experimental work.

Electronic oscillators for Industrial process control

By H. OLKEN

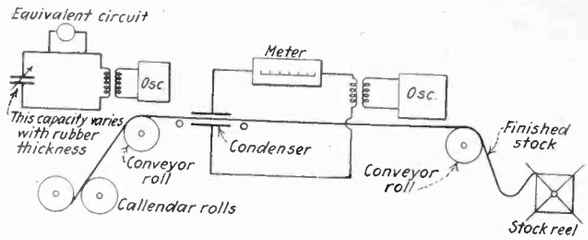
Consulting Control Engineer

THE electron tube has already found such universal application in every quarter of the industrial world, that it has become the "Aladdin's Lamp" of industry. Yet the remarkable possibilities of this device for improving some industries, transforming others, and creating new ones, have only begun to be realized.

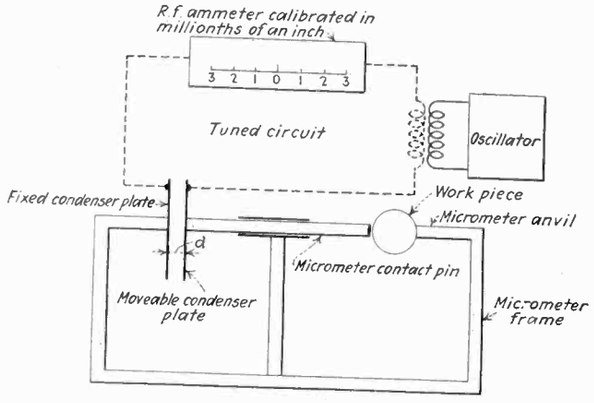
Prominent in this group of electricity-aiding electron-tube devices—and perhaps most promising for the future of industry generally—is the overlooked, neglected, oscillator. Though endowed with rich possibilities for aiding many industries, the oscillator is comparatively unknown outside of the field in which it was born—the communication industries.

In the first place, the oscillator makes possible industrial functions of control and measurement that were never possible before. It permits continuous measurement; measurement to extremely fine dimensions. And, strangest innovation of all, the oscillator makes it possible to *measure and control a product without contacting or disturbing that product.*

For example, when producing rubber in a continuous sheet, the sheet is passed between two plates of a condenser. Then as the thickness of the rubber sheet varies, so does the capacity of the condenser and consequently its impedance. The changing impedance changes the current in the tuned circuit to which the condenser is connected. A meter measuring this current thereby indicates directly the thickness of the rubber sheet.



Circuit used to measure thickness of rubber or other sheet



Circuit for the electronic micrometer

▼

OSCILLATOR methods of control permit continuous measurement, and measurement to extremely fine dimensions.

But strangest of all, the oscillator method makes it possible to measure and control a product without contacting or disturbing that product.

▼

No wearing parts, no lost motion

There is no moving contact element in this gage to wear out and introduce error. Nor does the gage touch the rubber when measuring it. Moreover, it does not disturb the normal schedule of operations in producing the sheet, for the condenser is placed along the path of the sheet wherever desirable, and the rubber is gaged when passing through the condenser, while going from one operation to the other.

All the simplicity and convenience of this condenser method of gaging are so much the more remarkable because the dimensions measured are so fine and the accuracy obtained so great. This machine easily measures, to 0.0001 of an inch, the thickness of a rubber sheet, whose entire thickness is about 0.0013 of an inch.

Now suppose a sheet of aluminum foil be inserted between the condenser plates. Then if the two plates of the condenser be connected electrically to form one side of a condenser, and the foil be connected to form the other side, changes of current in the tuned circuit will correspond to changes in thickness of the aluminum foil. One can thereby get a deflection of one-half an inch on the meter, for a change of $\frac{1}{0.0001}$ in. thickness of the aluminum foil, whose total thickness runs about $\frac{1}{0.001}$ in. So fine, so accurate a measurement, yet there is no injury, or even a possibility of injury, to the delicate aluminum foil.

Just a slight change of electrical connections, and the caliper for dielectrics like rubber becomes a caliper for conductors such as aluminum. Every material produced in sheet form is, therefore, an easy measuring job for the condenser caliper. And the electron tube oscillator,

though insignificant in the background, is the secret of it all.

Accuracy of $\frac{1}{0.0001}$ in. in a total dimension of $\frac{1}{0.001}$ in.—a device capable of so great accuracy in such fine dimensions obviously suggests itself as a good possibility for an ultra-micrometer. Naturally enough, the inventors who developed the rubber and aluminum calipers just mentioned, saw the possibility, and developed a condenser micrometer of extreme accuracy and sensitivity.

Here is how it works: Hold one plate of the caliper condenser fixed. The other plate, left movable, is attached to the back of a micrometer contact arm. Any movement of the micrometer contactor changes the spacing of the condenser's plates, hence changes its capacity and impedance. As the current in the circuit changes with the change of the condenser impedance, a meter measuring this current can be calibrated directly in terms of distance moved by the micrometer contact pin.

Suppose the work piece inserted in the micrometer is a standard gage of one inch diameter. Adjust the circuit to bring the meter to center scale, and the spacing of the condenser plates to give a one-inch meter deflection for every millionth inch change in plate spacing. Then remove the standard gage, and insert a gage to be compared with the standard. The meter will then read by how many millionths of an inch this gage deviates from exactly one inch. The beauty of this device is that it can be set for any standard spacing and the deviation of the measured piece from that standard measured easily to millionths of an inch. It thereby provides an ultra-micrometer of unlimited range and remarkable sensitivity.

The success of this device especially, and of the calipers also, is due in large part to certain accuracy-insuring features incorporated in these machines. One feature is an automatic adjustment to eliminate errors from voltage variation in the line feeding the oscillator. Another feature is the quick means of checking the device to keep the meter reference point fixed, called the "zero check."

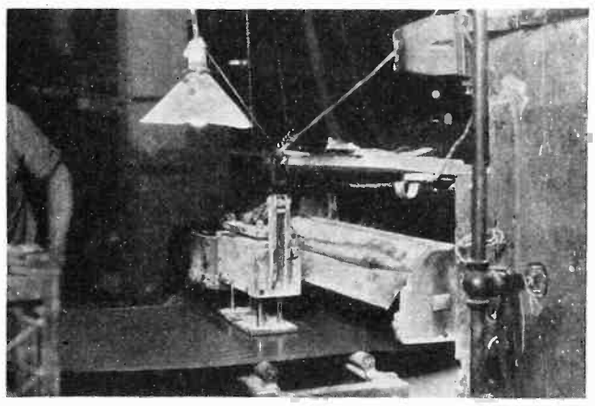
Limits of condenser method

It may be well to stop here and inquire, what are the limits to the possibilities of measurement by the condenser method? In the first place the higher the frequency used the greater the meter deflection obtainable for a millionth-inch change of plate spacing. By increasing the frequency ten-fold, we can increase the measuring sensitivity ten-fold.

Furthermore, for an air condenser of two similar plates, $C = \frac{KA}{4\pi d}$, where A = area of plates, and d = their distance apart. Then the graph for C becomes a hyperbola. The sensitivity with which it is measured is therefore very great for small values of d. In practice, small plates very close together, and a frequency at the top of the broadcast band, may be adequate for about a one-half-inch deflection per $\frac{1}{0.000001}$-in. change in d.

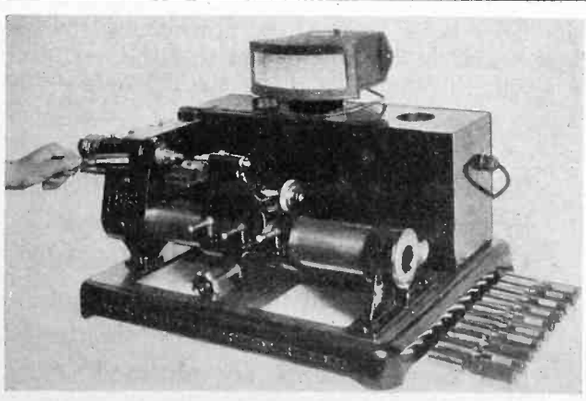
Even this ultra-micrometer is not the last word in the application of condenser measurement to industrial control, for by slightly modifying the ultra-micrometer it can be made to tell the manufacturer of newsprint what per cent of the paper is moisture. When a rayon ribbon

[*Continued on page 172*]



A continuous sheet of rubber has its thickness measured and controlled

Moisture-measuring device using an oscillator, in place in a paper mill



An ultra-micrometer capable of measuring to a millionth of an inch

Studio practice in noiseless recording

By GEORGE LEWIN

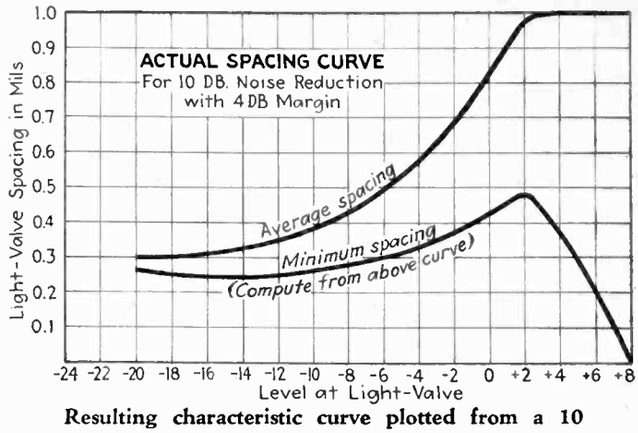
Recording Engineer
Paramount Publix Corporation

IN A preceding article on the theory of noiseless recording, *Electronics,* September, 1931, it was pointed out that the constant tone characteristics of the noise reduction circuit were not the same as the transient or dynamic characteristics encountered in actual recording.

Some modification must therefore be made in the set-up so that the actual spacing of the light-valve, at any level, is in general, somewhat greater than that called for by the ideal curve. There are two ways of accomplishing this. The conventional way is to apply what is known as "margin" to the adjustment. This amounts to simply setting the noise reduction amplifier gain control at 4 or 6 db. higher than the ideal adjustment setting.

The second way is to make several modifications in the electrical circuit, the result of which is to provide the characteristic which is shown for the 14 db. noise reduction curve. Here it will be noticed that the margin is obtained as a result of a change in shape of the characteristic, rather than by moving the curve over. The general effect, as shown by the curves, is not radically different in the two methods, but considerably better results have been obtained in practice by the second method. This is due to the fact that the modifications have resulted in improvement of the dynamic characteristics, as evidenced by the fact that the modified circuit has enabled us to use 14 db. noise reduction with greater reliability than the conventional circuit provides at 10 db. noise reduction.

THIS is the second and final article by the author on the theory and practice of noiseless recording. Special technique of adjusting the spacing of the light-valve ribbons to obtain the best overall results are outlined. A photoelectric cell photometer is used for checking purposes.



Resulting characteristic curve plotted from a 10 db. noise reduction circuit

Some explanation is in order as to the methods employed in obtaining the data for the characteristic curves just described. It will be noted that the curves show the average spacing of the valve while it is being modulated at various levels, and the question may well be asked how it is possible to measure the spacing of a valve while it is modulating and do it accurately enough to give the smooth curves which have been obtained.

Photoelectric cell photometer used

In order to keep several recording channels continuously operating reliably with 14 db. noise reduction, it is essential that facilities be available to check the characteristics quickly and accurately. This is accomplished with a photoelectric cell photometer of very simple design. A caesium type photoelectric cell is mounted in a special casing, equipped with a reflecting mirror so that when clamped onto a recording machine, it intercepts the light coming through the light-valve just before it strikes the film. A battery supply and micro-ammeter complete the equipment. A good photoelectric cell is remarkably linear with respect to illumination, so that if the light valve is properly spaced initially and is free from dirt and irregularities, the micro-ammeter will give a very accurate indication of the average spacing regardless of whether the valve is being modulated or not. For convenience, the polarizing voltage is adjusted so that with normal exciting lamp current and a one mil valve, the meter reads exactly one micro-ampere. The photometer can then be used as an accurate exposure meter, as well as for reading the valve spacing directly in mils.

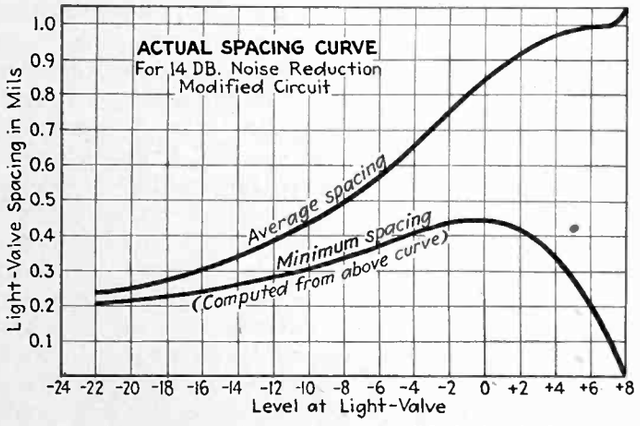
In setting up the noise reduction equipment, the first thing to determine is the overload level of the light-valve. This is accomplished with the aid of the photometer. With the noise reduction amplifier and the biasing current turned off, the valve is modulated with tone from an oscillator through the recording channel. At any level below the overload point, the average light coming through the valve is constant, since the increases and decreases during each cycle balance each other. The moment the ribbons start to clash, however, the increases become greater than the decreases and this is evidenced by a sudden increase in the micro-ammeter reading.

Having determined the overload point, the tone is shut off, and the static biasing current applied to the valve. This current is adjusted until the valve is biased down to 0.3 or 0.2 mils depending on the amount of noise

reduction desired. The tone is then applied once more at the overload level—this time with the noise reduction amplifier turned on at full gain. The result of this is to neutralize the biasing current completely and bring the valve spacing back to one mil. The gain of the noise reduction amplifier is then reduced until the valve just starts to close down again. This gives the setting where the valve is being held open just wide enough to handle the input level. In the conventional setup the margin is then applied by increasing the gain of the noise reduction amplifier by 4 or 6 db. In the modified setup mentioned above this is not necessary, although in either case, to be conservative, it is safer to balance the circuit at about 2 db. below the overload point.

After these adjustments are all made, the characteristic can be plotted by dropping the level in steps, and reading the valve spacing at each step. While doing this, it is usually customary to read the biasing current on the milliammeter also. This gives the relation between biasing current and valve spacing, and is a good check on the light valve itself.

Having balanced the circuit, the only variable in the daily operation is the static biasing current. This must be watched very closely as it is subject to considerable variation. Its value depends principally on the turning



Resulting curve when using a modified circuit for 14 db. noise reduction obtaining greater reliability

point of the light-valve, and this is to a large degree a function of the temperature. When the valve is first put on the machine in the morning, it is usually found that the biasing current must be kept rather high in order to bias down to the desired spacing.

After the valve has been warmed by the magnetizing winding, the ribbons loosen up somewhat and the tuning point not only drops, but the spacing decreases slightly. This calls for a reduction in biasing current, otherwise the valve will be biased down too far. The most satisfactory procedure is to tune the valve the first thing in the morning to about 9,100 cycles and to space it to about 1.1 mils. It should then be placed on the machine, with the magnetizing winding turned on. If some modulation is then put through for several minutes, with the biasing current and exciting lamp turned on, the valve will settle down more or less to its normal tuning and spacing. The proper lamp and biasing current can then be determined with the aid of the photometer. If this procedure is followed the valve will reman fairly constant throughout the day, although the photometer should be used for a check after every few takes.

In processing the film for a noiseless recording, the procedure is not radically different from that used for standard recording, except that it is more important to keep the overall gamma down as close to unity as possible, and there is considerably less leeway than formerly in the permissible transmission of the negative and print. The reasons for this are quite apparent. In standard recording, regardless of the level recorded, the average transmissions of the negative and print remain constant. In noiseless recording, the average transmissions keep sliding up and down the *H & D* curves of negative and print with every impulse. If the original volume variations are to be preserved then, it is essential that the variations and print transmissions be identical with the variations in negative exposure.

Consider for example the case of dialogue between two people, where one voice is, let us say, just 6 db. louder than the other. The average exposure on the negative due to the louder voice would then be greater than that due to the weaker voice by a certain amount, which could be determined from the spacing curves shown. If in the reproduction we expect to hear this same difference in level between the two voices, the corresponding transmissions of the print would have to bear the same ratio to each other as the ratio of the two exposures, and this would obtain only if the overall gamma were unity. If the overa gamma were greater than unity, the difference between the two voices would be exaggerated, and one would sound 8 or 10 db. louder than the other instead of the original 6 db. This same effect can be noticed in the voice of a single person as well, where for instance the end of a sentence might be allowed to trail off in volume for a dramatic effect. In reproducing such a sentence we might find that the volume trails off so badly that the lower level words are scarcely heard at all.

Method of recording measurements

Regarding the allowable transmissions of negative and print, it is apparent that we have less leeway in noiseless recording because we are continually using the full range of the emulsion, whereas in standard recording it is only on the peaks of modulation that we slide to either extreme of the emulsion range.

In noiseless recording all measurements of transmission and density must be made in terms of the unmodulated biased and unbiased tracks, since during modulation the exposure is changing continuously and it would therefore be impossible to make any measurements. For this reason it is customary to make an unbiased exposure at the end of each take, by opening the light valve circuit before the motors are shut down. This exposure can then be measured with a densitometer after the film is developed, and from this it can be determined the required printer point to give the correct print transmission.

The advantages to be derived from the use of noiseless recording are many, although they should be utilized with discretion. The most obvious advantage, and the one which is exploited most in discussing noiseless recording, is the ability to record sounds at a much lower level without sinking into the surface noise. The allowable volume range in variable density recording is determined at one extreme by the overload point of the film, and at the opposite extreme by the surface noise of the unmodulated track. In standard unbiased recording, we record at as high a level as possible without actually clashing the light-valve. Under these conditions the surface noise is generally about 35 db. down, so that we can allow our weakest modulations to drop this far below our average level before they begin to be drowned by the surface noise. With noiseless recording, if we

[*Continued on page 172*]

Grid-current measurement

By LEE SUTHERLIN

Research Laboratories
Westinghouse Electric & Manufacturing Company

DURING the past year or so several papers have been written concerning amplification of very small currents and voltages. The amplifier tubes which are used for these purposes must have very small grid currents. Various investigators have used selected standard tubes at special operating conditions. Some have used tubes constructed for low grid currents.

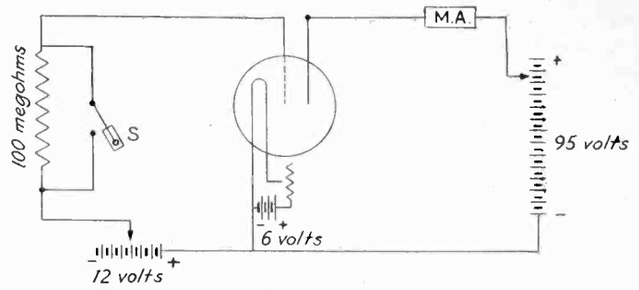
Nottingham has given a thorough discussion on the various components making up the grid currents in tubes and has shown methods of measuring small d.c. potentials. Nelson developed a special tube for electrometer work with which he could measure currents accurately to 10^{-14} amperes. Metcalf and Thompson developed a special tube which they have used to measure currents accurately as small as 10^{-17} amperes. Not only the tube, but the auxiliary equipment has a direct bearing upon the lower limit of current to be measured accurately.

These special tubes have made a definite contribution to small current and voltage measurements. They are of particular interest in connection with laboratory and research work. In getting the low grid current tubes which are necessary to detect or measure currents of the order of 10^{-14} amperes and less it has been the practice to use electrode voltages well below 10 volts so as to minimize ionization effects to the extreme.

Importance of high insulation

In the practical use of a tube with exceedingly low grid current (or extremely high input resistance) it is necessary to have the same high degree of insulation in certain portions of the associated circuit if full advantage is to be obtained. From a theoretical standpoint all that is necessary is to have a tube which has the ability to give very high current amplification irrespective of its anode current, voltage amplification or mutual conductance. Under certain favorable conditions this is also a practical condition.

Because of certain commercial applications the development of tubes having extremely small grid currents as compared to radio tubes has been carried on in this laboratory during the past three years. These tubes were designed to operate at such conditions as to give grid currents of the order of 10^{-8} amperes and less depending upon the exact conditions of operation. The tubes have been so designed and the operating points so selected as to produce tubes with plate currents, voltage amplification, and mutual conductance of the order of a good radio tube rather than to produce tubes with grid currents as small as some of the special tubes mentioned above which have very low voltage amplification, plate current and mutual conductance. For example, this makes practical the use of a phototube and single amplifier tube as a combination which may be used to operate a rugged meter or relay directly. Also it is not difficult to design the associated circuits with sufficiently high insulation so as to make use of such tubes to their fullest extent even over periods of months or years without attention.



Circuit diagram for measuring grid currents of low order

Indirect measurement of grid current

In this tube investigation it has been found practical to use a very simple test for what indirectly amounts to grid current. Above is shown a test circuit and the constants used in testing one type of tube which has been developed. In the general development work other voltages and other values of grid resistors have been used. This is an indirect and very sensitive method for determining the grid current. A given grid current through the resistor causes a voltage drop across the resistor and the grid is made less negative to the extent of the voltage drop; this in turn increases the plate current of the tube. From the grid voltage plate current curve of the tube a given change in plate current can be interpreted in terms of a given grid voltage change. When the value of the high resistance is known, the current in the grid circuit may be determined if desired.

One method of operation of the circuit shown above is to adjust all voltages, then read plate currents with S open and S closed. A maximum allowable change in plate current between S open and S closed will determine the test limit.

Another method is to readjust grid bias until the plate current is the same with S open as it was at another grid bias with S closed. A maximum change in grid bias may be used as the test limit.

This circuit is very practical and simple to use, particularly since it is easy to obtain small resistors of the order of several hundred or even a few thousand megohms. By using very high grid resistors the sensitivity of measurement may be carried to a high degree.

With one type of commercial tube in which a maximum grid current of 0.008 microampere was tolerated, measurements have been made in the laboratory using up to 400 megohms in the grid circuit.

REFERENCES:
(1) "Measurement of Small D. C. Potentials and Currents in High Resistance Circuits by Using Vacuum Tubes," by W. B. Nottingham—*Journal of Franklin Institute*, March, 1930, pp. 287-348.
(2) "A Vacuum Tube Electrometer," by H. Nelson—*The Review of Scientific Instruments*, May, 1930, pp. 281-284.
(3) "A Low Grid Current Vacuum Tube," by Metcalf and Thompson. *Physical Review*, Nov 1, 1930, pp. 1489-1494.
(4) "Amplification of Small Direct Currents," by Lee A. DuBridge. *Physical Review*, Feb. 15, 1931, pp. 392-400.

NOTE: Essentially this method has been suggested to and accepted by the I.R.E. Committee on Standardization.

Tube suits settled

Deforest, Arcturus and others accept RCA payments, take licenses

ANNOUNCEMENT of the settlement of a number of receiving-tube infringement and damage suits, and acceptance of RCA tube licenses by a group of manufacturers, the principal active ones being the Deforest and Arcturus Companies, came with the payment September 22, of $1,000,000 to the Deforest Company, and smaller amounts to some of the other concerns, by the Radio Corporation of America.

Under the new plan a 5 per cent license fee will be paid, although it is understood this may be later reduced to 2½ per cent. The licensees are not limited to any quota amounts, but may manufacture any output they desire, although eventually such quotas may be introduced to guard against overproduction. The agreement entered into covers only radio receiving tubes, and it does not authorize sales for export purposes.

See stabilizing effect

This cross-license settlement completes the licensing of all tube manufacturers, and is declared by those entering into it, to be a move for stabilizing the business, and a step of advantage to both the individual manufacturers and the industry generally.

Following is the complete list of companies entering into the settlement in addition to RCA, Deforest and Arcturus: A number of those on the list, as will be noted, are now out of business. It is not considered likely that such defunct concerns will return to active manufacturing.

Mellotron Tube Company, Vesta Battery Company, the Van Horne Company, Schickerling Products Corporation, Gold Seal Electric Company, Universal Electric Lamp Company, Republic Radio Tube Company, Mutual Electric Lamp Company, Continental Corporation, Sunlight Lamp Company, Marvin Radio Tube Corporation, Radex Corporation, Globe Electric Company, Duratron Radio Tube Corporation, Gold Seal Manufacturing Corporation, Supertron Manufacturing Company, Cleartron Vacuum Tube Company, Diamond Radio Tube Company and the Poughkeepsie Gold Seal Company.

The settlement follows the recent court decision against RCA in the Clause 9 case, as a result of which some $47,000,000, of damage suits were filed against the Corporation. On the other hand, a large number of infringement suits had been entered by RCA against the independent manufacturers. All of these suits are now cleared by the new agreement, and the receiving tube patents held by the Deforest Company are made available to the licensees.

Predict withdrawal of Government's dissolution suit

Meanwhile it is intimated from Washington that the Government's suit against the Radio Corporation may be withdrawn and the case settled out of court by the setting up of a patent pool, either "open" or limited to present operating concerns. It is known that the Administration does not desire to go into an election year with a case of this kind on hand, and every effort will undoubtedly be made to effect a settlement.

As an alternative to suit, the government is proposing a voluntary arrangement among the defendants that will accomplish the following three objectives:

1. An open patent pool to control all patents in the radio industry, making them available to all who would use them on equal terms.
2. Revision of the patent agreements now existing among the several companies so as to eliminate their exclusive provisions. In other words, the government is asking that the arrangements whereby one company of the "trust" group agrees to throw its patents into the present RCA pool upon agreement that the other companies remain out of its field of enterprise, shall be abandoned.
3. Abandonment by Radio Corporation of America of its exclusive traffic agreements in the field of radiotelegraphy. This proposal is aimed primarily at the arrangements the RCA now has with many foreign radio monopolies for an exclusive interchange of traffic.

Largely dependent upon the outcome of the Government's case, was the $30,000,000 triple-damage suit filed by the Grigsby-Grunow Company, makers of Majestic sets, but if the Department of Justice suit is dropped, it is believed this Grigsby-Grunow suit will be pressed independently to a court decision. The plaintiffs feel that the strength of their claims have been considerably reinforced by the recent events ending in the payment of large sums as damages by the Radio Corporation.

Efforts of the Department of Justice attorneys and of counsel for Grigsby-Grunow to dissolve the Radio Corporation group and to return the scope of operations to the individual component manufacturing companies, would have an important effect on the industrial tube situation, as well as radio tubes, it is declared.

As *Electronics* goes to press, conferences are being held by Judge Olney, of the Department of Justice at Washington, and upon the outcome of these meetings depends the future course of the Government's litigation, and the eventual setting up of a patent pool.

▼

DEFOREST COMPANY RECEIVED $1,000,000 CASH

TERMS of the RCA-Deforest settlement, as announced by C. G. Munn, president of the Deforest Radio Company, included payment to the Deforest Company by the Radio Corporation of $1,000,000 in cash.

The other companies listed received smaller amounts, not stated.

▲

Simplified attenuation network design

By L. B. Hallman, Jr.

Every telephone or radio engineer is, at times, faced with the problem of designing a "pad" or attenuation network, to be placed between given input and output impedances and produce a particular loss—measured in db. The formulas that must be applied in such a design, though simple, are often tedious to work and require some care in order that accurate results be obtained. A method is given which dispenses with the necessity for substituting in formulas and at the same time allows speedy and accurate results. Alignment charts that accomplish this purpose will be described and should be of assistance in designing attenuation networks. The accuracy obtainable is comparable with that of slide-rule calculations and is sufficient for all practical purposes.

To derive the chart equations, let us consider the formulas in the form usually given for an "H" type pad. (Fig. 2)[1]. They are:

$$R_1 = Z_1/2\tanh(\text{db.}/8.686) - \sqrt{Z_1Z_2}/\sinh(\text{db.}/8.686)$$

$$R_3 = Z_2/2\tanh(\text{db.}/8.686) - \sqrt{Z_1Z_2}/\sinh(\text{db.}/8.686)$$

$$R_2 = \sqrt{Z_1Z_2}/\sinh(\text{db.}/8.686)$$

or

$$R_1 + 1/2(R_2) = Z_1/2\tanh(\text{db.}/8.686)$$

$$R_3 + 1/2(R_2) = Z_2/2\tanh(\text{db.}/8.686)$$

It will be recognized that both equations are now of the type, $x + y = z/w$, for the solution of which, a simple "N" type alignment chart may be constructed. It is also obvious that both equations may be combined into the same chart by making the "R_2" and "db." scales common. If these equations were independent the complete solution of the network would be given on this chart. Such is not the case, however, as they are connected by the relation

$$R_2 = \sqrt{Z_1Z_2}/\sinh(\text{db.}/8.686).$$

It is therefore necessary to have a separate chart for determining R_2 before the N chart can be used.

The most satisfactory chart for R_2 is obtained by placing the equation for R_2 in the form:

$$1/2(\log Z_1Z_2) - \log\sinh(\text{db.}/8.686) = \log R_2$$

This form will obviously give a three-parallel-scale chart with the scales graduated logarithmically. Two charts that have been constructed as outlined above, and with scale ranges sufficient for most purposes are shown in Figs. 1 and 2.

It is believed that the two charts may be most successfully used by placing them side by side on a drawing board and using a "T" square, or similar straight-edge, and triangle for drawing the parallel lines on the chart in Fig. 2.

Assuming that this has been done, if we are to design a pad to be placed between two 600ω impedances and to produce a loss of 10 db. Then:

$$Z_1 \times Z_2 = 360{,}000$$
$$\text{db.} = 10$$

By laying a straight-edge across the parallel scale chart in Fig. 1, between 10 on the db. scale and 360,000 on the $Z_1 \times Z_2$ scale we find that the value for R_2 is 422ω. (Solid line in Fig. 1.)

Now, turning to the chart in Fig. 2, we have given:

$$Z_1 = 600\omega$$
$$Z_2 = 600\omega$$
$$R_2 = 422\omega$$

From these values R_1 and R_3 (see notation on pad in Fig. 2) may be quickly found. First, draw a straight line between the value of Z_1, on the Z_1 scale, and the loss in db. on the db. scale. Following the solid lines on the chart in Fig. 2, this line is shown drawn between 600 on the Z_1, Z_2 scale and 10 on the diagonal db. scale. Now, draw a line, parallel to this first line, from the value previously found for R_2, on the R_2 scale. This line will cross the R_1, R_3 scale at a value corresponding to the ohmic value of R_1 to be used in the pad. Referring to the second solid line, drawn from 422 on the R_2 scale and parallel to the first solid line, we see that the value for R_1 is 155ω.

But, $Z_1 = Z_2$, and therefore $R_1 = R_3$. The pad we set out to design is thus completely specified. It is evident that this method is much quicker and simpler than one requiring numerical computations. Too, it is just as satisfactory from a practical standpoint. When constructing the pad designed above it will probably be found advantageous to make $R_2 = 425\omega$ and $R_1 = R_3 = 150\omega$, instead of the exact values of 422 and 155ω. The chances are that the drop produced by the network will be just as near to 10 db. as if we had obtained resistances of supposedly exact values. This is, of course, due to errors nearly always made in obtaining the values of Z_1 and Z_2, and to errors caused by changing values of the resistances used, which may have been erroneously calibrated initially. We thus conclude that it is not necessary to interpolate the scales within narrow limits.

The values of R_1, R_2 and R_3 to make up a pad that will give a 20 db. drop when working between $Z_1 = 50\omega$ and $Z_2 = 500\omega$, are found by following the dotted lines shown on the two charts. The method of solving the network is similar to that described for the 10 db.

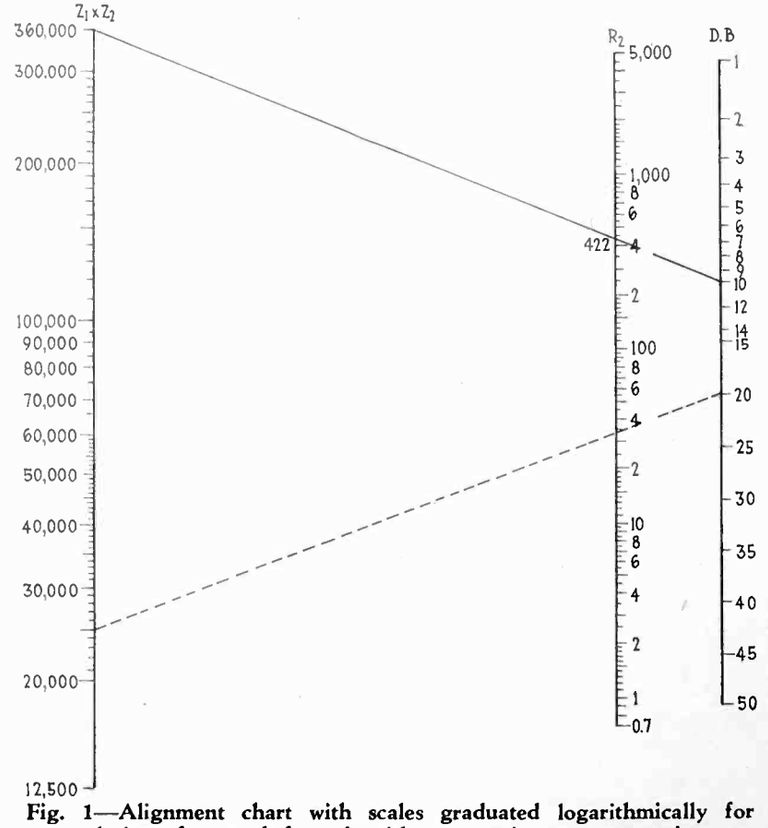


Fig. 1—Alignment chart with scales graduated logarithmically for solution of network formula without resorting to computation

[1]The same formulas may be used in designing a "T" type pad. In this case the R_1 in one branch of the "H" pad is zero and the resistance in the other branch is $2R_1$. Similar considerations apply to the branch containing R_3. R_2 remains the same.

IN THE LABORATORY + + +

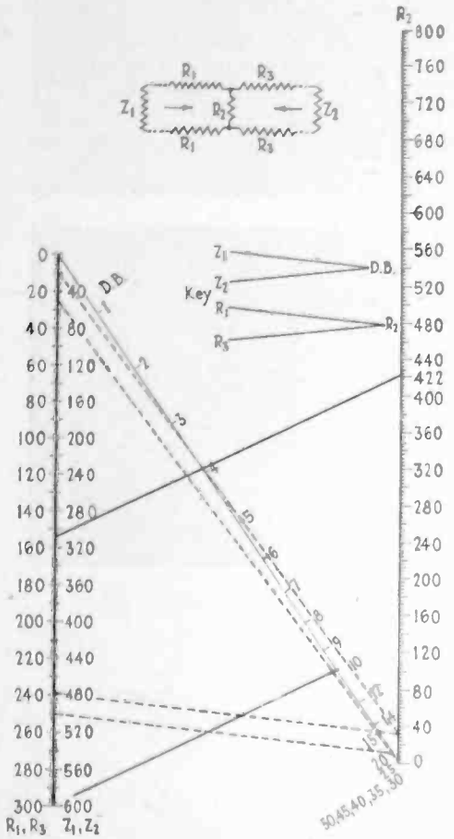


Fig. 2—Chart for solving network pad values and used in connection with chart in Fig. 1

pad and is easily followed by referring to the key given for the chart in Fig. 2. By following these lines we see that for the 20 db. pad specified above:

$R_3 = 32\omega$; $R_1 = 9.5\omega$; and $R_2 = 239\omega$

The most serious limitation of the charts is the range of the scales. While the scales shown will suit most practical problems, it is quite possible for extreme cases to arise where the charts will be inconvenient to use. The ranges of the scales can be increased by simply increasing their length. Unless such problems arise frequently, however, it will probably be more convenient to use the formulas. For instance, the R_2 scale may be easily extended to read values around 1000ω. Beyond this range the chart becomes difficult to operate.

Thus it is seen that the charts included with this description are a very convenient and efficient tool that may be used in most problems which concern the design of resistance networks or pads. In problems that necessitate extreme values for the various resistances, more suitable charts may be constructed or the formulas resorted to. Which course is the more efficient will depend entirely on the frequency with which such problems are encountered.

Binary logarithm tables

BINARY LOGARITHMS are logarithms calculated to the base 2, and their peculiar value lies in the difference in the exact measure of frequency intervals in terms of octaves and decimal divisions of the octave. This does not follow alone from the fact that the interval of the octave, which represents a doubling of the rate of vibration, has been established by usage in the comparison of frequencies of sound and electro-magnetic vibrations, although this has a great deal to do with it. It rather has a profounder philosophical justification in the fact that the number (1) being the unit of notation in general, (2) is the smallest integer which can be used as a base representing the logarithmic unit separating frequencies by the number (1).

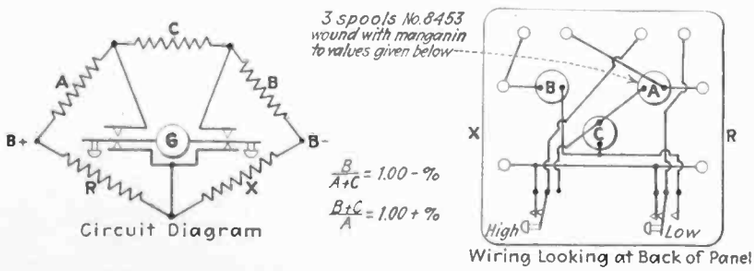
These tables brought out by G. H. Pohland give the binary logarithms to ten decimal places for all of the integers up to 1024, which is the 10th power of 2, and also an auxiliary table of binary antilogarithms so that it is possible to extrapolate values to five places for all integers up to 144,270, which is the largest number for which five-place binary logarithms are sufficient because of a peculiar relation to the modulus. The binary antilogarithms thus are especially convenient for large primes or for composites not easily factored. However, a person with some mathematical knowledge can derive 8-place values for numbers far beyond 100,000,000.

A mimeographed pamphlet of 24 pages containing three tables may be obtained from G. H. Pohland, P. O. Box 748, Chicago, Ill.

Limit bridge

THROUGH THE COURTESY of the Jewell Electrical Instrument Co., the accompanying diagram of a limit bridge designed by this company is given. In this circuit the switch is arranged so that the galvanometer swings to one side if the unit being measured is satisfactory, or to the other side if unsatisfactory. A galvanometer which has been used for this purpose is marked with a black "OK" on one side, and a red "NG" on the other.

Standard values in ohms for different per cent limits are also given. The upper values cover specific ranges which have been used in building special bridges, while the lower seven ranges are on a percentage basis, where A plus B plus C is equal to 1,000 ohms. It is suggested, in designing such a bridge, to keep the values of A and B somewhere within the range of the resistance being tested. This will give maximum sensitivity and frequency. Where a range of resistances are to be measured, then the bridge arms should approximate the geometric mean of the resistances under test.



STANDARD VALUES, OHMS				
%	A	B	C	A+B+C
10	3,800	3,780	400	7,980
10	760	756	80	1,596
10	190	189	20	399
5	3,900	3,895	200	7,995
5	780	779	40	1,599
20	450	440	100	990
20	4,500	4,400	1,000	9,900
3	19,700	19,691	600	39,991
3	6,556⅔	6,563⅓	200	13,330⅓
20	454.5455	444.4444	101.0101	1,000
15	465.1163	459.4595	75.4242	1,000
10	476.1905	473.6842	50.1253	1,000
5	487.8049	487.1795	25.0156	1,000
3	492.6108	492.3858	15.0034	1,000
2	495.0495	494.9495	10.0009	1,000
1	497.5124	497.4875	5.0001	1,000

Limit bridge designed by Jewell Electrical Instrument Company with circuit diagram and table of standard values in ohms for different per cent limits

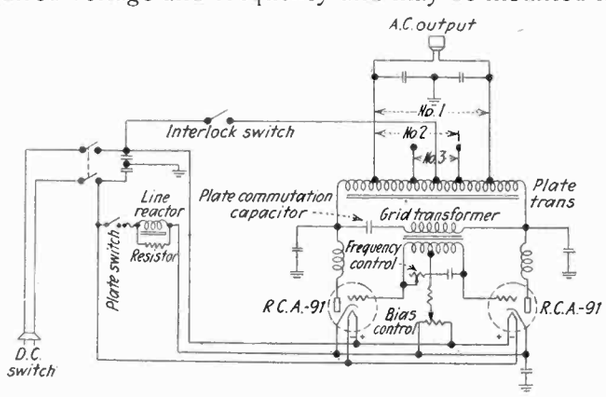
D. C. inverter for radio receivers

By W. R. G. BAKER and J. I. CORNELL

RCA Victor Company, Camden, N. J.

THE direct current inverter is a device for changing direct current into alternating current at any desired audio frequency, developed as a satisfactory power supply device for broadcast receivers operated in direct current districts. Existing broadcast receiver equipment, designed for operation on direct current, has been handicapped by the limitations imposed by direct current service on receiver design. Alternating current receivers have been supplied from the direct current mains by means of various kinds of rotating machines, such as motor generators, dynamotors, and rotary converters, with some degree of success, but the installation costs and maintenance have been such as to make such installations quite unsatisfactory. In addition, rotating machines limit the performance of the receiver because of radio frequency disturbances, generated through faulty commutation, audio hum arising from slot ripple and noise from moving parts.

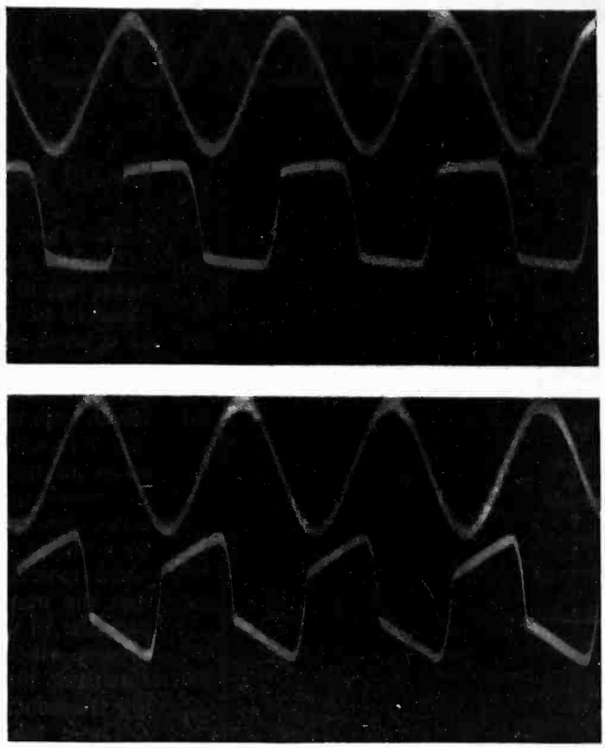
The direct current inverter is a device which has overcome the objections to existing equipment. It supplies alternating current from the direct current mains at the required voltage and frequency and may be mounted in a



Circuit diagram of d.c. inverter using Thyratron tubes

cabinet with the receiver, serving its purpose so satisfactorily that the performance of the receiver is equivalent to operation on alternating current delivered from a power source as found on modern public utility systems.

The development of the inverter has been made possible through the use of one of our most recent electronic devices, the Thyratron. The description of this tube, and some of its general applications, has appeared in previous issues of *Electronics* and will not be covered in this paper.



Output wave form for two characteristic loads

Above—Receiver load—100 watts—90 per cent power factor

Below—Phonograph load—140 watts—41 per cent power factor

The Thyratron tube used in the inverter is of special design, to meet the particular requirements for direct current mains operations. These tubes, (RCA 91) are hot cathode, mercury vapor, grid actuated tubes, which incorporate in their design a plate, a grid and a high efficiency electron emitting cathode, with an enclosed, insulated heater operating directly from a 110-d.c. circuit. A suitable 110-volt heater, with insulated cathode, is an important development and is a feature which makes the inverter a commercial possibility. Due to the high efficiency of the heater circuit and the relatively low power consumption for 110-volts operation, approximately seven minutes are required to heat the cathode to operating temperature. The high efficiency more than compensates for the starting period, since the heaters can be connected across the line continually, thus affording immediate starting by applying voltage to the plate circuit. The life of the tube is not materially affected by this type of service and the power consumption is approximately 20 watts per tube. The inverter utilizes two tubes and is designed to have a unity inversion ratio and will operate on direct current line voltages of 105 to 125 volts, supplying alternating current voltages corresponding to the d.c. supply voltages.

For safe operation the cathode must be hot enough to supply a sufficient quantity of electrons to at least equal the starting current required by whatever type load is being used. Since the cathode is the indirectly heated type, it requires approximately seven minutes to reach the temperature at which the active material will emit suffiient electrons.

If the cathode or plate potential is applied and at the same time sufficient grid potential or current is applied to ionize the mercury vapor to the extent that a sheath is formed around the grid, the glow discharge will occur

as soon as the cathode reaches a temperature at which it will emit. Fortunately, there is one other variable which enables it to act like a thermal delay relay. This variable is the mercury vapor pressure, which is controlled by the coolest part of the tube. In general, other things being constant or in a state of equilibrium, the higher the mercury vapor pressure or the temperature of the tube, the less grid current is required to form the glow discharge. This characteristic is used to start the inverter automatically. In order to accomplish this automatic starting, a predetermined definite amount of grid current is supplied to the grid of the tubes as soon as the line and operating switches have been closed, and as the cathode reaches emitting temperature a slight blue glow appears between the grid and cathode, but the anode current does not start until the mercury has been heated by the cathode to the point where the limited amount of grid current will allow the glow discharge between anode and cathode to form.

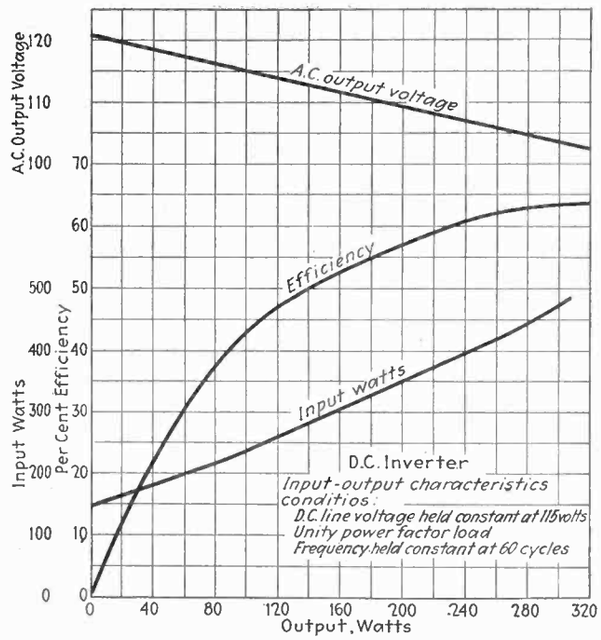
The electrical circuit

The inverter consists of a plate transformer, grid transformer, line reactor, plate excitation capacitor, radio frequency filter system, frequency and grid control circuits, load regulating resistor, line fuse, safety interlock switch, line and plate switch and a.c. outlet receptacle, in addition to the two Thyratrons.

The radio frequency filter inductors are designed to form a contact over the plate caps, in order to effectively eliminate radio frequency voltages generated by the tubes. A metal plate is mounted in a horizontal position above the base and functions as an air shield, diverting cool air currents entering the louvers in the sides of the case, toward the base of the tube, covering the tubes at the point where the mercury vapor condensation takes place, and making the operation of the tubes more stable by maintaining uniform vapor pressure.

Theory of operation

The Thyratron inverter is connected very similarly to a tuned plate, tuned grid, push-pull oscillator, (as shown by the schematic diagram above). The operation of the device depends on the alternating function of two Thyratron tubes through controlling variation of their grid circuit. The grid excitation system is one of the most important parts of the inverter circuit. It not only

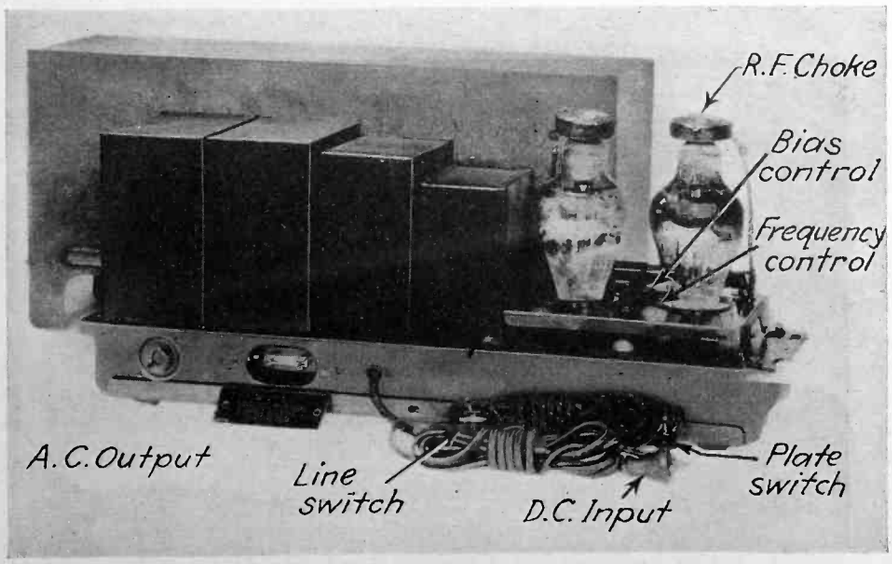


Electrical characteristics of the Thyraton inverter

determines the constancy of frequency, but to a large extent determines the stability of operation. A grid excitation system is more stable so far as starting the inverter is concerned than separate excitation, due to the tendency of the plate circuit to change frequency with load and power factor. If the grid system is too closely coupled, the plate shifts so far out of phase, with respect to the grid excitation, that the inverter fails. On the other hand, if the grid system is too tightly coupled the frequency of the output will shift a great deal with very slight changes in load, power factor and line supply voltages. It is, therefore, necessary that the grid system be a compromise between these two conditions for economical and stable operation. Another function of the grid system is to supply the proper bias for starting. The starting conditions vary with tubes, line voltage and ambient temperature, and the bias adjustment of the grid circuit provides the necessary variation of grid potential and maintains circuit stability under adverse operating conditions.

With the plate switch open, both grids are maintained at the same positive potential, obtained through either half of the grid transformer secondary winding from the variable resistance voltage divider system across the d.c. line. Upon closing the plate switch, full line voltage is impressed upon each tube, but because of the inherent variations in starting characteristics, there will be a slight time lag between the normal starting points of plate current flow through the tubes. The current passes through the tubes as a glow discharge, causing a voltage drop of approximately 12-15 volts which remains practically constant regardless of the current.

A glow discharge occurs in the first tube resulting in the consequent voltage reduction in one side of the plate transformer. The other end of the winding assumes



Layout of apparatus showing position of r.f. chokes on top of tubes

double line potential and the plate commutation capacitor charges to full plate potential (approximately twice line potential) through the primary of the grid transformer. The changing current induces an alternating voltage in the tuned secondary circuit of the grid transformer, causing grid potentials of both valves to traverse an oscillating cycle, the frequency of which is determined by the circuit constants. At some critical value, the grid current of the inactive tube will start plate current flowing through the plate commutation capacitor to drive the plate voltage of the first tube sufficiently negative to disrupt conduction through that path.

Electrical performance

Current now flows through the capacitor from the opposite direction, causing the plate of the first tube to assume double line potential. By virtue of reversing the direction of the current, the first grid is now brought to a critical positive value at the completion of the oscillating cycle and the entire cycle is again repeated.

Two switches are supplied with the inverter; one is the line switch, a double pole single throw switch, used to interrupt the d.c. supply circuit; the second, a single pole single throw switch, is used to interrupt the Thyratron plate voltage. When the Thyratron heaters are continually connected across the line the plate switch is replacing the "on" and "off" switch of the receiver.

The radio frequency currents generated during the operating of the Thyratrons are filtered from the a.c. output by means of series inductors and by-pass capacitors in the plate circuit. The line reactor limits the peak current drawn by the tubes and serves to filter the double frequency generated by the inverter which would otherwise be fed back to the d.c. line. The regulating resistor connected across the reactor is used to provide suitable voltage regulation from no load to any load within the rating of the equipment. The alternating current output is taken from the secondary of the plate transformer, which is tapped to supply the proper voltage to the load depending upon the d.c. line voltage.

The inverter is rated at 250 watts and is designed to have a regulation of approximately 16 per cent with constant frequency held at 60 cycles. Intermediate loads can be maintained at 60 cycles by adjustment of the frequency control. The frequency control provides flexibility of operation not usually found in rotating machines. The wave shape of the output voltage is rectangular in form and shows no appreciable variation between no load and full load at unity power factor. The wave shape is somewhat affected by low power factor loads and becomes slightly peaked.

In the typical input output characteristic shown the d.c. input voltage is held constant at 115 volts and the a.c. output current varied between no load and full load the frequency control being adjusted for 60 cycles at each point of observation. The resulting curve shows output voltage, input power and efficiency as a function of the output power at unity power factor. It is interesting to note the slight variation in output voltage which is a considerable improvement over any rotating machine of equivalent rating. The efficiency curve is the overall efficiency and includes the power consumed in the Thyratron heater circuits. It is appreciably better than is found for rotating machines designed for similar service. Because of the small voltage change between full load and no load and because of the frequency control, the inverter is particularly adapted for supplying synchronous phonograph combinations and particularly those incorporating automatic record changers.

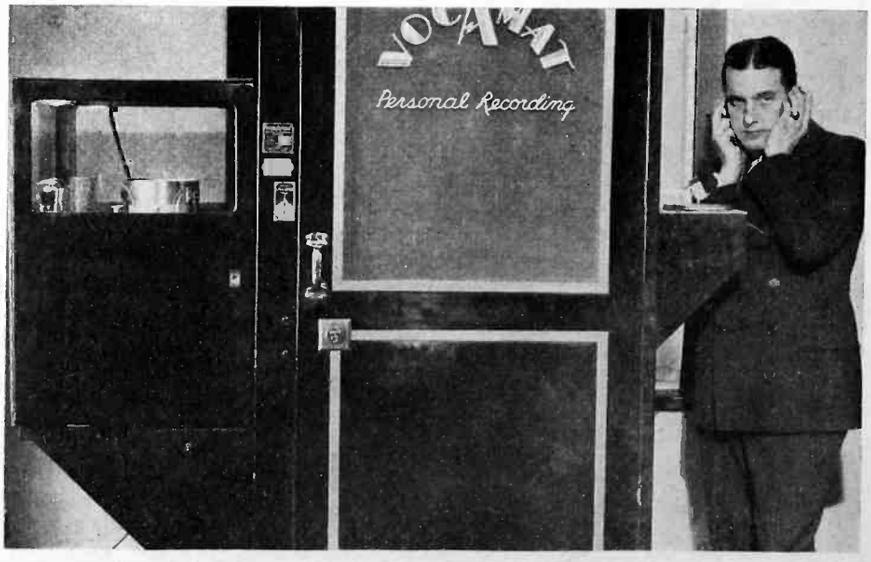
Comparison with rotating machinery

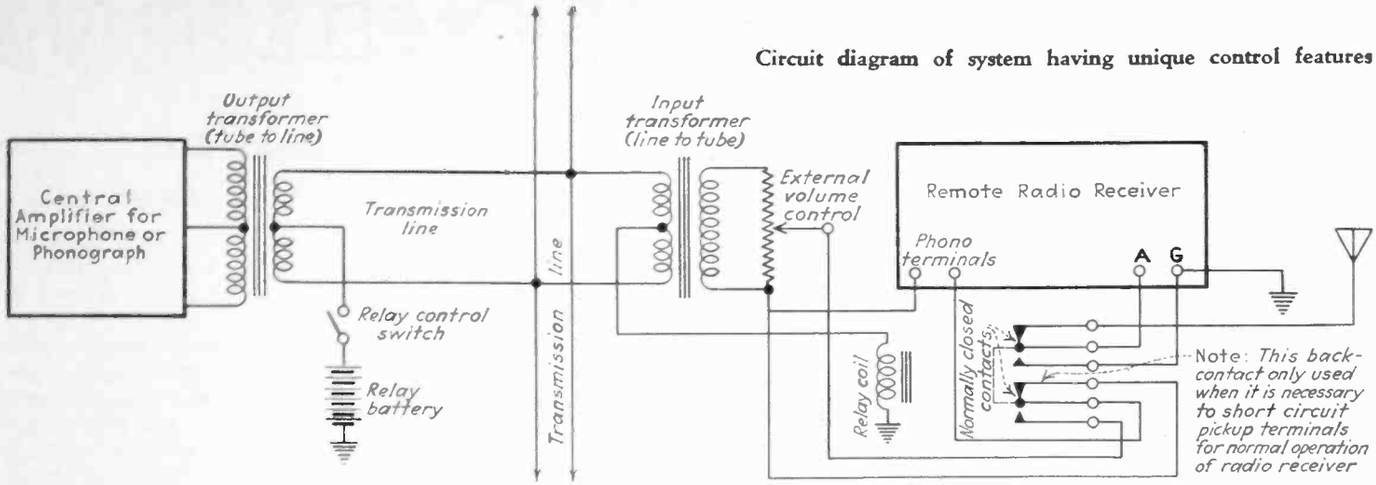
Since the reliability and dependability of the Thyratron inverter will be judged by comparison with rotating machine type of converters, a comparison may well be drawn at this time. The rotating machine is more certain in its operation because it does not have the variable conditions of changing tube characteristics. This does not mean that the inverter is not as satisfactory as the rotating machine, but that greater care is required in the design of the Thyratron circuits and greater factor of safety employed in order that satisfactory operation is realized. Experimental tests have shown the Thyratron inverter's ability to start a thousand times under widely varying line and load conditions without a single failure. Failure to operate usually is the result of mal-adjustment of some portion of the circuit and results in failure of the protective fuse. This is a positive warning that the device should be checked and the trouble remedied.

▼ ▼ ▼

"PHONOGRAPH" YOUR MESSAGE HOME

Newest application of self-recording phonograph equipment developed by Loftin-White for sending brief messages home or to the office—furnishes a metal disk record and mailing envelope for a quarter





Circuit diagram of system having unique control features

An audio-radio distribution and control circuit

By RALPH P. GLOVER

THE use of centralized radio, record and microphone distributing systems is becoming increasingly common in schools, apartment buildings and for other services. Invariably, however, the complete control of programs, with the possible exception of individual volume controls at the receiving points, is concentrated at the distributing center.

In some instances it would be desirable to retain the feature of selection and control over radio programs at individual receiving points and at the same time afford the advantages of centralized distribution of voice and records. In school installations, for instance, individual radio receivers (perhaps already installed) might be used in the classrooms, allowing considerable latitude in the selection of radio program material. The system outlined below makes it possible to use such receivers in conjunction with a simple audio-frequency distributing system and has the advantage that complete supervisory control may be exercised at the central point.

A schematic diagram of such an installation is shown in the illustration. At the distributing point, usually the principal's office in the case of schools, a microphone, phonograph pickup and a suitable amplifier are located. The output of this amplifier is connected to a transmission line which is tapped off at the desired points.

Under normal conditions, the radio receivers may be used independently and are operated as though the rest of the system did not exist. When it is desired to address the various rooms or to supply phonograph music or other program material, the control switch at the central point is closed. This energizes all relays, automatically connects the audio systems of the receivers to the transmission line and at the same time disconnects the antenna and short-circuits the antenna-ground terminals, thus eliminating radio cross-talk. It is therefore possible to break-in on radio reception at any time, substituting an original program, or to direct those in charge to tune-in on some radio program then being broadcast.

There are a number of technical features which are worthy of attention. Since individual power amplifiers and loudspeakers are available at each receiving station, the main amplifier functions mainly as a repeater and need only furnish a nominal amount of power to the transmission line. A low-gain amplifier is all that is required since one volt across the high-impedance pickup terminals is usually sufficient to give maximum output of the receiver. It is, of course, desirable to supply energy at a higher level than the minimum required in order to secure a favorable signal-to-noise ratio on the line. The level is then reduced by means of the external volume-control potentiometer, which should be adjusted once and for all and placed so that it cannot be tampered with. A screw-driver adjustment is desirable here.

The use of the balanced relay-operating circuit is advantageous for several reasons. Since the operating current flows through both halves of each transformer in opposite directions, on the line side, there is no net magnetizing effect on the cores and therefore high self-impedances are easily secured in the transformers at a minimum of cost.

It should be evident that all of the receivers must be connected to the power line and in operating condition at all times, if the system is to function effectively. It is perfectly permissible, however, to silence a receiver by adjustment of the normal volume control in the radio-frequency end for this in no way affects the ability of the set to pick up programs from the distributing system.

It must not be inferred that this system is being advocated in competition with the usual forms of centralized radio or public address systems, since it possesses some inherent defects which are admirably avoided in the latter installations.

HIGH LIGHTS ON ELECTRONIC

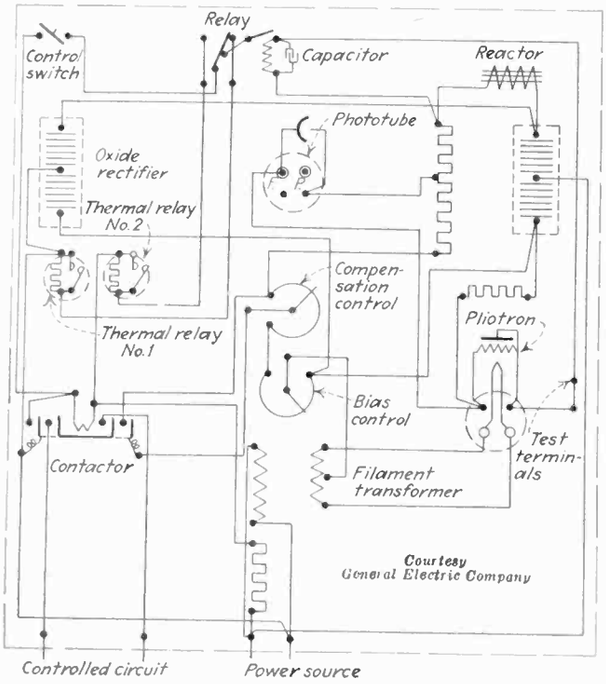


Photo-cell control of street lights

PHOTO-CELL CONTROL has been applied to nine street-lighting circuits in North Albany, N. Y., and the New York Power & Light Corporation reports that all of the 75 circuits in Albany will be operated in a similar manner. Plans are also under way to apply the system in Schenectady, Troy and other districts served by this company.

As soon as a predetermined degree of darkness prevails, regardless of time of day or season, the photo-cell actuates a relay, which in turn operates the switch controlling the street lights. When natural light is sufficiently restored the reverse operation occurs.

The photo-cell is mounted on the roof of a building and the eye is directed toward the north, so it will receive average light and not direct sunlight. A thermal time-delay relay prevents instantaneous operation or fluttering of the street-lighting control in response to disturbances such as the passage of a cloud over the sun, a flash of lightning at night, a person walking in front of the unit, etc.

✦

Adds chlorine for water purification

IN WATER-PURIFICATION plants, the "electric eye" has been installed in such a manner that the amount of residual chlorine added to the water supply may be automatically controlled and recorded. This is accomplished by causing a ray of light focused on a photo-electric cell to pass through a water sample container which receives fresh samples of water and the requisite amount of a certain chemical for a residual chlorine test automatically at stated intervals. The density of color obtained in the test regulates the amount of light reaching the photo-electric cell. This, in turn, activates the apparatus furnishing liquid chlorine to the water supply, and increases or decreases the amount of chlorine as needed.

It is now proposed to adapt this system to the hydrogen-ion test and it can doubtless be used also in regulating the application of chemicals to compensate for changes in turbidity and natural color of raw water. Other methods of using the cell in colorimetric reactions will in all probability suggest themselves.

✦

An amplification of ten quadrillion times

A DEVICE WHICH AMPLIFIES an electric current ten quadrillion times was exhibited by E. S. Darlington of the vacuum-tube department of the General Electric Company at the radio and electric show of the Electric League of Washington, D. C., in September. The device is a low-grid-current tube, which in conjunction with a thyratron tube is capable of utilizing 0.00000000000000001 (10^{-17}) ampere to control 0.1 ampere—or 100 milliamperes—directly. (See *Electronics*, Sept., 1930, page 290.)

To demonstrate the remarkable sensitivity of the combination, Mr. Darlington utilized the relatively small current generated by rubbing an amber rod with a piece of paper, to turn on and off a 10-watt incandescent lamps, with the amber rod at distances varying from 5 to 15 feet. A current of 10^{-17} ampere thus directly controlled the 0.1 ampere used by the lamp—introducing an amplification factor of ten thousand million million times.

Spot welding with tube control of intervals

APPLICATION OF gaseous tubes for controlling and timing welding operations have been experimented with in several quarters.

Higher speeds in intermittent line and spot welding than have hitherto been possible with mechanical interrupters or magnetic contactors are now practicable through vacuum-tube control. In addition to the advantage of high speeds, contact wear is eliminated both on the contactor tips and on the entire mechanical assembly. Interruptions as high as 1,000 per minute are readily handled with this equipment.

✦

Sintering beds controlled by photocells

AT A LARGE WESTERN MINE where iron ore is sintered, the speed of travel of the sinter-bed pallets is controlled by a photocell to insure uniform depth of bed without any manual attendance.

As the "feed" drops onto the bed it falls against a "shoe" which hangs from a rod that spans the machine horizontally above the pallets. The shoe is thus deflected more or less, the amount of deflection depending on the height and width of the pile. As the shoe moves, the horizontal rod from which it hangs and to which it is rigidly attached, rotates, while a pinion on its end actuates another smaller pinion on an adjacent shaft on the opposite end of which is mounted a rocker.

In one end of this rocker is a hole, which, as the arm rocks, permits a beam of light to pass at intervals from a lamp to the photo-electric cell. Every time the beam is intercepted, a magnetic switch is actuated. This switch is hooked up between the second and fourth contactor of the controller motor of the propelling pallets. The second contactor would give a speed of 4 ft. per minute and the fourth contactor a speed of 8 ft. Thus the device permits a speed range of 4 to 8 ft. per minute. This speed is therefore indirectly governed by the amount fed on the 24-in. conveyor. The device described will not let the feed pile up but, if it tends to do so, the apparatus makes the bed run faster. The speed normally is between 6 and 7 ft. per minute. The relay used is a photoelectric unit working on 110-120 volts, 60 cycles. The magnetic switch operates on 440 volts at 60 cycles. Formerly to insure a full bed, the services of a workman were required, but this man's services are now used elsewhere since the advent of the photocell.

DEVICES IN INDUSTRY + +

Electric eye to protect orchards against moths

ORIENTAL PEACH AND coddling moths, foes of the peach and apple crops, may be routed with the assistance of the photoelectric eye if experiments now being carried on by the New Jersey Agricultural College prove successful. These moths cause much damage by laying their eggs on the trees, but they will not lay when the temperature is below 60 degrees F. or in the daylight.

To defeat the moths it was decided to floodlight some experimental orchards and have the light turned on and off by photoelectric relays. When darkness approaches, the photoelectric cells turn on the floodlights; when daylight returns, the cells turn the floodlights off again. The moths, finding a state of continual daylight, are expected to be discouraged from their egg-laying in that particular orchard.

As it is unnecessary to use the floodlights when the temperature drops below 60 degrees, a thermostat will be used to cut out the floodlights entirely under such conditions. The moths then will be discouraged by the low temperature, as they will not lay their eggs below that temperature even though it is dark.

A foot-candle meter is used to measure the different light intensities at different parts of the orchards, to determine the minimum amount of artificial light necessary to stop the moths from laying. The trees will be examined at the end of the egg-laying season and compared with the artificial light intensity at corresponding points. The cost of the artificial lighting will then be compared with the cost of spraying trees.

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Aviators warned against high-frequency hazard

JUST AS THE MOTORIST must shut off his engine while having his gasoline tank filled, so must the airplane pilot halt all short-wave radio transmitting when in close proximity to airplane fueling areas.

Aviation experts scent a potential danger from fires or explosions in high-frequency radio transmissions, and accordingly the government's liaison committee on aeronautic radio research has recommended that short-wave radio stations should not be located close to aircraft fueling points and that "special precautions be taken to see that radio transmitters on aircraft are not in operation while the aircraft or other aircraft in close proximity are being fueled."

The high-frequency hazard, explains the committee, is similar to that from static charges accumulating on airplane gasoline tanks and gasoline supply hose. The precise amount of hazard cannot be determined until more "fundamental data on the transmission characteristics of the radio medium" can be determined, yet the committee felt constrained to send out a warning as to the existence of the hazard preliminary to undertaking a thorough research into the subject.

+

Recording eclipse phenomena with photo cells

NOVEL USE WAS MADE OF photocells and sound-picture apparatus in recording the eclipse of the sun of April 28, 1930, by F. B. Brackett, of Pomona College, Claremont, Calif. From an airplane flying 19,000 feet above the earth's surface, attempts were made to photograph the approach of the moon's shadow as it swept across the desert, the film being "timed" by radio impulses delivered to the sound-track.

A photocell method of recording sunlight intensity in the path of the eclipse shadow was described by Mr. Brackett before the recent Hollywood meeting of the Society of Motion Picture Engineers. In his own words:

"We undertook to measure the intensity of the sun's radiation, especially the intensity of the sunlight itself, at a number of points in a line across the path of totality. Five such points some 500 yards apart were selected at Ramm's Ranch, in a line perpendicular to the computed central line. At each point an instrument was placed, consisting essentially of a photoelectric cell and amplifier, and a milliammeter whose index marked the changes in intensity of light as the shadow passed over the point during the partial and total phases of the eclipse. All these milliammeters, each connected by long lines to its distant photometer, were mounted upon a panel at a central station together with two timepieces, so that all these ammeter dials and clock faces could be photographed simultaneously by a motion-picture camera—by two of them, in fact. In this way a continuous picture was taken showing the variation in light intensity at each point, and graphs were plotted for each point. The net of these curves, then, not only locates the path of totality, but tells much more as to the intensity of the radiation and illumination."

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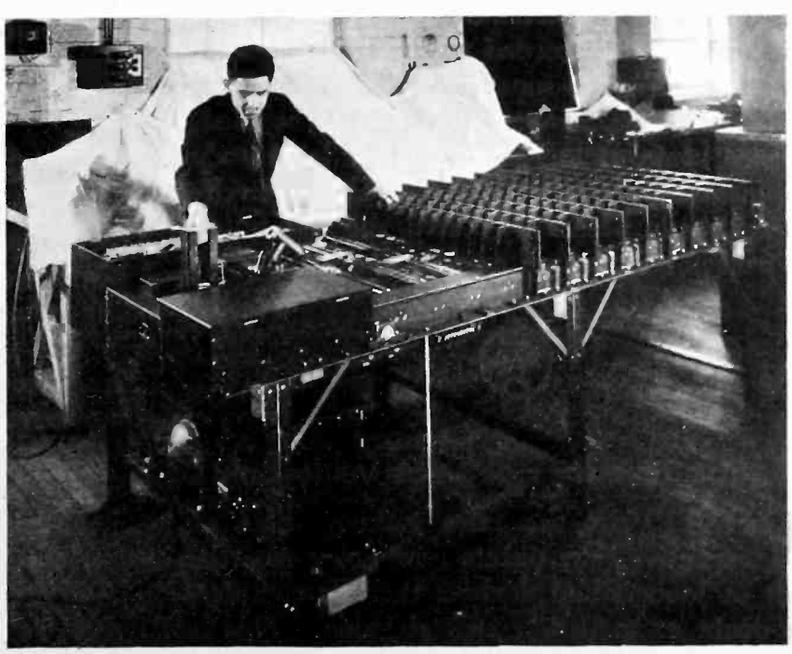
PHOTO-ELECTRIC TABULATOR SORTS CARDS



This device—the work of D. A. Young of the Westinghouse Newark plant—can instantaneously "read" cards fed to it and direct them to the right compartment among the 100 provided. Combinations up to 100,000,000 are possible on the small 3 by 1½-inch cards used

electronics

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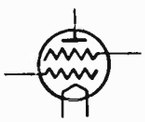

Stabilizing business—let's apply the laboratory method

RADIO'S experience with government administration has shown the dangers of admitting Washington commissions or bureaus too far into any business operation. Federal governmental control too often becomes the football of politicians, as those who have been close to Washington well know.

But the plan for general industry stabilization proposed by Gerard Swope before the National Electrical Manufacturers Association has much sound common sense and practical wisdom to commend it. Certainly the Swope proposal deals with the fundamentals of any industrial situation. By its terms, new opportunities for industrial and public service are accorded to the trade associations and the Federal supervisory body. Such an experiment as Mr. Swope outlines should be tried. We need some of the same kind of laboratory experimentation in economics and industry itself, as has already been freely used and has borne such fruit in science and the products of industry.

Tube testers—of sales value only?

WHATEVER the sales making value of expensive tube testers now going into the hands of jobbers and dealers, there is considerable doubt as to their technical value. This is no reflection upon the ability of their makers, but is an indication of the complexity of the problem the tester is supposed to solve.

Tubes working perfectly in one socket of a modern radio may not operate at all when put in another socket or in another set. Good amplifier tubes may make poor oscillators or detectors. No tube tester can show these differences. The tube tester shows in one way or another the plate-current change produced by a certain grid voltage change and therefore is a mutual conductance meter. But on some testers is the illuminating statement that values as far from the indicated normal as 30 per cent will be found.

Tube testers will not indicate noisy tubes, or those which the dealer or someone has used for several hundred hours. They will not discriminate between tubes of various makers, they cannot hope to indicate which of two new tubes (of reputable manufacturers) is better.

Probably the best all round tube tester is a radio receiver set up and working. If the tube works in each socket it probably will work in the socket of the purchaser.

Utilize—don't fear—non-linear functions

RECENT developments in magnetic-saturation and other "non-linear" control functions have caused some apprehension among electronic engineers that these iron-core methods might take the place in industry predicted for electron tubes.

On the contrary, magnetic-saturation methods, by the very bulkiness and great weight of the iron-core apparatus required, automatically exclude themselves from most places where control of any volume of current is needed. Ingenious and smooth-working as these core-saturation schemes are, they carry far too much excess baggage for the service performed.

But the development of these non-linear principles has given the electronic-tube engineer a tremendously useful new tool. For by applying iron-core saturation methods to very tiny magnetic circuits, and then feeding the very small currents so obtained, to the control grids of tubes handling the main circuits, the non-linear characteristics desired are obtained,—but without the great weight and bulk otherwise needed by the all-magnetic method.

Needed—more basic physics of the electron

ENGINEERS who are closest to the advances recently made in vacuum tubes, and who have contributed most to these advances, frankly admit that more fundamental physics of the electron is needed to be known, before electronic phenomena can be much further harnessed commercially.

The designer produces a new product; it performs dependably in certain ways, but some undetermined factor is soon noted to be present, and the tube's performance becomes "erratic." It is erratic, of course, only because of this X condition, and as soon as that characteristic is isolated, performance stabilizes—until some new variant is detected. The history of radio tubes with their continuously increasing list of definitive characteristics is a striking case in point.

The commercial tube designer for radio or industrial applications, still depends heavily upon the worker in fundamental physical research for clues to unlock the mysteries that present themselves each time an advance is made into new operating terrain.

Home sound-movie libraries —a cooperative plan

A PLAN has been proposed for the establishment of a group of 16-mm. sound-film libraries, through the active and unified support of all manufacturers building home-movie sound-equipment. This plan calls for the payment of $1 for each sound-equipment the manufacturer *estimates* he will sell in selected areas during one year, and $9 for each unit when *sold*,—the entire sum to be used exclusively for the establishment of local libraries in the cities selected.

Some such plan as this appears to be a way out, for financing the establishment of the necessary distributing system for 16-mm. films. Unless a unified plan can be agreed upon, the possibility of any one company making much progress in this direction is remote. Only by group financing can the rental cost of films to the ultimate consumer be brought low enough to entice a market for this equipment.

High-frequency food preservation?

FOR two years or more, it is known that experimental work with very high frequencies has been going on in this country for the preservation of meats and other perishables. Now comes announcement of similar studies in Europe.

Bad eggs will be things of the past in a new sense, if Robert Pape, of Soest, Holland, can substantiate his claim of being able to arrest the decomposition of organic products by means of ultra-short wave radiations. His transmitter, generating waves of from 25 cm. to 1 meter, it is claimed will within a radius of about 20 feet, set up an electromagnetic field in which no organic product can decompose.

In the inventor's house, food several months old is reported to have been seen in an odorless and undecayed condition. Eggs stored away a year ago were opened and found "beautifully yellow and without odor."

Thus electronics may yet become "the art preservative of all the other arts."

ELECTRONICS' NEW HOME

The new 33-story McGraw-Hill Building, 330 West 42d St., near Eighth Avenue, New York City, to which the editorial offices of *Electronics* will be removed about the middle of October. Blue tile and vast expanses of glass windows make this one of the notable designs of Raymond Hood, also architect for Radio City, the American Radiator Building, New York, the Chicago Tribune Tower, and the Chicago World's Fair of 1933

The march of the electronic arts

RMA studies patent pooling

ASSOCIATION ACTIVITIES of the Radio Manufacturers Association for the fall and winter have been started by President Coit, executive officers and committee chairmen of the national radio manufacturers organization. President Coit has filled all committee chairmanship vacancies with the recent appointment of C. E. Brigham of Newark, N. J., as director of the engineering division, and Roy Davey of Springfield, Mass., as chairman of the advertising committee.

Director Brigham succeeds former Director H. B. Richmond of Cambridge, Mass., and Mr. Davey succeeds Paul S. Ellison of New York. Mr. Brigham is organizing the entire engineering division, including important new standardzation work on tubes.

President Coit and committee chairmen of the RMA have been engaged intensively in study and negotiations in connection with the patent problem and the suggestion from the Department of Justice, in the anti-trust suit against the Radio Corporation of America, for creation of a patent pool. Several meetings have been held in New York of the three RMA patent committees appointed by President Coit, including the Receiving Set Committee headed by Captain William Sparks of Jackson, Mich.; the Tube Committee headed by B. G. Erskine of Emporium, Pa., and the Amplifier Committee of which A. C. Kleckner is chairman.

Consideration will begin soon of plans for the 1932 annual convention and trade show. Invitations already have been received from St. Louis, Chicago and Atlantic City, for future consideration of the show committee, of which B. G. Erskine of Emporium, Pa., is the new chairman.

Chairman Erskine has just completed organization of his committee by the appointment of Major H. H. Frost of New York; Fred D. Williams of New York; R. Del Dunning of Bridgeport, Conn.; Meade Brunet of Harrison, N. J.; Henry C. Forster and Leslie F. Muter of Chicago, and James M. Skinner and F. E. Basler of Philadelphia, Pa.

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National Press Building to have radio exhibit

PLANS HAVE BEEN ANNOUNCED by Carl H. Butman, former secretary of the Federal Radio Commission, for permanent exhibits of the latest types of radio transmitting and accessory equipment in the National Press Building, Washington, D. C. The exhibit is to show not only radio transmitters, but also such accessories as tubes, power supply, speech input and amplification equipment, calibration instruments, apparatus required in recording and reproducing electrical transcriptions, and also public address equipment. It is planned to maintain the exhibit primarily for the benefit of broadcasters and other users of radio.

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LATEST BRITISH HOME MOVIE

Everything but television is provided for in this cabinet combining radio, projector and synchronized turntable with storage space for films and records, demonstrated at the National Radio Show, London

Italian duty on radio imports

CABLES FROM ABROAD INDICATE that the Italian government is now contemplating to increase considerably the customs duty on radio sets and radio equipment. This increase to be some 500 per cent of the present tariff customs duties through reduced weight constructions. A 33⅓ per cent advalorem duty is to be adopted.

Foreign radio sets are still preferred by the Italian public despite the fact that Italy now possesses numerous and reliable factories. Owing partly to depression and partly to national competition, the importations of foreign radio sets have already declined in Italy by one third (both in value and quantity) during the first half year 1931 as compared with the first half year 1930.

The large exporters of radio sets and equipments to Italy are the United States, Germany and Britain. The first two countries will be mostly affected by the new Italian duty. The proposed increase seems, however, to have caused considerable concern in the Italian agricultural quarters; the Italian farmers place 20 per cent of their exportation in Germany, they are consequently afraid of German customs retaliations.

✦

Radio business looks up as new season is opened

THE RADIO TRADE is entering the season with higher hopes than it has had at any time in the last two years. These hopes are engendered not only by the growing popular interest in radio broadcasting but by cold statistics revealing that the market for radios is still big and that the demand continues fairly steady.

The 1931-32 radio season was formally inaugurated with National Radio Week, Sept. 21 to 27 and show in New York City. The Radio-Electrical Show scheduled for Oct. 19-25 in Chicago has been postponed until after the middle of January, 1932.

The New York show was marked by the display of a wide variety of electrical household appliances as well as radios. Many of the manufacturers, having found that their gross has been reduced by the extremely lower prices for the greatly demanded midget receivers, have turned to the production of such products as refrigerators, washing machines, vacuum cleaners, clocks, waffle irons and the like. It was for this reason that the sponsors of this year's show at New York and Chicago have named them radio-electrical shows instead of simply radio shows.

Radio exports total $2,222,569 for August

NEARLY 50,000 RADIO receiving sets were exported in August, valued at $1,411,981 compared to only 19,806 receiving sets, valued at $904,967 exported in August, 1930.

The value of transmitting sets, tubes and parts exported in August is shown by the returns to the Bureau of Foreign and Domestic Commerce to have been $141,467. This compares with $48,435 in August of 1930.

The number of radio receiving tubes exported was 199,224. This was slightly greater than the number exported in August of last year, but the value of exports in August, 1931, was $157,036, as compared with $237,475 in the August preceding.

Receiving set components valued at $399,873 were exported in August of this year, slightly less than the figure for August, 1930, which was $418,995. The value of loudspeakers exported in August of this year was $112,212, a decline from $142,047 in August of 1930. The number of loudspeakers exported in August of this year, however, was 34,155, as compared with 24,368 exported in August of 1930.

✦

Commission orders revision on all but broadcast waves

PRACTICALLY UNKNOWN to the radio-listening public, but none the less of tremendous importance to the vast majority of users of the radio wavelengths, a sweeping reallocation of the commercial and experimental communications channels of the ether will go into effect next Feb. 3, by order of the Federal Radio Commission.

So far as the short and long waves are concerned, this reallocation, though it will be accomplished without seriously disturbing the present order of things, is fully as important as the famous broadcasting reallocation of November, 1928, when radio listeners everywhere had to change their dialing habits in order to find favorite stations at new tuning points.

In general, the order is designed to apply to point-to-point transoceanic, aviation, amateur and experimental radiotelegraphy and radiotelephony. It puts into effect the new so-called "tolerances," or separations between channels, of one-tenth of one per cent, in lieu of the old standard of two-tenths of one per cent. In effect, it practically doubles the number of available frequencies, increasing the number of channels between 10 kilocycles and 28,000 kilocycles from 1,814 to 3,025.

SHIP TELEVISION SET

Receiver designed by M. P. Wilder and demonstrated on the S. S. Vulcania with a miniature screen

✦

New television channels under short-wave shifts

"MOVING DAY" FOR several television broadcasters will take place on Feb. 3, 1932. On that date, the Federal Radio Commission, under its new one-tenth per cent "frequency tolerance" reallocation of the long and short waves, will require that one of the four 100-kilocycle bands of wavelengths reserved for television broadcasting be vacated.

The 2,850-2,950 kilocycle band must be vacated in order that those channels may be turned over to aviation radio services. In its stead, the Commission is reserving the 1,600-1,700 kilocycle band (187.4 to 176.4 meters) for television. For the most part, it is understood, the limit is entirely agreeable to the television experimenters; in fact, the 1,600-1,700 kilocycle band, being nearer to the broadcast band, is looked upon with much more favor than the old one.

✦

SMPE holds symposium on 16-mm. equipment

THERE ARE SOME fifty papers scheduled for the fall meeting of the Society of Motion Picture Engineers at Swampscott, Mass., Oct. 5-8 inclusive. Of particular interest is the symposium on 16-mm. film and equipment. One paper on "Proposed Standards for 16-mm. Sound-on-Film Dimensions," by R. P. May, RCA Victor Company, Camden, N. J., will be received with much interest because of developments now going on in this field.

The society will honor the engineering pioneers of the industry and invitations have been extended to Eugene Lauste, Jean LeRoy, Thomas Armat, Donald Bell, George Melies (France), Oscar Messter and Max Sladanowsky (Germany), Robert Paul and W. K. L. Dickson (England), Charles Friese-Greene, son of William Friese-Greene, Miss Marie LePrince, daughter of L. A. LePrince, Edwin Porter, and D. W. Griffith.

✦ ✦ ✦

FALL CONVENTION—INSTITUTE OF RADIO ENGINEERS

Rochester, N. Y., Nov. 9-10, Virgil Graham, Executive Chairman

THE INSTITUTE OF RADIO ENGINEERS' fall meeting which will be held in Rochester, N. Y., Nov. 9-10, has many interesting papers scheduled for the two-day session. There will also be an exhibit of component parts, tubes and measuring equipment, on the roof of the Sagamore Hotel, adjacent to the meeting room.

Monday, November 9.

9:30 A.M. *Technical Session*

R. H. Manson presiding

"Battery Design Problems of the Air Cell Receiver" by F. T. Bowditch, radio engineer, National Carbon Company.

"European Reception Conditions" by W. A. MacDonald, chief engineer, Hazeltine Service Corporation.

"Pentode Circuit Operation" by David Grimes, engineer in charge, RCA Licensee Laboratory.

2:00 P.M. *Technical Session*

R. H. Manson presiding

"Magnetic Cores for High Frequencies" by W. J. Polydoroff, director of research Johnson Laboratories.

3:00 P.M. *Engineering Session*

L. C. F. Horle presiding

5:00 P.M. *Inspection of exhibits*

8:00 P.M. *Technical Session*

R. H. Manson presiding

"Experimental Visual Broadcasting" by A. B. Chamberlain, chief engineer, Columbia Broadcasting System.

"Advances in Ultra Short Wave Transmission and Reception" by Eduard Karplus, research engineer, General Radio Company.

Tuesday, November 10.

9:00 A.M. *Technical Session*

C. P. Edwards presiding

"Correlation of Radio Tube and Receiver Designs" by Roger Wise, chief engineer, Hygrade-Sylvania Corporation.

"Recent Developments in Amplification and Detection Systems" by P. O. Farnham, development engineer, Radio Frequency Laboratories.

"Use of Suppressor Grids in Radio Tubes" by E. W. Ritter, development engineer, RCA Radiotron Company.

"An Examination of Selectivity" by R. H. Langley, consulting engineer.

2:00 P.M. *Engineering Session*

L. C. F. Horle presiding

4:00 P.M. *Inspection of exhibits*

6:30 P.M. *Banquet*

A. Hoyt Taylor, Toastmaster

"The Radio Business" by O. H. Caldwell, editor of *"Electronics."*

REVIEW OF ELECTRONICS LITERATURE

HERE AND ABROAD

Photo-electric measurements of illumination

[W. R. G. ATKINS AND H. H. POOLE; T. F. YOUNG AND W. C. PIERCE] Using various screens, the color sensitivity of different photo-electric cells was tested; red-sensitive cells consisting of a thin film of potassium on oxidized copper, with a palladium side tube to introduce hydrogen; these cells were green sensitive, stood 140,000 meter candles at 120 volts equivalent to full daylight, giving 19 micro-amperes, new type red-sensitive cell thin-film cesium oxide on silver in vacuum, maximum sensitivity at 7,100, minimum at 5,000, giving one thousandth micro-ampere per meter candle at 62 volts, Burt sodium vacuum cell. For field work, such as measuring the composition of light in woods or shaded sites, comparison of sun and skylight, the thin-film cesium vacuum cell was very suitable; the current could be measured quite easily by counting the number of discharge flashes in a neon tube connected to the cell.

Quartz cells containing a thin cesium oxide layer on a silver plated copper sheet have maximum sensitivity at 7,000, a minimum round 5,000, a sharp maximum at 3,600 and a sharp minimum at 3,200 wavelength.—*Scientific Proceed. Royal Dublin Soc. July, 1931. Journal Optical Soc. of America, August, 1931.*

✦

Television reception

[BARTHÉLEMY] Deals with various solutions of synchronisation, especially with that in which synchronising signals of very short duration (1/1000 second) are sent out on the same wave as the television signals, sixteen times per second. These set off a local oscillation of relatively long period but less than ⅛ second at the receiver, which drives the motor after amplification. Such a local oscillator can be composed of a neon tube with condenser and resistance. —*L'Onde Electrique, Paris, August, 1931.*

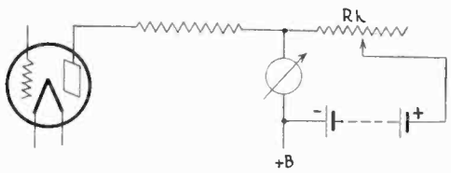
✦

Development of Ultra-short-wave radio

[ESAU] Article of a historical and controversial nature as regards early work on this subject, claiming priority in many matters. (Schröter) with a reply thereto. This controversy brings to light several interesting patent questions.—*Funk, Berlin, September 11, 1931.*

Compensated anode milliammeter as overload control

[PFITZER] Calculations for the method shown in the diagram, with optimum values and practical results Rk being



made 20 times the instrumental resistance for practical purposes.—*Funk, Berlin, July 17, 1931.*

✦

Oscillating crystals

[LOEST] Discussion of the theories of Lossew (miniature arc), Sixtus (temperature effects), and Habann (electronic space-charge) with special reference to the experiments of the latter.—*Funk Magazin, Berlin, August, 1931.*

✦

Indirectly heated direct current tubes

HEATER TYPE TUBES are the principal novelty of the season in Germany, and of great interest throughout Europe, where many areas have only direct-current and others (e.g. Berlin) are still in process of conversion to a.c. Four types exist, all having a filament voltage of 20 and a filament current of 180 mA.: These are—a screen-grid radio-frequency amplifier for 100 to 200 volts plate, 20 to 60 volts screen-grid, G_M of 1 mA/V, mu about 400, R_P about 400,000 ohms, normal I_P 2 mA, C_{g-P} about 0.001 micromicrofarads; a general purpose tube usable as detector, as resistance-coupled amplifier, as neutrodyned radio frequency amplifier and as oscillator, with plate voltage 40 to 200, G_M of 3 mA/V, mu of 25, R_P about 8,000, and normal I_P 3-MA; a loudspeaker tube handling about 5 watts with 100 to 200 volts plate, G_M 2.5 mA/V, mu about 6, R_P about 2,500 ohms; and a pentode loudspeaker tube also handling about 5 watts, with anode and screen-grid voltage from 100 to 200, G_M of 2.5 mA/V, mu of 100, R_P about 400,000 ohms. — *Electronics' European Correspondent.*

Precision short-wave measurement

[FEHR AND LEITHÄUSER] From the Heinrich Hertz Institute. The method used, consisting essentially of a double heterodyne against a harmonic of a quartz crystal, does not lend itself to an abbreviated description. Full and practical details are given. The method is at present usable down to 10 meters and is to be extended lower.—*E.N.T., Berlin, August, 1931.*

✦

Voltage generator for short waves

[DAVID] Description of an apparatus for supplying voltages ranging from one volt to one microvolt or less, on all waves from 10 to 100 meters. As on longer waves, the principle is to generate and measure higher voltages than those required, then attenuating these to a known degree. In adapting this to shorter waves the principal difficulties met with are the proper shielding of the generator, the determination of the circuit constants, and the practical simplification. The shielding (Faraday cage) finally developed is fully described with photographs and constructional diagrams. The generator uses a fully symmetrical push-pull circuit. Attenuation is obtained by a series of one to three transformers, the mutual inductance of each of which is variable, using the type developed by Mesny in which this is proportional to the sine of the angle of rotation of one of the windings. The elaborate method used to obtain the constants of the instrument (by check against a tube voltmeter) is fully detailed. The accuracy is estimated as 5 per cent.—*L'Onde Electrique, Paris, June, 1931, published July 5.*

✦

Vibration of steam turbine disk wheels

[R. H. COLLINGHAM] The turbine disk to be tested is mounted upon a shaft at the side of a very stiff wheel, both wheels carry coils. The currents induced by sideways or centrifugal motions of the disk wheel are amplified by means of vacuum tubes. Any wheel is tested in this way at the British Thomson-Houston Co.—*Journal Am. Society Naval Engineers May, 1931.**

***The same issue contains also a detailed article on Electron Tubes in Industry by W. R. King and on G. E. Photoelectric Tubes by L. R. Koller.]**

Photo-electric photometer for sorting glow lamps

[W. W. Loebe and C. Samson,] Osram Lamp Factory. By means of a cesium-potassium photoelectric cell followed in the usual manner by a three-electrode tube amplifier (one stage) used with 40 volts plate potential and a simple millimeter it is possible to construct a reliable photometer for factory use. Its range lies between 100 to 300 lumen. In a test 4,000 lamps (25 watt) were measured visually and with the photocell; there was agreement in over 98 per cent of the readings made by both methods, within the limits of accuracy of visual photometry (2 per cent). It is necessary to check the photometer every half hour. By suitably projecting the scale of the milliamimeter upon that of the wattmeter it was possible to read directly the lumens per watt, a quantity which is more important than the number of lumens.—*Elektrotechn Zeitszchr. July, 1931.*

✦

Radio patents

[L.] German 519902, for artificial piezo-electric crystals obtained by pulverizing such substances as amorphous quartz, heating this powder strongly and cooling with or without an electric field. German 526727, double tube with built-in push-pull oscillator for ultra short waves. German 522582 in which the piezo-electric crystals serving to produce the resonance glow in a partially exhausted tube are fitted externally to this tube so as to be readily interchangeable. German 521846, Piezo-electric oscillator. One end of a quartz crystal rests between two electrodes in a substance whose resistance varies with the pressure exerted on it, this circuit being completed through a source of current and the primary of a transformer; the other end rests between two electrodes connected to the secondary of this transformer. There is thus a mechanical feedback through the crystal and oscillations are maintained. *Funk, Berlin, August 21 and 28, 1931.*

✦

Tobis and Klangfilm sound-picture methods

[J. Mayer] Both produce a variable density film as mentioned incidentally in *Electronics,* September, 1930, in the article discussing the European sound picture industry, but the Tobis uses a discharge tube as a light source, the Klangfilm varies the intensity with the aid of a Kerr cell controlled by the voice current. The discharge tube is filled with argon or nitrogen at a pressure of 25 mm. Hg., both gases emit blue light at the cathode which is very suitable for photographic recording. The cathode consists of a funnel shaped piece of tungsten, 3 mm. diameter, welded to iron and sitting upon a copper rod which passes through the glass wall. The whole electrode is surrounded by a sleeve of magnesia. The anode consists of a fine platinum point 0.2 mm. (2/500 inch) in diameter; the light which it emits when the voice current is applied to the electrode of the discharge tube is negligible. The discharge current amounts to 20 ma. In April 1931 about 1,400 theaters in Europe had sound equipment, Klangfilm and Tobis, of which 1,000 alone were in Germany. —*Elektro Technische Zeitschrift E.T.Z. July, 1931.*

✦

Electronic instrument for determining moisture

[P. LeRolland and Tchang Te Lou] The conductivity over the surface of an insulator, such as mica, decreases suddenly when on decreasing the temperature it becomes covered with a thin film of water. Two copper rings a few tenths of one mm. apart and enclosing a circular piece of mica form a condenser which is put in parallel with the variable condenser of an oscillating tube. Water flows through the copper, cools the small space between the rings and causes the water to deposit on the mica. A sound is emitted by the tube which increases rapidly in pitch until a distinctly visible film is formed.—*Recherches et Inventions, June, 1931.*

✦

Electronic bean shooter

Beans to be sorted are fed into a hopper on the machine. Passing under this hopper is a drum with a number of small holes, and with a constant suction drawing air through the holes. Beans are thus picked up by suction, pass a mechanical "patter" which adjusts them to the right position and are then inspected by a photo tube while they pause for a moment. When a discolored navy bean passes, a thyratron tube comes into action and causes a metal finger to push the bean into a chute. A new elevator will be built near the bean district which will house 200 of the photoelectric bean sorters capable of sorting at least a carload (40,000 pounds) a day.—*Instruments, August, 1931.*

French selenium cell patent

[Rola] Among others: French 689585 for selenium cells of condenser form, in which one series of plates is of such metals (brass, nickel, platinum) as are dampened by liquid selenium, and the other of such (copper, gold, silver) as are not so dampened. The former are connected to a source of current. Separation is by mica plates.—*Funk Magazin, Berlin, September, 1931.*

✦

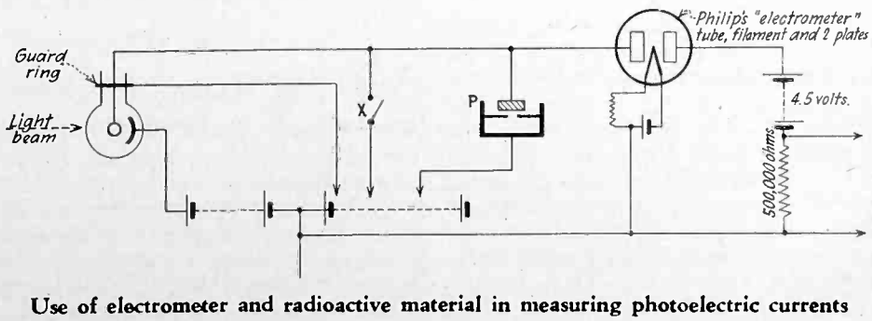
Polyphase self-excited systems

[Arenberg] By combining a multiplicity of single-tube oscillators, polyphase currents can be obtained, with great stability of frequency, making this method particularly advantageous for the ultra-short waves. A new method of stabilization for these waves also results, since a voltage taken from the feed-circuits of such an oscillator can be applied to the grid of a neutrodyned ultra-short-wave oscillator, a freqency n times the fundamental being present in these circuits, and this latter being held steady by a crystal.—*L'Onde Electrique, Paris, June, 1931, published July 5.*

✦

Amplification of weak photoelectric currents

[Lejay] An electrometer tube (Philips) is used, normal triode amplification following. P is a cell containing radioactive material (e.g. polonium), the aperture of the diaphragm between this and the plate, and the applied voltage being both variable and serving to produce an exact balance of the leakage current of the tube. The contact X is provided to be able to adjust the potential of the input electrode ("grid") to such a value that the "grid" current is nil: i.e. that the opening or closing of this contact has no effect on the "plate" (output electrode) current. The contact can then be left open, the potential adjusting itself to remain at this value. Details of the practical precautions necessary (soldered filament rheostat, shielding in internally blackened, dried, and grounded box, etc.) are given, and examples of the application to astronomical observations.—*L'Onde Electrique, Paris, August, 1931.*



Use of electrometer and radioactive material in measuring photoelectric currents

Variation of tube capacities with frequency

[L. HARTSHORN] National Physical Laboratory. The anode circuit capacity of some typical vacuum tubes (filament-plate plus grid-plate) may be one and a half to twice as large when the plate current flows than when measured cold; it drops several mmfd. when the frequency increases from 1,000 to 4,000 cycles; this change is small when the filament is cold. If we divide up the current path between filament and anode into a number of elementary volumes, each of these volumes may be considered as a leaky condenser when the filament is hot, and the theory of this combination predicts qualitatively the changes observed.—*The Wireless Engineer & Experimental Wireless (formerly Exp. W. and W. Eng.) August, 1931.*

✦

From the 30 to the 100-line picture

[WINCKEL] Description of the modifications necessary to existing systems in order to attain 100-line pictures. The new Tekade-Telehor "mirror-screw" with long and narrow glow-lamp illuminating the whole length of the screw. The Telefunken "mirror-wheel" with 50 mirrors only, but with two lamps, so that two revolutions are necessary per image. The Braun tube giving a 12 by 14 centimeter image, satisfactory except for the short life of the tubes.—*Funk, Berlin, August 21, 1931.*

✦

Pentode tubes and loudspeakers

[FORSTMANN] Study from the point of view of maximum sound energy and optimum equality of amplification for all frequencies, with unusual conclusions—the relation between the internal resistance of the tube and that of the loudspeaker has no effect whatever on the efficiency; the equal reproduction of all frequencies is chiefly to be attained by using tubes of high internal resistance and low-resistance loudspeakers.—*Funk, Berlin, August 21, 1931.*

✦

A special form of photocell

[VON HARTEL] Notes on the applications of a cell using the principle of the Geiger electron-counter, responsive to extremely low light intensities: e.g. for the recording of spectra of too low intensity to be photographed. The cell consists essentially of an exhausted quartz tube containing a semi-conducting layer and an anode, insulated from one another by amber and subjected to a polarization of some 1,000 volts.—*Funk, Berlin, July 24, 1931.*

Power detectors

[HORST, BERG, JKL.] Three articles on this subject, all emphasizing the confusion that has arisen in Germany between the true Power Detector (handling large input) and the use of a screen-grid tube as leaky grid detector with the title "Power Detector." There appears to be little appreciation in Germany of the possibilities of true power detection. The third article deals more especially with the disadvantages of the screen grid tube when used as leaky-grid detector — *Funk, Berlin, August 7, 1931.*

✦

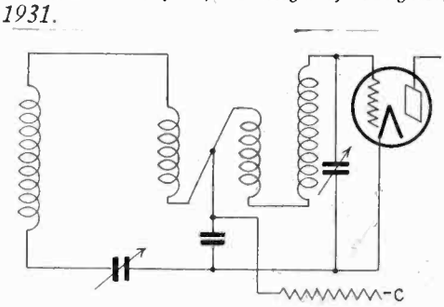
New electrodynamic band-microphone

[HARTMANN] Communication from Siemens and Halske Laboratories. The new type is as sensitive as a carbon microphone but retains the advantages (absence of noises and of distortion) of the earlier band types; it also has fewer resonance peaks than these thanks to stronger damping, and an extended frequency scale. The increased sensitivity is due chiefly to a stronger magnetic field, the better frequency range (50 to 10,000 cycles) to a special arrangement of air-chambers behind the band, the larger of which is practically closed at higher frequencies. Photographs and constructional diagrams.—*E.N.T., Berlin, July, 1931.*

✦

Constant band-width filter

[UNSIGNED] Variable band-filter with constant width from 200 to 2,000 meters. The principle is that of combining capacitative and inductive coupling (with negative mutual inductance) as in the diagram. Potentiometer with rolling contact, avoiding friction between this and the fine windings. Readers should note *Electronics*, December, 1930, p. 414. —*Radio B.F.f.A., Stuttgart, August, 1931.*



✦

Control of volume by chokes

[HOFFMANN] From the German National Broadcasting Company Laboratories. Instead of the usual control by potentiometer it is frequently preferable to use chokes, and the calculations are given for obtaining a control independent of frequency, and smooth in use. —*E.N.T., Berlin, August, 1931.*

1931 receivers

[HEMARDINQUER] Interesting summary of recent French receivers, with many diagrams and photographs. Among points of interest may be mentioned that the use of mains feed with indirectly heated tubes is still in most cases confined to local receivers, most "sensitive" (four tubes and over) receivers being battery fed or employing rectified and filtered filament current with directly heated tubes. Of the foreign receivers present on the French market the American sets are considered the most interesting, but the uneconomical use of many stages of radio amplification of low gain as compared with the European few stages of high efficiency is insisted on. — *La Nature, Paris, September 1, 1931.* (Issue entirely devoted to Radio).

✦

Ultra-short waves in medicine

[GRADENWITZ] Description of the studies of Schliephake of Jena, and of the new Siemens apparatus based thereon. Waves of less than 10 meters are used, and a diathermic action can be produced on organs lying far from the body surface, this being difficult or impossible with normal diathermy apparatus using waves of about 600 meters. The effect is maximum in the case of the bones and liver, then fat and brain, and finally skin and muscles, this being exactly the reverse of the order with normal diathermy. Another important advantage of the shorter waves is that they can be directed to influence a given organ. A secondary and direct curative effect (other than the diathermic) appears also to exist.—*La Nature, Paris, September 1, 1931.*

✦

Radio alarm

[SALMONY] Alarm to operate on a predetermined signal consisting essentially of Morse signals of more than usual length. A combination of normal and delayed relays (as in automatic telephony) is used. The method for dealing with interference, by a self-releasing relay operating at intervals during the signal, is particularly neat. Simplified diagram and photographs.—*E.N.T., Berlin, July, 1931. (See also article by the inventor, Ristow, in Funk Magazin, Berlin, August, 1931.)*

✦

Studies with Braun tubes

[VON ARDENNE] The use of this tube for the study of mains-hum in receivers is described, with oscillographs showing the effects of incorrect polarisation of the cathodes and the measurement of the "hum factor."—*Funk Magazin, Berlin, September, 1931.*

+ NEW PRODUCTS

THE MANUFACTURERS OFFER

Special tubes for industrial purposes

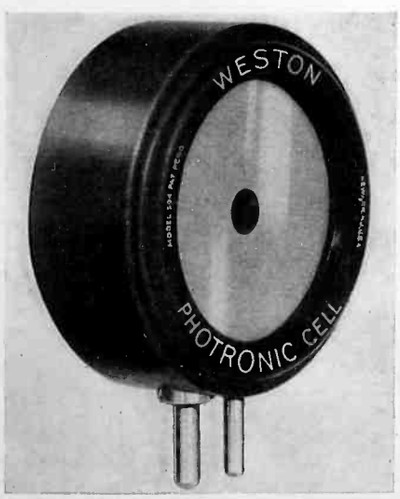
THE VAS CORPORATION, 125 N. Third St., Newark, N. J., of which Dr. Paul G. Weiller, formerly with the Westinghouse Lamp Company, is president and in charge of development, is now in production of various classes of rectifiers and vacuum tubes of special design. Rectifiers up to 75 amperes and 50,000 inverse peak voltage capacity have been produced, also a vapor power amplifier for large currents.

Mercury vapor rectifiers, plain and grid-controlled are available — *Electronics, October, 1931.*

✦

Light sensitive cell for direct relay operation

ELECTRONIC IN ITS CHARACTER, the Photronic Cell developed by Weston Electrical Instrument Corporation, Newark, N. J., employs a highly light-sensitive disk which transforms light energy directly into electrical energy without the use of any auxiliary voltage. Its response to light variations is instantaneous and sufficient current is developed to directly operate Weston relays without the use of auxiliary apparatus or any battery. It delivers about one microampere per foot-candle of light intensity. When exposed to direct sunlight the output is approxi-



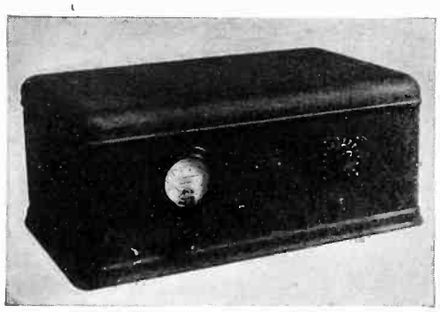
mately 5 milliamperes. The cell resistance varies from about 1,500 ohms for 10 foot-candles light intensity to about 300 ohms for 240 foot-candles intensity.

As far as is known, the life of the cell is practically unlimited and a continuous current flow does not harm it in any way. It has a constant output and can be exposed to direct sunlight without deterioration. The cell has no dark current since its energy is derived directly and only from light; no drifting, hence no circuit adjustments are necessary; no fatigue and is nonmicrophonic.—*Electronics, October, 1931.*

✦

Remote control amplifier

DESIGNED FOR USE where only one microphone is required, such as police, market and news broadcasts or small musical combinations, the Model A-100



amplifier has recently been announced by the Gates Radio and Supply Company, Quincy, Ill. It uses a two-stage transformer coupled circuit which employs the new dry cell tubes. A type 230 tube is used in the first stage and two 231 tubes are used in the final push-pull stage. The frequency response is flat from 30 to 8,000 cycles and a gain of 45 decibels is claimed. It is supplied in a well finished mahogany cabinet of metal design and room for all batteries is provided. Price, f.o.b. Quincy, Ill., $85.—*Electronics, October, 1931.*

✦

Photoelectric cells for sound pictures

SEVERAL NEW TYPES OF photoelectric cells have recently been brought out by the Telephoto Corporation, 133 West 19th St., New York City. They are available in various sizes and types to meet the requirements of all types of sound-on-film reproducing equipment. Detailed specifications are furnished in Bulletin No. 5, issued by this company. —*Electronics, October, 1931.*

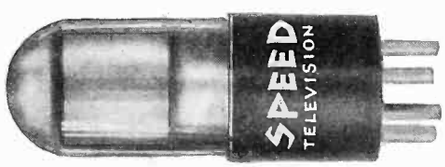
Puncture-proof filter condenser

ELECTRO FORMATION, INC., 155 East Ohio St., Chicago, Ill., announces its new Merhon puncture-proof filter condenser. This unit is built in seamless copper containers in $1\frac{3}{8}$ inch and $1\frac{3}{4}$ inch diameters, depending upon the value of the capacitor unit desired. The container is fitted at the open end with an insulating cover to which the electrode or anode is attached. Electrolyte leakage is prevented by a flexible rubber gasket between the cover and the container. The rim of the container is spun down, preventing leakage at this point. The anode proper consists of a hard drawn aluminum strip 2 or 3 inches wide, 0.010 in. thick, and of a length depending upon the capacity desired. Standard units are made up with one capacitor in each container; special units may be constructed with from one to four separate anodes in the same container. The capacity of each capacitor may be of any value up to 8 microfarads at 500 volts, or higher at lower voltages.—*Electronics, October, 1931.*

✦

Neon tube has coating on glass

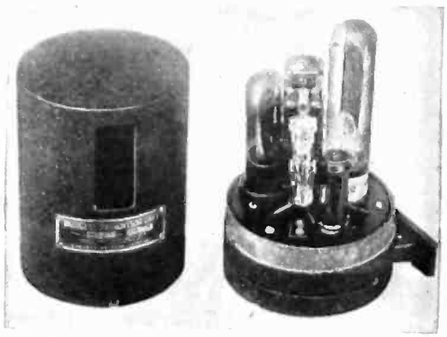
THE ENGINEERS OF THE Cable Radio Tube Corporation, 84 N. 9th St., Brooklyn, N. Y., have recently developed a new type of tube for use in the reception of television signals. It consists of two electrodes within a glass sealed bulb, which, when connected across a source of potential glows with a pinkish light. In this new tube the entire wall, with the exception of a small window,



is covered with a metallic coating, which acts as the positive element. The plate inside the tube is the negative element. This method of construction is said to prevent the slowing up of the tube when in action and presents advantages in that less current and less output power from the amplifiers are required. The tube is made in one size only, having a plate area of 1-inch square, permitting the use of any disk up to 20 inches in diameter.—*Electronics, October, 1931.*

Light-control units

FOR THOSE PREFERRING ready-to-use equipment, a complete line of impulse type light-control units, available for a.c., d.c., or battery operation is announced by the Burgess Battery Company, 202 East 44th St., New York City. Light source and bridge units are contained in compact metal cases arranged for convenient mounting. They are supplied with the bridge mounted in the

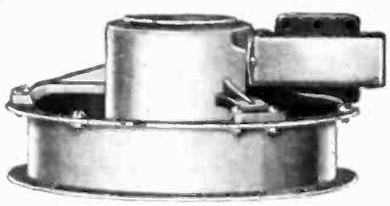


case or separately for external or remote mounting. The complete units contain the necessary tubes, transformers, resistors, condensers and relay, ready for immediate use. If the Burgess vacuum contact is included, the unit will control a load up to 1320 watts. Further data on the Burgess Radiovisor units as well as the Burgess vacuum contact may be obtained by writing the company direct.—*Electronics, October, 1931.*

✦

Midget dynamic speaker

AN EXTREMELY SMALL dynamic speaker for use with very small midget sets has just been added to the line of speakers built by the Operadio Manufacturing Company of St. Charles, Ill. This unit



is only 6 inches in diameter and 3⅛ inches overall including the speaker transformer. A larger field coil than the ordinary size is used in this speaker. —*Electronics, October, 1931.*

✦

Lighting control relay

TO ENABLE THE INTENSITY OF natural light to control artificial lighting automatically, a new photoelectric lighting control relay has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. When the intensity of daylight decreases to a certain point, this device operates turn-on electric lights, and conversely, when the natural light increases to a certain intensity, it causes the lights to be turned off. The operation of this unit is affected by variations in the intensity of the light falling on a photoelectric tube. These variations produce proportional changes in the amount of current passing through the tube, which in turn is amplified in a specially-designed amplifier tube, which energizes the primary relay controlling an auxiliary contactor used for operation of the main lighting control switches. A potentiometer is fitted for adjusting the circuit for operation at different intensities. — *Electronics, October, 1931.*

✦

Electrolytic condensers

IN ORDER TO MEET THE demand of radio manufacturers for an electrolytic condenser possessing the same general characteristics of Hi-Farad dry electrolytic condensers, with aluminum can containers, the Aerovox Wireless Corporation, 70 Washington St., Brooklyn, N. Y., has recently announced new

Hi-Farad electrolytic condensers encased in heavy paper cardboard boxes. These new type P condensers have the same electrical characteristics as the units in aluminum cans, but are sealed in cardboard containers. They are available in single sections from 1 to 8 microfarads, and in double section combinations from 2 to 8 microfarads per section. The working voltage of these condensers is 500 volts peak.—*Electronics, October, 1931.*

✦

Power amplifiers

AMONG THE RECENT developments of the Webster Electric Company, Racine, Wis,. are three series of power amplifiers. These units are fully described in S.D.-Bulletins No. 11 and 12, which may be obtained from the company. The Model 6039-R amplifier in a high-gain 3-stage amplifier, using the new variable-mu tube in the first stage, and two pentodes in push-pull in the output stage. It is compact and light, and fulfills the requirements for portable sound-on-film apparatus to operate directly from the P.E. cell. The power output is approximately 6½ watts, and gain 85 bd. The Model 6040-R amplifier is a 2-stage with a single pentode output of 2.5 watts. Model 6041-R is a 2-stage amplifier with a push-pull pentode output.—*Electronics, October, 1931.*

Photoelectric test set

THE PHOTOELECTRIC TEST SET recently brought out by the Radiart Corporation, 13229 Shaw Ave., Cleveland, Ohio, offers many advantages to the physicist, chemist, engineer, and experimenter in the electronics field for carrying on any research or experimental work not involving highly technical light or color measurements. Manufacturers claim that this unit has an extreme range of accuracy for all commercial uses, and has the additional utility of operating from 110-volt, 50 or 60 cycle, a.c. light socket or from 220 or 440 volts by using a Radiart stepdown transformer. The following units are included in this set: Photometric screen, reflection shield, combination photoelectric relay and amplifier, light source, test tube holder, color reflector, refraction pan and mirror, color filter holder, color filter and meter. The Radiart Corporation maintains a complete electronics department and welcomes inquiries.—*Electronics, October, 1931.*

✦

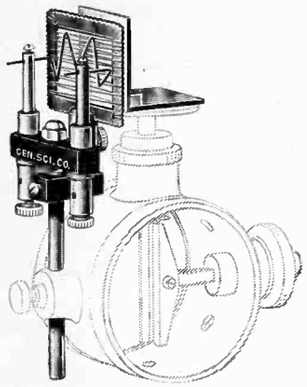
Visual test set

FOR ADJUSTING intermediate frequency amplifiers and their component parts, the Type TMS-36 visual test set is announced by RCA Victor Company, Inc., Camden, N. J. The operation is extremely simple. An image of the resonance curve is projected on a screen, and it is only necessary for the operator to adjust the device under test to obtain the required resonance curve. The screen may be calibrated, both as to band width and amplification. An attenuator system is included for adjusting the signal to the proper level for the various stages when cascade amplifiers are being tested. An im-

pedance matching unit is included, eliminating the use of an additional tube when individual transformers are being tested. This instrument contains a variable frequency oscillator, an attenuator, an impedance matching unit, a combination amplifier or detector unit, and a single element oscillograph.—*Electronics, October, 1931.*

Zeleny electroscope

FOR USE IN COLLEGE PHYSICS and research work on ionization, an instrument known as the Zeleny Electroscope has been developed by the Central Scientific Company, 460 East Ohio St., Chicago, Ill. The feature which distinguishes the Zeleny Electroscope from



the ordinary type electroscope is ease of observation of the effects of ionizing agencies, and ease of demonstration of these effects to a large class. The particular quantity observed is the frequency of oscillations of the leaf, which increases proportionally to the intensity of the ionization which is being measured. The operation of the Zeleny Electroscope depending, as it does, on ionization of the air in the space between the insulated leaf system with its horizontal metal disk and a conducting plate or screen connected to earth, readily adapts itself to all experiments in which ionization can be produced in such space.—*Electronics, October, 1931.*

✦

Moving coil microphone

A MICROPHONE OF unique design has been announced by the Western Electric Company, 50 Church St., New York City. Essentially it is composed of a diaphragm supporting a coil of fine aluminum ribbon, wound edgewise, in the field of a permanent magnet. The diaphragm vibrates in response to sound waves impinging on its surface and causes the coil to vibrate in a like manner, cutting lines of magnetic force. Coil and diaphragm are so shaped and constructed that they act as a unit and their mode of vibration in the range of audible frequencies is substantially that of a plunger. In actuality then, the microphone is a generator whose electrical output, while very small, is proportionate to the magnitude of the sound vibrations which cause the movement of the diaphragm. The design of the diaphragm, and the manner in which it is compensated against resonance peaks by the use of acoustic circuits coupled to it, has resulted in a microphone which gives a uniform response throughout the audible frequency range.—*Electronics, October, 1931.*

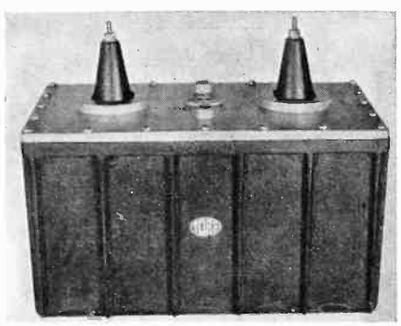
Light sensitive units

THE CHARACTERISTICS OF THE Light-O-Stat unit manufactured by the Photo-Electric Laboratories, Lansing, Mich., make it adaptable to many industrial applications including the following: Counting, grading and sorting according to color, transparency, etc., illumination control systems, measurements of absorbed and reflected light and traffic control systems. Manufacturers claim that these units are capable of responding to several thousand light changes per second. Current changes as high as four to five milliamperes may be obtained with this device depending upon the type of unit, voltage and light change used. — *Electronics, October, 1931.*

✦

Moisture-proof condenser

A MOISTURE-PROOF CONDENSER is now being manufactured by the Tobe Deutschmann Corporation, Canton, Mass. Manufacturers claim stock condensers of this new type have been left immersed in water for two weeks at a time, and when tested after being removed from the water showed no loss in resistance due to absorbed moisture.

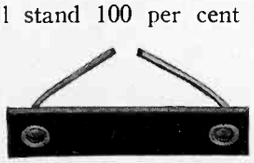


They also state that this same condenser has been left exposed to the elements—dew, rain, and the direct rays of the sun, during the high temperature and humidity of the entire month of July, and on being tested showed no loss in efficiency—*Electronics, October, 1931.*

✦

New process fixed resistors

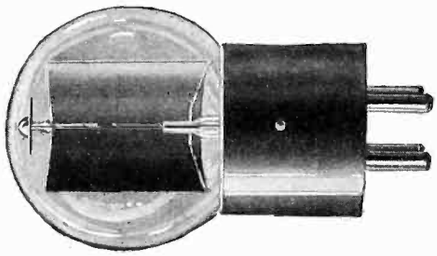
THE NEW LINE OF fixed resistors of the Soreng-Manegold Company, 771 Mather St., Chicago, Ill., are furnished in all standard resistance values, dissipating up to one watt. Manufacturers claim they will stand 100 per cent overload



for a considerable time and are noiseless in operation. They are stamped with their actual values, no color code being used. Samples are available on request. —*Electronics, October, 1931.*

Medium size photoelectric cell

TO MEET THE DEMAND for a cell of medium size with a globular bulb, a "Visitron" photoelectric cell is announced by the G-M Laboratories, Inc., 1731 Belmont Ave., Chicago, Ill. This



cell measures 2 1/8 inches from the bottom of the Bakelite base to the top of the bulb, the bulb itself being 1 5/8 inches in diameter. — *Electronics, October, 1931.*

✦

Dynamic speakers

WITH HEAVY STEEL CONSTRUCTION throughout, increased size of field case and core, and input transformers designed for individual output tube requirements, are some of the developments incorporated in the new Series 40 speakers (Models 144, 142, 143) announced by the Magnavox Company, 155 East Ohio St., Chicago, Ill. The Model 144 has a 7-inch cone, the Model 142 an 8 3/4-inch cone and the Model 143 a 10 3/4-inch cone. This series of speakers is provided with terminal panels having five solder-terminals. They may be obtained with screw-type terminal panel if desired at slight additional cost. An approved steel terminal cover, lined with insulation, fits tightly over the panel completely covering all high-voltage contacts. This is standard equipment and is supplied with all units unless otherwise specified.—*Electronics, October, 1931.*

✦

New bulletins available

The Ceco Manufacturing Company, Inc., announces publication of Engineering Bulletin No. 13A describing in detail the characteristics of the new 2-volt pentode Type 2333.

The DePree Sales Company, South Bend, Ind., has issued a bulletin describing the Fricker System of radio interference suppression.

The American Lava Corporation, Chattanooga, Tenn., has recently issued an illustrated bulletin on Lava and Magnesia. New materials, new designs and new applications for this type of insulation are given in detail.

The Automatic Switch Company, 154 Grand St., New York City, announces publication of Bulletin 1234 covering its Type L relay. This device is built in capacities of three, five and fifteen amperes, and supplements this company's line of remote control switches, contactors, etc., for use where the larger sizes are not required, and where space and the amount of control current are important factors.

Any of these bulletins may be obtained by writing the respective companies direct.

BRITISH PATENTS

IN THE FIELD OF ELECTRONICS

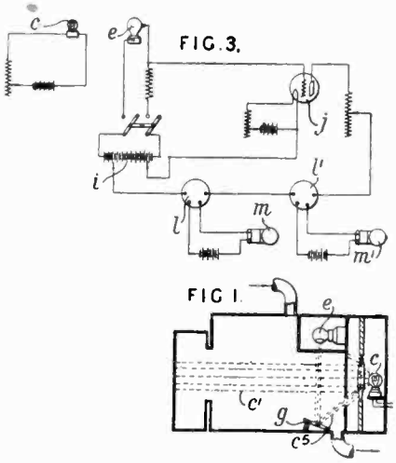
Patents recently issued by the British Patent Office and described briefly in the Advance Sheets, Groups 38 and 40 relating to thermionic valves, wireless, television, musical instruments, signals and alarms, and chosen by the editors of *Electronics* as of interest to the industry.

Electronic Applications

Gas characteristic measurement. Determining the quality of gas supplied for manufacturing by drawing it through a vessel which is in a high frequency circuit, the current in which is varied, impurities in the gas are read on a meter. Thomson-Houston, assignee of G. E. Inman, Cleveland Heights, Ohio. No. 349,204.

Distance-measuring apparatus. The use of thermionic valves to determine distances by means of sound waves. Siemens & Halske. No. 340,149.

Detection of foreign matter. A method of detection of foreign matter, smoke in air for example in which light is reflected or refracted onto a light-sensitive cell by the foreign matter. Kidde & Co., Cedar St., New York. No. 341,086.



Musical instruments. A method of varying the inductance in an oscillating circuit for variations of musical tone. N. S. Ananiew, Leningrad. No. 348,599.

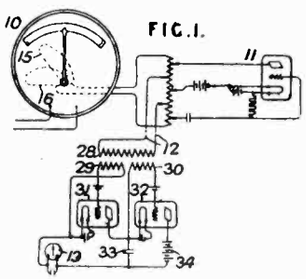
Protective system. Varying current flowing through light-sensitive cell in response to changes of light intensity, due to smoke, etc., is employed for biasing the grid of a tube. Associated Electrical Industries. No. 348,612, assignee of J. V. Breisky, Pittsburgh, U.S.A.

Sterilizing system. Automatic control of the addition of a sterilizing agent to water, by means of photo-electric cells. F. D. Allen, London. No. 348,654.

Alarm system. Burglar alarm system comprising a vacuum tube oscillator which is disturbed by capacity between a metallic object and the body of a burglar. E. M. F. Fromy, Paris. No. 349,496.

Photographic exposure control. Photo-electric system for varying the time of exposure according to the intensity of the light falling on the printed surface. A. Hilger, Ltd. No. 349,907.

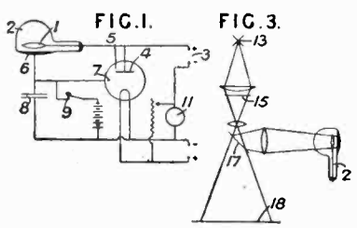
Remote metering. Indicating at a distance the movements of an indicating or integrating instrument for measuring or comparing frequencies by means of the charging and discharging of a condenser. British Thomson-Houston Co. No. 342,681.



Thermostat. A mirror device sensitive to temperature changes, controls the beam of light directed upon a light-sensitive cell whose output is amplified and fed back to a control device. Standard Telephones & Cables. No. 342,734.

Wireless control of doors. A method of opening and closing a garage door from a motor vehicle by wireless transmission. Martenet, Neuchatel, Switzerland. No. 344,278.

Exposure control. Automatic control of photographic exposure in printing by causing some or all of the light to fall upon a photo-electric cell. Cambridge Instrument Co. No. 344,900.

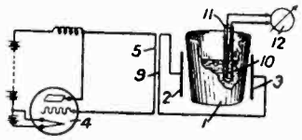


Apparatus control. Use of photo-electric cell and apparatus for the control of equipment such as train control systems. W. Baseler and F. Hoffman, Munich, Germany. No. 345,636.

Protective system. Oscillating circuit whose frequency is changed by the approach of a person or object, or by a rise of temperature. M. A. Chardin, Paris. No. 347,761.

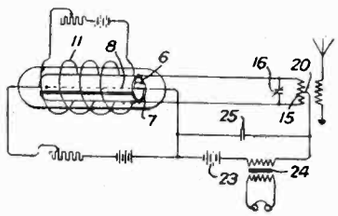
Direction determining system. A method of determining the direction of a source of sound waves by means of time retardation paths. Submarine Signal Co., Boston. No. 348,262.

Impurity measurements. Testing the purity of solid or liquid hydrocarbons by subjecting the material to the action of short electric waves, and measuring the resultant temperature change. Frequencies of the order of a hundred-million cycles are used. A. Esau, Jena, Germany. No. 345,464.



High Frequency Apparatus

Receiver. A magnetron receiver for the detection of waves of three meters and under. Thomson-Houston Co. No. 340,456.



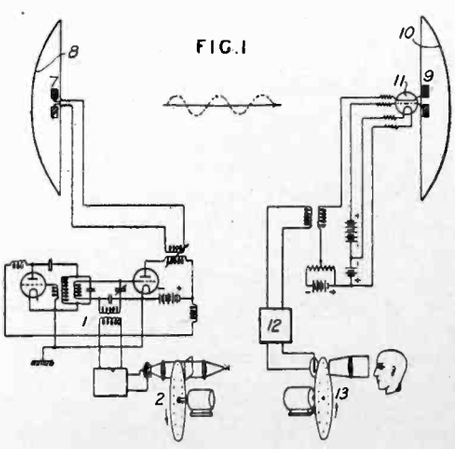
High frequency generator. A dipole radiator is arranged along the focus of a reflector, and excited to produce radiation of very short wave lengths by being connected to a low potential d.c. source, the two radiators being short-circuited periodically by an interrupter. J. J. V. Armstrong, Liverpool. No. 344,620.

High frequency generator. A piezo electric crystal ground to have two natural frequencies of vibration. Kolster-Brandes. No. 344,694.

Duplex system. Duplexing on a very short wave. Telefunken. No. 345,918.

Superheterodyne. A short wave superheterodyne designed to prevent readjustment of the input circuit from affecting the frequency of a local oscillator. Marconi Co. No. 347,272.

Double modulation transmission. A method of transmitting on frequencies (one meter and decimeter wave length) television, multiplex telegraph and other signals, by radiating them in a sharply concentrated beam and modulating them by one or more intermediate carrier frequencies. Telefunken. No. 348,328.



[*Continued on page 170*]

U. S. PATENTS
IN THE FIELD OF ELECTRONICS

A list of patents (Sept. 29) granted by the United States Patent Office, chosen by the editors of *Electronics* for their interest to workers in the fields of the radio, visio, audio and industrial applications of the vacuum tube

Vacuum Tubes, Light-Sensitive Devices

Double-grid tube. Manufacturing patent controlling a pair of concentrically-disposed control elements. F. S. McCullough, assigned to Westinghouse E. & M. Co., No. 1,822,162.

Supporting structure. A method of supporting the electrodes in thermionic tubes. Robert Hardy, Jr., assigned to Arcturus Radio Tube Co. No. 1,822,732.

Rectifier. A method of producing and maintaining a deposit of an electropositive metal on the cathode of a gaseous rectifier. H. C. Rentschler and W. W. Merrymon, assigned to Westinghouse Lamp Co. No. 1,821,238.

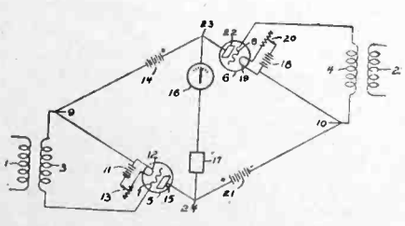
Light-ray source. Gaseous tube containing a filament, anode and control electrode, connected in an oscillatory circuit. O. T. McIlvaine, East Cleveland, Ohio. No. 1,821,442.

Vacuum tube manufacturing. A method of manufacturing vacuum tubes. Bernhard Loewe, assigned to RCA. No. 1,821,351.

Light control device. Doubly refracting liquid affected by electrostatic field, cathode and anode mounted in liquid. Emil Rupp, assigned to G. E. No. 1,823,703.

Generation, Detection, Etc.

Electrical balance circuit. A kind of bridge circuit in which two arms are composed of the cathode-anode path of tubes, and the other arms composed of batteries supplying the anode circuit. C. B. Mirick, assigned to Federal Tel. Co. No. 1,822,996.



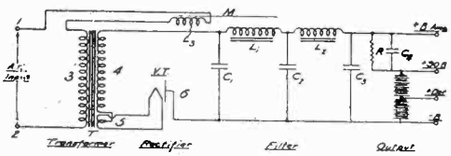
Voltage changer and booster. Vacuum tube oscillator supplies a.c. from d.c., this output is rectified and provides source of d.c. power. Rectified d.c. can be added to original d.c. to boost voltage. B. F. Miessner, assigned to RCA. No. 1,823,837.

Automatic gain control. Variable amplification method controlled by amplitude of signal; also method of indicating logarithm of amplitude of received signal. R. A. Heising, assigned to W. E. Co. No. 1,823,360.

Light relay control. A crystal light valve connected across the output of an amplifier for producing electric double refractions of polarized light beams in accordance with fluctuating potentials from the amplifier. Fritz Shroeter, Berlin, assigned to G.D.T. No. 1,821,948.

Frequency stabilizer. A method of maintaining constant the frequency characteristics of a high frequency circuit. L. A. Hyland, assigned to Wired Radio, Inc. No. 1,822,812.

Electrical filtering system. In a conventional rectifier filter system, coupled to one of the filter coils is an inductance carrying current from the primary side of the transformer connecting line to rectifier. H. W. KaDell, assigned to National Carbon Co. No. 1,821,016.



Rectifier relay circuit. The use of a parallel resistance and condenser to control the actuating and releasing periods of the relay in a vacuum tube circuit. D. Thierbach, assigned to Siemens & Halske. No. 1,822,072.

High potential generator. A constant output generator for X-ray tubes. Arthur Mutscheller, assigned to Wappler Electric Co., Inc. No. 1,822,463.

Power supply. Transformer, rectifier, filter, output potentiometer, power supply, also adapted to furnish negative potentials of various values to the grid of a tube. H. S. DeMalaussene, Los Angeles, Cal. No. 1,822,592.

Push-pull amplifier. Resistance input and output circuit. C. A. Culver, assigned to Wired Radio. No. 1,822,922.

Three-phase generator. Method of generating three-phase high frequency current by means of a push-pull circuit. S. A. Barone, assigned to Federal Tel. No. 1,823,851.

Frequency range compression. A method of compressing a 3,000-cycle band into a 1,000-cycle band by modulating, for example, a 7,000-cycle frequency with the output of a 3,000-cycle low-pass filter. The frequencies between 4,000 and 7,000 cycles are then admitted to a modulator through a band pass filter, where they are combined with a frequency varying between 8,500 and 10,500 cycles at the rate of 1,000 cycles per second. This output then passes through a band pass filter, attenuating everything except the band between 14,500 and 15,500 cycles. At the receiving end, the inverse process to recover the 3,000 cycle band. W. T. Wintringham, assigned to A. T. & T. Co. No. 1,821,997.

Frequency compression. A method of reducing the width of the frequency band required for signalling, by breaking the message into narrow frequency bands, replacing each band by a lower frequency, transmitting these frequencies to the receiving circuit where the inverse process goes on. Allen carpe, assigned to A. T. & T. Co. No. 1,821,004.

Electronic Applications

Condenser testing system. Combined a.c. and d.c. circuit with indicating instruments for measuring and testing condensers. H. W. Houck, assigned to Dubilier. No. 1,823,492.

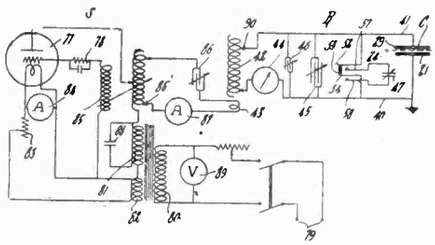
Synchronous brake. Use of amplifier and rotating disc in a synchronous braking system. Rene Barthelemy, Seine, France. No. 1,823,779.

Intensity of ignition measurement. When an explosion in a cartridge occurs, the biasing battery of a tube is disconnected or changed in voltage. P. P. Quayle, assigned to Peters Cartridge Co., Cincinnati. No. 1,824,407.

Electrical musical instruments. Patents No. 1,823,716, C. J. Young and No. 1,823,724, W. L. Carlson, both assigned to G. E. using vacuum tubes and accessory apparatus for the electrical production of music.

Telephone recording system. V.t. amplifier for recording telephone conversation on dictaphone record. H. S. Worrell assigned to Dictaphone Corp. No. 1,823,717.

Material testing. Material to be tested is run through the plates of a fixed condenser acting as part of an oscillatory circuit. Variations in frequency give an indication of thickness, etc., of material. Albert Allen, assigned to Atlantic Precision Instrument Co. No. 1,824,745.



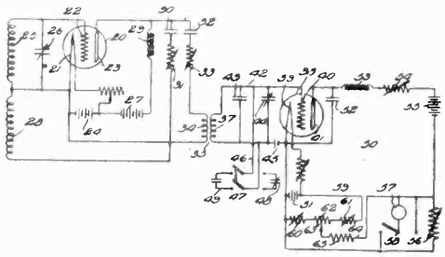
Remote graphing. A method of transmitting graphs to a distant point by means of two sets of two frequencies, one varying in accordance with right- and left-hand components of the graph, and the other corresponding to up and down components of the graph. David Grimes, assigned to Grimes Radio Engineering Co. No. 1,822,868.

Remote control indicator system. The use of high frequencies for translating to a distant point the motions of an indicating instrument. Kurt Wilde, Berlin. No. 1,822,683.

Photo-electrically controlled pattern apparatus. The use of photo tubes for controlling apparatus of looms for weaving figured fabrics. K. Nakanishi, Japan. No. 1,822,306.

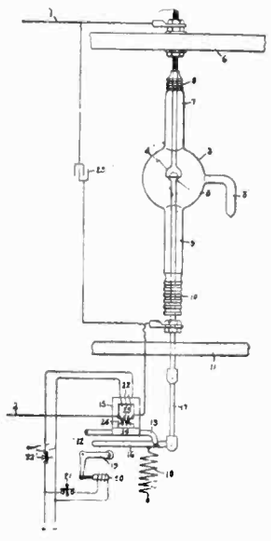
Phonograph coupling. Phonograph coupling into a detector tube turned on and off automatically by the tuning mechanism whereby the detector can be used as an amplifier. A. H. Grebe and P. D. Lowell, assigned to A. H. Grebe & Co. No. 1,822,653.

Measuring the freeness of pulp. The dielectric capacity of pulp is measured by an electron tube oscillator circuit. F. L. Simons and R. M. Fuoss, and H. A. Kenna, assigned to Skinner & Sherman, Inc., Boston. No. 1,822,604.



Synchronizing. To prevent effect of transients in television or facsimile synchronizing, the signal for such synchronizing is divided at the receiver into several parts, delay apparatus is inserted and the signal is united again. A. C. Stocker, assigned to G. E. No. 1,824,635.

Circuit breaker. Contacts within an evacuated tube are separated by a magnet placed external to the tube. C. A. Nickle, assigned to G. E. Co. No. 1,821,813 and No. 1,821,814.



Light indicating system. Gas discharge tube with cold electrodes is arranged in an oscillatory circuit so that for given light intensity no current flows, but that current flows for a decreased light intensity. G. R. Fisher, assigned to Federal Tel. Co. No. 1,821,698.

Geophysical prospecting. An alternating current method of discovering and determining position, configuration and nature of ores, salt solutions and other bodies under ground. Karl Sundberg and E. D. Lindblom, Stockholm, Sweden. No. 1,820,953.

Electrical measuring instruments. The use of amplifier tubes and lamps for controlling voltage between two points in the circuit. Samuel Aronoff, assigned to Westinghouse E. & M. Co. No. 1,822,075.

Measuring light intensity. A method of measuring light intensity by translating various intensities into various frequencies. Walter Roberts, assigned to RCA. No. 1,822,061.

Hall effect apparatus. Alternating current supplied to Hall effect apparatus is translated into a direct current. P. H. Craig, Cincinnati. No. 1,822,129.

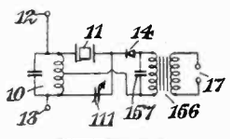
Inverter. A method of converting d.c. into a.c. described in *Electronics*, May, 1931. P. H. Craig, assigned to Invex Corp. No. 1,822,130.

Selenium door closer. L. J. Kinnard and James Dunlop, assigned to Westinghouse Elec. Elevator Co. No. 1,822,152.

Radio Circuits and Antennas

Superheterodyne local-distance switch. Changing the gain in a superheterodyne intermediate frequency circuit in such a way that a change in the frequency response characteristic of the coupling device is not changed. H. C. Allen, assigned to G. E. Co. No. 1,821,780.

Piezo crystal receivers. Two patents granted to James Robinson, London, England. No. 1,821,032 and No. 1,821,033, forming the basis for the Stenode system. Claim 1, of the first patent which has 33 claims, indicates a system including transmitter and receiver, the selectivity of the receiver being such that there is no response to interfering signals whose carrier frequency lies outside the resonant curve of the receiver, but differs from the frequency of the wanted carrier by an amount less than the highest modulation frequency of the wanted signal. The relative amplitude of different modulation frequencies is altered in modulation of the carrier wave of the wanted signal, corresponding to the whole of the required modulation range to be reproduced, and either at transmitter or receiver, the relative amplitude of different modulation frequencies may be altered in the opposite direction.



Selective signaling system. Two oscillatory circuits of the same frequencies, but having different ratios of inductance to capacity, impress their signal energy on a third circuit in opposition to each other. The resulting electrical effect is passed on to a detector and amplifier. Louis Cohen, Washington, D. C. No. 1,821,906.

Short-wave receiving antenna. Transverse pick-up wires coupled to feeder wires, such pick-up wires being smaller than a half wave-length in order to de-tune them and to limit their effect on the velocity of energy transfer on the feeder wire. H. O. Peterson, assigned to RCA. No. 1,821,402.

Directive aerial system. Several parabolic reflectors arranged side by side, an aerial at the focus of each reflector, all aerials maintained in the same phase, so that concentration of energy radiated is substantially proportional to the sum of the apertures of the reflectors. C. S. Franklin, Buckhurst Hill, England. Assigned to RCA. No. 1,821,380.

British Patents

(Continued from page 168)

Superheterodyne. Receiver for frequency modulated signals, in which the amplitude from the intermediate frequency amplifier is kept constant by current limiters. J. E. Hammond, Gloucester, Mass. No. 343,538.

Piezo electric receiver. A series of patents granted to J. Robinson, Mill Hill, London, in which by means of Piezo crystals, the selectivity of a receiver is increased to such a point as to prevent interference removed from the carrier frequency by less than the highest modulation frequency of the desired signal. Nos. 344,034, 344,869, 344,887, 346,811, 347,638, 349,083, 349,557, 350,014.

Superheterodyne receiver. To prevent heterodyne hisses and other noises in reception, the average percentage modulation in the transmitter is maintained approximately constant for soft and loud signals, and the amount of energy radiated from the aerial is varied in reverse proportion to the strength of the microphone current. Marconi Co. No 346,318.

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1,710,073, 1,714,191, S. Ruben, Electrical condenser, filed June 3, 1931, D. C., E. D. N. Y., Doc. 5525, *Ruben Patents Co. et al.* v. *Aerovox Wireless Corp.*

1,403,475, H. D. Arnold, Vacuum tube circuit; 1,520,994, same, Electron discharge amplifier; 1,448,216, R. A. Heising, Signaling system, filed June 15, 1931, D. C., E. D. N. Y., Doc. 5548, *Radio Corp. of America et al.* v. *Airplane & Marine Direction Finder, Inc.*

1,797,205, H. W. Houck, Electron tube apparatus, filed July 29, 1931, D. C., Del., Doc. E 898, *Dubilier Condenser Corp.* v. *National Union Radio Corp.* Doc. E 899, *Dubilier Condenser Corp.* v. *Perryman Electric Co., Inc.* Doc. E 900, *Dubilier Condenser Corp.* v. *Radio Corp. of America.*

1,173,079, E. F. Alexanderson, Selective tuning system; 1,195,632, W. C. White, Circuit connections of electron discharge apparatus; 1,251,377, A. W. Hull, Method of and means for obtaining constant direct current potentials; 1,297,188, I. Langmuir, System for amplifying variable currents; 1,728,879, Rice & Kellogg, Amplifying system, D. C., E. D. Mo., E. Div., Doc. 9412, *Radio Corp. of America et al.* v. *Trav-ler Mfg. Corp.* Consent decree July 27, 1931.

1,231,764, F. Lowenstein, Telephone relay; 1,426,754, R. C. Mathes, Circuits for electron discharge devices; 1,465,332, H. D. Arnold, Vacuum tube amplifier, D. C., E. D. Mo., E. Div., Doc. 9413, *Radio Corp. of America et al.* v. *Trav-ler Mfg. Corp.* Consent decree July 27, 1931.

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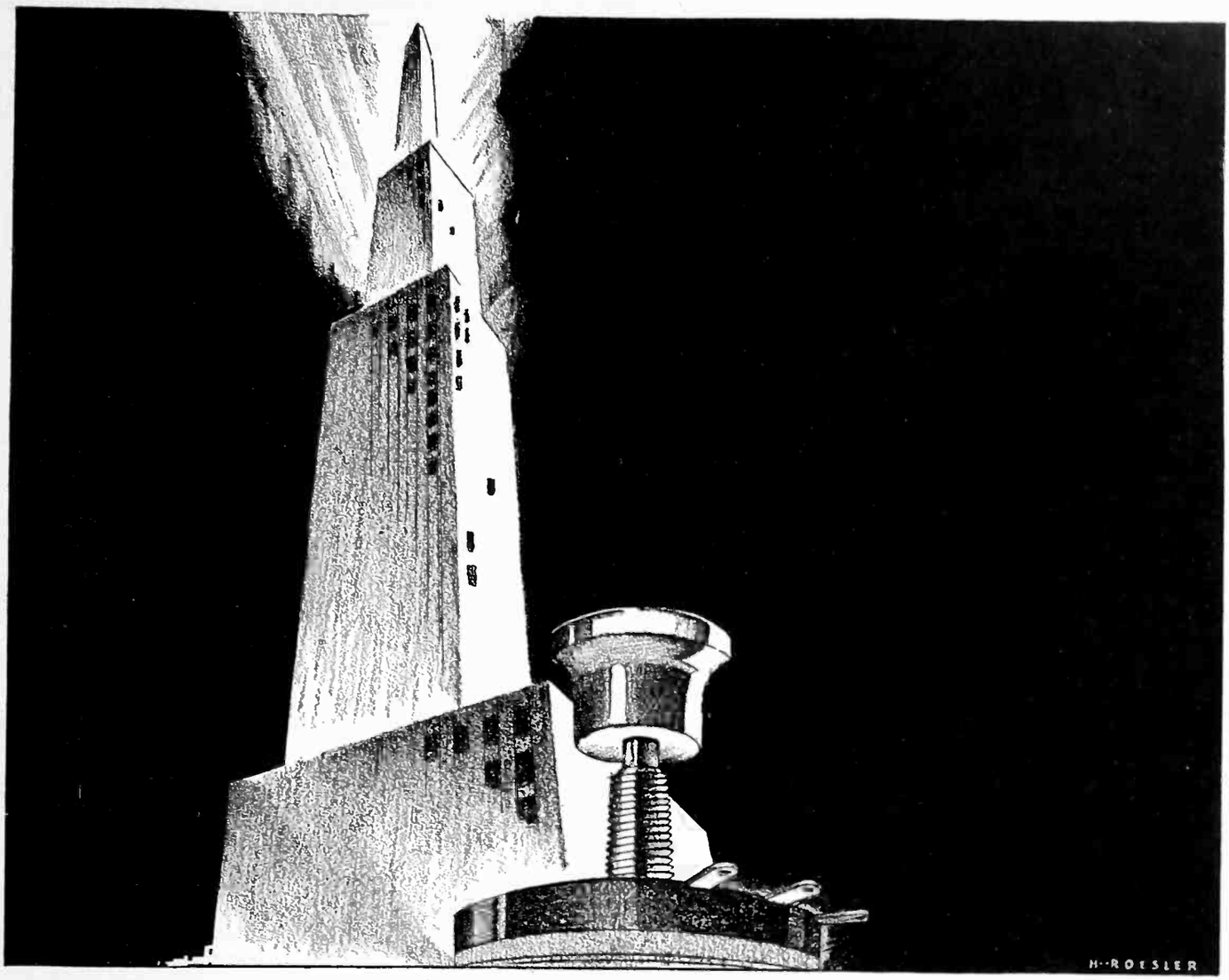
1,125,476, G. Claude, System of illuminating by luminescent tubes, filed Apr. 17, 1931, D. C. N. D. Calif., N. Div., Doc. 582, Claude Neon Electrical Products, Inc., v. A. Alderson (Alderson Neon Sign Co.). Doc. E 3158, Claude Neon Lights, Inc., et al. v. J. B. Linstrom et al. Consent decree dismissing bill against The Pierce-Arrow Sales Co. and for an injunction against J. B. Linstrom May 22, 1930.

1,271,529, M. C. Hopkins, Acoustic device, D. C. N. J., Doc. E 2770, Lektophone Corp. v. Pal Radio Corp. Discontinued Feb. 18, 1921. Doc. E 3999, Lektophone Corp. v. Apollo Radio Co., Inc. Discontinued Feb. 9, 1931. Doc. E 4000, Lektophone Corp. v. Naedele-Janney, Inc. Decree as above.

1,018,502, Just and Hanaman, Incandescent body for electric lamps; 1,180,159, I. Langmuir, Incandescent electric lamp, appeal filed June 26, 1929, C. C. A., 3d Cir., Doc. 4182, Santa Fe Electric Co., Inc., et al. v. General Electric Co.



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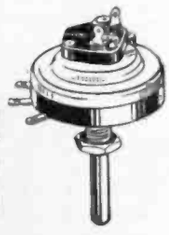

Electronic oscillators for industrial process control

[*Continued from page 145*]

is held above a swiftly moving sheet of newsprint, the ribbon's length varies minutely with the moisture content of the paper. One end of the ribbon is fixed, the other end is attached to the movable plate of an ultra-micrometer. Then, as the percentage of moisture in the paper varies, so does the length of the ribbon. These minute changes of ribbon length are indicated by the meter of the ultra-micrometer, which is calibrated directly in per cent of moisture content.

Publishers demand a certain percentage of moisture left in the paper when manufactured, to give it the characteristics desirable for high-speed printing. Furthermore, in paper mills where production runs about 600 tons a day, it is a very costly waste to dry the paper more then is necessary. On duty, therefore, in pulp mills all over North America are condenser ultra-micrometers, guarding every page of tomorrow's newspaper against being too wet to print clearly—or too dry for going through a high-speed press without tearing.

Consider, for instance, continuous indication in a manufacturing process—the operator knowing at every instant the condition of his product. No process can be operated faster than the characteristics of the product can be controlled. Rubber sheet must not be turned out faster than its thickness can be measured, for either it will be too thin, and will not stand up in the final product, or it will be too thick, thereby wasting rubber. Only when the sheet is just the thickness desired is its manufacture profitable. When the thickness is slightly off either way, there is a loss—and the faster the production the greater the loss.

Listing these many developments does not indicate that the possibilities in this field have been exhausted. On the contrary, the condenser measuring devices only lead to the thresholds of great new fields of application. For example, in the field of industrial control alone, the condenser calipers and moisture meter are but an introduction. Almost every conceivable property, every condition of a product, can vary the characteristics of an electrical circuit, especially at high frequencies. It is therefore possible, by measuring the changes in electrical circuit, to indicate the changes in the product. But above all;—these indications can be had continuously, without touching the product, and with extraordinary sensitivity. All these three characteristics are becoming basically essential in control methods.

For these same reasons—the close profit margin and immense volume of modern quantity production, does the condenser caliper serve as guide to the future in precision measurement. Measurements in the hundred thousandths of an inch, or finer, are at the present time rare in industry, but will have to become a matter of course as quantity production and standardization increase.

Continuous indication and fine measurement are not the only industrial developments of which the condenser caliper is an advance notice. It also foreshadows the coming of control without contacting or disturbing the product controlled. Regulating the thickness of rubber without touching the rubber; or the moisture of paper without in any way abusing the paper—both show that the day is not far off when mixtures will be sampled without taking samples; when the fineness of finely divided aggregates will be measured without measuring; and when materials will be weighed without weighing. And the road into these fields lies through the application of electron tubes to measuring and controlling by electrical methods.

Studio practice in noiseless recording

[*Continued rom page 147*]

maintained the same maximum level, we could allow our weakest modulation to drop still lower by the amount of noise reduction we were using. In practice, however, this has not worked out so well, because it has often been found, that while the very weakest modulations do actually keep out of the surface noise when listened to in a small and quiet review room, they are usually drowned out completely by audience and ventilator noise when projected in the average theater.

General recording level kept lower

A much better way to utlize the advantages of noiseless recording is to reduce the general recording level somewhat, so that more leeway is had for occasional peaks, and still allow enough room at the low modulation end. The combination which has worked out with greatest success so far is to use 14 db. noise reduction and drop the recording level 4 db. below that used for standard recording. This gives us practically 10 db. less surface noise than standard recording, and at the same time provides 4 db. more leeway for occasional peaks. This setup has proved to be very practical. Every monitor man knows that it is virtually impossible to make a temperamental movie star keep his or her voice between two fixed limits of level, and whereas in standard recording the monitor man lived in constant fear of getting a raspy overload every time the volume indicator kicked off scale, due to the fact that the recording level was set so close to the overload point of the valve, he has now found that he can allow such peaks to ride and at the same time not worry about surface noise when the level drops way down.

Other "noises" should be reduced

It should always be borne in mind that with noiseless recording we have by no means eliminated every source of noise. In fact, as was mentioned in the first part of this article, some noises actually become more noticeable as a result of noiseless recording. With standard recording, a certain amount of background noise was always taken for granted, and this was often allowed to cover a multitude of sins. Noises originating on the stage, for instance, such as camera noise, trucking noises, and outside interference, were often allowed to get by because they would be drowned out by the surface noise anyway.

Noises in the theater itself, such as ventilator noise, or mechanical noise from the projection booth, become very noticeable, and even annoying, when noiseless recordings are played for the first time. This has actually aroused complaints in many instances from theater operators, who claimed the films were too quiet!

Noiseless recording undoubtedly has instituted a major improvement in recording sound for motion pictures. With its adoption we have also had to accept certain disadvantages, such as complicated equipment, more maintenance, more rigid laboratory specifications.