Radio Engineering

MARCH, 1937

VOL. XVII NO. 3

DESIGN • PRODUCTION • ENGINEERING

- Broadcast Receivers
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The Journal of the Radio and Allied Industries

RADIO ENGINEERING

REG. U. S. PATENT OFFICE

W. W. WALTZ • Editor

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VIEW IN THE PLANT OF THE F. W. SICKLES CO.

VOL. XVII *Member Audit Bureau of Circulations* NO. 3

PUBLISHED MONTHLY by the

BRYAN S. DAVIS • President
JAS. A. WALKER • Secretary
SANFORD R. COWAN • Advertising Manager
A. B. CARLSEN • Circulation Manager

BRYAN DAVIS PUBLISHING CO., Inc. 19 East 47th St., NEW YORK CITY *Telephone PLaza 3-0483*

CHICAGO OFFICE—608 S. Dearborn St.—C. O. Stimpson, Mgr. Telephone: Wabash 1903
CLEVELAND OFFICE—10515 Wilbur Ave.—J. C. Munn, Mgr. Telephone: Republic 0905-J
MELBOURNE, AUSTRALIA—McGill's Agency
WELLINGTON, NEW ZEALAND—Te Aro Book Depot

Entered as second class matter August 26, 1931, at the Post Office at New York, N. Y., under Act of March 3, 1879. Yearly subscription rate $2.00 in United States and Canada; 25 cents per copy. $3.00 in foreign countries; 35 cents per copy.

Editorial

THIS MONTH

AFTER TALKING ABOUT it for months past, we finally put our ideas on a tube numbering system into black and white—and in so doing, we discovered quite a few interesting things.

Among these can be mentioned the great duplication of tubes. It is, of course, quite apparent even to the casual observer, that there are duplications, but the terrific number of tubes bearing different numbers although designed for essentially the same purposes, does not become apparent until one starts to take things apart.

The tube numbering system which is discussed in our lead article is not perfect, but we feel that it is better than the one in use at present. There may be several objectionable points which we have not thought of—as, for instance, our system makes no distinction whatever between metal, glass, or metal-glass tubes, although we fail to see any good reason why this particular point is of any real importance—and the sooner they are brought to light, the better for all concerned.

Loudspeaker characteristics and their measurement have always been of interest to the industry; the first of a series of articles by S. V. Perry appears in this issue. Mr. Perry delivered these as a paper at the 1936 Rochester Fall Meeting of the IRE; those who heard it there will be glad to have this paper in a permanent form, and others should find it of equal value.

We continue our promised series of articles on phonographs with a comprehensive discussion of volume expansion and the ways and means of designing a satisfactory circuit to meet various conditions. And along the same lines, there is an article on pickups. We hope to have more of interest to the radio-phonograph manufacturer—actual or prospective—in the near future.

WE ASKED FOR IT!

LAST MONTH we intimated on this page that it might be of interest to hear from the musicians on the subject of radio. So we went out and talked with several members of that profession.

Very few of them had even a faint idea of what we wanted to know when we asked, "Do you like radio? If so, why? If not, why not?" Too many replies were of the well-known stock variety—canned music. These were discarded as being dictated—probably—by economic considerations in which we are not concerned in the least. However, the idea finally registered and we steered our musician to the nearest typewriter, produced a carton of cigarettes, a padlock and chain, and the suggestion that we'd be back later with the key.

As we have suspected for a long time, the objections to radio boil down to this: lack of proper compression at the source and of proper expansion at the receiver. We suspect that our musician-writer hasn't heard a carefully monitored program or a phonograph record reproduced through the medium of a system incorporating expansion, otherwise he might not be quite so critical. But it seemed best, in view of the almost universal lack of expanders in receivers, to obtain his reactions to average reproduction.

The comments of this musician are offered—with only enough editing to make this publication acceptable for mailing—as corroborative evidence of what we and our colleague of COMMUNICATION AND BROADCAST ENGINEERING have been discussing editorially for some months.

CABINETS

SEVERAL TIMES DURING the past year we have mentioned on this page the idea of going in for plastic cabinets in a big way. We have had in mind the large console type as well as the table or mantle sets. For these smaller models, the molded cabinet is well-established practice.

For the console types, however, plastics apparently have never been seriously considered. But, with the apparent breakdown—literally as well as figuratively—in wooden cabinets as supplied to many set manufacturers, something must be done or else a lot of otherwise high prestige is going to suffer.

We are firmly convinced that something on the order of "sky-scraper" construction will eventually prove to be the answer. In the meantime, we are looking around, asking questions; also, we are getting ready actually to try something of the sort in the hope that what we learn will serve as a stimulus, either one way or the other.


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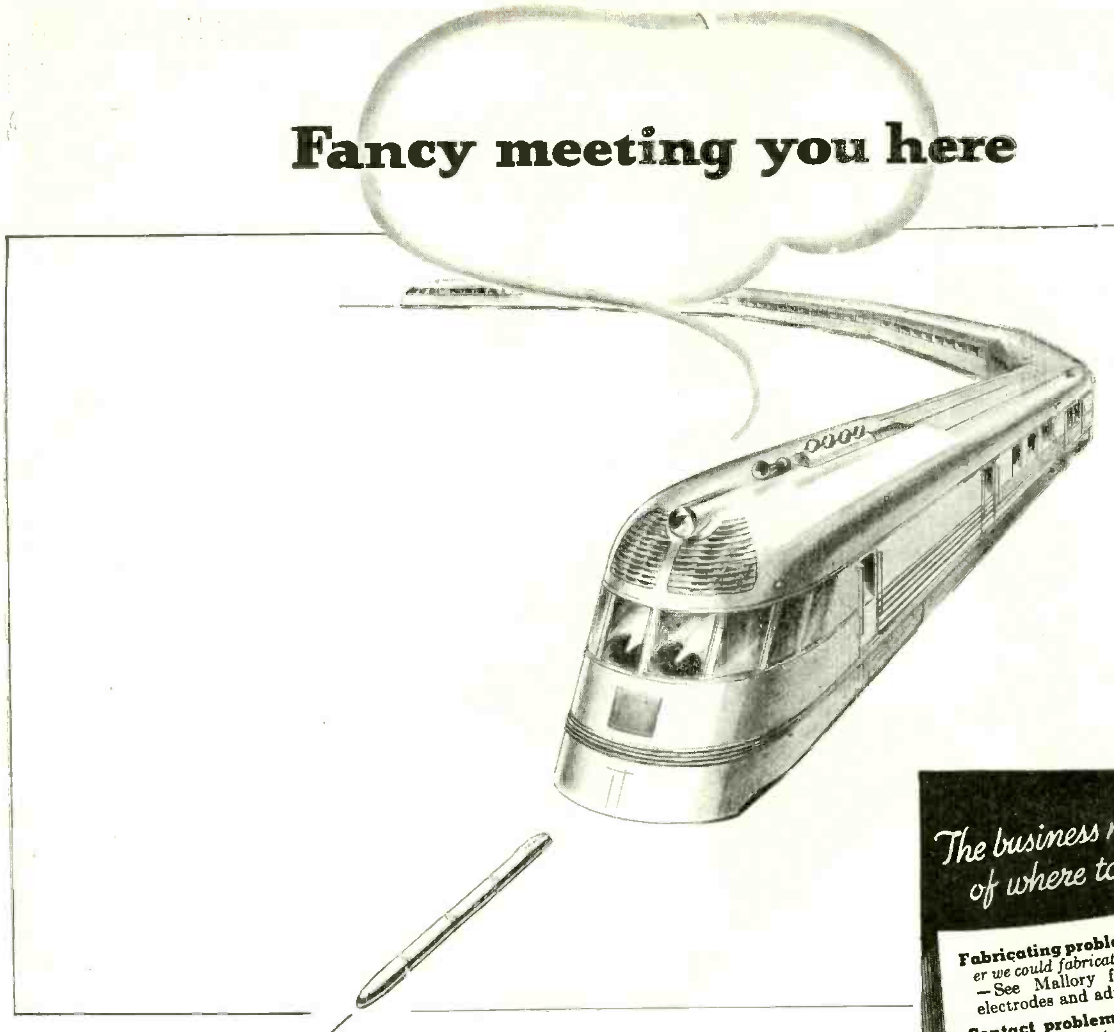
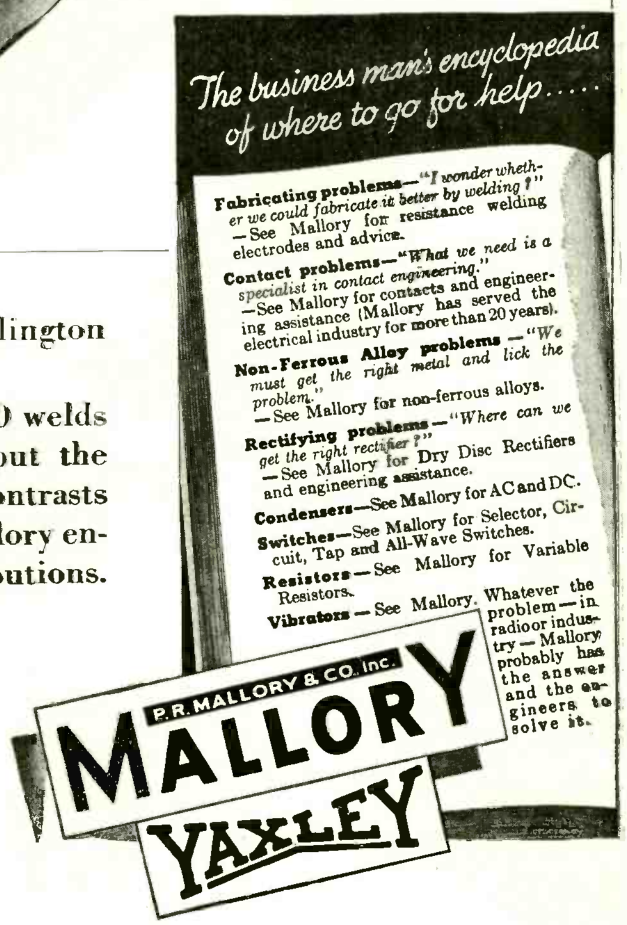


IF a Lionel toy train meets a Burlington "Zephyr" they can talk about Mallory!

Mallory resistance welding tips put 9,000,000 welds on the "Zephyr" and a Mallory Rectifier put the whistle on the Lionel. It is a graphic picture in contrasts of the industries and operations to which Mallory engineering and Mallory products make contributions.

IF ultimate consumers could look into and behind many products in daily use, they would say of Mallory, "Fancy meeting you here", a dozen times a day.

Three out of every four auto radios are equipped with Mallory Vibrators. Electrical contact points in most automobiles are made by Mallory. The tips for resistance welding of automobile bodies and chassis, trains and coffins and hundreds of metal products are supplied by Mallory. Switches, condensers and volume controls used in all-wave radio sets and in other industries are Mallory products.



NATURALLY, Mallory's list of customers include well-known names in many industries—the motor car manufacturers, the radio builders, the railway and airway suppliers, the companies producing electrical products and appliances.

The purpose of this advertisement is to add to that list—to make what we have to offer so clear, that you will think of us when definite problems confront you. To that end, we have noted a sample list of production situations—situations in which we can be of help.

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RADIO ENGINEERING

FOR MARCH, 1937

NUMBERING TUBES

DESPITE THE FACT that the tube classification and numbering system, which is introduced herewith, is apparently "full of holes", it is felt that something should be done to alleviate the impossible conditions imposed by the present system. Floods—literally—of new tubes show only too well just how the present system fails completely to function; when a tube has to have a designation like 6AC6-G, it is time that a halt is called and a search begun for something less meaningless. It is with these thoughts in mind that we present—simply by way of suggestion—the following ideas. Let no one think that criticism is going to hurt any feelings; we know only too well of any number of weak spots in the system, but it is, at least, a step toward what we believe can be a tube numbering system which will not go to pieces every time a few new tubes are made available.

However, one prerequisite to the satisfactory use of this system is that of doing away with quite a few of the tubes that are now available. We can see no good reason for the further existence of the 01-A, the 00-A, the 12-A, or the 27—just to cite a comparatively few.

Not only these older tubes, but quite a few of those not quite so antique could probably be dispensed with after a reasonable time. Among some of these might be mentioned the 76, the 53, the 79, and the 77 and 78.

No doubt, quite a few receivers still in use employ some of these or other types of tubes which might be deleted from the lists. But, better tubes of approximately the same characteristics are available in the octal-base varieties, either glass or metal. The cost of replacing the old sockets should not be excessive, and the service men, upon whom this replacement will naturally fall, should welcome the opportunity of making a little more profit on each job.

Of course, the change will have to be gradual, otherwise it will have the appearance of a "racket." But the public will eventually become accustomed to the fact that holding on to a 1927 vintage receiver is going to cost a little more than in the past, at least for the initial change to newer tubes. It will be, after all, a problem in salesmanship on the part of the service men.

In so far as the set manufacturer is concerned, there is absolutely no reason for incorporating the old type tubes in a modern design. The advantages to be gained from the use of present-day tubes more than off-set any fancied gain in circuit efficiency or economy due to the use of obsolete types. There may have been a time when such was not the case—as for instance, at the time the 75 type was introduced it was the only high-mu triode available; several manufacturers used this tube as a voltage amplifier despite the fact that it also included double diodes for detection and avc—but with the number of tube types available today there is no earthly reason in not designing a circuit around the latest types.

But there is another and even more practical reason why the receiver manufacturers should get behind any movement looking to the elimination of old type tubes. Just recall the figures which the government released last fall regarding the number of out-of-date receivers in use—the potential market for replacement sets is enormous, but it can only be opened if some good and sufficient reason is presented to the millions of persons who own the old sets. And what better reason is there than the inability to buy tubes to keep the old sets going?

Someone is sure to mention that parts for the model T Ford car are still obtainable, but the analogy is not quite exact enough in this case. In many cases, a man's investment in his model T represents just that—an investment. It may be that the owner of the relic is a farmer or small business man to whom appearances mean nothing, and who, as long as the thing will turn a wheel, feels that it is sheer waste to junk the one-time car.

In the case of the ancient radio, however—and despite what some other writers have said on these pages—we do not feel that buying a new radio set is, for the average person, a matter of "keeping up with the neighbors," but rather that of absolute need or—this time we agree with the aforementioned writers—of replacement buying because the old set is just about unbearable. In other words, most persons buy a new set because they want improved reception or because there is no other alternative.

Here, then, is a market for sets—provided the set manufacturers lend their whole-hearted assistance to a program of tube elimination.

The numbering system which we are to outline has, as mentioned, several more or less serious possibilities for discrepancies. Such of these as we have found in trying out the system will be described; others are undoubtedly sure to come up sooner or later. In any event, we are anxious to know the reactions to these proposals, and the remarks and criticisms of our readers are invited.

To begin with, we must set up an arbitrary classification of tubes by their *most evident use*. In order to keep things within the bounds of reason, we have limited these classifications to ten; they are as follows:

Audio amplifier—low (20 or under) mu 1
Audio amplifier—high (over 20) mu 2
Audio amplifier—power amplifier, triode 3
Audio amplifier—power amplifier, pentode 4
R-f amplifier—sharp cut-off pentode 5
R-f amplifier—remote cut-off pentode 6
Detector—diode 7
Mixer—pentagrid 8
Rectifier—high vacuum 9
Rectifier—gaseous or vapor 0

Next, we can classify another way—either by base prongs, which will immediately give an indication as to the socket to be used with the tube; or, we may indicate the *total* number of connections that are brought out of the tube. In the latter case, filament or heater terminals might well be neglected—cold cathode tubes are not available just yet—as all tubes obviously require two terminals for heater or filament.

This however, is one point that is decidedly open to discussion, the reason being apparent in what follows later.

Some indication should be given of the filament or heater voltage; this is standard with the present system and, pending the time when all heaters and filaments will operate at some standard voltage, we will borrow from the present system.

Collecting these various points, we can now set up an example of the use of the new system: Let us take, for example, the 6L6—which, under the present system, might be a very close relative of the 6L7.

We will use a digit, 6, to indicate approximate heater voltage. Follow this with a hyphen; then the digit 4, to indicate (see above) a power amplifier pentode; another hyphen, then the digit 8 to indicate that the octal 8-prong socket is used.

If we had used the digit 7 for the final place, it might give the impression that a 7-prong socket is used; actually, of course, the 6L6 has but seven prongs. This is one excellent reason for using numbers—corresponding to the socket—for the base prongs rather than for the total number of external terminals.

Be that as it may, the 6L6 has become the 6-4-8, or, as it might conceivably get to be known, the "six forty-eight."

Applying the numbering system to another familiar type, the 6F5, we find that in this case it becomes the 6-2-8—again using the final digit 8 to indicate the octal-base socket. In the case of the 76, for instance, this would be, obviously, 6-1-5; the 2.5 volt equivalent, the 56, would be 2-1-5.

Twin tubes, such as the 6N7, can best be handled in this manner: Instead of a single digit in the second position, two can be used, each of which will indicate a certain tube type. The 6N7 might well be considered as a twin triode arrangement, disregarding its possible use as a class B amplifier, with high mu triodes; its designation would then be 6-22-8.

In the case of dual purpose tubes such as the 6Q7, the same would apply; the second position would consist of a two digit number each of which describes one function. The 6Q7 would become 6-71-8; the earlier version of this tube, the 85, would be 6-71-6, and the 75 would become 6-72-6.

It is with the typing of tubes like the 6A8 and the 6L7 that this system tends to go "haywire." It can readily be seen that each of these tubes—considering the 6L7 as a mixer rather than an r-f amplifier—would have the same number, an obvious incongruity. However, if the 6L7 is considered as an r-f amplifier, it may be typed in this way: In the second position again use two digits, one to describe the tube's remote cut-off feature, and the other, its sharp cut-off characteristic; thus, 6-65-8. The 6A8, of course, is 6-8-8.

In the case of diode detectors, there is, of course, but one available at the present time; this, the 6H6, would become the 6-7-8. It is seen that there is no distinction made of the fact that the 6H6 is a double-diode; it is felt that this is not especially important since most diodes in combination with other types—such as the 6Q7 double-diode triode—are of the dual-diode variety.

Rectifiers offer no particular difficulties, unless it should become necessary to indicate full-wave and half-wave types. Here again it is thought that the comparatively great number of full-wave as against the half-wave variety is sufficient reason for neglecting to provide separate classifications for these categories.

The distinction is entirely between high vacuum types, represented by the 80, the 5Z4, the 83-V, etc., and the gaseous or vapor types like the 82 and 83.

The familiar 80 would, under the new system, be the 5-9-4, while the 82 would become the 2-0-4.

It is classifications like the one for the 82 that will cause the greatest trouble—using this one simply because it has happened to fall that way. There is a transmitting tube with the type number 204-A; the similarity is pronounced, especially as many persons refer to a tube, like the 204-A, simply as the "two-o-four." It is entirely possible that there might be some conflict between this proposed system and the method of designating the transmitting tubes, but the difficulty is not insurmountable, especially if transmitting tubes should be brought under the same system of numbering. It might be necessary, for transmitting tubes, to use different classifications for the first digit of the tube number group.

It has been said that numbers are more difficult to remember than letters or words; and this has actually been found to be the case by no less an authority than the telephone company. As is well known to all, telephone numbers except in small communities are made up of a central office *name* plus the line number. It is, for instance easier to remember Plaza 3-0483 than if it was given as 7530483.

This same argument may be brought up about this new numbering system; it may be claimed that the inclusion of a letter tends to improve the chances of the tube number being remembered. However, there will be few cases indeed where more than four digits would be employed to describe a tube, and unless we have an influx of multi-purpose tubes there is no reason why three digits will not almost entirely cover the field.

EQUIPMENT AND METHODS USED IN ROUTINE MEASUREMENTS OF LOUDSPEAKER RESPONSE

by S. V. Perry *

PART I

DURING THE PAST two or three years there have been a number of papers presented and published describing very useful and somewhat elaborate equipments for making loudspeaker response characteristics and other acoustic measurements. It is the purpose of this paper to describe relatively simple equipment and methods used in the laboratory for routine measurements of this kind. The problem of measurements and tests of loudspeakers in production is entirely different and will not be dealt with in this paper.

To convey a complete picture of the performance of a loudspeaker it is necessary to specify, as a function of frequency, a number of characteristics including the following:

Impedance characteristic
Efficiency characteristic
Directional characteristic
Response characteristic
Power handling capacity.

Of these, by far the most important is the response-frequency characteristic, and it is to this characteristic and to the methods and equipment used for obtaining it that the major portion of this paper is devoted.

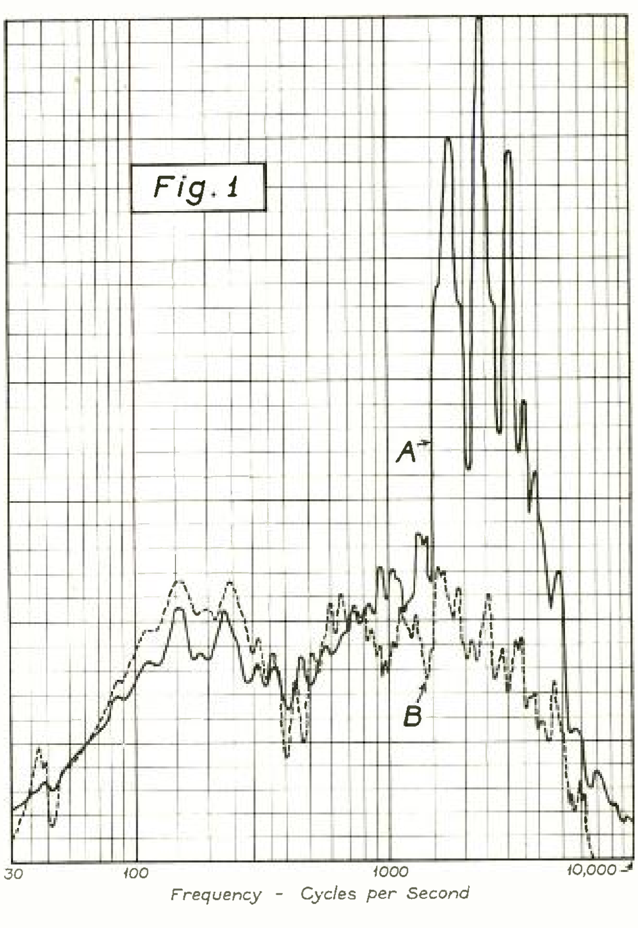
When the response-frequency characteristic of a loudspeaker is obtained under proper test conditions, and is properly interpreted, it gives definite and permanent information regarding the range of response, the degree of uniformity of response within that range, the sharpness of cutoff at the ends of its response range, and by comparison with the response-frequency characteristics of other loudspeakers it gives its relative sensitivity. Since the response-frequency characteristic constitutes practically the only source of definite information regarding the direction and progress of a given loudspeaker development project, loudspeaker development work has in the past been influenced to a marked extent by the performance of the measuring equipment. Referring to Fig. 1, the impression gathered will be that loudspeaker A has very much more response in the region between 1000 and 5000 cycles than loudspeaker B, and that loudspeaker A would be greatly improved if this response could be considerably reduced, whereas loudspeaker B needs very little change, but would be improved by a small increase in response from 2500 cycles to 5000 cycles. The importance of the response measuring equipment is indicated to some extent when it is realized that curve A and curve B represent the performance of identically the same loudspeaker, the entire difference being in the measuring equipment itself.

The performance of the response measuring equipment has, in the past, influenced the direction of loudspeaker development work to such an extent that during the past ten or more years a great deal of time, thought and expense have been devoted to the development of equipment for obtaining response-frequency characteristics conveniently, rapidly and accurately. This development has been equal in importance with the work of producing improvements in loudspeakers themselves.

The fundamental requirements for a response measuring setup are as indicated in Fig. 2, and the various methods may be classified according to the arrangement of the equipment employed. The chief items of equipment are:

An audio-frequency oscillator.
A room suitable for the measurement of sound.
A microphone and amplifier.
A vacuum-tube voltmeter and output meter.

The original or manual method used equipment which



*RCA Manufacturing Co., Camden, N. J.

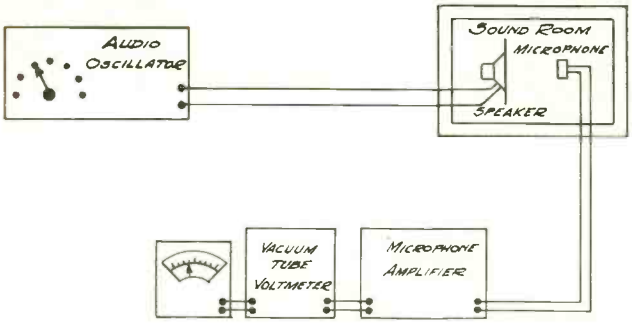


FIG. 2.

was available in the laboratory when response measurements on loudspeakers were first needed. In general, this equipment consisted of a direct audio oscillator adjustable over the frequency range by small steps rather than continuously. The microphone was of the condenser type and was at first calibrated by the thermophone method and later by means of an electrostatic actuator, either of these methods giving its output voltage characteristic in terms of constant pressure on its diaphragm, thereby neglecting pressure doubling, cavity resonance, diffraction and other acoustic effects. The amplifier was in general not electrically compensated for the microphone characteristic and the output meter was a thermocouple type, since a suitable linear vacuum-tube voltmeter had, at that time, not been developed. The curve was obtained by the step-by-step method, known corrections were applied by slide-rule and the plotting was manual. This method was obviously slow and cumbersome and was soon superseded by more adequate methods.

The first modification and improvement in this equipment was the development of the beat-frequency oscillator which is continuously variable in frequency over the desired range by the simple rotation of one control. This made possible the semi-automatic method, which has proved to be both adequate and highly satisfactory for this type of work and which has been improved over a period of years to a high degree of efficiency. Fig. 3 indicates the major features of the semi-automatic response measuring setup. The important difference between this arrangement and the manual setup is the substitution of a beat-frequency oscillator having geared to its frequency control shaft a drum or movable table on which is mounted the graph paper. A pen is mounted over the paper movable in a direction parallel to the axis of ordinates and is manually controlled by the movement of a pointer mounted over the pivots of the moving system of the output meter. An operator keeps this pointer in exact synchronism with the motion of the needle of the output meter while the frequency control is being rotated. In order to avoid the necessity of frequency correction, the microphone amplifier is electrically adjusted to compensate for the frequency characteristic of the microphone employed. With equipment of this type a response curve can be obtained in from one to ten minutes, depending on the mechanical and electrical damping of the moving system of the output meter and upon the acoustic characteristics of the sound room.

A more recent modification of this equipment is indicated in Fig. 4. In this modification the output meter is caused to draw the graph on the graph paper without manual assistance, thereby making the equipment completely automatic. A number of methods have been employed, such as the galvanometer and optical system indicated in Fig. 4, which has the disadvantage of requiring light-sensitive paper and a developing process. Other arrangements include a more or less commercial recording type meter used in certain laboratories in Europe, and an arrangement of motor driven clutches and attenuators, such as is used in the high-speed, sound-level recorders. These methods each have their own particular advantages and it is not our purpose to discuss them in detail here. In general, the full automatic equipment has the obvious advantage of requiring little attention from the operator while the curve is being drawn. It can also be made to operate at a rate of ordinate change which would be impossible to follow by the semi-automatic method. This is a distinct advantage in certain types of measurements, but is not particularly advantageous in the routine measurement of loudspeaker response.

There is another classification of methods of measuring loudspeaker response, namely, according to the acoustic system employed. It is not within the scope of this paper to cover these methods in detail but a few brief notes are in order. The sound pressure set up by a loudspeaker at a given point in space depends not only on the electro-acoustic characteristics of the loudspeaker itself but also on the acoustic properties of the room in which it is located. One of the most important of these acoustic properties is the reflection coefficient of the walls. Sound reaching the microphone comes not only directly from the loudspeaker, but also indirectly, reflected from all the surfaces of the room. In general, these room reflections produce very sharp peaks and dips in the response curve, making it almost valueless as an index of the loudspeaker performance, and they must be eliminated from the curves in order to render the curves useful. The most obvious methods of eliminating these reflections are:

(a) To make measurements out of doors, removed from all reflecting surfaces, including also the ground. The obvious disadvantages are the uncontrollability of the weather and of disturbing noises.

(b) To provide a sound room whose walls completely absorb all sound with only negligible reflection. It has not been found practical to build such a room up to the present time.

In ordinary routine work we are therefore limited to the use of sound rooms whose walls even though heavily padded with acoustic absorbing materials are nevertheless fairly good reflectors of sound. In such a room the sound pressure distribution at any fixed frequency measured along the axis of the loudspeaker will be somewhat as indicated in Fig. 5. At points close to the source, the reflected waves are small in magnitude, compared to the direct wave, and therefore produce a

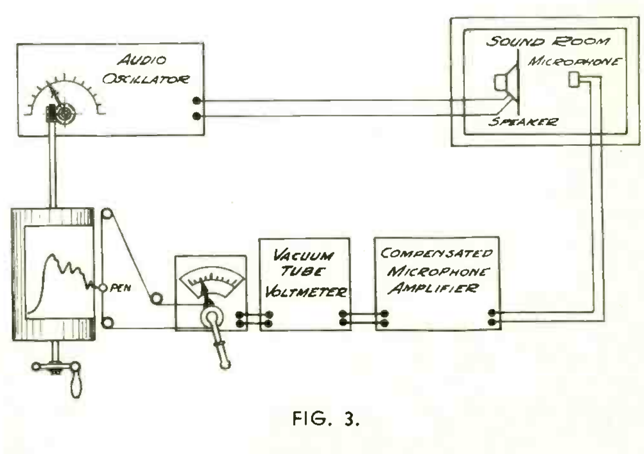


FIG. 3.

minimum effect. This is the justification for the so-called "close-up" method of measurement. The microphone is placed sufficiently close to the loudspeaker that the effects of reflection are greatly minimized.

Another method of eliminating reflection is suggested by Fig. 5. If a microphone is moved from a point d_1 to a point d_3, and if the variations in sound pressure over this range of motion are averaged out, the resultant average sound pressure will be very nearly equal to the pressure from the direct wave at some mid-point d_2. This is the basis of the moving microphone method, sometimes known as the rotating microphone method since the microphone is usually moved in a circle.

In a room of the type we are considering, the sound pressure at a point removed from the source will vary over the frequency range somewhat as indicated in Fig 6, in which it is assumed that the source has an ideal flat frequency characteristic. If the frequency be varied rapidly from a frequency f_1 to a frequency f_2, and if the resultant variations in sound pressure be averaged out, the resultant average sound pressure will be very nearly equal to that from the direct wave without reflections averaged over the same frequency interval. This is the basis of the "warble-frequency" method. Using this method, if the frequency is varied with sufficient rapidity,

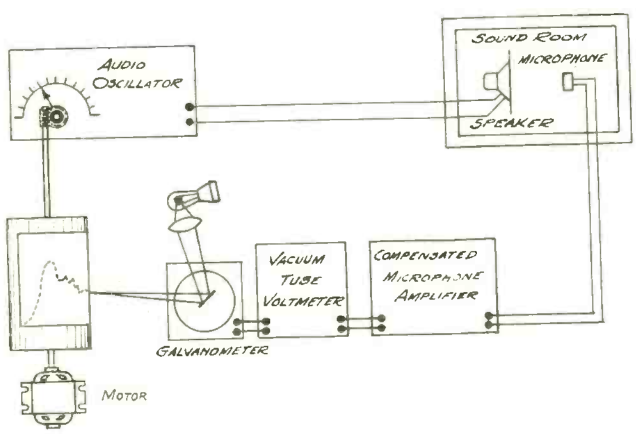


FIG. 4.

the reflection pattern suggested in Figs. 5 and 6 will not exist. In this case the analysis of pressure at the microphone vs. time is very complicated, but the overall result is to produce an average very much as suggested above.

A fourth method is suggested by Fig. 6. If the frequency be continuously varied at a fairly rapid rate, the variations in output of the vacuum-tube voltmeter due to the reflected sound will constitute an a-c component in the current delivered to the output meter which may be filtered out by a low-pass filter or other suitable electrical means. This method is used to some extent in conjunction with one of the other methods, in practically all sound measuring setups.

Of course, it should be remembered that in a given room with six reflecting surfaces and various dissymmetries of reflection the actual conditions are much less regular and in general worse than has been indicated in Figs. 5 and 6, and therefore none of the methods suggested for eliminating reflections from the response curves are entirely successful. Hence, response-frequency characteristics on a given loudspeaker by different laboratories employing entirely different sound measuring rooms and different methods of eliminating reflections will differ greatly from each other.

There are other variations in the acoustic system

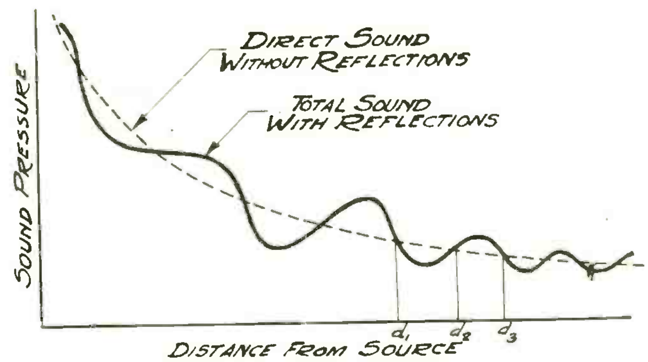


FIG. 5.

which should be mentioned. One of these is the baffle used for measurements of response of loudspeaker units. The low-frequency response will be considerably affected by the size of the baffle. Another important source of variation is the microphone. Microphones may be either pressure operated or velocity operated, and in general in a room in which there are appreciable reflections the pressure pattern and the velocity pattern will not be the same and therefore the pressure microphone and the velocity microphone will give different results. Similarly, the directional characteristic of the microphone is of considerable importance. One of the most important differences in microphones is the method by which they are calibrated, resulting in differences in the compensation of their amplifiers. The methods of microphone calibration which have been and are still used are the thermophone, the electrostatic actuator and the Raleigh disc or other "free-wave" methods; the first two of these neglect pressure doubling, cavity resonance, and other acoustic effects, while the "free-wave" methods give the response of the microphone in terms of the sound in the undisturbed or free wave, but are in general more difficult to use. These variations in microphone calibrations result in further differences in recorded response frequency characteristics from one laboratory to another.

The total result of all the variations in equipment, acoustic conditions, methods of treating room reflections, types of microphones and their calibration, and method of recording has been to produce so much variation from one laboratory to another that while the response-frequency characteristic of a loudspeaker is a perfectly definite index of its performance, and is subject to exact definition, the characteristics of a given loudspeaker recorded by various laboratories often bear very little resemblance to each other.

(To be continued)

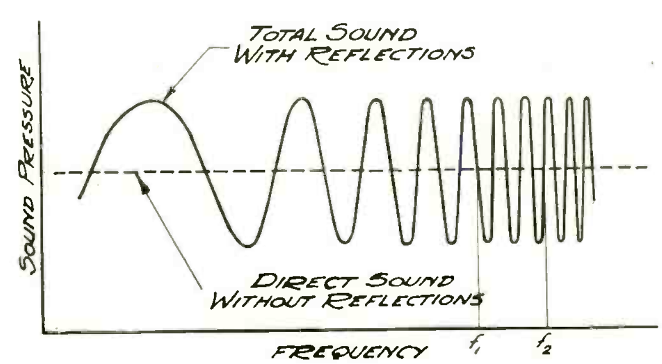


FIG. 6.

One of the largest plastic cabinets being molded is this one for Pilot Radio, all corners of which have large radii. It is entirely molded in one piece.

PLASTIC CASES

by Franklin E. Brill*

"MERELY A NOVELTY" was the way many radio men classed the first plastic-cased midget radio announced by International Radio a few years ago. Acoustic qualities and ease of changing designs favored wood cabinets, they argued; and besides, small radios were faddish and would disappear in the swing back to consoles.

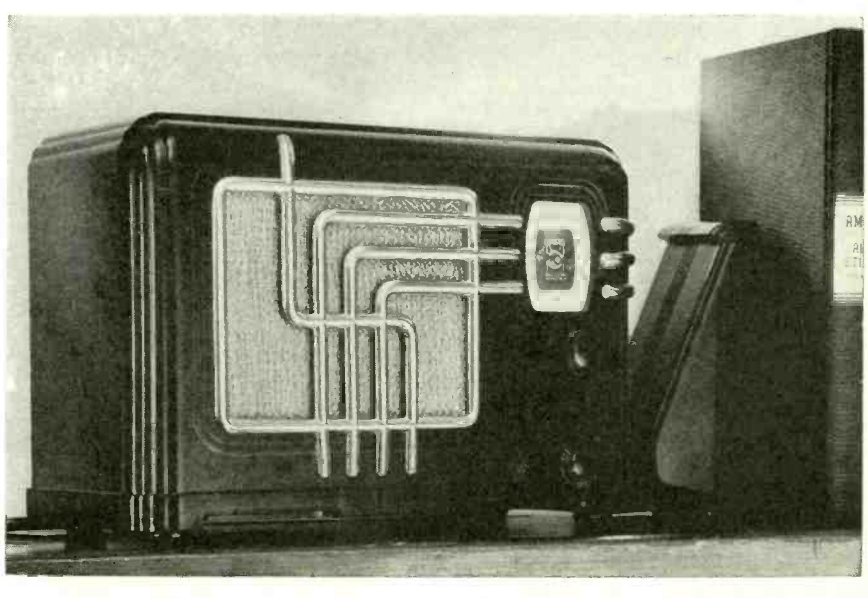
Any radio store today shows how incorrect their judgment was, the number of plastic-cased midgets having increased considerably. Furthermore, as the size of the table radios increased from the original cigar-box size, plastic molding methods and materials improved even more rapidly, until today molded cabinets a foot and a half square do not faze the molding industry. The majority of the present-day cabinets are smaller than this, but the advantages of the early molded cigar-box cases—absence of joints and seams, resistance to heat and humidity, incorporation of attachment inserts, permanent scratch-proof finish, and the decorative possibilities—are just as valuable today.

The strides being made in the design of molded table cabinets are graphically shown in the comparison of an old and a new Kadette cabinet. Early molded cabinets went in for imitation wood effects in a big way, often capitalizing on the possibilities of intricate mold engraving, which was so easy with plastic molding once the dies had been made. Comparing it, however, with the latest Kadette Classic, it is obvious that the trend away from imitation wood effects and heavily ornamented surfaces has been for the good, and that the smooth unornamented surfaces, which capitalize on the unusual contours possible and contrasts between different types and colors of materials, result in a more practical, more economical and much more attractive cabinet.

Smooth surfaces and contrasts between different types and colors of plastic materials explain the appeal of the new Kadette Classic. The main body of the cabinet is molded of black phenolic, and the top of bright scarlet phenolic plastic, while the grille bars are molded of translucent thermoplastic compound.

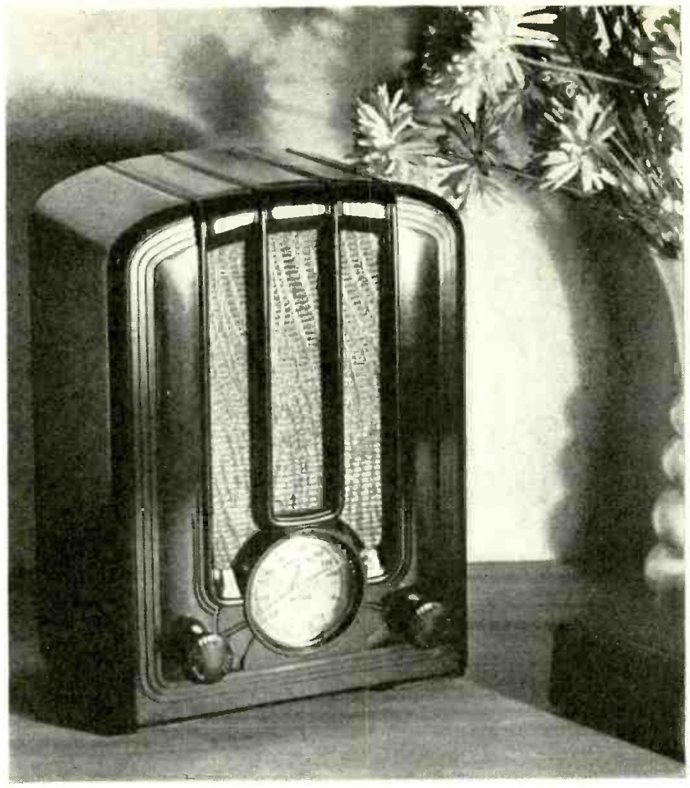
Similar in its smooth contours is the Sears-Roebuck cabinet, also molded of phenolic plastic material with integral grille bars running vertically over the loudspeaker to the rear of the cabinet. This is accomplished by molding the entire cabinet vertically, with an open bottom instead of the conventional open back, which permits fitting the case over the chassis after final inspection. This

More conventional in shape, but distinguished by bright metal trim, is this cabinet for Fada's Compact. Contrast between black plastic and metal is very appealing.



*General Plastics, Inc.

FOR TABLE RADIOS



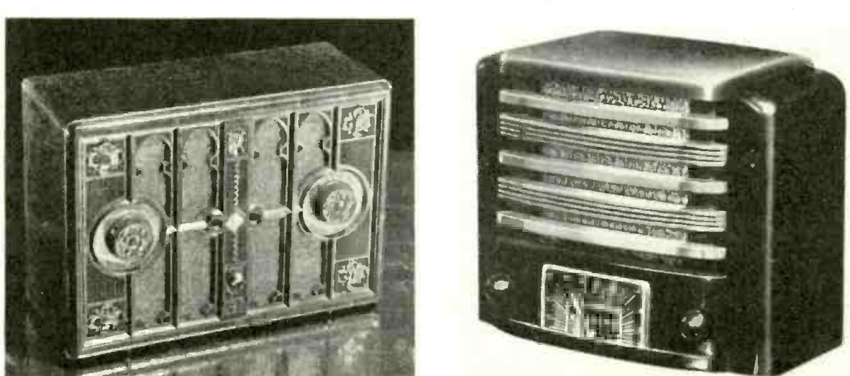
Emerson's Compact is a vertical model with grille, dial bezel and all decoration formed in the single molding operation.

cabinet was awarded first prize in the decorative group of the recent Modern Plastics Competition, largely because it looks equally well from front or rear, permitting its use in the middle of a room instead of being pushed in a corner and being used as a shelf, as with most open-back models. Brown plastic cabinets with ivory dials and grille cloth, black cabinets with white dials and grille cloth, and light colored cabinets with dark colored dials were the color combinations used on this popular set. This receiver was shown in RADIO ENGINEERING, September 1936.

Larger than either the Kadette or Sears models is the Pilot cabinet, a vertical model which uses the extra space gained in increased loudspeaker and baffle area, illuminated airplane dial, etc. Completely fabricated in one molding operation and designed with an open back, the Pilot cabinet incorporates more decorative features than most, including set-back panels on the sides, flared base, lettering on the front panel and a formal flower petal design between the grille bars. The cabinet is probably the largest molded in this country.

Metal accents on the grille and front panel of the Fada Compact are its main distinguishing feature, a single plated metal stamping forming the entire grille and frame in the model shown here. In less expenive models the metal trim is eliminated, and rounded bars, produced in the same molding operation, are very decorative in themselves. Combinations of black plastic and gold or chromium plated accent, and all solid color cabinets, fit a variety of tastes with very slight production changes. The backs of all of Fada's molded cabinets are also molded, with ventilation spaces spelling the word F-A-D-A, and attached with six bolts fitting into molded-in inserts in the rear of the cabinet.

Original Kadette Midget contrasted with new Kadette Classic, both molded of phenolic plastics.



Another vertical cabinet is the new Emerson model, in which the flaring base is eliminated and the grille bars continue across the top for decorative accents. Furnished with an illuminated dial mounted in an integrally molded bezel, it gains interest and contrast from contrastingly colored grille cloth.

These few models described merely illustrate some of the more cautious experiments on the part of prominent radio manufacturers to capitalize on the possibilities of plastic cases; more daring designs are on the way. There is a cabinet soon to be in production which takes a design tip from the 1937 automobiles, and features a fluted plastic grille running entirely around three sides on a horizontal plane, the ivory grille contrasting with a black phenolic molded case and colored dials.

Then, there are novelty shapes such as the two-foot-high Coca Cola radio. Planned as a counter display, the bottle cabinet encloses a five-tube chassis, and is molded in brilliant scarlet phenolic plastic. It dramatizes the Coca Cola name, and illustrates the decorative possibilities of molded plastic cabinets. Another novelty cabinet was the Colonial Globe radio in which a black molded world globe served as chassis case and a molded base served as speaker.

GRAPHICAL REPRESENTATION OF
BAND-PASS CHARACTERISTICS

by Carl V. Erickson

THE PRESENT TREND in high-fidelity receiver design has given increased attention to the band-pass characteristics of the tuned units; graphical representations may be utilized advantageously in determining various relationships between factors influencing the response. A detailed study of many of the conventional units will show how considerable improvement may be attained in present design. Also, new applications such as automatic tuning make use of the phase relationships of currents in different circuits.

Graphical representations from formulas of different types of coupling are used for illustrating how the different types of frequency-response curves are obtained. For analytical purposes, this gives a very complete picture of the nature of the frequency-response curves and indicates how various factors affect the response. For the two most common circuits, the tuned r-f and the inductively-coupled tuned primary and secondary i-f transformer, frequency-response charts have been prepared showing the variable factors of design. From this, the band-pass response curves of a radio may be predetermined.

The response of the inductively coupled i-f transformer may be expressed by

$$\frac{I_2}{I_P} = \frac{-M/C}{\omega^2 M^2 + Z_1 Z_2}.$$

With identical components in the primary and secondary, this may be expressed as

$$\frac{-M/C}{R^2 + \omega^2 M^2 - (\omega L - 1/\omega C)^2 + j2R(\omega L - 1/\omega C)}$$

To conveniently adapt this expression to a chart, a few simplifying assumptions must be made; these will result in an error of only a few percent over the range in which they will be used. This range is considered to extend over the resonance frequencies and into the adjacent channels so that the selectivity factor may be determined.

The plate resistance is assumed to be infinitely high

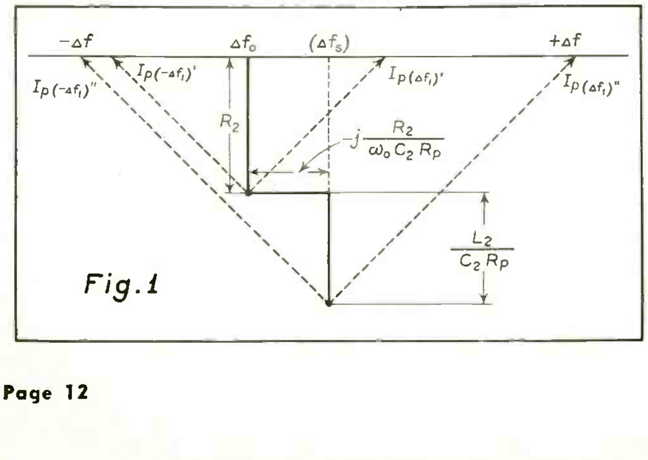


Fig. 1

so that I_P is proportional to E_P. The resonant frequency, ω, is considered a constant and the reactive factors are expressed in terms of frequency deviation from resonance. Also, factors which do not affect the relative response at different frequencies are dropped. The following expression then results:

$$\mu = \frac{1}{R^2 + \omega_0^2 M^2 - (4\pi \Delta fL)^2 + j2R(4\pi \Delta fL)}.$$

The numerator is a constant and the denominator contains the variable factors expressed in simplified form. The "j" term is directly proportional to the frequency; and the squared term involving the frequency deviation, is proportional to the square of the frequency. These two terms plotted on scales at right angles will form a parabola. The expression of the denominator is represented by a vector whose point follows a parabolic curve. The origin of the vector is at a point whose distance from the apex of the parabola is determined by the constant terms.

Such a representation can be applied to a chart of the frequency-response of a band-pass filter.

To determine the correct proportionality between the linear and the squared terms, the point at which the linear term equals the squared term may conveniently be considered. At this point 2R equals $4\pi\Delta f L$. Solving for this frequency,

$$\Delta f_1 = \frac{R}{2\pi L}.$$

Then, at the point on the frequency scale at which the factor of $\frac{R}{2\pi L}$ is unity, the parabola is made to have its two components equal.

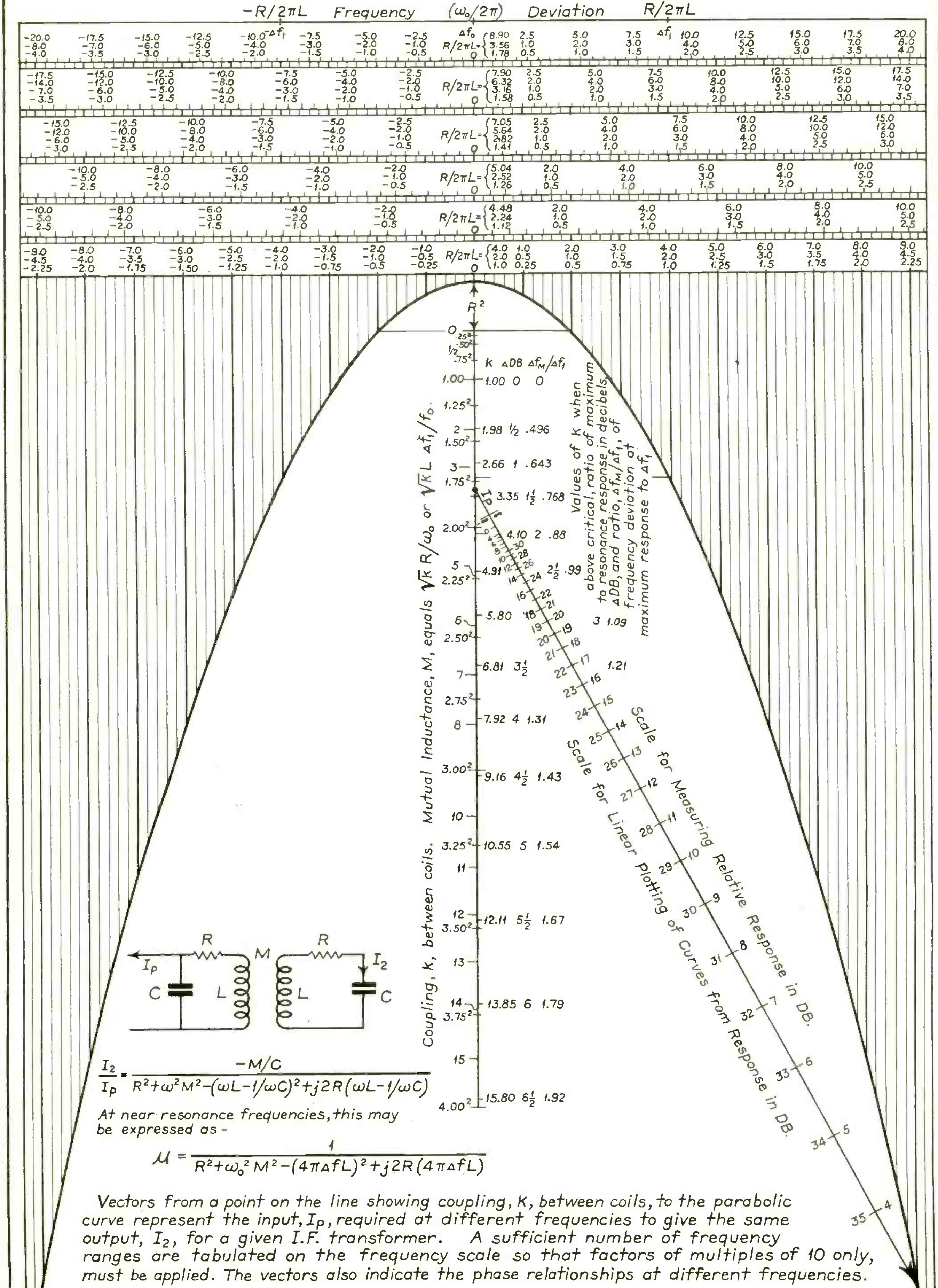
In calibrating the frequency scale with Δf_1 taken as unity, the values may be multiplied by the actual frequency of

$$\Delta f_1 \text{ or } \frac{R}{2\pi L}$$

to obtain scalar values of frequencies. The chart is tabulated with a series of twenty scalar values of frequencies in approximate equal percentage increments of Δf_1 from 1 to 10, so that factors of multiples of 10 only need be applied in practical application. For most i-f transformers, this factor is 100 or 1000, or the $\frac{R}{2\pi L}$ value is somewhere between 100 and 10,000 cycles per second.

The origin of the vector is determined by R^2 and $\omega_0^2 M^2$. In determining the relationship of the scalar values of R^2 and the two components of the parabola, the value, U, at which the two components are equal,

I.F. Transformer Frequency-Response Chart



$$\frac{I_2}{I_p} = \frac{-M/C}{R^2+\omega^2M^2-(\omega L-1/\omega C)^2+j2R(\omega L-1/\omega C)}$$

At near resonance frequencies, this may be expressed as -

$$\mathcal{M} = \frac{1}{R^2+\omega_0^2M^2-(4\pi\Delta fL)^2+j2R(4\pi\Delta fL)}$$

Vectors from a point on the line showing coupling, K, between coils, to the parabolic curve represent the input, I_p, required at different frequencies to give the same output, I_2, for a given I.F. transformer. A sufficient number of frequency ranges are tabulated on the frequency scale so that factors of multiples of 10 only, must be applied. The vectors also indicate the phase relationships at different frequencies.

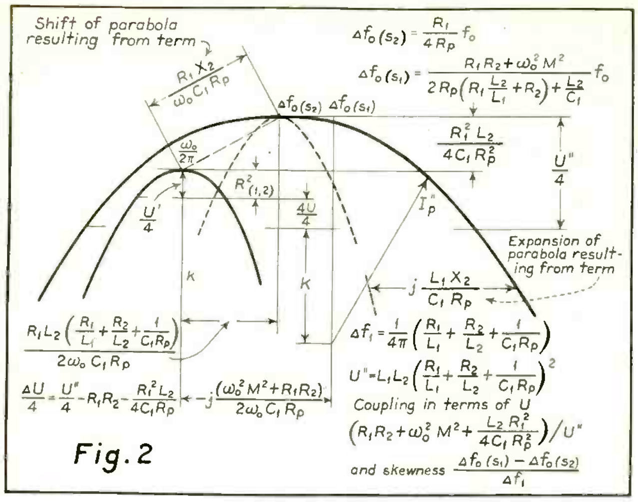


Fig. 2

may conveniently be considered. Substituting

$$\frac{R}{2\pi L} \text{ for } \Delta f$$

in either component and equating to U,

$$R^2 = \frac{U}{4}$$

results in solving for R and squaring. The coupling between coils has been calibrated arbitrarily in terms of k, such that kR^2 equals $\omega_0^2 M^2$. The mutual inductance, M, then equals

$$\sqrt{k}\,\frac{R}{\omega_0} \quad \text{or} \quad \sqrt{k}\,L\frac{\Delta f_1}{f_0}.$$

A scale is shown calibrated in db response for applying to linear measurements of I_p. A more convenient application consists of placing the center of a transparent scale of concentric circles with radii corresponding to the db calibrations, at the point k representing the coupling between coils.

The response curves of the inductively coupled r-f transformer and the impedance coupled r-f units are, in general, alike. If $4\pi\Delta f L$ is sustituted for (ωL — $1/\omega C$) in the expressions for the response of either unit, the plate current required to maintain a given resonance circuit current at different frequencies may be represented by a vector from a point to a straight line with proper frequency calibration.

The response of the inductively coupled unit may be represented by

$$\frac{I_2}{I_p} = \frac{-j\omega M}{Z_2}.$$

The corresponding expression for the impedance coupled unit may be given as

$$\frac{I_2}{I_p} = \frac{R_2 + j\omega L_2}{Z_2}.$$

Over a small range of frequencies, either may be expressed as

$$\mu = \frac{1}{R + j4\pi\Delta f L}.$$

The denominator contains a fixed quantity, R, and a variable proportional to the frequency. The frequency at which they are equal is

$$\Delta f_1 = \frac{R}{4\pi L}.$$

This determines the scalar values for applying the expression to a frequency response chart.

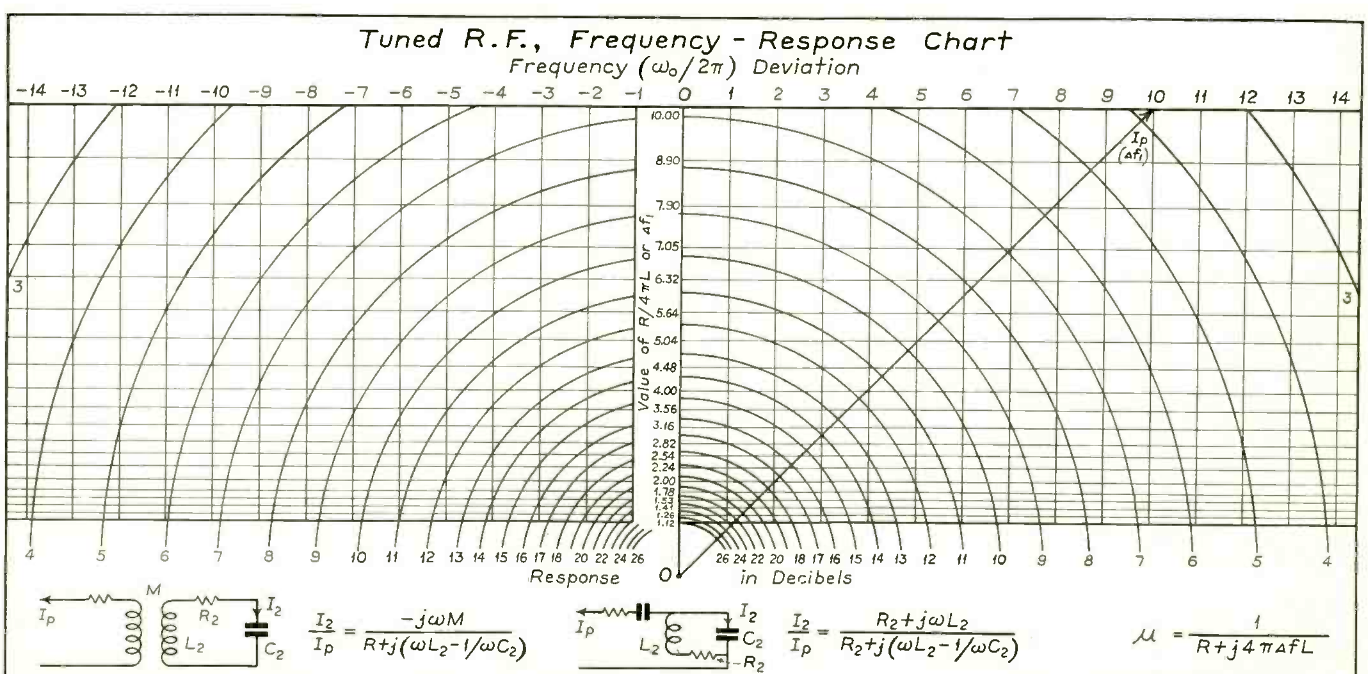
A fixed scale of concentric circles calibrated in db may be used by placing horizontal lines with the same frequency calibrations at proper distances from the center of the circles. These lines correspond to different values of

$$\frac{R}{4\pi L} \quad \text{or} \quad \Delta f_1.$$

The same factor should be applied to both Δf_1 and the frequency deviation scale for other values. In practical use, factors of multiples of 10 only need be applied to the chart.

In the application of the expression of frequency response to charts, the plate resistance has been taken as infinite. Certain modifications must be applied for consideration of the plate resistance. In most cases, the cor-

(*Continued on page* 23)



A CASE AGAINST RADIO

by J. G. Foresman

ADMITTED THAT RADIO is the wonder of the century, an incalculable influence on our daily lives—admitted that it is the very spirit of the age—there is still at least one member of the human race who dislikes it heartily and who welcomes an unexpected and somewhat surprising opportunity to catalog his grievances against it. However, it is with some hesitancy that these objections are launched, as heretofore the occasional criticisms I have attempted have been along musical lines only, and (dare I say it here?) to me radio and music are not even distantly connected terms. A musician by profession, I confess that the mechanical side of wireless sound transmission is not only a closed book, but one written in some forgotten tongue, sealed with the Seven Seals of Solomon and sunk in the depths of an uncharted ocean. My entire experience with radio has been listening, usually under protest or for politeness' sake, to sets in friends' homes—sets ranging from cracker-box size up to the monstrosities that combine with victrolas, portable bars, bookcases, desks, or what have you—only in rare instances the super-something-or-other costing more than $200—usually the ones priced from $20 to $90, bought "on time," played almost constantly, and apparently enjoyed by every member of the family. My antipathy to radio is based then only on a superficial familiarity with the set owned by the average householder, and I make no denial of the fact that wavelengths, ground wires, armatures, aerials, sound filters, and so forth, are unknown quantities to me. So I apologize in advance if these remarks fail to take account of all the latest improvements and developments, out of reach—both for lack of cash and knowledge—of the ordinary layman. This indictment must be taken as coming from the point of view of a consumer with a total ignorance of the technical side of what is now one of this country's foremost industries.

To mitigate in some degree what follows, I will admit that radio does have certain attractions for me: broadcasts of sporting events, political speeches, news flashes, even at times dance music. (Of course, to the child in my family some programs are just "coppers from the ether," as one of our most popular crooners might say.) Generally speaking though, my dislike for it is constant and unswerving, and here are a few of its minor but, to me, more irritating aspects. To begin with, the mere fact that a man owns a radio does something to his ordinary common sense. He plays it too loud, or too early in the morning, or too late at night. He plays it when people in the same room are trying to concentrate on some other diversion. (Believe it or not, I've been asked to play bridge with a radio going full blast not more than six feet from my elbow.) This same prize imbecile tunes in (God help us!) while he is reading, as if his magazine or newspaper were the libretto of the piece, forsooth. He falls asleep to Cab Calloway and eats his meals to Amos and Andy. No other than radio music exists for him. He boasts no piano, no violin, nor even a humble zither. Conversation in his home is monosyllabic—which recalls the story of the husband who, because his radio had broken down, unexpectedly spent an entire evening talking with his wife and was properly astounded and delighted to discover what an intelligent, companionable, charming woman he had been married to for seven years.

In the next place, nine out of ten radio fans either do not know how or won't take the time to get the best results from their sets. Tuning in is no delicate operation for them. Interference? Turn up the volume! Drown out the competition! Hence the adjective "blaring," automatically associated with radios, although used elsewhere chiefly with reference to brass bands and fire bells. And speaking of fire bells, all the engine companies, elevated trains, taxi-horns, and riveters in New York City are preferable to one blaring radio in the apartment next door. Yes, the more thought I give to radio, the more violent becomes my antipathy to it. Have you, gentle reader, ever been tortured by the station-jumper, who flits from wavelength to wavelength as a bee from flower to flower, sipping enjoyment from one program for a bare thirty seconds and then spending two full minutes hideous with the usual shrieks, howls, caterwauls and buzzing noises in locating fresh territory, only to repeat the whole process over again? It is not really necessary to mention the horrors of the average program—the cheap jazz, the hit songs used again and again until even their most ardent advocates turn away, the forced humor, the mawkish sentiment, the false joviality, the hours of advertising drivel, the crooners, the close harmony, the innumerable and meaningless skits, opera stars singing ballads and torch singers Puccini—but this list is interminable! True, you will say, but in spite of the many poor programs, isn't radio educating people up to a real appreciation of music? I doubt it. During the past week or two I have asked about fifty people three questions: "Do you listen to the radio much?" "Do you enjoy it?" "What programs do you like best?" Almost without exception the answers to the first two are affirmative, some enthusiastically so. But does the third show any marked progress in the public attitude toward serious music? Not at all. People whom you would expect to appreciate the higher type radio offerings do so, that is (outside of professional and amateur musicians) about a fifth of the better educated half of the public, who would enjoy Wagner just as much had Marconi been a plumber. The rest prefer Rudy and Bing and Kate. Now that every home boasts a radio, can we discuss Brahms and Beethoven, or the mathematical genius of Bach, or Stravinsky's ideology with even every hundredth truck driver? Try it!

If it isn't being too picayune, let me take a moment to smile at some of the cabinets with which radio tubes and coils are camouflaged today—the "moderne" miracles of the imagination, so much like fancy tinfoil candy boxes—the artistic sets, with inlay on every available surface—the Gothic window effects, suggestive of a coffin sawed in two—the endless veneer and varnish and ornateness and poor taste. Perhaps, too, one deep-seated prejudice is at the root of a good part of my animadversion; I am frank to admit that I prefer to see whoever is doing the singing or playing or talking. If I must listen to music from a box, give me a good, dependable phonograph, free from sponsors, that will grant as many encores as I want and begin when I'm in the mood for it.

Perhaps nothing has been said as yet that either cannot be overcome or avoided, or that isn't just a personal reaction to a still imperfected instrument. So what is probably a more reasonable objection: Is the music that comes through the loudspeaker music,

(*Continued on page* 18)

THE OFFSET-HEAD CRYSTAL PICKUP

by J. R. Bird and C. M. Chorpening*

SINCE ELECTRICAL recording was introduced it has been standard practice to cut a constant velocity-versus-frequency characteristic on the recordings themselves for fixed voltage to the recording cutter, except for frequencies below 250 to 300 cps where constant amplitude was maintained in order to avoid the excessive amplitudes which constant velocity characteristics produce when carried below 250 cps. Of late the high fidelity recordings carry this tendency still further, making the transition to constant amplitude at either 500 or 800 cps, thereby allowing a higher level to be engraved on the wax and making for a marked reduction in surface noise.

The Brush Bimorph crystal is inherently well adapted to a pickup for reproducing the conventional recording characteristic. Fundamentally, the crystal will produce a constant voltage for constant amplitude of vibration independent of frequency except near its own resonant frequency, which is naturally placed in the higher audio frequency range or above. Therefore, a crystal pickup is inherently right for the constant amplitude portion of the recording characteristic and the decrease in the voltage which occurs with increasing frequency in the constant-velocity portion, is readily equalized by properly controlling the high-frequency resonance of the crystal and vibrating system as a whole.

This results in the general characteristics shown in Fig. 1, which represents the response of the offset-head crystal pickups recently announced. It may be noted that the response below 1000 cps is relatively independent of the constants of the mechanical system, while the response above this frequency is closely related to the manner in which crystal and needle chuck are designed and mounted.

The internal impedance of crystal devices is of importance here. Internally, their impedance approximates that of a fixed capacity and is therefore a high negative reactance for low audio frequencies, decreasing steadily with increasing frequency. Constant voltage for constant amplitude of vibration is maintained under open circuit conditions, and a high enough load resistance must be maintained so that the very low frequencies are not attenuated through purely electric circuit phenomena, such as occur in resistance-coupled amplifier circuits. A crystal capacity of the order of .002 mfd has been found satisfactory and this requires a load resistance of the order of ½ to 2 megs to avoid excessive low-frequency attenuation. (Response curves of Fig. 1 are for pure resistance loading and in general result in a full bass response free of resonance peaks and with a generally lower level of response above 1000 cps.) Equalization to adjust the relative bass response is very easily accomplished by loading the pickup with capacity and resistance in series, as in Fig. 2. This results in a uniform loss below 1000 cps, and does not alter the response at high frequencies.

Curves of both Fig. 1 and Fig. 2 are based on frequency records representing the present high-fidelity recording characteristic with the transition from constant amplitude to constant velocity at about 500 cps. Usually the response characteristics of Fig. 1 will be chosen, by listening tests with ordinary speakers, as preferable to the flatter overall response of Fig. 2. This occurs even when surface noise is not a factor, and is probably caused by the compensation which Fig. 1 provides for the excessive response of most commercial loud speakers in the 2000-5000 cycle range.

The circuit arrangement of Fig. 2 may be preferred, however, in cases of limited power-handling ability in the reproducing system, or where mechanical noise from the turntable motor is important. It may be said generally that the crystal pickup requires more thorough elimination of motor noise than do other types, in order to utilize fully the wide-range bass response of the crystal. This is a reflection rather on the cheaper turntable motors than on the pickup itself.

With regard to surface noise, the most important factor is to avoid pronounced peaks (of over 3 db) in the response between 3000 and 7000 cycles, and this is being done commercially. As was stated above, the high-frequency response of the crystal pickup is critically dependent on the choice of material used to clamp and damp the crystal and the method in which such materials are used—materials must be carefully chosen, also, in order that original characteristics be maintained. This requires freedom from flow under pressure and freedom from changes with temperature and age. Materials which will satisfy these requirements have been obtained, and are being used. The most satisfactory method yet found for protecting crystals against atmospheric moisture, impregnation of the paper coated crystal in paraffin, is being used for pickup crystals.

Over a year ago it was realized that the development of crystal pickups had been carried to the point where further development for improved frequency response curves in the crystal cartridge proper could be made secondary to improved arm design in possibilities for betterment of reproduction. Two limitations of conventional straight pickup arms are outstanding. One, a tendency for arm resonance to enter the picture at the low frequencies, introducing resonance phenomena of limited amplitude, and, second, the large tracking errors and variation of tracking error which occur over the playing range of the record. By the term "tracking error" is meant the angle between the tangent to the record groove at the point of needle contact and the needle itself projected into the plane of the record.

Ideally, of course, it is assumed that the needle axis itself and the groove tangent at the point of contact are both in one plane perpendicular to the record surface; but this has been far from true. Several undesirable effects result: First, with a large tracking error, the needle pressure is exerted mainly on one side wall of the groove instead of being equally divided between the groove walls. This results in rapid wear on the record, and at the same time the

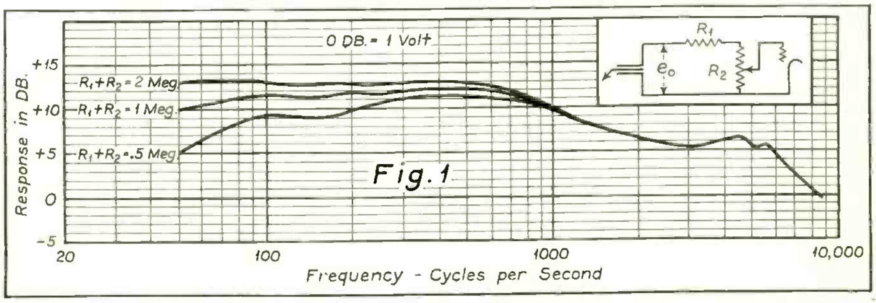


Fig. 1

*Astatic Microphone Lab., Inc.

groove cannot exert a proper grip on the needle to cause the latter to follow exactly the modulation recorded on the groove. Second, the large tracking error at one point is naturally accompanied by a large variation of this tracking error from point to point on the record surface. This means that a needle point worn in the first few grooves to a shape which fits the groove at that point will become a fairly effective cutting tool for wearing out the record when the needle has progressed so that the tracking angle has changed considerably. Third, since the needle point must vibrate about an axis at an angle to the groove tangent, sinusoidal modulation of the groove will not produce sinusoidal vibration of the needle point even when close contact is maintained, and therefore a certain amount of wave-form distortion occurs with a large tracking error. These factors all indicate the desirability of a low maximum tracking error combined with a minimum overall variation of this error.

The curves in Fig. 3 have been calculated to show the initial tracking angle which occurs with a conventional pickup arm as a function of the radius R of the playing circle, the length of the arm L, and the overhang D, which is the distance between the center of the turntable and the needle point when the neeedle point is in line with the centers of the base and turntable. To make the curves of general use the horizontal axis is plotted in terms of the ratio R/L and the different curves shown represent different ratios, Q=D/L, between the distance D and the arm length. Taking the case of a 10¼″ arm, the ratio R/L varies from .195 to .57 for a 12″ record. (4″ to 11¾″ playing diameter.) It has been the best practice with straight arms to mount them so that the needle point will not quite reach the center of the turntable (D negative), and the reason for this is apparent in the reduction in tracking angle at the inside of the record, where tracking error is particularly important on account of the short wave length corresponding to a given frequency. The old standard, "make the needle point swing through the center of the turntable" (D = 0) results in a tracking error increasing directly with diameter of the playing circle, attaining values as high as 22° for an 8″ arm on a 12″ record. As D is given increasing positive values, larger initial tracking angles occur, but the tracking angle, particularly where D has values of .05 and above, becomes much more nearly constant over the playing surface of the record and may therefore be compensated by a fixed angular offset θ between the vibration axis of the pickup and the axis of the arm itself. This is the offset-head principle which has been universally used in Europe for a considerable time.

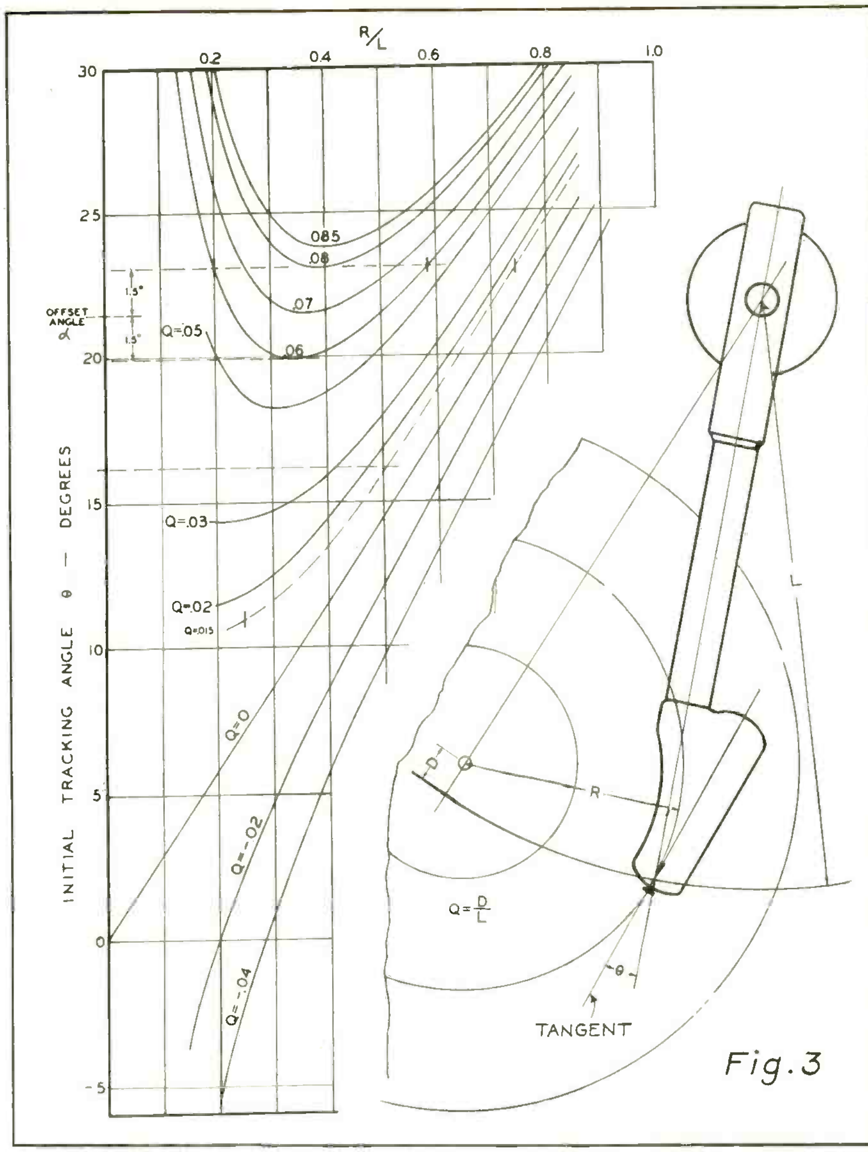


Fig. 3

Fig. 4 shows the manner in which tracking error varies when the offset angle and overhang distance are chosen so that the working region is around the minimum point of one of the upper curves of Fig. 3. It may be seen from this and from the upper dotted lines in Fig. 3 that the variation of tracking error with a 10¼″ arm on a 12″ record may be held to a maximum of 1½° by combining an offset angle of 21.6° with an overhang distance D of ⅝″ (Q = .06). It should also be noticed that the very small tracking error swings from positive to negative and back to positive values, as the needle progresses over the record, and that the maximum variation is limited to 3° which minimizes the record wear caused by variation in the shape of the needle point during playing of the record.

It is at once apparent that the offset-head offers possibilities for attaining practically a negligible tracking error in short pickup arms—in fact, low values of tracking error which could only be obtained with straight arms several feet long. In designing to obtain maximum effectiveness from the offset principle, it is essential that the working region be around a minimum of one of the upper curves of Fig. 3, choosing D

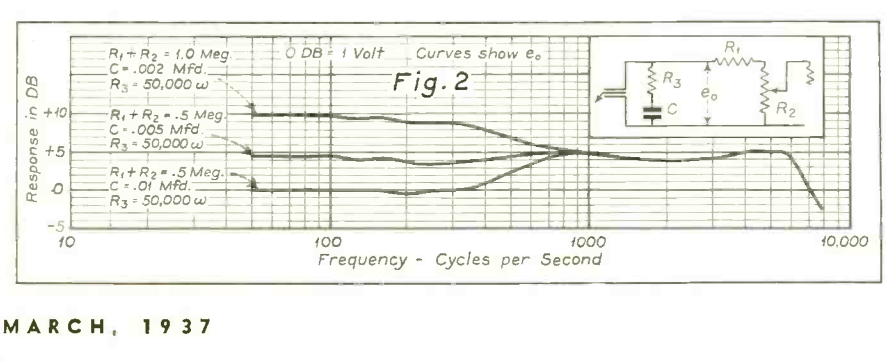


Fig. 2

(and Q) such that the initial tracking angle will have equal values at the inside and outside of the record. It may be shown that a value of

$$Q_{OPT} = \frac{1}{2}\left(\frac{R_1}{L}\right)\left(\frac{R_2}{L}\right)$$

will, to a close approximation, give equal values of θ for the inside playing radius R_1 and outside radius R_2. This value of θ is determined by

$$\sin \theta_{equal} = \frac{1}{2}\left(\frac{R_1}{L} + \frac{R_2}{L}\right)$$

while the value of θ at the minimum of the curve for the above determined value of Q is given by

$$\sin \theta_{min} = \sqrt{\left(\frac{R_1}{L}\right)\left(\frac{R_2}{L}\right)}$$

With these two values of θ determined, we set the compensating offset angle of the pickup head α midway between them. The result is three small and equal maximum values of tracking error (at the outside, inside, and at $R = \sqrt{R_1 R_2}$), and in between, two points of zero tracking error.

Using this design basis, the design constants D and α of the offset-head pickup have been calculated and plotted as a function of arm length. The resulting tracking error limits calculated on the same basis are shown in Fig. 5. The ordinates of this curve are the equal maximum tracking errors occurring at outside, inside and near the center of the record for arms with optimum values of offset angle α and overhang D. It is apparent from Fig. 5 that a 10¼" arm properly offset will handle 10" and 12" records with a maximum tracking error of 1½° and that a 12" arm will handle 10", 12" and 16" records with a maximum tracking error of 2.4°. Two new crystal pickups with these arm lengths, and combining properly proportioned offset-heads with several other features have recently been placed on the market.

Several alternatives were available with regard to the actual method of

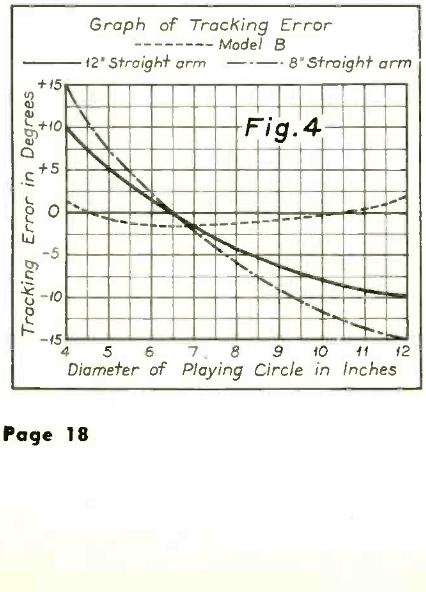


Fig. 4

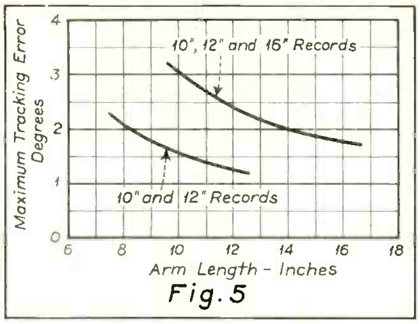


Fig. 5

obtaining the offset. One was to orient the needle with respect to the rest of the vibrating system; the other involved the offsetting of the entire head with respect to the axis of the arm. For several reasons—among others the desirability of retaining the simple cartridge design—it was decided to adopt the method of offsetting the entire head. It was found that this gave a pronounced reduction in arm resonance effects because a wider and stiffer arm is obtained for a given arm cross section.

The arm itself has been redesigned along more massive lines. It is provided with double-row ball bearings, which combined with the additional weight, serves further to reduce arm resonance effects.

In order to facilitate the insertion of needles in the needleholder chuck, the pickup head has been pivoted about the long axis.

•

A CASE AGAINST RADIO

(*Continued from page* 15)

or something only approximating it? Disregarding static and other interference—although how that can be done with equanimity, particularly in the middle of what would otherwise be an engrossing program—how one can be expected to maintain interest in even the most satisfying composition when at any moment the whole atmosphere may be shattered with assorted boiler-factory noises—how enjoyment can be attained when threatened by periodic or at least unpredictable nerve-shattering interruptions—is far beyond my ken. Disregarding static then, the tonal quality of sounds reproduced by radio, even under the most favorable conditions, is on the whole displeasing. Measure rates of vibration as accurately as possible, count overtones, devise a dozen new comparative tests—to the trained ear the quality of the sound is not the same, and in comparison with music at its source, is little more than mere noise. Can anyone with a reasonably good ear (a musically trained ear, not the so-called "ear for music") insist that a glorious soprano voice sounds as well over the air as it does from the platform? Can even the most insensitive listener fail to detect the vast difference in quality between music from a symphony orchestra broadcast and the concert itself? It is true that some of the more raucous tones of the human voice coming through a set in an adjoining room may be almost indistinguishable from life. Everyone can recall some version of the story of the woman alone in her house who was frightened nearly to death by the threatening voice from the next room shouting, "Aha! You thought you'd locked the door, didn't you?" But the fact remains that over the air there is a definite loss of quality in almost every tone of almost every medium. Of course, one can now differentiate between the instruments in an orchestral broadcast, but this can be done blindfolded and with far more facility at the broadcasting station itself, and as for differentiating between music from a receiving set and music at its source, a child can do it with no uncertainty whatever.

Consider an orchestra in its fortissimo passages and the uplifting effects of the terrific crescendos in, say Beethoven's "Fifth" or Stravinsky's "Sacre," and compare them to the effect one gets from these same compositions over the radio. In the most stirring passages the radio fills the room with such vibration, with such rushing, roaring cacophony, that the music becomes secondary to the noise, one's eardrums are threatened and one's nerves sadly frayed. Yet the volume from the radio is as nothing compared to the actuality. Listen to the orchestra itself, and while the volume practically lifts you out of your seat, never for an instant do you forget the music. Naturally, part of the answer lies in the size of the room as compared to the size of the auditorium, but this surely demonstrates that radio is irreconcilable with music of any considerable force or volume. A radio broadcast of any composition of magnitude must of necessity come through the receiving set only as a reproduction in miniature. Nobody wants a full orchestra in his nineteen-by-eleven living room, and for one, I want no watered-down version of one. Nobody would really enjoy Tibbett, for example, singing with all his voice in such limited space, and I can see little reason for encouraging what used to be called "parlor" voices, the male editions of which are known today as crooners. Consequently there arises at once a very definite and considerable restriction in respect to volume alone on what music is suitable for reception by the average radio set. It is possible to get satisfactory reception on story-telling hours, children's and other volume-deficient voices, harmonicas, ukuleles, the good

(*Continued on page* 31)

TOBE AUDI-O-GRAPH TOBE

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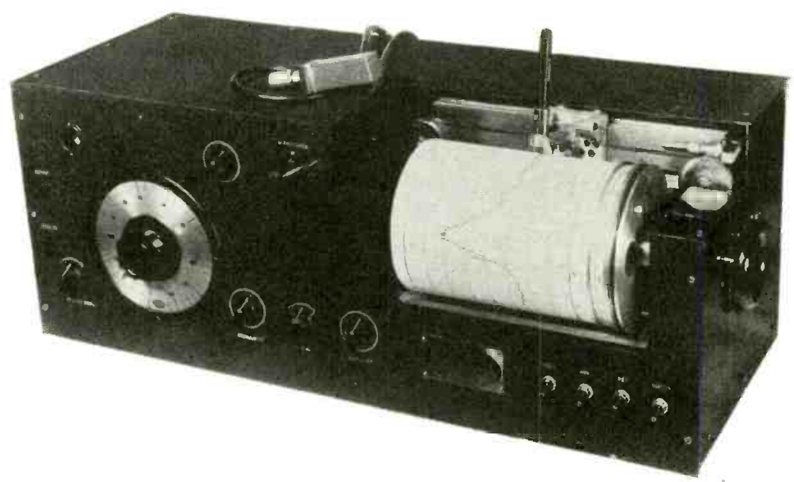

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TOBE DEUTSCHMANN

CORPORATION

INSTRUMENT DIVISION

CANTON MASSACHUSETTS

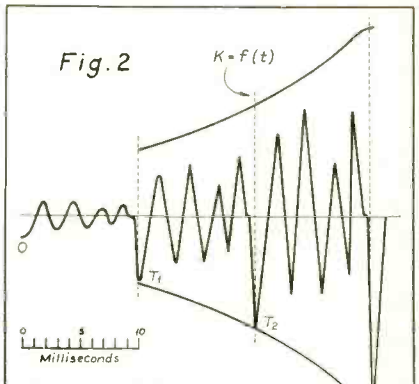
VOLUME EXPANSION TECHNIQUE

by L. A. de Rosa

THE PROBLEM of reproducing sound with the self-same relations in dynamic intensity that are present in the original source has beset the "facsimile reproductionist" for some time. It is only possible at the present time to preserve the original excursions in dynamic contrast by the correlated use of a "compressor" and "expander" in the transmitter and receiver respectively. The compressor incorporated in transmitter circuits reduces the dynamic spectrum below and above a fixed datum level, in conformity with some predetermined law (generally logarithmic); and the expander, located at the receiver end, works in converse fashion, thus restoring the original loudness ratios.

Without the use of auxiliary apparatus, the acoustical powers encountered in the radio broadcast studio are of much too great a range to permit true reproduction over the entire expanse. An orchestra, passing from a pianissimo passage, in which there may be only one softly playing violin with a very light orchestral background, to a fortissimo with the entire orchestra of possibly 100 musicians playing as loudly as they can, represents a range in powers in the approximate proportion of 1:100 million or 80 db. The necessity for retaining the original contrast is evident by the results of experiments in which musicians and ardent musical critics were subjected to reproduction with and without the original contrasts. They all invariably preferred the test in which the true contrast was retained. Apparently the changing of the acoustical level through a wide range creates a pleasant sensation in the listener and also alters the timber or character of the sound. This latter characteristic is caused no doubt by the introduction of subjective tones and crossmodulation components which arise during the phenomenon of hearing. This explains why thousands of dollars are expended in building huge organs and assembling large orchestras. In this manner music is given another extensive dimension—along which it can create varying sensations—namely, that of variations in acoustical power. When the loudness range of a program is limited, the composer is deprived of a very powerful means of expression.

There are many difficulties which prevent the transmission of a program with its normal dynamic contrasts. The maximum loudness point is fixed by the overload level of the apparatus and occurs at the transmitter end when the carrier wave is modulated to 100 percent. The lower level is determined in the case of studio programs either by the noise level of the transmitter or by prohibitive reduction in the coverage area. As an illustration of the seriousness of the latter handicap, imagine a 50-kilowatt transmitter located near a city such as New York. If this station attempted to radiate its programs with the true volume ranges there would be periods when the modulated power would drop to about one-half milliwatt or approximately 1/2000 the power output of an ordinary ac-dc midget receiver! While this station might ordinarily cover about 15,000 square miles, during the course of a soft passage in the program, it would not be heard beyond 100 yards from the transmitter. Additional difficulties arise when the programs are relayed from remote points by lines. In this case the lower level is fixed by the noise level of the lines, and the maximum level fixed by the cross talk and interference which this high level would cause in adjacent circuits.



The action of the expander when the volume of the vowel o͞o, as in po͞or, is suddenly increased.

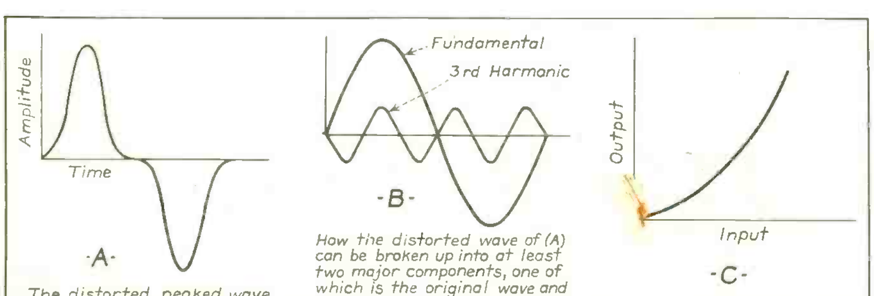
Criticism has been directed to the extremely high level which would be necessary in order to reproduce the program in its true proportions at the receiver. Experiments have shown this is not necessarily so, since in a fairly quiet room it is possible to get a 70 db range and still keep the maximum power input to the speaker at about 10 watts. This latter value in the opinion of the writer is the minimum level which is satisfactory to produce subjective and crossmodulation tones in the ear.

In the making of phonograph recordings the use of a compressor and an expander seems to be mandatory. If an attempt were made to record a program with its full dynamic range, the width of the sound track would be extremely large and would offer serious drawbacks.

In all present-day volume expander circuits, the signal itself is used to control the gain of the main audio channel. The controlling voltage derived from the signal itself must not act instantaneously since such operation would result in the introduction of serious odd-order distortion. This is evident from an inspection of Fig. 1. If the characteristic of the audio amplifier with its associated expander circuits was such that any change in the signal input instantly produced a non-linear change in the output, the expander or compressor action would occur during the course of one lobe of a signal wave and result in a highly peaked and distorted wave form. The characteristic of a device such as is shown in Fig. 1 might be represented as

$$i = \phi(e)$$

where i is impressed current and e is the resulting voltage; $\phi(e)$ is a non-linear function such as is required for

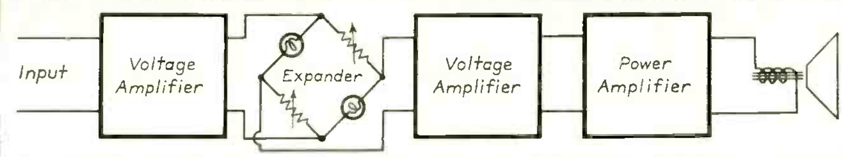


-A- The distorted, peaked wave which results when a pure sine wave is fed through an expander circuit having an insufficient time lag.

-B- How the distorted wave of (A) can be broken up into at least two major components, one of which is the original wave and the other an extraneous third harmonic distortion factor

-C- The input vs. output characteristic of a representative expander circuit

Fig. 1



An expander layout. The variable resistor arms are 5 ohms each and have a common shaft. The bulbs are 3 C.P., 6-8 volt automobile lamps.

Fig. 3

either compression or expansion.

Now, let us assume that a small change in i, say δi, is accompanied by a small change, δe, in the voltage, then $(i + \delta i) = \Phi(e + \delta e)$. If we expand this according to Taylor's theorem, we get

$$(i + \delta i) = \phi(e) + \delta e \phi'(e) + \frac{\delta e^2}{2!}\phi''(e) + \ldots$$

where

$$\phi'(e) = \frac{d}{de}[\phi(e)]$$

and

$$\phi''(e) = \frac{d^2}{de^2}[\phi(e)]$$

etc.

If we substitute the value of i in this equation we get

$$\delta i = \delta e \phi'(e) + \frac{de^2}{2!}\phi''(e) + \ldots$$

And if this small change, δe, is an alternating voltage, we can substitute $\delta e \sin \Theta$ for δe.

This may be written as

$$\delta i = \frac{\delta e^2}{4}\phi''(e) + \ldots + \delta e \sin \Theta \phi'(e) - \frac{\delta e^2 \cos 2\Theta}{4}\phi''(e) + \ldots$$

If the above phenomenon occurs instantaneously, and if $\phi(e)$ is a sharply curvilinear function, the co-efficients of the extraneous terms introduced by the device will be large. If, however, a time lag is introduced so that while $\phi(e)$ still operates through the same range, but less rapidly as a function of time, the extraneous components will be reduced in relation to the stimulating signal and

$$i \doteq \phi'(e)\delta e \sin \Theta$$
$$\doteq k\delta e \sin \Theta$$

In practical applications a compromise must be chosen so that the time lag in the operation of the expanding or compressing device is not too great to become noticeable to the ear and still be large enough to prevent serious distortion from taking place. The conditions which are most critical occur when there is a sudden peak caused by a signal having a very steep wave front. A typical case is the sound emanated by a strictly percussion type of instrument such as the bass drum. In this case the signal reaches its maximum value almost instantaneously. An examination of the probable action in the hearing mechanism of the ear will acquaint us with the factors involved. If the ear is adjusted to receive a certain low signal and the loud sound of the bass drum is interjected, this latter sound is transmitted to the brain as a transient. As the sensation builds up, a damping action occurs by reflex. The cochlear nerve is stimulated by the interjected sound. As the sensation at the brain increases to conform with the peak stimulus another nerve is stimulated, namely the stapedius nerve which is a branch of the facial nerve. This nerve causes a contraction of the stapedius muscle and in conjunction with the muscles which regulate the tension of the ear drum, causes an increased labyrinthian pressure, damping the vibration of the basilar membrane, thus causing a loss of sensitivity in the overall auditory channel. There is a time lapse before the brain senses this sudden loud sound. This time varies with the level of the signal and frequency, but is in the neighborhood of several milliseconds. It is obvious that if we can secure our expansion action in an interval comparable to this lag and still keep the distortion to a tolerable level the gradual expansion will be fairly inaudible.

Experience has shown that if the time lag is limited to 20 to 30 milliseconds, the ear does not perceive the gradual expansion. However, at the low audio frequencies this time is not sufficiently great to keep the odd-order distortion to a tolerable value, so that on high-fidelity reproducing systems the time lag must be increased.

In Fig. 2 we see the action of an expander circuit. The wave O-T_1 is a rough reproduction of the sound ōō, as in poor. At time T_1 ten milliseconds afterwards, when the level is suddenly raised, the expander action begins to function as $k = f(t)$. Twenty milliseconds afterwards at T_3 the expander has reached a quiescent point. If the interval T_1–T_3 is too small, there will be serious wave-form distortion characterized by the familiar rasping sound of odd-order components. The above condition is the most serious problem in the design of automatic volume contrast apparatus.

Using the circuit of Fig. 3, it has been possible to secure an additional contrast of 40 db without serious distortion. The circuit is a standard bridge network in which two arms are elements having a non-linear relation between resistance and current. In the actual apparatus these consist of two 3-candle-power automobile lamps. A static characteristic of the apparatus is shown by Fig. 4. By choosing the initial setting of the bridge it is possible to secure any desired expansion or compression. If the bridge were in perfect balance, the output would be zero; whereupon, any slight unbalance would result in the appearance of an output voltage, and therefore an infinite rate of expansion. It is necessary of course to follow the bridge circuit by enough amplification to bring the power to the required level in the output. The time lag of the apparatus is determined by the thermal lag of the dependent variables, namely, the resistance characteristic of the bulbs. The amount of expansion is dependent upon the adjustment of the bridge.

In a later setup a 6C5 was used to drive the bridge circuit through a step-down transformer having a secondary matching impedance of 1½ ohms. The output of the bridge was stepped up to the grid of a 6F5 which in turn drove a pair of 6L6's. The disadvantages of the expander circuits now in general use are to a great extent eliminated by the use of this setup. The possible expansion is practically unlimited; the insertion loss can easily be compensated for by an increased gain of the voltage amplifier section of the audio channel, and expansion is possible, by the simple varying of these parameters, even at the lowest power levels.

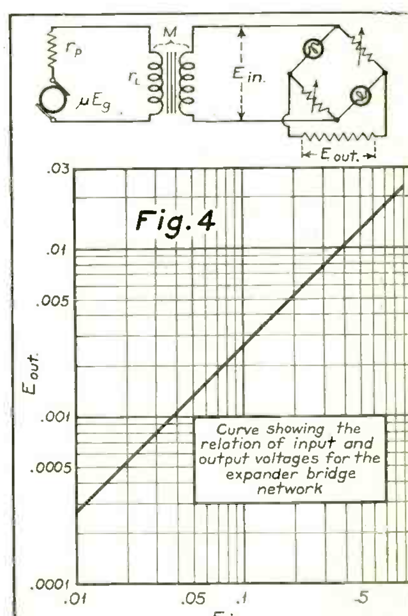


Fig. 4

BAND-PASS CHARACTERISTICS

(*Continued from page* 14)

rections amount to only a few percent, chiefly in a change of the frequency scale.

Considering the impedance coupled unit, the response expressed as

$$\mu = \frac{1}{R_2 + j\,(\omega L_2 - 1/\omega C_2)},$$

requires a correction factor of

$$\frac{L_2}{C_2 Z_P} - j\,\frac{R_2}{\omega C_2 Z_P}$$

added to the denominator. Z_P may be considered as resistance, R_P, as the capacitative reactance of the coupling condenser is small as compared with R_P. Fig. 1 shows these corrections applied graphically. The result is a shift in frequency and a broadening of the response or an apparent increase of R. The frequency shift is of no particular concern as its correction requires only a shift of the frequency scale and its value is small. However, $\frac{L_2}{C_2 R_P}$ may be rather large. It may be added to R_2 in determining the $\frac{R}{4\pi L}$ value as applied to the chart.

The correction factor for the inductively coupled unit is

$$\frac{\omega^2 M^2}{R_P + j\,\omega L_1}.$$

$j\,\omega L_1$ is ordinarily only a small percent of R_P.

$$\frac{\omega_0^2 M^2}{R_P}$$

may be added to R_2 for application to the chart.

In applying corrections for the plate resistance to the inductively coupled i-f transformer, the response may be expressed by

$$\frac{I_2}{E_P} = \frac{-M/C_1 R_P}{\omega^2 M^2 + Z_1 Z_2 + Z_{C1}\,\omega^2 M^2/R_P + Z_{C1}\,(R_1 + Z_{L1})\,Z_2/R_P}.$$

The modifications occuring are shown graphically by Fig. 2 with $4\pi\Delta f L$ represented by X.

All these quantities are insignificant except

$$\frac{L_1 R_2}{C_1 R_P} \quad \text{and} \quad j\,\frac{L_1 X_2}{C_1 R_P}$$

These may be of the order of ten to fifty percent. Both may be simultaneously corrected by substituting

$$R_{(1,\,2)} + \frac{L_{(1,\,2)}}{2 C_1 R_P} \quad \text{for} \quad R$$

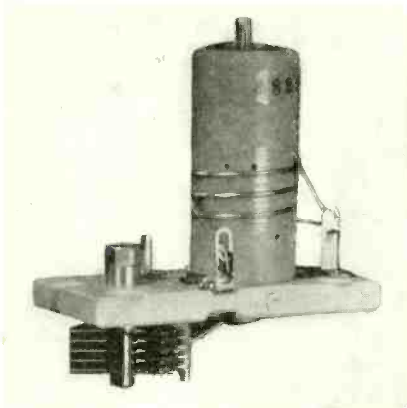
in determining the value of

$$\frac{R}{2\pi L} \quad \text{or} \quad \Delta f_1$$

This gives a value for $\frac{U}{4}$ or R^2 which is less than the value applied to the chart. This introduces no appreciable error and may be corrected by an increase of coupling.

(To be continued)

Design . . NOTES AND



20 - 40 mc oscillator coil assembly.

"SUPER-PRO" RE-DESIGNED

AFTER AN INTENSIVE period of experimenting, Hammarlund has produced an additional new model of the 16-tube "Super-Pro" with a 20 to 40 megacycle band, that is unusually efficient.

This model like the other "Super-Pro" types has been carefully engineered, with the additional frequency range incorporated only after considerable thought, laboratory work and modeling, rather than by the casual makeshift application. Specially built measuring equipment is believed to permit an accuracy of construction heretofore impossible. Then theoretical and practical tests were checked against each other to insure perfection. Where standard materials were found to be objectionable due to losses, and so forth, selected low-loss substances were substituted. In other words, the care in design and production followed for the standard "Super-Pro" was duplicated in this new model. The natural result is that its efficiency is said to be remarkably high.

In this new model, two steps of radio-frequency amplification have been included for all the five ranges. This affords a gain and an image rejection ratio exceedingly high. To be more specific, on a test on 28 megacycles the image rejection ratio was found to be 150 to 1, while the sensitivity on the same frequency with a six-to-one signal-to-noise ratio was 0.8 microvolt. Such a high image rejection ratio definitely eliminates all fear of the "two-three spot tuning."

Another interesting characteristic of this new receiver is the tremendous band spread possible on the 28 to 30 mc band. This 2000-kilocycle region is covered by 90 degrees of the band-spread dial. Thus it becomes quite a simple matter to really pick apart even the most crowded sections. Due to the design of this receiver, all the amateur bands fall in the center of the tuning range of each band. Thus it is possible simply to set the tuning dial at any particular amateur band and turn the band switch. The set will fall into the next amateur channel without further adjustment. Then, turning the band-spread dial will bring in the stations desired.

As in the standard "Super-Pro," there are five tuning ranges. Here the tuning begins at 40 mc, then follows: 20 to 40 mc, 10 to 20 mc, 5 to 10 mc, 2.5 to 5 mc, and 1250 to 2500 kc. This tuning coverage arrangement provides complete control of the ultra-high-frequency and high-frequency channels most popular today.

All of the features of the standard "Super-Pro" have been retained. That is, the accurately calibrated three to sixteen kilocycle continuously variable bandwidth panel control is still used not only to afford selectivity control, but also fidelity and tone control. The graduated audio and sensitivity controls permit, as before, accurate adjustment and simplified logging. With the zero to twenty-five hundred cycle beat note panel control, it is possible to select a frequency within this range on either side of zero beat.

For those who require additional hair breadth selectivity for c-w code a crystal model is also made. By properly adjusting this crystal control additional selectivity for phone or other modulated signals can also be obtained.

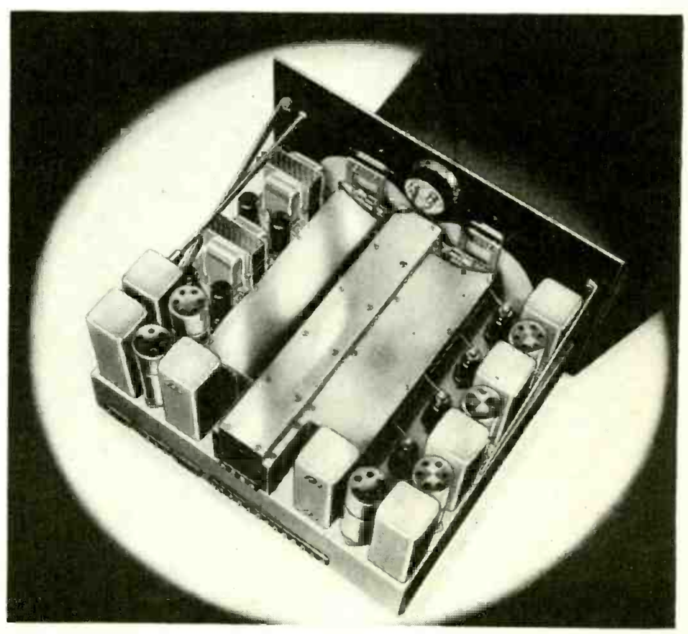
Hammarlund Mfg. Co.

A PRE-SET TUNER

BRINGING IN a station with this tuner is said to be as simple as pressing down a key on a cash register. The comparison may be carried further, for a number of small levers are arranged in line across the face of the device with the ends extending through slits, in the same manner as the keys of a cash register.

Each lever regulates the tuning of one station, and may be set for any station desired. The setting is simply accomplished, and need be done only once. To do this a lever is pressed down and a set-screw, located just below, is loosened. With the lever still held down, the selected station is tuned in manually. Then the set-screw is tightened and the lever released. All that is necessary to bring in the station after this is to push down the lever.

Each lever is connected to a tuning shaft running horizontally behind the face of the device, and the downward



New "Super-Pro" chassis.

COMMENT . . *Production*

stroke of the lever turns this shaft exactly the right distance to tune in the station for which it has been set. Each control consists of only three working parts, and there is nothing delicate nor complicated to get out of order.

Stations are tuned in with an accuracy that eliminates the need for stabilization circuits, a feature that represents a saving in the cost of construction.

The fact that any selected station is always found at the same place is also an added advantage over the dial types of automatic tuners now in use. In these the whole dial is rotated with every change in station. For example, WEAF may be found at the top of the dial at one time, and at the bottom the next time it is tuned in. The Leishman tuner, on the other hand, could be operated in the dark. If lever No. 1 is set for WEAF, pressing it down will always bring in WEAF.

Although this tuner will first be used for radio, it has been perfected for both radio and television together, and it is in this capacity, doubtless, that its effect will be of the greatest importance. In this combined capacity, each lever controls two stations, one radio and one television. The same downward stroke, instead of simply bringing in a radio station, brings in a television station also. The setting operation is the same, save that both dials are tuned in and set at the same time. The important fact here, however, is that this may be done regardless of how far apart the broadcasting frequencies of the sound and television may be.

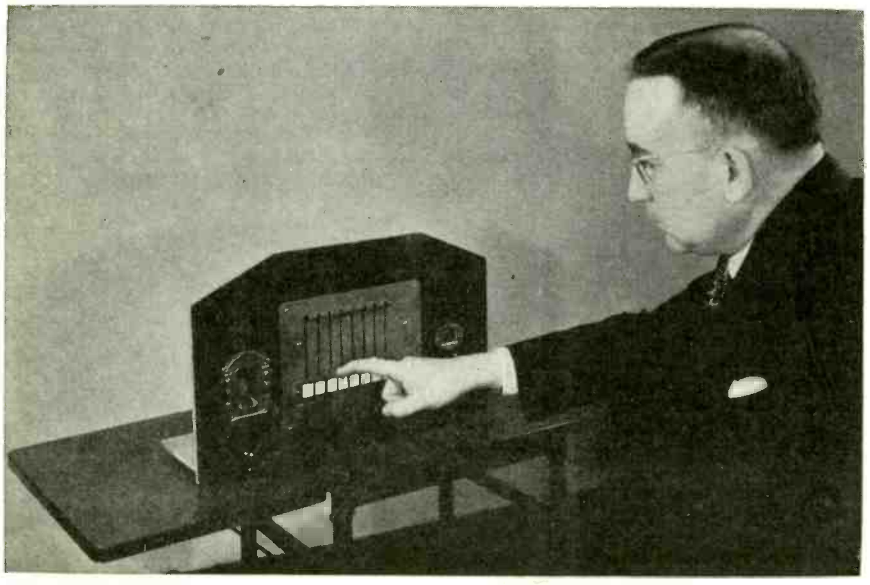
Since it has been proposed to the Federal Communications Commission that short-wave assignments be made for the sound to accompany television, so that single tuning will be possible, and since such a short-wave assignment would prohibit the use of all present radios as receivers for this sound, the meaning of the Leishman tuner is at once apparent.

Because the broadcasting frequencies for sound and vision will not have to be kept close together in order to be tuned in with a single operation on this tuner, this small device saves our radio sets for television.

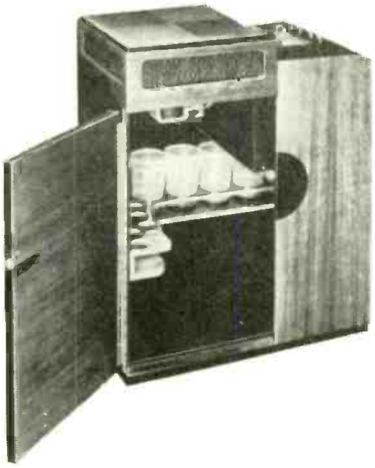
It also does away with the necessity of each television station installing its own sound broadcasting equipment, or from the other angle, permits a radio station to add television equipment and use its present setup for the sound. Multiply the cost of sound equipment by the number of television stations that will some day cover the United States, and some idea may be had of the enormous saving in this respect.

In addition to these things, the whole assignable band of frequencies may be used for television, which, if the sound and spacing were left out, would mean a saving of some eight megacycles.

Ralph Baker



The Leishman tuner.



Kadette "Equafonic."

"EQUAFONIC"

IN THE NEW Kadette "Equafonic" a new method of sound projection is utilized. In the first place, it was almost essential to put the average console radio against the wall. The greater flexibility of being able to use radio as an occasional piece of furniture in any part of the room has been lacking from many standard type radios.

But more important, the conventional method of delivering the program to the listener has restricted itself to a form of sound projection similar to the sound issuing from a cornet. In other words, a listener directly in front of the average radio receives its output full blast. Those sitting on either side of the radio hear it at a much lesser volume. The thought here was to equalize this situation so that radio would deliver the program on a non-directional basis and with equal volume to everyone. This means that the radio need not be turned up to the point of becoming a violent source of annoyance to the person sitting in front of it in order that others occupying more distant locations can listen to the program wanted.

International engineers claim to have solved this problem in their design of the Kadette "Equafonic." In this new model, which is of the arm-chair type, the speaker cone is mounted horizontally. Immediately above this cone is a special baffle, designed to carefully computed acoustical curves, which bend the sound waves and project them in all directions. The grilles are located on all four sides and equal volume intensity is obtained.

International Radio Corp.

RMA NEWS

IDAHO AUTO-RADIO BILL KILLED BY RMA ATTACK

Despite passage by the Senate, the Idaho bill to prohibit automobile radio has been killed through opposition developed by RMA. The radio and automotive trades and broadcasters, in Idaho and national organizations, joined RMA in defeating the bill.

Introduced by Senator R. E. Whitten and hurriedly passed on February 5 by the Idaho Senate, 22 to 20, the prohibitory auto-radio bill was killed in the Idaho House of Representatives. Its "State Affairs" committee, after a spectacular hearing at Boise on February 18 before the entire House of Representatives and a large applauding public audience, decided unanimously to "pocket" and thus kill the bill. It is doomed to die in committee, without a House vote which certainly would be overwhelmingy adverse.

After the bill's abrupt passage in the Idaho Senate, opposition of RMA members, radio and automotive trades and broadcasters was organized by Bond Geddes, executive vice-president of RMA, at Washington. He went to Boise and personally managed the opposing campaign and the public hearing in the Idaho House. The opposition campaign, which now has resulted successfully like similar attacks of RMA against similar legislation in Connecticut and St. Louis two years ago, was deemed necessary and authorized by President Muter, Chairman A. H. Gardner of the RMA Legislative Committee, and RMA Directors. The major objective in Idaho, to prevent such a prohibitory precedent against auto-radio, has been achieved; no state or city restricts or prohibits public use of automobile radio.

Great public interest in Idaho against the bill was manifest. An over-flow crowd of spectators, said by the Idaho press to be the largest in two years since a state sales tax was considered, was present at the public hearing. The hearing was arranged by Mr. Geddes with Speaker Troy D. Smith of the Idaho House and Chairman Robert G. Bailey of the "State Affairs" committee and the House of Representatives recessed especially for the hearing so that the entire House membership was present.

Idaho broadcasters were especially aroused against the bill, broadcast programs in a campaign of opposition and opened the public hearing. Broadcasters attacking the bill were C. G. Phillips of the Boise Station KIDO; J. W. Duckworth of the Idaho Falls Station KID, and Frank E. Hurt of the Nampa Station KXFD. Managing Director James W. Baldwin of the National Association of Broadcasters had notified all Idaho members and their cooperation was especially helpful.

Other speakers were Idaho representatives of the radio and automotive trades representing the Boise Radio Dealers Association, the Motor Equipment Manufacturers Association, the Motor and Equipment Wholesalers Association, the Automobile Manufacturers Association, the National Standard Parts Association, and the American Radio Relay League, all of whom gave valuable aid to the RMA in defeating the bill. About fifty representatives of the radio and automotive trades of Idaho attended the hearing.

Senator Whitten, the bill's author, urged the Idaho House at the hearing to approve the Senate's action and also pass the bill. His vigorous advocacy of the bill as a safety measure belied some reports that it was proposed as a joke. These reports marked its introduction but any jocular stage passed when the bill was formally passed by the Senate. Senator Whitten inveighed against "three thousand or six thousand pounds of steel pounding down the highway" with an automobile radio turned on.

The closing statement at the hearing was made by Mr. Geddes representing the RMA. He presented a detailed statement declaring that the bill was unnecessary, unenforceable, invalid, and actually unwise. Senator Whitten moved a vote of thanks to Mr. Geddes for his "complete and also dignified presentation."

On February 19, following the House hearing, the "State Affairs" committee voted unanimousy to kill the bill and it is scheduled to die in committee, in view of the overwhelming legislative and public sentiment for its defeat.

JANUARY EXCISE TAXES

Collections during January 1937 of the five percent tax on radio and phonograph apparatus by the U. S. Treasury were $683,578.06, an increase of 13.7 percent over the January 1936 collections of $601,-144.68. Both included taxes payable in January on previous December production.

Excise taxes collected on mechanical refrigerators in January were $392,886.01 compared with $210,143.58 in January 1936.

NOVEMBER LABOR INDICES

Declines in employment, stated in the government report to be "seasonal" in the radio manufacturing industry, are detailed in the latest report, for November 1936, of the U. S. Bureau of Labor Statistics.

Radio factory employment last November declined 3.5 percent, according to the current federal report for November, and November employment was 6.2 percent less than November 1935. The November radio employment index figure, based on the new revised index of the 1933 census, was 210.6, compared with the October index figure of 218.3.

Radio factory payrolls last November declined 4.7 from October 1936, and were 1.4 less than November 1935. The November index figure on payrolls was 169.4, compared with 177.9 in October 1936.

Average weekly earnings during October of radio factory employees were reported at $21.11, a decrease of 1.3 from October 1936 but 5.0 over November 1935 payrolls. The October national average of all manufacturing industries was $23.94, while the national average of all durable goods manufacturing establishments was $27.13.

Average hours worked per week in radio factories last October was 38.6 hours, a decrease of 3.2 percent from the average hours of 40.1 hours last October, and were 1.2 percent less than average hours of November 1935. The national average work hours of all manufacturing industries during November was 40.6 hours, while the national average of all durable goods manufacturing industries was 42.7 hours.

Average hourly earnings last November of radio factory employees was 54.7 cents, an increase of 2.0 percent over the average hourly earnings during November of 54.0 cents, and were 6.5 percent over average hourly earnings in November 1935. The national average hourly earnings in all manufacturing industries was 58.0 cents, and that of all durable goods manufacturers was 62.7 cents.

CHICAGO PARTS SHOW ASSURED OF SUCCESS

All expectations for the radio parts manufacturers' national trade show next June at Chicago have been exceeded. The goal of 100 booths set by the management for the show at the Stevens Hotel, June 10-13, was attained in one month, and latest report of booth reservations for the show was 106. Little additional booth space remains and a most successful show is now assured.

The thirteenth annual convention and membership meeting of the RMA will be held at the Stevens Hotel, June 8-9, immediately preceding the national parts show.

OKLAHOMA TAX BILL KILLED; OTHER RADIO LEGISLATION

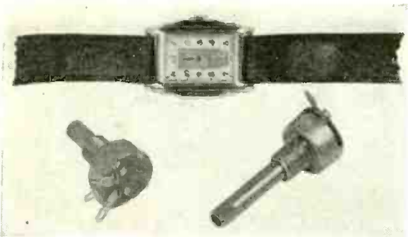
Many bills affecting radio have come from the forty-three state legislatures meeting in January and February, providing an unusually busy season for the RMA Legislative Committee, headed by Chairman A. H. Gardner of Buffalo, and Washington headquarters of RMA. Some of the legislation is designed to be helpful to industry and trade interests, such as a bill to prevent interference with radio reception.

A harmful bill, introduced but later defeated, was a "luxury" tax bill in the Oklahoma legislature proposing a 10 percent excise sales tax on radio, refrigerators, automobiles and many other articles. This bill has been killed after active opposition by RMA and other industry organizations. The RMA enlisted opposition of Oklahoma distributors and dealers and the bill died in the Oklahoma House of Representatives on January 29.

In the Connecticut Legislature a bill appropriating $340,000 for extension of the Connecticut police radio system has been introduced by Senator Daly. An appropriation would be provided for construction and radio equipment of new buildings at Colchester, Beacon Falls and Litchfield, and for radio and identification bureau installations and equipment.

In Arizona a bill providing for exemption from personal property tax of one automobile, one refrigerator and one radio has been introduced.

New Products



CENTRALAB CONTROLS

A series of controls which are claimed to be exceptionally small in size has been announced by Centralab, 900 East Keefe Avenue, Milwaukee, Wis. The controls are available in rheostat or potentiometer types with insulated or grounded shafts. The controls are said to be especially adaptable in the design on auto radio sets where compactness is essential.

— RE —

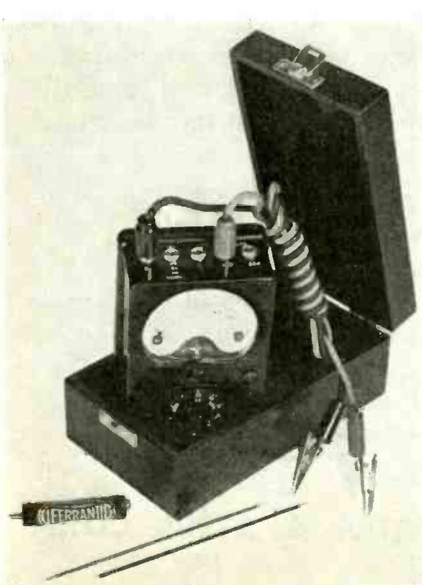
A-C, D-C CIRCUIT TESTER

Ferranti Electric, Inc., 30 Rockefeller Plaza, New York City, have announced a new a-c, d-c circuit tester for the communications field. This instrument, weighing only 14 ounces, is designed for the measurement of a-c voltage, d-c voltage, a-c mils, d-c mils, and ohms. It is contained in a polished black bakelite case and has a scale length of 2-½ inches.

There are five a-c voltage scales: 0-15, 0-150, 0-300, 0-450 and 0-600 volts. The six d-c voltage ranges are 0-3, 0-15, 0-150, 0-300, 0-450 and 0-600 volts. The a-c milliampere range is 0-1 mil, and the d-c milliampere ranges are 0-1, 0-7.5, 0-30, 0-150 and 0-750 ma. Resistance ranges are 0-50,000, 0-150,000, 0-750,000 ohms, and 0-7.5, 0-15, 0-30 megohms.

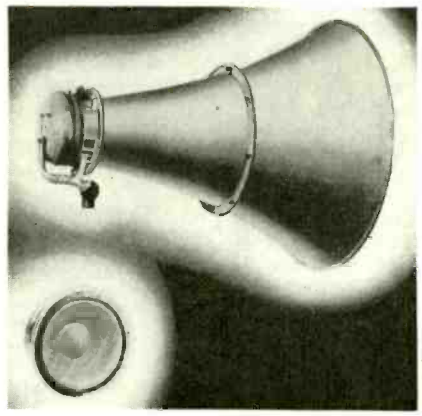
A clearly marked rotary switch is fitted at the front for range selection. The terminals of the instrument are of the socket type.

Complete descriptive literature will be supplied by the manufacturer. Write for Bulletin IN 1/B.



CINAUDAGRAPH HORNS

Announcement has been received that the Cinaudagraph Corp., Stamford, Conn., is making available a line of exponential horn speakers which are said to incorporate several basic improvements. The horns have been designed to withstand the most severe conditions imposed by weather or rough handling.



ATR VIBRATORS

The American Television & Radio Company of St. Paul, Minnesota, announces a complete line of replacement vibrators for auto and farm radios featuring longer life, improved performance, precision construction, and lower prices.

This company has had more than six years of experience in vibrator design and research, development and manufacturing.

A guide covering all ATR Vibrators is available direct from the factory, free of charge, on request.

MINIATURE PANEL INSTRUMENTS

A new line of round and rectangular design miniature instruments available in alternating-current, direct-current, rectox and radio-frequency types has been announced by the Westinghouse Electric and Manufacturing Company. For use as ammeters, milliammeters, microammeters, voltmeters, millivoltmeters, power level meters and voltohmmeters this line of Type 35 miniature meters is accurate, durable and easily read. Complete information may be obtained from the nearest Westinghouse office.

— RE —

PLUG-IN CONDENSERS

An innovation in condenser mounting is claimed by Tobe Deutschmann Corp., Canton, Mass., in their plug-in type. This condenser is of the electrolytic variety; it is mounted in a metal case with a standard octal base.

— RE —

FILAMENT ALLOY FOR TWO-VOLT TUBES

Under the name of "Tensite," the Wilbur B. Driver Co., Newark, N. J., has just introduced a new aluminum-nickel filament alloy peculiarly adaptable to 2-volt tubes. This material has a high hot tensile strength.

"Tensite" may be drawn down to .001 inch for the purpose mentioned, because of its high hot tensile strength, thereby offering the necessary resistance in the requisite length. The material is already finding its way into certain types of tubes produced by several tube manufacturers.

— RE —

MEISSNER WAVE-TRAP

A dual control wave-trap, designed to eliminate both i-f and broadcast band interference, has just been made available by the Meissner Mfg. Co., Mt. Carmel, Ill. The attenuation of the unwanted signal is said to be 40 db.

— RE —

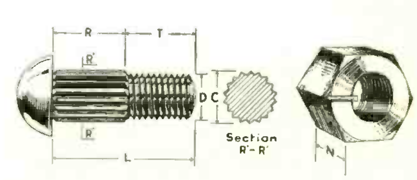
ARCTURUS TUBES

The Arcturus Radio Tube Company, Newark, New Jersey, announces that the following types have been added to their line which consists of glass, "G," Coronet, Sparton, Majestic and 15-volt tubes: 6J5G, 6K5G, 6U7G, 6V7G, 25L6G, and 950.

— RE —

RIB BOLT

The Structural Rib Bolt, announced as a practical substitute for riveting, is described in a bulletin from the Automatic Nut Co., Lebanon, Pa. An automatically locking nut, available in any standard thread, is also manufactured by the same company. Complete information may be obtained from the manufacturer.



TUNING INDICATOR

The Sunco Neon Tuning Wand Model No. 5146, made by the Sundt Engineering Co., Chicago, Ill., is a highly sensitive gaseous discharge current measuring tube for indicating oscillations, resonance, neutralization, modulation percentage and antenna currents on radio transmitters, diathermy equipment, etc.

Current is indicated by the height of glow along the 6" central electrode. The physical measurements are 8½" x ½" dia.

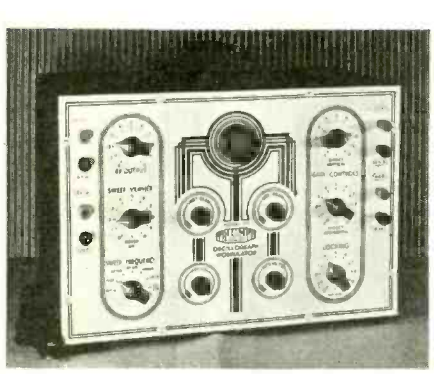
The tuning wand is coupled either directly or inductively to the equipment in much the same way as a thermocouple ammeter, and will not cause any appreciable change in the normal operating circuit. Short overloads do not affect the wand's operation, and the instantaneous action without lag makes it ideal for peak current measurements.

— RE —

OSCILLOGRAPH-WOBBULATOR

A complete oscillograph using the 913 cathode ray tube and thyratron linear sweep with horizontal and vertical amplifiers combined with an adjustable electronic wobbulator is the description of the new Model 77 Oscillograph-Wobbulator announced by the Triumph Mfg. Co., 4017 West Lake Street, Chicago, Illinois.

Substantial economics are made possible through the combination of the wobbulator with the oscillograph. A single full wave power pack employing an 80 rectifier tube supplies all d-c operating voltages. An 885 thyratron performs the dual function of supplying the linear sweep circuit and the single trace wobbulator. A 6A6 dual high gain amplifier provides the vertical and horizontal beam amplification.



DU MONT PRESENTS
BLACK-AND-WHITE C-R SCREEN

Due to the increasing demand by experimenters and the bright prospects of commercial television in the near future, Allen B. Du Mont Laboratories, Inc., have developed a screen material for cathode-ray tubes which allows a black and white picture. The intensity of the spot is approximately the same as the blue or green but is obviously more satisfactory.

The screen may now be obtained on the Du Mont 3", 5" or 9" cathode-ray tubes, types 34-XH, 54-8-H, or 94-8-H respectively.

Tests have been made on these various tubes for television reception and the necessary modifications have been made in them so that they can be used equally well in a cathode-ray oscillograph or television receiving set.

— RE —

CLOUGH-BRENGLE ANALYZER

In addition to offering an unusually complete array of a-c and d-c voltage ranges, the new Clough-Brengle Model 95 Super-Unimeter has direct reading capacity scales to cover all values from .00025 to 16 mfd. The resistance ranges allow accurate measurement of values from ½ ohm to 20 megohms. A complete listing of the voltage and current ranges, as furnished by the manufacturer, The Clough-Brengle Co., of 2815 W. 19th St., Chicago, Ill., is as follows: d-c volts, 0-5-50-500-1000, d-c ma, 0-50-500, a-c volts, 0-8-40-160-400-800, plus five resistance ranges and three capacity ranges.

— RE —

"M-SCOPE"

A new instrument, which, it is said, quickly locates buried pipes, cables, and other objects made of metal, measures their depth, and permits the rapid and accurate mapping of underground metallic systems, with their branches and supplementary equipment, has been announced by the Fisher Research Laboratories Sales Company, Board of Trade Building, San Francisco, Calif., and 45 Rockefeller Plaza, New York.

According to the announcement, this instrument, which is known as the "M-Scope," is of interest to all those who lay or use underground pipe or cable systems, or who excavate ground where such systems are located. By means of it, surveys can be made readily, records checked, and errors corrected. Lost lines, valves, manholes, etc., can be located. Unrecorded and illicit connections can be discovered. The stealing of water, gas, and oil can be detected and stopped. Costly exploratory excavations can be avoided. Damage to pipes and conduits and to excavating machinery during excavating and ditching can be prevented.

— RE —

ELECTRIC COUNTERS

Struthers Dunn, Inc., electrical control specialists of Philadelphia, have recently made available a new line of electric counters. These counters are available with five digits in either the reset or non-reset types.

NEWS OF THE INDUSTRY

AIR EXPRESS OBSERVES BIRTHDAY

More than 2,023 tons of air express were flown by the Railway Express Agency in the first full year of expanded service, beginning February 1, 1936, and ending January 31, 1937, it was announced recently. This visualizes the extent to which Americans are using the fastest present method of package transportation and delivery.

Gross revenue from air express for the twelve-month period increased 67½ per cent over the gross revenue of the old and new contract airlines for the corresponding period of 1935-1936.

The half-million mark was approached in the total number of shipments. Most of the 487,299 consignments for the year were carried by 500 regularly scheduled planes. There are, however, many occasions during the twelve months when the volume of business called for the dispatching of planes loaded to capacity with express and carrying no passengers. Ships always are available for this purpose, it was said.

The first regular air express service in the United States was started by Railway Express September 1, 1927. It was expanded from time to time until early in 1936, when contracts signed by L. O. Head, president of the company, extended the service over seven additional airlines. As of February 1, 1936, Railway Express became the exclusive express handler for twenty-three airlines. This marked the end of the period of transition from emergency and "stunt" shipments and the beginning of the acceptance by shippers of air express as a necessity in modern transportation.

— RE —

PHEOLL BUILDS PLANT ADDITION

The Pheoll Manufacturing Company, 5700 Roosevelt Road, Chicago, Illinois, manufacturers of screws, bolts and nuts, are constructing a two-story addition to their factory fronting three hundred feet on Roosevelt Road and extending back seventy-five feet to connect with the present factory building.

— RE —

SCHENCK REPRESENTS CROWLEY

Henry L. Crowley & Company announce the appointment of LeRoy Schenck, manufacturers' representative with offices at 570 Lexington Avenue, New York City, to handle their manufacturers and jobbers sales on Crolite products consisting of condensers, resistors, ceramics and magicores for the New York Metropolitan district and New Jersey.

— RE —

LEPEL APPOINTS SALES MANAGER

Vincent S. Wagner has been placed in charge of engineering and sales by the Lepel High Frequency Laboratories, 39 West 60th Street, New York City. Lepel manufactures high-frequency converters ranging in capacity from 3½ to 20 kva. Literature on this equipment will be furnished by the manufacturer.

— RE —

CORNELL-DUBILIER CATALOG

Specifications on the new type TL capacitors are now available in Cornell-Dubilier's Catalog 135A. The type TL's are high voltage paper condensers, impregnated with filled with Dykanol. These capacitors, conceived and recently developed in the laboratories of the Cornell-Dubilier Corporation, are extremely compact, yet retain the excellent characteristics of the more bulky types. Especially suited for power supplies and high fidelity amplifiers. Address requests for Catalog 135A to the Cornell-Dubilier Corporation, South Plainfield, N. J.

Octave Blake, president of the Cornell-Dubilier Corporation, announces that all C-D condensers are union made under a contract with the International Brotherhood of Electrical Workers, affiliated with the A. F. of L.

— RE —

IRC MANUAL

A handy, pocket size manual in durable cover containing complete resistor information for engineers and designers of electric and electronic equipment has just been issued by the International Resistance Company, 401 North Broad Street, Philadelphia, Pa. A copy will be supplied free on request to engineers and designers who request it on company stationery.

— RE —

WESTINGHOUSE OFFICE MOVES

The Westinghouse Electric and Manufacturing Company will move its Pittsburgh office and some of its general offices now located at East Pittsburgh to the Union National Bank Building in Pittsburgh. Occupying nine floors of the building, from the fifth to the thirteenth floors, the Pittsburgh district office, subsidiary district offices and headquarters offices including executive, legal, industrial relations, sales and accounting department, will be centrally located in the Union Bank Building to facilitate their operations.

Formerly the company's district office and subsidiary offices had been in this same building. The move will be made about May 1.

— RE —

WRS CATALOG

The Wholesale Radio Service Co., Inc., of 100 Sixth Avenue, New York, announces the release of the new Spring and Summer 1937 catalog No. 68. This catalog, like its predecessors, is distributed free of charge. This catalog has 116 pages and contains over 2,000 illustrations. All wave and short wave receivers, transmitters, and transmitter parts, experimenter parts, service replacement parts, a complete line of service test equipment and the latest 1937 Lafayette Radios are listed in a comprehensive collection of radio items.

— RE —

GENERAL CABLE CATALOG

General Cable Corp., 420 Lexington Avenue, New York City, has just published a new booklet, "Building Wires and Cables." Copies may be obtained by writing to the company at the address given.

— RE —

TRANSTAT BULLETIN

A bulletin which completely describes the Transtat voltage regulator has just been issued by the American Transformer Co., 178 Emmet Street, Newark, N. J. Copies may be obtained by writing to the manufacturer.

— RE —

INDUSTRIAL PACKINGS

In order to insure the most efficient application of industrial packings to the specific purposes for which they were designed, United States Rubber Products, Inc., has issued a 112 page manual on the subject. The manual, which is one of the most complete ever compiled for use by electrical engineers, has required the efforts of many engineers and technicians in its preparation.

Copies may be obtained by addressing the company at 1790 Broadway, New York City.

— RE —

SOLAR ISSUES NEW SERVICE CATALOG

A new complete condenser catalog designed for easy reading and reference is announced by the Solar Manufacturing Corporation of 599 Broadway, New York City. Designated as catalog number 8-S, this new reference book devotes two full pages to each type of condenser. Each type is illustrated by both a photograph and a diagram.

— RE —

CRESCENT WIRE CATALOG

A comprehensive, yet compact catalog bulletin of four pages has just been published by the Crescent Insulated Wire & Cable Co., Trenton, N. J.

Complete information is given on various types of insulation and coverings; rubber jacketed, lead sheathed and varnished cambric cords and cables together with weatherproof wire and cable, Armored Bushed Cable, Cresflex, a non-metallic sheathed cable, Parkway Cables and Special Cables.

Data on Crescent Building Wire and Cable and conduit sizes for Rubber Covered Building Wire are set up in convenient table form for ready reference.

In its entirety, the new bulletin will make a valuable addition to the catalog files of those who wish to specify the latest and best types of wire and cable to meet their particular requirements.

— RE —

ALADDIN TECHNICAL BULLETIN

Technical bulletin 536 has been published by the Aladdin Radio Industries, Inc., 466H West Superior St., Chicago, Ill. The bulletin, which can be obtained from the manufacturer, describes in detail the Polyiron inductors produced by this company.

— RE —

TAYLOR FIBRE COMPANY

Announcement is made that Taylor & Co. will be known in the future as the Taylor Fibre Company. The company's address remains Norristown, Pa.

— RE —

A CASE AGAINST RADIO

(*Continued from page* 18)

old comb-and-tissue paper combination, and little more that is worthwhile. Moreover, with this loss of volume there must necessarily be an accompanying loss of all the delicate shadings, all the subtle gradations of extended crescendos and decrescendos. Much of the music, therefore, is lost to the radio listener—if not the melodies and harmonies themselves, at least all the finer points of the interpretation, all the delicacies of expression, perhaps the entire spirit of the opus.

Again, take piano music as it comes to the listener over the air. Where are all the splendid dynamics so dear to the hearts of all lovers of the piano? Where is the resonance, the rich tonal abundance that the master pianist can give us? What comes to the radio listener is merely a demonstration of manual dexterity, a reproduction of the notes, but not the true "feel" of the music. It resembles real music as much as a snapshot negative resembles its original. Instead of a performance with a soul, we get the tinkle-tinkle of an old-fashioned music box. The piano is only one instrument, but what has been said of it applies to all the others as well. If the piano seems tinny, the violin sounds nasal, the flute too shrill, the horns too flat or too brassy, the drums dull and sodden, and so on.

Therefore, even allowing for small prejudices, radio today is deserving of just criticism from the standpoint of musical reception. Tonal quality is poor, satisfactory volume impossible of attainment, and these two factors combine to take from the radio listener a great part, if not all of the purity and beauty of the effects produced by the musician's best efforts. Eventually, let us hope, all these difficulties will be overcome, reception, even in the average, inexpensive set, will be perfect and music will pour forth from millions of loudspeakers in glorious, golden tones. But even when that day arrives, and every home has its own perfected radio, when programs are all arranged for adult intelligence and advertising patter is down to the irreducible minimum—when all these ideal conditions are available to everyone, and a broadcast is scheduled for the combined Boston, Philadelphia and Philharmonic Orchestras—and I am offered a gallery seat for a second-rate piano recital by some obscure artist, eight-twenty will find me, not in my favorite chair puffing away on my pipe and manipulating the dials, but crowded into an uncomfortable seat close to the roof of some stuffy concert hall, scanning the program with eager interest.

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