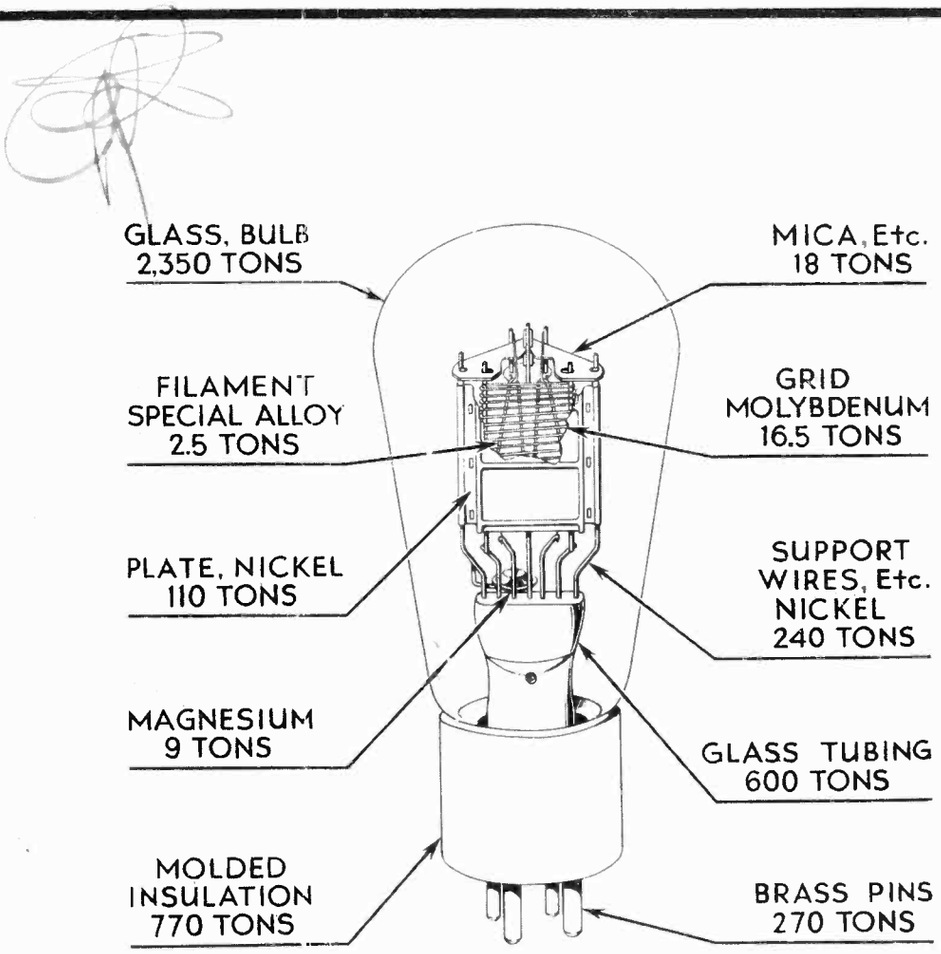
electronics

electron tubes—their radio, audio, visio and industrial applications

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



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A McGRAW-HILL PUBLICATION

New York, November, 1930

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he march of the electronic arts

radio case
preme Court

the welter of litigation in which leral Radio Commission has be- nvolved, the Supreme Court of ited States will get the case of a ly small Chicago broadcasting this year for the first real show- n the basic radio law.

eted at No. 29 on its fall calen- e case of WCRW is expected to efore the highest tribunal in the me time this month or next. se, arising out of an order of the sion reducing the power of the o station from 500 to 100 watts, finitely determine the constitu- y of the Radio Act of 1927 which the commission and under which ody has been functioning for three years.

ther point raised in this case is r the waiver of vested or priority signed by each station owner in g for a federal license, is con- nal. In certifying the case to the court, the Court of Appeals did rtify whether the Commission's was void; in fact stated nothing ning the Commission's authority, t the station has been in status nce it reduced its power.

case of WMBB-WOK, also of go, a 5,000-watt station which was d off the air altogether in one of rliest decisions of the Commission, een combined with the WCRW inasmuch as many of the same are involved. Besides the dep- on of property issue, however, the B-WOK case raises the point that is not interstate commerce and s the validity of the Davis amend- equalizing broadcasting facilities g the zones and states.

e standards prescribed for radio ns in the radio act are also a point ue.

U. S. radio exports ahead of last year

United States exports of radio apparatus during the eight months ended August 31, 1930 registered a gain over the corresponding period of last year, according to the Electrical Division, Department of Commerce.

Total exports of radio apparatus during the 1930 period amounted to $11,904,171, an increase of $15,050 over the total for the eight months of 1929.

Shipments of receiving sets alone totaled $5,583,301 during the 1930 period as compared with $4,620,922 for the eight months of 1929; receiving tubes $1,592,578 in comparison with $1,112,096, and receiving set components, $2,201,736 as against $2,194,200.

Canada was the leading market for radio apparatus during the first eight months of 1930. Italy is becoming an increasingly more important market for radio apparatus and during the month of August shipments of receiving sets to that country were valued at $52,325 and receiving set components at $38,128, while shipments of loudspeakers amounted to $11,436. Mexico imported $89,379 worth of radio receiving sets from the United States and New Zealand, $77,727 worth. Argentina and Uruguay each took approximately $39,000 worth of these sets. Argentina also imported $32,223 worth of American receiving set components.

✦

DR. R. A. MILLIKAN

with the electroscope he used at the north magnetic pole to determine effect of earth's field on cosmic rays

Atom is X-rayed by new process

Invention of a new X-ray tube which takes "snapshots of atoms" was announced to the New York section of the American Chemical Society at a meeting in the Engineering Society Building Oct. 17. The new tube takes in one minute difficult pictures that formerly required 100 hours and in one-fiftieth of a second "simple" pictures that took two hours.

The pictures are not the familiar shadow photos, such as taking the bones of a human hand, but a newer branch of X-ray photography known as diffraction patterns. These are pictures which show the arrangement of atoms in crystals. The tube was developed by Dr. George L. Clark, Professor of Chemistry of the University of Illinois. Dr. Clark stated the new tube would have wide applications in industrial development.

Fifty-one cities to use radio to catch criminals

So useful has radio proven in the apprehension of criminals in the larger cities that the Federal Radio Commission has been besieged with applications from smaller cities for radio stations. At present there are 29 cities utilizing short-wave communication service and 22 other cities hold construction permits.

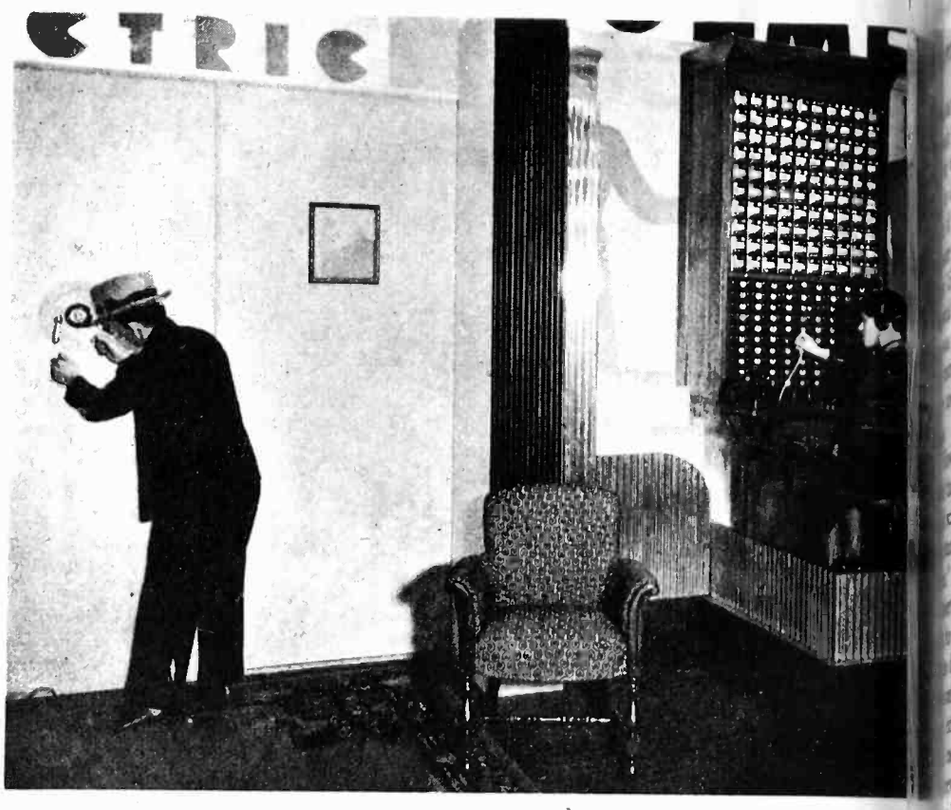
Stories of robbers being caught within a few minutes after they had held up a bank or forced a safe continue to multiply in the municipalities where this radio service is in operation. Radio-equipped automobiles patrol the city and are ready to speed to the scene of a crime immediately upon receipt of the signal. Thus the chances of a criminal escaping are greatly lessened from those of the time when police had to be reached by telephone or dispatched from headquarters or a precinct station. The service is being adopted in a few instances by Fire Departments.

The national capital is one of the most recent cities to obtain a permit to erect a station and equip its police cars with receivers. The contract has just been let, and the service is expected to be in operation before many weeks.

Construction permits have been awarded to Berkeley, Calif., Philadelphia, Pa.; Beaumont, Texas; Buffalo, N. Y.; Chicago, Ill.; Auburn, N. Y.; Youngstown, Ohio; Lansing, Mich.; State of Missouri; Kansas City, Kan.; Portland, Ore.; Rochester, N. Y.; San Antonio, Texas; San Francisco, Calif.; Toledo, Ohio; Seattle, Wash.; Akron, Ohio; Washington, D. C.; Vallejo, Calif.; Oklahoma City, Okla; New York Fire Department and El Paso, Texas.

✦ ✦ ✦

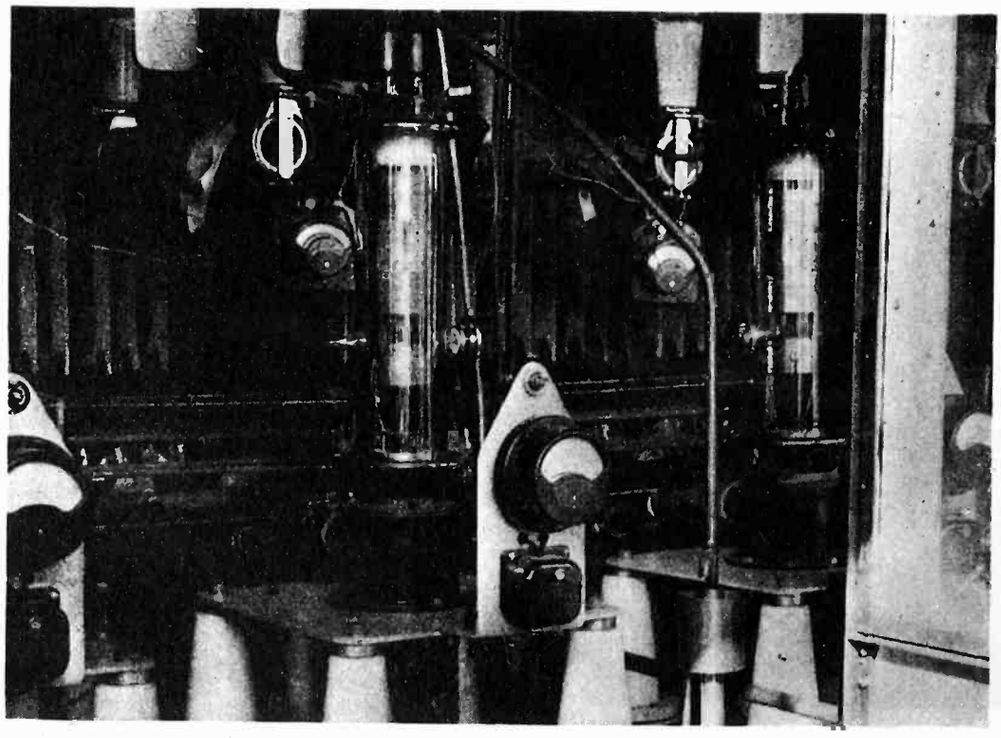
PHOTOTUBE ALARM AT N. Y. BUSINESS SHOW



As yeggman unknowingly obstructs invisible light beam an alarm is sent to switchboard. Device demonstrated by Holmes Electric Protective Company at New York Business Show, October 20-25

✦ ✦ ✦

POLISH RADIO STATION TO HOWL DOWN REDS



To combat Soviet propaganda broadcast from Moscow, Poland is building one of the most powerful stations in Europe. Six 100-kilowatt water-cooled tubes built by the Marconi works will be used

NBC admits practicability of synchronizing

In a statement to the Federal Commission, October 20, M. H. worth, president, National Broadc Company, reported the success of experiments in synchronizing the stations of WEAF, WGY and K on the 660-kc. channel, under the tion of C. W. Horn, chief engine

These experiments thus indicat a nation-wide broadcasting chain operated on one or two broadc wave lengths—instead of the prese of 15 to 25 wave lengths, all ca the same program (which results mid-west listener hearing the Ev Hour at 25 different places on his

How the new "synchronization is to be commercially applied rema be seen. Undoubtedly some p large broadcasters will willingly fer to the chain wave length for r operation and thus become more outlets. Other owners will certai sist on keeping their stations' own tity, making it necessary for the management to build its own high transmitters to cover such regions estimated total expense of $35,000

In any event, as pointed out b Aylesworth, the development wil slow evolution, involving consic reallocation of present broadcaste resulting in many more regiona grams of high signal intensity.

ican College of ons favors tronic knife"

nary results of a survey by the an College of Surgeons to deter- e actual worth of the electrical n combating disease were the of an enthusiastic report at a um on electro-surgery conducted 15, at Philadelphia, Pa. during ical congress of the college. The was made to determine the merits nstrument specifically in neuro- and the surgery of malignant

Howard A. Kelly of Baltimore l that electro-surgery was as far f scalpel surgery "as the modern tram is ahead of the lumbering ar."

sserted that the new technique the extension of surgery of the to delicate areas not dreamed of and opens up the possibility of extending the application of measures to the spinal cord. never is electro-surgery halted of hemorrhage, he said.

Ernest Sachs of St. Louis de- the development of the electrical one of the three great epochal ries for assisting the neuro- in his work. Where hitherto sometimes necessary to use sixty enty silver clips for ligating blood vessels, large tumors are moved without recourse to clips.

✦

ical transcriptions are used by many stations

broadcast stations are experi- with a new form of program ation. This new form which is electrical transcriptions consists k-up from a disc record. These are not played on regular phono- but by a special reproducing ma- esigned to meet the requirements dcasting.

sponsors of this type of enter- t see numerous advantages to ge them. In the first place, the can be made in a studio designed best accoustical effects. If an nakes an error the record can be gain which would not be possible normal broadcasting conditions. r advantage claimed is that the m may be presented at the se- hour for any station. This of is not possible with present na- nook-ups for big programs with a nce of three hours in time from to coast. Also the expense of ines to connect stations is elimi- by using the record system.

BROADCASTING SPORTS

Designed for short wave use this transmitter may be easily carried by two persons in following athletic events

✦

Carrier-current talk reaches 445 miles

Carrier-current communication for regular operating service has been installed between Pine Bluff, Ark., and New Orleans, a distance of 445 miles. This is said to be the longest communication distance ever covered in this way for regular service.

Incident to the construction of a 10-kv. line between Amite, La., and New Orleans, forming the final connecting link in the interconnection between the Market Street plant of the New Orleans Public Service, Inc., and the Sterlington steam plant of the Louisiana Power & Light Company, in the northern part of Louisiana, General Electric carrier-current equipment is used to permit communication between New Orleans and Amite, La.; Jackson and Indianola, Miss., and Pine Bluff, Ark.

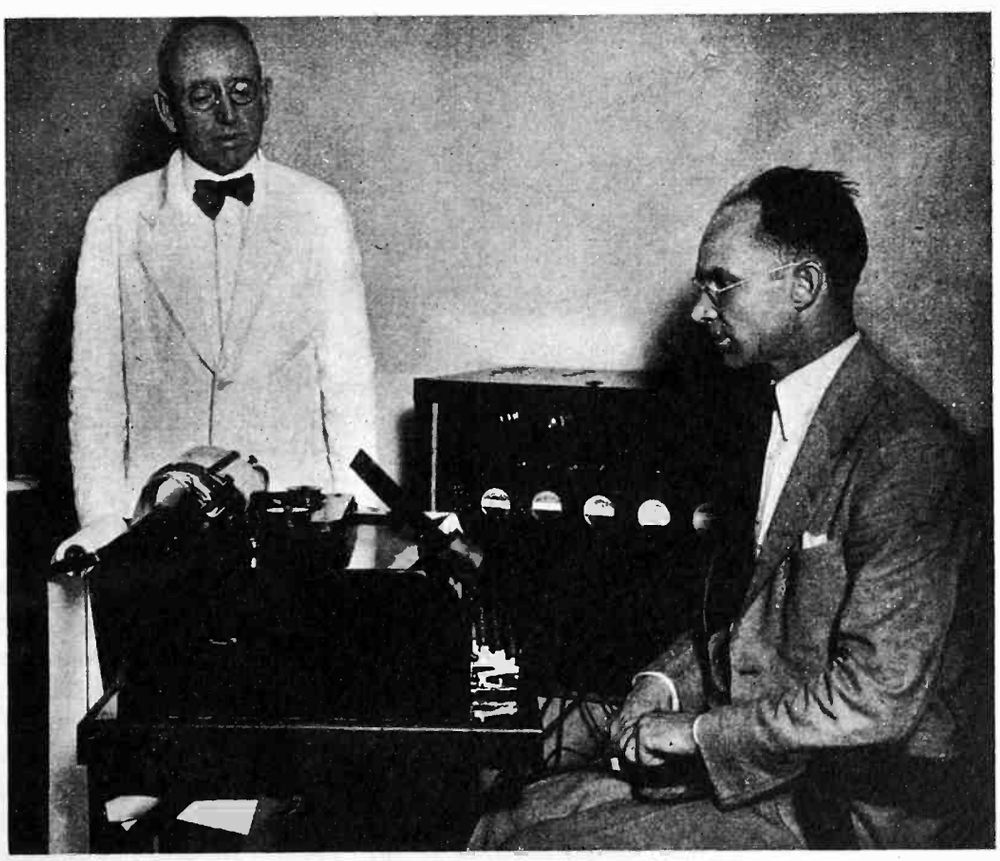
✦

Soviets spending millions on radio

A network of 62 radiotelegraph stations, furnishing service to strategic points throughout Soviet Russia, is planned by the Soviet government as part of its revised five-year program for the development of communications, the Department of Commerce has learned. The entire communications program of the Commissariat for Posts and Telegraphs involves capital investments aggregating about $683,000,000. Soviet Russia is paying particular attention to "wired wireless" or the transmission of radio programs along telephone wires.

✦ ✦ ✦

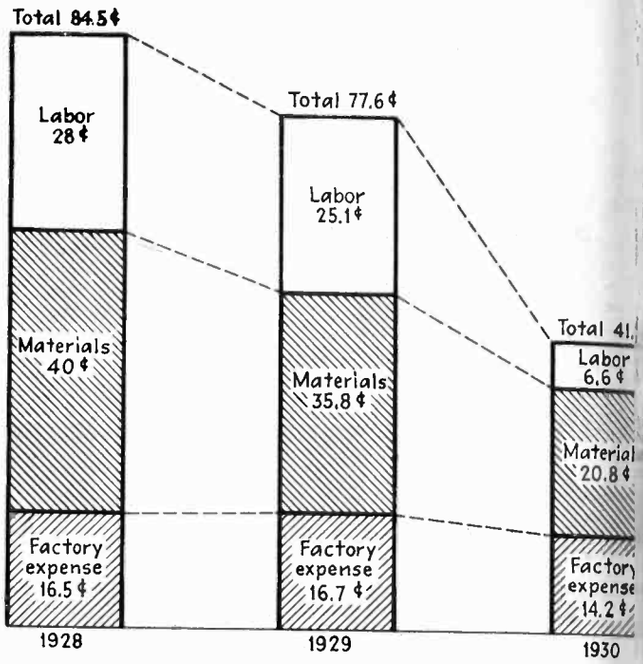
NAVY ADOPTS RADIO-OPERATED TYPEWRITER



Radio impulses are used to transmit typewritten messages direct from the Navy Department, Washington, to the Naval Operating Base, Hampton Roads, Va. Captain S. C. Hooper, Chief of Naval Communications is shown standing

RAW MATERIALS, COST

Price ranges over ten-year period. Labor and overhead factors in finished cost

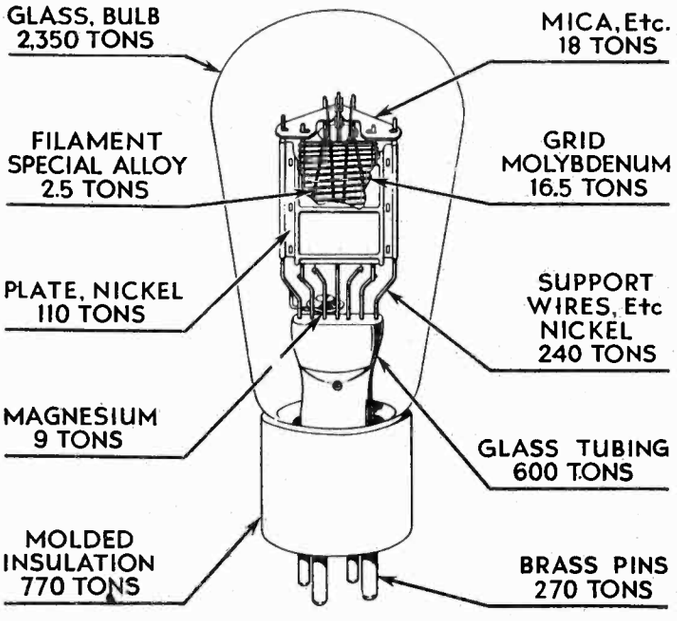


How the factors entering into manufacturing cost of tubes have been reduced since 1928. Material costs have come down, but owing to automatic machinery the labor cost per tube has been even more greatly reduced

CONSERVATIVE estimates indicate that 69,000,000 tubes of the types used in radio receivers were produced during 1929 and that the 1930 production will be of the order of 80,000,000.

The first "big" year of vacuum-tube production was 1923, when 4,500,000 tubes were made; since then the production has had an annual increase of about 10,000,000 tubes. During this period the costs of raw materials, labor, and other expenses have changed, with the results shown here. At the same time greater use of automatic machinery, coupled with quantity production, has lowered the tube cost; manufacturing experience and research during this period have given the consumer better tubes.

This vast assembly of glass, rare earths and common metals has consumed thousands of tons of raw materials made from 37 of the 90-odd elements found in the universe. Some of these elements are used in extremely minute quantities, but at great saving to the user of the tubes, strontium, barium, and thorium, for example (see page 390, this issue of ELECTRONICS); other elements are used in enormous quantities. In ten years the prices of these raw materials have fluctuated appreciably; the chart presented herewith shows these variations and points out how low present prices are.



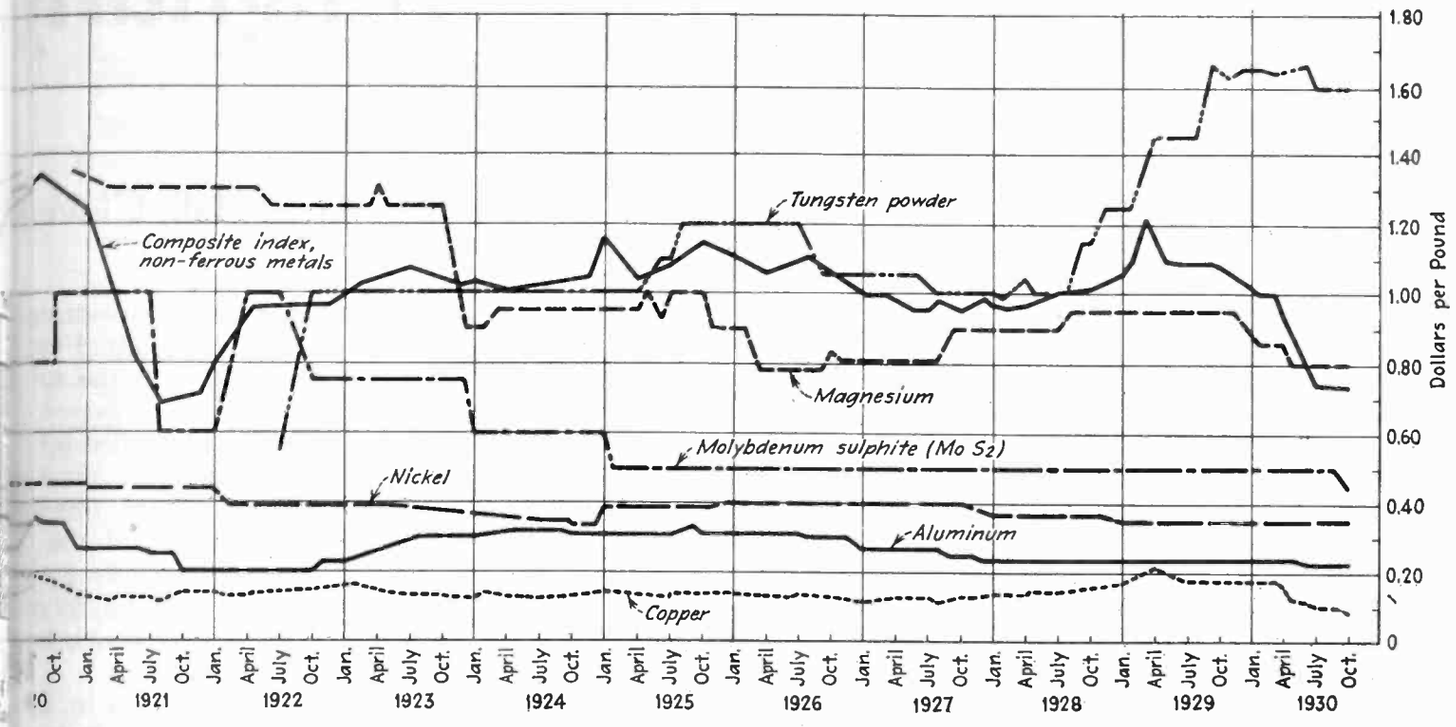
Total material used in 69 million receiving tubes

	Tons		Tons
Glass	2,950	Magnesium	8.9
Nickel	350	Copper-steel	50
Molybdenum	16.5	Molded material (base)	770
Brass	280	Barium, strontium compounds	?

Kaleidoscopic changes in industry

During this decade the uses of some of the elements entering into vacuum-tube production have increased. At the same time there has been a change in the metals used for specific parts of tubes, so that the entire picture of ten-year history is rather kaleidoscopic. The production of molybdenum is an interesting example. In 1923 three sales were made by one company. The prices were 80 cents, $1 and 60 cents. At that time very little had been found for the now well-known "moly." Since then other uses than tube manufacture have appeared so that the stock on hand of one company is sufficient for last tube manufacturers about 200 years. Molybdenum is mined in Colorado as molybdenum sulphide (MoS_2), the concentration of the ore being about 85 per cent. This sulphide, about 60 per cent of which is molybdenum, is sold to chemical concerns, which in turn sell it to tube manufacturers and suppliers of tube parts as an ammonium compound of molybdenum. From this material grid wires are wound.

TUBE MANUFACTURE



How the prices of some of the raw materials and commercial metals entering into the electronic-tube industry have varied during the past decade. In general, the price movement is seen to have been downward. As the chart shows, prices for most materials are now at the lowest point reached during the past ten years

years the prices of tubes have dropped appre- ue to development of automatic machinery, onstruction, or other economies. As an exam- cost to produce a *227* by a well-known manu- in the month of September in three successive given here. It is broken down into labor, ma- st, and factory expense, the latter item including t and replacement of machinery at the rate of ent per year, rent, light, heat, power, etc., in ry. The most startling reduction in cost is to labor, occasioned by the greater use of auto- chinery. This cost has been cut in four; at the e the materials cost has been halved in three The over-all cost has been halved, and at the e better and better tubes have been made.

Estimates of material consumed

ties of material indicated here as entering into uction of 69,000,000 tubes were estimated in the manner: The weight of material used in ing 227, 224, and 245 types of tube were aver- l this value multiplied by 69,000,000. It is a ative but not accurate estimate of the tons of consumed by tube manufacturers in 1929. It include power tubes of the types used in trans- telephone repeater tubes (of which there are r-million in use), or special tubes of various ld by hundreds or thousands for various pur-

Roll-Call of Materials Entering Into Electronic Tubes

Glass

Silica
Sodium carbonate
Calcium oxide
Sodium nitrate
Lead oxide
Borax
Zinc oxide
Cobalt oxide
Potassium carbonate

Base

Bakelite
Porcelain
Glass
Wood fiber
Zinc
Copper
Nickel
Tin
Marble flour
Ethyl alcohol

Filament

Tungsten
Thorium nitrate
Carbon
Nickel
Cobalt
Iron
Titanium
Silicon
Barium carbonate
Strontium carbonate
Calcium
Barium nitrate
Strontium

Grids

Nickel
Monel
Molybdenum
Copper
Chromium

Plates

Nickel
Monel
Molybdenum
Iron
Tantalum

Leads

Zinc
Iron
Nickel
Copper
Borax

Supports

Glass
Mica
Lava
Isolantite
Nickel
Molybdenum
Monel

Getters

Magnesium
Calcium
Strontium
Barium
Sodium
Potassium
Caesium
Phosphorus
Carbon
Tantalum
Mischmetal

Gases

Hydrogen
Helium
Neon
Argon
Nitrogen
Oxygen

Electronic control of

Complex auditorium lightin

By DEAN H. HOLDEN*

Keyboard manipulation of color effects in great new Severance Hall, Cleve

WITH much of the success of the decoration of Severance Hall dependent on the subtle control of its light, the main switchboard required very special design. The synthetic system of red, green and blue lights, combined to give any hue, necessitated proportional dimming. A dimming preset mechanism with simple control of fadeout and fadein from setup to setup was vitally essential.

Basically, the intent of the designers of this system was to make it possible for a single operator, seated at a movable console, of organ type, to control, singly and in combination, all lighting circuits of the main auditorium and stage in a manner analogous to an organist's control of sound. All operating devices are in easy reach of hand or foot, and of sizes consonant with the finger or foot, respectively. The operation of all moving parts is not unlike the touch of a typewriter or organ.

All this is a far cry from the average switchboard of today, which has been aptly likened to a fourteenth century organ, struck with clenched fists. It was, then, the thought that centuries of development by organ builders could be applied to lighting control, and in the completed board in Cleveland there will be many standard organ parts. In fact most of the console equipment has been borrowed direct from either radio, telephone or organ practice.

Reactor and vacuum-tube system

Down in the basement apparatus room is a rack some twenty feet long and seven feet high which contains 114 reactors and their associated tube units. One reactor per load is provided. To make the operation of these units clear we will take any reactance dimmer as an example. The a.-c. load current flowing in the reactor is directly dependent on the d.-c. saturation current flowing in the other coil of the same unit. This d.-c. is supplied by two neon-filled rectifier tubes. Incident life of these tubes should be several thousand ho means are provided for compensation as the tul as well as for easy testing.

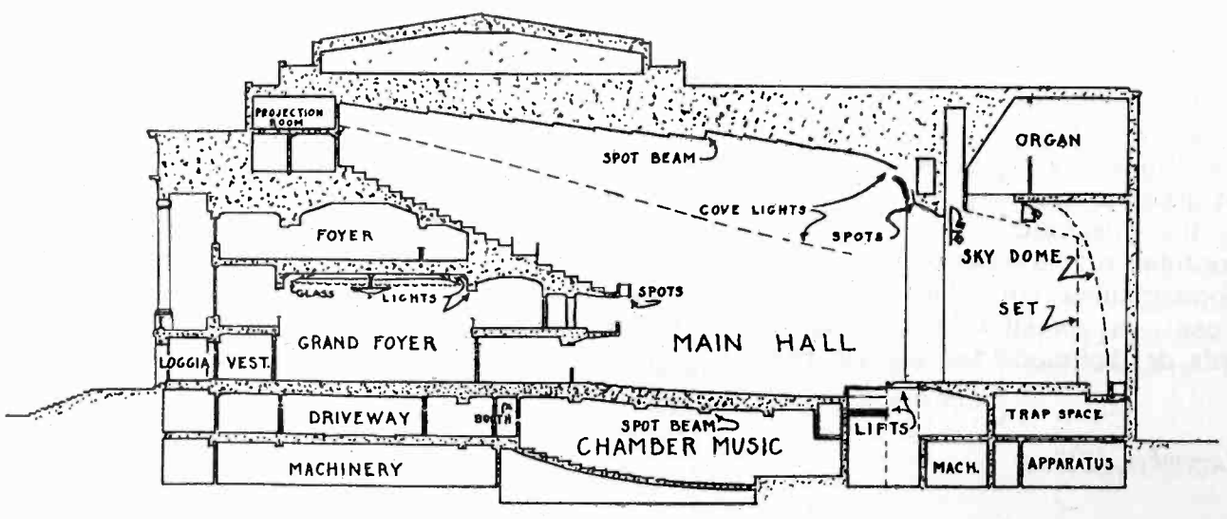
The output of these rectifiers is controlled by their grid bias. This is accomplished by a small conventional radio amplifier type. In turn, this a has its ouput controlled by a variation of the conventional radio "C" battery bias on its gric control wires to this grid come from one of the o dred and ten *vertical* busses on a relay panel, th center of the cross connecting mechanism.

The relay cross-connecting panel is also in th ratus room, very near to the tube system. It con 36 horizontal rows of relays, 110 in each row. *horizontal* row is connected with one of the 36 control drums on the console. Each vertical row nected to a one-tube control unit, its associated and in turn, load. It will be seen that by closi relay at the intersection of a *horizontal* with a bus, any one of the 3,960 possible connections made.

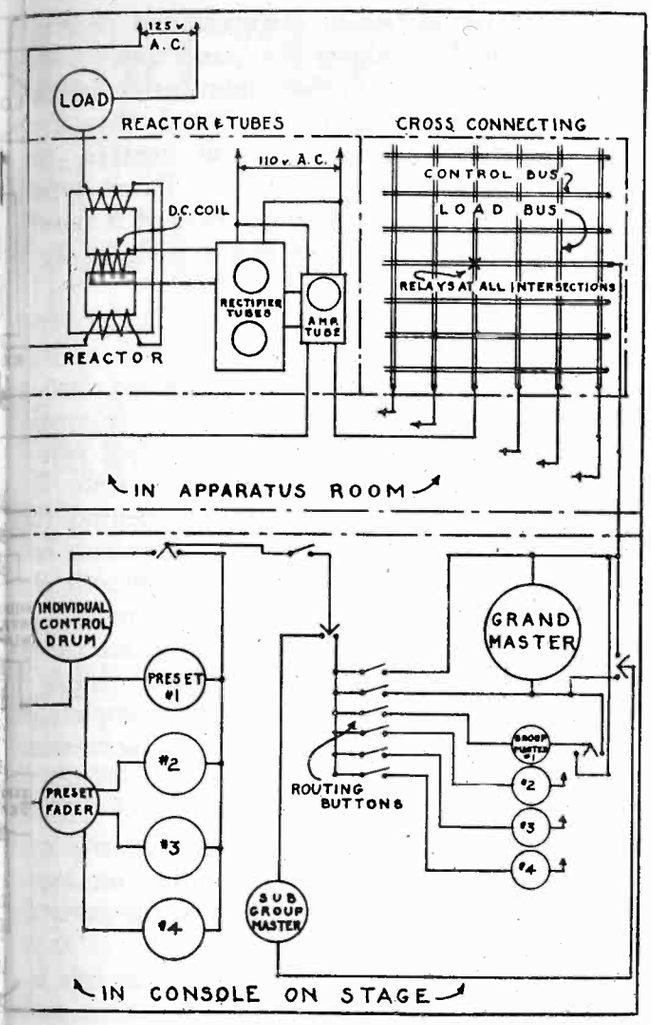
Operating console

It was obviously impossible to run four thousan to the console or accommodate that number of s The architects developed a diagram wherein th 110 load switches and 36 control selectors at the The operation of connecting loads No. 3 and N control No. 17 is as follows:

(1) Throw load switches No. 3 and No. 91 t
(2) Touch control selector button No. 17 whi pletes the circuit to the closing coils of f appropriate relays, which are then autom latched closed. Had the operator touched selector No. 2 instead, then these loads wou been connected to control drum No. 2. Th



Cross-section
main audit
which seats
hundred p



iagram of control circuits, showing method of acuum-tube supply of direct current to third leg f reactor, to produce magnetic saturation of core

peration is continued until all needed loads are connected to appropriate controls. Of course. after setting up a given control bus, all load switches, as No. 3 and No. 91 above are returned o neutral. To clear the board, all active load switches are thrown to "Off" and the hand run rapidly over the control selector buttons thus actuating the opening coils of all active relays.

e is an additional contact on each relay, which a pilot light. On the console are 36 buttons ed with the dimmer control selectors. By closing these, pilots glow at each load switch whose relay d thus giving a visual picture of the board setup. ppearance closely resembling in size and design ntional organ console, the Severance Hall switchrovides flexible control of 110 lighting circuits ty-six flexibly connected dimming controls, and ditional controls which do not pass through the nnecting mechanism. These latter are permaconnected to the down lights in the auditorium. y item we have:

Remote controls enabling the switching of any one or seven of the 110 load circuits to any one of the 36 inal control drums.

Thirty-six individual control drums which remotely l the resistance dimming of whatever circuits may be ted to them by the switching under (a).

Nine sub-group foot pedals, each capable of electrically lling any or all of the corresponding sub-group of four l drums.

Four group masters, foot or motor operated, each capf electrically controlling any combination of the 36 in-

er & Weeks, Architects, Cleveland, Ohio.
paper before *Illuminating Engineering Society*, October

dividual drum controls which it may be desired to connect to them.

(e) One grand master, foot or motor operated, capable of controlling electrically any or all individual controls or group controls.

(f) One preset dimming device associated with each individual control drum, but with individual scene faders operated on a common gang shaft by motor or hand. Small sliders provide for four presets of dimming on each control unit.

(g) Four individual controls and one master for handling the house direct lighting.

(h) Remote individual control for 20 four-color boomerangs on spotlights.

(i) Remote individual "Joy Stick" control for direction and focusing of nine spotlights.

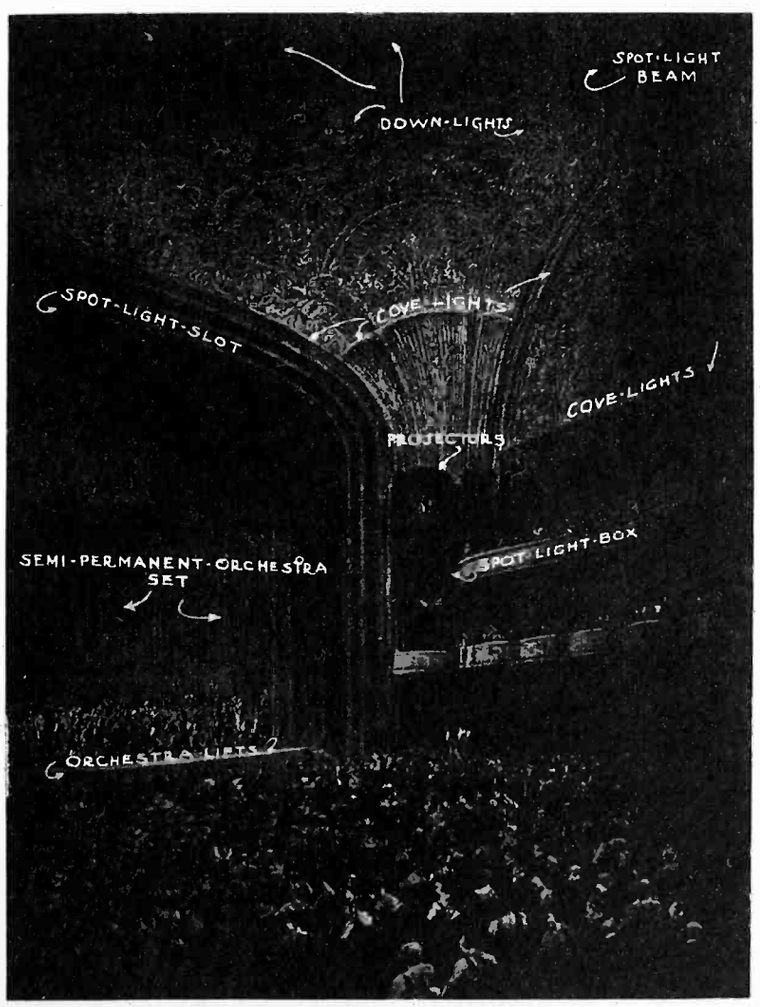
(j) Signals and remote iris diaphragm control to nine arc spot positions.

(k) Telephone to ten stations.

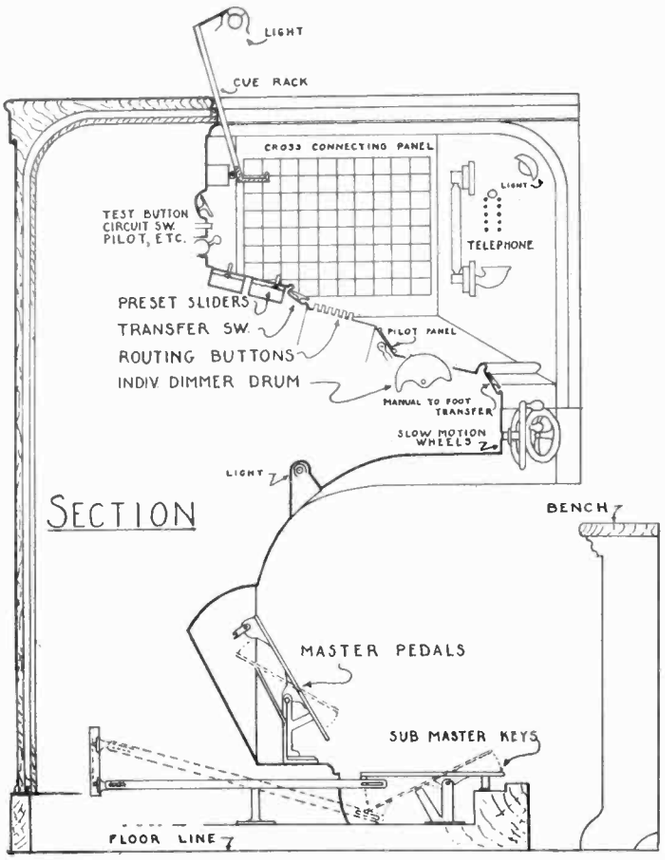
(l) Adequate illumination for cue sheet rack and all working faces of console, including pedal portion.

The console can be plugged in at two positions, one on the front orchestra lift and the other near the prompt position. It has a forty foot cable attached to it, containing in the neighborhood of 1,200 wires, encased in a vacuum cleaner hose. The weight of the console will probably not exceed half a ton.

In the console are located the potentiometers which control the grid bias on the small amplifier tubes mentioned earlier. Each individual control drum operates one of these resistance units. In turn these units can be cascaded through sub-group or through group master, each of which in turn can be fed from the variable voltage grand master bus or from direct feed. The individual unit, too, can operate direct from feed, independent of the mastering system. Lastly, any combination of individual controls can be fed from the grand master bus, without first going through group or sub-group masters.



Location of light-sources in auditorium



Physical arrangement and function of controls

Beginning at the floor, there are inclined foot pedals comparable to the swells of an organ, one for each group master and one for the grand master. In front of these are nine broad foot keys. These operate the sub-master potentiometers.

Next above, and at the edge of the operating manual position are thirty-six tilt tablet switches, again of the usual organ type. Each of these is associated with one of the thirty-six individual control drums, and in turn, each group of four tablets is tied to one of the foot-pedal sub-group masters. These switches enable the operator to transfer control of all individual circuits to foot operation in a given sub-group of four dimmers, or any one singly, thus freeing his hands when necessary. Immediately above these on a sloping ledge are thirty-six individual drum controls.

These are six inches in diameter and protru quarters of an inch above the panel face. Th milled edges and a scale for definite recording tings. Like all controls on the board, they are fifteen sixteenths of an inch on centers, th spacing of piano and organ keys. Drum type was adopted because experiment proved it possi to operate several with one hand, some going others down simultaneously.

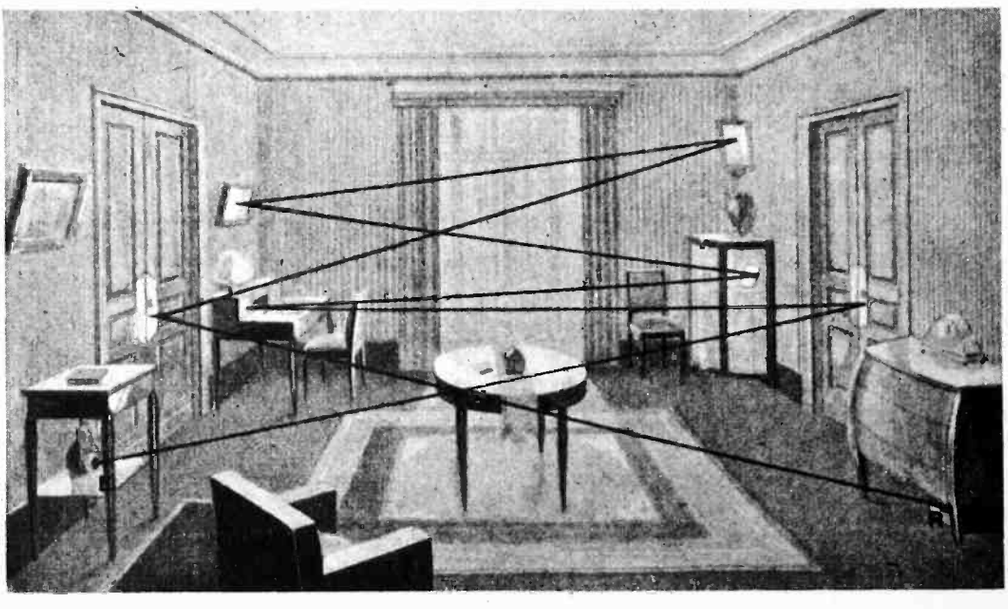
On the slope containing the preset, slider-typ tiometers, there are four of these to each of th six control circuits. They are crowded into only six inches high yet they are easy to work these sliders that are set to predetermined point up the brilliance of any circuit for four sc advance. Associated with these, but behind th is a preset fader potentiometer. All of these fa ganged on a common shaft and give smooth ch light from scene to scene whether one circuit is and another down, all moving in the same dire individual lights changing at various ratios. single motion of a single drum, can completely one lighting scheme into another, an achieven possible on any other board.

The last row at the top of the board has t tilt tablet switches to throw a given control o and a test button which lights pilot on loa switches, showing they are hooked to the partic trol being examined.

A four-inch wide panel running from top t through the center face of the console contains a controls. At the top is a clock, below, the mas drum. The grand master drum follows. Be are the four group master interlocks from foot control. Lock and master switches and othe laneous items are worked into the spare space j these. Scene pilot lights are provided which f scene to scene.

On the diagonal sides of the board in the faces, are the 110 cross connecting switches a fifty-five on each side of the operator. On th face at the left are the house light dimmers a these are located the boomerang controls. In t hand inclined panel are the "joy sticks" fo directional spot control. They also are the signals and diaphragm controls.

▼ ▼ ▼



Reflected infra-red-be safeguards whole roo

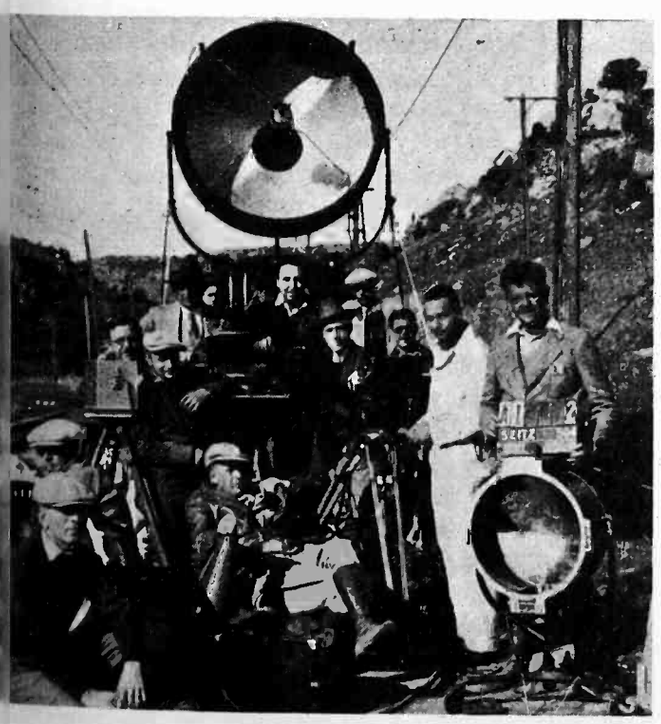
METHOD proposed by Fre for protecting a room agains burglars, utilizing an invisibl infra-red-light. The beam flector *R* is projected back between successive reflective that it criss-crosses the en before finally reaching the ph cell *E*. Interception of thi any point rings a bell.

ound "tricks" picture oduction

:ARL DREHER*

[E making of a moving picture is essentially a omposite process. Scenes which dovetail smoothly o produce comical or dramatic effects were origi- ade in disjointed form and in an order dictated y considerations of convenience and expense. The as it is finally seen and heard from the screen, nthetic product in which many special and cleverly processes play a part. Some of these fall within l of engineering, particularly those having to do e recording of sound in conjunction with the pho- ing of action. This article describes some of cial devices in use, particularly as they affect ecording.

t is known as trick photography, or in more d terms, special process photography, was of course well known in the art before the introduction of sound. Sound, in fact, was at first a severe handicap to the camera man and trick expert with creative ideas, and only recently have the two arts assumed a normal relationship in which each is an aid rather than an obstacle to the other.



m microphone mounted on railway car to obtain g distance pick-up for outdoor scenes in sound recording

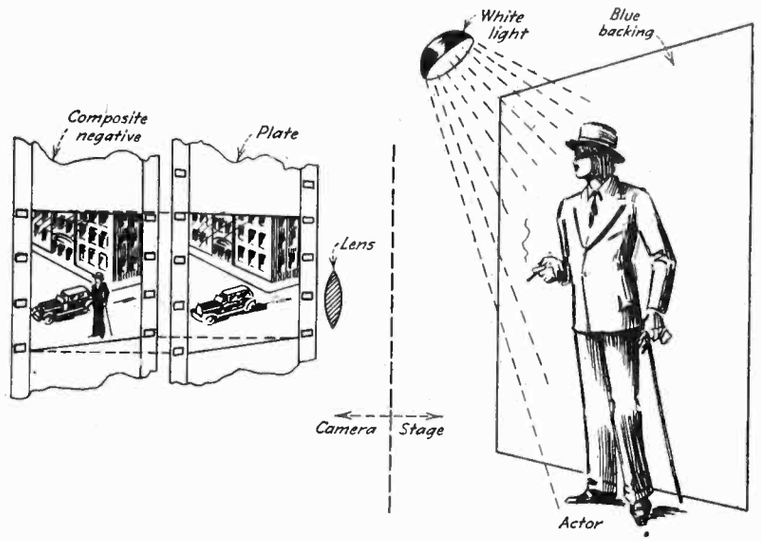


Fig. 1—Schematic diagram of composite photographic process to show an actor against a street background which could not be easily simulated by other processes

The principal application of composite photography is in providing a background which is not actually available in the place where the foreground action is to be photographed. For example, an actor may be available for work in a Hollywood moving picture studio at a particular time, but it may be desired to show him against a Mississippi river background. Instead of taking the actor to the river, the river may be brought photographically to the actor. The means used will first be outlined in their purely optical aspects and later we will see how the problem is handled with the additional complication of sound.

Figure 1 shows the process schematically. An actor is represented on the stage where he is to be photographed. It is desired to show him against a street background with moving traffic and other features which could not be simulated by an ordinary painted back drop. The street scene which is to provide the background is first photographed, if it is not already available. Usually all kinds of background scenes are on hand in the producer's library in negative form. From the negative of an appropriate scene a double image print is made. This double image print contains a superimposed positive image in color and a netural negative image. The color (perhaps red) and the neutral or gray shade are selected by careful testing so that when interposed positive image in color and a neutral negative of white light, the two will give an equal fogging effect. Thus no image results as long as the printing light is white, since for white light the superimposed tones neutralize each other over the entire area. But if the light impinging on the double image transparency is suitably colored, some of it will pass through the transparency and a black and white image will result on the developed negative.

In Fig. 1, the actor is shown under white lighting against a blue backing. He may of course have around him any desired foreground props, which in the illustration have been omitted for the sake of simplicity.

*Director of Sound, RKO Productions, Inc., Hollywood, Calif.

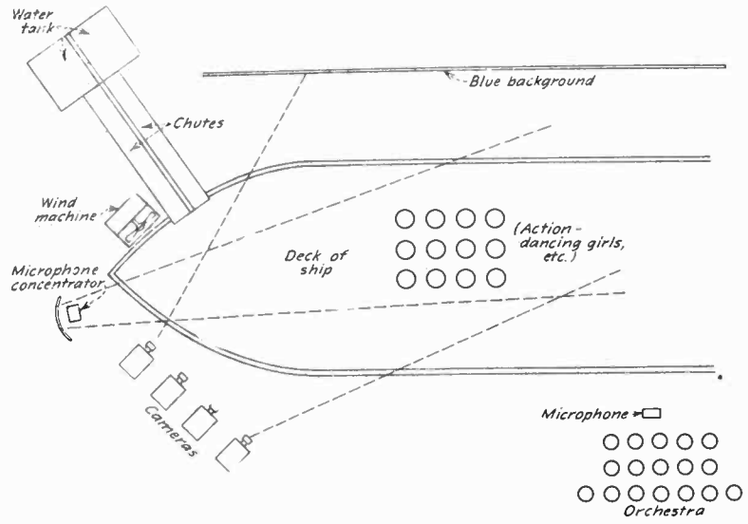


Fig. 2—Set-up of a ship scene for composite photography with sound pick-up

To the left of the figure is shown the camera lens, next the double image transparency or "plate" of the street scene, and finally, the negative on which the composite picture is to be photographed. In the special camera used in this technique, the transparency is unrolled from an intermediate magazine and threaded across the camera aperture in front of and in contact with the unexposed film stock. The light reflected from the actor is not affected by the "plate" except for a certain diminution in intensity. Hence, all that this light does is to produce an image of the actor on the raw stock. But the blue light reflected from the backing where it is not covered by the actor, does carry with it a print of the street scene, since the double image transparency is balanced or neutralized for white light but not for blue light. Blue objects in the foreground must of course be avoided since they will cause a phantom image of the street scene over the foreground image. But with this restriction it is readily possible to photograph persons and objects on a stage with the utmost convenience and at moderate expense, and then to represent them against a background which in the final released prints will appear just as real as if the work had been done in the actual setting. In up to date practice the blue background is generally illuminated by hard white light, while the foreground is under orange light, the double image transparency being balanced for the latter illumination.

Readers who are interested in composite photography will find further data in an article by C. Dodge Dunning: "Composite Photography," *Transactions S.M.P.E. Vol. XII, No. 36, September, 1928.* The Dunning Process Company does most of the work in this line in Hollywood.

Figure 2 shows a rather complicated case of composite photography with sound pick-up. The scene to be photographed is the forward deck of a ship. The ship is built outdoors against a background of deep blue curtain, several hundred feet long and about fifty feet high. The deck is arranged so that it may be swung or oscillated by a number of men to give the illusion of rolling. Everything on or above the deck, such as the railing, mast, halyards, and the part of the ship's superstructure included in the picture, is made very realistic, but of course at the point where the cameras cut, all pretense at reality is dispensed with. In this figure the cameras are shown taking in a part of the deck in which the action takes place. Since the picture is a musi edy, a large chorus of dancing girls goes thr evolutions, using the deck as a stage. An orc placed to one side off stage and picked up with phone close by. The footsteps of the dancing picked up by an additional michrophone out camera line, provided with a parabolic reflecto it will function efficiently at a distance of thirty feet from the sources of sound. During the the action where it is desired to produce the of a rough sea, water is released from four lar erected on towers some fifty feet high. Thi sweeps over the deck, to the discomfiture of the in the action at that time. At the same time machine, consisting of an electric motor and propeller, sweeps the spray before it. This pa action is shot silent, as the wind machine is t to permit recording. Since there is no dialogu section, it is a simple matter to add a sound tr containing synthetic wind and wave noises. A background of rolling waves and tilting horizon tographed in by the composite process describe When the picture is finished, we have to all int appearances a vessel rolling in the ocean wav an occasional comber sweeping over the forwa and this result has been secured at a far lo than would be entailed in taking a large com on an ocean steamer and hoping for a storm up obligingly at the right time.

Use of play-backs, pre-scoring and "dubl

Often it is expedient to shoot a scene silent, v in part, and to add a musical accompaniment at time. This is because the acoustic conditions may not be favorable for recording, or becaus to the camera shots required, it is impossible microphones for good pick-up without getting t the camera field. Figure 3 shows a practical

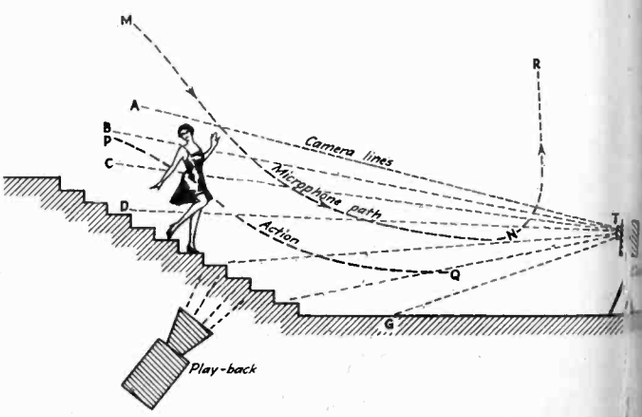


Fig. 3—Dancing scene requiring recording sound action with playback to get proper effects for clo and long picture shots

Here we have a grand staircase, at the top of actress begins a song and dance which takes the stairs and into a final rapid dance with a of performers at the foot. Both close-up and ture shots are required in order to give the prop The procedure in this case is as follows: the her dance with the camera following her down in a close-up shot, so that the upper limit of th field is represented successively by the lines CT, etc. The action follows the line PQ. Ac ment is supplied by an orchestra off-stage, wit stationary microphone. The microphone for t

on a boom or other overhead suspension along
h NR, always keeping just out of range of the
This gives us a close-up sound track of the
ng and a close-up picture only, since the micro-
is too low to permit the taking of a long shot
aph including the entire staircase and the landings
nd below it. This close-up sound take is rushed
aboratory, developed and printed. The next day
nd track thus secured is played back on the set
a film phonograph in combination with a small
ddress system, retaining, of course, the normal
speed of ninety feet a minute at which the
was made. The girl is now photographed, danc-
singing in time with this reproduction, in a long
ainst the background of staircase and landings.
nism is readily maintained, since all that the girl
lo is to dance in time to the music and, if she
le out of time with her singing, it will not be
le in a long shot. Two complete picture films
available, one giving the close-up and the other
shot. In a musical number it is generally
ble to match a close-up sound track with a long
all the elements which facilitate a good job of
are now available. However, the method is
at costly, since the cast must be brought back
l day for the long shot.

lso possible to make the entire musical take in a
room separate from the stage. This room may
to afford excellent characteristics for musical
g and pick-up. Here the orchestra plays and
goes through her song and dance for sound
only, no photographing being involved. Later
rd is played back and long shot and close-up
aphs are made on the set. This is called the
ing method.

rd procedure, less expensive but also less con-
and artistic, could have been used. This would
olved starting the scene at the top of the stair-
h long shot and close-up cameras shooting simul-
y and with the microphone suspended high up
of range of even the long shot camera. As the
gins, the microphone is moved down to the long
ich is thereupon terminated for cutting purposes
e close shooting for both sound and picture con-
the bottom of the staircase. The microphone
once more lifted out of camera range, and the
nera shot is again available for the dance. A
y microphone remains with the orchestra off-
By this method there is no long shot available
interval during which the girl is coming down
s, and likewise a close-up sound record has been
d with in the beginning and end sections of the
he cutter is therefore limited in his operations
e of the potential effect of the scene may be lost.
uestion may be asked, "Why cannot one actress
a procedure be used for the vocal portion of the
d then another girl be put in her place for the
on the stage?" The answer is that it is pos-
ere is no technical reason why one person's voice
e recorded and then another performer be used
icture, in the long shots, at any rate. However,
the operation is feasible technically, it is not
r the reason that it would be bad business to
pictures on this basis. In the very early days
d picture production, such illicit "dubbing"
'doubling") was resorted to in a number of
s where the producer had a great deal of money
in stars who could not sing or whose diction

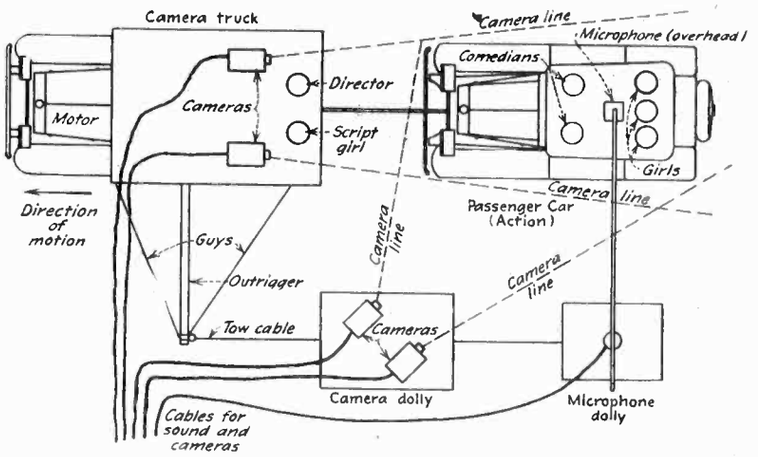


Fig. 4—Intricate set-up for sound recording requiring four moving units to obtain necessary action in special street scene

was not good, and before the dangers inherent in the practice were realized. When anything like this is done there is no possibility of keeping it secret, since a large number of technicians, actors, musicians, and other studio employees are necessarily aware of what is afoot. As soon as the public gets wind of the deception, and realizes that the captivating voice issuing from the loud speakers does not belong to the attractive face on the screen, the reaction is very adverse.

There is a legitimate form of "dubbing" which is used to some extent in the production of foreign dialogue versions to be added to pictures originally made in English. Here the picture is projected silently for a group of foreign players who talk into a microphone just as they would for the broadcasting of a play, the voices being recorded, however, on another sound negative, which is then synchronized with the original picture. The foreign voice "dubbers" watch the action on the screen and synchronize the words as closely as possible with the screen lip movements. Of course, it is necessary to make many modifications in the wording and idiom of the foreign dialogue in order to match it even approximately with the lip movements of the original English speech. Even after many trials, the result usually contains portions in which the synchronism leaves much to be desired. Accordingly, many Hollywood observers doubt whether this particular technical device has any future in the art. However, there is a compromise scheme which may develop into extensive use. This involves shooting the picture and sound with American actors and then getting the same actors to learn the foreign dialogue used in the close-up portions. These people are then re-photographed in silent close-ups, and then foreign players "dub" in the same lines by the method previously described. Under these conditions it is possible to get accurate synchronism in the close-ups, while for long and medium shots the ordinary foreign "dubbing" procedure is sufficient. The practicability of the method depends upon whether American stars with box office value abroad can become proficient enough in foreign languages to carry out their part of the enterprise.

Traveling shots

With the advent of sound, the operation of "panning" the camera to afford a changing point of view became a more complicated process than in silent motion picture photography. Figure 4 shows an intricate moving shot.

[*Continued on page 408*]

A simplified harmonic analyzer

By A. W. BARBER*

IN THE development and manufacture of radio receivers it is often desirable to supplement the ordinary routine measurements of sensitivity, selectivity and fidelity by measurements of the distortion present, i.e. harmonics.

Prohibitive cost and complexity have prevented the general adoption of the apparatus hitherto available for such measurements. Indeed, if a range of frequencies is to be covered one may hardly hope to avoid such complexity in any device for analyzing electrical wave forms by means of tuned circuits.

Fortunately, one may go some distance on the road of harmonic analysis with a quite simple analyzer, adapted for work at a single frequency. The information so gained is sufficient to give a good general view of the performance of the radio set under investigation. This follows from the nature of the causes which generate harmonics within the set. They are dependent more on amplitude than on frequency.

Apparatus based on this simplified procedure has been devised at Radio Frequency Laboratories by P. O. Farnham, C. J. Franks and A. W. Barber, primarily for the study of some special audio amplifiers. The circuits are such as to make a considerable variety of uses possible. The general arrangement of a setup is shown in Fig. 1. In Case "A" the audio source must have a wave form which is nearly sinusoidal or at least whose harmonic content is known under all conditions of loading. Since the sources ordinarily available are not pure, it is a great convenience to have available the analyzer in its present form which permits investigation of the wave form at the input terminals of the set, as well as at the output terminals. One is thus certain what was fed to the set originally.

In Case "B" of Fig. 1 the source may be the usual standard signal generator, whose modulation is almost invariably at 400 cycles, of a known percentage, and of good wave form.

The analyzer consists of an input attenuator, a filter to remove the fundamental 400 cycle wave during the investigation of a harmonic, a second attenuato tunable circuit across which appear voltages whi be measured by means of the vacuum tube ampli rectifier. The circuit diagram is shown in Fig. photograph of the completed instrument in Fig.

Since the analyzer is a voltage-operated device put circuits must be of high impedance. Th wound voltage divider R_1 accordingly has a resist 18,000 ohms. Connected between the slider grounded end of R_1 is a series of resistors totalin ohms, of which 900 ohms lies in R_2. Thus only cent of the voltage picked off by the slider of R to the high-pass filter, which loss must be made by the amplifier. The advantages of this arra are that the series resistor R_2 prevents excessive of input impedance as the slider is moved upv

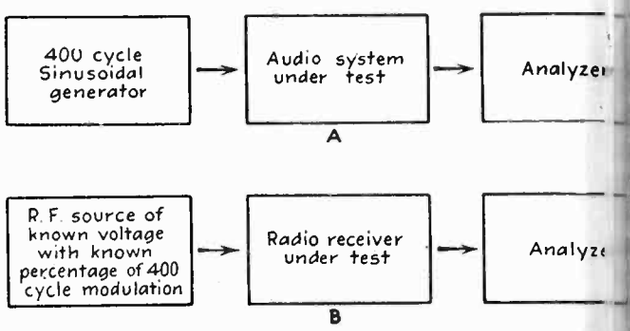


Fig. 1—Two methods by which the harmoni analyzer can be put to use

R_1, and that the filter is fed from a source of th impedance.

The filter has two high-pass sections with 6 cutoff and is designed to work between 100 ohm impedances. When switched into the circuit it at the fundamental 400 cycle frequency, making it to measure the relatively weak harmonics wh through it almost undiminished. About 2 per ce fundamental 400 cycle wave passes through th the transmission rising so rapidly at higher fre that even at the 2nd harmonic (800 cycles) 88 transmission occurs. The coils of the filter ar with No. 14 enameled copper wire and are so tioned as to give a low power factor (0.02 cycles). These coils are mounted at right angles other inside a heavy aluminum shield which also the filter condensers which are of the ordinar and-foil bypass type.

The filter output is fed to the calibrated 1 attenuator. The construction of R_7 and R_8 is s unusual. Two heavy insulated copper wires are cores for a single-layer winding of double-cotton resistance wire. The two elements are then fitte a bakelite drum and the cotton insulation partly so that a slider traveling around the drum may the two resistors together at any desired poin the filter and the calibrated attenuator can be b when it is desired to work with the 400 cycl mental.

The filter is followed by a series-resonance cir to select the frequency to be measured. Th system consists of the iron-core inductor L_3 and densers C_4 to C_{11} inclusive. The latter are so c to two rotary cam switches as to permit step micro-microfarads from 500 to 30,000. The 5 variable air condenser C_7 makes the range co One of the cam switches is so connected that w

*Radio Frequency Laboratories, Boonton, N. J.

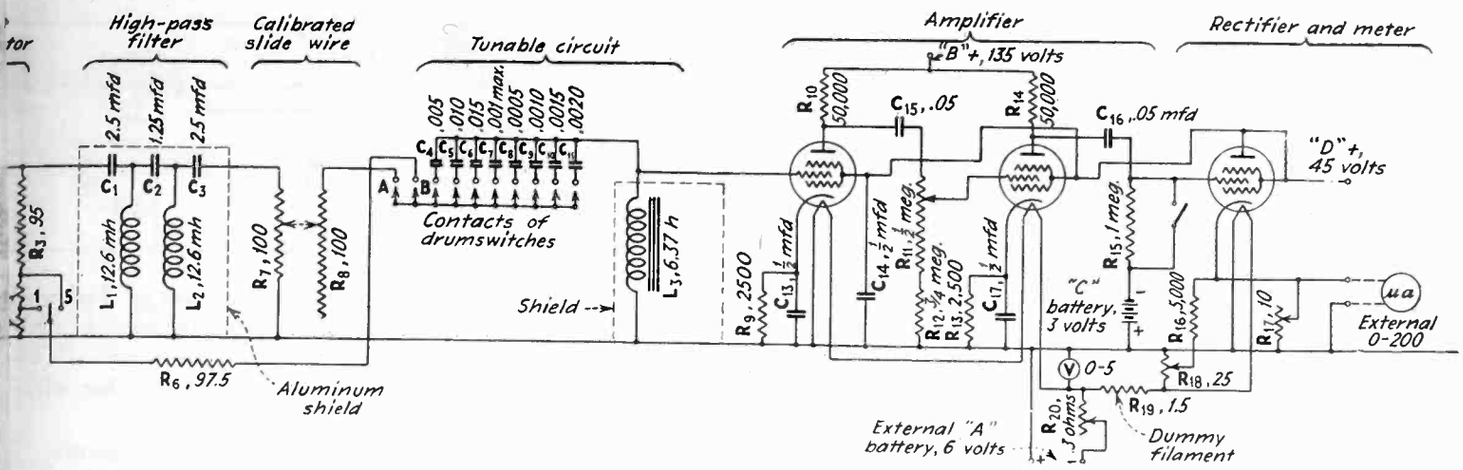


Fig. 2—Circuit diagram of the complete instrument

tune to 400 cycles the fundamental is shunted the filter and the calibrated slide wire.

the purpose of the tuned circuit is to select a frequency it is important that this circuit be selective and that there be a known ratio between age fed to the tuned circuit and the voltage which equence appears across L_3 where it is applied to plifier. A very good coil is necessary to secure lectivity, good gain, and reasonable flatness of ainst frequency. Of many coils tried, the one he best gain has a 1,000 cycle inductance of 6.37

It consisted of 10,000 turns of No. 28 enameled ound on an open core measuring $3\frac{3}{8}$ in. x $\frac{9}{16}$ in. x To decrease pickup the coil is enclosed in a cubi- inum can 10 in. on a side. A smaller can de- the efficiency greatly. With constant voltage at point "A" or "B" (L_3 and tuning condensers s) the voltage appearing across L_3 varies as :

Frequency	Per cent of 1,200 Cycle Voltage
400	81.3
800	95
1,200	100
1,600	96
2,000	86
2,400	73.6
2,800	68.7

it is desired to work with constant output-meter this variation necessitates a compensating adjust- yond the tuned circuit. This is provided by the n R_{11}. As to the selectivity of the tuned circuit, it is found that the 2 per cent of the 400 cycle fundamental which comes through the filter is so suppressed by the tuned circuit that it cannot be detected at the output meter at 800 cycles or above. No harmonic shows any reading when tuned to another unless the "unwanted" harmonic has the higher amplitude in a ratio of more than 20 to 1.

The resistance-coupled amplifier uses 224-type tubes. The first two tubes give a gain of 300 while the voltmeter tube shows a 100 microampere change in plate current when one volt is impressed on the grid. Over the 400-2,800 cycle range essentially flat amplification is obtained. The gain potentiometer R_{11} permits a one-third reduction in gain to provide the means of compensating for the variation with frequency of transmission through the filter and tuned circuit. Batteries are used on the heaters, as a.c. operation proved unsatisfactory because of magnetic field pickup in the tuned circuit and fluctuations in the line voltage. For economy, two heaters are placed in series in one circuit and the remaining heater is run in series with the dummy heater R_{19}.

The first adjustment to be made is that of "bucking" out the steady cathode current through the microammeter (output meter), Next it is necessary to set the fundamental at a convenient level. The tuned circuit is set to 400 cycles, whereby contact B is automatically closed, making available the "detour" via R_6. The tuned circuit now strongly suppresses any harmonics which may be present so that only 400 cycles is being fed to the amplifier. The slider of R_1 is now turned up until a 100 micro-

(Continued on page 408)

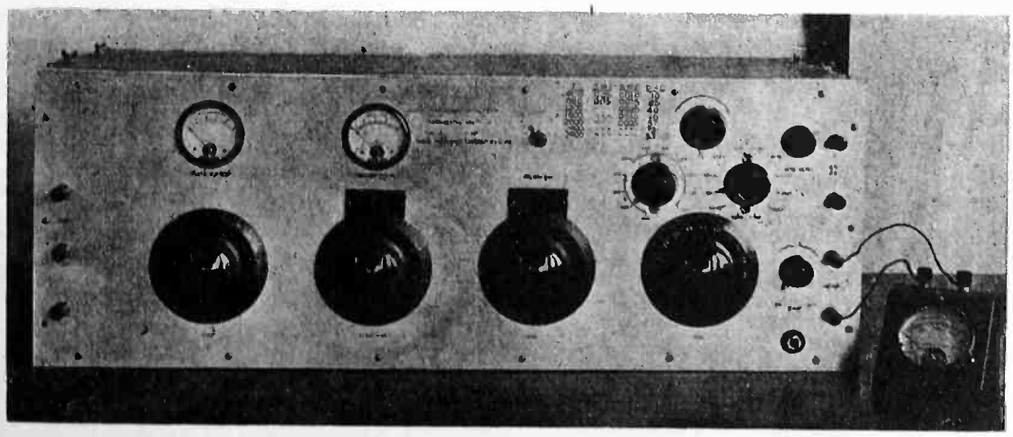


Fig. 3—Photograph of the analyzer as used at Radio Frequency Laboratories

Developments in ultra-high frequency generation

By C. W. LOEBER

SINCE the use of short wave lengths for radio communication has become of great importance, radio engineers have been investigating the utility of the so-called ultra-short wave lengths, those lying in the electro-magnetic spectrum between five meters and the wave length of light. The various methods of generating these oscillations have all been developed in the past decade or so.

Whiddington[1], in 1919, found that gassy triodes could be made to generate oscillations of very high frequency. In the same year Barkausen and Kurz[2] described vacuum tube apparatus with which they were able to produce oscillations of a wave length below one meter.

Barkhausen-Kurz effect

This effect was produced with a triode connected as shown in Fig. 1. It will be noted that a strong positive voltage was applied to the grid while a relatively weak negative voltage was applied to the plate. Variations of capacitance and inductance in the external circuit of the vacuum tube were found to have practically no effect upon the wave length, but when either grid or plate voltage was changed, the frequency also changed. Increasing the emission from the filament also affected the frequency. Oscillations could not be produced unless the vacuum tubes used had cylindrical concentric elements with the filament passing through the geometrical axis of the grid and plate. Grid voltages were varied from 80 to 200 volts positive while the plate was kept between 4 volts positive and 40 volts negative.

Theory of operation

Since it was found that only changes in applied voltage affected the frequency of the oscillator, Barkhausen and Kurz believed that the oscillations existed within the

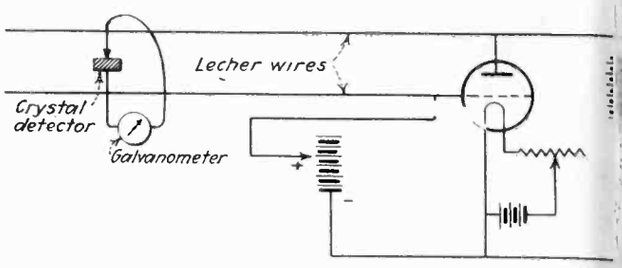


Fig. 1—Ultra-high frequency oscillator of Barkhausen and Kurz, in which the voltages determine the frequency. Wave length was measured by moving the crystal detector along the Lecher wire

tube and were caused by the motion of electrons. their theory was as follows: If a high positive p is applied to the grid and a low negative potential plate, electrons emitted by the cathode will be at to the grid. Because of the construction of th and the speed with which the electrons are moving of these will pass through the grid to the field plate where they will be repelled. Upon returning grid, some will again pass through and reach the of the cathode where they originated. Thus on will be completed. The period of one oscillati be very short because of the short distance betwe trodes of the tube and because of the velocity electrons.

The results of the Barkhausen-Kurz investi

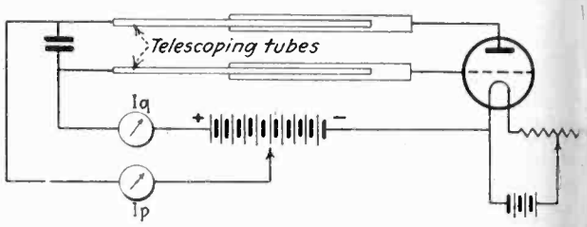


Fig. 2—Gill and Morrell's oscillating circuit. Th frequency could be varied by the telescoping tube

were substantiated by Scheibe[3], but he, as well investigators, discovered the existence of still othe lations at these frequencies, and it is quite likely th account for the irregularities which were observed early investigators. Gill and Morrell[4], with ap shown in Fig. 2, were able to vary the wave le their oscillator by changing the constants of the The Gill-Morrell oscillator differed from that o hausen and Kurz in that a positive potential was to the plate. The theory was advanced that w arrangement all electrons which pass the grid sorbed by the plate where they cause secondary e The secondary electrons thus liberated pass to t where they in turn are absorbed. Thus the osc are not confined to the tube and exist in the circuit as well as in the inter-electrode space.

At this time it is difficult to estimate the r transmission that may be obtained at ultra-hi quencies since little quantitative work has been measuring signal strength at appreciable distanc

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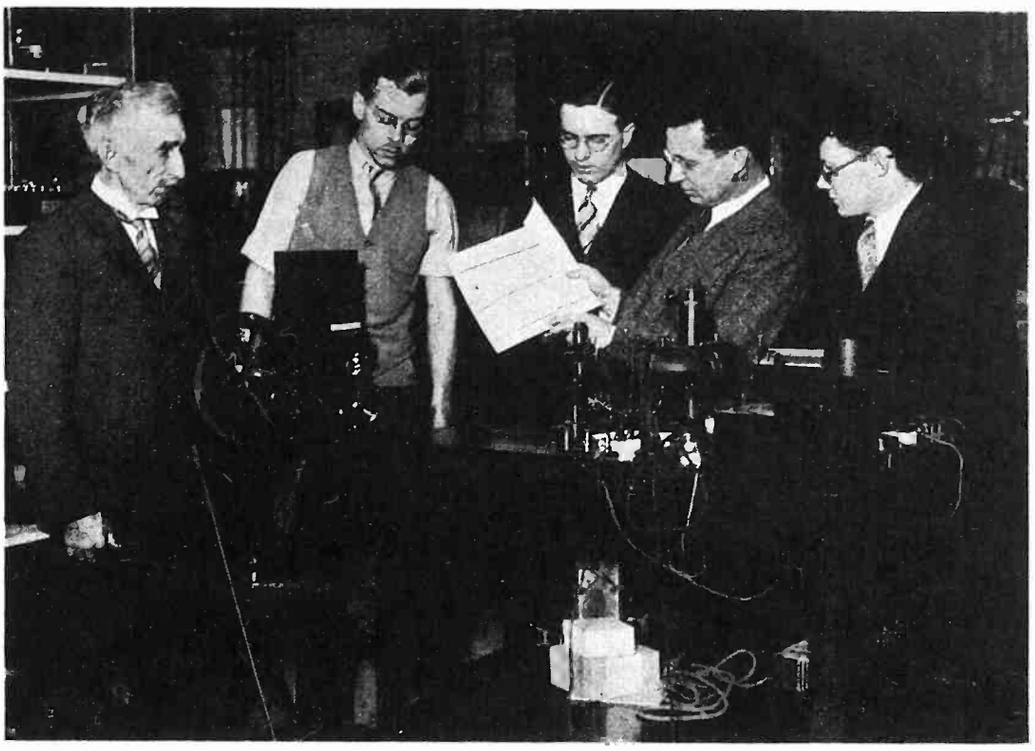
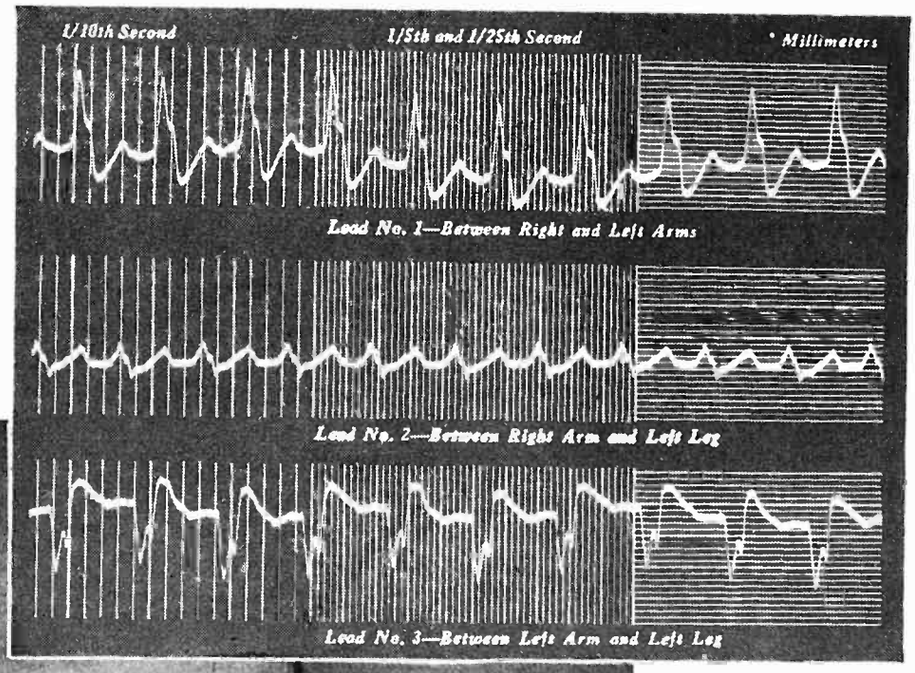
ctronics diagnosis

Measuring e heart's MF



very human being is an alternat-ng-current generator, his output mf being about one milli-volt one-thousandth of a volt), and his requency being that of his heart-eats. The "cardiagraph," using his method of detecting and ampli-ying the heart's voltage, is widely mployed by specialists to diagnose heart diseases



Three electrodes are employed, one on each wrist and one on the leg. This micro-voltage developed is multiplied by a group of amplifier tubes very much like an ordinary radio receiving set, and is recorded by an oscillograph, as above. The three sets of curves can be combined by vector analysis to show actual positions of the heart muscles

The phototube in automatic weaving

By ARTHUR KORN*

WEAVING is an art that has been practiced since the early days of history. It consists essentially in passing one series of threads called the shoots or wefts or woofs partly below and partly above a second series of threads called the warps. If the weft is white and the warp is black, the cloth will appear black when a weft passes below a warp, and white where a weft passes above the warp. To obtain the design wanted, the proper warps must be lifted for every weft and every weft must find the warp prepared for it.

In former times the lifting of the warps according to a given design was done entirely by hand. Automatic weaving was made possible by the invention of Jacquard (1728) which utilized a series of cards with holes punched in them to correspond with the design. Pins (one for each warp) entered the holes in the cards; this placed a small hook in position to be lifted; the raising of the hook prepared the corresponding warp for the shoot or weft. When the pin did not encounter a hole in the card, the warp remained unlifted and the weft passed over it. Thus hand labor was reduced to the task of preparing the cards according to given designs and to the attendance of the weaving machines.

In order to prevent the cards from becoming too long the holes of the Jacquard cards are arranged in a certain number of rows; when there are 400 warps, the holes are often arranged in eight lines; in other cases twelve lines, etc. The workman punching these cards uses a special punching machine provided with eight, twelve, or more punches according to the number of rows comprising a card.

The design serving as a basis for the work of punching has to be arranged in such a way as to allow the white and black spots of the weaving to be distinguished on a special design paper. In this design every line corresponds to one shoot. In every line each square corresponds to one warp; when the square is filled in (black or colored) on the design, this means that the warp is to be lifted, and a hole must be punched corresponding spot in the card.

The punching is first done for the eight squares upper-left corner of the design. The workman ha keys similar to those on a piano in the punching m before him. . He presses down these keys corresp to the dark squares on the diagram, and brings into the punches on the card by means of a foot lever. the card is moved to the left, and the workman p the next eight squares on the first line, and so on. one line is finished a new card is put on the machin the new card is punched according to the squares second line in the design; as many cards have to b pared as there are lines in the design. To give a how difficult a work the punching of these cards me explain that one to two thousand of such car generally required for one design and that it take an expert laborer one to two weeks to finish one cards. The workmen used to do this as homew the villages surrounding the big weaving centers, in their homes a simple kind of punching machine

▼

PROFESSOR KORN is internationally known for his work in transmission of photographs by wire and by radio. In 1907 he used light-sensitive cells in transmitting photographs between Munich, Berlin, Paris and London. His most recent work, described here, is an improvement in the art of weaving, again employing photoelectric cells.

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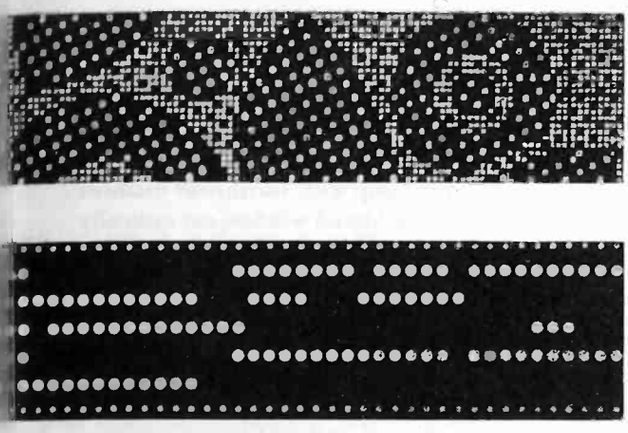
*Professor in Technische Hochschule, Berlin, Germany.



Patterns of design to be punched on card by phototube apparatus

progress which I am now going to demonstrate found in the mechanical manufacture of the cards ng to given designs by the aid of photoelectric that this painstaking hand labor can be entirely way with.

Application of phototubes

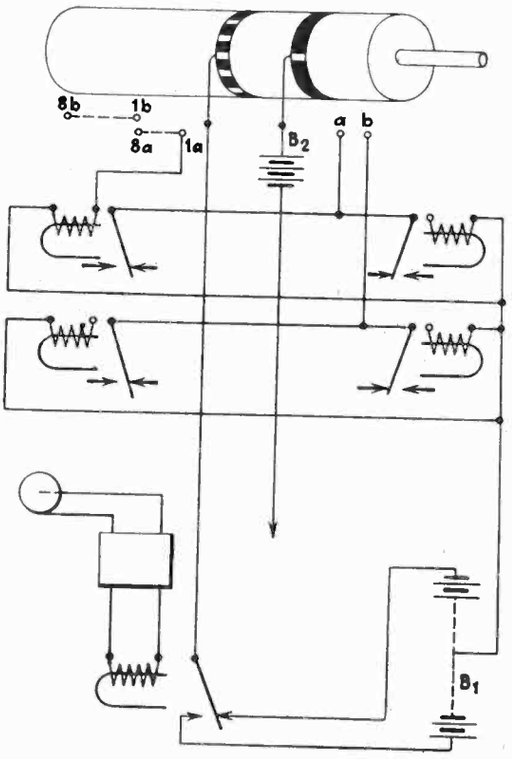
e new machine the design is wound upon a rotated by an electric motor and shifting some- the direction of the axis of the cylinder. The a lamp is concentrated upon one of the little by the aid of a lens, and the light reflected from ıre falling upon a second lens is directed onto a ctric cell. As the illuminated square is white ed, the cell receives more or less light. After amplification of the current produced by the tion of the cell, a relay is put into action which the punching of the Jacquard cards. When the rotates, one square after another is explored by to-cell, and the lever of the relay moves to one the other, closing one of two electric circuits.

Operation of the improved system

sets "a" and "b" of eight polarized relays each 8-line cards) are controlled by these currents. A -like distributor turning with the cylinder sends ent to each relay in turn as the squares are For the first line the "a" relays are used, for nd the "b" relays, and for the third we begin ith the "a" relays.

while a piston driven by the same motor as the cylinder shifts up and down above a card fitted special carriage and would set into motion all nches unless means are provided for putting out n those punches corresponding to colored squares. t this the lower part of the piston is divided into eight movable rods, individually rotatable around a horizontal axis and each provided with a protruding arm; these arms are stopped during the downward motion of the piston when the armature of a corresponding magnet is attracted by the latter, and will result in turning the corresponding rod in such a way as to prevent the punch from being struck. When the magnet is not energized, its armature will be withdrawn by a spring, and the rod will go down to its vertical position and punch the card. The armature is energized only by a corresponding white square on the design.

Before the piston shifts down for the first time, the magnets are connected with the first set of polarized relays. When the punching of the first row is finished and the piston begins its upward motion, the magnets return to their normal position. When the piston begins its second downward motion, the magnets will, by means of the distributor, be connected with the second set of polarized relays, so that the second row is punched; before the next upward motion of the piston the magnets

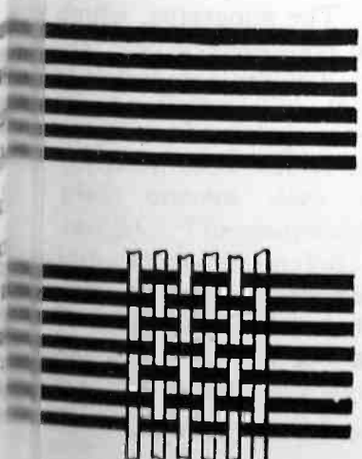


Phototube apparatus for punching design into Jacquard cards for weaving

will be again disconnected, and at the third downward motion of the piston they will be reconnected with the first set of relays for the third section of the line. After each action of punching, the carriage holding the card is shifted to the left to place the card in position for the next punching. When one card is complete it is automatically numbered and removed; the carriage runs back and takes up the next card.

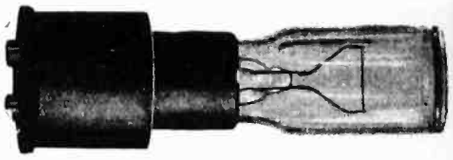
For the time reserved for the exchanging of the cards the punches do not work. To obtain this a dead track is provided on the cylinder by making the technical design so that it does not cover the whole cylinder but leaves a small part of it blank, and when the exploring light runs upon this part of the cylinder, the punches are put out of operation while the machine takes up the new card.

All in all the application of photoelectric cells to a weaving industry seems not only to save time and labor but to effect savings in cost. It is but one more application of results of scientific research to the more practical pursuits of industry.

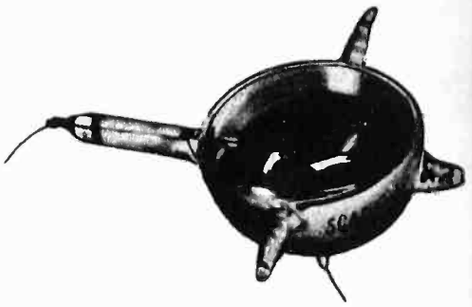


Enlargement of element of weaving pattern showing warp and weft

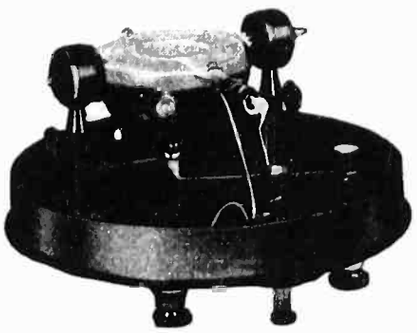
Sound film reproduction without mechanical slit



Exciter lamp with rectilinear filament and flat soldered window cut optically



Hemispherical photoelectric cell of L. Dunoyer



The photoelectric cell shown mounted in holder

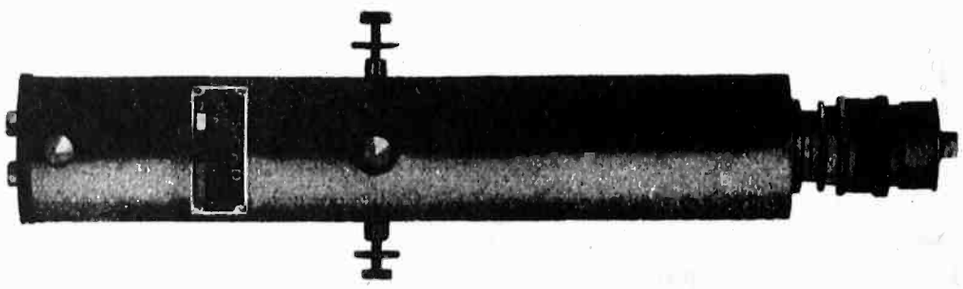
PROFESSOR L. Dunoyer, of the Société de Construction d'Appareils de Laboratoire, Paris, France, has developed an optical system for reproduction of sound-on-film without the use of a mechanical slit.

Due to the normal speed of film in reproduction, the height available for the individual modulation, for the higher frequencies, is very small. The exploring beam of light will only pass through the film over a very small height. The greatest admissible height is at present 0.05 mm., and in fact, 0.02 mm. is generally used. The problem of illumination of the photoelectric cell through the film is similar to that in all recording microphotometers for the analysis of spectrograms.

The illuminating apparatus for sound films in general use is provided with a sound slit. In some equipments, this slit is in contact with the film, or is very close to it —in others, the image of the slit is formed upon the film. In the first case, the height of the slit must be equal to the height of the illumination required for the film, i.e., 0.02 mm. The distance between the film and the slit must be less than this value, or of the same order. Dust, which is usually present on the surface of the film, or the atmospheric dust, which it draws with it, will soon accumulate on the edges of the slit; this accumulation not only causes a diminution of the amplitude of the sound, but, as it is irregular, it also causes undesirable ground noise. This effect is not present in apparatus with a projected slit, but such apparatus is subject to other faults.

The apparatus shown in the accompanying illustrations has no slit. The illuminant is a straight filament lamp, especially designed so that it will not be affected by vibration. A parallel faced window is used to close the end of the lamp and is soldered to the walls. T li falls upon a photographic lens of high quality a opening, by which the image of the filament is upon the film. By the use of a parallel faced wi known thickness, it is possible to take account matism which this window causes in the calcul the lens. Since the filament is only 0.1 mm. d one can readily obtain an image of 0.01 mm. he maintaining a considerable focal distance betw lens and the film, which is often convenient.

It is easy to obtain an exploring image whic narrower, enabling the higher harmonics to b duced. A wide opening of the lens provides quantity of light. The exciter lamp is fed by a of 1.5 amperes at 3 volts. The apparatus, which bined with a hemispherical photoelectric cell, wil a useful current of about 2 micro-amperes. T when operating, uses a moderate voltage and will several hundred hours.

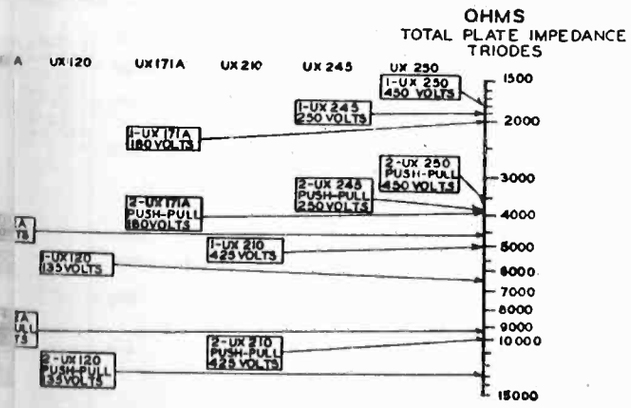


Complete assembly of excit lamp and optical system f lighting sound track witho slit

esign of e output nsformer

. C. HITCHCOCK
W. O. OSBON*

) OPERATE the power stage of an audio-equency amplifier under optimum conditions it essential that the coupling unit between the tubes and loudspeaker be designed properly. gives five commonly used circuits for single and ll audio-frequency tubes. In Fig. 1-B a con- n series with the loudspeaker prevents the steady urrent from flowing through the loudspeaker. ondenser may be omitted and the loudspeaker



g. 2—**Output impedance of commonly used tubes at maximum rated plate voltages**

d directly across the choke if the loudspeaker ce is several times the choke d.c. resistance, which lly the case. The tapped push-pull choke of follows usual practice in spacing the loud- turns on each side of the B-plus tap, so that the plate current does not flow in the loud- circuit. The combination of choke and output mer, as shown in 1-c, is frequently used, espe- hen an electrodynamic loudspeaker is a unit d from the radio set. The correct ratio of T_p the terms used to indicate plate and speaker espectively, in the diagrams of Fig. 1, is found

rch Department, Westinghouse Electric and Manufactur- any.

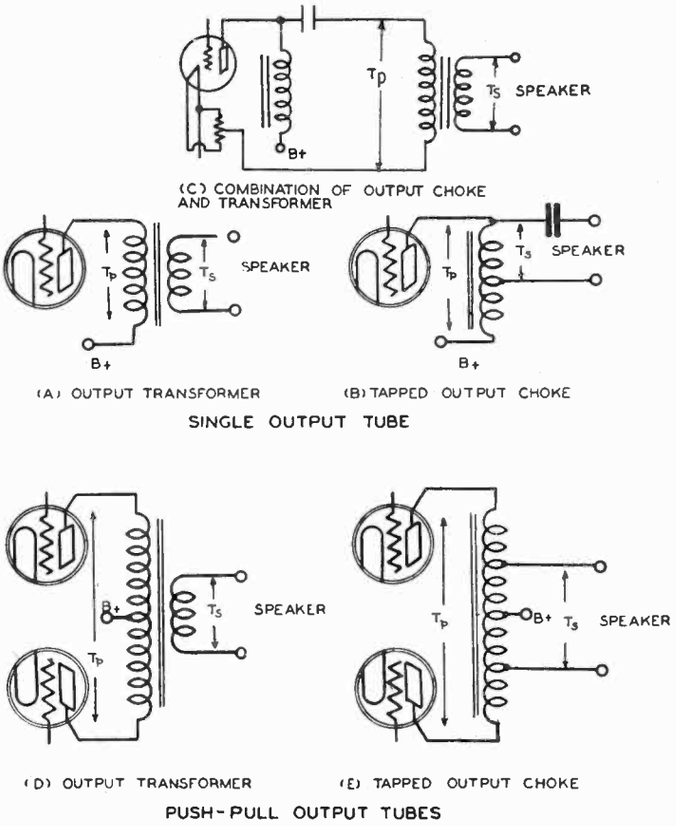


Fig. 1—Commonly used methods of connecting output tubes to loudspeaker

by the use of Fig. 4, as will be explained on another page.

Of the various types of coupling arrangements illustrated in Fig. 1 the transformer presents the greatest number of design problems, and a discussion of these problems will include solutions for other coupling devices. The authors know of no single article which discusses the effect of the various transformer constants on the quality of the transformer, and which at the same time presents data for designing transformers with predetermined constants. In this paper information gathered from various sources will be applied to the specific problem of output transformer design.

The three transformer constants which affect the efficiency of the output stage are the ratio of turns, primary inductance, and leakage inductance. The turns

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THE three important output transformer constants are the turns ratio, primary inductance, and leakage inductance. Each of these factors has some effect upon the transfer of power from an output tube to a loud speaker, whether that speaker is part of a radio receiver, a public address system, or a sound-picture installation. These effects are discussed in this part; in Part 2 the authors will discuss the design of the transformer.

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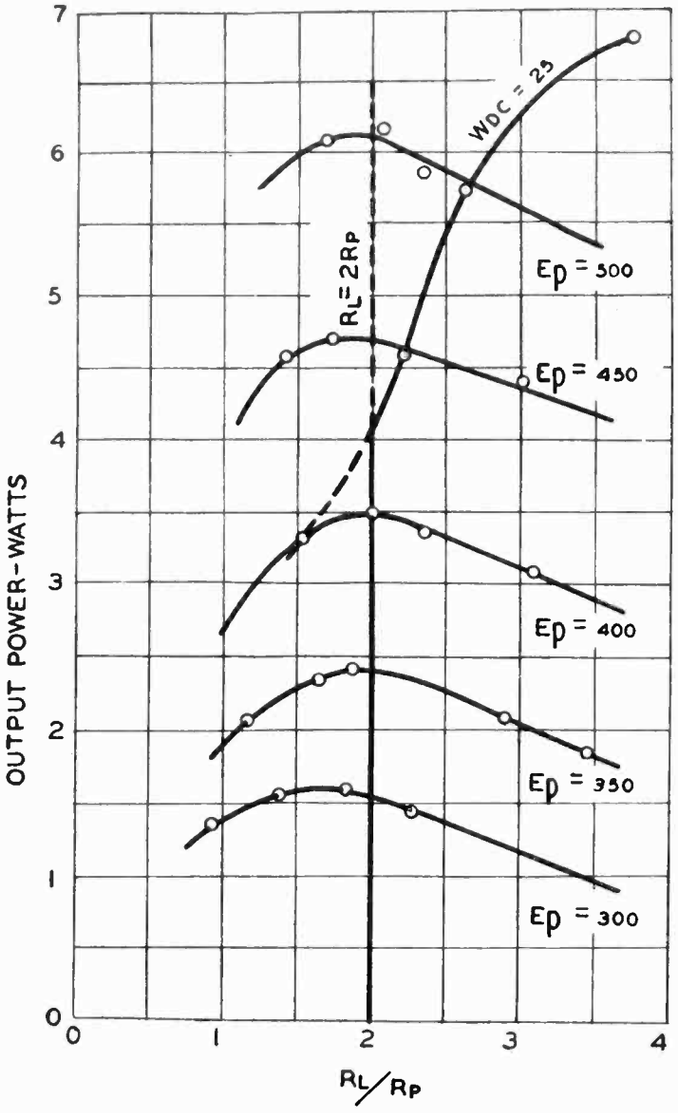

Fig. 3—Effect of load impedance on output power of UX-250

ratio determines the output of the power stage in the middle range of frequencies, that is, in the range where the response is uniform. The primary inductance determines the response at low frequencies, and the leakage inductance determines the response at high frequencies. The nature and magnitude of the effect of each of these constants, and the methods of designing a transformer when the correct constants are known will now be considered.

Ratio of turns

Several writers[1,2] have found that the maximum undistorted power output of a tube will be obtained when the load impedance into which the tube works is twice the impedance of the tube. This condition is not very critical, however, as is indicated by Fig. 3 which shows the effect of load impedance on the output of UX-250 for various values of plate potential. This figure is taken from the paper by Messrs. Hanna, Sutherlin, and Upp.[2] At a plate voltage of 450 it is seen that for values of R_L/R_p between $1\frac{1}{4}$ and 3 the greatest loss in power is only 7 per cent. Although the curves of Fig. 3 apply directly to the UX-250, the general conclusions drawn from them apply to all tubes. It should be noted in the case of the UX-250 that the ratio of load to plate impedance should be greater than 2 for high values of plate voltage in order not to exceed the maximum safe plate dissipation of 25 watts. Fig. 2 gives the plate impedances for output tubes now on the market.

The primary equivalent of the load on the sec is determined, then, by the foregoing consider The impedances of the various types of loudsp are well-known, so that the necessary transforme K, can be determined by the relation—

$$K = \frac{T_P}{T_S} = \sqrt{\frac{R_L}{Z_S}} \qquad (1)$$

where R_L = load impedance required by tul optimum power conditions
Z_s = loudspeaker impedance.

Fig. 4 is an alignment chart for equation (1) ba the condition that $R_L = 2R_p$.

The fact that the value of R_L is not critic fortunate circumstance, because the impedance o types of loudspeakers varies with frequency t rather wide limits. In using the alignment ch equation (1) to determine the correct ratio, it i factory to use the nominal value of Z_s.

As an example, suppose two UX-250 tubes ar connected in push pull with a plate potential volts. In Fig. 2 the impedance is found to b ohms. Using the nominal value of 3,000 ohms resenting the impedance of the usual magneti speaker, or the primary of the output transfor an electrodynamic loudspeaker, the turns ratio in is found to be 1.5 : 1. Similarly, using 12 ohms usual impedance of the moving coil of the louds the turns ratio is 25 : 1. These values are in by the dotted lines of Fig. 4.

The equivalent circuit of the output stage is in Fig. 5-A, where

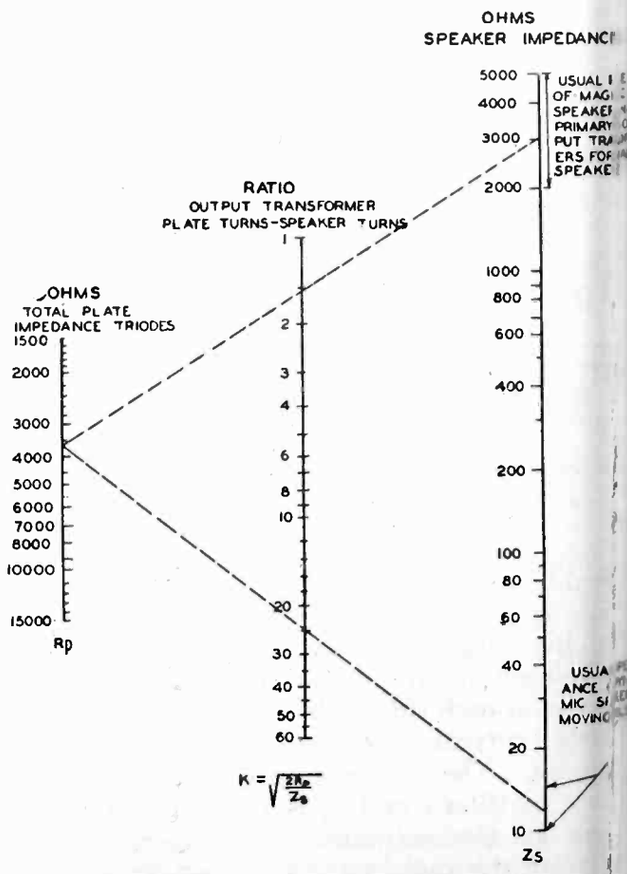

Fig. 4—Alignment chart correlating turns ratio transformer with resistance of tube and lou speaker

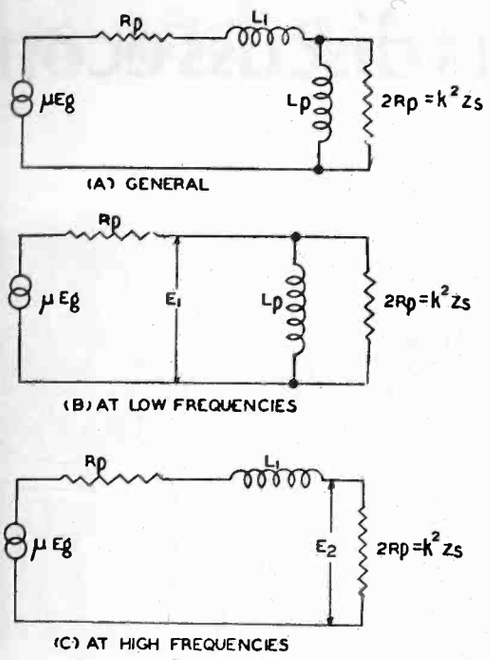

Fig. 5—Equivalent circuit of output stage

μE_g = voltage available in plate circuit
R_p = plate resistance
L_1 = leakage inductance referred to the primary.
L_p = primary inductance of transformer
R_p = primary equivalent of secondary load

r frequencies the leakage reactance is small com- to R_p, so that for these frequencies the circuit s to Fig. 5-B. At low frequencies then, the across the load is—

$$E = \frac{\mu E_g Z_L}{R_p + Z_L} \qquad (2)$$

$$\text{WHERE } Z_L = \frac{1}{\frac{1}{2R_p} + \frac{1}{J\omega L_p}} = \frac{2J\omega L_p R_p}{2R_p + J\omega L_p} \qquad (3)$$

$$E_1 = \frac{\mu E_g}{R_p + \frac{2J\omega L_p R_p}{2R_p + J\omega L_p}} = \frac{2J\omega L_p R_p}{2R_p + J\omega L_p}$$

$$= \mu E_g \frac{2J\omega L_p}{2R_p + 3J\omega L_p}$$

$$= \mu E_g \frac{2}{\sqrt{4\left\{\frac{R_p}{\omega L_p}\right\}^2 + 9}} \qquad (4)$$

It is evident from (4) that the greatest possible voltage is obtained at high frequencies when $\omega L_p/R_p$ is large, and that this maximum voltage is $E_m = \frac{2}{3}\mu E_g$. The actual voltage expressed as a percentage of the maximum is then given by—

$$\frac{E_1}{E_m} = \frac{1}{\sqrt{\frac{4}{9}\left\{\frac{R_p}{\omega L_p}\right\}^2 + 1}} \qquad (5)$$

Using equation (5) the per cent of maximum voltage can be found for various values of $\omega L_p/R_p$ and the results plotted as in Curve 1, Fig. 6. Since the power delivered to the load is proportional to the square of the voltage, the per cent of maximum undistorted power is given by the square of the ordinates of Curve 1, and is shown by Curve 2, Fig. 6.

The value of L_p to choose for a given tube depends upon the degree of uniformity desired in the low-frequency range. Curve 2 of Fig. 6 indicates that at the frequency at which the primary reactance equals the load impedance ($\omega L_p/R_p = 2$), the loss in power is only 12 per cent, and that at the frequency where L_p equals the tube impedance ($\omega L_p/R_p = 1$) the power

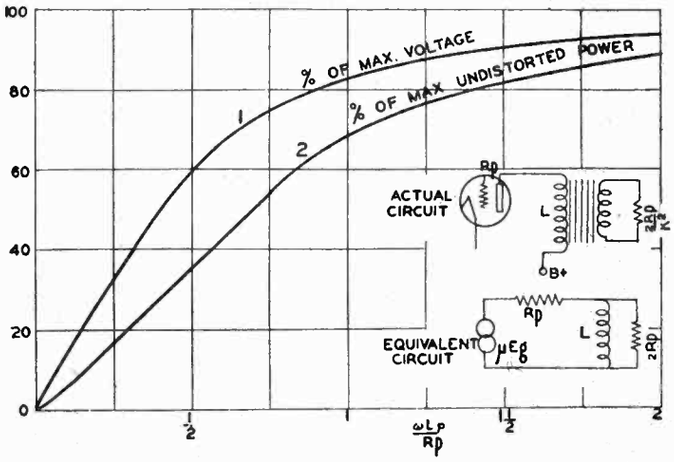

Fig. 6—Effect of primary inductance on power output of tube

has dropped to 69 per cent of the maximum. The actual design of the transformer will be given in Part 2.

[1] "Discussion, Symposium on Loud Speakers," *Proc.* London Phys. Soc., 36, Part III; Apr. 1, 1924.
[2] C. R. Hanna, L. Sutherlin and C. B. Upp, "Development of a New Power Amplifier Tube," *Proceedings* I.R.E., 16, 162; April, 1928.

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IN BIO-PHYSICS, SPECTROSCOPY AND GEO-PHYSICS

The electron tube has given physicists a new and wonderfully sensitive instrument with which minute currents and potentials may be almost incredibly magnified. The circuits are extremely sensitive to small changes in capacity and inductance.

One of the most recent developments is in the field of high-frequency oscillations, which have interesting possibilities not only in short-wave transmission but also in spectroscopy and biophysics. There are also possibilities in the application of vacuum-tube circuits to some of the important problems of geophysics.

HENRY G. GALE,
President, American Physical Society

Sound-picture engineers discuss econo

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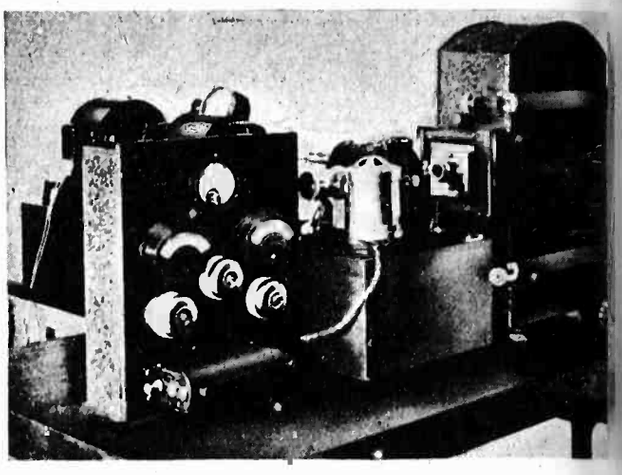
AT THE annual meeting of the Society of Motion Picture Engineers held in New York October 20-23, many interesting papers were given covering the advances in sound picture development, color films, and changing economic conditions in the industry. J. I. Crabtree, president of the society, presided. The high point of the convention was the banquet October 22, at which the leading motion picture producers were represented. Will H. Hays, one of the speakers on this evening's program, which also included Jesse B. Lasky, H. B. Charlesworth, Dr. A. N. Goldsmith and others, stated that an upward trend in business was at hand, and the future for the industry was bright. Serge Eisenstein, the Russian director, stated the American film industry has developed its mechanical and electrical art to a high state, but had neglected the background of training for its artistic side.



Sound-recording unit built in Russia employs an oscillograph with one ribbon suitable for either variable width or variable density recording

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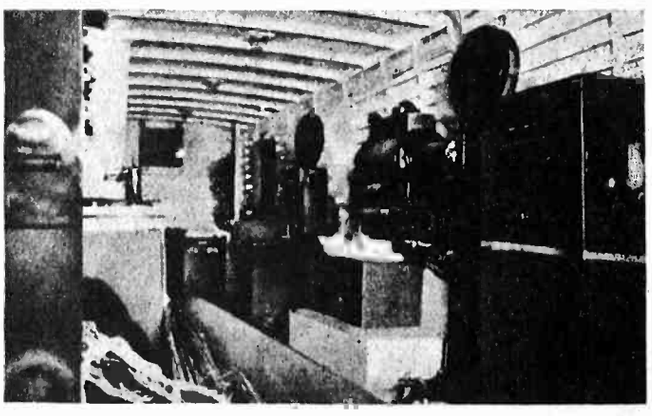
Meeting sound picture competition abroad

C. J. NORTH and N. B. GOLDEN
Bureau of Foreign and Domestic Commerce

The American film industry will continue to meet greater competition in non-English countries. European studios will probably supply not less than 300 feature sound pictures in their own language during the coming year. These studios are already achieving greater popularity with sound pictures recently released than formerly with silent films. This is attributed to the stage traditions of England, France and Germany, enabling these countries to adapt themselves more readily to the "talkies," which as an art form approaches more nearly the stage than did the silent films. In the latter two countries, likewise, the language barrier will undoubtedly cut down the American supply, and open play dates hitherto closed to the local product. This same barrier will have an important influence in other non-English speaking countries, heretofore large purchasers of American silent films.

American companies are going ahead vigorously with production of multi-lingual pictures, and will have close to 175 such pictures on the European market coming season. These will be made either in Hol or in American studios abroad, and foreign cas directors will be used, as it has been proved that such as voice-doubling are not popular. There i reason to believe, however, that while America enues probably won't be as large from non-l speaking areas as in silent film days, they will, theless, attain considerable volume.

Europe has gone sound, Mr. Golden stated, dicated by the fact that whereas only a year a than 650 theaters in Europe were wired, the has now increased to over 4,950, including all the theaters. Outside of Europe, about 1850 theate installed sound equipment. As a result, the sile ater owner must choose between wiring or because he cannot compete with the sound theat furthermore, will have increasing difficulty in suitable silent films. This means there is a wide still open for installation of sound equipment of type, for the smaller theaters throughout the w



Motor truck containing two complete sound projectors brings sound pictures to French theaters not equipped with sound apparatus

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Report of committee on progress

G. E. MATTHEWS, *Chairman, Eastman Kodak Compa*

A system of recording being developed in employs an oscillograph with one ribbon and i to be suitable for either variable width or varia sity recording. Another sound-on-film process a sound print having the record engraved in the the film. A sapphire roller pick-up device is emp the reproduction. A roll of clear celluloid is in preparing the master record and this record transferred to the sound print. No preliminar of amplification are said to be necessary in repr

A number of theaters throughout the Unite have increased the size of their screens anticip advent of the wide-screen picture. Practicall theaters in one circuit on the Pacific Coast

ress and new problems of industry

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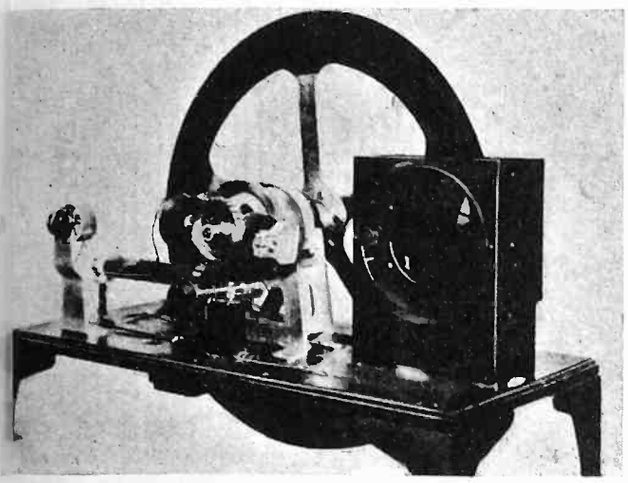

New form of television receiver developed by Baird Television, Ltd., London

larger screens. A survey indicated, however, bout 60 per cent of the theaters in this country ace for screens of more than 24 ft. width.

nd prints by the Technicolor process are now with a silver image sound track having a contrast mma" of unity which is claimed to represent a al advance in the art of reproduction. The fea- icture "Whoopee" was made with a sound track was developed in this way. It is stated to be tical to control the gamma of the sound track as as this on black and white prints.

ower level indicator has been announced for read- e signal amplitude in voice transmission circuits; from minus ten to plus thirty-six decibels can be ed. A monitor has been developed to meet the for accurate indication of volume levels from amplifiers in sound reproducing equipment.

nd film records made in England at the Wembly are identified by photographing at intervals on m, a lantern slide carrying the scene and shot rs. Each half minute, figures up to 10, in Morse re printed on the side of the film opposite the track. Corresponding figures are recorded on the negative in the space reserved for the sound

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mped diaphragm reproducer

LPH MIEHLING, *Universal Sound System, Inc.*

aper deals with a new type of speaker recently ed which differs from both exponential and cone orns. It is termed the damped diaphragm re- er because of the peculiar construction of this of the instrument. It employs a large, metallic agm rigidly attached to a heavy iron ring. The ic driving system is attached to the center of the agm and serves to actuate the diaphragm. The agm, which is made of duralumin, 0.002 of an hick, is not stretched on the ring to the extent s natural period of vibration is above audibility, nsion however is such as to place its resonance within the audible range.

To prevent resonance at this particular frequency the diaphragm is damped by attaching strips of balsa wood directly to it. By the proper arrangement of damping strips, adjustment of air gap and diaphragm tension, it is possible to tune the speaker so that it will have a rising characteristic as the frequency increases or a falling characteristic as may be most desirable under the conditions met with in its use.

The driving system is of the dynamic type employing a field coil consuming 0.75 amperes at 5 volts with 100 per cent safety factor. The voice coil wound with No. 36 aluminum wire 0.006 Bakelite enamel, has an impedance of 15 ohms and moves in a gap giving a clearance of 0.015 inches on each side. This large speaker requires no baffle but back stage treatment often is necessary to prevent undesirable echoes.

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Improvements in dynamic speakers

I. BOBROVSKY SERGE, *Consulting Engineer*
Utah Radio Products Corporation

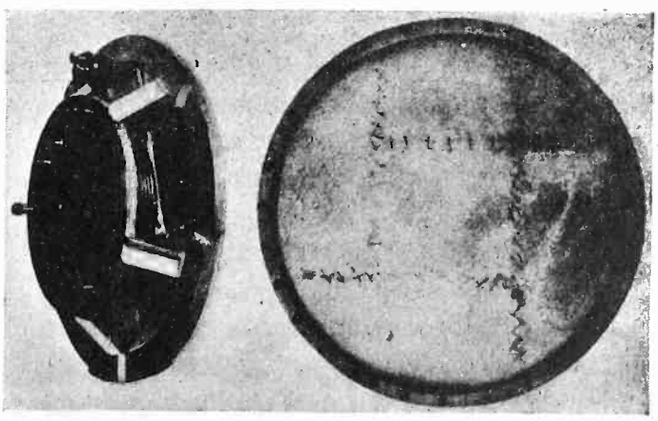
Acoustical problems are considered on the basis of a point source of sound. The number of sound sources leads to a number of technical problems. One unit is the ultimate solution, not yet reached, but necessity of fewer units is imperative. The ideal conditions may be approached by developing a cone type dynamic speaker which will have large power ratio. Problems of developing cone dynamic speakers for auditorium use are numerous of which some of the following are important.

1. Increase of output results in increased size of voice coil.

2. Maintaining as high flux density in the air gap to obtain highest ratio between mechanical watts radiated to electrical watts input.

3. Proper design of magnetic circuit which will develop maximum useful flux in the air gap for the total given flux. This results in selection of a set of dimensions to obtain minimum leakage flux. Substantial reduction of leakage is secured in design of new super dynamic speaker.

4. Increase of pole face to give a large and uniform density in the air gap. This will result in maintaining voice coil in uniform flux densities at all amplitudes to prevent subsequent variations in impedance that are detrimental to conversion efficiencies.



Loud speaker with a diaphragm three feet in diameter made of duralumin 0.002 in. thick

Linear detection of heterodyne signals

By F. E. TERMAN*

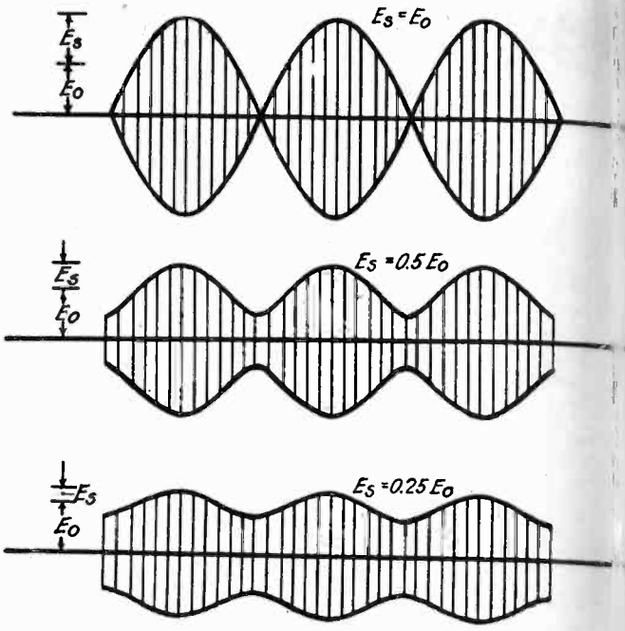


Fig. 1—Envelopes given by heterodyne signals having different values of E_s/E_o.

IN A radio broadcasting station the signals are modulated by causing the amplitude of the radiated waves to vary in accordance with the sound pressure that is to be transmitted. In reproducing the original signal without distortion it is therefore necessary that the detector in the receiving set give an output that is exactly proportional to the amplitude of the wave being rectified. Such a rectifier is known as a linear detector and will reproduce the ordinary modulated wave without distortion. Any other type of detector characteristic will introduce more or less distortion. Thus a rectifier developing an output proportional to the square of the amplitude of the wave will give proportionately more output when the amplitude is maximum than when it is minimum, with a resultant introduction of frequency components in the rectified output that were not present in the original signal modulated upon the transmitted wave.

In heterodyne signals, that is, in signals consisting of two superimposed waves of different frequencies, the object of detection is to obtain from the combination a rectified current that varies sinusoidally at a frequency that is the difference frequency of the two waves present in the signal. When this result is obtained the detection of a heterodyne signal is distortionless, while if in addition, harmonics of this difference frequency are p the detector can be said to introduce distortion.

PROFESSOR TERMAN points out an interesting phenomenon in connection with superheterodyne receivers. Linear detection produces distortion unless one of the component signals is strong compared to the other—as is usually the case in superheterodynes. On the other hand, detection of modulated carrier signals requires linear rectification if an undistorted product is desired.

Characteristics of heterodyne signal

In contrast with the situation existing in the det of modulated waves, where a linear detector gives tortionless output in the circuit, in the case of heter signals a square law detector gives distortionless tion while a linear detector will introduce distortion. is because the amplitude of a heterodyne signal do vary sinusoidally, with the result that a linear det which gives an output proportional to the ampl cannot be expected to give a sine wave output f heterodyne signal. The way in which the amplitu the heterodyne signal varies depends upon the ra the amplitudes of the individual frequency compo contained in the signal. The departure from the wave variation is maximum when the two waves a equal amplitude and becomes less as one of the ponents is made weaker with respect to the other. effect is clearly brought out in Fig. 1, which show envelopes that are obtained for a series of represen conditions. The exact way in which the amplitude is given by the following equation:

$$\left.\begin{array}{l}\text{Amplitude of}\\ \text{envelope heter-}\\ \text{odyne signal}\end{array}\right\} = \sqrt{E_s^2 + E_o^2 + 2E_sE_o \sin \omega t} \quad (1)$$

in which E_o and E_s represent the amplitudes o component frequencies contained in the heterodyn nal and ω represents 2π times the difference freq of the two components. The method of derivin equation is outlined in the appendix. It is apparen a detector producing an output proportional to the s of the amplitude of the envelope will give distorti detection of the heterodyne signal, since when Eq is squared, the right-hand member acquires a sinu variation.

When the heterodyne signal given by Eq. (1) i tified by a linear detector the output varies in accor with Eq. (1), which is plotted in Fig. 2 for s

*Associate Professor, Electrical Engineering, Stanford versity.

of $\frac{E_s}{E_o}$. The nature of the detector output of

can be most conveniently analyzed by expanding) according to the Binomial Theorem and then g a Fourier analysis to the result. When this is e following is obtained:

$$E_o\sqrt{1+r^2}(1-0.0625k^2 - 0.0146k^4 - 0.0064k^6 - \ldots.) + \frac{E_s \cos \omega t}{\sqrt{1+r^2}}(1+0.0938k^2 + 0.0341k^4 + \ldots.) - \frac{E_s r \cos 2\omega t}{4(1+r^2)^{3/2}}(1+0.313k^2 + 0.1535k^4 + \ldots.) + \frac{E_s r^2 \cos 3\omega t}{8(1+r^2)^{5/2}}(1+0.548k^2 + \ldots.) - \ldots\ldots\ldots\ldots\ldots \quad (2)$$

= weaker component of signal voltage
= larger component of signal voltage
$= E_s/E_o$ = ratio of weak to strong signal components
$= 2r/(1+r^2)$
$= 2\pi$ times the difference frequency of E_s and E_o.

ecting these equations it is of assistance to note depends upon the ratio E_s/E_o, and reaches a m value of unity when $E_s = E_o$ $(r = 1)$. For dition the equation of the envelope simplifies to

$$E_s(1.274 + 0.851\cos\omega t - 0.170\cos 2\omega t + 0.0729\cos 3\omega t - 0.052\cos 4\omega t + \ldots.) \quad (3)$$

fundamental properties of linear detection of ne signals are incorporated in equations (2)). These equations show that the difference cy output is largely independent of the amplitude stronger signal component E_o and is nearly ional to the strength of the weaker component he magnitude of the deviations from these mate relations is indicated by the fact that ng the stronger signal component E_o from equal- E_s to a value many times E_s, while holding plitude of the latter constant, increases the dif- frequency output 1.00/0.851 times or nearly cent.

distortion frequencies produced in the linear n of heterodyne signals are greatest when the nal components have equal amplitudes, under conditions the second harmonic of the difference cy is seen from equation (3) to be 20 per cent difference frequency. This distortion is reduced ne signal component is much stronger than the and is less than 2.5 per cent when the weaker E_s is less than one-tenth the stronger E_o.

Application to beat frequency oscillator

foregoing shows that distortionless rectification erodyne signals with linear detectors can be d only when the strong oscillation E_o (ordinarily produced) is much stronger than E_s (which is the signal). Under these conditions the rectified in addition to being distortionless, will be pro- al to E_s (i.e., the signal), and independent of the ude of E_o (i.e., the local oscillation).

irect practical application of the above to the heterodyne method of generating audio frequencies indicates the desirability of using linear rectification in the "mixer" tube, and making one of the oscillations much weaker than the other. This gives a distortionless difference frequency output that is proportional to the weaker oscillation and independent of the stronger

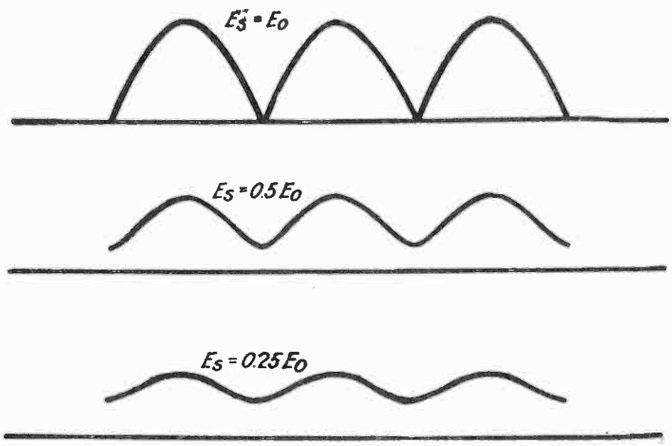


Fig. 2—Wave shapes obtained by linear detection of heterodyne signals. The detector output acquires a variation that is nearly sinusoidal if one of the components is small

Straight line rectification is to be avoided in the first detector of the super-heterodyne receiver because of interference effects resulting from distortion components of the difference frequency. Thus a super-heterodyne receiver with a linear rectifier will respond to strong signals when the beat frequency is one-half, one-third, one-fourth, and so on, of the intermediate frequency. Inasmuch as the first detector is very likely to have a linear characteristic because of the large amplitude of the local oscillation, it is important that this point be carefully considered in the design of super-heterodyne receivers. The same effect can also produce cross-talk effects in the demodulation of single side band carrier current communication signals.

APPENDIX

Envelope equation of heterodyne signal

The problem is to find the envelope of a signal having the equation

$$e = E_o \sin \omega t + E_1 \sin[(\omega + \delta_1)t + \phi_1] + E_2 \sin(\omega + \delta_2)t + \phi_2 + \ldots \quad (4)$$

where ϕ_1, ϕ_2, etc., are phase angle constants, and δ_1, δ_2, etc., are 2π times the frequency by which their respective terms differ from the E_o term's frequency. The envelope of equation (4) can be found in the usual manner,[1] which when applied to (4) consists in solving (4) for zero, equating to zero the *partial derivative with respect to* ω of this transposed equation, and simultaneously solving the resultant equation with (4) to eliminate ω. Carrying out these operations give the result

$$\text{Envelope} = [E_o^2 + E_1^2 + E_2^2 + \ldots. + 2E_oE_1\cos(\delta_1 t + \phi_1) + 2E_oE_2\cos(\delta_2 t + \phi_2) + \ldots + 2E_1E_2\cos(\delta_1 - \delta_2)t + (\phi_1 - \phi_2) + \ldots\ldots\ldots] \quad (5)$$

When only two components are present and ϕ_1 is taken as zero, this equation reduces to (1).

[1]For example, see *Mathematical Analysis*, by Goursat-Hedrick, Vol. I, page 426.

HIGH LIGHTS ON ELECTRO

Detecting adulteration with filtered ultra-violet or "black light"

"During a recent study of bootleg whiskey products it was possible to detect under the ultra-violet, or black, light the fluorescence of the adulterant of the industrial alcohol from which the bootleg whiskey was made, despite the fact that the original commercial alcohol had been distilled and that casual laboratory examinations for diethylphthalate had been reported negative," said Dr. Herman Goodman, in a recent talk before the Society of Medical Jurisprudence at New York. "By the judicious use of various colored fluorescing dyes it should be possible to determine the source of industrial alcohol used in the bootleg trade. The various districts could each have its individual dye and fluorescing signature."

One source of the near ultra-violet or black light shown by Dr. Goodman was a Cooper Hewitt low-pressure mercury-vapor lamp. Instead of the usual glass tube, used when the lamp is intended as a source of ordinary light, or the quartz tube used when the lamp is intended as a source of short, or far, ultra-violet radiation, the lamp used by Dr. Goodman was made of a dark blue-black glass. This glass, containing nickel and cobalt, is opaque to both the visible light to which glass is transparent and the far ultra-violet to which quartz is transparent. It is, however, transparent to the near ultra-violet, or longer wave-lengths than the middle ultra-violet, found in sunlight and produced by health lamps, and the short or medial wave lengths. Since the light to which the human eye is sensitive is cut off by the blue-black nickel-cobalt glass, this emission has come to be known as black light. Such tubes have been used in spectacular theatrical illumination work, but have not been applied commercially otherwise.

Counterfeiting of bank notes and stock certificates, alteration of bank checks, and erasures in account books can be detected with black light, since papers, even from the same manufacturer, which seem alike under ordinary light are at once revealed as different by ultra-violet. Similarly, invisible inks which glow under ultra-violet can be used as a protection against forgers and check raisers. Such inks could also be used in marking cloth and other commodities as an invisible mark of ownership and protection against loss by theft.

Natural teeth fluoresce with a brilliant white light. False teeth, no matter how cleverly matched to the natural ones in ordinary light seem chocolate colored under black light if made by one manufacturer, or yellow if of another composition. A record of the fluorescence of the teeth could be added to identification charts.

An important place for black light in the cosmetic industry has to do with the substitution of cheap imitations for well known trade marked perfumes. By the addition of a tiny amount of a secret fluorescent dye it would be possible to detect substitution.

Scrutinizing bank checks for erasures, under ultra-violet light

✦

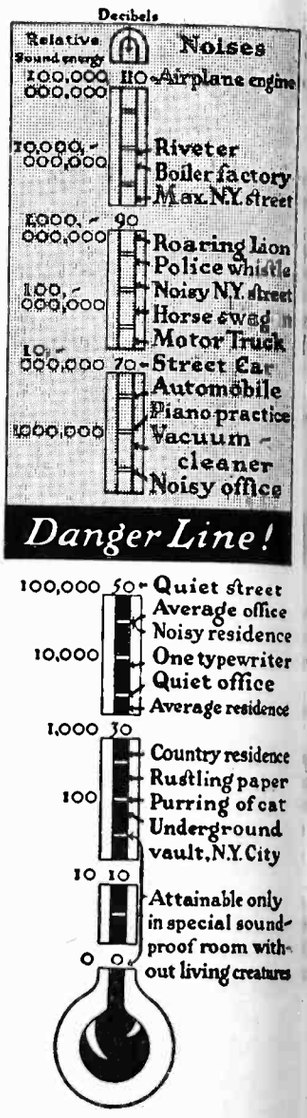
Analyzing industry and traffic noises

Dr. E. E. Free, consulting engineer, New York City, who has made surveys of the noise conditions in several cities and industrial centers, reports on the results of the New York Noise Abatement Commission's work as follows:

"A necessary first step in organized attack on the noise problems of any city is the accurate measurement of the noises which actually exist, with the determination of their sources and the preparation of a 'noise map' of the city.

"All noise surveys which have been made indicate that the chief source of city noise is street traffic. In most instances, the noisiest points are also the points of greatest traffic concentration. Our New York City measurements indicate that the average sources of noise at a noisy street corner are approximately as follows:

Automobile trucks.....40 per cent
The elevated railway..25 per cent



"Noise thermometer" showing sound levels existing under various conditions

Street-cars .....20 per
Other noise sources...15 per

"The reduction of total city n be expected from a successful ca will range between 20 and 50 pe

"Noise surveys, recommended essential basis of such a noise co sion's activities, are now usually by noise-measuring instruments acoustimeters, which instrument sist essentially of a microphone to the microphones used in radio-casting, a vacuum-tube amplifie those used for radio-receivers, a electric-meter on which the out this amplifier is measured.

"The microphone picks up the energy from the air and conver into electric oscillations, just as in radio-broadcasting. The an magnifies these electric oscillatio eral million times, keeping the fied energy exactly proportional energy entering the microphone. magnified energy then is measu the meter."

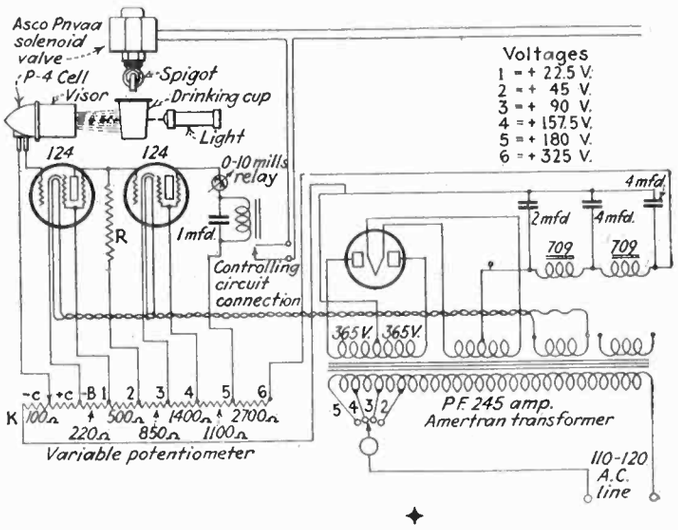
ICES IN INDUSTRY ✦ ✦

:up under faucet; flows

ompanying diagram shows the employed in the "automatic oler" which was exhibited at City by the Arcturus Radio ompany. According to H. L. nn, the amplifier used consisted 124 tubes, resistance-coupled, orked a relay in the output hose secondary contacts were f passing five amperes at 110 he output of this relay was in nected to a solenoid valve which ll the flow of water.

cing a cup under the faucet was interrupted and the change ial on the grid of the first tube e by the photolytic-cell caused s in the output circuit of the to function.

✦



Circuit of automatic water cooler. When cup is held under the faucet, intercepting the light beam, the photo cell operates the solenoid valve

-prevention methods. tube starts blower

methods of using the vacuum- revent the production of smoke stacks are now available and in ervice.

of these remarkable devices "see" smoke released by a care- man by day or night and in- apply correctives without the ion of a human hand. For ex- here is the electronic "smoke " now installed in a number of ants. This device comprises an eye or photo-electric cell near m of the smoke stack. Opposite s the stack, is an ever-burning ight. If a cloud of black smoke, from careless firing, starts up the photo-cell is eclipsed and operates switches to start up ers. These at once deliver an f fresh oxygen to the furnace smoke is burned up. All this automatically and is in full n before the smoke gust has even the top of the chimney.

hoto-cell also can be arranged a sign indicating "smoking" and an alarm bell in the boiler room ecord occurrences of smoke on y-four-hour recording tape on of the big boss, either at the elsewhere.

is special significance in the t the electronic smoke warning remedies it applies are equally day or night.

natic detection of night smoke is ly important in doing away with 's smoke pall. Despite human lness, many chimneys are now to pour forth great clouds of smoke under cover of darkness. Usually there is little wind in the early morning, therefore these smoke clouds settle on the community and produce the familiar black gloom which overhangs the city until nine or ten o'clock in the morning.

Electronic tubes are being used in other ways to suppress soot and dust. Electro-static smoke preventers now installed in plant chimneys have high-voltage plates charged with static electricity which attracts the soot and dust particles out of the flue gases in the same way that the static electricity in a comb attracts hair or paper particles on any frosty morning. Electron-tube rectifiers are used to produce high-tension direct current for charging these precipitator plates with static electricity.

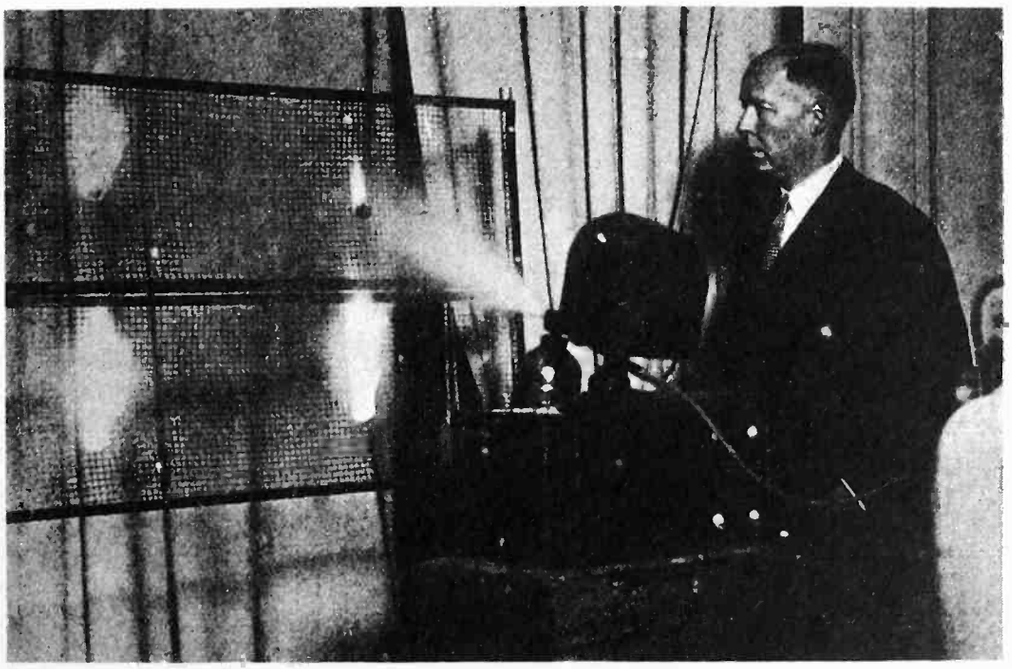
A mechanized "Army Band"

The Acting Secretary of War, Honorable F. Trubee Davison, has authorized the Quartermaster General to procure for service test one mechanical substitute for an army band. This device will be issued to Fort Washington, Maryland, for a test by the 3rd Battalion of the 12th Infantry.

This equipment is built into a three-fourths ton truck. The volume of music is equivalent to two large bands, and the volume may be controlled as desired. It is contemplated, if this apparatus is finally adopted for use by the army, to utilize it at stations which have no band, of which there are some sixteen such stations at present.

✦ ✦ ✦

SEARCHES OUT FIRES; EXTINGUISHES THEM



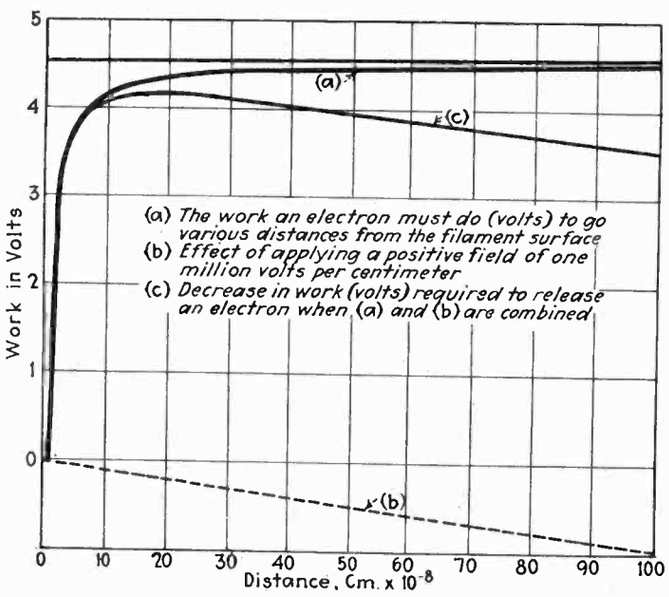
Before the A.I.E.E. at New York, Oct. 24. L. W. Chubb, Westinghouse director of research, demonstrated this "fire scanner." Four flames were lighted on the screen, the scanner was set in motion, and as it came in line with each fire, it stopped, aimed a stream of water, and then, the flame extinguished, went on to the next fire

The role of barium in vacuum tubes

By J. A. BECKER*

AMONG the filament characteristics most desired in the design of vacuum tubes are long life and low power for heating. The most desirable filament yet discovered for telephonic purposes consists of a platinum alloy whose surface is coated with a mixture of barium oxide and strontium oxide. A very minute amount of barium has been found to effect a vast increase in electron emission for each watt of power used to heat it—an obvious advantage when one considers that in the Bell Telephone system there are 250,000 tubes in use. Why the coated filament should liberate electrons more economically and how to increase these economies with added improvements in life and reliability have been important problems basic to tube development.

From the results of extensive research initiated by Dr. H. D. Arnold and followed by W. Wilson, J. E. Harris and M. J. Kelly certain facts have been established. An accompanying figure shows the remarkable effect that barium has upon the activity of a platinum filament. For filaments which are maintained at the same



Barium supplies a positive field tending to pull the electrons from the filament

temperature, there is a very much greater en in fact, more than a hundred million times as for a clean platinum surface without barium—v filament surface is just completely covered with layer of barium atoms. When the surface is o covered the electron emission is too small to the scale used in plotting the figure. Emission i rapidly as more and more of the surface is cove about 80 per cent is covered, when an enormous is noted. When filaments were studied with m enough barium to cover their surfaces, it was fo the current decreased and approached the value would have for bulk barium.

The remarkable fact is that the electron curre is possible at any heating temperature from layer of barium atoms on a platinum wire is eno greater than the current which could be obtain a filament of either substance alone.

In the filament of the standard repeater tube, t num core is covered by a thick layer of the oxide In the course of the treatment of the tube some oxide is electrolyzed and barium is stored up core and in the oxide. While the tube is bei some of this barium is adsorbed on the surface oxide as an invisible monatomic film. This a barium film is responsible for the high efficiency oxide coated filament.

Experiments have shown that barium on top oxide coating behaves qualitatively like barium o num. Its characteristics are even more d Apparently the forces brought into play betw barium and the oxide coating are essentially th as those between a platinum core and a single l barium atoms deposited upon it.

These are the facts but to understand the rôle by barium atoms it is necessary to understand fi emission takes place from a clean filament surfac electrons in the metal must have a certain speed i to break away from the forces holding them to th and escape into the vacuum. Because of the heat of the metal, at any temperature a certain ver fraction of the electrons have enough speed to and some do so. As the temperature goes up, the agitation of the electrons increases and the fracti escape increases rapidly. Therefore, the amo electron current goes up with increasing tempera

To make more electrons come out without rais temperature, it is necessary to arrange matters t it easier for them to get out. As the electrons escape from the surface, they must overcome pulling them back. These forces might be lik those acting on a ball which is started rolling The heavy line (a) in the accompanying figure ill such an electrical hill for metallic tungsten. It the work an electron must do to go from the su various distances from the surface. For practic poses if an electron ever gets out to a distance o 10^{-8} cm., or one millionth of a centimeter, it perm escapes from the filament and reaches the plate. this it must have had at least 4.5 equivalent v energy when it left the surface.

The electrons of the filament are continually t try at this hill, but only a very small fraction c start with sufficient velocity to reach the top and Of course, if the height of this hill can be reduce more electrons can, at any given filament temp

*Bell Telephone Laboratories, Inc.

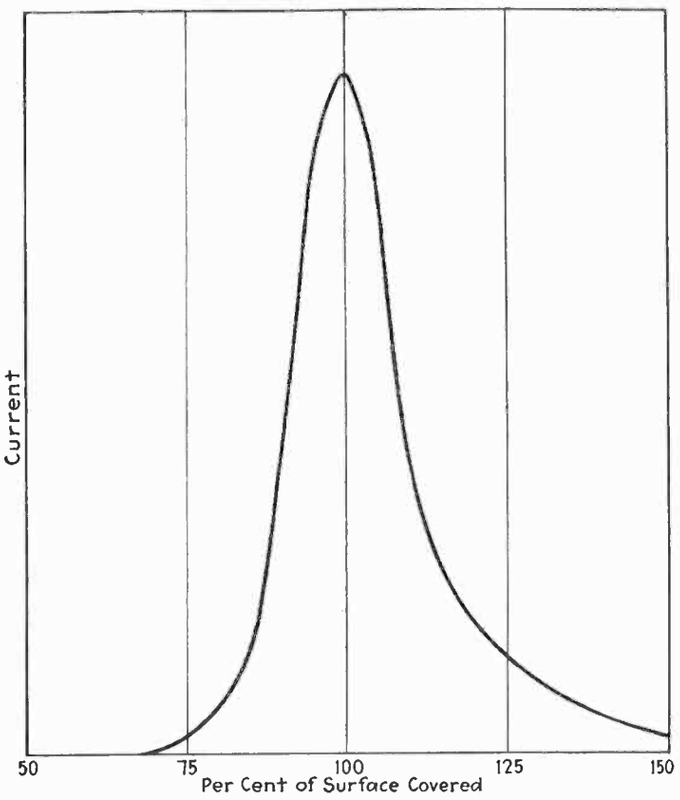
r it. One way of accomplishing this is to apply nal electric field which pulls the electrons out. d can be produced by raising the plate of the a positive potential. In the figure, the dotted line which slopes downward represents an ap- d of a million volts per centimeter. By combin- field with the original field, we obtain a new hill whose height has been reduced. An electron escape if it leaves the surface with 4.2 equiva- and reaches a distance of 20 x 10^{-8} centimeter.

he barium atoms on the surface increase the of the filament is a question. When the barium the surface, some of the atoms become ionized, ney give up one of their electrons to the surface ne positively charged.† These barium ions act same as would a very fine-meshed positively- grid placed exceedingly close to the filament. rid produces fields which, close to the surface, electrons escape. Due to the fact that this ion ery close to the surface, the fields produced by mendously great—several million volts per cen- and consequently the effect is proportionately he greater the number of ions on the surface er is the field and consequently the greater the emission.

s true only so long as the surface is covered than one layer of barium atoms. Beyond this dditional barium atoms cover up the spaces which the electrons come from the surface, and he number of ions on the surface. Consequently on emission is reduced more and more until it value characteristic of a solid barium surface. ame picture of barium ions stuck to the surface strong support from another set of experiments. been described a positive potential, applied to of a tube, increases the emission from its fila- rom the careful analysis of such current-voltage me can deduce the exact value of the forces t on an electron while it escapes from the sur- xperiment discloses the interesting fact that a distance of about ten atom diameters from rfaces, the only forces which tend to pull the back are those induced by its own electrical Near a clean metal filament there are thus no fields excepting those produced by the escaping If, now, this clean surface is covered with a ayer of barium ions, other fields are superposed mage fields. These fields are presumably pro- the adsorbed barium and may be called adsorp- ds. Very close to the surface these adsorption e tremendous and in a direction to pull electrons e surface. Further from the surface these fields and actually reverse their direction; for a while n increase in magnitude, come to a maximum and y decrease. These characteristics of the adsorp- d, revealed by experiment, are just those which e expected from a non-uniform positively charged very close to the surface.

adsorption fields have a marked effect on the voltage or saturation curves. It was long ago that while clean tungsten yielded curves which d very well, the corresponding curves obtained ated filament saturated very poorly in comparison. se of this marked failure to saturate is due to orbed barium atoms.

e of much value, the barium atoms must stick sly to the surface even at high temperatures. It, re, becomes of interest to inquire what holds them



Effect of barium, expressed as per cent of surface covered, on electron current

to the surface. Here again our picture helps us out. Since some of the barium atoms are barium ions on the surface, they are positively charged and hence are held to the surface by the negative charge they induce on it. Furthermore, since the field produced by the ions helps electrons from the surface, it hinders positive particles from leaving the surface. Consequently each ion helps hold its neighbor to the surface even at temperatures at which solid barium would vaporize rapidly.

Still another prediction from our picture receives experimental verification. Since the electrical forces are chiefly toward and away from the surface rather than parallel to or along the surface, we should expect that each adsorbed ion would not be attached firmly to one particular spot on the surface but should be able to move about on the surface. This prediction was verified experimentally by putting barium atoms on one side of a flat ribbon. After this ribbon had been heated at a moderate temperature, barium atoms were detected on the other side. This surface creepage continued until only half the original deposit remained on one side.

We thus see how the simple picture of the ionic barium grid accounts for many of the observed emission characteristics of coated filaments. The economical side of the picture is just as remarkable.

In the ordinary telephone repeater tube the single layer of barium weighs about one-sixth of a microgram. For all the thousands of tubes in use in the Bell System the total amount of barium effective in the emission of electrons is not more than a twentieth of a gram.

Each barium coated filament requires only about 2.2 watts for heating as compared to about 35 for a clean tungsten filament. Multiplying this saving by the 250,000 tubes used in the Bell System gives an indication of the tremendous importance of barium to the vacuum tube.

†"The Life History of an Adsorbed Atom." *Bell Laboratories Record*, Vol. V, No. 1, p. 12.

‡"On Electrical Fields Near Metallic Surfaces." J. A. Becker and D. W. Mueller, Bell Reprint B-300.

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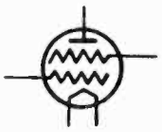


Motion Picture Engineers look into future

AT THE annual convention of the Society of Motion Picture Engineers held in New York City, Oct. 20 to 23, nothing very new in the development of equipment was brought out. The standardization of wide film is one step nearer solution, however, with the definite recommendation of the standards committee for a picture area of 1.8 to 1 (ratio of width to height), with the possibility of 50-mm. overall width becoming standard.

One paper scheduled covering a 16-mm. sound-on-film home projector, was withdrawn and not presented. This was unfortunate as the device which was to have been described would have been at least a new step in the home entertainment field.

Serge Eisenstein speaking at the banquet of the society stated: "Mechanical and electrical developments in the industry are now far ahead of the artistic side of motion pictures." This may mean that some of the kind of effort spent on engineering might be turned to advantage on the program side in order that progress of the industry as a whole may go forward.

Much advance, however, yet remains to be made in sound pictures if the public's interest is to be held. Improvements throughout the sound recording and reproducing system, especially the loud speakers, should be looked for to more nearly approach the natural voice of the artist or the music from an orchestra. Acoustic treatment of the great majority of theaters is far from satisfactory; the owners apparently are merely hoping to ride the present wave of popularity of sound films as far as this tide will take them.

Cold-cathode tubes

ELSEWHERE in this issue of *Electr* given notice of a new tube prod Germany, with a cold cathode. To d with the heating of cathodes has been the of tube engineers and users for a number o and this is probably the first description actual production and use of such tubes. particular case, the source of electrons is a electric surface which is illuminated by an descent lamp nearby. Other sources of el which have been suggested are radi substances. These tubes are not practi present-day circuits, because of their ver internal impedance and low amplification and engineers will probably classify them a osities. It should be remembered, howeve the "audion" of de Forest was a curios many years.

Obstructing the farmers' use of radio—

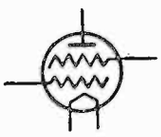
EVERY man who has taken the oath as F Radio Commissioner has thereby obl himself to exert all possible effort to bring radio reception to the people of the United The members of the Commission thus hav a great personal responsibility—and an ins opportunity—to enrich and brighten the li millions. It is their duty to so shape the channels with sufficient broadcasting powe strong, clear radio signals will be laid do every home in the United States,—so th most modest farm dwelling with the simples set, will enjoy the same priceless boon of entertainment as do people in the great citi nearby communities.

High-power stations on every clear chan the only answer to the demand for satisf broadcast reception on the farms and in towns remote from city centers.

There is now no reason why the farmers United States, the farmers' wives, and th and girls growing up on the farms and in towns should not receive a high standard of broadcasting—substantially the equal of th ice supplied to cities and nearby communitie

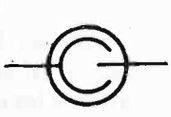
The radio art, after costly research, is re

broadcasting service of high technical qual-
very home. The channels are cleared ready
Twenty-seven responsible broadcasters
ling to invest several hundred thousand
each, to bring city-quality to additional
illions in their sections.
the Federal Radio Commission now blocks
to better radio on the farm and in the
owns of the nation.



ome recording devices ay point new methods

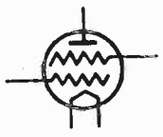
TH the addition of home disc-recording
quipment to the latest designs of phono-
adio combinations placed on the market,
nd interesting device has been made avail-
or home entertainment. The simplified
hone which is supplied as a part of the
ng equipment, together with the six-inch
n which the grooves are previously cut, is
pected to furnish the same quality of record-
the elaborate recording equipment used in
ofessional studios.
ground noise level is quite high in such
s, resulting from the hard texture in which
tting stylus has to operate. New materials
e developed that will furnish the necessary
or cutting, with low ground noise and still
the desired wearing qualities. From the
nds of users of such equipment, perhaps
deas and methods may be advanced which
esult in unlooked-for improvements in both
and professional use.



Sic transit "photo-cell"

EMBERS of the Vacuum Tube Technical
Committee of the Institute of Radio Engi-
recently decided to standardize the term
totube" in place of "photo cell," a much
word. On this committee are engineers
the large laboratories building and using
otubes, where the new designation is in com-
use.
he committee has arbitrarily limited itself to the "Hallwachs" phenomenon in which a pure electron stream is liberated by the reception of light energy, or in which this electron stream —through the medium of a gas—produces a tube of increased sensitivity. The committee has not considered photo-conductive cells such as selenium or the photo-voltaic types which are now being made and sold, and which will probably be used in increasing quantities.

Shall the term "phototube" be applied to all light sensitive devices, or should the photo-conductive and photo-voltaic types of cells be called by other names? Since most of the definitions which will be agreed upon by the committee and written into the year's I.R.E. year book will apply to these other types of cells as well as to the so-called "photo-electric" type it appears that a decision regarding the terms by which the cells are called, is desirable.



Alongside "celestial mechanics," now comes "celestial electronics"

FOR hundreds of years men have viewed the solar system and the universe as a magnificent piece of mere mechanics—a superb machine of purely mechanical elements—until we had come to accept the term "celestial mechanics" to describe the whole vast system.

But within the last few years astronomers are finding that the heavenly bodies involve much more than the mechanistic considerations of the old-time astronomy. For now it is realized that the sun and other stars are huge and complex magnetic structures, that they radiate electrical vibrations of a wide range of frequencies, that space is threaded and cross-threaded by a maze of electro-magnetic impulses of various wave lengths, that gravitation itself is perhaps electro-magnetic in nature, and that in the final analysis even the matter of which the stars and planets are made, is itself built up of countless minute "solar systems" of electrons or particles of electricity.

In the light of 1930, then, we must shape our ideas of astronomy around an *electro-magnetic universe,* and parallel to the old "celestial mechanics" we shall have to set up the new science of "celestial electronics" or "celestial electro-magnetics."

REVIEW OF ELECTRONIC LITERATUR
HERE AND ABROAD

Some measurements of optimum heterodyne

[J. F. HERD.] By taking static characteristic curves and their rectification curves for a triode it may be shown that the rectification characteristics of a given set of tubes show less variation than do the static characteristics. Moreover a glance at these curves indicates the point where the mean plate current is most sensitive to a change in grid voltage and so indicates the point of optimum heterodyne. Starting from this optimum point measurements were made with the following:

(a) a two stage choke coupled amplifier (as load on the detector tube)
(b) a tuned audio frequency amplifier
(c) an ordinary commercial transformer coupled amplifier.

All data showed: that the audio frequency output bore a linear relation to the input for small signals; that the point of optimum heterodyne corresponded to that obtained from the rectification characteristic; and that the gain in amplification of weak signals with optimum heterodyne was thousands of times that with equal heterodyne. — *Experimental Wireless, September, 1930.*

High frequency oscillator for general laboratory use

[F. S. EVANS.] In connection with the discharge of electricity through gases need was felt for an ultra high frequency oscillator. The basis of the oscillator described is the Gill and Donaldson circuit which consists essentially of two parallel equal Lecher wires connecting grid and plate, with a variable condenser forming the junction between them. The circuit oscillates readily with all low impedance valves and may be readily adjusted to a frequency of about 30 megacycles. The energy is supplied to the discharge tube through a coupled circuit consisting of two Lecher wires closed at the end near the valve.—*Journal Scientific Instruments, August, 1930, p. 261.*

✦

Recent progress in the construction of photo-electric cells

[ROY-POCHON.] Summary of the basic theories, details of construction (cathode, anode, gas, tube): with a bibliography.—*L'Onde Electrique, Paris, August, 1930, published September 26.*

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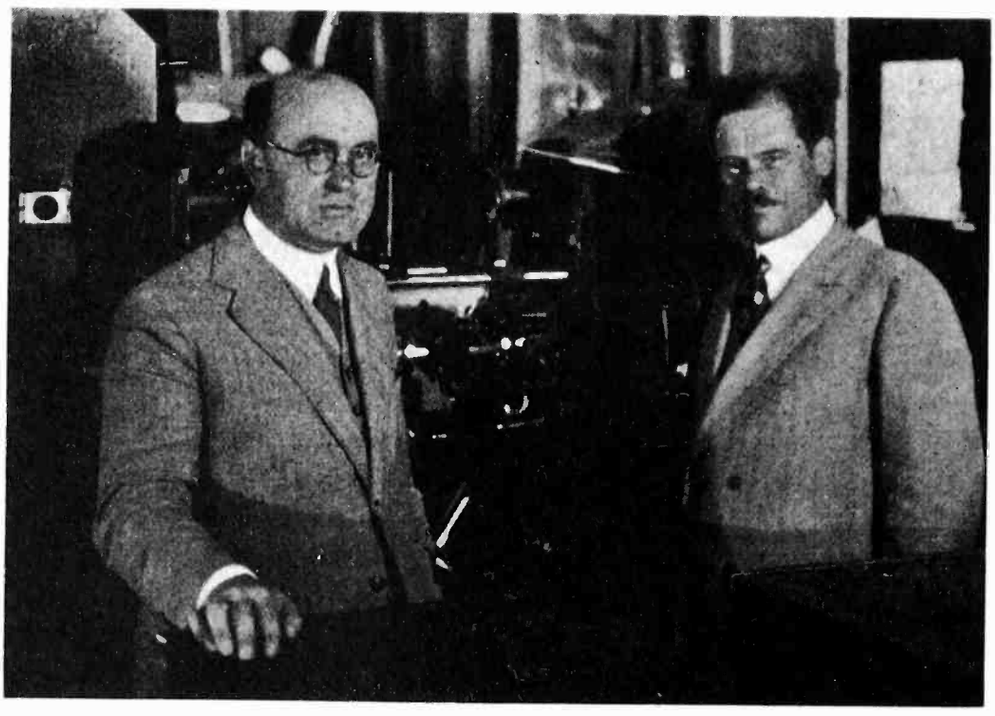


DR. KAROLUS AND DR. ALEXANDERSON

Dr. Karolus, of Germany, inventor of the Karolus cell for modulating polarized light, used in the Alexanderson system of movie-screen television, visits Dr. E. F. W. Alexanderson in the latter's laboratory at Schenectady

Television glow lamps

[H. W. WEINHART.] Developme the design of glow discharge lam television are recounted. The e lamps for monochromatic televisio flat plates for electrodes, cooled on radiation, so that the intensity of glow was limited by a current ca of only 50 milliamperes. Introdu of water-cooling permitted the u currents as high as 500 milliam giving a very bright glow on cathode. For the more recent wo monochromatic television, the glow charge is confined to a flat square face by mica shielding; and the a is a metal strip fencing off this a area. The cathode is clamped in tact with a glass tube through v the cooling water circulates. The recent tubes for color television en the same scheme for water coo mica is used on the cathode to pr a long insulating path and to pr the glow from forming anywhere b the desired flat rectangular area.

Hydrogen which must be adde the gas within the bulb periodical admitted from a separate glass cha attached to the main bulb. Two p plugs, one sealed in an extension o lamp and one in the end of the hydr supply bulb, are normally sealed mercury but when pressed together mit the passage of hydrogen into tube. Lavite is used for the plugs is heat treated until it is porous en to pass hydrogen but not mercury.

The uniformity of the glow of tubes and the sputtering from the a surface depend on the use of the pr technique in preparing the cathode face. It has been found that beryl deposited by the vaporization and densation method sputters far less other materials and so is used fo final plating of the surface. For m chromatic television and for the component in color television nec used as the discharge gas. For the and green components argon is ployed. Color filters are used wit lamps for color work.—*Bell La tories Record, October, 1930.*

✦

Customs regulations for travelers

[UNSIGNED.] Very useful summa the conditions governing the temp import of radio receivers in to E pean countries.—*Radio B.F.f.A., S gart, October, 1930.*

n of word "electron"

D McNicol]. Although it was l 1896 that the electron as we today was identified and de- ions made relative to its physi- acteristics, it is history that the Greek poets called the sun and Homer repeatedly so terms l Z/513: T./398). "Electron" d indefinitely by the Greek vriters. In the minds of the gold and the gold alloys were all of the sun "elector," and, in with these, amber, in Hellenic ame to be called "electron." rough search of historical elec- cords might disclose that the ls been used long after the sed it to refer to amber. That was current and had some ace in scientific circles is evi- the fact that in the electrical *The Telegrapher*, of December the word electron appears on at the bottom of the first —*Radio Engineering, New tober, 1930.*

✦

ncy modulation stortion

CKERSLEY.] Due to the differ- traveled by the direct and re- aves the signal received at a nt is composed of components e transmitter sent out at dif- nes. With frequency modula- means components of different es so that in addition to the eat tones between the carrier of the side bands for each of onents there will be beat notes the two carriers and also be- ch carrier and the two side the other component so that distortion results. Experi- hecks with frequency stabilized sion show that this explanation ly correct for the cause of dis- n short-wave radio-telephonic sion on alleged amplitude modu- pe. — *Experimental Wireless, r, 1930.*

✦

itive and ive coupling

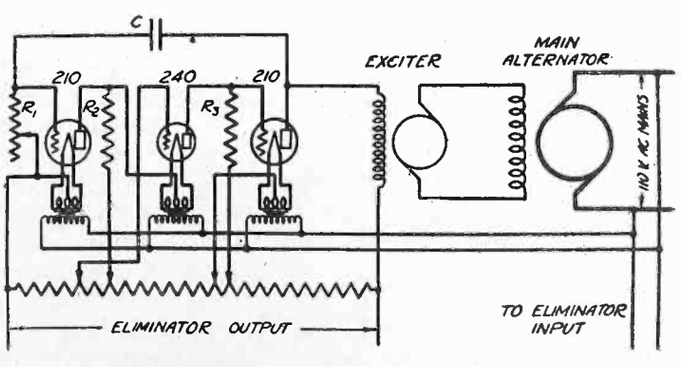
Wilmotte.] An able presenta- an important but complex and problem. The one objection our reviewer has is the conven- loyed for the sign of the mutual ce, which leads, for instance, to ept that the mutual inductance adjacent wires on the same egative. This is, however, the on normally employed by the Physical Laboratory and so, no doubt, much may be said in its favor.

After a preliminary explanation of impurities in condensers and mutual inductances the author presents two transformations, the first that of two self-inductances with mutual, connected at a common point, to a star arrangement of self inductances, and the second the star-delta conversions of Campbell (Kennelley?). By the aid of these transformations he shows how to convert capacitive coupling to its equivalent in magnetic coupling and vice versa. A means of measuring mutual inductance and its impurity is then disclosed and the paper ends with the comparison of the two types of coupling and a discussion of the limitations of the above mentioned transformations. — *Experimental Wireless, September, 1930.*

✦

Vacuum-tube voltage regulator for power alternators

[L. C. Verman and L. A. Richards.] Two novel features are incorporated in this vacuum-tube voltage regulator for a.c. power units. First, saturation current from the filament of a thermionic tube is used as the control element; and second, a feed-back stabilization system is employed which makes it possible to obtain stable regulated voltage conditions with high sensitivity. Operation of this regulator involves conversion of the a.c. line voltage fluctuations into d.c., amplifying these fluctuations, and applying them to the field of an exciter which supplies the main alternator field, thus controlling the line voltage. The exciter field winding is the only special piece of apparatus used in the system, all the other parts being standard and readily obtainable. The first tube (a UX 210) is operated at a low filament temperature and high plate voltage so as to obtain saturated plate current. Under these conditions the current through the coupling resistance R_2 is nearly independent of the plate voltage but changes rapidly with the filament temperature and hence with the r.m.s. value of the line voltage. A UX 240 is resistance-coupled to the first tube, so that a decrease in the line voltage makes the grid of the 240 tube more negative, cutting down the current through R_3, making the grid of the third tube (210) more positive and building up its plate current. The almost instantaneous response of the vacuum-tube system to small line voltage fluctuations tends to cause hunting, because of the considerable time lags in the fields of the exciter and main alternator. This has been overcome by a feed-back coupling system with condenser C and resistance R_1 which reacts on the grid of the first tube, virtually delaying the response of the regulator. This arrangement gives voltage regulation of 1.5 per cent at full load unity power factor as compared to 45 per cent with fixed excitation. The regulator also functions as overload circuit breaker.—*Review of Scientific Instruments, October, 1930.*



Circuit diagram of vacuum tube voltage regulator

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New radioelectrical instruments

[Weiss.] I. Radioelectric piano and organ, Givelet-Coupleux. Chiefly a general discussion of possible methods, with little details as to those actually used. II. Boreau "Radiotone." Full descriptions: the system is entirely new, a string in tension between a fixed support and the armature of a telephone receiver being "bowed" by a revolving wheel, and the currents induced in the receiver coils amplified. The critical positions of the bowing wheel for various pitches and its speed of rotation are discussed. Volume is controlled by a pedal. A system of filters controls the tone quality.—*La Nature, Paris, September 15, 1930.*

✦

Technical questions at the Vienna program convention

[Unsigned.] Descriptions of some of the demonstrations at this Convention of the German Radio Program Committee, more especially of: the ultra-micrometer, using variation in condenser capacity and the heterodyne principle to measure changes in length of the order of one millionth of a centimeter; and the Scheminzky electro-stethoscope, in which a special arrangement of a semi-flexible cup attached to a telephone diaphragm is used to absorb the mechanical vibrations associated with heart-beats and with breathing. The same inventor also demonstrated the minute bioelectrical currents associated with muscular movements.—*Funk, Berlin, October 10, 1930.*

Distant control with very short waves

[Besson.] Waves of 3 to 5 meters length are used (near La Rochelle) to start and stop the fog-signal, consisting of an acetylene-operated gun, at an isolated lighthouse without attendant distant 2.5 kilometers. The transmitter uses two tubes in a symmetrical arrangement (Mesny-Vallauri circuit) with a small dipole antenna. The receiver uses a similar antenna, and is itself of the super-regenerative type: it is switched on by a clock mechanism during seven seconds each 5 minutes only. The reception of a signal switches the gun into operation, the reception of a second signal switches it off: in order that a second impulse intended in reality to form part of the energizing signal may not de-energize, the receiver not only switches on the gun but simultaneously switches itself off, thus ensuring that the gun will actuate for at least five minutes. An anti-parasitic device is suggested, based on the saturation of a super-regenerative receiver by continuous wave signals. The system is to be extended on the Brittany coasts.—*L'Onde Electrique, Paris, August, 1930, published September 26.*

✦

A photo-electric cell with semi-conducting dielectric

[Von Hartel.] Discussion of the theory of the new Lange cell as compared with the normal types: in these cells a copper-oxide layer replaces the vacuum, and separates a film of copper (cathode) so thin as to be transparent, from the anode which may also be of copper. The maximum sensitiveness occurs towards the red end of the spectrum, even with copper as the cathode, thus rendering the use of rare metals unnecessary. A striking advantage of these cells is that no auxiliary voltage is necessary: the sensitivity is also much greater than in the case of the normal cell (about ten times that of a vacuum cell). The internal resistance is of some hundred ohms only.—*Funk, Berlin, September 19, 1930.*

✦

Electrical musical instrument

[Weiss] Description of the "Ondium Péchadre," using the heterodyne beat-note. Pitch is controlled by a variable condenser, actuated by the right hand: the left hand controls the volume, by depressing a key to a greater or less extent, and also the tone-quality (no details of this are given).—*La Nature, Paris, July 15, 1930.*

Cold cathode amplifiers

[M. Von Ardenne.] Employing a cathode of photo-electric material, valves with an audio frequency voltage amplification of 30 in sunlight, and of as high as 17 under the illumination of a 50 cp., half-watt lamp have been successfully produced in Berlin. The greatest advantage of this method is the total absence of hum and line noises, although search for a cold-cathode tube was the original incentive. The effect of line voltage fluctuations can be entirely eliminated on either d.c. or a.c. by the proper choice of a light source. In addition, a whole series of receiving circuits in which the cathodes of the various valves do not have a common potential can quite easily be realized.

The valves for experimental work employed a potassium cathode of several square centimeters area, which was sensitized with hydrogen, and the valve filled with an inert gas. The ionic current due to the gas does not appreciably affect the operation of the valve as an amplifier, though it necessitates the use of different grid-bias voltages. The amplification factor of the valve itself is about 40, and its a.c. resistance is of the order of two megohms. In the experiments described a plate resistance of ten megohms was used. The grid current curves have a shape which indicates that grid current will have no appreciable influence on amplification. A three-stage amplifier, resistance-coupled, with the three tubes grouped about a single motor-car headlamp, was found to work very satisfactorily. It was also found that a glow discharge in close proximity to the cathode, either in the same bulb or in a separate one, will provide as great a surface illumination as an ordinary electric lamp. This glow was energized from a battery eliminator. The results obtained are extremely interesting.—*Wireless World, September 3, 1930.*

Baron Manfred von Ardenne, German scientist and inventor, whose writings on radio and allied subjects have appeared in scientific journals throughout the world

Equivalent circuit of the thermionic valve

[N. R. Bligh.] Barkhausen der Pol have already shown t any given equation, all voltages rents are interchanged and ad substituted for the correspon pedances a new equation is which represents, as well as the equation, the phenomenon unde gation. Applying this princip triode Mr. Bligh has derived t tions for various types of load simple circuit which is usuall sented as a voltage μe_g working an internal impedance r_p and impedance Z is thus converte constant current generator G_n ing across an impedance cons r_p and Z in parallel. Either fo as the current through the load

$$i = \frac{\mu e_g}{R_p + Z}$$

The great advantage of the al method of representation is tha external impedances in the anod are thrown in parallel with the impedance and the plate-filame tance so that the combination and shunt impedances is avoid *perimental Wireless, Septembe*

✦

A valve-operated coreless induction furna

[Frank Adcock.] The oscilla sists of two 2.5 kw. valves in p fed with raw a.c. The circuit tuned plate type with the coil the energy into the furnace. methods of applying grid bia oscillating valves were tested. a combination of grid-leak a denser in conjunction with a negative C bias of 36 volts was The grid-leak and condenser tion when used alone did not yi cient protection when the valv oscillating under inefficient co on the other hand a high p bias unduly restricted the osc Much trouble was experienced ing magnetic materials due change of their magnetic proper hence loading on the oscillat temperature. A solution was a specially designed condenser *Transactions of the Faraday September, 1930.*

✦

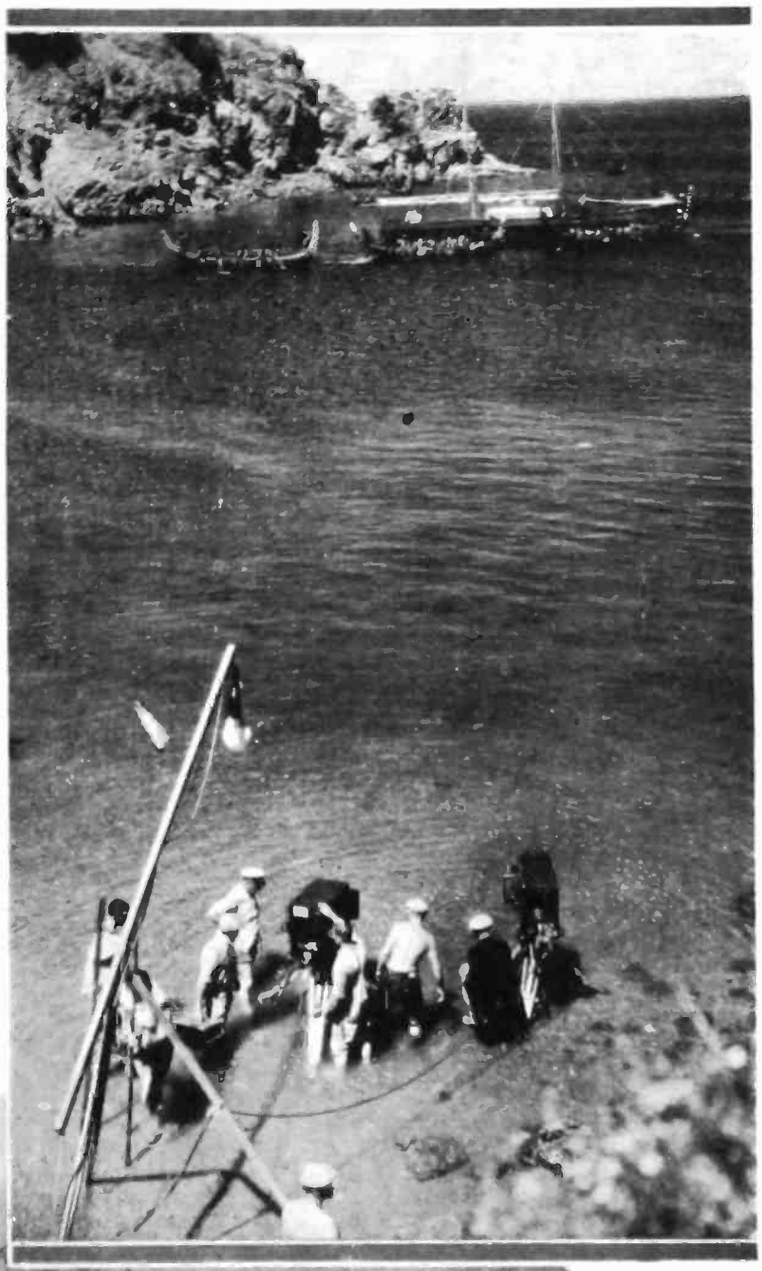
Continuous-wave diath and its surgical applica

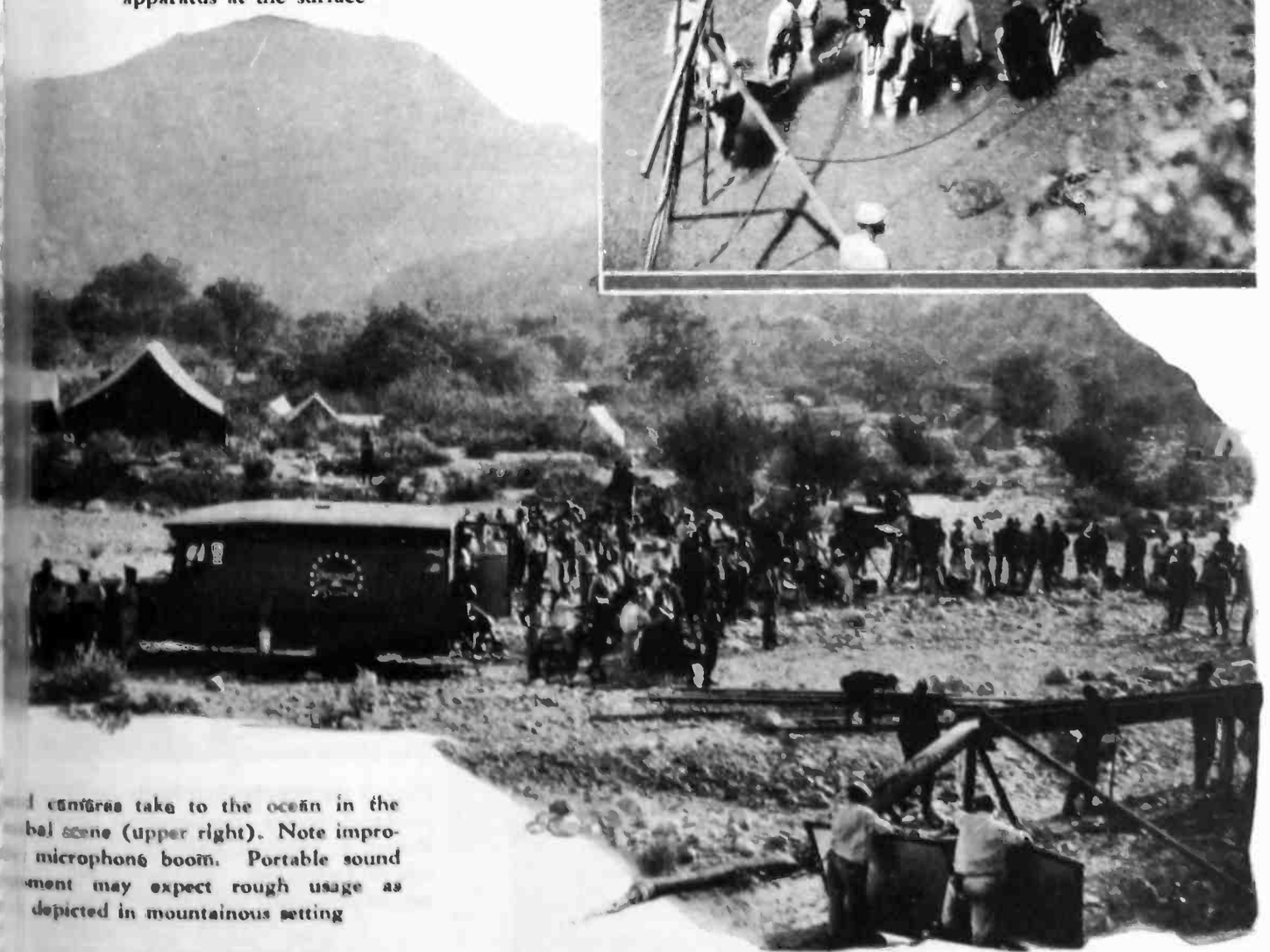
[Colombier.] More complet with diagrams and photograph actual apparatus, based on the previously described (these July, 1930). — *Radioélectricit October, 1930.*

ınd recording under difficulties

tions under which sound recording ment has to work. Illustrations taken *Recording Sound for Motion Pictures,* published by McGraw-Hill Book Com- this winter.

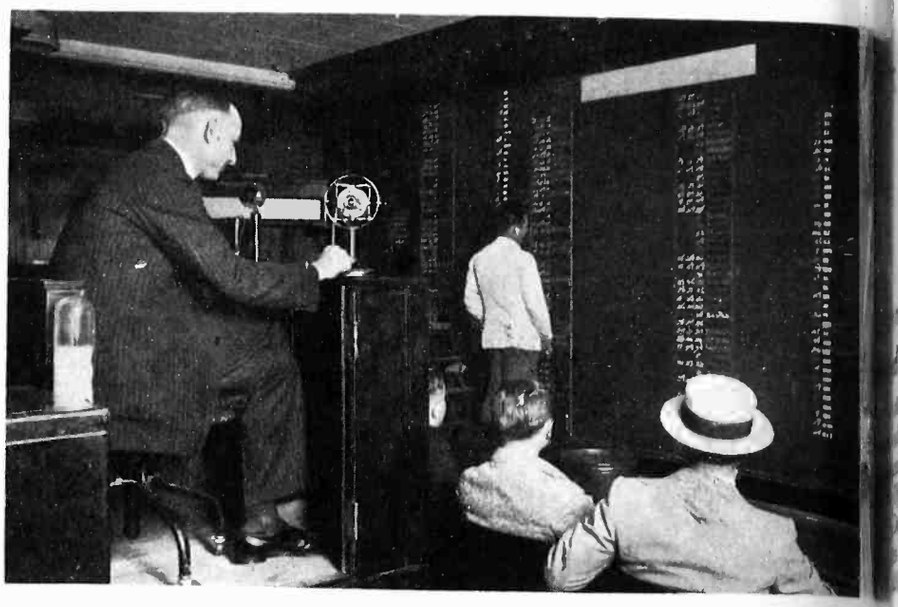
ameraman submerges for underseas sequences in nount's picture *The Sea God* with a water-proof a connected by a motor to sound recording apparatus at the surface





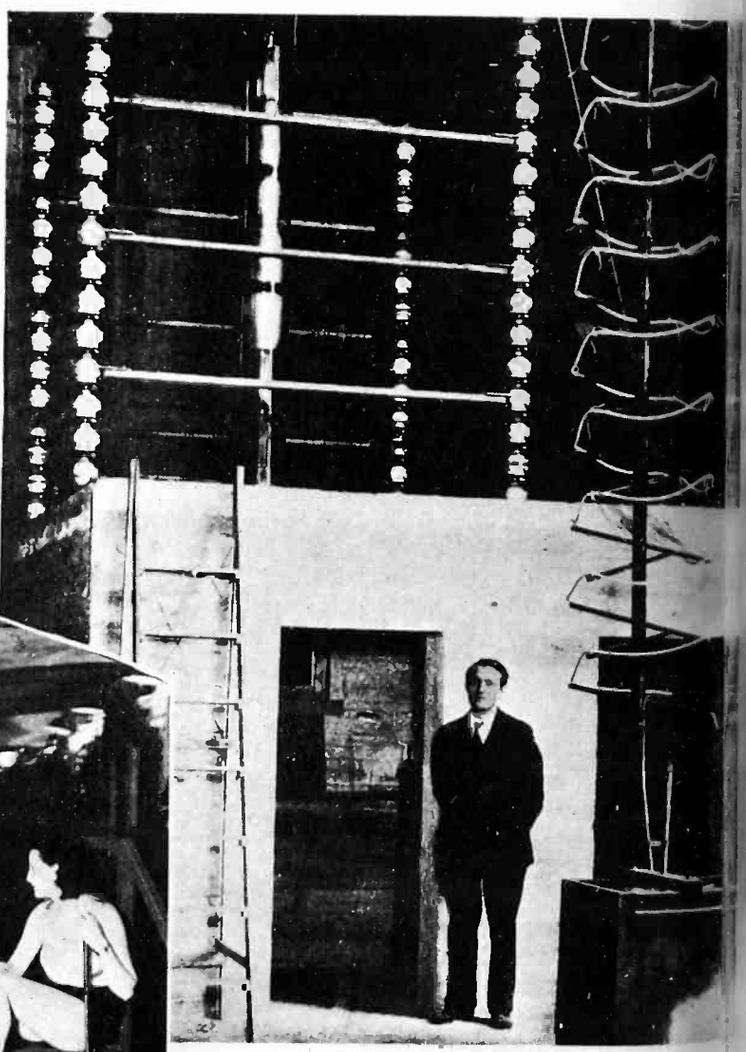
l cameras take to the ocean in the bal scene (upper right). Note impro- microphone boom. Portable sound ment may expect rough usage as depicted in mountainous setting

WITH ELECTRONICS' CAMERA



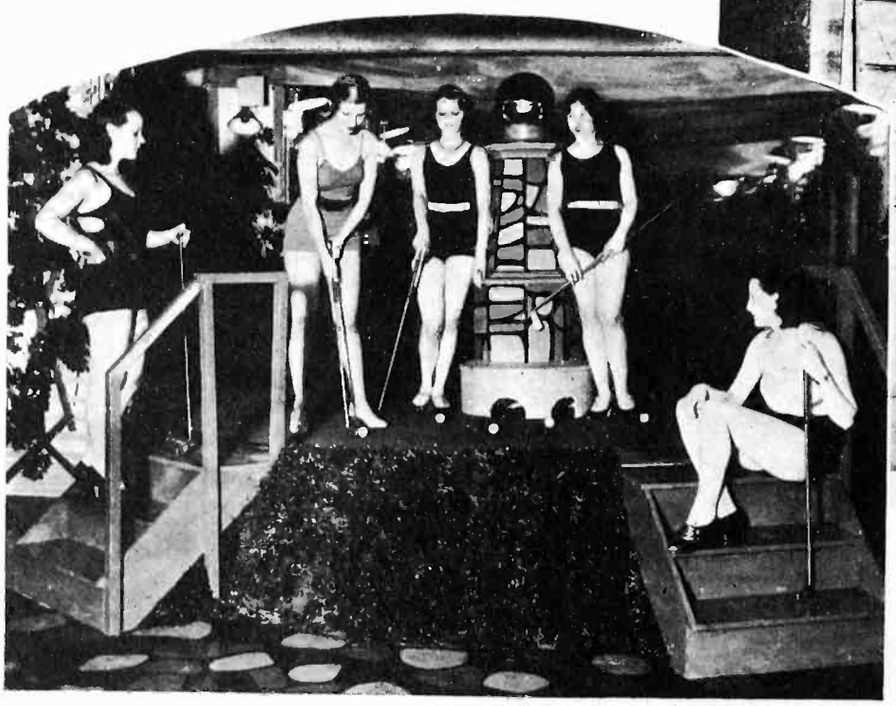
Chicago stock brokers are using microphones in their customers' rooms connecting to loudspeakers throughout their offices, so that every employee can be kept posted on stock movements

This thermo-couple, used with vacuum-tube amplifiers, will measure one-millionth degree, F. At Mt. Wilson, California, it detects heat rays of stars invisible to naked eye



Here is the 600,000-volt X-ray outfit produced under direction of Dr. Robert A. Millikan, California Institute of Technology. For therapeutic use, its rays equal those from radium

Ultra-violet light illuminates this Pittsburgh indoor golf course, assuring health and tan on darkest winter days



NEWS
THE ELECTRON INDUSTRIES

✦

adio sets
at 13,478,600

ıer family in the United States
dio receiving set, according to
ısus estimate of Marshall T.
hief of the Electrical Division
epartment of Commerce. The
in use on July 1 is placed at
0, whereas the families in this
number approximately 28,-

ork, doubtless because of its
in population, boasts the most
e California and Illinois come
ınd third. Pennsylvania is
These four States, with 29 per
he population, possess 39 per
ıe radios.

ewere only 11,500,000 sets in
try in January and but 9,500,-
ly, 1929.

rease was also reported in the
The total for the first eight
this year was $11,904,171 for
apparatus, an increase of $15,-
that of the same period in 1929.
ontinued to lead as the market
ıican radio products.

stimated number of sets by
s given as follows:

.....	87,700	Neb.....	203,000
.....	46,600	Nev.....	23,000
.....	90,500	N. H.....	47,000
.....	1,470,000	N. J.....	453,000
.....	172,000	N. Mex.....	28,000
.....	219,000	N. Y.....	1,752,000
.....	29,000	N. C.....	92,000
.....	105,000	N. D.....	61,000
.....	124,000	Ohio.....	845,000
.....	111,000	Okla.....	182,000
.....	42,000	Ore.....	219,000
.....	1,060,000	Pa.....	977,000
.....	348,000	R. I.....	111,000
.....	310,000	S. C.....	44,000
.....	195,000	S. D.....	77,000
.....	92,000	Tenn.....	104,000
.....	121,000	Texas.....	364,000
.....	80,000	Utah.....	72,000
.....	115,000	Vt.....	45,000
.....	656,000	Va.....	114,000
.....	627,000	Wash.....	351,000
.....	239,000	W. Va.....	86,000
.....	48,000	Wis.....	322,000
.....	433,000	Wyo.....	32,000
.....	54,000		

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ning meetings

itute of Radio Engineers—
lelphia Section, Nov. 18.
itute of Radio Engineers—Fall
ıg, Nov. 21, Rochester, N. Y.
American Physical Society—
go, Ill., Nov. 28-29.
erican Chemical Society—Rich-
Va., Dec 12.
ustical Society of America—Los
es, Calif., Dec. 12-13. Joint
ıg with **American Physical So-**

Webster Electric Company reports increased foreign demand. Proof that electrical reproduction and amplification of sound is fast gaining favor in foreign countries, is shown by a greatly heightened demand for necessary equipment. This company, manufacturers of electric pick-ups and power amplifiers, is now shipping its products to over forty foreign markets. The volume of export sales of Webster pick-ups, for the first eight months of 1930, shows an increase of 130 per cent over the corresponding period in 1929. The sale of Webster power amplifiers, comparing similar months, has increased almost 350 per cent.

The Acme Electric and Manufacturing Company, 1444 Hamilton Ave., Cleveland, Ohio, has just issued an interesting bulletin (No. 121) which describes Acme step-down transformers for the export field where the voltage supply ranges from 200 to 240 volts.

Robert C. Sprague, President of the Sprague Specialties Company, electrical condenser manufacturer, Quincy, Mass., has announced the expansion of its group insurance program and the extension of its benefits to the workers in the North Adams, Mass., branch. To the $130,000 of both life insurance and accidental death and dismemberment protection now in force, health and non-occupational accident insurance now rounds out the plan. The entire contract remains under the administration of the Metropolitan Life Insurance Company, and features the cooperative method of paying premiums, by which employer and employees jointly share the cost.

B. H. Noden, secretary Pacent Electric Company, New York City, sailed October 14 on the S. S. *Bremen* for Europe, where he will conduct important business for Pacent in the radio and talking picture fields. It was announced coincident with Mr. Noden's departure that both the Pacent Electric Company and the Pacent Reproducer Corporation have plans under way for the manufacture abroad of their radio, radio-phonograph and sound-reproducing products for the European market.

Howard W. Sams, general sales manager of Silver-Marshall, Inc., announces the appointment of Howard C. Briggs as assistant general sales manager. Mr. Briggs is a well known man in the radio industry in the middle west, having been five years with E. T. Cunningham, Inc., a year as district manager of Michigan for Grigsby-Grunow, and a year with the radio division of the Kellogg Switchboard & Supply Company before joining the sales organization of Silver-Marshall.

The Radio Corporation of America and others filed suits for patent infringement on October 17, 1930, in Brooklyn, New York, against DuoVac Radio Tube Corporation, because of the sale of DuoVac radio tubes, types 224, 227 and others, similar to RCA tubes, types 224, 227 and others. The plaintiffs claim that the unlicensed DuoVac tubes infringe their patents.

Goat Radio Tube Parts, Inc., 33 35th St., Bush Terminal Bldg., Brooklyn, N. Y., has published a comprehensive loose-leaf catalog, made up in the form of a handbook, with the idea of promoting standardization of tube parts. It is all in tabular form, classified under the types of tube, printed in large type, illustrated with many half-tones, and including specifications of various materials entering into tube parts. Engineers, purchasing agents and others connected with the manufacture of radio tubes will find this handbook of much assistance in ordering equipment.

Westinghouse Electric & Mfg. Company has issued in a new leaflet a description of the construction and uses for universal motors. Copies of this leaflet, No. L-20503, may be obtained from any district office or directly from the Advertising Department at East Pittsburgh, Pa.

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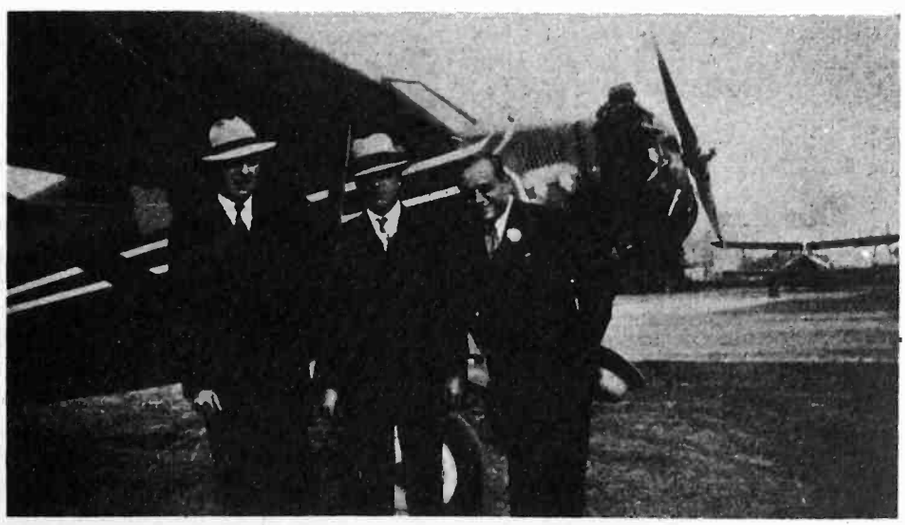


Henry S. Tenny, president of the Rola Company, Cleveland, Ohio, uses his own airplane to inspect company's plants in Cleveland and in Oakland, Calif. B. A. Engholm, vice-president, and Leon Golder, sales manager, are shown with Mr. Tenny

✦ NEW PRODUCTS

THE MANUFACTURERS O

This section is prepared by the editors of Electronics purely as a service to readers. Its aim is to present announcements of all new products, devices and materials of interest in the field of the paper. All items are published solely as news, and without any charge or any advertising consideration whatsoever.

✦

Constant voltage battery for two-volt radio tubes

ANNOUNCEMENT OF AN entirely new filament-supply battery for two-volt tubes has been made by the National Carbon Company, 30 East 42nd St., New York City. This Eveready air cell battery is expected to bring to the home not served by power lines the same quality of reception, ease of operation, and economical service as is enjoyed by the users of power sets. The battery, by virtue of its two special carbon electrodes,

is enabled to deliver a substantially constant voltage throughout its life. The carbon electrodes absorb oxygen directly from the air, eliminating the necessity for oxygen-evolving chemicals within the cell. Thus in the ordinary dry cell, as the oxygen becomes used up, the working voltage falls, but in the "air cell" a constant supply of oxygen insures constant voltage until the active electrode is consumed. The capacity of the battery is given as 600 ampere-hours, sufficient to run a seven tube two-volt set with a filament drain of 0.55 amp. for over 1,000 hours.—*Electronics, November, 1930.*

✦

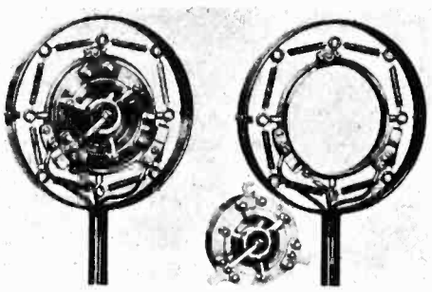
Renewable high-voltage fuses

PROTECTION TO EQUIPMENT used in amateur and power broadcasting, sound pictures, television, and amplifiers of all kinds is provided in a series of new high-voltage fuses manufactured by the Littlefuse Laboratories, 1772 Wilson Ave., Chicago, Ill. Circuits with a voltage of from 1,000 to 10,000 volts and a current of 2 amperes or less may be protected inexpensively in this way. An unusual renewable design feature permits the return of a blown fuse for renewal at only ⅓ or ¼ of the original cost of the fuse. Prices range from 35 cents to $1, with renewals at 10 to 20 cents. A fuse rated at about 50 per cent higher than the normal plate current of a power tube will save the tube when it begins to go "soft" or gassy. When power tubes are used as oscillators they will often overheat destructively unless protected by a proper fuse, if for any reason they cease to oscillate. A new catalogue describing these fuses in detail has been issued and will be sent to interested radio operators, amateurs, engineers, etc. —*Electronics, November, 1930.*

✦

Demountable microphones

TWO TYPES OF MICROPHONE, Models 29N and 30N, manufactured by the Ellis Electrical Laboratory, 337 West Madison St., Chicago, Ill., incorporate a new demountable feature. This permits the microphone button to be removed from



the stand by loosening a single wing nut. The contacts are made through the switch-blades attached to the microphone. Advantages claimed for this unusual feature include safety from theft and from exposure to the elements when not in use. There are many occasions when it proves to advantage to use the very sensitive Model 29N for the speaking voice and then change to the Model 30N for music. This is especially important in the production of talking films, both in the studio and in the field. In case of emergency the demountable feature permits a quick change to a reserve unit. The Ellis demountable microphone is shipped complete with all fittings, but does not include the desk stand and springs shown in the illustration. List price, including rim fittings, $85. — *Electronics, November, 1930.*

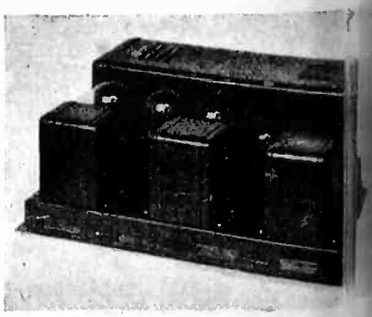
Self-contained ohmmet

COMBINING CONVENIENCE, acc sturdiness, a self-contained meter is being manufacture Jewell Electrical Instrument 1650 Walnut St., Chicago, Pattern 89 Ohmmeter uses flashlight cell within the case its voltage, and is therefore in of external voltage supply. A shunt corrects for variations i voltage. In operation the i can be adjusted to the cell ea series of tests is made, and the a high degree of accuracy. T ment is protected and long lif by the use of a bakelite case shatterable glass in the scale o *Electronics, November, 1930.*

✦

Power amplifier

SPECIALISTS IN AMPLIFIERS description, the Webster Com Blackhawk St., Chicago, Ill., cently announced its Style power amplifier. It is well a special high-class radio centralized radio and public ad tems, automatic musical ins sound picture recording and ing, and many industrial uses Webster catalogue has bee which includes descriptions an



tions of the many types of a equipment manufactured. T logue is available to any wh the company.—*Electronics, 1930.*

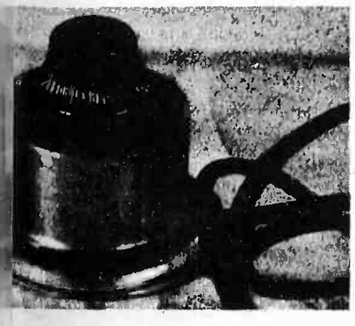
ıitting condensers

) SIZES OF stock condensers to demands for transmission are red by the National Company, an St., Malden, Mass. These ng condensers are widely used broadcasting stations and ransmitters, and are designed hanically and electrically cor- TM type condensers are sup- either $\frac{3}{16}$ or $\frac{1}{8}$ in. spacing be- acent stator plates for high ork. Standard insulation for M type condensers is crolite. acities range from 0.000035 to oltages, either 3,000 or 6,000, s from $7 to $22.50. These ude National Velvet Vernier ls. Prices on Navy type con- ith ball bearing rotor shaft insulators for high voltage be quoted upon receipt of ns. — *Electronics, November,*

✦

eceiver ıtrol

UTROL IS now available for of radio set, according to an ent by the Clarostat Manu- Company, 285 North 6th St., N. Y. This company has de- universal device applicable to set in the form of a small felt bottom, for use on any n top of the set cabinet, to- th two long flexible leads



g in disk connectors. The ectors are fastened one to the the power tube and the other ound binding post, or, in the type of receiver, the con- e slipped around the prongs of er tubes. — *Electronics, No- 930.*

✦

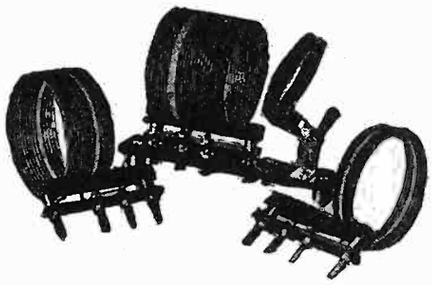
ontrol for raph pick-up

OLYPHASE PICK-UP, a new in- of the Audak Company, 565 e., New York City, it is pos- ary the tone to suit the taste tener. Such an improvement eful in the reproduction of speech and music as in radio With this method of tone ontrasted with the usual radio there is no loss of energy and the tone quality is improved rather than vitiated, according to the manufacturer. There are three settings of a switch on the pick-up, permitting the emphasis of the low, the middle, or the upper ranges. By the change in the setting the desired frequencies are phased in, without disturbing the other frequencies. This instrument may be used in phonograph reproduction, in connection with home recording, and for other recording and reproducing purposes.—*Electronics, November, 1930.*

✦

Short wave coil sets

TWO TYPES OF short wave coil sets, each containing five coils, for tuning from as low as 14 meters to as high as 205 meters, have been placed on the market by the Hammarlund Manufacturing Company, 424 West 33d St., New York City. These plug-in coils, known as types LWI and LWT, are space-wound, supported by a thin film of strong dielectric material, affording low distributed capacity and minimum re-



sistance. The LWT coil has both primary and secondary windings; while the LWI coil has only a secondary winding. Two types of base are also supplied for the LWT coils, one with a variable primary, and one without. The five coils forming each set have overlapping wave-bands so that all frequencies may be covered without a break.—*Electronics, November, 1930.*

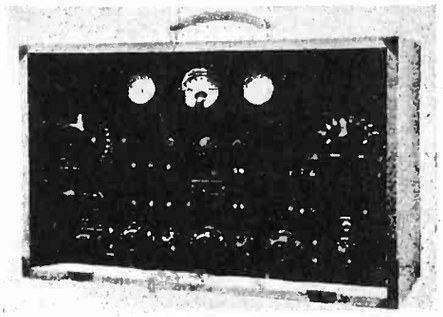
✦

Wire-wound resistors of extreme accuracy

RESISTANCE UNITS FOR the precision required in attenuation pads, resistance bridges, and level indicators are being manufactured by the International Resistance Company, 2006 Chestnut St., Philadelphia, Pa. Special nickel alloy wire, with the practically negligible temperature coefficient of 0.00002 per degree Centigrade, is employed. The wire is wound in sections on a special ceramic form of close accuracy, high heat conductivity, minimum moisture absorption, and very high resistance. Special varnishing treatment applied to the resistors prevents atmospheric and temperature effects from altering their characteristics. These units are made with an accuracy of 1 per cent, or $\frac{1}{2}$ or even $\frac{1}{4}$ of 1 per cent.—*Electronics, November, 1930.*

Portable amplifier

JENKINS & ADAIR, ENGINEERS, 3333 Belmont Ave., Chicago, Ill., have announced recently their Type B portable amplifier, primarily for broadcast station pick-up work. It consists of a three-stage amplifier, using standard tubes, together with a built-in level in-

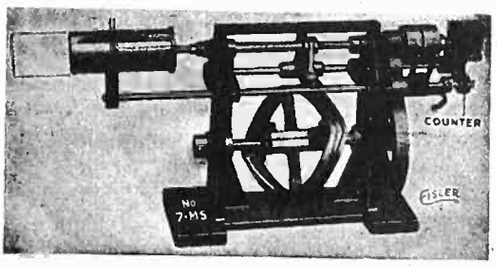


dicator. The two-position input is normally for either condenser transmitters or carbon microphones, but can also be built to accommodate wire lines or phonograph pick-up if desired. The input circuit switch, in addition to its normal duty, controls a relay in the output circuit, which prevents clicks from going out on the line. The maximum undistorted output level is approximately 6 db and the total variation between 50 and 6,000 cycles is approximately 1 db. The total gain is 70 db. List price $425, less tubes and batteries. — *Electronics, November, 1930.*

✦

Movable single spool wire winding machine

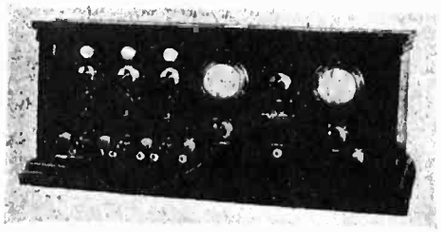
SPOOLING MACHINES embodying new improvements are being manufactured by the Eisler Electric Corporation, 744 South 13th St., Newark, N. J. These machines have a distinct advantage over older types because of their moving spool feature. On the other types of machines when coated wire is being spooled the guides have a tendency because of their reciprocating motion to scrape off a small amount of coating. In order to avoid this, in the new machine the spool itself moves back and forth, the guide remaining fixed, thus permitting the wire to run straight and



directly on the spool and preventing any scraping. The length of movement of the spool depends on a cam motion; this is readily made to suit requirements from 1 to 4 inches. The machine is also equipped with reset counter, indicating the number of revolutions of the spool. —*Electronics, November, 1930.*

Control amplifier for broadcast use

FOR REMOTE CONTROL or broadcast station amplifier work, the Gates Radio & Supply Company, Quincy, Ill., has announced its Model 102C amplifier. The amplifier uses a three-stage combination capacity and transformer coupled circuit, a pair of UX 171A tubes being used in the final audio stage in a push-pull circuit giving a possible undistorted



output of 1.4 watts with a gain of 80 db. overall. A microphone mixer is incorporated which has the ability to mix three carbon or condenser microphones. Each microphone circuit is controlled by a cam type anti-capacity switch. Signal lights designate which circuits are in operation. The mixer is featured with noiseless mixing and current controls and is designed for unrepulsive operation. A volume indicator is part of the equipment with separate indicator and monitor tubes employed. The output impedance is either 600 ohms for the input to a telephone line or 3800 ohms for the input of the final high stage amplifier where this equipment is used as a station amplifier. Price, F.O.B. Quincy, $325.—*Electronics, November, 1930.*

✦

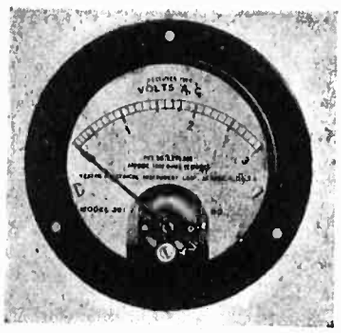
Simplified unit for remote tuning

REMOTE TUNING from any number of desired points is simplified by a new unit manufactured by the Pacent Electric Company, 91 Seventh Ave., New York City. The unit through which the set is remotely operated is smaller than a half-pound candy box, and, according to the inventor, it can be made even more compact in final manufactured form for radio manufacturers' use. On top of the single unit—combining remote tuning, automatic station selection when desired, remote control and on-off control, and calibrated station scale—are three small push buttons. By manipulation of one or more of them, the entire receiving range of the receiver is placed at the operator's command. The exact point of best reception of each station is before the eye on the graduated scale, above the tuning buttons. While the characteristic selectivity of a particular set is maintained, it is in no way made critical by the application of this system. Any one or number of programs may also be automatically tuned, as desired, with unwanted stations remaining silent during the tuning process. On the front of the unit is built a combined volume and power supply control, which provides remote control of the volume level along with on-off control of current to be set. A red light indicates whether or not the receiver is operative.—*Electronics, November, 1930.*

✦

Rectifier type instruments

USEFUL IN THE measurement of alternating currents of such small magnitude that they cannot be measured readily by means of the ordinary types of a.c. instruments, dry rectifier type meters are now available from the Weston Electrical Instrument Corporation, Newark, N. J. This type of instrument is applicable also where accuracy is not of so much importance as ruggedness and ability to withstand heavy overloads without damage. It consists of a sensitive d.c. permanent



magnet movable coil instrument, similar to that illustrated, used in connection with a rectifier made of four sets of copper oxide disks arranged in the four arms of a Wheatstone bridge circuit. Instruments embodying such rectifiers are subject to errors from several sources, among which are temperature, frequency, wave form, and the fact that the resistance of the rectifier varies with the amount of current passing through the disks. The instrument is discussed together with its sources of error and their corrections, in a bulletin issued by the Weston Company.—*Electronics, November, 1930.*

✦

Dry electrolytic condensers

DRY, SELF-HEALING under overvoltage, and with a power factor better than the ordinary, an electrolytic condenser has been announced by the Concourse Electric Company, 294 East 137th St., New York City. This dry condenser, made in several types, is housed in either round or rectangular containers, and may be mounted in any position. It is designed for peak voltages of 500, or higher. Capacities range from 1 mfd. to 200 mfd. Samples and prices may be obtained from the company, who is also prepared to build its condensers to specifications.—*Electronics, November, 1930.*

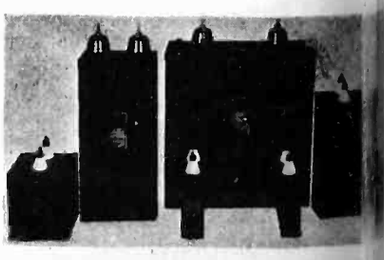
Power supply units for precision amplifier

ONE OF THE LATEST develop the American Transformer 178 Emmet Street, Newark, the type P-77 power supply, capable of supplying filtered voltages to precision amplifie the slightest a.c. hum cannot ated in the output. This unit directly from standard 110- or a.c. circuits and supplies pote the order of 375 volts at 2 amperes as well as intermedi ages. It has been designed for use with equipment using 2 tubes, but similar rectifiers wit ent output ratings are also The type P-77 power supply u ploy two 66-type mercury-vap in a full-wave rectifier circuit, equipment is so designed that one tube fail while in opera other tube will provide full out half-wave rectifier until the has an opportunity to make a ment. This fact insures continuo ation without the necessity of cate rectifier circuit. The u mounted on aluminum panels c ard 19-in. width and may be on conventional mounting *Electronics, November, 1930.*

✦

High-voltage filter condensers

A LINE OF high-voltage filt densers is announced by the Condenser Corporation, 342 Ave., New York City. These co are conservatively designed wit safety factor, thus eliminating ity of breakdown at rated They are available in a medium range, with 600, 1,000 and 2,(units of wax-filled and oil-impr construction, and in a high range, of 3,500, 5,000, 6,000 an volt units. The high-voltage co



also employ paper dielectrics, oil impregnated and oil filled, enclosed in a steel container. ternal construction is radically from anything now employed in of paper condensers. These u also of the single-section typ servatively rated, and provide a protective device.—*Electroni vember, 1930.*

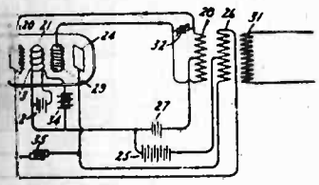
PATENTS

IN THE FIELD OF ELECTRONICS

A list of patents (up to Oct. 28) 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

...ion, Rectification, Control

...atic control. One of the two ... converters is connected be... o a.c. circuits and the other is ... to one of the circuits so that ...ive positions of the rotors of ...converter automatically reverse ...ation of the second converter. ...cCrea, assigned to G. E. Co. ...,175.



...neration. Two patents, Nos. ... and 7, covering oscillating ...e with two grids and two ...e other a triode. Irving Lang... ...gned to G. E. Co. Filed Oct., ...

...r circuit. In a full-wave recti... ...t, a solenoid is energized when ...ier is delivering power, which ...t a resistance in series with ...put. L. J. Buttolph, assigned ... Vapor Lamp Co. Filed Dec., ... 1,778,416.

...ctifier. A selenium layer be... ...o electrodes, one a ferrous ... the other of the tin group. ...esser, assigned to Süddeutsche ...parate, Kabel- und Draht... ...ktiengesellschaft, Nuremberg, ... No. 1,778,645.

... regulator. In parallel with ...ing winding of a generator is ...ge tube with filament current ... by the generator load. N. A. ...oeve and J. C. de Haas, as... ... N. V. Philips' Gloeilampen... ... Eindhoven, Netherlands. ...c., 1927. No. 1,778,614.

... regulator. Full-wave rectifier ...a unidirectional magnetomotive ...each of two coils for regulation ...pply. A. A. Oswald and E. J. ...ssigned to W. E. Co. Filed ...24. No. 1,778,725.

... of electrical variations An ... with a resistance in the input ...maintained at such a low ...ure as to be independent of ...perature changes. O. E. Buck... ...J. B. Johnson, assigned to Bell ...e Labs. No. 1,778,751.

... signalling. A high-frequency ... superimposed on a power dis... ... circuit with means for con... ... the frequency. E. R. Evans, ... to Westinghouse E. & M. Filed ...26. No. 1,778,827.

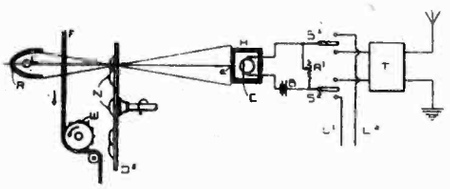
Harmonic generation. An arc converter tuned to a fundamental frequency with a coupled circuit tuned to a harmonic. H. O. Storm, assigned to Federal Telegraph Co. No. 1,779,198.

Oscillation generator. System employing conductive films exhibiting the Hall effect for generating electrical oscillations. P. H. Craig, Cincinnati, Ohio. No. 1,778,796.

Automatic volume control. Two patents, Nos. 1,776,821 and 1,776,822, utilizing a combination of neon tubes which break down in succession as the input voltage to the amplifier varies, thus controlling the gain of the amplifier. M. E. Strieby, assigned to A. T. & T.

Sound Recording and Reproducing

Binaural sound recording and reproducing. Two differently-colored sound tracks are superimposed on a film, and separated by photo-cells sensitive to light of different wave lengths. See also patents Nos. 1,769,907 and 8, illustrated in *Electronics,* August, 1930. Lee de Forest, assigned to de Forest Phonofilm Corp. No. 1,777,037.



Motion picture transmission. Each elemental area of a moving film is magnified by the scanning disc. C. F. Jenkins, assigned to Jenkins Laboratories, Washington, D. C. No. 1,777,409.

Combined motion picture and sound camera. E. I. Sponable, assigned to Fox Case Corp. No. 1,777,682.

Sound recording. Apparatus for synchronizing simultaneous photography and recording of scene and sound. E. H. Foley, Astoria, L. I., 99 per cent assigned to Sound Films Corp., Tacoma, Wash. No. 1,776,969.

Sound reproduction. Two sets of film-controlled switches start and stop the turntable. H. W. Rogers, New York, N. Y. No. 1,777,418.

Sound picture photography. A plurality of cameras at different focal distances from the scene are driven in synchronism. Lee de Forest, assigned to General Talking Pictures Corp. Filed Nov., 1924. No. 1,777,828.

Song film synchronization. A method of determining the number of frames to carry song words in a song film so that the words will synchronize with the music of the song. W. J. Conkie, assigned to Alexander Industries, Inc., Englewood, Colo. No. 1,778,104.

Electro-static pick-up. W. D. Crozier, assigned to United Reproducers Patents Corp., St. Charles, Ill. No. 1,777,397.

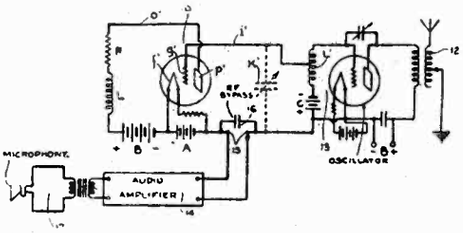
Phonograph drive. A method for progressively reducing the speed of a phonograph turntable as the record is played. L. L. C. Jaffard, Paris, France. No. 1,777,973.

Acoustic device. Col n Kyle, San Jose, Calif., assigned to United Reproducers Patents Corp., St. Charles, Ill. No. 1,777,170.

Heterodyning horn. Conduit to which are attached two diaphragm assemblies whereby a superimposed vibratory effect is produced upon the air column within the conduit, not only by the two diaphragms, but also by the reaction of the sound waves against the conduit wall. Butler Ames, Lowell, Mass. No. 1,778,206.

Loud speaker. A conical sounding board is secured to a rigid conductor in the form of a loop. F. Cutting and I. G. Maloff, part assigned to United Reproducers Corp. No. 1,779,114.

Radio Circuits and Apparatus



Demodulation. Demodulation system involving changes in condenser capacity. L. L. Jones, Oradell, N. J. No. 1,777,410.

Amplifying system. A series of vacuum tube push-pull stages, resistance-coupled, for distortionless amplification. Harry Nyquist, assigned to A. T. & T. Filed Nov., 1926. No. 1,778,085.

Amplifying system. Two-stage amplification system fed from a.c. mains. F. C. Barton, assigned to G. E. Co. Filed Nov. 1925. No. 1,778,058.

Receiving circuit. Detector and amplifier circuit using unipotential cathode tubes. Volume controlled by varying plate voltage. H. D. Currier, assigned to Kellogg Switchboard and Supply Co., Chicago. Filed Jan., 1926. No. 1,778,311.

Radio receiver. Tube filaments are connected in series, the d.c. voltage source being also used for plate supply. T. A. Willard, assigned to R.C.A. Filed Aug., 1922. No. 1,777,538.

Demodulation. System for demodulating radio signals by electrostatic means. G. W. Hale, London, England. Filed Oct., 1924. No. 1,777,433.

Wave antenna. A receiving circuit is connected to one end of the antenna, with an amplifier at the distant end. D. K. Martin, assigned to A. T. & T. Filed Nov., 1925. No. 1,777,374.

Demodulator. Heterodyne detector for telephone carrier circuits. E. Bruce, assigned to Bell Telephone Labs. Filed Dec., 1926. No. 1,778,750.

Negative impedance circuits. Three patents, all assigned to Bell Telephone Labs., No. 1,779,126 by F. H. Graham; No. 1,779,380 by H. W. Dudley; and No. 1,779,382 by R. C. Mathes; covering negative impedance circuits in telephone networks.

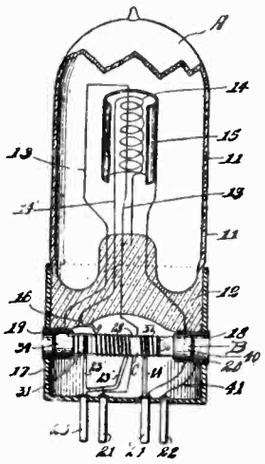
PATENTS—

Amplifying system. Two triodes, two batteries, and a variable resistance form the elements of a bridge circuit. Andre Rio and Lucien Levy, Paris, France. No. 1,779,292.

Modulation. Circuit for the modulation of static frequency changer current utilizing saturated core. M. Osnos, assigned to Gesellschaft für Drahtlose Telegraphie, m.b.H., Berlin, Germany. Filed Dec., 1925. No. 1,778,724.

Remote control. Remote tuning control for radio receivers. R. A. Heising, assigned to W. E. Co. Filed March, 1924. No. 1,778,761.

Radio relaying system. A method of transforming a singly modulated carrier wave into a doubly modulated carrier wave of a lower frequency. E. E. Clement, assigned to E. F. Colladay, Washington, D. C. Filed Aug., 1925. No. 1,777,690.



Vacuum tube. A three-element vacuum tube with means within the base for obtaining regeneration. E. G. Murphy, Chicago, Ill. No. 1,777,011.

Amplifying system. Automatic tuning, in which the frequency range is divided into portions and the circuit constants of the amplifying stages adjusted for automatic tuning in the different portions. L. L. Jones, Oradell, N. J. No. 1,779,881.

Amplifying system. An additional stage of amplification may be switched into the circuit between the initial stage and the output stage. H. I. Danziger, New York, N. Y., and L. L. Jones, Oradell, N. J. Filed August, 1924. No. 1,779,931.

Television and Facsimile

Television receiver. Synchronization of the receiving disc by means of a stationary electromagnet and armatures revolving on the disc. R. D. Kell, assigned to G. E. Co. No. 1,778,674.

Facsimile transmission. The wave is phase-modulated in accordance with the tone values of the image scanned. R. K. Potter, assigned to A. T. & T. Co. No. 1,777,016.

Television receiver. A magnifying mirror reflects the picture from a slightly inclined scanning disc. C. D. Fahrney, Cambridge, Mass. No. 1,777,556.

Colored facsimile system. A method for reproducing transmitted pictures in color. F. G. Morehouse, assigned to R.C.A. No. 1,779,261.

Television system. Three patents covering the method and apparatus for high speed television utilizing a wire screen, the wires forming electrodes which cause glow discharges at predetermined points on the screen. A. M. Nicolson, New York, N. Y., assigned to Communication Patents, Inc. Filed Sept., 1927. Nos. 1,779,747 to 1,779,749.

Scanning disc. A. O. Tate, Toronto, Ontario, Canada. No. 1,779,518.

Electron Tubes, Manufacture, Etc.

Photo-electric cell. The light-sensitive cathode has a high ohmic resistance, so that a moving light beam varies the voltage drop in the circuit. R. K. Potter, assigned to A. T. & T. Co. Filed Sept., 1926. No. 1,777,378.

Vapor lamp. Supplying a vapor lamp containing two anodes and two cathodes with d.c. voltage by means of a pair of diode rectifiers. L. J. Buttolph, assigned to G. E. Vapor Lamp Co. Filed Jan., 1927. No. 1,778,417.

Oxide cathode. An electron-emitting filament, comprising a metal wire helically wound on a core of refractory metal. J. Bruijnes, J. Vander Hoeven, and E. Oosterhuis, assigned to N. V. Philips' Gloeilampen-Fabrieken, Eindhoven, Netherlands. Filed Feb., 1927. No. 1,777,253.

Tube evacuation. A device for protecting the exhausting socket of vacuum tubes containing mercury. Erich Schott, Jena, Germany, assigned to Jenaer Glaswerk Schott & Gen., Jena, Germany. No. 1,777,861.

Gaseous fluid switch. Reception of radiant energy causes gas to expand and force a liquid conductor within the sealed tube to make or break contacts. I. E. McCabe, Chicago, Ill. Filed Apr., 1926. No. 1,777,887.

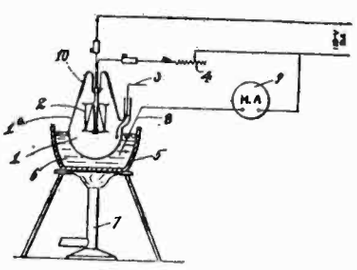


Photo-cell manufacture. The glass bulb is immersed in a molten alkali salt, and an electrical field set up between the salt and the bulb filament, whereby the alkali metal migrates through the glass, to serve as a cathode. R. C. Burt, assigned to California Institute of Technology. No. 1,776,993.

Vacuum tube. A triode in which the filament is held under tension. H. J. Nolte and W. I. Relyea, assigned to G. E. Co. Filed March, 1927. No. 1,780,033.

Thermionic tube. Several control grids, a space charge grid, and a cylindrical anode arranged concentrically. Siegmund Loewe, Berlin, Germany, assigned to R.C.A. Filed July, 1926. No. 1,779,550.

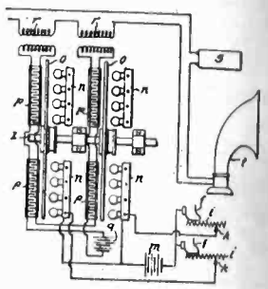
Direct-reading photometer. A portable instrument consisting of a light sensitive cell and a meter, mounted integrally. Samuel Wein, assigned to Radiovision Corp., New York. No. 1,779.574.

Miscellaneous Applicati

Radiation meters. Patents c two methods of measuring i radiations by transforming the visible radiations and comparing standard light. T. E. Foulke, a to G. E. Vapor Lamp Co. Filed 1926. Nos. 1,777,999 and 1,778,0

Telegraph repeater. The inpu triode is made through an imp high relative to the cathode-gr pedance of the tube, so as to att all portions of the waves betwe amplitude capable of saturating th and a predetermined lesser amp E. T. Burton, assigned to Bell phone Labs. No. 1,778,377.

Noise suppression device. Acc wave filter for selectively suppr the interfering speech currents in phone line. W. P. Mason, assig Bell Telephone Labs. No. 1,778,0



Electric musical instrument. contacts controlled by keys vary tensity of glow lamps, and photo-c cells transmit the variations to a reproducer. Emerich Spielmann, V Austria. No. 1,778,374.

Transmission-level control. for maintaining constant the tra sion equivalent of a line using a va frequency carrier. C. H. Fette signed to A. T. & T. Filed Sept. No. 1,777,355.

Vacuum measurement. Gas pre in the evacuation of incandescent are measured by a bridge circui taining resistance tubes, one a sta the other connected to lamps evacuated. J. S. Peoples, Oak Par assigned to W. E. Co. Filed Oct. No. 1,778,508.

Electrical measuring instrument. wattmeter with slotted squirre armature. P. H. Craig, Cinc Ohio. No. 1,778,795.

Measurement of hearing acut Apparatus containing a mech vibrator and a vacuum-tube which may be switched to give a rectifying or an amplifying actio measurements of the acuteness of ing. Helmut Sell, assigned to Si & Halske, Aktiengesellschaft, Sie stadt, Germany. No. 1,778,985.

Photometric apparatus. A re mounted to rotate about a light directs the light into a photo-electr during its complete movement. Long, Jr., assigned to G. E. Co. Aug., 1926. No. 1,779,324.

Liquid temperature regulator. resistance of an element immer a liquid varies with the temperat the liquid, causing a galvanomete bridged circuit to deflect. Rays o are reflected from the galvanomete ror, striking one of two photo-cel varying the heat supplied to the H. Essex, O. Gelormini, and Masterson, Syracuse, N. Y. 1,776,901.

plified harmonic analyzer

[*Continued from page 375*]

reading is obtained on the output meter corre- to about 3.2 millivolts on the first amplifier should be noted that the potential which is now plied to the tuned circuit is derived from R_5, but 1 ohm. Thus the tuned circuit receives but nt of the voltage across the filter input.

onics may now be investigated. The tuned cir- irst set to 800 cycles. In this process contact B d automatically and contact A closed, thereby g the full drop (minus filter losses) across 100 stead of that across 1 ohm only. If then we same reading of 100 microamperes it is evident harmonic (800 cycles) has 1 per cent the ampli- he fundamental. If the meter reads more than roamperes the calibrated slider R_7R_8 is turned ntil the standard 100 microampere reading is

Unequal passage of different frequencies through the system is compensated with R_{11}. This adjustment is permanently calibrated by means of an audio oscillator and is thereafter adjusted as a routine part of the process of tuning to 400 cycles, 800 cycles, etc.

Coupling between the filter and the tuned circuit was avoided by very careful shielding and placement of parts. Further shielding was added to prevent feedback from the voltmeter tube to the amplifier input. If this is not done the higher harmonics will regenerate and produce exaggerated readings.

An obvious precaution is to check the purity of the wave form of the source before it has passed through the radio receiver or amplifier which is being investigated. In such cases as that of Fig. 1A the procedure is obvious. In the case of Fig. 1B the test signal must first be demodulated by a linear detector.

The sort of work that can be done with such an harmonic analyzer may be seen from the accompanying illustrations. Many problems relating to the production

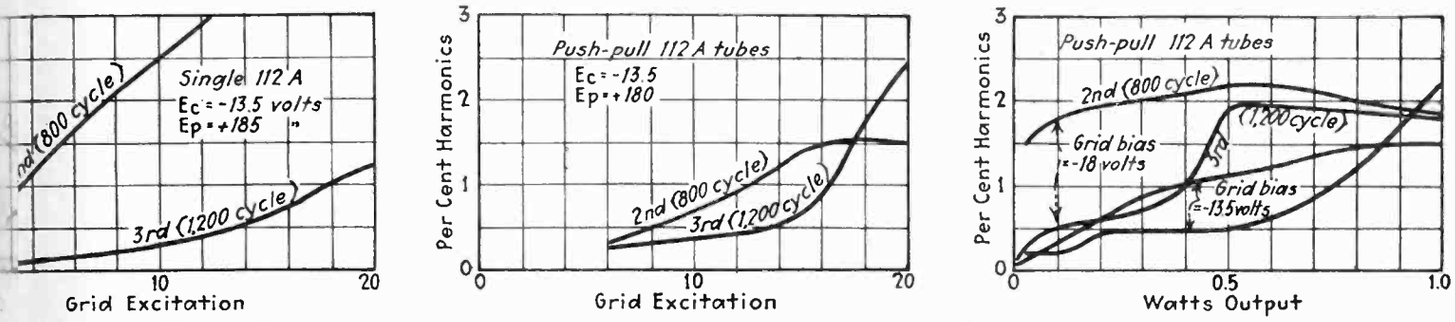


Fig. 4—Typical distortion analysis curves as made with the simplified harmonic analyzer

If the slider must be turned down half-way 2 per cent of the harmonic, and so on. The y therefore be calibrated and made direct read- e scale, however, is an inconvenient one because ntages above 5 become very crowded. For this switch provides an additional position which one to make a fresh start at 5 per cent of the ntal, thus multiplying the readings by five.

of distortion in audio or modulated radio systems may be solved by having handy a fairly simple mechanism for determining the harmonics in the output of the device or system suspected of distortion.

The range of the device as described is from 400 cycles to 2,800 cycles with any fundamental input from 160 millivolts to 50 volts. Harmonics in the range of 1.0 per cent to 50 per cent may be measured.

"tricks" in picture production

[*Continued from page 373*]

on takes place in the passenger car, which does under its own power but is drawn by a camera rovided with a sufficiently powerful motor to ne additional load. In the rear of the passenger are three girls and in the front seat two male ns, one of whom pretends to be driving. The ruck in the front carries two cameras shooting back to the passenger car where the action takes Besides the camera men, this truck carries the and a script girl sitting underneath the cameras of the field in a position where they can hear . The camera truck also tows, by means of the r arrangement shown in the figure, a camera hich is in this case merely a platform on air- heels, carrying two cameras which photograph on in the passenger car from the side. This dolly in turn tows a microphone dolly carrying a hich is manipulated by a sound man riding on the The microphone is kept above the upper border camera field.

grotesque procession moves around a large out- t representing a Parisian square. French taxi- cabs, U. S. Army trucks and other vehicles (the time is 1918) move with it, supplying appropriate traffic noises, against a background of French restaurants, statues, public buildings, and walls plastered with war posters. With the caravan, behind the cameras, there moves a collection of assistant directors, sound supervisors, and "grips." The "grips" have the job of handling the various cables running to the camera motors and microphone so that they will not get into the picture nor into the way of the moving cars.

The task of the sound man in charge of the microphone boom, it may be imagined, is not easy. As the various cars move around the circle his unit swings through a curve which cannot be accurately forefold, but it is his business to keep the microphone at each instant over the head of the character that happens to be talking, and not to allow any erratic variations in the sound pick-up. At times it is necessary for the grips walking beside the microphone dolly to prevent it from tipping over as the sound man attempts to keep his microphone where it ought to be. Usually a shot like this must be gone through six or eight times in order to secure two good takes. It is well worth while if, after all the processing and cutting and editing, something mechanical, synthetic and artificial is transmuted into the vital elements of comedy or drama.