electronics

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

The patent pool and the inventor

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What will home-talkies cost the public?

•

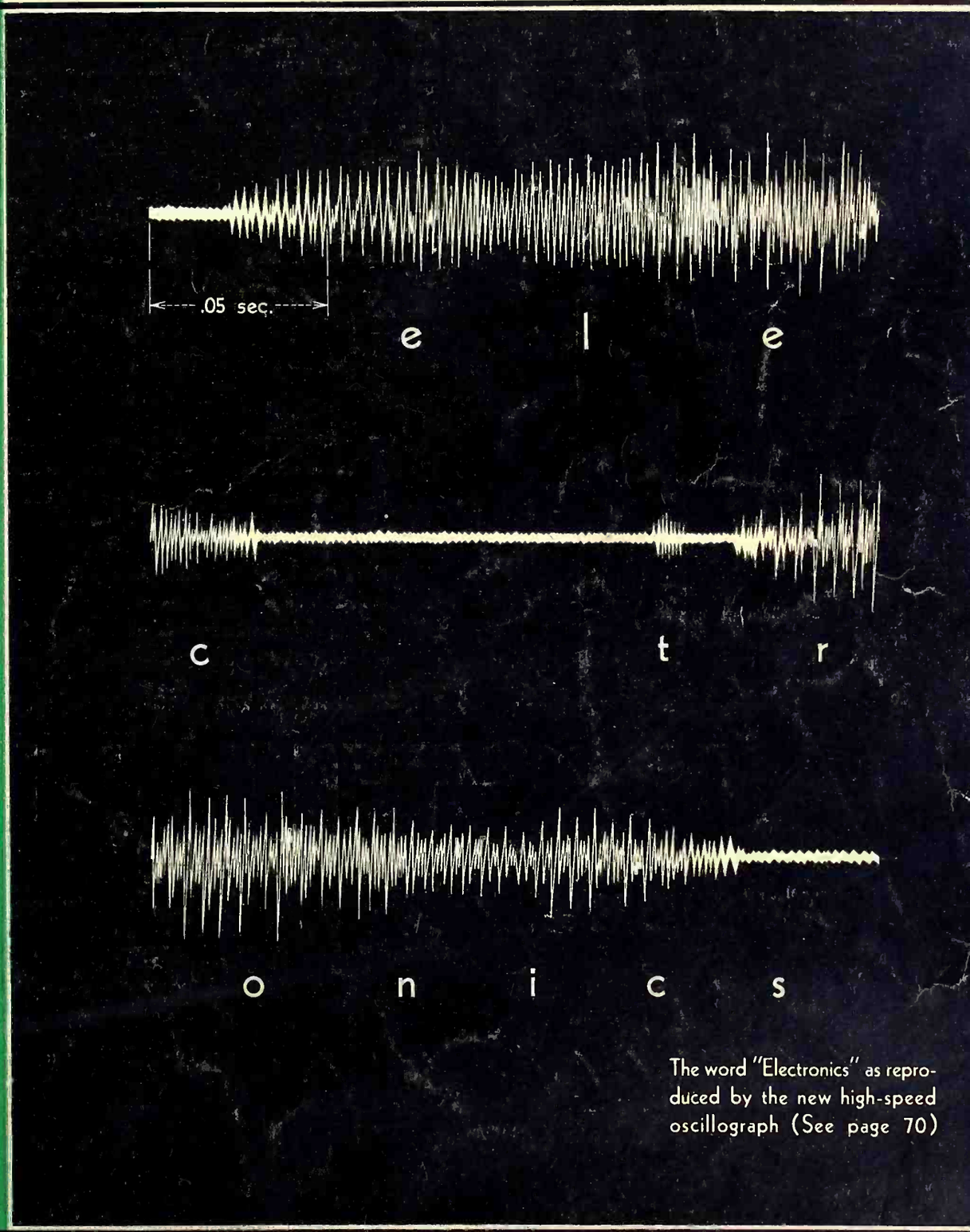
Measuring very high resistances

•

Loudspeaker design

•

Quartz-crystal receivers



The word "Electronics" as reproduced by the new high-speed oscillograph (See page 70)

A McGRAW-HILL PUBLICATION

Price 35 Cents

AUGUST 1931

Electronics, August, 1931. Vol. 3, No. 2. Published monthly. McGraw-Hill Publishing Company, Inc., New York, N. Y. $3.00 per year, 35 cents a copy. Entered as second-class matter April 4, 1930, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

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New York, August, 1931

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radio
sound pictures
telephony
broadcasting
telegraphy
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grading
carrier systems
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photo cells
facsimile
electric recording
amplifiers
phonographs
measurements
receivers
therapeutics
traffic control
musical instruments
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crime detection
geophysics

Lifting the lid off radio

ANY engineer who has been confronted with the problem of allocating radio channels to all the manifold demands for radio service, must quickly become impressed with the fact that a "ceiling" has always overhung the usefulness of space radio. Nature has provided us with only one ether spectrum, and all classes of radio service must accommodate themselves to its sharp limitations. Multiplication of the spectrum, it was apparent, could come only through subdivision—or else through expansion into the higher frequencies.

Recent work with television in the very short waves and with quasi-optical waves, now seems to open up a vast new realm for radio service.

Kilocycles have always been the crying need in radio, and as we go down into the short waves, we turn up kilocycles in profusion. *For, every time we halve the wavelength* made useful for radio, *we add* to the former spectrum *as many kilocycles as we had, altogether, before!* For example:

Range	Added Channels	Total Available Spectrum
Infinity to 10 meters (present spectrum)	.....	30,000 kc.
10 meters to 5 meters	30,000 kc.	60,000 kc.
5 meters to 2½ meters	60,000 kc.	120,000 kc.
2½ meters to 1¼ meters	120,000 kc.	240,000 kc.
1¼ meters to ⅝ meters	240,000 kc.	480,000 kc.
⅝ meters to 5/16 meters	480,000 kc.	960,000 kc.
5/16 meters to 5/32 meters (15.6 cm.)	960,000 kc.	1,920,000 kc.

At last then, we have "kilocycles enough," and down in the short waves we can use the same frequency over and over again, even in the same locality.

Thus the lid is lifted. *From this point on, the limits on the multiplied use of space radio become only those of equipment, and demand.*

Already the pioneers are trekking out into this new promised land. As this is written, tests have been witnessed of telephoning between two panels, each hardly larger than this page of *Electronics*, mounted on 30-ft. poles, 25 miles apart, using 68-cm. waves. The English Channel has been bridged with 10 cm. waves. The week's newspapers have reported the leasing of the 1,250-ft. Empire State Building for television broadcasting within visible range, over New York City, probably on 2½ meters.

Private-line telephones, mechanical control, and a host of other uses may follow, until the cities and countryside of the future are everywhere cross-threaded with "wireless" local circuits. With simple terminal sets, and the cost of intervening wires eliminated, it staggers human imagination to say what may be the uses of this new radio realm. Here also may develop an equipment market that will parallel broadcast receivers in numbers and volume. Engineers and manufacturers will want to watch this short-wave—and quasi-optical—field closely.

At last, the lid is being lifted off space radio!

THE PATENT POOL AND

Incentive must be provided for creative minds to continue to produce radio progress

PROPOSAL by the Department of Justice of an "open patent pool" as the condition of withdrawing the government's suit against the Radio Corporation of America and its associated companies, has created wide discussion in radio circles. Whatever the degree of assent of the principal defendants to the proposal—from several independent quarters have come opinions that a patent pool of the kind proposed might turn out thoroughly unsatisfactory to the radio industry, and especially to the radio inventors to whom the art must look for its further advances.

The fear among the independent radio manufacturers is that an "open patent pool," administered under the supervision of the Federal Government, would have to admit as members all applicants for licenses, whatever their experience in radio. "Every pants-maker, every ex-soap-manufacturer, who has had a hungry eye on radio in the past, would come rushing to the Federal Radio Patent Pool to get a license to go into the radio business," declared one commentator, "And since the government can make no distinctions, we would soon have a whole crop of new manufacturers in the radio business, adding to all our present troubles of overproduction."

It is known, for instance that with only 35 companies how holding Radio Group licenses (and some of these out of business), there are at present 55 applications of other "intending manufacturers" before the present custodians of the Radio Group patents. And it is declared that a dozen times as many "intending manufacturers" might be expected to demand licenses of a government board or "open patent pool" administration.

In Radio Manufacturers Association circles, informal and confidentially expressed opinion was to the effect that while a patent pool is most desirable, it would be better to abandon the "open" pool idea, and adhere to a private pool of RMA members. Such a pool would keep radio in the industry's hands, without admitting a horde of new radio-set builders.

Inventors fear pool would eliminate bids

But it is the radio inventors who have expressed chief concern at the recent proposals to pool all radio patents. Under such circumstances, they fear, the inventor would have only one prospective customer, the pool, to which to sell his brain-child. There might be little incentive to the inventor to produce, if no competitive bidding were offered by which to fix a price for his patent. And there would be no incentive for any single manufacturer member of the patent pool to tender a handsome check to the inventor, if the patent thus purchased immediately or shortly became available to all competitors in the radio business.

Patent pools have been conducted in the automobile, electrical, petroleum and other industries. The "Patent Club" of the oil producers was dissolved two years ago, under government pressure, following two years of patent interchange on oil "cracking" processes by the larger concerns in petroleum production.

Another industry employing patent interchanges to a limited extent, is the electrical manufacturing field. Here the two largest concerns, the General Electric and Westinghouse companies, have long had an agreement by which each other's patents may be used, on a fee basis, known and arranged in advance. This patent interchange agreement has eliminated patent litigation between the two concerns using it.

Success of Auto Chamber of Commerce pool

The cross-licensing patents agreement of the National Automobile Chamber of Commerce, has been in operation since 1914, and is now continued, by recent agreement, to 1935. One hundred and thirty-six automobile concerns made up the original membership, controlling 500 patents. At the present time 1,700 patents are involved. During the life of the automobile patent pool, it is estimated that more than 27,000,000 cars valued at $24,000,000,000 have been built under its provisions.

The automotive pool has been several times extended. On January 1, 1925, it was voted to extend the pool's operation, including patents owned or controlled by members on that date, but without patents afterward acquired. A similar extension was voted as of January 1, 1930, running to 1935.

The automobile pool has apparently worked to the full satisfaction of its members. It has eliminated litigation, and has quickly made available to the engineers of each member company, all the various known developments of the art.

Inquiry among automotive engineers regarding the experience and attitude of individual automotive inventors toward the pool idea, has met with encouraging responses. The feature providing that the member company owning a patent may enjoy the exclusive use of that patent for several years, before sharing it with others, has put a limited but actual premium on individual invention and improvement. Again, if the outside inventor has made a good dicker with the first purchaser, on a royalty basis, that inventor becomes assured of a handsome income when later a large number of other member concerns take over the license, under the pool plan.

Provision was also made in the automobile pool for "patents of a special or revolutionary character," which could remain the sole property of the owner company. It is of interest, however, that no such patents have developed during the long life of the automobile pool agreement.

Those who discuss the patent pool from the standpoint of the inventor's interest, admit that the existence of such a pool in an industry undoubtedly gives the patentee

THE RADIO INVENTOR

Independent manufacturers oppose government "open pool" that would admit all applicants

a market of a widely distributed stabilized character. Their fear is, however, that unless there is provided some initial period of individual exclusive use, there will be no economic basis for evaluating the patent in dollars and cents to the inventor's credit.

"The inventor is the key man in radio"

Radio is as yet in a formative state, technically. It is an uncrystallized art. For some years ahead it is likely that important and revolutionary changes will be introduced, as the result of inventions which are to come. "The inventor is still the key man in radio," was the way one radio pioneer put it.

But inventors do not feel that a government pool administration would be a satisfactory way to handle matters when it comes to the disposal of their intellectual wares. Any pool the government might set up, they fear, would be likely to be so stiff and "bureaucratized" that little would be accomplished, without wasteful, costly delays.

"You would simply be setting up another Federal Radio Commission having jurisdiction over radio patents, in the same way as the present Radio Commission rules the communication channels. The political character and awkward bungling of the Radio Commission are well known to all who have had to deal with it. A government open patent pool would simply extend the same awkward Commission plan to radio apparatus, too."

The three attitudes toward patent pooling

Meanwhile it is known that the Radio Corporation group are giving careful consideration to the "open pool" plan proposed by the Department of Justice. With a gun at their heads, in the form of the government suit accompanied by some $60,000,000 in private triple-damage cases (which would undoubtedly be assessed against the RCA group if the government case should go against them) the "trust" appears willing to listen carefully to any proposal which might mean the withdrawal of this government suit and its accompanying menace of staggering fines.

The independent radio manufacturers want a pool, but a pool limited to their own or present industry membership.

And the radio inventors point out that if radio is to

[*Continued on page 68*]

Radio Manufacturers Ass'n will intervene in patent pooling

According to an announcement by J. Clarke Coit of Chicago, president of the Radio Manufacturers Association, the board of directors of the organization, meeting July 30 at Niagara Falls, Canada, decided formally to take part in negotiations between the Department of Justice and the Radio Corporation of America regarding the possible founding of a radio patent pool for the interchange of patent privileges between radio manufacturers. The R.M.A. statement as issued reads:

"The patent problem is one of long-standing and far-reaching effect upon every radio manufacturer and inventor and the public. Because of the large interests of all radio manufacturers in the outcome of the negotiations between the Department of Justice and the Radio Corporation of America, it was determined by the R.M.A. board of directors to enter the negotiations, secure all possible information and data and the views of all interests concerned, and assist in developing, if possible, a solution of the patent problems which may be acceptable and equitable to every interest.

Committees to meet by groups

"President Coit was authorized to appoint a committee or small committees to represent the R.M.A. in conferences with various groups of manufacturers and with officials of the Department of Justice and the Radio Corporation of America. Mr. Coit will call meetings soon of various manufacturing groups involved, including the set manufacturers, the tube manufacturers, the speaker and amplifier, and other group interests. The R.M.A. committee or committees will confer with the various groups in an effort to work out some patent plan which may prove acceptable to them and to the Government and also the Radio Corporation of America.

"In the membership of the R.M.A. there are now 34 receiving set manufacturers and a dozen tube manufacturers who are licensees of the Radio Corporation of America and also several other manufacturers without R.C.A. licenses, indicating in part the important interests of other manufacturers in the outcome of the patent pool.

Government negotiations resumed Sept. 1

"The proposed meetings of the receiving set, tube and other groups with the R.M.A. committees will be held between now and September when, according to official announcement of the Department of Justice, the Government negotiations on patent pooling with the Radio Corporation of America will be resumed. By this time it is hoped that some workable patent plan may be evolved through the R.M.A. which will protect the public's interest and also that of all manufacturers and inventors and be acceptable to the Government, stabilizing the radio industry, so far as patent problems are concerned, like the automotive and aircraft industries.

"In the discussions of the R.M.A. directors there were wide differences of opinion regarding the possibility or advisability of pooling radio patents, because of the thousands of patents involved and their distribution, but vigorous efforts will be made to solve the patent problem somehow, through an equitable patent pool or otherwise."

Supply and cost of 16-mm. film for the home

BY FRANKLIN S. IRBY

Associate Editor, Electronics

This complete cabinet model which includes radio and storage space for films was developed by the Talkiola Corporation

THE successful exploitation and development of home sound-pictures depends upon two principal factors at present: First, the supply of a sufficient number of film subjects that will have a wide public appeal; and, second, the furnishing of a suitable number of reels to the *consumer* on a reasonable rental basis.

These may not be the only factors needed to promote home talkies on a national scale, but they represent at least the "bottle neck" of future growth in this field. There are already some 14 manufacturers who have developed and are now in commercial production of 16-mm. sound-picture equipment. These companies have been the pioneers in bringing out well-designed and satisfactory equipment for this phase of the development. Equipment now available ranges from portable units selling around $150,—to de luxe cabinets, including a radio, for $600. Manufacturing facilities now available can supply practically any type of equipment that the public demands, and at a reasonable *initial* cost, depending upon the individual's pocketbook.

Assuming that suitable equipment can be sold, a prospective owner is going to satisfy himself that the supply of film subjects available will be generally entertaining for his family, that rental libraries are in existence and reasonably convenient to his use, and further, that the amount he pays for this entertainment is comparable to what it is worth. At present there is a wide variance of opinion as to what this latter sum should be to even "crack" the national market for such equipment. The plans proposed by two manufacturers have tentatively set the price per reel at 50 cents rental a day, or $2 for a four- or five-reel program. Other companies have set a figure as high as $1 per reel,—or $4 to $5 for an evening's entertainment.

▼

SUCCESSFUL exploitation of home talkies depends upon the supply and rental costs of films. Present costs permit only a class market. Future growth depends upon producer affiliation with the manufacturer of equipment.

▲

Average life of films

Statistics are not available on the upkeep cost and number of times a sound film and accompanying record may be used before it is worn out. Actual tests that have been run over a single projector—in proper adjustment—have shown that such films may be used two hundred times. This, however, is quite different from individual rentals over a wide class of projectors and operators. From similar experience in the rental of silent films, about 60 times appears to be the *average* life to be expected. There are exceptions where silent films have been rented a considerably greater number of times. We are, however, speaking of average conditions to be expected in this market.

It is readily recognized that continuous patching (where necessary), to keep the film and record in synchronism, has increased the problem of upkeep and multiple rentals. When sound-on-film for 16 mm. use becomes available, the problem of keeping the film and record in synchronization, of course, will be eliminated.

In connection with the latter, several companies claim a solution of sound-on-16-mm. film, but so far neither commercial machines nor films are available. The technical difficulties involved, due to the lower speed than that used for 35-mm. film, lack of space on the narrow film for a sound track, maintaining uniform speed past the sound gate, and greater complexity of the projection machine have been deterring factors in this development. Successful equipment may, however, be expected in the near future as such difficulties are not insurmountable.

For the present we have only sound on the accompanying disk, which is a standard 33⅓ r.p.m. professional type. Very shortly a new 12-in. non-breakable record, using a "hill and dale" cut will be introduced for sound-film

use, instead of the present 16-in. lateral cut record. This new record will play the same length of time as the 16-in. record, and being much lighter, smaller in size, and also unbreakable, will simplify the present problem of sound-films for home, educational and industrial use.

Film library supply

The only available sources for 16-mm. film, covering short subjects and feature pictures, is the reduction of professional 35-mm. film to this use. The large producers control the outlet of films to the home field. The availability of such films at present depends upon certain economic factors governing the theater field. First, before a 35-mm. picture is released by the producer, the sale of this picture in the theater market must be exhausted. This period varies from six months to one year, or longer, from its initial release depending upon the class of picture and the interest maintained by the public. Generally, one year is required before feature pictures are available for release through non-theatrical channels. The accounting procedure of the various film companies differ, but in general the cost of a negative film is amortized over a period of six months to one year, corresponding to the theater rental life. There are exceptions, of course, to this procedure.

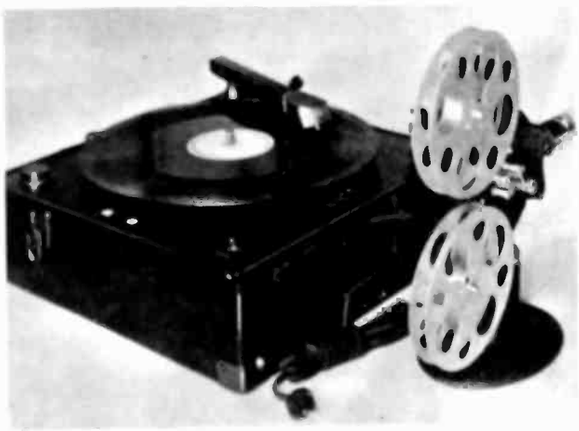
For the above reason, it is quite obvious that subjects suitable for home use, which would include short subjects, comedies, etc., and feature pictures, will not be available on an average before an elapsed period of twelve months after the initial release to theaters. This itself is no serious drawback in so far as the "newness" of the picture is concerned, and, in fact, the publicity gained for such pictures in the professional market will create favorable acceptance in the home rental library. Since the producers thus control the outlet of films to the 16-mm. field, only the future can tell how far they will go in releasing their negative films for this market.

Companies interested in this field

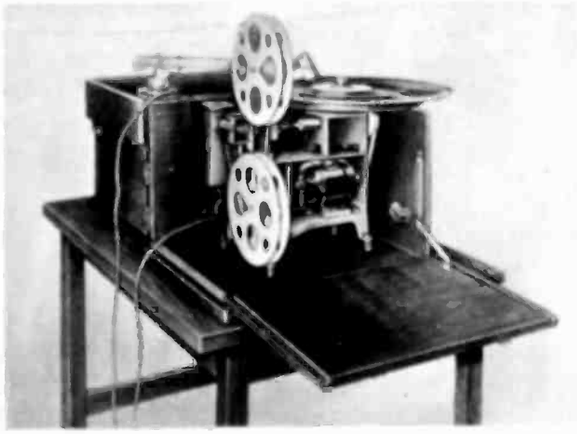
Universal Pictures Corporation, Pathé, Fitzpatrick Pictures and Columbia are important producers in the professional field who have actively promoted the 16-mm. silent and sound-films. These companies, with the exception of Pathé, do not have any sound-equipment to offer, and, therefore, have no stake in the apparatus field. On the other hand, Fox Film through direct affiliation with International Projector, does have 16-mm. sound equipment available having recently taken over the Victor-Animatograph sound-projector for distribution through the National Theatre Supply Company.

RKO as a producer of pictures is similarly affiliated with RCA-Victor, the latter organization claiming to have completed development of 16-mm. sound-equipment for home use, as announced by General Harbord in the annual report to the stockholders of the corporation. Warner Bros. Pictures owns Brunswick Radio, and

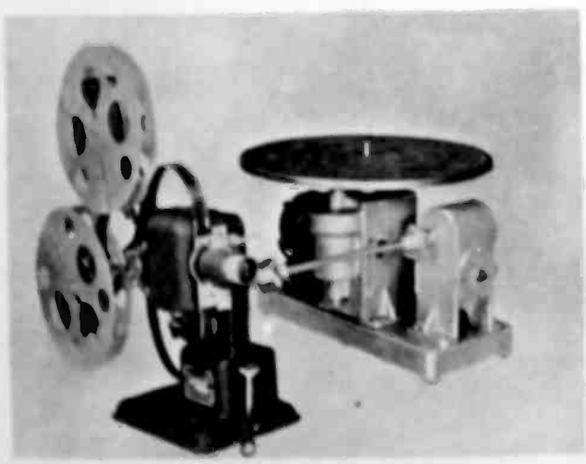
New portable 16 mm. equipment developed by Western Electric Company primarily for educational and industrial use



Portable units consisting of a turntable, projector and separate amplifier speaker designed by Pacent Electric Company for home use; available also in cabinet models



One of the portable models developed by Sprague Specialties Company; cabinet models are also available



Projector and turntable designed by Peko, Inc., for installation by manufacturers in radio cabinets for the home market

Cost of 16 mm. sound-films

(based on 400-ft. reel)

	Raw Stock	Laboratory	Distributor or Library	Rental per Day
Film	$4	*$9-$11 reel	$18-$24 reel	**50c.-75c. reel
Record	..	..	$1 record	..

*Does not include cost of obtaining original 35 mm. negative, but includes cost of raw stock.

**Rental charges required to liquidate cost of film in 36 rentals and to make possible wide acceptance outside of a class market.

therefore is situated as Fox Film and RKO in the control of negative film and manufacturing facilities for producing 16-mm. apparatus. Fox Film, RKO or Warner Bros. have not, however, signified what course they expect to follow in making available their present 35-mm. negatives for the home market.

The greatest profit in this field appears in the manufacture and sale of apparatus, rather than in the handling of films alone. Should a national acceptance be developed, then the repeat business of rentals might become comparable to the sale of initial equipment but this appears improbable at present.

Unless some such affiliation exists, as noted above, the cost of the negative film, even at the end of complete amortization for theater use, may be a stumbling block in obtaining such pictures from independent producers for the 16-mm. market. No fixed prices on such negative films can be used as a criterion. (Note that all prints of 16-mm. sound-films now available have been prepared by the original producers who have retained rights to the 35 mm. negative. There are a few exceptions to this practice.) Assuming a nominal price of $500 per reel, this sum can be easily prorated in a production of two hundred or more prints and would be relatively small for 1,000 prints. Any price much in excess of this amount simply means that the overhead cost of the prints must be loaded accordingly, resulting in an excessive cost of the 16-mm. print to the distributor, library, and ultimate consumer. The cost of obtaining one 35-mm. lavender print from which the 16-mm. duplicates are obtained must also be considered.

Laboratory and distribution costs for film

Production costs of 16-mm. duplicate prints are not high, considering the present limited print orders. The smaller film laboratories will turn out a 16-mm., 400-ft. reel for $9 to $11 in groups of one hundred or more prints, where the original negative is furnished by the purchaser. Their profit on this transaction is reasonable, considering the cost of the raw film positive stock at one cent per foot, or $4 for a 400-ft. reel. Note that no allowance in these figures has been made for the cost of the original negative. This, of course, would have to be pro-rated depending upon the number of prints disposed of.

The distribution cost from the 16-mm. laboratory to the ultimate consumer on a rental basis may be the deciding factor in setting up a nation-wide group of libraries. At present the cost to the distributor for a 400 reel is not less than $18, and an additional one dollar for a record. The rental of *one reel* on this basis may not be high, but when a group of five to six reels, to put on a program lasting one hour, is considered, the cost becomes excessive. In this connection the psychological factors in showing movies in the home present a ray of hope, as it is believed that one hour is too long a period for such entertainment. Any time less than this will reduce the number of films required to 4 or less thus lessening the cost appreciably. This point is borne out by experience with present libraries where the demand is usually for only 2 or 3 reels.

On the above basis of cost, a feature picture, we will say, of five reels, plus five records, will cost $95. On a rental basis of $2.50 per day, or 50 cents per reel means that these films must be rented 38 times and passed through 38 hands before the cost to the library or other distributing agency has been liquidated. It also means that such a film may be held in the library three to six months before its cost can be realized. That is, the same film or feature may not be rented each day and will lay on the shelf in several instances a week or more before it is called for. The number of additional rentals above this figure before the film is completely damaged, considering the overhead, inspection and repair costs, will determine what profit will be realized. (Present 16 mm. sound-film libraries are asking $5 to $7.50 for feature-picture rentals to meet such costs and thus reach only a limited class market.)

The rental cost to the consumer, if restricted to approximately $2 for four or five reels, should liquidate the cost of the film in 20 or 25 rentals at the outside to make any plan successful for a wide acceptance. This means that the cost of a four- or five-reel feature film should not exceed $50 to $60 to the library, or approximately $10 to $12 per reel.

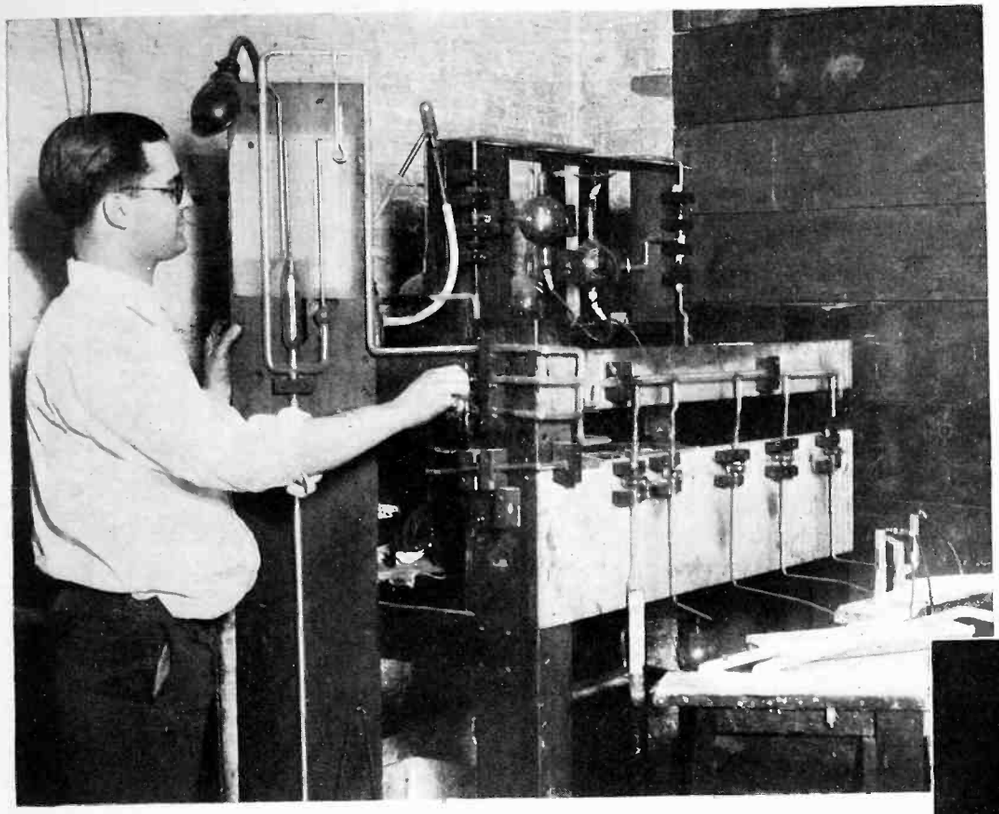
The differential between present costs and those specified to make national distribution of 16-mm. sound films a success may possibly be taken care of in a number of ways. It has been suggested to meet this problem by lower distribution cost from the film laboratory to the library, by establishing one central source as a film board, for the distribution of film in each principal city for handling such films. Another plan suggested is for a group of manufacturers to underwrite a percentage of this differential by supplying one film gratis to the distributor for every two machines sold, and adding to the cost, in this case, about $5 per machine in the list price.

Another suggestion which has some merit is obtaining strong support of large companies advertising nationally, to furnish sponsored 16-mm. pictures for home use. The latter plan may have a chance for success in the future, in view of the discontinuance of sponsored pictures in the theater, which were withdrawn by the producers controlling large chains and not by the unwillingness of the advertiser to continue.

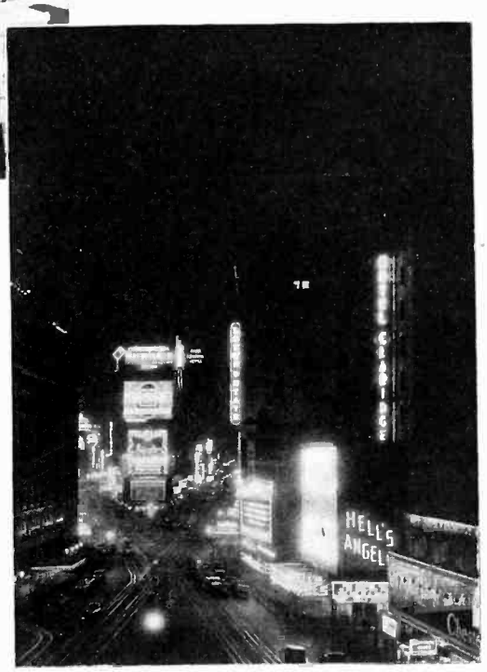
16 mm. sound pictures available

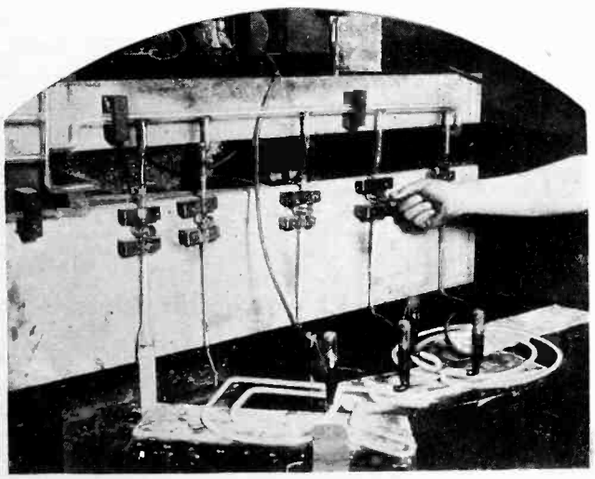
Company	1	2	3	6	7	8 Reels
Cine Art	18	..	..	..	..	..
Fitzpatrick	46	..	..	..	..	..
Kapit	..	5	1	..	..	..
Pathegrams	43	13	..	1	..	2
Show At Home	10	20	..	2	3	1
Talkiola	42	15	..	1	..	1
Ufa	43	..	..	..	..	..
Totals	202	53	1	4	3	4

Building neon-tube signs

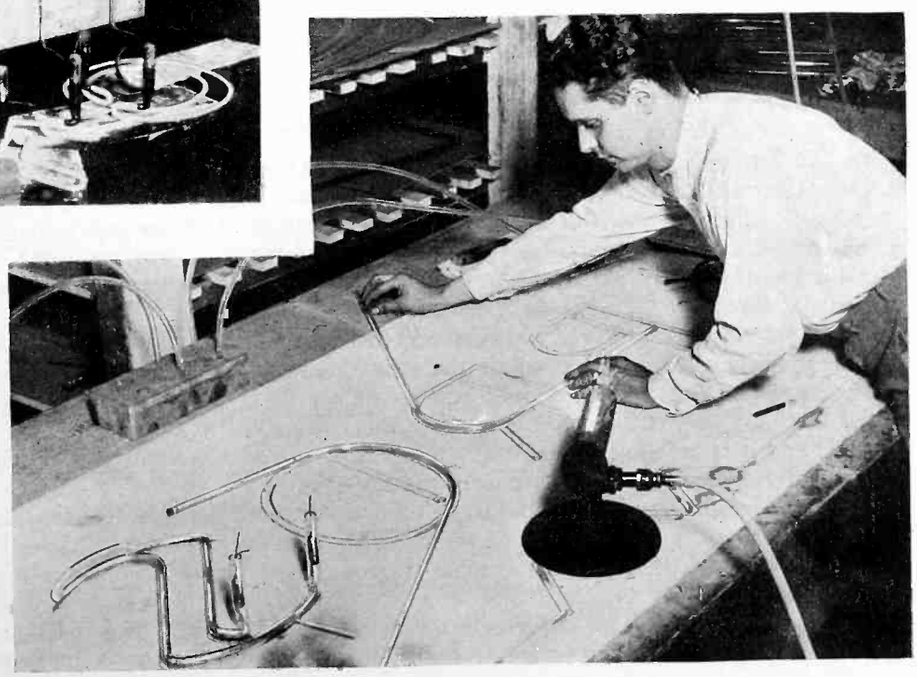


Exhausting a completed tube with a mercury vacuum pump. During the simultaneous bombarding process 17,000 volts a.c. is sent through the tube. Although no gas has as yet been put into the tube, it glows very brightly

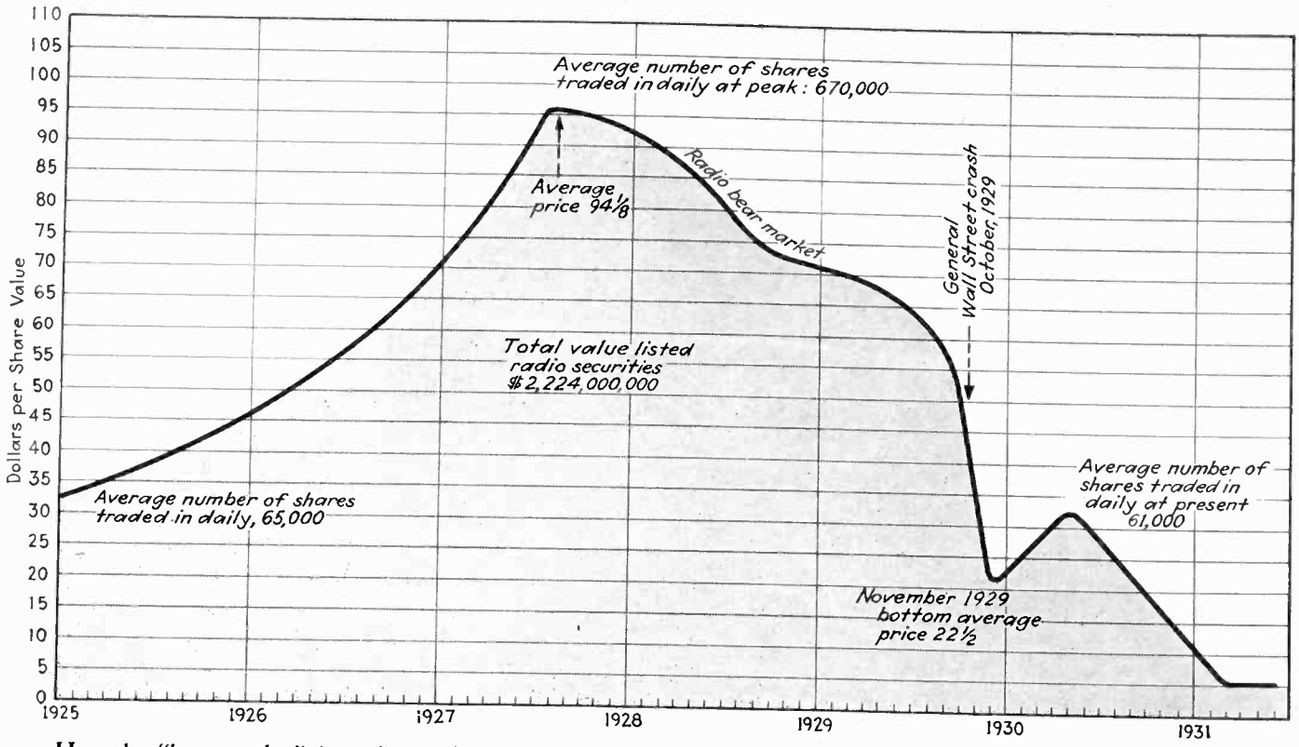




Pumping gas into the tube after the bombardment. The red signs use neon gas, the blue ones mercury vapor and rare gas and the yellow ones helium



Bending the glass tubing to correspond with the lettering on the sheet asbestos. This is accomplished by holding the glass tube over the gas burner shown



How the "bear market" in radio stocks began two years before the general Wall Street crash. The curve traces average values of all radio shares listed on the New York Exchanges

Prices of radio stocks

By RAYMOND FRANCIS YATES

IN 1918 we had but one radio stock listed, and that was the Old Marconi Company, one of the so-called "cats and dogs" selling at about $3.00 a share. By 1925 there were listed on the various exchanges of the United States no less than 24 radio stocks, six of them on the "Big Board," eleven of them on the Curb and the rest divided between local exchanges throughout the country. While the writer has no record of the many issues that were brought out and floated by means of the less popular methods of distribution, the number was rather formidable and it is safe to say that many millions of dollars' worth of practically worthless paper was absorbed by people with inflamed imaginations. The public was gullible, eager to share in the bonanza of radio. All in all, it amounted to one of the saddest and most tragic chapters in our financial history.

But the facts and figures of radio-stock manipulation and distribution, as it was carried out in connection with securities listed on the New York Stock Exchange and the New York Curb, are available and they provide a rather startling analysis when properly assembled for inspection. Prior to 1929 and at the height of the great radio "bull market," listed radio securities reached the almost unbelievable value of $2,224,000,000. The total value of the securities of the Radio Corporation alone at one time reached over one and one-quarter billions. To have paid investors a 6 per cent return on the money invested in the industry during those heavenly days of dollar distortion, the radio industry would have had to have *earned no less $132,000,000,* a rather healthy figure. It will be interesting to hold this $132,000,000 in mind until the next paragraph.

A shrinkage of 91 per cent in values

Figures for 1931 show that the total present market value of the 29,000,000 shares of radio stock (which includes all listed securities) amounted to only $185,000,000 or approximately $53,000,000 more than the interest that would have to have been earned on the total capitalization of the industry in 1929, if 6 per cent interest had been paid.

During the height of speculation and at a time when the lambs of the country were flocking to the market, the earning power of the industry was large but financial experts were firm in their opinion that it was not stable, a theory that has since been very sadly proven. During the past year, earnings have been 2 per cent less than zero and in many individual cases losses have been more severe.

During 1927, Kolster Radio Corporation, was selling above $90 a share, Charles Freshman was in the twenties, Crosley was over a hundred, and equally expanded figures were quoted on everything listed. Today there is no Freshman, Freed-Eiseman or Kolster-Brandes, and many others have come to the brink of ruin.

A number of factors have brought this about. First and foremost, there is the factor of security indigestion and this is combined with over-production and the competition that must follow such industrial folly. On top of these troubles, the crippled buying power of the public must be laid. Some index of the difficulties involved may be had when it is recalled that the strongest unit in the industry has recently had to draw from surplus to meet the obligations in connection with its preferred stock.

There can be no doubt that the violent manipulation of radio stocks and their sensational collapse has hurt the industry. No industry can be thrown back from the extreme heights of speculation without suffering severe financial disorder. Perhaps those who have not followed the movement of such stocks will gain a better impression of the situation if the highs and lows of some of the more prominent members of the family are listed:

	High	Low
Radio Corporation	114¾	1⅜
Columbia Graphophone	87⅜	7⅛
Crosley	125	4⅛
Kolster-Brandes	96⅜	Zero

When compared with the performances of any other class of securities, radio stocks have made a rather sad showing, for their depreciation has been painfully severe. Even the best has been reduced to less than a tenth of its bull market value and the industry as a whole is not now earning enough to meet its preferred obligations. The oils, ragged and depressed as they are, have performed marketwise much better than radio stocks and this indeed is a painful admission by anyone who has followed the market during the past two years.

Getting widespread distribution

Many of the manipulators of radio securities took advantage of all of the manipulative practices to distribute their wares to a gullible public. Rights were issued in great volume, stocks were split for no good financial reason other than that of making the security more available to the small, odd-lot buyer, rumors of mergers were current and grossly exaggerated and increases in dividends that were being barely earned were freely predicted. The performance in some cases was carried to such extreme lengths that some of the manipulators themselves had their securities fired back at them in such appalling volume that they, too, suffered severe financial losses. It was a disastrous lesson and in the future it is expected that radio securities will be handled more in accordance with sound financial logic.

$2,224,000,000

was the total value of listed radio securities at the market's peak. To earn 6 per cent on this capitalization would have required annually

$132,000,000

Present market value of same securities now 8 1/3 per cent of peak value, or

$185,000,000

What of the future? At least this much may be said. Many radio stocks are now selling as low as they will get. This does not mean that they are worth more or worth less. It simply means that selling has exhausted itself; that the public holders have completed their dumping and that enough investors have appeared to absorb the selling that now appears. In other words many radio stocks may now be purchased with a feeling that there is little prospect of them going much lower. Buyers are easier to find and sellers are becoming scarce. This does not mean that some stocks will not go lower or that some units will not pass out of existence altogether. It is still time for keen discrimination but in the same breath it must be confessed that it is certainly no time for deep purple gloom. The depression we are passing through and from which we are gradually emerging, will eventually make for more stability. It is even fair to assume that many of the 29,000,000 shares of radio stock available are safely tucked away in the strong boxes of the country, and that the good ones will some day be worth much above their present value.

▼ ▼ ▼

ELECTRONIC MUSIC—THE MUSIC OF THE FUTURE

MUSICAL instruments up to the present have been developed on the cut-and-try basis. Electrical instruments offer us the really scientific method, with much greater possibilities.

When I return from Europe, I am planning to organize an orchestra made up entirely of artists playing electrical instruments. For the time being it may well be advisable to seek musicians who can play the old instruments well, and are willing to work up ability with the new.

LEOPOLD STOKOWSKY

Director, Philadelphia Philharmonic Orchestra

Effects of optical slits in Light-valve sound recording

By JOHN P. LIVADARY

Technical Sound Director,
Columbia Pictures Corp., Hollywood, Calif.

THIS is the third of a series of articles dealing with frequency characteristics obtainable in recording sound through optical slits. The first two articles dealt with glow lamp and variable area recording (*Electronics,* February, and April, 1931). The present article deals with recording through a light valve, which is essentially an optical slit of varying dimensions.

In the light valve system of recording the exciting lamp is of constant intensity. The filament of this lamp is focused by means of a condenser lens upon the light valve. A schematic of the light valve is shown in Fig. 1(a). It is made up of a loop of duraluminum ribbon six mils wide and one-half mil thick, fastened to binding posts *MN* and kept under tension by means of a spring acting through a roller *S*. This roller is used to equalize the tension between the two sides of this loop.

The recording aperture of the light valve is made up of two fixed edges *AC* and *BD*, the other sides (*AB* and *CD*) being formed by the ribbon itself. The entire assembly is placed in a magnetic field which is directed perpendicularly to the plane of the ribbon loop. Thus a current flow through the loop in one direction tends to increase the separation between the ribbons, while a current flow in the opposite direction tends to decrease it.

The result of this arrangement is to make the light valve equivalent to an aperture of varying dimensions, whose area is proportional to the instantaneous values of the sound currents. The light of the exciting lamp passes through this aperture and its image is focused by a 2:1 reduction lens upon the moving film. The loop of the light valve ribbon is kept under sufficient tension to place its resonance frequency well above the range of the frequencies to be recorded.

Figure 1(b) shows the instantaneous positions of the light valve ribbons with respect to a neutral axis *O–O'* through the midpoint of their separation. The lines *AB* and *CD* show the normal position of the ribbons. The amplitude of the current which is allowed to pass through the light valve is so controlled that each ribbon is allowed a maximum deviation from its normal position equal to half of the spacing between them. This is necessary in order to avoid the clashing of the ribbons at the point where they come together, as shown at *M*. Such clashing is termed "light valve overload."

The successive instantaneous positions of any point on the light valve ribbons when plotted against time repre-

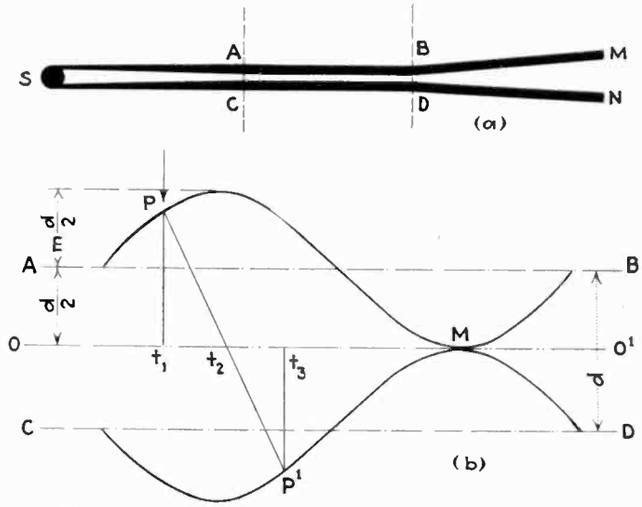


Fig. 1 (a)—Light-valve ribbons used in variable density recording. (b) Locus of the instantaneous position of the light-valve ribbons during recording

sents the wave form of the sound to be recorded. In this case it is assumed to be a perfect sine wave. We further note that the voice currents flow through opposite directions in each of the ribbons, which causes a motion symmetrical to the axis *O–O'*; that is, both ribbons either recede from or move toward this axis at any given instant.

Derivation of equations

If we assume that the film is moving with a velocity v in the direction shown by the arrow in Fig. 1(b), we note that the time that a given point *P* on the film, crosses the upper ribbon is different from the time it crosses the neutral axis. This is also different from the time it meets with the lower ribbon at *P'*. The total time in seconds during which point *P* has remained exposed to the light between the two ribbons is defined as the time exposure of this point and is given by the expression $t_2 - t_1$ or $t_3 - t_2$ for either one of the two ribbons and $t_3 - t_1$ for the exposure due to both ribbons.

The derivation of an expression which will define the time exposure of every point on the film in terms of the value of the time at which this point crosses the neutral axis will be determined. This study will reveal the attenuation of the fundamental frequencies and the magnitude of the harmonics generated through this type of recording. We will further consider both single- and double-ribbon valves. The following symbols will be used:

THIS is the final article of a series of three dealing with the effects of optical slits in the different systems of sound recording. Definite conclusions are reached as to advantages and disadvantages of the principal recording systems.

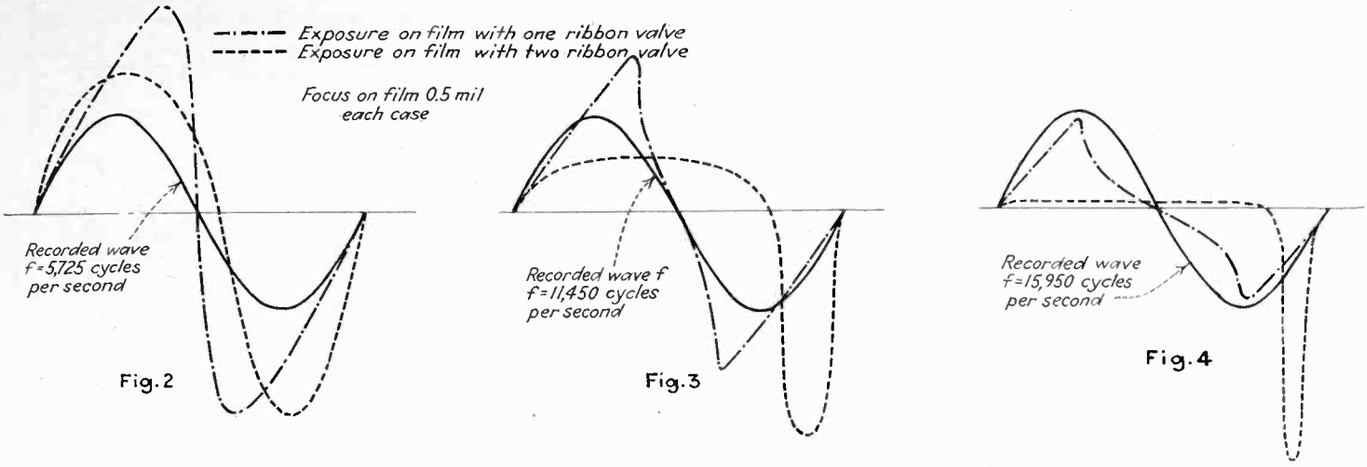


Fig. 2 Fig. 3 Fig. 4

Figs. 2, 3, 4—Wave distortion shown by graphical method of a single and double ribbon light valve with a ribbon spacing of one mil and focus on the film of 0.5 mil

d = normal separation of the l.v. ribbons in mils.
m = per cent of modulation.
y_1 = instantaneous distance of the upper ribbon from the neutral axis.
y_2 = instantaneous distance of the lower ribbon from the neutral axis.
v = velocity of the film, 90 feet per minute.
t_1 = time measured at the upper ribbon.
t_2 = time measured at the neutral axis.
t_3 = time measured at the lower ribbon.
$\omega = 2\pi f$.
f = frequency in cycles per second.

y_1 and y_2 may be written as follows:

$$y_1 = \frac{d}{2}\ (1 + m \sin \omega t)$$

$$y_2 = -\frac{d}{2}\ (1 + m \sin \omega t)$$

where t represents the time of variation of the recorded sound.

At any given time, t_1, the distance of point P from the neutral axis has a definite value, and the exposure of point P due to the upper ribbon alone may be given by the relation:

$$v(t_2 - t_1) = \frac{d}{2}\ (1 + m \sin \omega t_1) \qquad (1)$$

If we denote the time exposure $t_2 - t_1$ by T_1 this relation takes the form

$$T_1 = \frac{d}{2v}\ [1 + m \sin \omega\ (t_2 - T_1)] \qquad (2)$$

This is an implicit function of t_2 the independent variable, and T_1 the dependent quantity. A solution of this equation takes the form of a Bessel-Fourier expansion. Exposure of upper ribbon T_1:

$$T_1 = \sum_{n=1}^{n=\infty} \frac{-2\ (-1)^n}{n\omega} \cdot \int_n \left(\frac{n\omega md}{2v}\right) \cdot \sin n\omega \left(t_2 - \frac{d}{2v}\right) \qquad (3)$$

where

$$\int_n \left(\frac{n\omega md}{2v}\right) = \sum_{P=0}^{P=\infty} \frac{(-1)^P \left(\frac{n\omega md}{4v}\right)^{P+2n}}{P!\ (P+n)!} \qquad (4)$$

Similarly the exposure of the lower ribbon T_2 may be given as

$$T_2 = \sum_{n=1}^{n=\infty} \frac{2}{n\omega} \cdot \int_n \left(\frac{n\omega md}{2v}\right) \cdot \sin n\omega \left(t_2 + \frac{d}{2v}\right) \qquad (5)$$

Considering both ribbons together we obtain for the exposure T:

$$T = \frac{4}{n\omega} \cdot \cos \frac{n\omega d}{2v} \cdot \int_n \left(\frac{n\omega md}{2v}\right) \cdot \sin n\omega t \quad n \text{ is odd}$$

and (6)

$$T = \frac{4}{n\omega} \cdot \sin \frac{n\omega d}{2v} \cdot \int_n \left(\frac{n\omega md}{2v}\right) \cdot \cos n\omega t \quad n \text{ is even}$$

The solution obtained above is valid for all values of f up to the critical frequency f_c. This frequency is defined as the frequency at which the instantaneous maximum velocity of the light valve ribbons becomes equal to the velocity of the film. Beyond this frequency the expression for the exposure becomes multiple-valued and this study does not hold.

The maximum velocity of the ribbon is given by the expression $\frac{sm\omega}{2}$ from which the critical frequency may be derived $f_c = \frac{v}{sm\pi}$, where s is the distance of either ribbon from the neutral axis.

In a two ribbon valve of 1 mil separation or 0.5 mil focus on the film, $s = 0.25$ and $f_c = 11{,}450$ cycles per second at 100 per cent modulation. In a single-ribbon valve under the same conditions $s = 0.5$ and $f_c = 5{,}725$ cycles per second.

One ribbon vs. two ribbons

From the consideration of the cut off frequency the superiority of the two-ribbon valve is apparent. However, a study of the results derived in this article bears out this fact in a more striking manner. The harmonics of higher order than the fundamental have a higher level in a single-ribbon valve, particularly the second harmonic whose value is 13.2 per cent at 1,000 cycles. The attenuation of the fundamental frequencies is lower than in the double-ribbon valve, but this advantage is offset by the above two considerations.

Recording with a two-ribbon valve spaced at 2 mils or more, is also unsatisfactory, as at 2 mils f_c takes the same value as in the single-ribbon valve and the attenuation is higher than with either a one- or two-ribbon valve spaced at one mil.

Figures 2, 3, and 4 show the wave distortion and are obtained by graphical means which are not subject to the limitations of the mathematical solution.

In this manner we are able to show the wave form beyond the critical frequency for one- and two-ribbon valves. In Fig. 2 the frequency represented is 5,725 cycles per second, which is the critical frequency for the one-ribbon valve but well within the range of the double-

ribbon valve. In Fig. 3 we used the cut off frequency for the double-ribbon valve and we see that a definite added distortion appears on the wave form of the one-ribbon valve whose critical frequency is exceeded in this figure.

In Fig. 4 we exceed the critical frequency of both valves which shows added distortion as well as marked attenuation in comparison to the undistorted fundamental wave shown on all figures for the purpose of comparison.

The expressions for the amplitude of the harmonics in the case of the upper and lower ribbons are identically the same, although even harmonics in the upper ribbon valve seem to be 180 degrees out of phase with even harmonics in the lower ribbon.

Although the wave form for the two ribbons is slightly different, the amount of distortion is essentially the same, particularly since the human ear does not recognize any change in a phase difference between two steady tones.

The best possible results in this system of recording are obtainable with a two-ribbon valve spaced at 1 mil or better. Although at the present time it is not practicable to operate with valves spaced at less than a mil, the introduction of noise-reduction equipment effectively does so, up to a certain per cent of modulation. A description of this type of equipment is beyond the scope of this article.

As stated in a previous article (*Electronics*, April, 1931), the recording slit frequency characteristic alone does not constitute the final criterion of a good recording system. Although very essential, it must be studied in conjunction with the following factors:

(1) Frequency characteristic of the recording system of amplifiers.

(2) Characteristic of the optical systems used to illuminate the recording slit.

(3) Mechanical features of moving elements in the optical systems.

As a concrete example the characteristic of a glow lamp, or the overload characteristic of a light valve is just as important as that of the optical slit.

In the case of the light valve, the ribbons are tuned to a frequency from 8,000 to 10,000 cycles per second so that the mechanical resonance of the valve will not affect the range of the frequencies to be recorded. In the case of an 8,000-cycle tuned valve, a 7,000-cycle cut-off low pass filter should be used in the recording system.

The same considerations apply to the vibrator of the variable area system.

Comparison of recording systems

In Figs. 6-7 and table below a comparison is made of the attenuation of the fundamental frequencies and per cent of second harmonic in the three systems of recording covered by this series of articles. This comparison is made from an analysis of the recorded wave forms obtained in recording by the three methods considered. The electrical input in the recording elements of these systems has been assumed to be of pure sine wave form, and of equal amplitude at all frequencies.

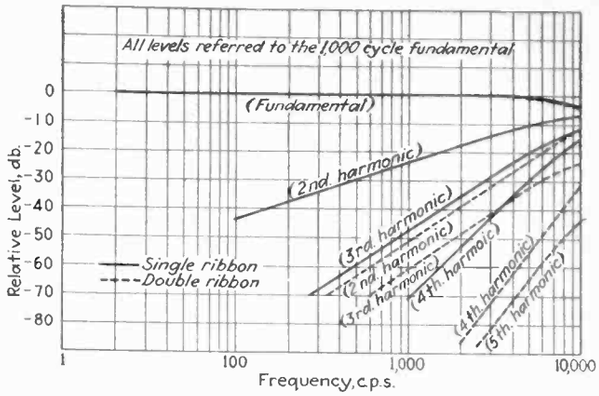
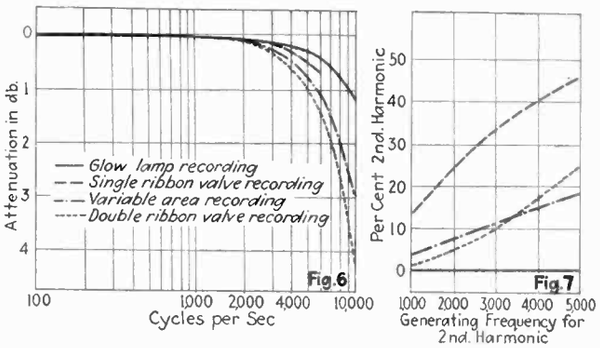


Fig. 5—Graphic analysis showing comparison between single and double light valve ribbons for upper harmonics



Figs. 6, 7—Comparison between the three systems of recording showing variations in attenuation for the fundamental frequency and second harmonic

Although the attenuation suffered by the fundamental components of the recorded waves is very small in the working frequency range of any of the systems studied, the following merit rating may be given the systems as a basis of comparison:

First: Glow lamp recording (Least attenuation)
Second: Single ribbon light valve
Third: Variable area recording
Fourth: Double ribbon light valve.

The above comparison is based on a 0.5 mil focus. This practice is now being followed in light valve recording; however, in the case of variable area the focus is limited in actual practice to 0.75 mils, and in the case of

[*continued on page 88*]

Comparison of recording systems

Attenuation of recorded fundamental frequency indicated as a function of impressed frequency. Second harmonic given as per cent of its generating frequency, and tabulated against that frequency. All calculations based on effective slit width of 0.5 mil at the film.

	Variable Area		Glow Lamp		Variable Density: Single Ribbon Light Valve		Variable Density: Double Ribbon Light Valve	
Type of recording freq.	Fundamental Loss	Per Cent 2nd harmonic	Fundamental Loss	Per Cent 2nd harmonic	Fundamental Loss	Per Cent 2nd harmonic	Fundamental Loss	Per Cent 2nd harmonic
500	0.00	1.8	0.00	0.00	0.00	6.5	0.00	0.3
1000	0.00	3.7	0.00	0.00	0.00	13.2	0.00	1.1
2000	0.09	7.4	0.05	0.00	0.06	21.9	0.11	3.6
3000	0.26	11.2	0.12	0.00	0.14	33.9	0.29	9.7
4000	0.43	14.9	0.17	0.00	0.26	40.0	0.58	17.4
5000	0.75	18.4	0.26	0.00	0.46	46.3	0.96	24.9

Application of piezo-electric crystals to receivers

By R. R. BATCHER

NUMEROUS articles have appeared concerning receiving systems in which a quartz crystal is used in a bridge circuit in the intermediate-frequency amplifier output By slightly unbalancing this circuit heterodyne beat notes existing on one side of the desired carrier can be eliminated.

At *Electronics'* request, Mr. Batcher has analyzed this bridge circuit and has developed a simple relation between the degree of unbalance and the impedance of the quartz crystal and holder which governs the response of the bridge as a whole, showing that almost all of one sideband is eliminated but that the other gets through to transmit the desired modulation.

MANY unusual effects are accomplished in electrical circuits by the use of bridge circuits. In ordinary cases the requirements are that the bridge be balanced, either by adjusting one of the arms or by selecting a frequency at which a balance occurs. The present paper deals with effects that occur when such a circuit is not adjusted in this manner. The general equations for the unbalanced condition based on the circuit indicated in Fig. 1 are not difficult to derive. Here the arms of the bridge represent either resistances or the impedance values for the applied frequency. Of particular interest is the ratio of the output voltage to the input voltage, which is equal to zero at balance but rapidly approaches unity as the balance is upset. The sharpness of balance depends upon the relative ratio of impedances of the various arms and the impedance of the output circuit.

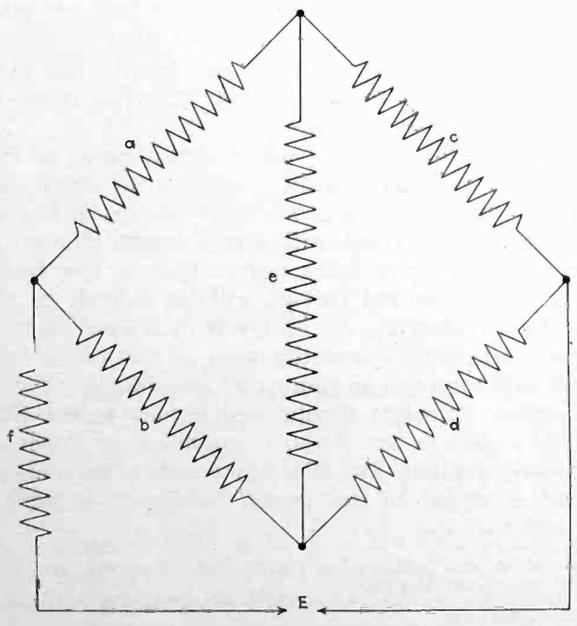


Fig. 1—Bridge circuit of usual type

In case the balance indicator utilizes a vacuum tube the value of e may be extremely large in comparison with other impedances and the formula is somewhat simplified. Applied to a bridge in which all four arms are capacitances the ratio of the output voltage to the input voltage is as follows:

$$\frac{e_o}{e_i} = n\left(\frac{1}{n+1+x} - \frac{1}{n+1}\right)$$

$$\text{where } \frac{b}{d} = \frac{a}{c} = n$$

$$\frac{\Delta c}{c} = x$$

Here the symbol Δc (Fig. 2) represents a small change in the capacity of the arm c, and may be either negative or positive, that is, the capacity of c may be either decreased or increased. It is assumed that the values of a, b, c, and d represent the values required to balance the bridge and therefore do not contribute to the output voltage. The output voltage depends entirely upon the relative value of Δc. Moreover a negative value of Δc is equivalent to a positive value of Δd, and vice versa, insofar as the value and direction of the output voltage is concerned. The absolute value of Δc may be very small since it represents a small change in a large capacity, in fact much smaller than values of capacitance usually found in electrical circuits, or it may be large, of the same order as the capacities found in the circuit. It is these two facts (that it may have either a negative or positive value, and that its range of values may be quite large) concerning this ficticious capacity Δc that is of particular interest in this discussion.

Effect of shunting one bridge arm

It is possible under certain conditions to shunt one of the arms of a bridge with a series resonant circuit without serious harm to the balance conditions. Thus in Fig. 2 assume that the capacity c_2 is very much smaller than the capacity of c, and that the reactance of the inductance is very much larger than the reactance of the arm c. The balance point will be practically un-

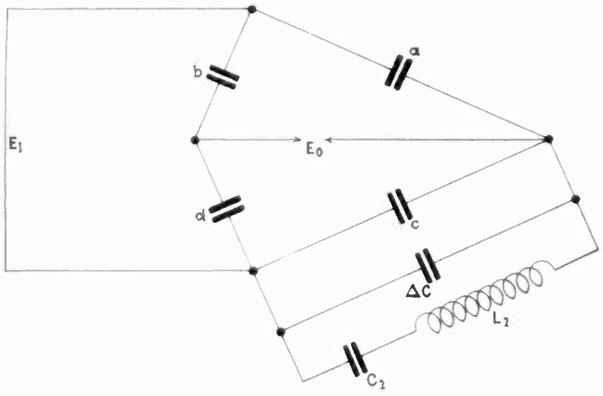


Fig. 2—Shunting a resonant circuit across one arm of the bridge

affected by this addition at all frequencies not near the one at which this series circuit is resonant. At the latter frequency however the tuned circuit practically short circuits the arm c, so that this frequency is readily passed. The assumed condition assures that the damping factor is very small so that the sharpness of this circuit as a band pass filter is at once apparent if Δc is zero. It will be found that the effect of c is still balanced out so that it introduces but little effect upon the resonant frequency of the series circuit.

Now consider the effect of a slight unbalance in this circuit of Fig. 3. We have mainly to deal with the effect of the small capacity Δc upon the resonance value of the series circuit. A solution of this circuit (Fig. 4) for a set of assumed values has been plotted in Fig. 3 in which the ordinates represent the reciprocal of the effective impedance. The ratio of the two capacities $\Delta c/c_2$ (equals m) has been given values of $+10$, -10 and -1. It will be seen that the resonance curve is very much sharper on one side than on the other, and that it takes but very little capacity variation to produce this condition. Also that there is a certain value of m which will cause a definite cutoff at a certain sideband frequency (where the curve cuts through the base line). At this frequency the frequency of the combination is infinite. Sideband frequencies on the opposite side of the carrier are attenuated less than if the bridge were completely balanced however, so that audio frequencies can pass through this path.

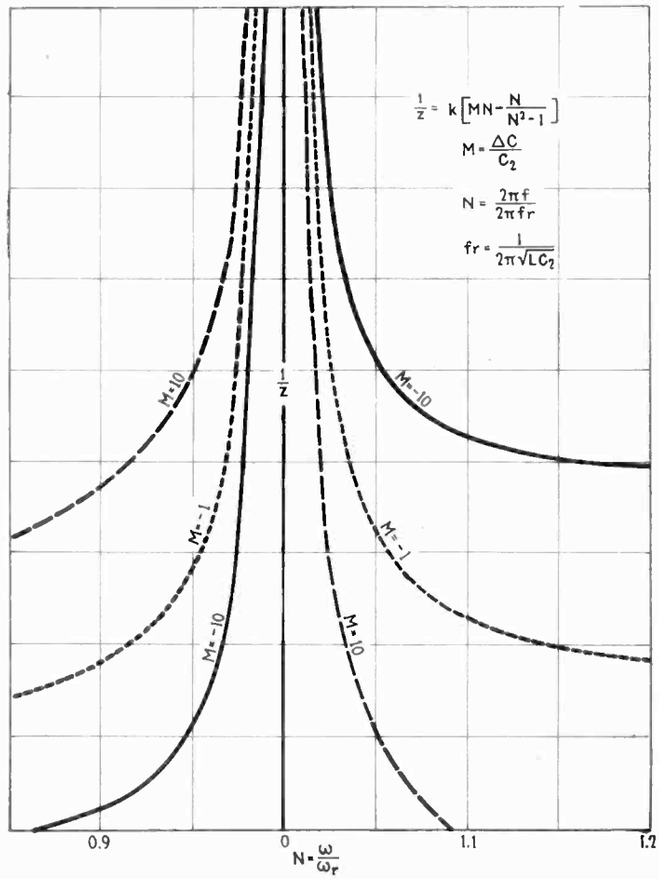


Fig. 3—Resonance curve of the circuit shown in Fig. 4

Application to radio receivers

This condition represents graphically the effect that has been noticed by users of the Stenode circuit (1), A slight unbalance introduces this unequal cutoff in the filter circuit and enables the elimination of, let us say, a 5,000 cycle whistle caused by station carriers heterodyning while it still permits a certain amount of the higher frequencies in the audio range to pass. In this case the unbalance is introduced manually so that the sharp cutoff is produced on the side toward the interfering signal. In practice the amount of unbalance required is very small, Δc may have a value of the order of .01 mmf.

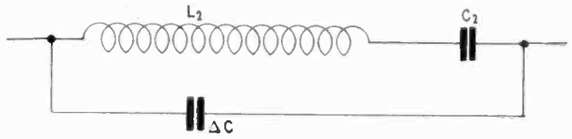


Fig. 4—Circuit representing a quartz crystal shunted by its holder

In order that the band itself is not shifted by this manipulation care must be taken that no other impedances appear in that arm of the bridge.

The author has noticed a number of interesting effects other than the above both in using the unbalanced bridge effect and the crystal filter circuit. In this analysis primary effects only have been considered, since the introduction of second order effects might obscure the points of interest. The effect of circuit and crystal damping factors, and the possibility of the crystal introducing regeneration or oscillations in the first intermediate frequency tube will influence the results. Certain expedients in the audio amplifier used in the Stenode attenuate the lower audio frequencies, and produce relatively a greater gain in the higher audio frequencies so that the audible effects of the peculiar response curve indicated by Fig. 3 are corrected.

The impedance of the parallel circuit made up of the crystal and its holder has the inverse of the characteristic of Fig. 3 which gives a good representation of the interesting effects obtained with the Stenode circuit. For example heterodyne beats nearer than a few hundred cycles to the desired carrier will be difficult to eliminate, by unbalancing the bridge with a small condenser whose total capacity is of the order of that of the holder, either side band can be eliminated and the other received.

Interested readers should see German patent D.R.P. 515702 issued to the Radio Corporation of America in Germany, January 10, 1931, in which a parallel tuned circuit is added to the crystal bridge to broaden out its response.

[1]See K. S. Van Dyke, *proc. I.R.E.*, Vol. 16, p. 742, and bibliography associated therewith.
Wireless World, Vol. 28, pages 9, 129, 166, 220, 244, 269, 362, 388, 418, 449, 520.
Exp. Wir. & W. Eng., May, 1931, page 250.
Electrician, Feb. 20, 1931, page 294.

Relations between Modulation and antenna current

By W. F. LANTERMAN

National Broadcasting Company

IN CIRCUITS carrying modulated radio frequency currents the effective value of the current is a function of the degree of modulation, due to the additional power present in the sidebands. If the modulation is steady and of sine wave form, the increase in current is readily measurable with thermo-instruments and offers one of the most direct and reliable methods of securing data on the depth of modulation. Such data are invaluable in determining overall frequency characteristics of radio or carrier transmitters, or of signal generators for testing receivers.

Let I_o represent the amplitude envelope of the unmodulated antenna current, and I_o' the peak amplitude of the modulating current. Assume both the carrier and modulation to be of sine wave form. The depth of modulation is $m = \frac{I_o'}{I_o}$. Then the envelope of the modulated wave is $I_o(1 + m \cos \omega_1 t)$, where $\omega_1 = 2\pi f_1$ and f_1 is the frequenecy of modulation; and the instantaneous power is $p = i^2R$, R being the antenna resistance. The average power is

$$P_{av} = \frac{R}{4\pi^2}\int_o^{2\pi}\int_o^{2\pi} I_o^2(1 + m \cos \omega_1 t)^2 \sin^2 \omega t \, dt dt$$
$$= \frac{I_o^2 R}{2}\left(1 + \frac{m^2}{2}\right)$$

The modulated antenna current is thus proportional to $\sqrt{1 + \frac{m^2}{2}}$ and the percentage increase above the unmodulated antenna current is equal to $\sqrt{1 + \frac{m^2}{2}} - 1$.

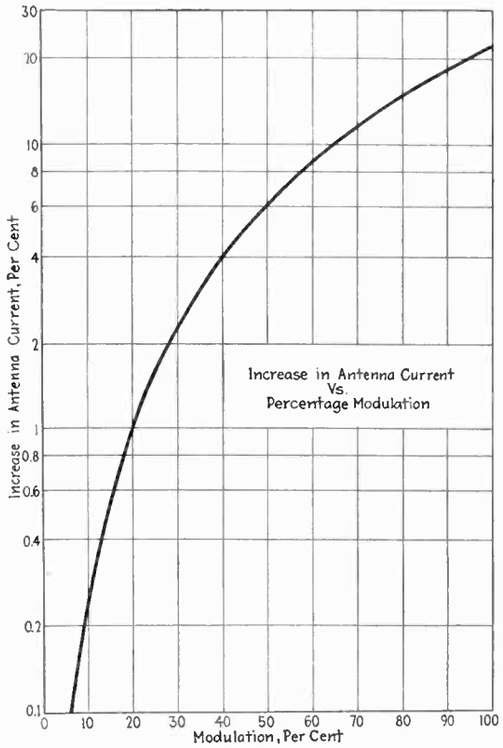
Increase in antenna current due to power in sidebands

By the conventional sideband theory, the instantaneous antenna current is

$$i = I_o \sin \omega t + \frac{mI_o}{2} \sin (\omega + \omega_1) t + \frac{mI_o}{2} \sin (\omega - \omega_1) t$$

The average power in the carrier is $\frac{I_o^2 R}{2}$ and is independent of m, since the modulation envelope is symmetrical with respect to the unmodulated envelope. The amplitude of the current in each sideband is $\frac{m}{2}$ times the carrier amplitude, giving average power in each sideband of $\left(\frac{mI_o}{2}\right)^2 \frac{R}{2} = \frac{m^2 I_o^2 R}{8}$. The total power (modulated) for carrier and two sidebands is

$$P_{av} = \frac{I_o^2 R}{2} + \frac{m^2 I_o^2 R}{8} + \frac{m^2 I_o^2 R}{8} = \frac{I_o^2 R}{2}\left(1 + \frac{m^2}{2}\right)$$



Relation between modulation and increase in antenna current

The power in the carrier therefore is unchanged due to modulation, while additional power is represented by the sidebands. This additional power accounts for the increase in antenna current when modulation takes place.

The above expressions lead to the following table and curve showing relations between modulation and antenna current:

TABLE

% Modulation	% Increase in antenna current
0	0
5	0.065
10	0.22
15	0.52
20	1.00
25	1.60
30	2.20
35	3.10
40	3.90
45	4.90
50	6.00
55	7.30
60	8.70
65	10.00
70	11.70
75	13.10
80	15.00
85	16.60
90	18.70
95	20.20
100	22.50

Solving network problems by graphs

By W. WATERMAN *Deforest Radio Company*

DURING the past few years it has become a custom, both in radio and telephone industries, to express transmission gain or loss in terms of decibels, db. The unit is defined as follows: Two amounts of power differ by one decibel or one transmission unit, when their ratio is equal to $10^{0.1}$.

From this fundamental definition, we can write

$$N = 10 \log_{10} \frac{W_1}{W_2} \qquad (1)$$

where N is the transmission gain or loss in db., W_1 is the power at one end of the transmitting network, and W_2 is the power at the other end. For a passive dissipative network, the expression above may be written in terms of voltage and current. The connecting equations are:

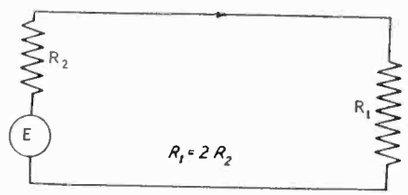
$$W = I^2R \qquad W = \frac{V^2}{Z} \cos \theta$$

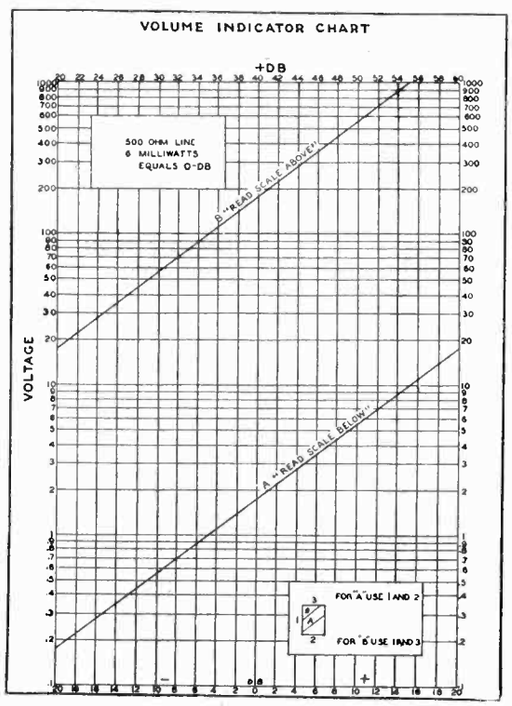
where I is the current, R is the effective resistance, V is the voltage, Z is the impedance, and $\cos \theta$ is the power factor. In terms of current, equation (1) is

$$N = 20 \log_{10} \frac{I_1}{I_2} + 10 \log_{10} \frac{R_1}{R_2} \qquad (2)$$

In terms of voltage, equation (1) is

$$N = 20 \log_{10} \frac{V_1}{V_2} + 10 \log_{10} \frac{Z_2}{Z_1} + \log \frac{\cos \theta_1}{\cos \theta_2} \qquad (3)$$





Modification of db. chart for special use

It will be shown how these formulas may be used and solved by means of a decibel chart.

First, let us take the decibel chart itself. The abscissa is plotted in db. from —20 to +20. The ordinate is plotted in ratios from 0.01 to 100. There are three diagonal lines *A*, *B*, and *C* (see key in lower right-hand corner of chart). For solution of 10 log ratio use line *A*, and for 20 log ratio use line *B* and subtract 20 db. from abscissa reading, or use line *C* and add 20 db.

To illustrate with specific examples: (1) It is desired to determine power level in a telephone line, when a high-resistance voltmeter connected across the line reads 5 volts. The standard telephone line has an impedance of 500 ohms and zero power level is considered to be 6 milliwatts. Six milliwatts for a 500-ohm line is equivalent to 1.73 volts. In the equation (3), second and third terms drop out, as the impedance of the line is constant and power factor change is neglected. The ratio of voltages is 5/1.73, or 2.89. Using line *C* we get 9.3 db., 9 db. is close enough for the answer, as a change of 1 db. cannot be determined by the human ear.

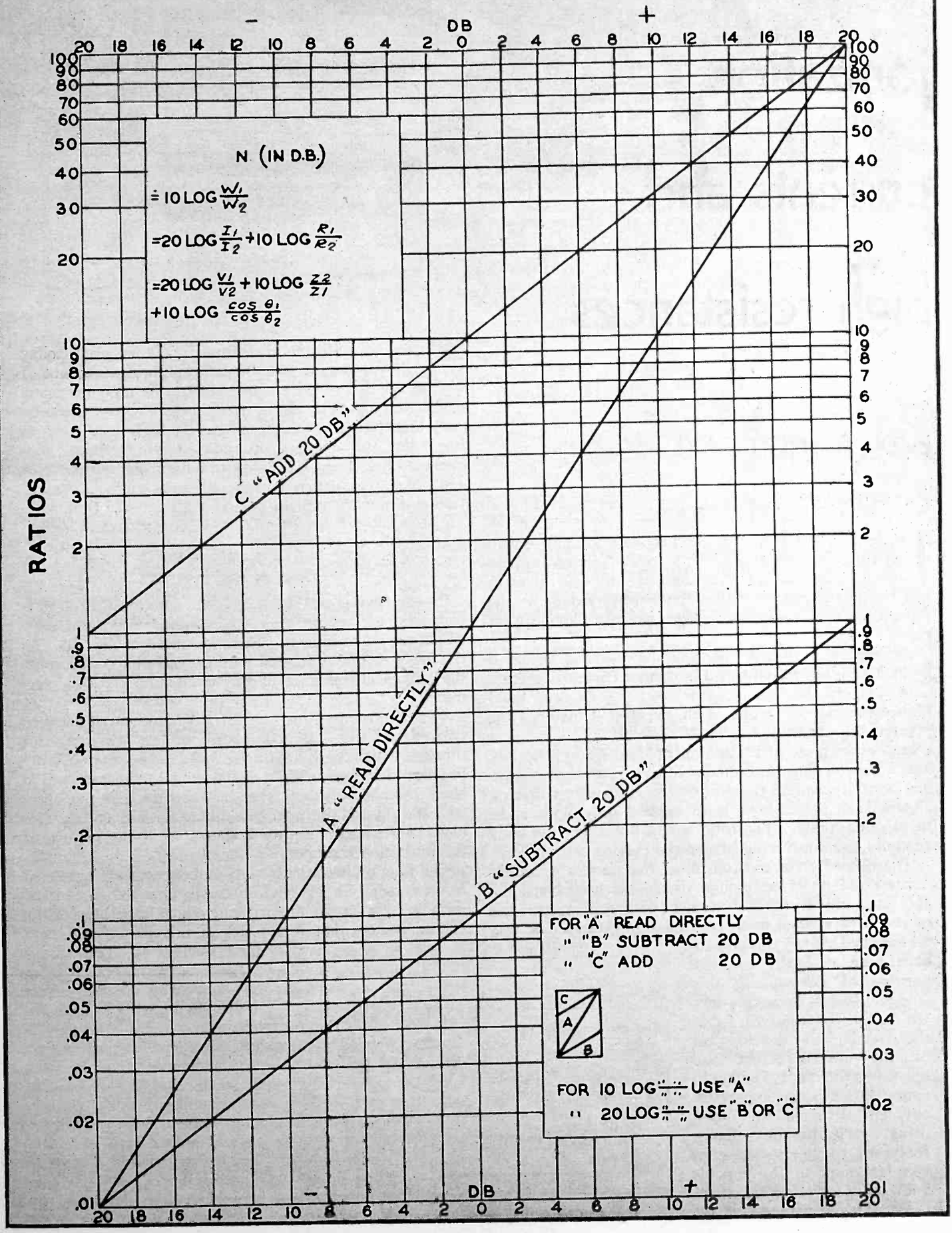
(2) It is desired to determine the loss, when the impedance mismatch is two to one. In general $I = \frac{E}{R_1 + R_2}$. (See accompanying figure.) Before mismatch, current $I_2 = \frac{E}{2R_2}$. After mismatch, current $I_1 = \frac{E}{3R_2}$. Current ratio $\frac{I_1}{I_2} = \frac{2}{3} = 0.66\frac{2}{3}$. Using line *B* for current ratio, we get —3.5 db. Using line *A* for resistance ratio, we get +3 db. The ***net gain*** is therefore —0.5 db., or *loss* of 0.5 db.

(3) To determine the gain of one stage amplifier for 500-ohm line. Input transformers normally have secondary impedance of 150,000 ohms. Therefore voltage step up ratio is $\sqrt{\frac{150{,}000}{500}}$ or 17.3.

Since the input transformer does not supply any power to the tube, the tube being biased negatively, only the voltage ratio has to be considered. Referring to the chart, we get a gain of 25 db. (i.e., 5 db. + 20 db. for "*C*" line). Let us assume that the tube is being operated at 180 volts. Then plate impedance is 9,000 ohms and amplification factor is 9. For maximum undistorted power output the load impedance has to be twice the tube impedance, or 18,000 ohms. Under these conditions the voltage gain in the tube is, $\frac{9 \times 18{,}000}{18{,}000 + 9{,}000}$ or 6. This is equivalent to a gain of 15.5 db. The output transformer has a stepdown ratio of $\frac{18{,}000}{500}$ or 6 to 1. This represents a voltage loss of 15.5 db. Adding up all gains and losses, we get a net gain of 25 db.

The specific examples quoted, illustrate how the decibel chart may be used for solution of various problems. It is also possible to plot other charts from it. For instance, the volume indicator chart shown is plotted for 500 ohms. It shows the relation between the power level of line and voltage.

DECIBEL CHART FOR SOLVING TRANSMISSION PROBLEMS



Measuring ionization currents and high resistances

By DR. IRVING J. SAXL

IF X-rays fall upon the human body or any object whatsoever, only a part of the rays is allowed to pass through the object. This share we can use for making visible the interior parts of the body hidden to the human eye on a fluorescent screen or on a photographic plate.

Another part of the radiation, however, is absorbed by the tissue and transformed into other forms of energy. The longer the wavelengths of the X-rays, and higher the atomic weight of the irradiated material the greater the absorption. Thus chemical and biological changes take place in a tissue radiated with X-rays. Not long after the dangerous effects of these absorbed X-rays had been discovered, there arose the necessity of making certain that the X-rays were applied only within the therapeutic limits. Too little would not affect the body enough—too much would harm the patient.

The necessity for the control of the amount of radiation applied upon the human tissue increased considerably later on with the advancement of the therapeutic use of the X-rays when intensive radiation in a specific way was applied. Many equipments have been designed for the purpose of determining this dosage. It was, however, only within the last few years that the tremendous development of the electronic art and science has made it possible to manufacture such apparatus, although designed for measuring very minute effects, foolproof enough to make its broader application possible with sufficient scientific exactness. This instrument is the Mekapion of Siegmund Strauss[1]. It is used today primarily for the purpose of determining the amount of X-rays applied to the patient, but can be used for many different purposes. It is easily possible, for instance, with the Mekapion to determine very high insulations as used for lamp sockets on radio tubes, electrical condensers, insulating oils, or for measuring minute currents, e.g., photo-currents (these minute currents in addition to the measurement can be made audible thus making it possible for the first time to construct a "photometer for the blind").

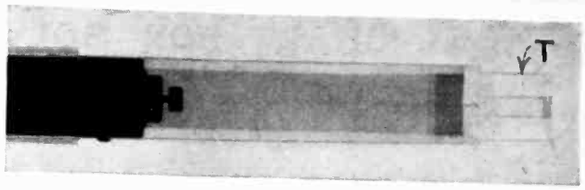


Fig. 1—X-ray picture of the ionization chamber which registers the minute currents

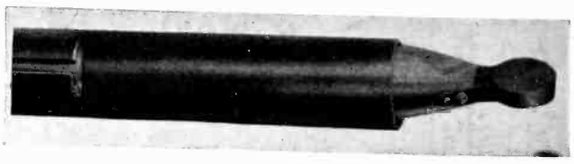


Fig. 2—"Grenz-ray" chamber for use with relatively long X-rays

Method of making tests

The biological effect of the X-rays within the tissue is proportionate within reasonable limits to the ionization which the same kind of X-ray produces in dry air. As the latter can be measured with the aid of the Mekapion the biological influence of this irradiation can be determined.

For determining this, the current is measured between two electrically charged plates of an air-condenser through which the X-rays are passing. In medical X-ray practice, however, this condenser is converted into a small chamber of about the size of a thimble, the outer wall and the rod in the middle taking the place of the two condenser plates. Figure 1 shows an X-ray picture of the ionization chamber.

On a highly insulated rod of amber, which is protected against radiation by lead, there is attached a kind of thimble of a very thin material which absorbs so little of the X-rays that it appears in this photo only as a faint shadow T. The X-rays passing through this chamber on their way to the object ionize the air within the chamber. If a suitable voltage is applied, a small ionization current is allowed to pass between the center rod and the wall of the chamber. For relatively long wave X-rays, "Grenz-rays," another type of chamber construction is used as shown in Fig. 2. Other chambers have been developed by Braun and Kuestner[2].

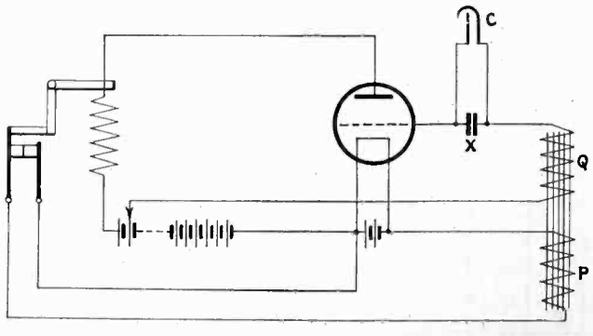


Fig. 3—Circuit diagram of the Mekapion system

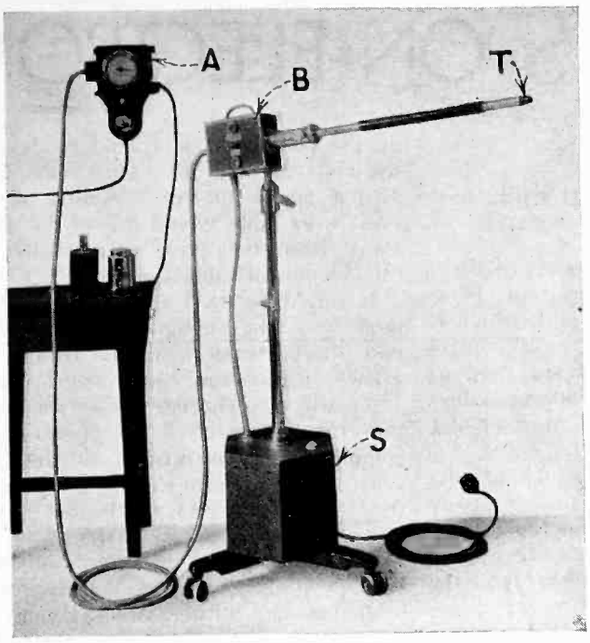


Fig. 4—The complete Mekapion apparatus with the recorder (A) calibrated directly in X-ray units

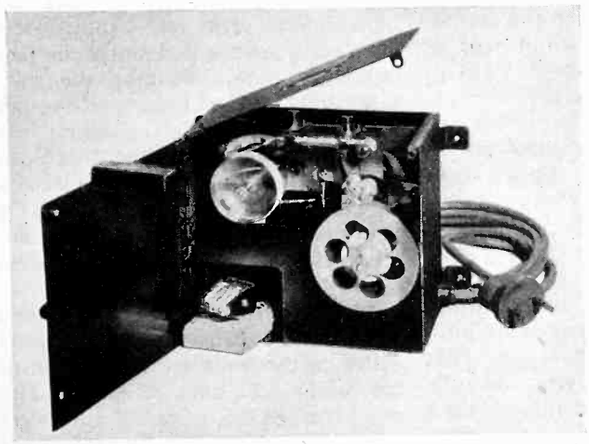


Fig. 5—Automatic recorder for measuring the amount of X-ray dosage on a tape

These ionization currents are too small to be measured with the usual instruments. As galvanometers are not foolproof instruments for a physician's room, and besides only with great difficulty can be adopted for registering continuously the amount of current applied, the Mekapion is to be regarded as an improvement in the methods of automatically measuring and registering extreme minute currents in a relatively simple way. This is important not only for ionization measurements as used in X-ray work but opens many possibilities for testing and research in the various fields of the electronic industries.

The principal wiring of the instrument is shown in Fig. 3. C is a sketch of the ionization chamber consisting of a middle rod and a surrounding cone of material with a very small coefficient of absorption for X-rays (air-chamber). Instead of using this chamber in measuring resistances, photo-currents, etc., the material or the cell to be tested is inserted. The leakage across this object is measured in the following way:

A radio tube, the elements of which are highly insulated from each other, is used for this purpose. The grid of this tube has enough negative bias that no current can pass between the filament and the plate. If we

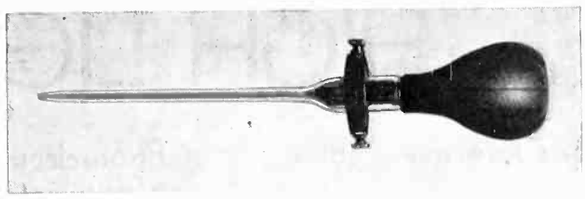


Fig. 6—Pipette with electrodes for testing the insulation of various oils

bring a resistance or connection between this grid and the filament, the grid current will be allowed to flow off, thus giving way for the anode current. Now, considering the ionization chamber as a kind of resistance, the grid current will be allowed to flow away if the ionization of the chamber is high enough to carry the grid current. The electric charge accumulated in the condenser C is thus suddenly discharged, and is similar to a dielectric break-down or the reaching of the ionization voltage of a neon lamp. At the same moment, the plate current can pass. This current, however, is already of the order of 2 milliamperes. This is strong enough for operation of a sensitive relay, which would not have functioned from the minute ionization currents directly.

This relay opens the circuit of an auto-transformer Q. Magnetically connected with this transformer is the winding through which the voltage for the bias is applied. Opening the primary winding P which is done if the plate current passes and opens the switch, the current in P is interrupted. The magnetic flux induces a voltage which charges the capacity X again negatively to an extent that the current in the tube is interrupted.

The above cycle is thus repeated. If an ionization current is in the chamber, the grid current flows away, the relay moves, and so on. Naturally, this movement of the relay is proportionate to the ionization current. As this current is proportionate to the biological effect, we have here an excellent means for measuring and registration of extremely small ionization currents and thus the dosage of X-rays.

This gives the principle of the system. The practical wiring is more complicated, but the principle is the same. The actual construction of the Mekapion units is shown in Fig. 4. The chamber T is brought to the part of the

[*Continued on page 86*]

▼

MEASURING INSULATION RESISTANCES UP TO 12 x 10^{13} OHMS

DESCRIPTION is given of equipment designed by Siegmund Strauss, an Austrian, for measuring X-ray dosage but applicable also to determine high insulation properties of radio tube sockets, insulating oils, minute photo currents, etc.

▲

HIGH LIGHTS ON ELECTRONIC

Shows how many autos in tunnel

THE VEHICULAR TUNNEL connecting New York and New Jersey now uses an ingenious application of photocell counters to indicate how many automobiles are in the bore at any given instant.

Photocells, employing beams of light intercepted by passing cars, are installed at both the entrance and exit of the tunnel.

The "entrance" photocell works the counter forward, adding up cars. The "exit" photocell is arranged to work opposite or subtractively on the counter, thus subtracting one point for each car that leaves the tunnel. In this way the number remaining on the counter index at any instant represents the number of cars actually in the tunnel at the moment.

A similar device might be arranged to indicate foot passengers, audience attending a theater, traffic on a street corner, etc.

✦

Artificial eye for blind finds doors or windows in room

BY DR. E. E. FREE

AN ARTIFICIAL ELECTRIC EYE for blind people, which has already been found able to distinguish light-colored objects from dark-colored ones and is believed to be capable of important further development, has been devised by MM. Georges Fournier and Pierre Auger of Paris. The new type of photoelectric cell, developed by M. Auger, converts light rays into electricity but somewhat more efficiently than is possible with other types of such cells. A special arrangement in the new device for blind people converts light rays that enter the cell into a musical note the character of which changes with the intensity and other characters of the light being "seen." The blinded individual then listens to this musical note by means of a small telephone receiver like those worn by deaf persons who use electric amplifiers to improve hearing. A blinded French soldier, M. René Roy, has been using the new device, M. Fournier states, and has learned not only to distinguish daylight from darkness but to locate the direction of an open door or window in a shaded room or of a light fixture at night, to locate light-colored or dark-colored furniture, to find a sheet of light-colored paper on a darker table top, to tell the difference between persons dressed in light or dark clothes and to find a dark-colored door in a light-colored wall.

Photoelectric tubes as limit switches in sheet mill

BY A. F. BOWERS*

THE WORTH STEEL COMPANY, of Claymont, Delaware, recently put in operation a new jobbing sheet mill, which is unique from the standpoint of control since photoelectric relays are used as limit switches on the run-out tables from the annealing and normalizing furnaces.

The run-out tables on which patents have been applied for, differ in many ways from the usual construction. They were designed by the Worth Steel Company, and were built by the McCarter Iron Works, of Norristown, Pa. The several tables in the train are synchronized and run at exactly the same speed to prevent slipping and resultant scratching of the sheets in the transfer from one table to the next. The general layout of the tables is shown in the accompanying sketch, from which it will be noted that because of space limitations, it was necessary to reverse the direction of the sheets through the mill.

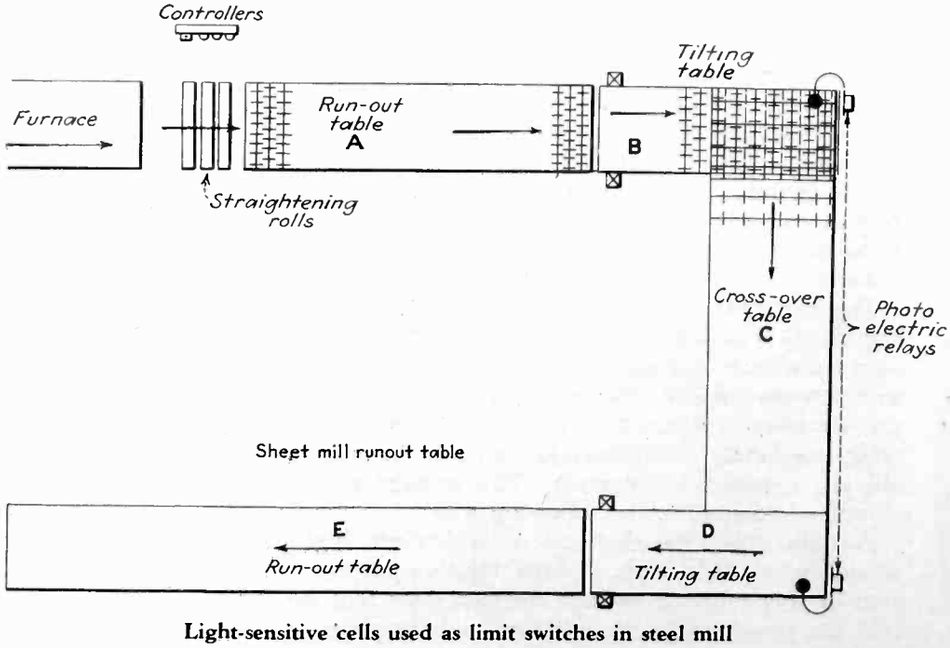
The operation of this equipment is entirely automatic after once being started, the movements of the sheets being out of the operator's hands after they leave the straightening rolls. The sheet, after leaving the straightening rolls, travels to the end of the tilting table B where it passes between a photoelectric relay and its light source. This relay stops the motors driving the rolls of the run-out table A and tilting tables B and D and starts the tilting motion. Tables B and D tilt until their rolls are below the level of the cross-over table rolls C and are stopped in this position by a limit switch. The sheet now rests on the rolls of table C and is clear of the rolls of table B. This same limit switch starts the roll motors of the cross-over table C and moves the sheet away from the area occupied by the intersection of table B and C.

It might be well to state here that table C is long enough to accommodate two sheets between tables B and D. Hence, before the equipment becomes automatic, two sheets must be placed on the cross-over table. The operator accomplishes this by turning out the light source for the photo-electric relays until the first two sheets reach the proper position.

Assuming that these two sheets have been properly located on the cross-over table between tilting tables B and D, the transfer of the third sheet onto table C and the movement of table C sufficiently to clear the crossing of tables B and C places a sheet between the photoelectric relay located on table D and its light source. This relay stops the cross-over table motors and starts the tilting-table lift motor, bringing the rolls of the tilting tables to a position above the cross-over rolls. A limit switch stops the tilting tables in this position and starts the roll motors of tables A, B, and D. The sheet on table D then runs out to the shears on table E. Thereafter, when a new sheet enters table B the cycle repeats itself.

Photoelectric relays were used on this installation because the sheets that are rolled in this mill are too thin to operate mechanical limit switches. This is another instance in which the electron tube has successfully invaded the steel mill.

*General Electric Company, Philadelphia, Pa.



Light-sensitive cells used as limit switches in steel mill

DEVICES IN INDUSTRY

Sees paper break and stops printing press

PUBLISHERS ATTENDING the annual convention of the American Newspaper Publishers' Association in the Hotel Pennsylvania, New York City, in April, witnessed the demonstration of a model, demonstrating the ability of the photo-electric tube to detect paper breaks and "wrap arounds" on high-speed printing presses. By an ingenious arrangement of white and black stripes, simulating actual conditions on the press, the model showed how the press could be stopped whenever a break occurred in the paper or whenever a wrap-around occurred following a break.

The photo-electric unit consists of a small bulls-eye focusing a beam of light either on a traveling belt (representing the sheet of paper) or the blanket cylinder of the press, and a photo-electric relay which picks up the reflected light and governs the action of the mechanism. White stripes on the belt represent a break in the paper, just as in actual operation a break in the white paper causes a dark space to appear where the paper was. Conversely, the black portion of the blanket cylinder represents the normal condition of no paper and the white portion, the paper which gathers on the cylinder when a wrap-around occurs.

When operating from the paper sheet, the reflection of the white sheet keeps the relay in normal condition and nothing happens, the press functioning as usual. When a break occurs, the interruption of the white light actuates the photo-electric relay and causes the control devices to stop the press.

In the case of a wrap-around, when the relay is actuated, the control devices stop the press and at the same time cause a cutting knife to rise and break the paper. Thus paper is prevented from accumulating on the blanket cylinder.

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The industrial salesman and the electron tube

BY FRANK INNES*

DESPITE the fact that there is no other electrical apparatus that performs with such time-shattering abruptness as does the electron tube, the tube has none the less a quality of slowness. This lethargy does not reside in the device itself but in the spread of common understanding of the uses to which it may be applied; for it is true that the tube is entering only slowly those fields of electrical control to which it is so admirably adapted.

The electron tube has as yet been accorded no place in the philosophy of the control salesman who roams about through industry seeking locations and duties in and to which the product he sells can be applied. It is the function of the salesman to show the prospective user where and how specific devices may be used. The customer probably has a little general knowledge of the possibilities of the electron tube, but to him it is still something in development, not yet far enough along to be included among his practical ideas on electrical matters. It is the duty of the salesman, therefore, to acquaint the customer with specific possibilities of the tube in the customer's specific applications. But the salesman does not do this, because primarily he has little if any conception himself of electronic engineering and his factory executives have never made him conscious of that lack in his selling equipment.

The reason is simple. Almost every advance in the art of electrical control in industry has had its origin in the field, not in the plant of the manufacturer. It is as much the salesman's job to perceive the problems of his field and present them to his factory for solution as it is for him to sell the products of the factory. The salesmen have not been carrying back to their factories suggestions for uses of electron tubes, and naturally the factories do not produce equipment embodying those suggestions. From this it appears that it is up to the wide-awake control salesman to take a course in electronics.

*In *Electrical World*, July 11, 1931.

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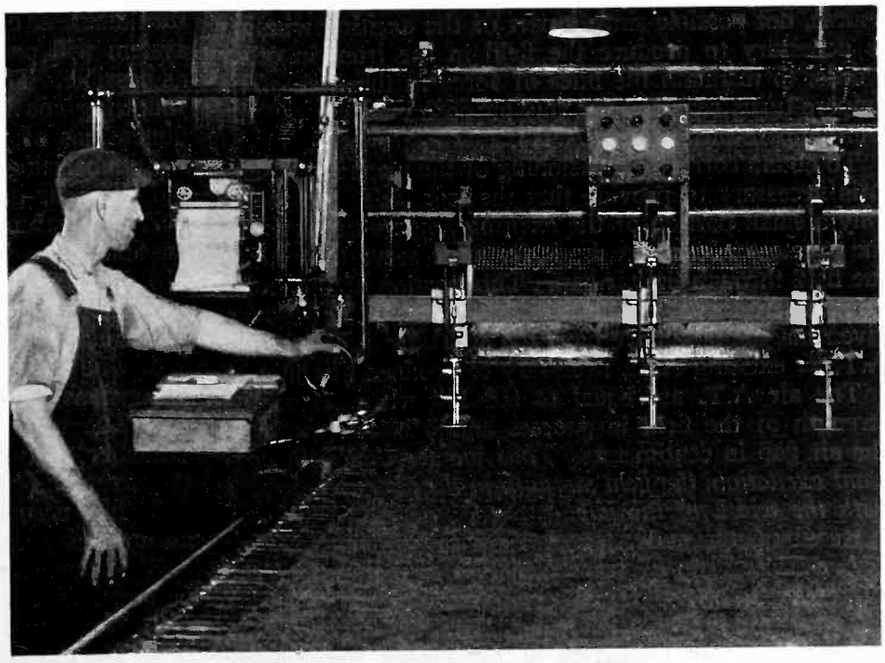
Electrical recorder put to new use

The Flax-Li-Num Insulating Company, St. Paul, Minn., has installed Brown strip-chart electrical recorders on all of its felt machines. These instruments give a mechanical inspection by constant operation of the recorder during the manufacture of the felt. This installation eliminates several inspectors and thus the human element in the inspection for thickness of the insulating material. Every square foot of felt produced is now measured as to thickness, and automatically a record of this thickness is made. The recorders also indicate weaknesses in the manufacturing process, and any changes in the felting machine as to uniformity of the product are immediately made known.

The operation of the instrument is quite simple. A sliding shoe contacts the surface of the felt, and operating under a fixed pressure, transmits its motion through a system of levers to a Wheatstone Bridge. Thus, the motion of the shoe is multiplied and the record which is produced magnifies variations in the product thickness. Such equipment as this would be adaptable to all sorts of similar manufacturing processes.



The sliding shoes contacting the surface of the felt operate through levers a Wheatstone Bridge, which in turn operates an electrical recorder. Equipment installed in the Flax-Li-Num Insulating Company's plant, St. Paul, Minn.

Dynamic loudspeaker design

By J. E. GOETH*

IMPORTANT factors determining the output of a dynamic speaker are:

1. The strength of the field in the air gap which must be as great as possible.

2. The length of the conductor, that is, the product of the length of a mean term and the total number of terms, which should be as great as possible.

3. The current, which should be as large as possible.

The strength of the field is approximately proportional to the exciting ampere-turns as long as the iron of the magnetic system is only weakly saturated. As the saturation of the iron is increased, the strength of the field increases less in the air gap when the number of exciting ampere-turns increases. The ideal condition would be reached when all of the exciting winding served only to produce the magnetic field in the air gap. This is, of course, not possible since a part of the exciting winding is necessary to produce the field in the iron, in other words, to maintain the lines of force in the iron. The ampere-turns required for this purpose we shall call the iron ampere-turns (Iron A.T.).

To obtain correct dimensioning of the magnetic system it is necessary to provide that the iron A.T. represents only a small portion of the exciting ampere-turns, while the greatest portion of the latter must serve to produce the field through the air gap. This portion of the exciting ampere-turns we shall call the air A.T. For a given magnetic flux we have the sum: air A.T. + iron A.T. = exciting A.T., necessary to produce this flux.

The air A.T. are equal to 0.8 $H\delta$ where H is the strength of the field in gausses and δ is the width of the air gap in centimeters. *Thus we see that with constant excitation, the field strength in the air gap increases with the width of the gap.*

Requirements under 2 and 3 are satisfied as follows:

A definite ratio of transformation is required of the output transformer for a given number of turns on the armature, other factors remaining unchanged. If the ratio of transformation of the output transformer is suitable for the number of turns on the armature, the ampere-turn product is maximum and the same in all cases.

As regards the effect of the mean length of a turn and the cross-section of the wire on the armature, we can show that nothing is gained by increasing the armature diameter. On the contrary, we do increase the mass which is to be moved. This results in a smaller amplitude and therefore a decrease in volume. From the standpoint of the weight, it may be said that:

If, with a suitable number of turns on the armature and a suitable armature diameter, the proper ratio of transformation of the output transformer is chosen, then for a given output the number of turns on the armature and its diameter are immaterial and without effect upon the power actuating it as long as the output transformer is suitably matched. *The motive power for the speaker is finally dependent upon the strength of the field and the available output.*

Importance of wire diameter

The effect of the armature wire diameter is easily determined. A part of the energy applied to the armature is used to produce motion while the rest represents heat loss. Since it is desirable to have the maximum possible amount of applied energy available to produce motion, it is necessary to reduce the ohmic losses to a minimum so that the wire must be as large in diameter as possible. We must therefore attempt to accommodate as little as possible of the inactive materials (armature frame and insulation) and the maximum amount of active material (copper) in the given air gap.

The moving force which is exerted upon the armature having a given diameter and number of turns is, with a properly matched output transformer and a given output, maximum when the total copper cross section (the product of the number of turns and the wire cross section) and the flux in the air gap are as great as possible.

With a given force acting upon the armature, the amplitude of the speaker cone is maximum when the mass to be moved and the forces opposing motion are minimum. It is therefore advantageous to make the armature diameter as small as the dimensions of the magnetic system will permit. The mounting should be as loose as possible. The available flux, as we shall see from the following consideration, is entirely dependent upon the dimensions of the magnetic circuit.

Summarizing the conclusions reached:

1. The air gap should be as small as possible.

2. The strength of the field should be as great as possible.

3. The magnetic circuit must be designed so that only a small part of the exciting ampere-turns is necessary to maintain the flux in the iron.

4. The armature diameter should be as small as the dimensions of the magnetic system will permit.

5. The total cross-section of copper in the air gap (number of turns × cross-section of wire) should be the maximum possible.

6. The necessary insulation in the air gap should be as little as possible.

7. The mass to be moved (cone and armature) should be as small as possible.

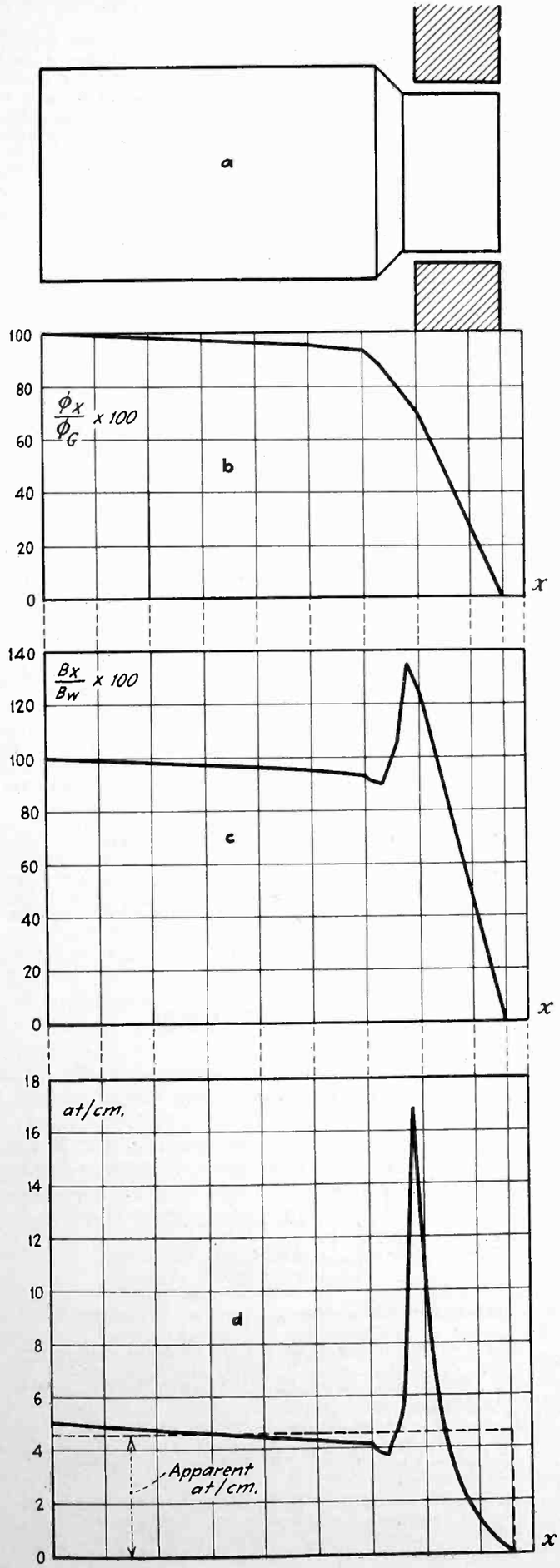
8. The mounting should be as loose as possible.

9. The number of turns on the armature is immaterial.

In regard to the items in which these requirements are contradictory it will be necessary to make a reasonable compromise.

*Translated from the German of J. E. Goeth, "Funk Bastler," by C. W. Loeber.

Fig. 1—(a) the core, (b) flux distribution in the core, (c) distribution of magnetic flux density in the core, (d) ampere-turn consumption in the core



We can now consider the calculation of the magnetic circuit. The exciting coil, which is wound on the core, produces a magnetic flux Φ_G when a current flows through it, made up of the largest portion of the flux Φ_N which permeates the entire core, and a smaller portion Φ_S which divides throughout the length of the core and the lines of force recombine without passing through the gap in which the armature floats.

In order to calculate the circuit correctly, we must have a clear understanding of the flux distribution in the various parts of this circuit. For this purpose Fig. 1(a) shows the core and Fig. 1(b) shows the flux distribution in the core in terms of the flux Φ_X, which exists in the cross-section of the core at a distance X from the lower end of the core, in per cent of the total flux Φ_G. The abscissa is the distance X. From this curve we can determine the flux which exists in the cross-section of the core at any point in its length. For example, at the lower edge of the upper yoke, the flux is 70 per cent of that present at the fixed end of the core. That is, 30 per cent of the total flux has passed over to the shank and upper yoke as stray flux without passing through the air gap between the core and the upper yoke. If at a distance X from the fixed end of the core, the cross-section is Q_X the flux density is

$$B_X = \frac{\Phi_X}{Q_X}$$

Values of B_X in per cent of the value of B at the fixed end of the core are shown in Fig. 1(c). If the magnetic flux density at the lower end of the core is known, we can determine the value of B at any point from the curve.

The magnetic flux density at the fixed end of the core is

$$B_W = \frac{\Phi_G}{Q_W} \text{ gauss,}$$

where Φ_G is the flux in Maxwells.

Q_W is the cross section at the fixed end of the core.

We shall assume a definite value for Φ_G and by Fig. 1(c) determine the magnetic flux density for this flux at any cross-section of the core. At a distance X from the fixed end, for example, the flux density is

$$\left(\frac{B_X}{100} \cdot B_W\right).$$

From the magnetization curve of such materials as wrought iron, steel, cast steel, and cast iron, we can determine the ampere-turns per centimeter required for this value of flux density.

The number of ampere-turns for each value of X are shown in Fig. 1(d). The area under this curve gives the number of ampere-turns available to maintain the existing condition in the core. If this area is changed to a rectangle, one side of which is equal to the length of the core, then the other side represents the "apparent ampere-turns per cm." The area under the curve represents the actual ampere-turns required by the core. If we imagine a core of uniform cross-section equal to the cross-section of the actual core at its fixed end, the length of which is equal to that of the actual core and which has a flux Φ passing unreduced throughout its length, then the magnetic flux density

$$B = \frac{\Phi}{Q_W}$$

exists at every point in the core.

[*Continued on page 88*]

Patent pool vs. inventor

[*Continued from page 47*]

progress, the pool plan adopted must give every incentive to the inventor to produce the new inventions of the future, by being adequately paid for his work and effort.

Further communications received from readers on the subject of the radio patent pool are reproduced below.

Radio business has its very foundations on work of inventor

By Benjamin F. Miessner
Consulting Radio Engineer, Short Hills, N. J.

While no definite information appears available regarding the modus operandi of the proposed "pool," it appears, from the tenor of the comments of some of the manufacturers, that one of its important objects is to pool the resources of the patent users *against* the patent producers. I note such expressions as "strong-arm," "tactless," "racketeering," "clamoring for royalties," "harass the industry," "unadjudicated patents," "extortion," etc., in reference to inventors and patent owners.

Is it possible that these good people do not realize that the very foundations of their business constitute the inventions made or owned by those they now so strongly indict? Have they forgotten with what acclaim they hailed each new announcement of old barriers to progress overcome by these self-same inventors; and how they appropriated these improvements just as fast as they could get the details? Do they perhaps feel that the art is so far developed that the inventors are no longer necessary to keep their business profitable; that they should cast off those whose mental sweat has made their very existence possible? Do they not realize that a mass assault on these pioneers will only stop progress by removing incentive for invention?

It appears to me that the plan now proposed is to create a monopoly controlled by manufacturers, the effect of which will absolutely eliminate competition for the inventor's work and thereby permit the pool to dictate its own terms in its dealings with them.

I feel sure that the comments of representative inventors in the art, particularly those independents not employed by manufacturers, would be very interesting at this time.

May I suggest such names as Hazeltine, Armstrong, Ballantine, Jones, Lowell, Dunmore, Pierce, Morecroft, Dubilier, Fessenden, De Forest, Vreeland, Stone, Hogan, Case, Pickard, Pupin, Cohen, Cady, Horle, Pridham, Jensen, Hopkins, Donle, Nakken, Pupin, and dozens of others?

Must increase inventor's productivity

By John V. L. Hogan
Consulting Engineer, 41 Park Row, New York City

A patent pool in radio may be desirable or undesirable depending largely on the opportunity and incentive its organization gives the individual inventor to go on creating. The inventor is still one of the most important men in radio, and he will continue to be so for some time to come. Radio technology is stabilized to only a very small extent, and the future value of the science depends tremendously upon what will be done in laboratories. The work of the radio inventor must go on, whether he is independent or associated with some corporation. Any truly successful patent pool must be designed along lines that will certainly preserve and preferably increase the inventor's productivity.

Believes open pool should cover whole electronic art

By Oswald F. Schuette
Executive Secretary, Radio Protective Association, Chicago

Personally I am anxious that the open patent pool promised by the Radio Trust should cover the electronic art. If we cannot eliminate, from the entire electronic art, the danger that all of its developments will have to go through a fight such as we have witnessed in the last four years, before they can shake themselves free from monopoly, there is nothing but disaster ahead.

To my mind we must create a comprehensive Electronic Foundation which will eliminate needless patent litigation, and in that way will do in the patent field what the Interstate Commerce Commission has done for industry as a whole, by eliminating rebates and other discriminations in railroad service.

But the success of such a pool depends upon the completeness with which it covers the field and the whole-hearted support it receives from every interest—large and small. Properly and honestly built, such an Electronic Foundation can be a wide boulevard to progress. But if it is to be mis-built at the outset by an attempt to perpetuate the evil conditions that have caused so much trouble it will lead the industry to chaos.

The whole subject is a vital one and deserves the widest possible discussion. We can either make or break the future of the electronic art by what we do in the creation of this pool. Throughout the past four years the Radio Trust has been responsible for the failure of every effort to create such a pool. Thanks to our four years of fighting that combination is now willing to cooperate.

RMA committee appointments for coming year

Important services to the radio industry, including action in the patent situation, during the coming year, were outlined by the board of directors of the Radio Manufacturers Association at their mid-summer meeting at Niagara Falls, Ontario, July 30. Active work of RMA committees on many industry problems is planned by President Coit and the RMA Board.

An innovation in the RMA organization instituted by President Coit was the establishment of a managing committee to take action in emergency matters between meetings of the directors. The managing committee also will act as a contact body with other radio organizations. With President Coit as ex-officio chairman, the new managing committee includes: A. L. Wells of Chicago; Fred D. Williams of New York and N. P. Bloom of Louisville, Ky., vice-presidents of the RMA; L. F. Muter of Chicago, treasurer of the Association, and H. B. Richmond of Cambridge, Mass., past-president of the manufacturers.

One of the important enterprises of the managing committee will be cooperation with the Radio Wholesalers Association and the National Federation of Radio Associations in promoting "National Radio Week," September 21-27.

Organization of groups of manufacturers to deal with their special interests was continued, and the following group chairmen appointed:

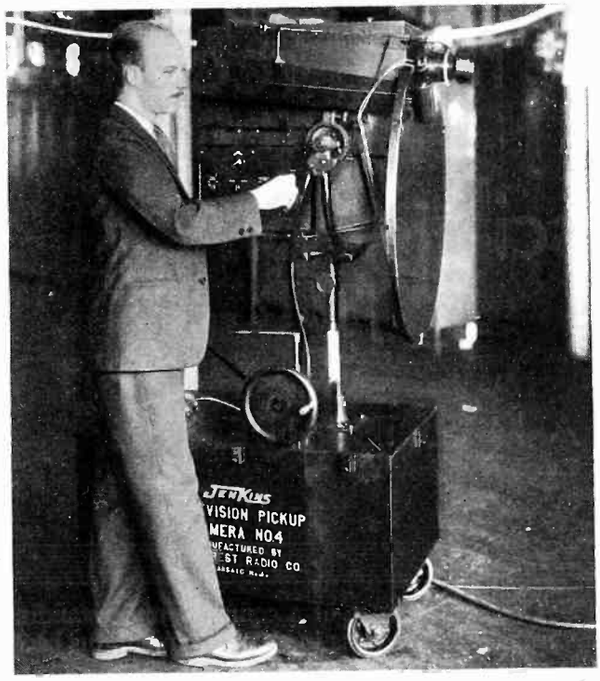
Receiving Sets—A. L. Wells of Chicago, Ill.
Speakers—Henry C. Forster of Chicago, Ill.
Cabinets—N. P. Bloom of Louisville, Ky.
Amplifiers—A. C. Kleckner of Racine, Wisconsin.
Raw Materials—R. T. Pierson of New York.
Miscellaneous Parts—Ray L. Sparrow of Chicago, Ill.

RMA committee chairmen for the ensuing year follow:

Credit Committee—Thos. A. White of Chicago, Ill.
Fair Trade Practice Committee—Fred D. Williams of New York.
Finance Committee—Leslie F. Muter of Chicago, Ill.
Foreign Trade Committee—Arthur Moss of New York.
Legislative Committee—H. B. Richmond of Cambridge, Mass.
Membership Committee—N. P. Bloom of Louisville, Ky.
Show Committee—B. G. Erskine of Emporium, Pa.
Statistics Committee—G. C. Furness of New York.
Traffic Committee—R. T. Pierson of New York.

Television direct pickup camera

BY DON W. SHORT
Deforest Radio Company



Self-propelled television camera for interior or outdoor pickup purposes

A NOVEL method of "picking up" television images is made possible by means of a direct pickup camera. This device differs from the indirect pickup method or so-called flying spot equipment, inasmuch as the image of the person or object being televised is focused directly upon spiral number one of the scanning disk. This scheme is used instead of a strong ray of light scanning the subject with the photoelectric cells responding to the variation of the reflected light.

The image is sharply focused by means of a high-speed special lens mounted in front of the revolving disk, which scans at the rate of twenty pictures per second. The sixty square holes of this disk pass across the picture, in proper sequence, from left to right and scan the picture from top to bottom. The light passing through the disk takes the shape of a rapidly diverging cone and enters a condensing lens system which concentrates it on the sensitized surface of the photoelectric cell.

The cell responds to the variation in the light impulses and sets up minute electrical currents which are fed into the amplifier. The output of the amplifier actuates a neon lamp which follows every impulse of the photoelectric cell. Thus the image is reconstructed upon the second spiral of the disk. This spiral is offset 36 degrees on the circumference from spiral number one to facilitate the mounting of a visor so the operator may monitor the picture constantly while the camera is in use.

Specially designed for portable use

The camera is mounted upon a rubber-tired truck which runs under its own power. This power is secured from a small motor and transmitted by means of a reversing clutch to the differential gears on the rear axle. The clutch control is so placed that the operator standing upon the small running board, may control it with his left hand. The front wheels are steered by a handle adjacent to the clutch control.

The necessary batteries for the amplifiers are placed in the truck. The amplifiers mounted in the camera head are fed through copper shielded cables. The camera head is mounted within a yoke which is arranged to allow the head to tilt up and down and to swivel left or right.

The head housing contains the photoelectric cell amplifier with the lower part divided into two sections, one housing the monitoring amplifier and the second the control panel. The motor for driving the disk is mounted at the front and below the support frame. The camera lens is mounted at the front end of the photocell amplifier box. This lens is held in a spiral focusing mount and controlled through a system of gears and shafting. The monitoring visor is mounted in direct line with the operator's eyes and connected to the spun aluminum disk case on the operator's side. The neon lamp is housed on the outside.

It is very easy for the operator to see the picture change gradually from "close up" to "long shot" or vice-versa as the camera travels backward or forward.

For inside work in the studio a small stage approximately 25 feet wide and 15 feet deep is used. The lighting system employs foot, side and border lights equipped with special diffusing reflectors and color filters. This gives an evenly diffused light over the entire stage giving the actors freedom of movement always under the "eye" of the camera. With this lighting method the actors do not face glaring lights as they are mounted below, above and to either side of the eyes. Short plays engaging as many as five people have been televised by this means, these pictures showing the full length of the actors and taking in the entire width of the stage.

When used outside, with sunlight illuminating the subjects, the camera is mounted upon a motor truck, quite similar to those employed in sound motion picture work.

The television signal passing from the camera amplifier is fed into the main amplifying equipment where a second operator monitors the picture going out to insure it is free from distortion. The amplifier feeds the modulator of a shortwave transmitter.

Successful television tests have been conducted with this equipment of moving trains, baseball games, tennis matches, and airplanes in flight. The results so far obtained have been very gratifying as detailed movement of the players and machines may be easily followed.

A rapid-record oscillograph

By A. M. CURTIS and I. E. COLE
Bell Telephone Laboratories

AS THE importance of a complete understanding of transient conditions in electrical apparatus becomes generally realized, the use of the oscillograph in engineering investigations increases, but its application still falls short of exhausting the possibilities. This is easily understood when it is remembered that most of the available oscillographs do not give an immediate answer to the question of what happened when the exposure was made. Prompt conclusions as to the effect of changes in apparatus or circuit conditions are hampered by a delay of several hours for the film to be developed, fixed and dried and a natural disinclination to use the oscillograph results. An additional drawback lies in the fact that the sensitivity of many oscillographs to the higher frequencies is inadequate and variable, and cannot be accurately determined except with the assistance of auxiliary apparatus not available in many laboratories.

A rapid-record oscillograph has been developed in the Bell Telephone Laboratories and has now been in use for telephone studies for about a year. Oscillograms may be taken with this instrument as rapidly as conditions can be changed and the result of the changes can be known at once as the finished record appears developed and fixed within a minute after exposure is made. This oscillograph, which is described here, has some features in common with the oscillograph developed during the war under the direction of Major Augustus Trowbridge for sound ranging of enemy artillery. The new instrument extends the frequency range from about 200 c.p.s. possible with the older instruments to 6,000 c.p.s., with a corresponding increase in the speed of exposure of the paper on which the oscillogram is made.

Study of electrical transients

The rapid-record oscillograph has been employed in the study of voice frequency transients in complicated networks, in studies of the operation of telegraph apparatus, in investigations of various elements of dial switching telephone systems, for the determination of the peak values of speech currents, and in observations and analyses of the circuits used for voice-operated telephone repeater switching and the associated echo suppressors. It is particularly useful for studies of transients of all kinds within its frequency range, as it is unnecessary to synchronize the transient with the operation of the oscillograph. The addition of suitable equalizers makes it possible to extend the range of frequencies investigated beyond that normally set by the galvanometer characteristics, although naturally at a corresponding decrease in sensitivity, and a frequency range of zero to 9,000 c.p.s. is attainable.

The oscillograph may be considered as a combination of three pieces of apparatus, a galvanometer, a photographic mechanism, and a time measuring device.

The characteristics of the three types of galvanometer used with the Rapid Record oscillograph are as follows:

Frequency Range without supplementary equalizer	Number of strings	Sensitivity in Milliamperes per millimeter	Impedance in ohms
0—1000 c.p.s.	6	0.6	9.0
0—3000	3	4.0	7.0
0—6000	2	9.0	6.6

The galvanometers are of the "string" type, the vibrating elements being duralumin wires 0.0008 inch in diameter and from 1 to 1.8 inches long. A steady field having a flux density of 32,000 lines per square centimeter is maintained in the 0.012 inch wide air gap in which they are mounted. The resonance of the strings is corrected by equalizing networks, which result in a practically linear relation between current and deflection over the frequency range. This feature adds considerably to the convenience of the instrument by avoiding the continual variation of the vibrator frequency characteristics common to oscillographs in which oil is used as the damping

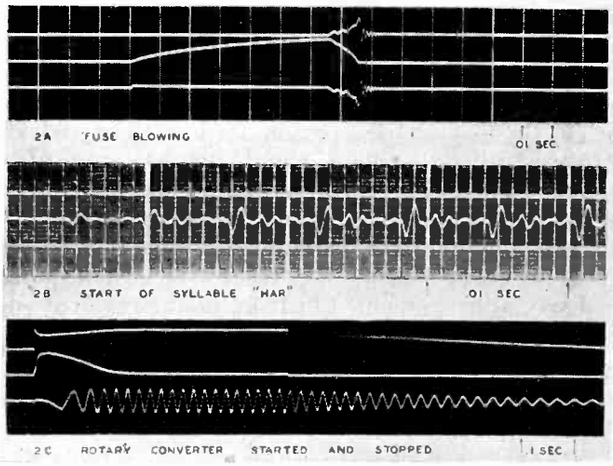


Fig. 1—Representative oscillograms: (a) a fuse blowing in an inductive circuit; (b) the beginning of the word "harmonic"; (c) a rotary converter started and stopped (see also the cover of this issue of *Electronics*)

means. It also makes unnecessary the tedious adjustments required in the case of quartz fiber oscillographs, the characteristics of which depend on a proper balance between the air damping and the fiber tension which in turn depends on the not easily controllable mass of the silvered quartz fiber.

Mechanical and optical details

The string mounting and adjusting means are combined with the front pole face of the galvanometer which is easily removable, and interchangeable with spares. Thus if strings are destroyed by overloading, a spare front plate may be substituted and work continued with a loss of only a minute or so.

A circuit is provided which permits the rapid adjustment of the strings to the proper tension. In the case of the 1,000 and 3,000 cycle galvanometers a component of the proper frequency and strength is selected by a filter from the complex wave present in the circuit of the

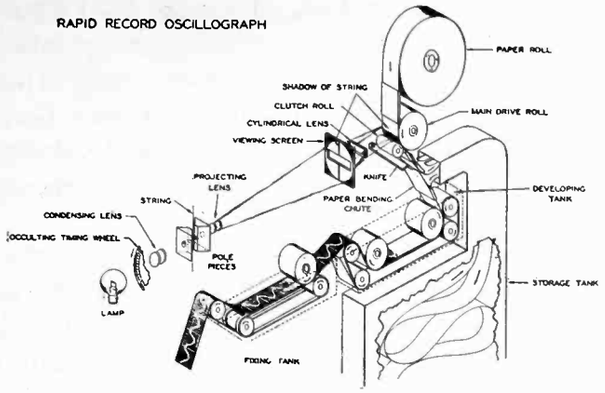


Fig. 2—This diagrammatic sketch of the oscillograph illustrates its operation

timing mechanism, and is fed to the strings which are then adjusted to maximum deflection. The 6,000-cycle galvanometer is tuned with the assistance of a simple vacuum tube oscillator. The natural frequency of the strings is maintained at its adjusted value regardless of changes in temperature by thermostatic tension regulating devices built into the galvanometer.

The optical system comprises a tungsten filament lamp, and a simple system of lenses which magnifies the motion of the strings and compresses their shadows to black spots on a line of light extending across the recording paper, with the result that the oscillogram appears as white lines on a dark grey background. Rulings on one of the lenses mark the oscillogram with horizontal lines 0.05 inch apart, to serve as a measure of the deflection of the string.

The sharp definition of the string image permits accurate observations to be made with deflections much smaller than are common with other types of oscillograph. This makes for economical operation as it permits satisfactory oscillograms to be taken on a strip of paper only 35 mm. wide,—a point of importance, as frequently a thousand linear feet of paper are used per day in some investigations. In cases where harmonic analyses are to be made, the oscillograms may be enlarged by photostat until the deflections are increased to about four inches, without sacrificing the sharply defined lines.

Time intervals 0.001 second long are marked on the paper during its exposure by occulting vanes carried by the rotor of a synchronous motor and passed between the lamp and its condensing lens. The motor is operated by current from an electrically driven tuning fork vibrating at 100 c.p.s. which is electrically and acoustically shielded by a metal box lined with masonite.

Operation of the oscillograph

The process of taking an oscillogram may be understood by reference to Fig. 2 which shows the operation of the mechanism in diagrammatic form. The sources of current which it is desired to investigate are connected to the galvanometer strings and the controls adjusted until suitable deflections are noted on a screen on the camera which permits a continuous observation of the string's vibration. The motors are started and an operating lever is pulled out and restored after the deflection of the image on the screen shows the expected phenomenon has occurred. The developed and fixed oscillogram commences to pass before the operator's view about ten seconds later. It may be examined and measured immediately. If it is desired as a permanent record, it is returned to the large hypo tank for a few minutes and then washed and hung up to dry.

Separate motors for the exposing and for the developing and fixing mechanism permit the oscillogram to be developed and fixed at a slower speed than that of exposure, the surplus exposed paper being stored in a light tight box from which it is automatically drawn by the developing apparatus. Although it is most usual to make our oscillograms at a paper speed of about 50 inches per second, which allows measurement of intervals 0.0002 second long, the speed during exposure may be varied from 4 to 150 inches per second and the oscillogram is developed at from 2 to 10 inches per second.

Figure 1 shows representative oscillograms taken with the instrument described. Two (a) shows what occurs when a fuse blows in a circuit containing an inductance shunted by a small capacity. The top string shows the voltage across the inductance, the middle string the current, and the lower string the voltage across the fuse. Two (b) is the current wave from a telephone at the start of the syllable "har." Two (c) shows some of the things which happen when a small rotary converter is directly connected to a 110-volt d.c. line and disconnected after coming up to speed. The line current is shown on the middle string, the voltage across the brushes on the upper string, and the uncommutated armature voltage (taken between the slip rings) on the lower string.

As the current necessary to give a satisfactory oscillogram is not always available, an amplifier has been designed for use with the rapid record oscillograph. It has only two stages, both "push-pull" and directly coupled, the first stage using two screen-grid tubes and the second eight low impedance tubes. The amplifier is considerably simplified by designing its characteristic of gain vs. frequency so as to compensate partly for the galvanometer frequency characteristic and the combination of amplifier and galvanometer gives a linear relation between input voltage and oscillograph deflection from direct current to 3,000 c.p.s. A voltage of 0.3 volt across 20,000 ohms is required for an oscillogram of convenient size and the amplifier automatically limits the output current to a value which will not burn out the string. When it is not necessary that very low frequencies be accurately recorded, the addition of input and

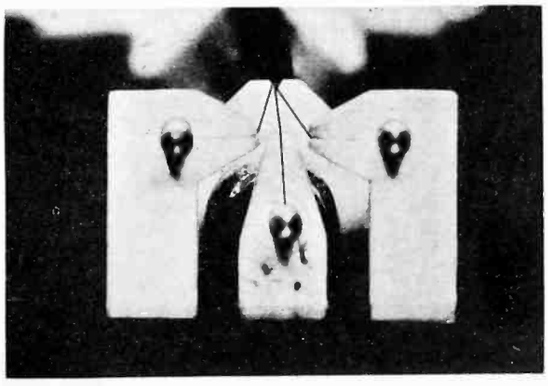


Fig. 3—An enlarged view of the string supports. Since each string vibrates in a different plane, they do not interfere with each other

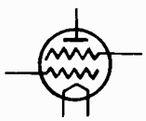
output transformers permits distortionless oscillograms from 50 c.p.s. to 3,000 c.p.s. with as little as 0.003 volt across 50 ohms. In this case a voltage limiting device associated with the output transformer definitely limits the output power to a value which prevents the strings from being destroyed by an excessive voltage on the amplifier input.

electronics

McGraw-Hill Publishing Company, Inc.
Tenth Avenue at 36th Street
New York City

O. H. CALDWELL, *Editor*

Volume III — AUGUST, 1931 — Number 2



Must designate whether tubes included

WHEN a company advertises radio sets for sale, it must specify whether the prices quoted include an outfit of tubes with each set. The Federal Trade Commission has so ruled in the case of a manufacturer, whose identity was not disclosed, but who was found advertising "in a way which tends to deceive buyers into believing that the prices quoted by the company for its sets include an outfit of tubes with each set, when such is not the fact."

A stipulation agreement was entered between the company and the commission, under which it was agreed that "the company will also not advertise its price for its radio set where such price does not include an outfit of tubes without at the same time disclosing in type equally as conspicuous as that in which the price is printed the fact that an outfit of tubes is not included or that the cost of the necessary tubes is to be added to the price stated."

The contribution made by instruments

THERE is perhaps no field where instruments have played such an important rôle in the advance of an art as in the radio, sound and allied industries.

Instrument manufacturers by their ingenuity, patience and workmanship have produced many standard and special instruments to meet the most exacting requirements of development engineers and the production line. To make even a partial list of such instruments, would run up into the hundreds. Instruments are man's most valuable tools. Perhaps the "ingenuity" of man has not increased since the stone age, but the development of instruments has made possible the crowning of many geniuses in modern times.

The electronic industries owe much to the instrument makers for their assistance in the past, but even more so, each manufacturer in this field owes it to himself to equip his engineers with the latest of instrument models in order that even greater advances in the art may be expected. Instruments are the wherewithal to carry forward into practical development the revolutionary advances made in an infant industry during the past decade.

Will short-distance fading be worse this winter

WHAT radio reception is to be, this coming winter, is at the moment a matter of interesting conjecture. Certainly long-distance reception during the present summer has been phenomenal. Accepting the usual theories, the Heaviside-Kennelly Layer has been exhibiting itself recently as an almost perfect reflector. Distant stations have come roaring in like locals, above even summer static. But the same admirable electronic mirror which reflects dx, is also bringing down local sky waves at nearby points with unprecedented strength. And with these sky waves chopping up the ground wave, producing fading and distortion, the good-service area of broadcasting stations has shrunk from 150 miles, as of two years ago, to a mere 30 to 80 miles. All parts of the country are experiencing this annoying fading.

Already there is evidence of a close relation between sunspots and the condition of the Heaviside reflecting layer. As the number of spots decreases, reflection improves, and nearby fading (due to sky-wave interaction) increases. But the disquieting thing is that the last sunspot maximum occurred in 1928, and the next minimum is not due until 1934. Therefore the curve is still downward throughout 1931 and 1932.

Does this mean that recent and present short-distance fading and mutilation are to grow even worse during the coming winter? And the next? Or, happily, shall we alight at nodes of reflecting-layer height, which will restore the halcyon reception of yesteryear?

Speech is a complex performance

THE tortuous oscillations which every part of the electrical and radio circuits must undergo, if speech or music is to be reproduced with fidelity, are well shown on the front cover of this issue.

Even an engineer steeped in wave theory, must find amazing the complex and extraordinary response of the microphone diaphragm, the rise and fall of currents in the electrical circuits, the ebb and flow of electron streams in the vacuum tubes, the magnetization of the iron in the transformers, and the pulsations in the ether, (and also the ejection of photons in the photocell of the talkie projector), as all are called upon to play their elaborate role in perfect unison.

When the designer lays out these parts, does he always visualize the complex vibrations to which the product must respond?

Vacuum tubes replace traffic cops

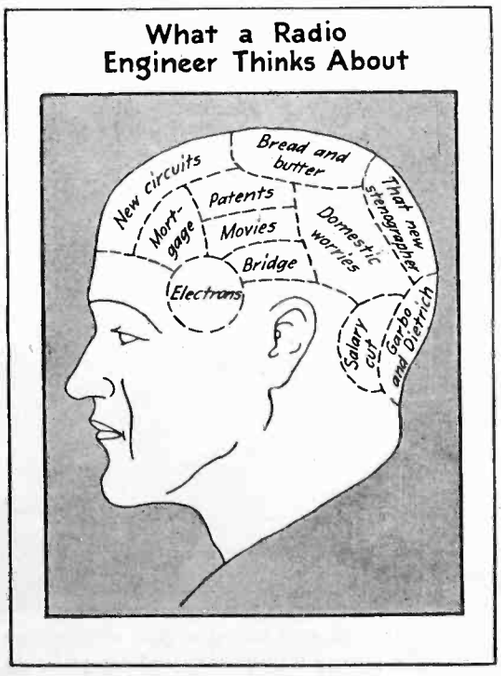
AS AN indication of the practical application of vacuum-tube control of traffic signals at dangerous street crossings, one company has already installed such units in 169 municipalities, within the last two years. Traffic officials readily recognize the greater efficiency and economy of such controls, over a detail of police.

Installation of this equipment has relieved traffic officers of monotonous and exhausting work, and at the same time, established efficient 24-hour supervision of the highways. This apparatus, with recent improvements, will automatically handle traffic conditions depending upon the speed and number of vehicles. It even prevents stragglers from holding up main traffic lanes. Potentialities exist for the installation of one million such units in this country, to overcome the rising tide of accidents. Further, such equipment uses tubes, condensers, transformers, resistors, relays, switches and cables, and represents only one part of the electronic industry of the future.

Blue are the skies in New York

TELEVISION, according to the prophets, is just around the corner—like prosperity. The prophets are behind the times, as stock salesmen will tell you. "Help-wanted" advertising appearing in New York newspapers gives the impression that stock salesmen do not agree with the prophets and the engineers—and the editors—who do not believe that television is ready for popular consumption.

Those familiar with the early days of the radio boom wonder if television is to be beset with similar stock market activities; which led to vast quantities of money being lost by a misguided investing public.



The march of the electronic arts

Total radios may not exceed 10,000,000 in census reports

WITH NEARLY TWO-THIRDS of the states and the District of Columbia already accounted for, it appears that the "radio population" of the country, taken as a part of the decennial population census last year, will fall short of earlier estimates of 15,000,000 sets.

The analysis of the United States Census Bureau thus far tabulated discloses that 34 states and the District of Columbia had only 4,168,510 sets on April 1st of last year. This report showed that out of an aggregate of 12,941,653 families, 32.2 per cent reported sets. Since last year, of course, the number of sets in use has increased considerably, but so has the number of families.

It is estimated officially on the basis of returns thus far received, together with the "expectancy" in those states unaccounted for, that between 40 and 50 per cent of the families have radio sets. It is difficult for these officials to see how the number of sets will exceed 10,000,000 or so.

✦

Poland's 120,000-watt station

POLAND IS COVERED "like a blanket" by its new 120,000-watt broadcasting station near Warsaw, according to a report received by the Department of Commerce. Using more than twice the power allocated to the largest American stations, the Polish transmitter ranks among the most powerful in the world. Radio "subscribers" now registered in that country aggregate 230,000, an increase of more than 27,000 as compared with 1930.

✦ ✦ ✦

SIAM LEARNS FROM SCHENECTADY

King Prajadhipok of Siam, fascinated by the thyratron tube organ, demonstrates his talent before Dr. Willis R. Whitney, director of the General Electric laboratories

✦ ✦ ✦

TELEVISION PICTURE SIX FEET SQUARE

U. A. Sanabria with his latest type of television pickup which provides for picture transmission and reception on a six-foot screen

Lowenstein grid-bias patent ruled invalid

IN COMMENTING ON the effect of the decision of Judge Galston in the suit brought against Sol Wallerstein, a Buffalo theater exhibitor who had installed a Pacent talking-picture apparatus, by the American Telephone and Telegraph Company, Western Electric Company, Inc., and Electrical Research Products, Inc., Louis G. Pacent, pointed out that the claims of infringement originally involved in the suit which related to eight patents, on three of the patents had been wholly abandoned by the plaintiffs and the aggregate number of claims had been voluntarily reduced from 54 to 18. Of the remaining patents which were litigated, by far the most important were the Lowenstein, covering a negative grid bias, and the Colpitts, so-called push-pull patent. The first was declared invalid and the latter expires in February next.

The Lowenstein patent, Mr. Pacent said, was heretofore considered basic with relation not only to amplification for sound picture reproduction but also for radio receiving set amplifiers, radio broadcasting and in connection with telephone transmission.

The principal remaining patents relate merely to one feature of the structure, namely, the arrangement of tubes in push-pull relation.

The Western Electric Co. is entering an appeal from Judge Galston's decision declaring the Lowenstein patent invalid.

Office building specially equipped for radio reception

ARRANGEMENTS FOR THE installation of a special antenna receiving system for the operation of radio receivers in each of the 425 offices in the modern 33-story building now under construction in Philadelphia for the Philadelphia Saving Fund Society, have been completed.

The new structure will be the first large office building in the United States to make such elaborate provision for modern radio reception and marks an important step towards a recognition of the valuable service which radio can render to the business man.

The radio equipment to be installed in the new building is the newly developed "Antenaplex" receiving system. Two single antennae located on the roof of the building will supply antenna and ground connections from a wall-plate socket to approximately 500 receiving sets of any standard type.

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Telephone conversation recorder

A TELEPHONE CONVERSATION RECORDER, a device by which both sides of conversations on the wire or radio is recorded on a magnetic steel wire in such manner that the voices can be reproduced at any later time, will soon be made available to the public by the International Telephone & Telegraph Corporation, through subsidiary companies. Rights to the device were obtained when I. T. & T. recently affiliated with the Echophon-Maschinen A. G., of Germany, which developed it. One of the features of the wire is that the message can be obliterated so that the wire can be used again.

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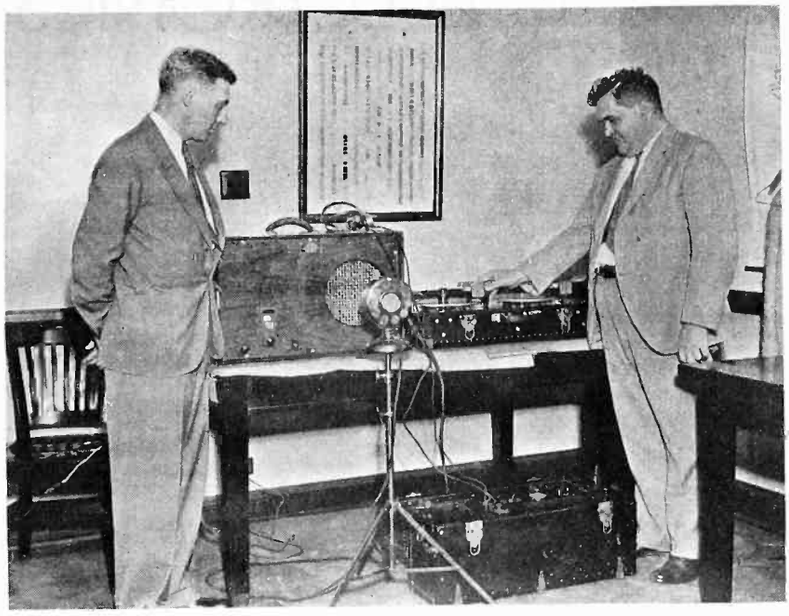
Giant dirigible to have powerful radio

FOR USE ON THE new giant dirigible Akron, the Navy Department is having constructed the most powerful radio set that has ever been installed on an aircraft. There are to be three receiving sets: one for high frequency, one for intermediate frequency, and a direction finder. Provision is made for two trailing antennae of the reel type and for one fixed wire antenna. The fixed wire antenna will follow a longitudinal girder and will be secured between short struts extending out from the hull of the airship. This location eliminates the possibilities of the fixed wire antenna being fouled during landing and handling operations. Two independent gas-engine-driven generators located in the generator room will be used for auxiliary purposes.

PORTABLE RADIO PROGRAM RECORDER



Pre-grooved blank disk records are used with this equipment to make a permanent record of a broadcast program for tests of interferences

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Television licenses in great demand

SPURRED BY RECENT encouraging pronouncements as to the progress of television, a veritable landrush for the television wavelengths is slowly gaining momentum. Not only the two great national networks, but more and more individual stations are climbing atop the television bandwagon. The result may soon be an overcrowding of the television wagelengths somewhat akin to that on the broadcasting channels.

Twenty-two experimental television stations have already been authorized by the Federal Radio Commission. All but five are now operating on fixed schedules, their pictures being received on home and laboratory televisors whose numbers are variously estimated up to 10,000 in the United States.

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SCIENCE TO QUIET AUTOS

Dr. William Braid White making oscillograph records of noises inside a car, seeking a solution against obnoxious sounds

Useful, too, when you argue with your wife!

LOUDER AND LOUDER grow our loud-speakers, as new research reveals new powers of amplification.

Just at the present time the record for long-distance audible conversations seems to be held by the recent Lakehurst tests of the U. S. Navy. Speaking into an eight-head Hoovenaire unit, the officer in charge asked all persons more than three miles away to notify him. One man telephoned from 18 miles, saying he had heard every megaphoned word plainly. Another Jerseyite, driving in his closed car, 10 miles away, reported he heard the words above the sound of the engine.

These new loud-speaker developments have great possibilities in speaking between ships at sea, and in talking from planes and dirigibles with the ground. At present the only way the Los Angeles can make an emergency landing is to drop an officer by parachute, who rounds up a ground crew, which takes time. With a powerful speaker, all directions could be given directly and quickly, and a landing rapidly effected.

REVIEW OF ELECTRONICS LITERATURE

HERE AND ABROAD

A new cathode ray oscilloscope

[W. O. OSBONE] The oscilloscope with a.c. heated filament is housed complete, except for batteries, in a metal cabinet 9 in. by 19 in. by 21 in. It was originally developed for television work and has a low voltage and a second, high voltage, 500 to 15,000 volts, anode. The timing wave generator is a multivibrator oscillator modified so as to produce a wave in which the linear portion is nearly the whole of each cycle. Recurring phenomena can be viewed on a fluorescent screen in an ordinarily lighted room.—*The Electric Journal, May, 1931.*

✦

Simple television with Braun tubes

[VON ARDENNE] Deals especially with simple laboratory apparatus for experiments with these tubes, using two similar tubes as receiver and sender respectively. The control described is that utilizing the Wehnelt cylinder (this being given a polarising voltage and receiving the incoming signals through a condenser) although it does not reproduce the half-tones but only black and white.—*Funk, Berlin, May 22, 1931.*

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Vacuum tubes and their applications

[W. C. WHITE] Four features characterize the uses of the vacuum tube: (a) independence of frequency, (b) continuous control instead of step by step action, (c) voltage control, (d) rectification. Its disadvantage is the small output; it requires 10 to 150 watts per amp. passed through the tube. The gaseous or thyratron tube requires about one watt per amp., but it lacks the features of continuous control and in its present form it is limited to below a few thousand cycles per sec.—*Electrical Engineering, June, 1931.*

✦

High-power—800 watts—membrane loudspeaker

[H. NEUMANN AND F. TRENDELENBURG] Research Laboratory, Siemens Concern. Increasing the area of the membrane above that of the 300-watt speaker or above 50x50 cm. was out of question, as the directive properties of such a source would become intolerable. By putting in series four air-gaps and by introducing pole pieces of ferrocobalt, the magnetic resistance per gap could be diminished, and by changing the plan for the field coils the stray-field could be reduced from 90 to 50 per cent, with the result that fields of 20,000 gauss could be produced economically. At 22,000 gauss a pull of 4,000 kilogram exists across the air-gaps, into which long copper ribbons plunge which are traversed by the voice current. At low frequencies they produce amplitudes of the vibrating duraluminum membrane reaching 10 mm. In this form the speaker has a range of a few miles.—*Zeitschrift f. Hochfrequenz Technik, April, 1931.*

✦

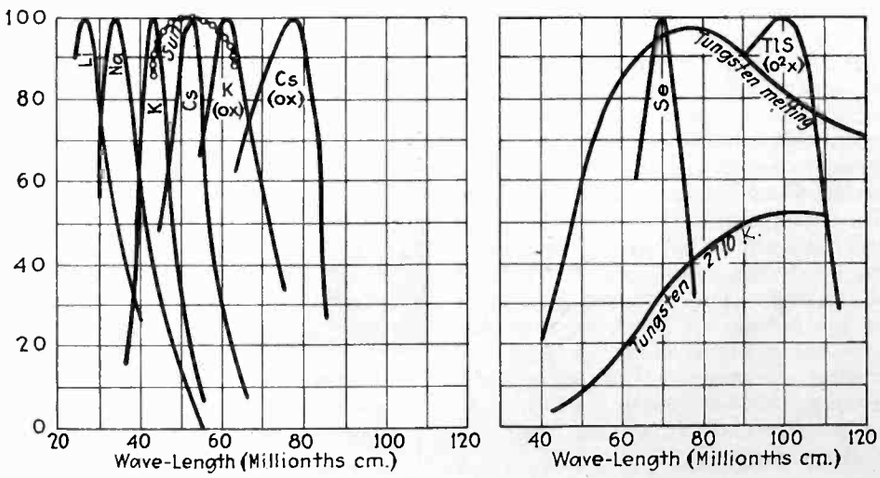
Comparison of certain commercial getters

[M. R. ANDREWS and J. S. BACON] A number of well-known active elements: calcium, barium, magnesium, sodium and phosphorus used as thin coatings on the inner wall of the tube are studied with regard to the degree of vacuum produced under given conditions and the speed with which this vacuum is reached. As expected the best vacuum is obtained from getters which have been degassed previously and distilled in vacuum. Pressures below one-millionth of a mm. of mercury may be obtained.—*Journal Am. Chem. Society, May, 1931.*

✦

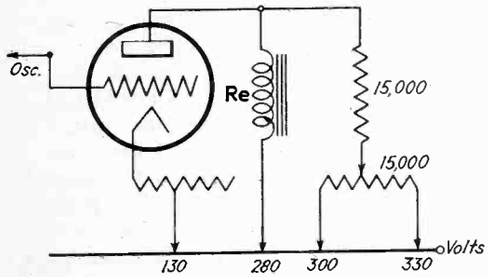
Modern photoelectric cells

[F. SCHROETER] Telefunken Laboratory. Among the devices based on the internal photoelectric effect, thallofide cells containing an oxygen compound of thallium sulphide on a gold and quartz support give the greatest change in conductivity when dealing with infra-red radiations. In modern selenium and thallofide cells inertia begins to become troublesome above voice frequencies. Among the cells based on the external photoeffect, cells with a monatomic layer of cesium upon oxidized silver foil have their highest sensitivity near 7,000 A, and in these thin layers evaporation of the metal is greatly reduced. With the energy distribution of kinolamps these cesium cells give almost as good results as gas-filled hydrogen-treated potassium cells. By forming a monatomic cesium layer upon a surface of salt or oxide obtained by distillation, cesium upon cesium oxide, 12 micro. amp. per lumen could be obtained in a high vacuum cell, or one electron per fifty unit quanta of light, as against 0.17 micro amp. in the ordinary cell. The response to yellow and red may also be enhanced by treating the surface with sulphur vapor or oxygen, or both, and almost any spectral sensitivity distribution may thus be obtained. For the still longer wavelengths cells based on the principle of the attenuating layer, such as cuprous-oxide-copper cells are available, the light falling either upon the extremely thin semiconductor which is in contact with a screen electrode (rear-wall cells), or upon a thicker layer of cuprous-oxide through a transparent film of gold (front wall cells). One of these front wall cells of 50 sq.cm. surface having an internal resistance of 300 ohms. gave 50 micro-amperes without external e.m.f. when exposed to bright daylight or 0.75 micro-watts. The front-wall cells have their maximum in the green region, the rear-wall cells toward longer wavelengths. Finally a third type of cells belongs to this group, the light sensitive contact detector characterized by the feature that the light does not need to fall upon the surface of separation itself.—*Zeitschrift für technische Physik, April, 1931; also Bell Laboratories Record, March, 1931.*



Improved model of the neon tube contactor

[H. J. REICH] The author describes a simple vacuum and neon tube device, capable of closing a circuit periodically at any desired frequency and holding it closed for any desired fraction of the cycle. A power-pack giving 350 to 500 volts is used; the two filaments are heated separately. A 0.001, 0.1 and 1 mfd. condenser may be switched in parallel with a G10 type neon tube and charged through a 199 tube with filament center-tap and grid connected together and the plate at 175 volts. The voltage changes in the discharge tube are amplified by means of a 112A tube having as a load a 15,000 ohm resistor and a relay in parallel. The grid bias is set at the value which gives the maximum variation of plate current, and the time in the cycle at which the relay operates is controlled by changing the steady component of the relay circuit.—*Review Scientific Instruments, March and April, 1931.*



Contactor amplifier

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Radio patents

[UNSIGNED] Austrian 115784, Aigner. Stabilization of amplifying tubes by a resistance and capacity in series connected between anode and grid, thus altering the phase relations. Specially suitable for screen-grid tubes since here the capacity can be so small that that existing between the leads within the tube suffices. Austrian 115798, Lorenz. Modulation of a carrier-wave by the picture frequency and by a synchronizing frequency, giving thus two picture and two synchronizing side-bands. One of each (e.g. the left picture and the right synchronizing side-band) is then suppressed at the sender.—*Funk Magazin, Berlin, July, 1931.*

✦

Characteristics of small thyratrons

[W. B. NOTTINGHAM] Bartol Research Foundation. The d.c. and a.c. characteristics of several small grid-controlled hot-cathode commercial mercury discharge tubes of the controlled rectifier and inverter type are carefully examined, and the relative advantages, for phototube work, of the phase-shift a.c. and the more sensitive critical potential d.c. methods of control are discussed. The maximum voltage drop in all the tubes is 24 volts, the minimum drop 10 volts, the average current a few amps. A grid current flows in the grid circuit before the discharge begins, but it amounts usually to a fraction of a microamp. only. At a critical value of the (negative) grid such a large number of positive ions are collected that they neutralize the field due to the grid and the arc starts. The heavy positive charges move rather slowly, and in 60 cycle operation a lag of the order of one-thousandth sec. exists between the observed starting of the current and the moment at which it would be expected to start on the basis of the d.c. characteristic. The variable condenser which in the phase-shift method of control is placed between filament and grid allows this lag to be determined by trial, because for a certain shift between anode and grid potential no current passes at all. In the case of the inverter type thyratron, where both anode and cathode are surrounded by the grid, the grid current grid voltage characteristics may become very complicated.—*Journal Franklin Institute, March, 1931.*

✦

New photo-cells

[HEMARDINQUER] Largely dealing with the American Arcturus and German Pyroxyd Cells, but also with details of the Gruma cell in which the sensitive area is the point of contact of a metallic feeler and the surface of a galena crystal, thus rendering it unnecessary that the band of light through which the sound-film passes shall be extremely narrow, and increasing the possible detail of a television image.—*La Nature, Paris, June 15, 1931.*

✦

Broadcasting on ultra-short waves

[JACOBACCI] (Compare these Digests March, May, etc.) General discussion, largely based on the German experiments, and with photographs of the transmitter, antenna installation and receiver, but with stress laid on the practical difficulties resulting from the low field-strength of the ultra-short-wave transmissions and from the difficulties of radio-frequency amplification on these waves.—*Radiogiornale, Milan, April, 1931.*

✦

Industrial band-filter components

[SCHWANDT] Description of the principal German commercial products, chiefly for use with the intermediate frequency amplifier of the superheterodyne but also for use with straight radio-frequency amplification.—*Funk, Berlin, June 12, 1931.*

Short-wave single side-band telephony

[TROLLER] Description of the system in use between Trappes (France) and Madrid, with photographs. In this a separate "pilot" radio frequency oscillation is transmitted for synchronization, at about 400 cycles higher frequency than that of the single side-band. Reception comprises radio frequency amplification, frequency-changing with a crystal-controlled heterodyne, local oscillator regulated by the synchronizing signal, and the usual detection and amplification.—*La Nature, Paris, July 1, 1931.*

✦

Image formation in television

[HUDEC] The objective image-formation is mathematically analyzed and compared to a screened newspaper photograph. Faults in present systems are studied, and improvements suggested and calculated.—*E.N.T., Berlin, June, 1931.*

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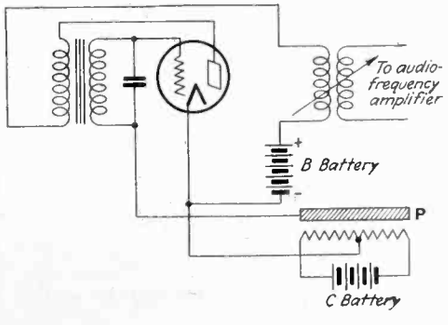
Antenna couplings

[KAUTTER] Mathematical analysis of the most suitable coupling conditions with regard to antenna resistance and oscillation resistance of the coupled circuit, and with respect to selectivity and volume.—*E.N.T., Berlin, June, 1931.*

✦

The Hellertion

[SCHW.] Description of a new radio-musical instrument developed by Helberger and Lertes. Each finger of the player controls one sound, each of these being variable independently of the others as regards pitch and volume, the former being controlled by the position of the finger and the latter by the pressure exerted. The tone is produced from true audio frequency oscillations, and not from heterodyning. In the diagram P is a band of metal which can be depressed into contact with the resistance, thus altering the grid potential. A pitch range of 4 to 5 octaves can be obtained. A complete circuit as shown exists for each finger. The control of volume is mechanical, both P and the resistance below it being flexible, so that they bend under the pressure of the finger: this movement then alters the coupling to the amplifier. *Funk, Berlin, July 3, 1931.*



A thermionic megger with linear scale

[Otto Stuhlman] University of North Carolina. Experiments with a 199 tube having a positive grid potential of 270 volts and a plate potential varying from zero to 300 volts show that the increase in current with plate potential is represented by a straight line at least between 0.2 and 0.4 microamperes when the plate potential approaches the grid potential. The slope of the line depends on the external resistance, and as all the lines go through one and the same point when the external resistance is varied, the change in slope may be used for estimating external resistances of the order of 1 to 10 megohms.—*Journal Franklin Institute, May, 1931.*

✦

Recent improvements in records

[H. J. Braunmuehl] Analysis of the needle noise by Buchmann and Meyer shows that the noise has its smallest value at a frequency of about 500 cycles per sec., the intensity of the components of lower and higher frequencies increases steadily as the frequency is varied from 500 cycles upward or downward. The higher frequencies, near 10,000 cycles per sec. are caused by roughness of the surface. The noise limits the intensity variations to 1 : 100 in the reproduction as against 1 to a few thousand in the original music.

For the analysis of the qualities of the record a method indicated by E. Meyer is of great value. The walls of the groves are sinusoidal surfaces and when properly illuminated such a surface appears as a band of light of a certain width. The width b depends on the slope of the sine line at the point of inflexion and this slope again on the velocity amplitude an (vibration amplitude by frequency) : $2\,an = bs$ when s is the number of revolutions per sec., so that the different frequencies may be readily compared as to faithful recording.—*Zeitschrift V.D.I., April, 1931.*

✦

Measurements on radio receivers

[Troeltsch] Communication from Siemens-Halske laboratories. The various parts of the testing apparatus are described in detail. The sender works from 150 to 3,000 meters, using Heising modulation: difficulties arising from frequency modulation with this system are mentioned and their cure (close coupling of anode and grid circuits, blocking of grid current). For selectivity measurements a short-circuited single turn coil coupled to the tuning inductance is used, for frequency changes of ± 30,000 cycles. Modulation is to 90 per cent without appreciable distortion. Especially full details are given of the coupling to the receiver under test, an inductive system being used in view of the simplicity of use, although the determination of the constants of this is difficult: three methods are described which supplement and check each other. Actual practical measurements and the precautions necessary are described, and examples comparing old and new type receivers are given.—*E.N.T., Berlin, April, 1931.*

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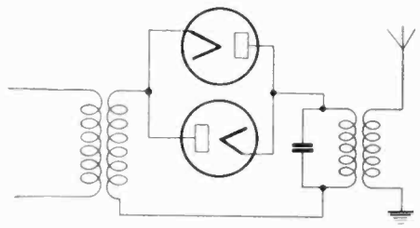
Patents

[L.] Description of French patent 692050 using a very negative grid and regeneration from the series circuit(s) in the anode lead tuned to the higher frequency desired, back to the grid; and of German patent 519822, using two diode tubes in push-pull so that both halves of the original wave are distorted. Alternatively a special tube containing merely two heated filaments may replace the two shown in the diagram, each filament acting alternately as cathode and as anode.—*Funk, Berlin, June 19, 1931.*



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The Copenhagen radio meeting

[Münch] Among recommendations of special interest are: that the present accuracy of 1/100,000 in frequency measurements be increased to 1/1,000,000; the power of a sender to be expressed by two figures, the first being the carrier-wave kilowatts and the second the maximum normal modulation percentage; the allowable strength of harmonics to be fixed without reference to the power of the sender (an interesting description is given of the discussions on this point between the American and European delegates, the latter point of view eventually prevailing); the maximum tolerance for carrier-wave variations to be 50 cycles/second.—*Funk, Berlin, July 3, 1931.*

✦

The beginnings of tube amplifiers

[Teucke] Historical summary, with a useful list of patent numbers and early publications, from Deforest in 1901 to 1916.—*Funk, Berlin, June 19, 1931.*

Medical application of the ultra-short waves

[Ancelme] Preliminary report of experiments tending to show that the effect of short waves is chiefly due to diathermic action, and that of ultra-short waves chiefly to a sort of electromagnetic massage of the cells. Oscillators of 20 and 140 watts are described with photographs and diagrams, and the results of experiments on microbes, liquids (blood, etc.), small animals, cancerous growths, etc., are given.—*L'Onde Electrique, Paris, May, 1931 (published June 13).*

✦

Photoelectric effect from barium oxide coated platinum filament

[K. Newbury and F. Lemery, D. Ramadanoff.] On account of many conflicting statements regarding this effect, the influence of light was reexamined. The thermionic current was balanced out and then light from a mercury arc allowed to fall on the filament mounted crosswise in a cylindrical quartz tube. At a given temperature the photoelectric current increases when the plate potential is increased from 0 to 15 volts; above this point saturation is practically established. A small saturation current is observed when the filament is at a dull red heat, it increases to 7 micro amps. at about 800 to 1000°C and decreases at higher temperatures. At the maximum the photo current was 30 times smaller than the thermionic current. The effect is difficult to explain.

In the second article, an amplifier and a cathode-ray tube are used to measure the current produced by interrupted illumination.—*Journal Optical Society, May, 1931, Physical Review, April 15, 1931.*

✦

Needle-scratch frequencies

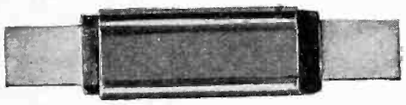
[Buchmann and Meyer] The needle noises on disks without recorded modulation was measured by an automatic sound-analyser. Among other interesting points the increase in the higher scratch-frequencies on the outer edge of the disk as compared with the center is discussed. The existence of a previously unobserved second interference-noise is demonstrated, apart from the needle-scratch proper, and present only in the lower frequencies, with a maximum about 60 cycles and decreasing to 400 cycles, and fully comparable in strength to the needle-scratch: this may be due to the driving mechanism during recording of the disk or to a "waviness" of the surface.—*E.N.T., Berlin, May, 1931.*

✦ NEW PRODUCTS

THE MANUFACTURERS OFFER

Tooth-pick type condenser

THE DUBILIER CONDENSER CORPORATION, 4377 Bronx Blvd., New York City, announces the Type 704, or large sized tooth-pick condenser for radio telegraph and telephone transmitters, carrier-current work, Tesla coil high-

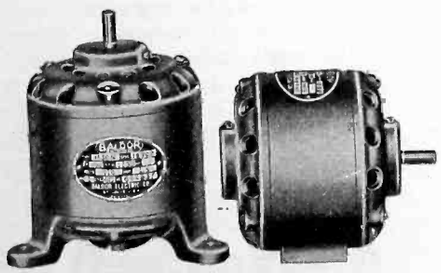


frequency circuits, and electro-therapeutic applications. This unit is of the mica dielectric type, rigidly and permanently held by a brass clamp casing. It will handle 2 amperes at 140 meters, and has an effective a.c. voltage rating of 2,000. It is compact and neat, measuring 2½ in. long by $\frac{13}{32}$ in. wide by $\frac{21}{64}$ in. thick.—*Electronics, August, 1931.*

✦

Synchronous motor for television

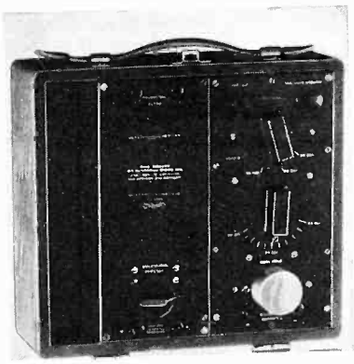
THE INCREASED INTEREST IN television has been one of the factors that has caused the Baldor Electric Company, 4351 Duncan Ave., St. Louis, Mo., to develop a synchronous condenser type motor that will operate the disc or drum exactly in step with the sending station. It is sometimes difficult for a synchronous motor to pull a heavy disc or drum into step, so a special starting hook-up has been devised which operates with a push-button to bring the heavy disc into synchronism. Most



of the manufacturers developing sets today are beginning to standardize on a 1,200 r.p.m. motor. Baldor makes both a vertical and a horizontal type motor built for 110-volt, 60-cycle, to operate at 1,200 r.p.m. The motor is fitted with ball bearings so that it may be operated in any position and with little attention to lubrication. The motor is dynamically balanced and has no intricate centrifugal switch.—*Electronics, August, 1931.*

Test oscillator

THE RADIO PRODUCTS COMPANY, 5th and Norwood Sts., Dayton, Ohio, has recently announced manufacture of a new model test oscillator which will be known as the 330 Multi Frequency Oscillator. This instrument is calibrated for transmitting self-modulated signals of 130, 175, and 180 kilocycles for intermediate frequency adjustments on super heterodyne receivers. Two settings are available for simultaneously transmitting a number of self-modulated frequencies. One setting trans-



mits 750, 1,000, 1,200, and 1,500 kilocycles and another 600, 800, 1,000 1,200 and 1,400 kilocycles. The instrument is shielded and equipped with volume control. Price, $26.50.—*Electronics, August, 1931.*

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Non-magnetic, non-corrosive alloy

ERAYDO ALLOY is the trade name of a new metal developed by the Illinois Zinc Company, 332 South Michigan Ave., Chicago, Ill. It is a white metal meeting the modernistic color scheme for metallic decoration now in vogue for interior and cabinet trim. Its tensile strength is 50,000 lb. per sq.in. It will take a bright polish or dull finish without the use of any plating and may be enamelled with any color scheme. This alloy being non-ferrous does not rust or become pitted, nor does it stain adjacent parts of wood or other material. It may be stamped out in a variety of forms for chassis or bases of radios. Manufacturers state they are prepared to furnish Eraydo cut to size or perforated and formed chassis from dies designed by the manufacturer. Its electrical and physical properties make it adaptable to many uses in electronic equipment.—*Electronics, August, 1931.*

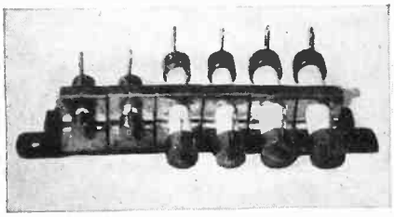
High frequency oscillator

THE MIDGET TESLA COIL made by the Central Scientific Company, 460 E. Ohio St., Chicago, Ill., is of the quenched gap type, having a primary transformer tuned and loosely coupled to a secondary high frequency circuit consisting of a single layer high frequency transformer, mica condensers and an adjustable spark gap assembly. The arrangement of parts and the design is such as to eliminate faradic surges, to give long life to the unit and to insure safe and easy handling. It was designed for utility in both the laboratory and lecture room. By separating the primary transformer from the secondary transformer and oscillating circuit it has been possible to produce a high frequency oscillator of small size that can be handled safely while in operation and therefore can be quickly applied to demonstration devices or the parts of a vacuum system. Price, $20. —*Electronics, August, 1931.*

✦

Moulded gang resistor

SIMPLICITY, CONVENIENCE AND LOW COST, together with compactness, mark the novel type of gang resistor introduced by the International Resistance Company, 2006 Chestnut St., Philadelphia, Pa. The usual metallized resistor, with ceramic body and cast metal ends including soldering lugs, is provided with a special cast metal center support so that the resistor may be mounted, along with any other combination of resistors, to form a gang resistor. Each unit is separate. The units are placed side by side and a rod is slipped through



the aligned holes. End brackets and nuts on the rod complete the assembly. Any desired combination of resistors may be assembled, with a choice of ½-watt, 1-watt and 2-watt units of any resistance value required. Thus the resistance network costs very little more than the total of the individual resistors, since the center support is cast at the same time as the cast metal ends.—*Electronics, August, 1931.*

Sound amplification unit

THE FOX ENGINEERING COMPANY, Toledo, Ohio, has designed an electrodynamic unit for reproducing both the oral and musical range in equally exact values. Manufacturers claim that this unit attains every range and volume required without distortion, making it suitable for theaters, public address systems, etc. Tolerances as fine as .001 inch are maintained by using precision gauges. A minimum number of parts is used in this device so that it can be quickly taken apart or assembled by means of one large master screw. An interchangeable "voice coil cartridge" may easily be substituted if ever necessary without the expense and bother of exchanging an entire unit. The outer bowl of the unit is stamped from one piece of heavy alloy. In this bowl rests the field coil for supplying the magnetic energy required.—*Electronics, August, 1930.*

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Special tubes for battery-operated receivers

IN RESPONSE TO A growing demand for radio tubes to be employed in battery-operated receivers, the Perryman Electric Company, 130 West 42nd St., New York City, has announced three new tubes known as types P236, P237 and P238. These tubes have been especially designed to meet the requirements which motor boat, auto and portable radio receivers will place upon them. The P236 is a type of screen-grid, the P237, a general purpose tube and the P238 a pentode amplifier. These one-quarter ampere tubes draw six volts and are of the indirect heater type. Manufacturers claim that they are ruggedly designed so that their construction will offset the vibration which is inherent to most mediums using portable battery-operated receivers.—*Electronics, August, 1931.*

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Home talkie

PEKO, INC 2400 West Madison St., Chicago, Ill., has announced a home movie unit designed especially for manufacturers to incorporate with their own radio or separate cabinets. This unit provides two speeds for the turntable, 33⅓ r.p.m. and 78 r.p.m. One motor is used for the projector and turntable drive. To mount into a cabinet, it is only necessary to supply extra extensions for outside controls where desired. Projector has the features of tilting and framing. The size of lenses are optional. Provision is made to increase the illumination if desired. The gear box is sealed to eliminate oiling, and bearings are all oil-less including the motor.—*Electronics, August, 1931.*

Instrument for visual tuning

FOR VISUAL TUNING, the Jewell Electrical Instrument Company, 1642-U Walnut St., Chicago, Ill., has developed an extremely compact indicating instrument, 2 in. in diameter and $1\frac{9}{64}$ in. deep. These meters are available in either

flange mounting or barrel type cases. The latter fits a special mounting clamp which is part of the receiver chassis.—*Electronics, August, 1931.*

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Low melting point brazing alloy

HANDY AND HARMAN, 57 William St., New York City, producers of sterling silver sheet metal and wire, silver solders and silver alloys in general have applied for a patent on a new brazing alloy which is called "Sil-Fos." It contains a small percentage of silver and is described as flowing freely at 1300° F. As to strength, the makers report that lap joints of copper sheets show tensile strength of approximately 30,000 pounds per square inch. "Sil-Fos" can be used in many cases for joining brass, bronze, nickel, nickel-silver, extruded brass and bronze, monel metal and other metals and alloys fusing above 1300° F. It is sold by the avoirdupois pound and the prices quoted range from $3.00 a pounds, for thin strip in small quantities, down to $1.25 a pound for rods in large lots.—*Electronics, August, 1931.*

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Lacquer materials for radio components

THE FOLLOWING LACQUER materials are made by the Maas & Waldstein Company, 438 Riverside Ave., Newark, N. J.: Chassis—cadmium lacquer, water dip lacquer, bronze lacquer, prismlac enamel; Shields—lacquer enamel, prismlac enamel; Coils—clear insulating lacquer, black insulating enamel, winding cement; Speakers—paper cement, metal cement, leather cement, wire cement, voice-coil cement and waterproof paper enamel.—*Electronics, August, 1931.*

Impregnated tubing

AN INSULATED SLEEVING for wire in all types of electrical apparatus is now manufactured by William Brand & Co., 268 Fourth Ave., New York City. It is resistant to oils, acids, water, friction and high voltages. This tubing is trade marked "Turbo." This tubing is impregnated and not dipped. It is supplied in 30 sizes from .020 to $\frac{7}{8}$ in. I.D., and is packed in bundles for convenient use.—*Electronics, August, 1931.*

✦

Transmitting condensers for moderately high voltages

SUITABLE FOR AMATEUR USE and for medium power commercial stations, the new type 16-B transmitting condensers, manufactured by the Allen D. Cardwell Manufacturing Co., 81 Prospect St., Brooklyn, N. Y., are primarily intended to meet the requirements for moderately high voltages in a medium size condenser. The 16-B sizes are intermediate between the larger type 166-B constructional design and the smaller T-183, T-199, etc., designs.

The new condenser uses aluminum plates of .050 in. thickness. The rotor plates have a radius of $2\frac{1}{4}$ in. With the rotor plates extended a panel space $6\frac{1}{8}$ in. wide by $5\frac{3}{8}$ in. high, is required. A rotor to frame contact is used, a double arm brush being provided. The shaft diameter is $\frac{3}{8}$ in. stainless steel being used as the shaft material.—*Electronics, August, 1931.*

✦

Radio resistors

FORMATION OF A radio resistor department for the manufacture of two new types of units especially designed and developed for use in radio receivers has been announced by the Ohmite Manufacturing Company, 636 N. Albany Ave., Chicago, Ill. The new units are: Carbon resistors in all resistance values having the trade name of "Carbohm," intended for use in dissipating one watt and less and wire wound resistors, up to 25,000 ohms. The latter are even smaller in size than three-watt carbon

resistors, and are covered with a new red cement. These units are known under the trade name of "Wirohm Red Devils," and are capable of dissipating up to 10 watts. They can be furnished with lugs or leads and can also be supplied with an intermediate tap which makes them economical to use.—*Electronics, August, 1931.*

Turntable for electrical transcriptions

FOR RENDITION OF electrical transcriptions at a minimum investment, the Stevens Manufacturing Corporation, 42 Spring St., Newark, N. J., has developed a turntable and pick-up. This equipment is suitable for broadcasting, theater, auditorium, club, demonstration or other purposes where quality reproduction of 16-inch, 33⅓ r.p.m. records are sought. It comprises an 18-in. turntable, an electromagnetic pick-up with balanced tone arm, the necessary controls, and is mounted in a wooden case with cover and handles for portability. The turntable is driven by a silent and constant speed motor through a friction drive applied directly to the inner face of the turntable rim. The motor is mounted with a pivotal spring tension so that the friction drive makes positive contact at all times. An automatic governor maintains constant motor speed despite fluctuations in line voltage. —*Electronics, August, 1931.*

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Complete line of components

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, 1066 West Adams St., Chicago, Ill., has now rounded out a complete line of component parts for the electronics field. In addition to the No. 29 hand microphone which has been introduced for home recording and other uses, a new double-button instrument having certain improvements over other models has been announced. Other components include: filter, by-pass, ignition and telephone condensers and condenser cans in a wide variety of sizes and capacities. This concern also manufactures a well established line of choke, speaker and transformer coils and several types of transformers including power transformers, microphone modulating transformers, radio and audio frequency transformers.—*Electronics, August, 1931.*

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Photo-conductive cell

THE CICO CELL, a product of the Clark Instrument Company, Inc., 119 North Fourth St., Camden, N. J., is a photo-conductive, photo-electric cell having properties or characteristics that make it suitable for a vast number of commercial and industrial uses. Its operation depends on its ability to change its electrical resistance in accordance with the change in intensity of illumination of its sensitive surface. The cell operates simultaneously as an electrical device and as a light-sensitive device by transforming light energy into electrical energy; thus satisfaction in using it is dependent upon the proper selection of values in both fields. — *Electronics, August, 1931.*

Transmitting condensers

A. M. FLECHTHEIM & Co., 136 Liberty St., New York City, has announced the type ZX condenser, rated for continuous operation at 7,000 volts d.c. (M-G) or

5,000 volts r.m.s. rectified a.c. The net prices, f.o.b. New York City, are as follows: 1 mfd—$50; 2 mfd—$95; 4 mfd—$175.—*Electronics, August, 1931.*

✦

High frequency converter

FOR USE AS A SOURCE of high-frequency energy for bombarding radio tubes on exhaust, for metallurgical research, etc., where heating of metals by induction is required, the Lepel High Frequency Laboratories, 39 West 60th St., New York City, have brought out a 2¼ kva. converter with 100-ampere high-frequency output. The unit is tunable to a load inductance ranging from 3.5 to 12 microhenries, at wavelengths from 700 to 1,300 meters. The power output is adjustable from 30 per cent to maximum. Coupling between circuits is arranged to utilize the entire L value of the secondary or load circuits without the use of external tapping points and other complications and losses.

Pentodes and receiving power tubes can be bombarded in a 3.5 to 5-second cycle, while elements of 50 to 100-watt power tubes can be heated on a trolley with this type D converter.—*Electronics, August, 1931.*

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Battery connector

DESIGNED TO PROVIDE an inexpensive means of fusing the "A" and "B" circuits of automobile and battery sets without using an exposed cutout, the No. 1039 Gryp-connector has recently been announced by the Littelfuse Laboratories, 1772 Wilson Ave., Chicago, Ill. The connectors are made of tinned spring brass and about 5 lbs. pull is required to withdraw the Littelfuse. All

metal parts are covered by a gum rubber sleeve and the entire assembly hangs in the line by the wire soldered to it. Overall length is 2 in. The ⅛ amp. Littlefuse is usually used in protecting the "B" circuit of sets using the new 2-volt tubes or 199 type.—*Electronics, August, 1931.*

High voltage condensers

A NEW LINE OF high-voltage, oil impregnated, oil filled and tank constructed condensers has recently been brought out by the Tobe Deutschmann Corporation, Canton, Mass. Manufacturers claim that these condensers are so carefully constructed that they are willing to extend a two-year guarantee with immediate replacement should the condenser break down under any conditions. The complete line includes condensers operating from 3,500 to 15,000 volts continuously. A catalog describing these units in detail will be furnished upon request, by writing the company direct. — *Electronics, August, 1931.*

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Rotary converters

TWO NEW ROTARY CONVERTERS have recently been added to the line of the Janette Manufacturing Company, 556 W. Monroe St., Chicago, Ill. One of these converters, type CA-25-F, is available for 32 volts d.c. only. It develops 60 watts, from a 110-volt, 60-cycle alternating current, and its consumption is only 4 amperes. It is designed especially for the operation of a.c. midget sets on 32-volt farm lighting systems. A second converter, CA-18-M, develops an output of 150 watts of 110-volt, 60-cycle a.c., and is available for operation on 32, 115, or 230 volts d.c. List prices $49.50 and $58, respectively.—*Electronics, August, 1931.*

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New bulletins available

The Ellis Electrical Laboratories, 337 W. Madison St., Chicago, Ill., announces publication of a new bulletin describing in detail its new line of demountable microphones. A complete description of the Ellis matched microphone transformer, designed especially for Ellis and other two-button microphones, is also included.

The Acheson Oildag Company, 654 Madison Ave., New York City, has recently brought out Technical Bulletin No. 102.2 on "The Lubrication of Small Mechanical Devices." A section of this bulletin is also devoted to the lubrication of radio parts.

Radio Engineering Laboratories, Inc., 100 Wilbur Ave., Long Island City, N. Y., has recently brought out bulletins Nos. 201, 202, 203 and 204 illustrating its commercial type apparatus such as power tube sockets and short-wave specialty apparatus.

The Universal Microphone Co., Ltd., 1163 Hyde Park Blvd., Inglewood, Calif., announces publication of its new 1931 catalog, describing its complete line of microphones and accessories.

Fansteel Products Company, Inc., North Chicago, Ill., has prepared an interesting booklet covering the history, properties and uses of rare metals including tantalum, tungsten, molybdenum, caesium, rubidium and columbium. In view of the great number of uses that these metals are finding in the electronics field, engineers and others will find valuable information contained in this book. The appendix contains tables giving the wire data on tantalum, tungsten and molybdenum.

The Ward Leonard Electric Company, Mt. Vernon, New York, announces it now has available copies of an enlarged edition of Circular 507 describing its line of resistors and rheostats for radio.

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

PATENTS

IN THE FIELD OF ELECTRONICS

A list of patents (July 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

Radio Circuits

Receiver control apparatus. A method of automatically connecting the rectifying device to a source of alternating current depending upon the operating condition of the tubes in a radio receiver. C. C. Lauritsen, assigned to Colin B. Kennedy. No. 1,813,541.

Wave conductor signalling. A system for the reception of radio signals by means of a wave conductor, which is adjustable to a quarter wavelength of the signals to be received. Lewis Cohen, Washington, D. C. No. 1,813,563.

Polarized wave transmitting system. A radio signalling system for radiating carrier waves polarized in one of several planes. E. F. W. Alexanderson, assigned to G. E. Co. No. 1,814,813.

Switching device for radio-phonograph combinations. M. C. Long, assigned to W. E. Co. No. 1,811,856.

Radio photography transmitter. C. A. Schoenberg, Chicago, Ill. No. 1,813,204.

Radio frequency amplifier. A tuned input circuit and inductive plate circuit, and two resistances in series between the grid and the tuned input circuit, with provisions for paralleling parts of the resistances by a capacity. P. D. Lowell, assigned to A. H. Grebe. No. 1,813,180.

Inductive tuning. A receiving circuit in which the tuning of the various stages is secured by varying the inductance of the secondary windings by mutual variations. H. D. Currier, assigned to Kellogg Switchboard & Supply Co. No. 1,813,232.

Generation control. A potentiometer generation controlled in the conventional receiving set. B. T. Jacobs, assigned to Splitdorf. No. 1,813,054.

Radio frequency amplifier. A balanced bridge type of circuit. B. B. Minnium, assigned to Story & Clark Radio Corp. No. 1,813,067.

Radio apparatus. Multi-element tube circuit. A. J. Kloneck, New York, N. Y. No. 1,812,407.

Directive antenna system. J. C. Schelleng, assigned to W. E. Co. No. 1,813,961.

Radio receiver. A source of oscillations having a frequency which differs by a small amount from one-half the frequency of the incoming wave, is connected to a radio receiver. R. A. Heising, assigned to B.T.L. No. 1,813,923.

High speed radio telegraphic receiver. Joseph Bethenod, Paris, France. No. 1,813,908.

Fading control. A method of reducing the effect of fading in a double-channel receiving system by means of light emitting receiving device. R. B. Dome, assigned to G. E. Co. No. 1,814,832.

Receiving circuit. Receiving apparatus having a combination of tuned and untuned circuits. Sarkes Tarzian, assigned to Atwater Kent. No. 1,814,774.

Oscillation preventer. E. A. Somersalo, New York, N. Y. No. 1,813,775.

Signalling system. Amplifying system in which a cell containing a body of liquid is in the field of the tuning coil. W. L. Edison, assigned to W. L. Edison Mfg. Corp. No. 1,815,055.

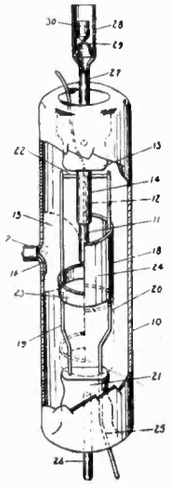
Radio receiving system. An oscillatory radio circuit and tuning means for causing receiver to be periodically and extensively responsive to low frequencies within a predetermined band, an output circuit and means for deriving a direct current from a beat frequency and using the direct current to control the application of power from a source to a load. C. A. Boddie, and R. C. Curtis, assigned to Westinghouse E. & M. No. 1,815,045.

Direction finder. A combination of cross-loop antenna and two non-directional antennas. C. R. Englund, assigned to B.T.L., Inc. No. 1,815,246.

Radio broadcast distribution system. A wired radio system of broadcasting. E. E. Clement, assigned to E. F. Colladay, Washington, D. C. No. 1,815,833.

Vacuum Tubes, Photocells, Etc.

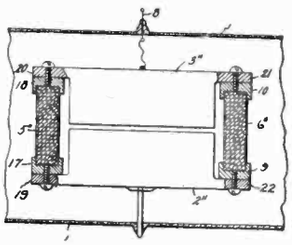
Uranium phototubes. An envelope transparent to ultra-violet light, an anode in the cathode inside, the cathode consisting of metallic uranium. H. C. Rentschler, and D. E. Henry, assigned to Westinghouse Lamp Co. No. 1,815,073.



Vacuum tube construction. Kenneth H. Kingdon, assigned to G. E. Co. No. 1,814,711.

Vapor electric apparatus. A combination of alternating and direct current circuits in a vapor discharge tube apparatus in which the control circuit is resonant at a frequency slightly above that of the alternating current circuit. D. C. Prince, assigned to G. E. Co. No. 1,814,850.

Kerr cell. Construction of a light control device of the Kerr type. Albert Narath, assigned to G. E. Co. No. 1,814,843.



Multi-element tube. A vacuum tube in which there are four independent sets of electrodes. A. M. Nicolson, assigned to Federal Tel. Co. No. 1,814,327.

Tube construction. A method of mounting and supporting elements in a vacuum tube. W. L. Krahl, assigned to Arcturus Radio Tube Co. No. 1,814,316.

Glow discharge tube. E. Travis, assigned to Atwater Kent. No. 1,814,270.

Vacuum tube cathode construction. A. W. Franklin, New York, N. Y. No. 1,814,681.

A circuit for discharge tube. A multiplicity of incandescent electrodes spaced apart, and auxiliary electrodes in close proximity to each of the emitters, is in a discharge tube for dispersing the electron field around the incandescent electrodes. Carl von Wedel, assigned to Electrons, Inc. No. 1,814,499.

Electron tube construction. Cylindrical anode and a cathode consisting of at least one conducting ribbon having its metal surface at right angles to the anode. R. G. Berthold, and Robert Strigel, Berlin, Germany, assigned to Siemens. No. 1,815,229.

Gaseous rectifier. Low wave rectifiers of the type used extensively a few years ago. H. P. Donle, assigned to Radio Inventions, Inc. No. 1,815,369 and 1,815,370.

Device for testing vacuum tubes. A tube testing device, with plurality of tube sockets, indicating meters, etc. D. E. Johnson and P. F. Jackson, Dayton, Ohio. No. 1,815,375.

Gaseous rectifier. F. A. Young, assigned to Radio Inventions, Inc. No. 1,815,390.

Electroscope. An indicating element for an electroscope, comprising a sheet of gold leaf and a sheet of lens paper, cemented together. Roger Barton, assigned to Central Scientific Co. No. 1,815,606.

Electrical relay. A thermionic relay containing argon at low pressure, contact-closing element being responsive to ionic bombardment. Samuel Ruben, assigned to Ruben Patent Co. No. 1,815,483.

Gaseous rectifier. E. E. Charlton, assigned to G. E. Co. No. 1,815,762.

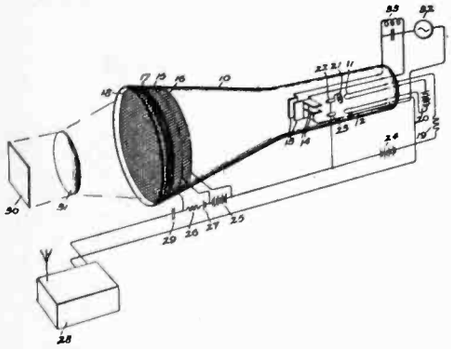
Photo-electric device. Two phototubes in a single envelope, a pair of beams of light, one of which may be varied, directed into the photo-cell, and a method of indicating variations in the intensity of the light beams. W. E. Story, Jr., assigned to G. E. Co. No. 1,812,763 and No. 1,812,764.

Preparation of ductile thorium. Three patents relating to the method of preparing ductile thorium, vanadium and uranium. J. W. Marden, H. E. Rentschler, and M. N. Rich, assigned to Westinghouse Lamp Co., Inc. Nos. 1,814,719 to 1,184,721, inclusive.

Heater type tube. A heater type tube in which the cathode terminals come out at the top of the tube. E. L. Coch, assigned to Kellogg Switchboard & Supply Co. No. 1,813,341.

Tube construction. A manufacturing patent on vacuum tubes, relating to the position of the mount, etc. F. W. Walton, assigned to Westinghouse Lamp Co. No. 1,813,593.

Cathode ray device. A device including several "cathodes to be maintained at different potentials, an anode, a photo-electric control element interposed between the anode and cathode, means for concentrating the ray emitted by one of the said cathodes, and a means for causing said rays to scan photo-electric elements." W. J. Hitchcock, assigned to G. E. Co. No. 1,814,805.



Generation, Detection, Etc.

Echo suppressor. Two patents assigned to the A. T. & T. Co., one by Joseph Herman, No. 1,814,038, and the other by Doren Mitchell, No. 1,814,052, dealing with the suppression of echoes by electronic tube circuit.

Noise suppressing circuit. In a telephone line is put some resistive material, the impedance of which decreases with increasing applied voltages. V. E. Legg, assigned to B.T.L. No. 1,811,947.

Noise reducing circuit. A transmission circuit into which a device is introduced having varying attenuation dependent upon the current amplitude in the circuit. In particular, the device has an attenuating region for currents of small amplitude. C. R. Keith, assigned to B.T.L. No. 1,811,941.

Cross-talk reduction. Patent No. 1,811,963. Eugene Peterson, assigned to B.T.L., No. 1,811,905, H. A. Affel, and Alan Carpe, assigned to A. T. & T. Co., and No. 1,811,915, Alan Carpe, assigned to A. T. & T. Co., all for the purpose of reducing cross-talk current.

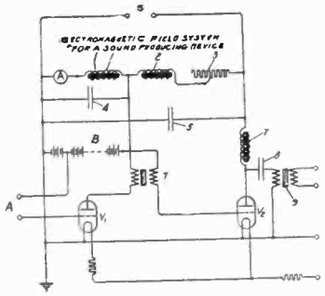
Train control circuit. Patents No. 1,814,017 and 1,814,018, by F. D. Wright and Doren Mitchell, assigned to A. T. & T. Co., on methods of controlling sensitivity of voice-operated devices.

Transmission volume control. Two patents, No. 1,811,954 and 1,811,955, Doren Mitchell and H. T. Silent, assigned to A. T. & T. Co., for regulating the volume control of a transmission system.

Voltage regulator. Use of a resistance having a positive sensitive coefficient to maintain voltage constant. G. B. Crouse, assigned to Conner Crouse Corp. No. 1,815,141.

Power supply circuit. Apparatus for energizing the plate circuits of several vacuum tubes from a source of direct current containing alternating components. G. B. Crouse, assigned to National Carbon Co. No. 1,815,498.

Amplifying system. Power supply system for an amplifier and electro-magnetic speaker. Between the terminals of the current supply system, is a series of reactors. These reactors draw a certain excitation current and reduce fluctuations in voltage. One of the reactors constitutes an electro-magnetic field system for a sound reproducer. Anode circuits of the tubes of the amplifier are separated from each other by at least one of the reactors. A. P. Young and J. Hutt, Kenilworth, England. Assigned to G. E. Co. No. 1,814,849.



Remote control device. Certain signals transmitted from the transmitting station are picked up by a radio receiver and serve to hold up relays, keeping the receiver in operation so long as these signals are transmitted. D. A. Stevenson, Edinburgh, Scotland. No. 1,814,346.

Amplifier coupling device. A transformer with two secondaries coupled to a primary with different degrees of couplings. The high ends of the two windings are connected together with a condenser. The low ends of the secondaries are connected together. H. E. Donle, assigned to Radio Inventions, Inc. No. 1,815,023.

Frequency indicator. Limiting the amplitude and energy per cycle of the energy that the energy per unit of time is proportional to the number of cycles per unit of time, rectifying the resulting energy, and utilizing the magnitude of the rectified energy as an indication of frequency. C. W. Hansell, assigned to R. C. A. No. 1,813,922.

Selective system. A method of differentiating between fluctuating or alternating currents of different amplitude. D. G. McCaa, Philadelphia, Pa. No. 1,814,051.

Wave filter. Hendrik Bode, assigned to B.T.L. No. 1,814,238.

Neutralizing system. Independent-coupled circuit to neutralize undesired capacity coupling. E. W. Fearing, East Orange, N. J. No. 1,814,247.

Tube with protective device. A switch in the common lead of the plate and filament circuit is arranged to close the filament circuit an appreciable time before the plate circuit is closed. F. J. Wolff, Trenton, N. J. No. 1,813,334.

Piezo generator. A method of producing constant frequency by having two crystals connected in the input circuit of a triode. One of the crystals is set to vibrate in resonance at a frequency approximately the same as that of the other. R. S. Ohl, assigned to A. T. & T. Co. No. 1,812,977.

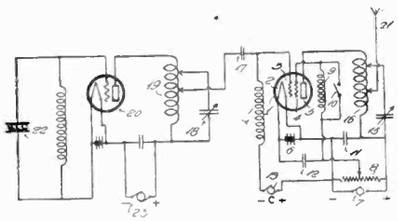
Oscillation preventor. Across part of the secondary of an interstage transformer between two radio frequency tubes, is circuit of the losser type to prevent oscillation. H. Hollerith, Jr., and A. N. Senton, assigned to Victor Talking Machine Co. No. 1,813,051.

Selective program service system. A method of transmitting programs to subscribers whereby the subscribers can, by remote control, get any desired program and automatically compensate for the varying numbers of channels connected to any program. W. T. Powell, assigned to Stromberg-Carlson. No. 1,812,169.

Plate potential equalizing circuit. A method of maintaining constant the plate potential for an oscillator by rectifying part of the oscillator's current and using the direct current component of the rectified wave. Rudolph Urtel, assigned to Telefunken. No. 1,812,688.

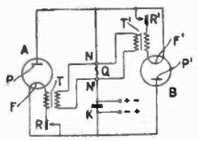
Frequency stabilizer. A method of neutralizing the effect on secondary current of changes of voltage impressed on the primary of two oscillatory circuits. R. F. Field, assigned to Atlantic Precision Instrument Co. No. 1,813,488.

Frequency multiplier. A crystal oscillator drives an additional tube which has two grids. Arrangement is made that this tube either act as a power amplifier or as a frequency doubler. A. H. Taylor, assigned to Wired Radio, Inc. No. 1,813,469.



Series filament radio. The familiar system in which a number of resistances are placed in series across the power supply system. The voltage drop across these resistances is applied to the grid and filament circuits of vacuum tubes, the filaments of which are also in series with the resistances. W. H. T. Holden, assigned to A. T. & T. Co. No. 1,814,158. Filed 1926.

Current rectifier. A two-tube rectifier system, to be used in connection with measuring apparatus for high resistances and ionic currents. Siegmund Strauss, Vienna, Austria. No. 1,814,063.



Wired radio apparatus. Method of insuring continuous service on wired radio system regardless of terminal conditions of line. Paul Tatz, Berlin, Germany. No. 1,809,081.

Volume control. Moving several tuning elements simultaneously in a multi-stage receiver in search of a desired signal and using the motion to decrease the sensitivity of the receiver when passing through strong signals. L. T. Phelan, Philadelphia. No. 1,809,530.

Carrier control apparatus. Method of operating relays from each of several frequencies for circuit control. W. T.

Rea, assigned to A. T. & T. Co. No. 1,809,945.

Cylindrical scanning. A system for photo-electrically engraving plates for printing. Walter Howey, New York, N. Y. No. 1,815,105.

Carrier telegraph. Method of transmitting a carrier current for purposes of controlling detection of several carrier signals at the remote end. V. P. Thorp, assigned to A. T. & T. Co. No. 1,809,950.

Voice operated relay. System using polarized relays and a vibrating device. B. G. Bjornson, assigned to B.T.L. Inc. No. 1,810,004.

Volume control. Controlling remotely and automatically volume on a multiple channel transmission system. J. L. Hogg, assigned to B.T.L. No. 1,810,015.

Volume control. Controlling volume automatically at any desired level on a transmission system and using a condenser shunted by a resistor to hold gain control in any position for a limited period. R. C. Mathes, assigned to B.T.L. No. 1,810,025.

Power apparatus. Combination of dynamo-electric machine and a two-element mercury arc device. Joseph Slepian, assigned to Westinghouse. No. 1,810,033.

Magnetic modulator. Generating a flux by intermodulating magnetmotive forces. Eugene Peterson, assigned to W. E. Co. No. 1,810,326.

Piezo receiver. Reflected from the surface of a piezo-electric crystal vibrating in tune with incoming signals is light beam into a phototube and thence to an amplifier. C. W. Hansell, assigned to R. C. A. No. 1,810,475.

Magnetic amplifier. Current changes are amplified by a magnetic circuit. B. N. Sokoloff, assigned to Federal Tel. Co. No. 1,810,539.

Output circuit. On same core with output winding of transformer is another winding of proper turns and coupling that the d.c. flux in the core is zero. Horace Whittle, assigned to B.T.L. No. 1,809,879.

Voice operated relay. Use of a condenser and resistance to form a slow electrical circuit to hold up a relay. J. L. Hogg, assigned to B.T.L. No. 1,810,016.

Cable transmitter. Before land line transmission is put on a submarine cable the lower voice frequencies are suppressed. O. E. Buckley and R. V. L. Hartley. No. 1,809,828.

Code recorder. A pair of magnets, one to push the paper tape against the stylus and the other to act during spaces. Henri Chireix, Paris. No. 1,809,821.

Artificial impedance. Apparatus for telephone repeater. Myron Lebedinsky, assigned to Grammont, Paris. No. 1,809,484.

Cable signalling system. A long loaded cable and a method of simultaneously impressing upon a terminal section of the cable a series of signals and a uni-directional current to improve the magnetic characteristics of the cable. J. J. Gilbert, assigned to B.T.L., Inc. No. 1,806,754.

Oscillator-modulator system. One tube supplies modulation for the grid of the power tube, and another tube supplies deficiencies in the grid current. Gunther Jobst, assigned to Gesellschaft für Drahtlosie Telegraphie, Berlin. No. 1,800,536.

Electronic Applications

Frequency measuring system. A method of measuring the difference in frequency of two currents by a heterodyne oscillator, rectifying system and a polar relay. R. W. Deardorff, assigned to A. T. & T. No. 1,814,898.

Indicating system. A glow discharge device and source of potential for keeping said device in critical condition, a piezo electric crystal, and an inductor in series with the glow discharge device, and a means for supplying an alternating potential to the inductor. Alexander Meissner, and Otto von Bronk, assigned to G.D.T. No. 1,814,399.

Fluid flow indicator. A method of making certain that the water is flowing through a water-cooled power amplifier tube system. A. M. Trogner, assigned to Wired Radio, Inc. No. 1,814,235.

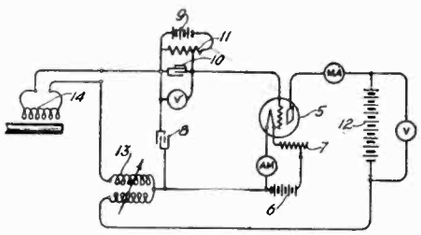
Train control system. A thermionic tube system for controlling locomotives. C. S. Williams, assigned to Electric Service Supply Co. No. 1,814,612.

Locating terrestrial conducting bodies. An exciter coil is isolated from, and prevented from influencing, another receiving coil. An electro-magnetic field in any terrestrial conducting body is induced by the exciter coil and then influences the receiving coil. Theodore Zuschlag, assigned to Swedish-American Prospecting Co. No. 1,812,392.

Conductor heating system. A method of heating an electrical and thermal non-conducting body by incorporating in it sufficient conductive material to heat up in an electro magnetic field. E. E. Rosaire, assigned to W. E. Co. No. 1,813,425.

Voltage regulator system. A vacuum tube method of controlling the output of a dynamo electric machine. E. R. Morton, assigned to B.T.L. No. 1,811,860.

Measuring variations in thickness of metallic body. Method of using an oscillating circuit to determine thickness. H. E. Kranz, assigned to W. E. Co. No. 1,815,717.



Device for measuring high resistances. Resistance to be measured is inserted in the grid filament circuit and acts as a grid leak. Siegmund Strauss, Vienna, Austria. No. 1,813,778.

✦

Acoustics, Sound Apparatus, Etc.

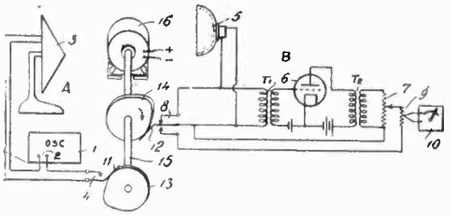
Magnetic speaker. D. C. Guedon, assigned to G. E. Co. No. 1,814,798.

Loud speaker protective means. A relay completing the circuit of the actuating winding in the loud speaker when the field winding is energized. K. B. Austin, assigned to G. E. Co. No. 1,814,817.

Recording and reproducing sound. A method of producing a phonogram of magnetic material by engraving the sound track in the center by an arc. A. F. Pollock and D. A. Pollock, Jedburgh, Scotland. No. 1,815,010.

Sound reproducing apparatus. Photographic sound system with light sensitive cells, etc. F. H. Owens, assigned to Owens Development Co. No. 1,812,303.

Acoustometer. A method of determining the period of reverberation in a room by the average intensity of sound to be suitably indicated during a predetermined period of time when the sound is varying logarithmically. C. A. Andree, assigned to C. F. Burgess Labs. No. 1,812,030.



Recording system. A method of eliminating noise in the reproduction of a sound record, consisting in reproducing the record for monitoring purposes, separately reproducing for entertainment purposes only those portions of the record upon which matter has been recorded as indicated by the monitoring reproduction. J. C. Benjamin, assigned to B.T.L. No. 1,811,841.

Sound reproduction. Apparently a method in which the amplifier tube also acts as a light source in photographing a sound record. Otto Sandvik, assigned to Eastman Kodak Company. No. 1,813,681.

✦

Adjudicated Patents

(C. C. A. Wash.) Claude patent, No. 1,125,476, for system of illuminating by luminescent tubes, Held valid and infringed. Claude Neon Electrical Products v. Brilliant Tube Sign Co., 48 F. (2d) 176.

(D. C. N. Y.) Jones patent, No. 1,658,804 for capacitive-coupling control system, Held invalid. Jones v. Freed-Eisemann Radio Corporation, 48 F. (2d) 300 and Jones v. Walthal Electric Co., 48 F. (2d) 310.

(D. C. N. Y.) Jones patent, No. 1,658,805, for capacitive-coupling control system, Held invalid. Id.

Patent Suits

1,763,380, 1,798,962, C. E. Trube, Electric coupling system, filed Apr. 22, 1931, D. S., S. D. N. Y., Doc. E. 59/254, Hazeltine Corp. v. General Motors Radio Corp. Doc. E 59/255, Hazeltine Corp. v. Westinghouse Electric & Mfg. Co. Doc. E 59/256, Hazeltine Corp. v. General Electric Co. Doc. E. 59/257 Hazeltine Corp. v. Radio Corp. of America. Doc. E 59/258, Hazeltine Corp. v. R. C. A. Victor Co., Inc.

1,221,030, H. D. Currier, Telephone system; 1,283,400, same, Trunk circuit; 1,556,761, Currier and Eaton, same; 1,594,877, same, Telephone system; 1,261,492, H. D. Currier et al., same, D. C., W. D. N. Y., Doc. 350, Kellogg Switchboard & Supply Co. v. New York Telephone Co. et al. Dismissed Feb. 24, 1931.

1,371,404, R. H. Wappler, High potential electric machine, appeal filed Mar. 4, 1931, C. C. A., 2d Cir., Doc.—,Wappler Electric Co., Inc., v. The Bronx Hospital & Dispensary.

LETTERS TO THE EDITORS

Tone quality of small radio sets

Editor, ELECTRONICS:

I was interested to note in July *Electronics* on page 7, the statement that in current small-type radio receivers the deficiencies due to smallness of baffle were being made up in loudspeaker performance. The statement that one manufacturer has no difficulty in making up an 8-db. loss at 100 cycles in this way, is of particular interest, as we have yet to test any small receiver or loudspeaker in which a compensation of anywhere near such magnitude was effected in the loudspeaker. I am aware that such claims have been made before, but our measurements have shown them to be unsubstantiated. It is our belief that such statements are not based upon reliable acoustic measurements; usually they are based upon no acoustic measurements whatsoever.

It is true that the first resonance frequency of many of the loudspeakers now used in midget receivers is placed higher than formerly in order to help out the small cabinet, the practical effect being slight but noticeable and certainly not as much as 8 db.

It is deplorable that so much technical misinformation is being given out by manufacturers, some of whom are in a position to know better.

I have noted with interest your campaign for better quality reproduction and trust that it will prove an effective factor in the return of radio-set engineering to a sound basis.

BENJ. OLNEY,
Acoustical Engineer, Stromberg-Carlson Telephone Mfg. Co.

✦

Deforest's invention of "radio knife" in 1907

Editor, ELECTRONICS:

From time to time in your columns have appeared very interesting articles on the accomplishments in surgery through the use of the "radio knife."

I secured a broad patent on this idea on Dec. 17, 1907 (Patent No. 874,178). In the same year, I demonstrated the "cold cautery" in my Parker building laboratory to surgeons at St. Luke's Hospital, who were greatly interested in its possibilities. Sundry dogs and guinea pigs succumbed at that time to the doctors' enthusiasm over this new device. In 1908 I demonstrated the "cold cautery" before surgeons in Paris and in Berlin and sold German patent rights on the device to a firm manufacturing surgical and therapeutic apparatus. At that time I was unaware of the oscillating qualities of the audion and, therefore, employed a small Poulsen arc generator as my source of high-frequency current.

A year or two later, I made arrangements with the Kny-Sheerer Company in New York to manufacture and market this device. However, the cold cautery attained no great vogue until the oscillating audion was perfected.

Shortly after the war, a Hoboken concern manufacturing X-ray equipment, constructed and marketed to a limited extent my cold cautery.

Since that time the idea has gradually won its way into the favor of leading surgeons and today seems to occupy a very enviable position in modern surgery.

In view of the above facts and particularly considering that my basic patent on the idea was issued so early that it actually expired before the medical art came to an appreciation of the merits of the invention, I feel that Electronics' readers will find interesting this history of the cold cautery which has never been published.

LEE de FOREST.

✦ ✦ ✦

NEW BOOKS ON ELECTRONICS

Foundations of radio

By Rudolph L. Duncan, John Wiley & Sons, Inc. 246 pages; 150 illustrations. Price $2.50.

THIS IS A SIMPLE BOOK leading up to a study of radio; it has little or nothing of radio in it itself. Such matters as d.c. circuits are treated in a most elementary fashion, such matters as a.c. circuits being left to other texts. The book, in fact, deals almost exclusively with d.c. phenomena; in addition there is a chapter on sound, one on preparatory mathematics and a good lot of tables, etc., in an appendix.

✦

Radio in broadcast advertising

BY ORRIN E. DUNLAP, *radio editor of the New York Times, Harper & Brothers, New York. Price, $5.*

MR. DUNLAP DESERVES hearty congratulations and the gratitude of all who are concerned with broadcasting, for his preparation of such an interesting, compact and useful book on the commercial aspects of radio. A careful study of its contents indicates that here indeed is the epic of this fascinating new art.

"Radio in Advertising" draws extensively on current practice, discusses in detail programs, continuities, rates and other questions of operating technique. Advertising agencies, radio-station owners, and everyone who advertises or contemplates advertising through the radio will find this an illuminating and useful volume.

✦

Principles of electricity

By Leigh Page and Norman I. Adams, Jr. D. Van Nostrand Company, New York. 620 pages. Price, $4.25.

BUILDING ON THE electron theory of matter and reconciling all derivations with the relativity principle, these Yale professors have set up the fundamentals of electrical phenomena in rigid mathematical fashion. Electrical apparatus is emphasized only in so far as it bears on the laboratory technique of measuring the electrical quantities and properties. Dielectrics, fields, magnetics, thermal and chemical relations, circuits, absolute measurements, coupled circuits, filters, waves and oscillations are treated with due regard to power and communication dependence on fundamentals. The book's full scope lies pust beyond the customary general physics course and thus elaborates to intermediate level the conventional electrical content. The calculus and differentials are employed throughout.

✦ ✦ ✦

AND THE ELECTRON TUBE IS HIS PROPHET

WE have learned to think and talk, not of the industrial revolution, but of our successive industrial revolutions.

The new God is Technological Process, and the electron tube is his prophet.

—JAMES RORTY *in The New Republic, July 22, 1931*

Measuring ionization currents and high resistances

[*Continued from page 63*]

patient which is to be irradiated. The entire registering mechanism is placed in the box B with the handle, fully protected against the influence of the X-ray machine nearby. All sensitive parts are included in this part. The necessary currents for working the fully electrified Mekapion are produced in the bottom part of the apparatus S, and brought through cable to the instrument. The output from the instrument is a low voltage current which controls a recording instrument A calibrated directly in X-ray (R) units, thus registering the X-ray dosage applied to the patient. This instrument also controls the current which starts an electric clock ringing if the dosage is reached and interrupts the X-ray machine at the desired time.

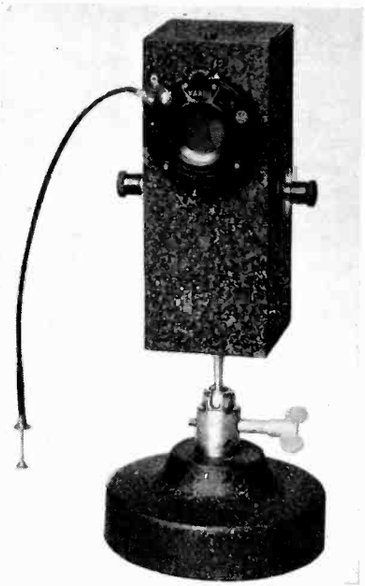


Fig. 8—Photocell housing with shutter to measure photo-currents accurately

The Mekapion can register on a strip of paper as shown in Fig. 5. The length of this paper is proportionate to the applied X-ray dosage. This paper can be filed away with the patient's records so that in later use the applied dosage can be easily determined.

It is also possible to insert, instead of the ionization chamber, any other material by means of suitable contact devices for test of high resistance or very small currents. For instance, the same instrument can be

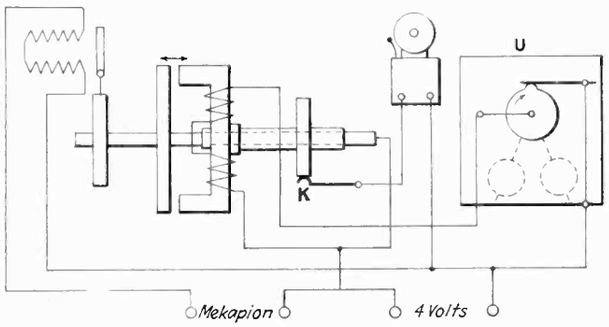


Fig. 7—Apparatus for automatic and continuous control of insulation tests

attached to a small chamber which is filled with insulating oils, thus measuring its resistance.

Figure 6 shows a pipette which can be filled with any fluid to be tested for insulation or conductivity. Two platinum electrodes are sealed in directly to secure a simple way for quick testing.

In the design and the construction of suitable high-tension transformers and high-tension switches the quality of the insulating oil is of the greatest importance. Various oils and paraffins as used in the manufacture of electrical condensers have been tested with this instrument. Differences in the number of knocks or impulses within one minute have been found to be of the order of 1:40 for excellent insulating oils and oils not suitable for this purpose.

For the maintenance of a standard of highest insulation in transformer oils or in the production of insulating material such as Bakelite constant survey is necessary.

Figure 7 shows a layout of apparatus for automatic and continuous control of insulation tests.

In this system the material is tested after a certain time which can be preset at the clock U. If the resistance of the material to be tested falls continuously under a certain limit, a bell starts to ring. If the number of knocks per minute remains below that limit the apparatus automatically switches itself off and return to its starting position.

The insulation of materials of many kinds can be tested with the Mekapion quickly and in a more foolproof way than with any electrometer or galvanometer heretofore used. With this instrument objects can be tested which have a high insulation for themselves but change this resistance under the influence of vapors and gases under different pressure. Making use of this effect, the humidity of the air can be measured exactly and by using an apparatus similar to that shown in Fig. 7 the humidity within factories can be controlled effectively.

Great possibilities are opened in the field of production tests. For example a well known factory for radio tubes is continuously testing the insulation of its bases with the Mekapion. Furthermore a photocell can be inserted instead of the chamber C which makes it possible to register photo-currents in the most exact manner. Figure 8 shows such a cell with a shutter to measure exactly the number of knocks within a definite period of time. As these can be made audible, we have here also a kind of "photometer for the blind." Like experimentations wherein readings are taken from the swingings of a pendulum, the exactness of these observations increases with the time of observation.

In the instrument shown in Fig. 4 an amplification system has been used. For laboratory experiments no amplifiers are necessary. Instead of the relay attachment, it is possible to insert a headphone in the plate circuit. At the moment the ionization current passes, a knock is heard in this earphone.

Insulations from $1 \cdot 10^9$ to $12 \cdot 10^{13}$ ohms can be measured with this method. This instrument serves as a valuable means for measuring the smallest currents, the highest importance of which in electronics we are realizing more and more.

For the Roetgenologist, the instrument briefly described above gives the guarantee that he applies the right dosage under all circumstances. As in most cases, the exact dosage is of basic importance for acquiring the effect of the treatment, the dosimeter has become a principal part of reliable X-ray therapy.

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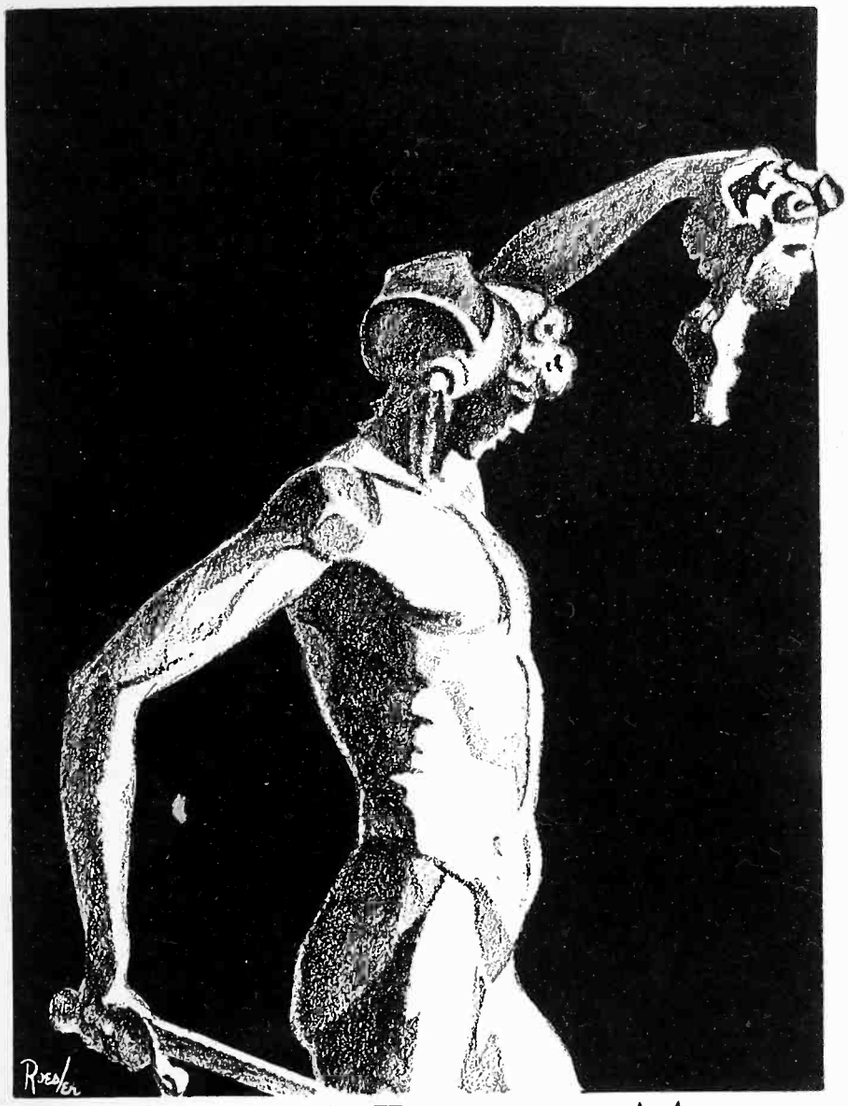
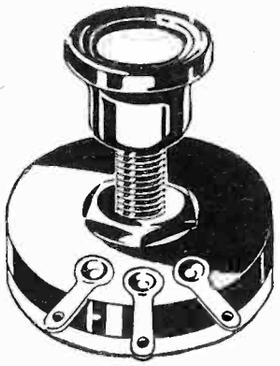
[1]Siegmund Strass has been known in the Electronic Sciences for quite some time. He was a collaborator of Robert von Lieben. (Robert von Lieben, an Austrian, had constructed in 1904 a radio tube (German patent No. 179807) called "cathode ray relais" which practically brings about the same construction later on used by Deforest.)

Siegmund Strauss also invented the feed back principle, the foundation of the tube transmitter which was patented in 1912, Austrian patent No. 71340. In 1914 he invented the resistance coupled amplifier D.R.P. 458197. His last work in 1925, an instrument for measuring very high resistances and smallest ionization currents, etc., D.R.P. 371061 is described in this article.

[2]Braun and Kuestner, Ionizations-Chambers Strahlentheraple 32, 550, 1929





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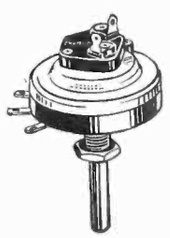
The New CENTRALAB Volume Control with Off and On Switch

More convenient than when mounted separately. Saves space, saves assembly cost, saves in first cost. Engineers: send your volume control specifications for sample.



Dynamic loudspeaker design

[*continued from page 67*]

If we now choose the flux Φ so that the ampere-turns per centimeter associated with the flux density B are equal to the previously mentioned "apparent ampere-turns per cm.," then, A.T. consumption in the imagined core is equal to the A.T. consumption in the actual core. Thus, to determine the actual ampere-turn consumption in the core, we must only know the relation between the apparent flux Φ in the core and the total flux Φ_G, figuring with the flux Φ, the core cross-section Q_N, and the length of the actual core. Strictly speaking, the relation $\Phi : \Phi_G$ is not constant but changes with the degree of saturation of the core. This change is, however, insignificant with regard to the result and need not be considered in practical calculations.

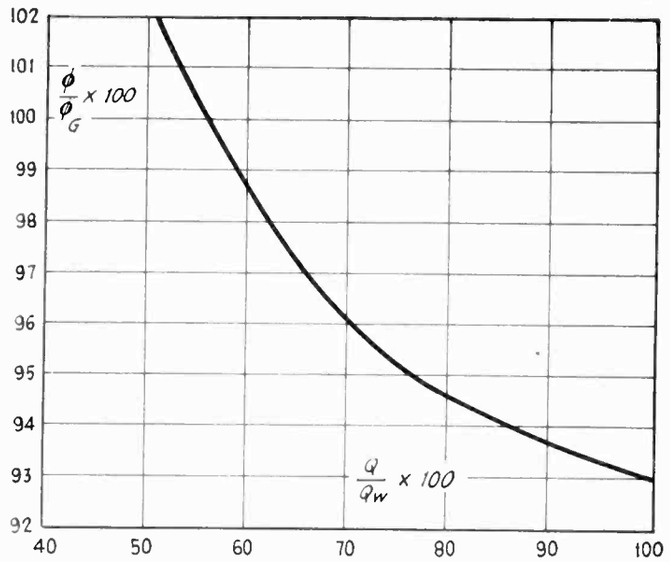


Fig. 2—Apparent flux in the core in per cent of the total flux shown in relation to the reduction of the free end of the core

In Fig. 2 the reduced section Q of the core in per cent of the unreduced core section Q_W is shown together with the apparent flux Φ in per cent of the total flux Φ_G obtained by measuring a number of cores of different degrees of reduction.

If, for example, the cross section of the reduced end of the core is seventy per cent of that of the large diameter, then from Fig. 2 we see that we must figure with a flux $\Phi = 0.961\ \Phi_G$. The apparent flux density is then

$$B = \frac{0.961\ \Phi_G}{Q_W}$$

From the magnetization curve we determine the ampere-turns per centimeters required. This value, multiplied by the length of the core, gives the actual ampere-turn consumption in the core for a total flux of Φ_G. For every magnetic system the dimensions of which are proportional to those given here, the stray flux may be regarded as 30 per cent and the flux distribution similar to that illustrated in this article. With the help of the problem worked out in the second half of this discussion, it will be possible for anyone to design and compute a larger or smaller magnetic system to suit his needs.

(Note:—The concluding part of this article will appear in an early issue of Electronics.)

Light valve sound recording

[*continued from page 56*]

the glow lamp 0.8 mils is the sharpest focus that has been used to date. If we compare the systems under study, considering the sharpest focus used in each case, we may show that there is very little difference in attenuation between systems, the maximum difference being less than one decibel, up to 5,000 cycles. The harmonic content, however, remains practically the same and is the only criterion of quality.

Comparing the second harmonic content of the recorded waves, the merit rating of the systems studied is as follows:

First: Glow lamp recording (No harmonics)
Second: Double ribbon light valve
Third: Variable area
Fourth: Single ribbon light valve.

From a practical standpoint all three systems are capable of high-grade recording and any difference such as we have shown will not become very apparent or objectionable until such time when the film grain noise is suppressed and sound reproducing systems are capable of reproducing commercially, frequencies up to 10,000 cycles or over. Until then all three systems will be competing on practically equal terms.

In concluding I wish to acknowledge the valuable assistance of Dr. B. F. Miller of this studio in the preparation of this paper.

Calculations for 1 mil single ribbon valve

(0.5 mil focus on film)

Freq.	1st Harmonic Loss—db.	2nd Harmonic Loss—db.	3rd Harmonic Loss—db.	4th Harmonic Loss—db.
100	0	....	....	....
200	0	37.6	....	....
500	0	....	....	....
1000	0	23.7	47.4	71
2000	.06	17.6	35.4	53.2
3000	.14	....	....	....
4000	.26	12.2	23.8	35.5
5000	.46	....	....	....
6000	.64	9.5	17.6	25.8
7000	....	....	....	....
8000	....	8.3	14.1	19.5
9000	....	....	....	....
10000	....	7.2	12.1	15.2

All levels referred to 1000 cycle level.
Harmonics plotted against their own frequency.

Calculations for 1 mil double ribbon valve

(0.5 mil focus on film)

Freq.	1st Harmonic Loss—db.	2nd Harmonic Loss—db.	3rd Harmonic Loss—db.	4th Harmonic Loss—db.
100	0	....	....	....
200	0	....	....	....
500	0	63	....	....
1000	0	50.8	60.8	110
2000	.11	39.0	48.3	86.5
3000	.29	....	....	....
4000	.58	27.0	36.3	62.5
5000	.96	....	....	....
6000	1.40	20.6	29.7	48.7
7000	1.94	....	....	....
8000	2.60	15.8	25.8	39.4
9000	3.36	....	....	....
10000	4.24	13.1	23.5	31.7

All levels referred to 1000 cycle level.
Harmonics plotted against their own frequency.