THE BROADCAST ENGINEERS' JOURNAL
ED. STOLZENBERGER, EDITOR
116-03 91ST AVENUE RICHMOND HILL 18, N. Y.

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OFFICIAL PUBLICATION OF THE NATIONAL ASSOCIATION OF BROADCAST ENGINEERS AND TECHNICIANS

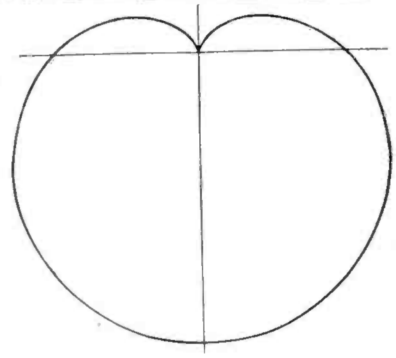
The Broadcast Engineers' Journal

VOL. 14 No. 7

JULY 1947

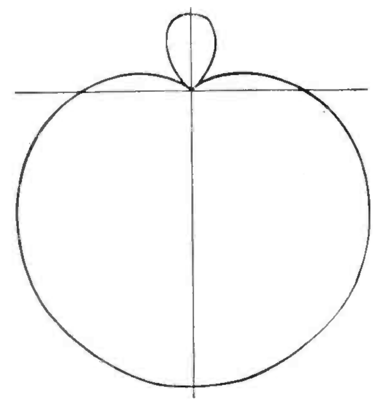
SINCE 1934 -- OF, BY, AND FOR THE BROADCAST ENGINEER

. . This is Cardioid



"Cardioid" means heart-shaped. It describes the pickup pattern of a microphone as illustrated in this diagram. Unwanted sounds approaching from the rear are cancelled out and the pickup of random noise energy is reduced by 66%. The actual front to back ratio of reproduction of random sound energy is 7 to 1.

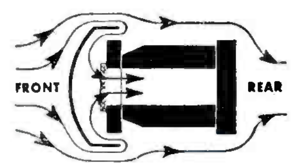
. . This is Super-Cardioid



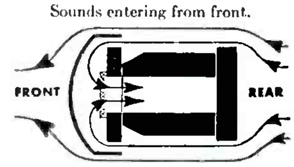
"Super-Cardioid" also describes a pickup pattern and is a further improvement in directional microphones. The Super-Cardioid has a wide front-side pickup angle with greater exclusion of sounds arriving from the sides and the rear. The front to back random sound ratio is 14 to 1 which makes it twice as unidirectional as the "Cardioid." A 73% decrease in the pickup of random noise energy is accomplished.

. . This is Uniphase

"Uniphase" describes the principle by which directional pickup is accomplished in a single Microphone unit. This is a patented Shure development and makes possible a single unit "Super-Cardioid" Directional Microphone eliminating the necessity of employing two microphone units in one case—it gives greater uniformity in production, greater ruggedness, lower cost for comparable quality and more uniform vertical pickup pattern.



Sounds entering from front.



Sounds entering from rear.

. . This is the result

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Editorial, Advertising and Circulation Offices:
116-03 91st Avenue, Richmond Hill 18, N. Y.
Telephone: VIrginia 9-5553

Volume 14, No. 7   409   July, 1947

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THE BROADCAST ENGINEERS' JOURNAL

OFFICIAL PUBLICATION OF THE N.A.B.E.T.

The Broadcast Engineers' Journal is a privately printed monthly publication issued by NABET Publications. Address all communications to Publication office: E. Stolzenberger, 116-03 91st Avenue, Richmond Hill 18, L. I., N. Y. Telephone VIrginia 9-5553.

Advertising rates and information supplied on request. Subscription, $2.50 per year; $4.00 for two years. Single copies, except Christmas Yearbook, 35c; Christmas Yearbook, $1.00. All remittances in advance. Foreign: add postage. Back copies 50c, back Yearbooks, $2.00.

NATIONAL N.A.B.E.T. OFFICE
Room 501, 66 Court Street, Brooklyn 2, N. Y.
A. T. Powley, President

NABET ACTIVITY

ONE of the major disputes won by the NABET Negotiating Committee was the insistance that the wage scales remain the same from coast to coast. NBC-ABC Management was demanding that the living cost differential be reinstated again. If they had been successful in this move, it would have re-established a practice which NABET had spent many years in combating. In view of the recently passed Taft-Hartley Labor Law, I have asked NABET's attorneys to prepare a full explanation of how this new law will affect NABET organizationally, and what effect the law will have on existing and future NABET contracts.


A. T. POWLEY

The NBC-ABC contracts have been printed in booklet form and have been mailed to all chapters.

You have no doubt learned that the IBEW-CBS contract has been signed, the wage scale being the only change over the old contract. This scale calls for $125.00 tops per week in the Group 2 classification. This is, as I predicted when their committee left town in March, —— an agreement was made whereby whatever NABET secured in the way of an increase, CBS would better it, without the necessity of negotiating. It was also planned at that time by the IBEW that if we were forced to strike, IBEW would furnish strike-breakers and thereby take over NABET. Fortunately, this phase of their strategy never came to pass.

Here in New York, there have been several joint meetings of the three New York Chapter Councils for the purpose of forming one New York Chapter, fighting Local 1212 propaganda and securing the services of a local business agent. It was finally concluded that the three chapters would not join but remain under their present charters. The question of the 1212 propaganda will not be outlined here except to say that certain plans have been effected which will be carried out locally. The local council felt that as there existed over five hundred members within the New York area, that there should be a full time business agent to represent them here, whose time would be exclusively taken up with matters of the three local chapters. However, it was shown that the three local chapters could not support a business agent without an increase in local dues. The Hudson Chapter flatly refused to go along with an increase in dues, but still insisted that a local business manager be secured, whose salary should be paid by the National organization. The other two chapters did not agree in this instance but recommended that a National Representative be appointed to take care of the New York area including New York State and the New England stations. The Hudson Chapter finally agreed to go along with this idea until the next National Council Meeting in October, when it will be brought up for discussion by their chairman. The

(Continued on Page Twenty-two)

LIVENESS IN BROADCASTING

. . . It Gives Life, Reality and as much as 6 db Extra Coverage to AM and FM Broadcast Programs

Reprinted by permission from the Western Electric *Oscillator*

By J. P. Maxfield
Bell Telephone Laboratories

WHEN your friend tells you the news, do you prefer to have him sit comfortably in your home with you or to talk at you from a box? When you attend a concert, do you prefer to be in the audience and hear the sweep of the music through the hall, or to have the sound shot at you from a cabinet? Your radio can now bring your favorite newscaster, in living reality, to your home, or can transport you to the best seats in the concert hall. This article tells you how it is done.

Under normal conditions, you listen to an orchestra, a singer, or perhaps to someone telling you the latest news, with two ears. The binaural sense which results from the use of the two ears enables you to pay attention to the sound arriving from any desired direction and to partially exclude the sound from other directions. Similarly, you easily separate nearby sounds from the more distant ones. You have, therefore, two means of accentuating at will, certain parts of the sound.

If, however, the sound has been picked up by one or more microphones, and reproduced through a single loudspeaker, your binaural ability to pay attention to the sound from any desired direction is completely lost. This results in an apparent increase in the "liveness" or reverberation present and also in the intensity of the incidental noises. However, your ability to distinguish between nearby and distant sounds is in no way impaired, but is frequently enhanced.[1,2]

Therefore, the situation may be summarized as follows:

(1) You have lost all ability to accentuate at will certain parts of the sound such as solo artists, by the help of the direction from which that particular sound comes.

(2) You still maintain your ability to accentuate by the distinction between nearby and distant sounds.

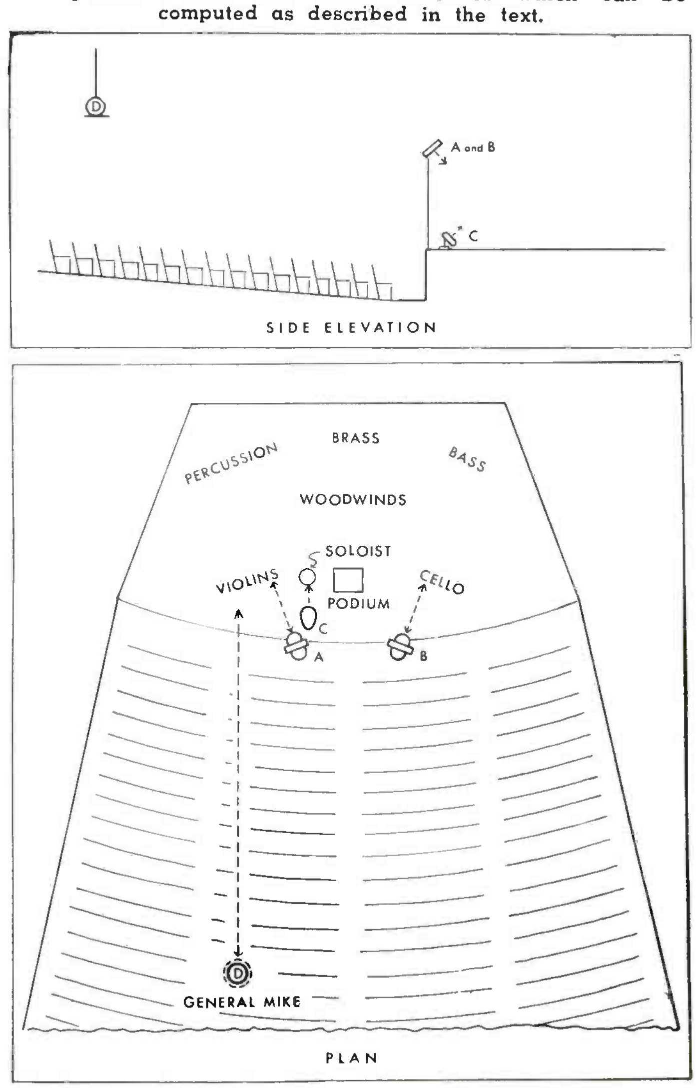
View of famed New York Philharmonic Symphony at Carnegie Hall, where technique of microphone placement and control described herein is used in weekly broadcasts.

(3) The liveness, i.e., the apparent amount of reverberation has been automatically accentuated.

Any studio technique which is to reproduce life-like and realistic programs must (1) provide the studio engineer with a means of supplying the necessary accentuation lost by the failure of the binaural sense, (2) provide the engineer with means of making full use of the distinction between nearby and distant sounds, (3) eliminate the undesired accenuation of the apparent liveness.

This is particularly true, as the sense of realism experienced by the listener is as much dependent on the micro-

Figure 1—Large auditorium with a symphony orchestra. A. and B, accentuation microphones; C, solo microphone; D, general microphone. Dotted lines show distances which can be computed as described in the text.



phone placement and the studio acoustics as it is on his home conditions.

Greater Coverage

The purpose of this article is to describe a technique of studio and auditorium sound pick-up which fulfills the above requirements and which places control of the desired accentuations on the dials of the studio mixer panel. Fortunately, the correction for the increased apparent reverberation can be accomplished by the initial placement of the microphones used.

One of the important advantages of this live type of pick-up is as much as 6 db gain in coverage at no extra expense to the sponsor or the broadcasting company.[3]

This unexpected gain is a result of the manner in which the ears of the listener perform. For a given power supplied to the loudspeaker, the loudness of a program picked up with this new technique can be 6 to 8 db greater than the loudness of programs from "dead" pick-ups. Since this gain in loudness permits the listener to operate his receiving set with a correspondingly lower electrical gain, static and other noises are reduced by this amount. Thus, this effect is a real gain in coverage.

In view of this apparently complicated situation, a search was made for some simple acoustic constant which would clarify the studio problems. Such a constant has been derived mathematically and checked by practical application to studio practice.

This constant is called *liveness* and represents the acoustic properties of an enclosed space, such as a studio or auditorium, including the effect of the distances from the artists to the pick-up microphones.[4] The properties of this constant are such that the formula can be readily applied to the use of one general or "over-all" microphone in combination with the necessary additional microphones for accentuation purposes.

The liveness formula is:

$$L = \frac{1000T^2D^2}{G_pV} \qquad (1)$$

where L = Liveness
- T = Reverberation Time in Seconds
- D = Distance from Sound to Microphone in Feet
- V = Volume of Studio in Cubic Feet
- G_p = Directivity of Pick-up Microphone from source to microphone.

The value of T used for the practical application of this technique to broadcast pick-up is an average of the values over the frequency range from 500 cps to 2000 cps. Where this average is unknown, the value at 1000 cps or even 500 cps may be used as a guide.

The range of the limits of liveness for satisfactory binaural listening is very great but is quite narrow for monaural or single channel reproduction. However, experience has shown that with single mike pick-up the limits of the value of liveness selected for best monaural pick-up always lie within those acceptable for direct listening. This means that in the concert hall, for example, the microphone position is always farther from the sound source than the front row of acceptable seats but nearer to the sound source than the rear row. The center of the monaural range is always closer to the source than that position generally rated as best for direct listening. This increased closeness of the monaural microphone automatically removes the accentuation of the apparent excess reverberation present.

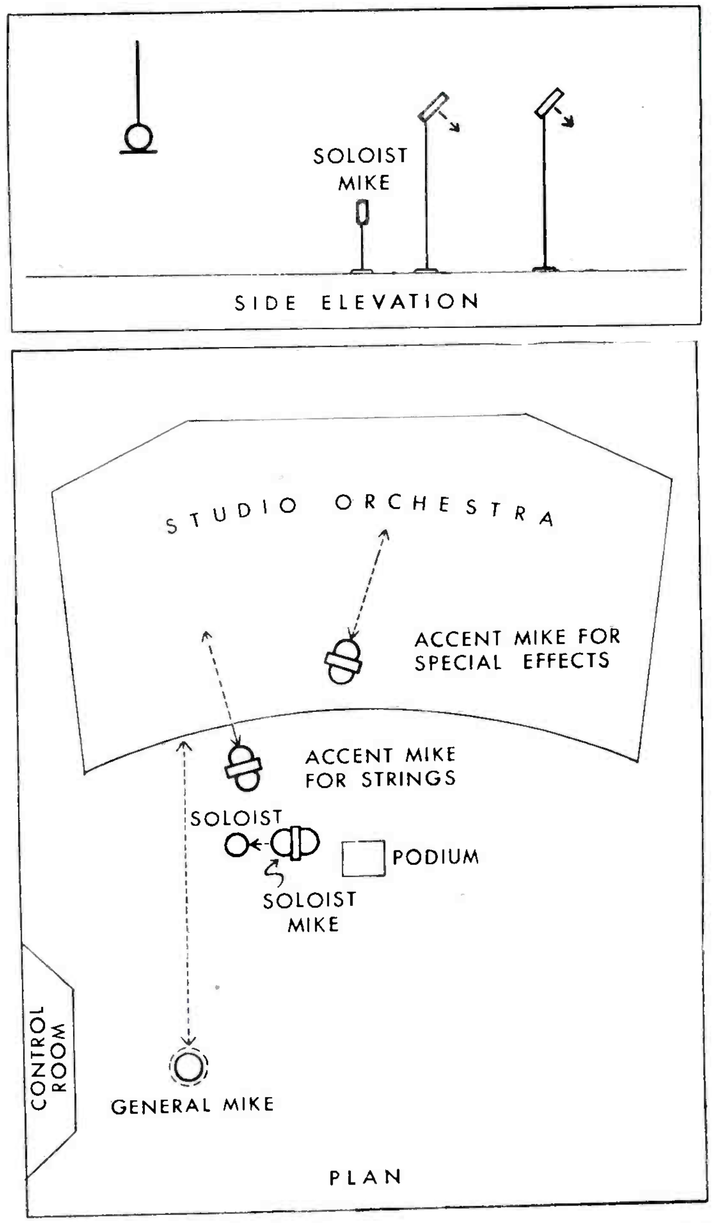


Figure 2—Plan and side elevation of normal studio, set up for orchestra with vocals. It should be noted that all of the Accentuation Microphones in this arrangement are not necessarily used at the same time.

The full useful range of liveness for monaural pick-up varies materially from one type of sound to another as, for instance, from symphony orchestra to solo singing to speech. Table 1 shows the values of the monaural liveness range for several different types of sound when picked up for reproduction in average living rooms. It may be of interest to know that where the reproducing space is abnormally live, both limits of the useful range are moved upward, not downward. Where the listening space is abnormally dead, the values must be decreased accordingly.

Table 1

Type of Sound	Liveness Range
Piano	4 – 16
Symphony Orchestra	5 – 20
Small Orchestra	3 – 12
Solo violin, cello, etc.	1 – 4
Solo singing	1/2 – 3
Speech	1/6–2/3

Increased Sense of Reality

If sound is reproduced from a pick-up in which the liveness is controlled within the useful range as shown in Table 1, the subjective effect might be described as the acoustic re-creation of the pick-up space around and behind the loudspeaker position. This effect adds greatly to a sense of reality and renders music or speech both natural and "easy to listen to". Under these circumstances, it is difficult to locate the position of the loudspeaker laterally, the sound appearing to flood in from behind it through an opening completely across the room. In other words, the effect is that of adding the studio space behind the plane of the loudspeaker without any intervening wall.

When the liveness is near the lower limit of the useful range, you get the impression that the sound is situated in the near end of this added space. In the case of a person speaking, there is the illusion of a real person speaking from the position of the loudspeaker.

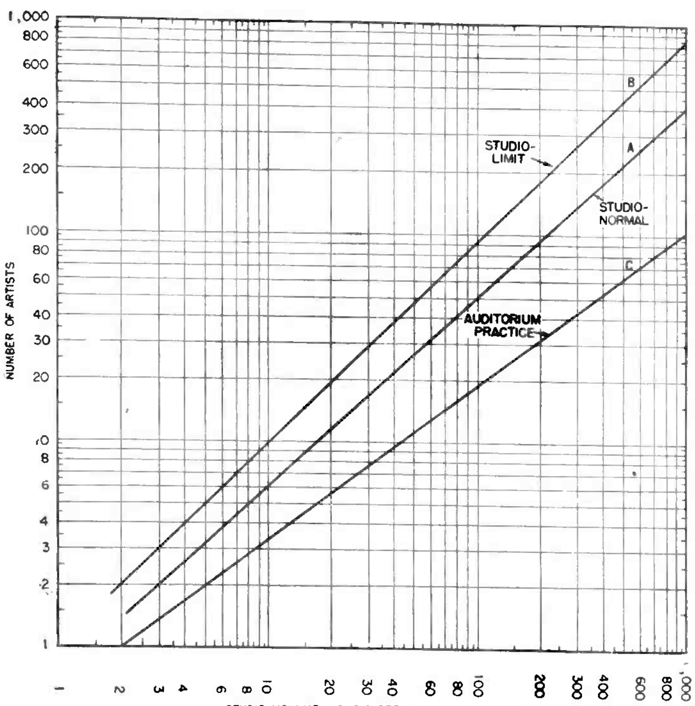


Figure 3—Relation between number of artists and studio size. A, shows good studio practice; B, maximum crowding without loss of realism; C, for comparison, shows auditorium conditions for symphonic music.

When, however, the liveness is near the upper limit of the useful range, the source of sound appears to be considerably behind the plane of the loudspeaker as if it were coming to the hearer from a position in the remote end of the added space. In the case of broadcasting large symphony orchestras, this control of liveness enables one to so broadcast a concert that the listener in his home may

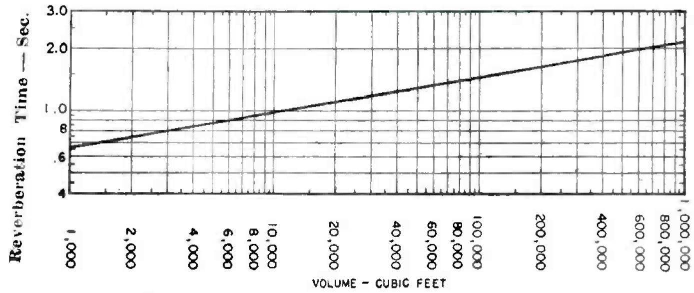


Figure 4—Curve showing optimum reverberation time with artists in place, as a function of studio or auditorium size. Any values within 30% of above can be compensated for by microphone placement.

seem to occupy any seat from the front to the back row of the auditorium. Since most auditoria have seats which music critics consider to be best, it is desirable to control the liveness of the broadcast so that the listeners are placed acoustically in that portion of the auditorium.

When pick-ups are made with a liveness value well below the useful range, this effect of added space disappears and one is aware of the sound being projected from the box containing the loudspeaker. Under these conditions, it has an artificial quality which could never be mistaken for the presence of a real person or a real orchestra. This effect might be called "absence" as opposed to the much desired "presence" of good broadcast pick-up.

Under these dead conditions, the lateral position of the loudspeaker can be accurately located by ear and the interpretation of quality is quite sensitive to one's position with respect to the high frequency beam of the loudspeaker and to the volume at which the sound is being reproduced.

On the other hand, when the liveness value is well above the upper limit of the useful range, one can again locate, with ease, the position of the loudspeaker. However, instead of feeling that the sound is being projected from a point source, the hearer experiences the effect of the sound reaching him through an open window from a room which is much more reverberant than the one in which he is listening.

Considerable evidence has been obtained that the public much prefers recordings made well within the useful range and in the case of orchestral music near its upper limit.

The advantages of this type of pick-up may be summarized as follows:

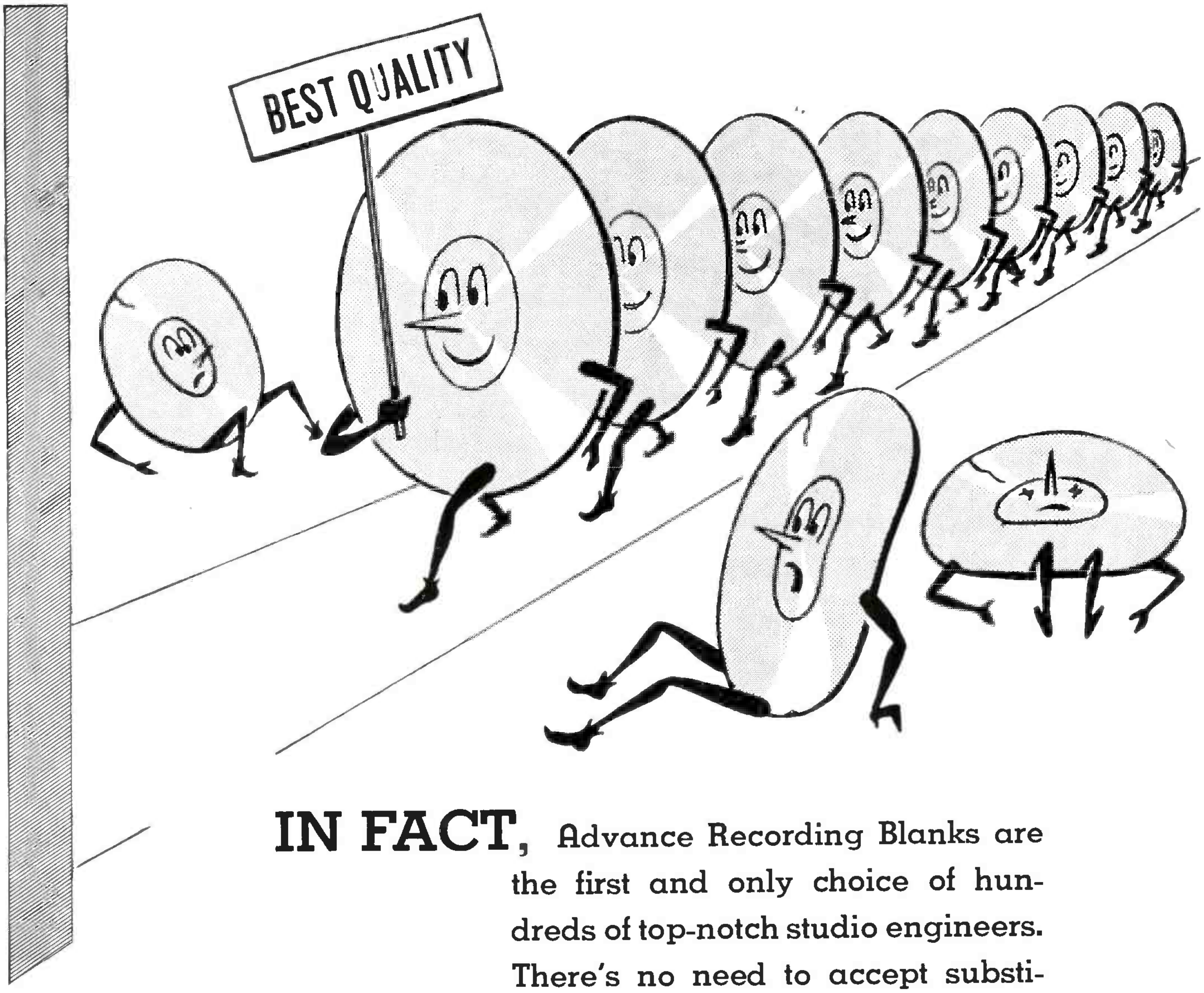
(1) The 6 db gain in coverage previously mentioned.

(2) When operating within the useful liveness range, the amount of manual volume control normally necessary with dead pick-up is markedly decreased without either overloading the equipment or causing the sound to sink into background noise, and therefore permits a higher average per cent modulation.

(3) For a given volume range as indicated by the vu meter, reproductions from monaural sound pick-ups made within the useful range have an apparent volume range nearly twice that of similar reproductions from dead pick-ups.

(4) The change in quality of the monaurally reproduced sound as a function of the loudness of reproduction is materially reduced. This characteristic may be best illustrated by two contrasting cases.

No Substitutes Accepted . . .



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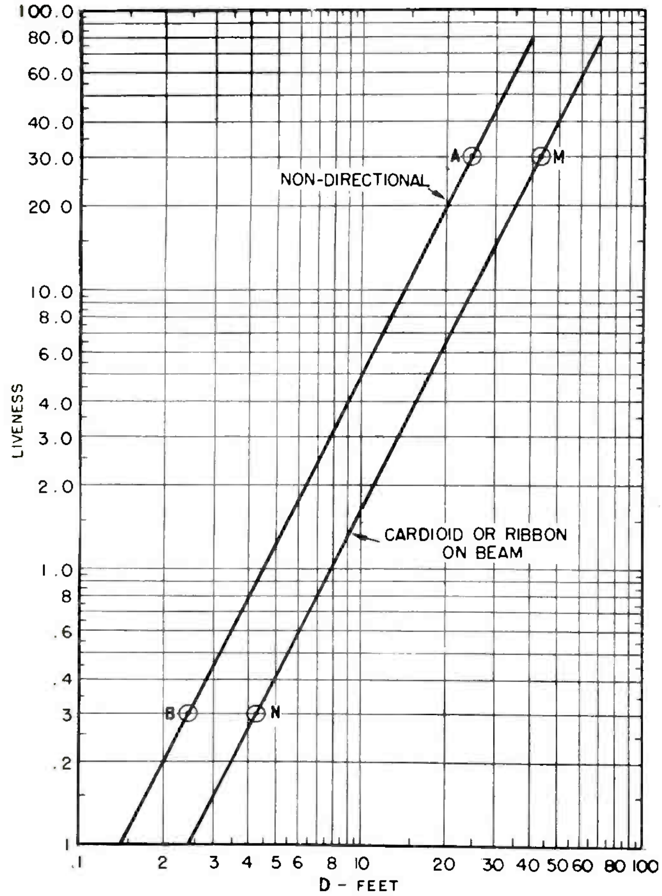


Figure 5—Typical chart used for positioning General and Accentuation Microphones in active studios.

Case 1—Assume that the sound from an orchestra, for instance, has been picked up under conditions of liveness well below the useful range and that this sound has been balanced for reproduction at an average intensity level of 75 db at the ear.

If this sound is now reproduced at an average ear level substantially lower than 75 db, marked distortion of the balance takes place. The lower notes and the high harmonics appear to be greatly attenuated. A similar effect in the reverse direction occurs if the sound is reproduced at a level substantially higher than that for which it was balanced. An equalizer introduced into the reproducing circuit will correct this unbalance if its characteristics correspond with the differences in the loudness contours of the Fletcher-Munson curves.[5]

Case 2—Assume that the sound referred to in Case 1 has been picked up under conditions of liveness well within the useful range and as before, has been balanced for reproduction at an average ear level of 75 db.

If this sound is reproduced at either an average ear level substantially lower or substantially higher than 75 db, very little if any apparent change of quality is noticeable. This advantage is of great value to the listening audience as it enables the listener to reproduce a sound in his living room at any desired level without a corresponding loss of quality.

Two or More Microphones

The pick-up technique being described consists basically of the use of (1) a microphone situated at some distance from the performers to pick up the general blend of sound and (2) one or more accentuation microphones for accenting desired portions of the orchestra, soloists, etc.[6] This accentuation is obtained by controlling the liveness instead of the loudness.

The general microphone preferably has nondirectional characteristics as typified by the Western Electric 640 AA or the 633 Type. The accentuation microphones are usually of the bidirectional or of the cardioid type typified by the Western Electric 639 Type. Any high quality microphone, having the proper characteristics, will operate in an entirely satisfactory manner.

Figure 1 on page 4 shows a qualitative arrangement for a symphonic broadcast with soloist, and some orchestral accentuation, while Figure 2 on page 5 shows a typical studio-set-up for orchestra with vocals. It should be realized, of course, that all of the accentuation microphones are not necessarily used simultaneously.

Arrangements such as these insure the fulfillment of the following requirements:

(1) Over-all liveness control is available to the sound engineer at all times during the broadcast.

(2) Accentuation control is similarly available at all times.

(3) The loss, by failure, of any one microphone does not render the pick-up unsuitable for broadcast.

(4) The arrangement is versatile and capable of rapid adjustment during rehearsal.

The employment of this technique requires studios with acoustic properties of a "pleasing" nature, i.e., studios of good acoustic properties.[7] It also requires that studios shall not be overcrowded.

Figure 3 shows the relation between the number of artists and the studio size.[8] Curve A represents good studio practice while Curve B represents the maximum crowding possible without loss of realism. Curve C is given for comparison only and represents auditorium conditions for symphonic music.

Figure 4 shows the optimum reverberation time with artists in place, as a function of studio or auditorium size.[4] Any values within 30 per cent of those shown can be compensated for by a proper choice of microphone positions.

Placement and Control of Microphones

A. Positioning the General or Over-all Microphone.

1. Choose from Table 1 the maximum value of liveness necessary for any part of the program. For instance, for a studio pick-up of a dance orchestra with vocals the maximum value of L is 12 for small orchestra.

2. Choose a value 1.5 times this (L=18) as suitable for the overall microphone. The increase of one and one-half is to allow you margin for leaving some accentuation microphones in circuit at all times without reducing the general liveness too much.

3. Determine the distance D from equation (2) below. D represents the distance of the microphones from the front of the orchestra.

Equation (1) may be solved for D and we get

$$D = \frac{\sqrt{L \times V \times G_p}}{31.6T} \qquad (2)$$

Where studios are in active use, a set of curves as shown in Figure 5 may be prepared. To aid you in preparing such a chart the following typical case is worked out in detail.

Assume a studio whose volume V is 30,000 cu. ft. and whose reverberation time T, with musicians in place, is 1.2 seconds. For nondirectional microphones $G_p = 1$ and for bidirectional or cardioid type $G_p = 3$ for sound sources on their beams. Assume a range of L from 0.3 to 30.

From equation (2) for a nondirectional microphone we get

$$D = \frac{\sqrt{30 \times 30{,}000 \times 1.0}}{31.6 \times 1.2}$$

$$= 24.6 \text{ ft. for } L = 30.$$

Similarly $D = 2.46$ ft. for $L = 0.3$

Plot these two points (A and B of Figure 5) and connect them with a straight line. From this chart the distance D corresponding to any desired value of liveness may be obtained for a nondirectional microphone.

To obtain the plot for bidirectional or cardioid microphones proceed in a similar manner letting $G_p = 3$. Then we obtain the points M and N, Figure 5. Connect these with a straight line.

This completed chart is now available for use in positioning the general microphone and, as described in the next section, for positioning the accentuation microphones also.

B. Positioning the Accentuation Microphones

1. Choose from Table 1 the minimum liveness for the portion of the orchestra, the soloist or other source to be accentuated. For instance, for solo parts in the string section choose L = 1.0 (Solo Violin, etc.) or for a vocalist choose L = ½ (Solo Singing).

2. Choose a value which is two-thirds of that obtained from Table 1 as the practical operating liveness for the accentuation microphone. This decrease to two-thirds is to allow you margin for the increase in liveness due to the over-all microphone which is always in circuit.

3. Choose a suitable type of microphone, cardioid, bidirection or nondirectional. One of the directional types is usually preferred as the accentuation microphone, since it can be "beamed", i.e. partially limited to the sound sources on or adjacent to the high sensitivity axis.

4. Determine the distance D from Equation (2) or from the studio chart typified by Figure 5. If you are using this microphone for accentuation of the string section or any other group of artists, D represents the distance from the microphone to the nearest artist in that group.

5. Proceed in a similar manner for any other accentuation microphones which may be necessary.

C. Determination of Approximate Mixer Dial Settings.

No hard and fast rules can be given for control of the amount of accentuation necessary. This amount depends upon the type of program and upon the nature of the esthetic or dramatic illusion you are trying to create for the listener.

However, there are some general considerations which will help you acquire experience more rapidly than is possible with mere "cut and try" methods. In the first place, make it a rule to start your rehearsal with the general microphone only—all others being out of circuit. Then slowly fade in the accentuation microphones until the desired result has been obtained. When in doubt, use less accentuation than appears desirable over your monitor. This is due to the fact that most monitoring rooms are both smaller and acoustically more dead than the average living room.

The details of this mixing technique are described in Appendix 1 on page 10. General adherence to the methods outlined there will result in the production of acceptable programs with very little rehearsal.

Important Applications

There are three broad classes of programs to which this technique has been successfully applied: namely, (1) Large concert hall pick-up, such as symphony orchestra, opera, choral singing, etc., (2) Studio music programs with or without vocals, (3) Speech only, such as news, lectures, announcements, etc.

1. *The Large Concert Hall Type of Program.* The most pleasing broadcast of a symphonic or operatic program is the one which creates for the listener the illusion that he is actually present in the auditorium. That effect is obtained when the liveness of the orchestra, including accentuation of any section such as strings, woodwinds, etc., lies between 8 and 20. A good average value for heavy music is 16 while for light delicate music a value of 10 is often preferable.

If the orchestra is accompanying a soloist, for instance, a violinist, a singer or a pianist, the liveness value for the soloist should never be less than one-quarter of the orchestral liveness and should preferably be between one-half and one-third. When the one-half of orchestral liveness is used the soloist is well out in front of the orchestra. As the solo liveness is increased the voice or solo instrument seems to move back and finally becomes merely an accentuated part of the orchestra itself.

The method of determining the dial settings to obtain these effects will be described in detail in Appendix 1. If you will use the quantitative method for setting the dials on your first few rehearsals with this new technique you will soon find that you easily recognize the desired effects by ear and no longer require the computed values, except for an approximate check.

Figure 1, page 4, shows the approximate arrangement of the microphones for the broadcast of the New York Philharmonic Symphony concerts by CBS on Sunday afternoons. This arrangement was arrived at in cooperation with Howard A. Chinn, CBS's Chief Audio Engineer after experimentation, with the valuable assistance of engineers and production personnel of the Columbia Broadcasting System.

Table 2 shows the liveness value for each of the three microphones and the power used, expressed in db above (+) or below (—) the power supplied by the over-all microphone D, Figure 1.

Table 2

Mike	L	db
D (general)	21	0
A (violin section)	0.6	—18 to —12
B (cello section)	0.6	—18 to —12
C (soloist)	0.5	not used

The effective liveness of this arrangement is about 13, which value is well within the useful liveness range shown in Table 1.

2. *Studio Music Programs with or without vocals.* As before, the most pleasing result is obtained when listener feels that he is present in the studio. A liveness between 6 and 12 for the orchestra yields this effect. Solo voices should have a value 1/2 to 1/3 of the orchestra value, while crooners may operate as low as 1/6 of it. These values are easily obtainable in a good studio which is not overcrowded much beyond curve B in Figure 3.

Figure 2, page 5, snows a typical studio set-up. The method of setting the distances and choosing the types of microphone has already been described. However, a sample computation may be helpful.

Assume a 20-piece orchestra and a crooner in a studio crowded to the curve marked B, Figure 3. Therefore, the studio volume is about 22,000 cu. ft. and it should have a reverberation time of about 1.1 seconds (see Figure 4) with orchestra.

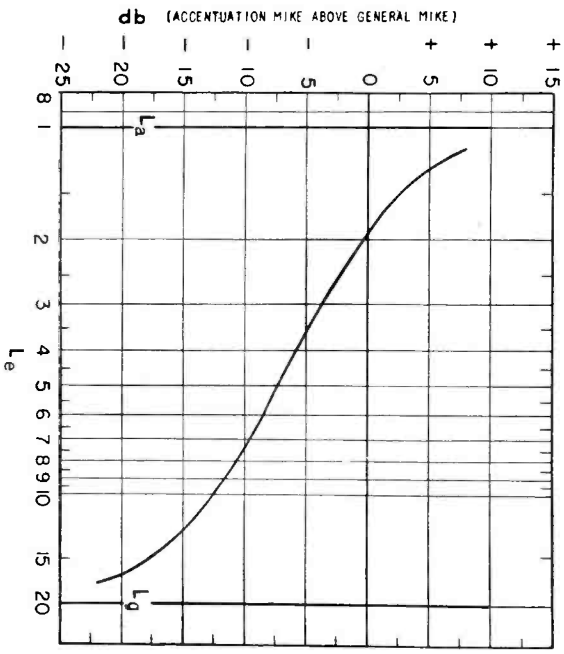


Figure 6—Chart showing effective liveness of two microphone combinations as function of relative level.

Assume

(1) the desired liveness, L, for the orchestra is 10.

(2) the desired liveness, L, for the crooner is about 1.6.

(3) the general microphone has nondirectional characteristics.

(4) the microphone for the crooner and any accentuation microphones for parts of the orchestra have bidirectional characteristics.

Proceed as follows:

a. Set liveness of general microphone at a value $1.5 \times 10 = 15$.

b. Set liveness of crooner microphone at a liveness not greater than $1.6 \times 2/3 = 1.0$ approximately. Use 0.5 if in doubt, as slightly more flexibility is assured.

c. Set orchestral accentuation microphone at a liveness not greater than $2.0 \times 2/3 = 1.3$. Use 1.0.

From equation (2) you get the values in Table 3.

Table 3

Microphone	Type	G_p	L	Distance
General	Non-direct	1.0	15	16′ — 17′
Crooner	Bidirect	3.0	½	4′ — 6′
Accentuation	Bidirect	3.0	1.0	7′ — 9′

If the distance of 4′ — 6′ for the crooner worries you cut it down to any value not less than 2′ and mix accordingly (see Appendix 1).

3. *Speech such as announcers, newscasters, lecturers, etc.* These programs usually originate in small rooms of 1000 to 2000 cu. ft. with reverberation times of the order of ½ second.

They get the full benefit of the extra coverage and naturalness due to liveness, for values of L greater than 1/6 to 1/4. From equation (2) the distance for a non-directional microphone for a 2000 cu. ft. studio, having a reverberation time of ½ second, would be 1¼ ft. and for a ribbon or cardioid microphone on beam would be 2 ft.

APPENDIX 1

Method of Setting Relative Gain for General and Accentuation Microphones

Let L_a = liveness for the accentuation mike, and
L_g = liveness for the general mike, and
L_e = effective liveness of the combination
P_r = equal the ratio of the power contributed by the accentuation microphone to the power contributed by the general microphone; then db = 10 log P_r.

It can be shown that

$$P_r = \frac{1 - L_e/L_g}{L_e/L_a - 1} = \frac{L_a}{L_g} \bullet \frac{L_g - L_e}{L_e - L_a} \qquad (3)$$

and

$$L_e = \frac{L_a L_g (1 + P_r)}{L_a + P_r L_g} \qquad (4)$$

For example if $L_a = 1.0$ and $L_g = 20.0$ we may use equation (3) and compute the data shown in Table 4.

Table 4

L_e	P_r	db	Approx. db
1.25	3.75	+ 5.8	+6
1.50	1.85	+ 2.7	+3
2.0	0.90	— 0.5	0 or — 1
3.0	0.43	— 3.7	—4
4.0	0.27	— 5.7	—6
6.0	0.14	— 8.5	— 8 or 9
8.0	0.086	—10.7	— 10 or 11
12.0	0.036	—14.4	—14
16.0	0.013	—18.8	—19

Where a studio or auditorium is in regular use, it is worth the time to plot this data as a curve. Figure 6 shows such a plot.

In Table 4 and Figure 6, negative values of db mean that the level of the accentuation mike is below that of the general mike by the number of db shown.

Since the sensitivities of the varous microphones are not equal, the following procedure must be used to determine this relative gain value.

During rehearsal, set the general microphone attenuator control and master gain control as if the broadcast were to be made on this microphone alone. Read attenuator dial setting for maximum peaks on vu meter.

Then turn off general microphone and turn up accentuation microphone, until maximum peaks have the same vu reading. Read attenuator dial for the accentuation mike. This becomes the zero of the db scale illustrated in Table 4 or in Figure 6.

For example, assume the general microphone had an attenuator dial setting 10 db and the accentuation microphone had a dial setting of 14 db for the same maximum peaks as read by the vu meter. This means that with a setting of 14 db the accentuation microphone is contributing the same power as the general microphone.

Then if the desired over-all liveness is 9 we find from Figure 6 that the accentuation microphone should be op-

(Continued on Page Twelve)

RCA Miniature Tubes enhance the tonal brilliance of RCA Victor Globe Trotter portable radios.

She shall have music wherever she goes!

Wherever you go with an RCA Victor Globe Trotter portable radio you'll enjoy richness and clarity of tone—volume enough for outdoor dancing—made possible through tiny tubes.

Miniature tubes save valuable space in small radios—space that can be used for larger and better loudspeakers and for longer lasting, radio-engineered RCA batteries.

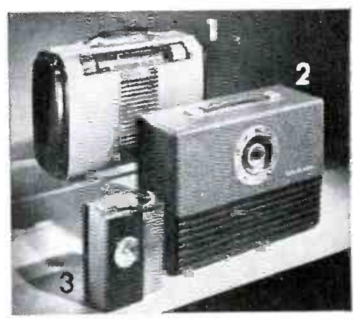
These miniature tubes were developed by RCA Laboratories—a world center of radio and electronic research—and long a leader in development of electron tubes for all purposes.

At RCA Laboratories, the same research, experimentation and advancement that resulted in these improved tubes, keep all RCA products and services at the top in their particular fields.

When you buy a product bearing the name RCA or RCA Victor—a radio set, television receiver, Victrola radio-phonograph, a radio tube or phonograph record—you get one of the finest products of its kind that science has yet achieved.

"Victrola" T. M. Reg. U. S. Pat. Off.

Radio Corporation of America, RCA Building, Radio City, New York 20. Listen to the RCA Victor Show, Sundays, 2:00 P.M., Eastern Daylight Saving Time, over NBC.



Ideal traveling companions. (1) RCA Victor "Globe Trotter" portable radio—operates on AC, DC, or batteries. (2) RCA Victor "Escort"—has a battery *you* can recharge from any ordinary AC electric outlet. (3) RCA Victor "Solitaire"—less than 6¼ inches tall!

RCA

RADIO CORPORATION of AMERICA

LIVENESS

(Continued from Page Ten)

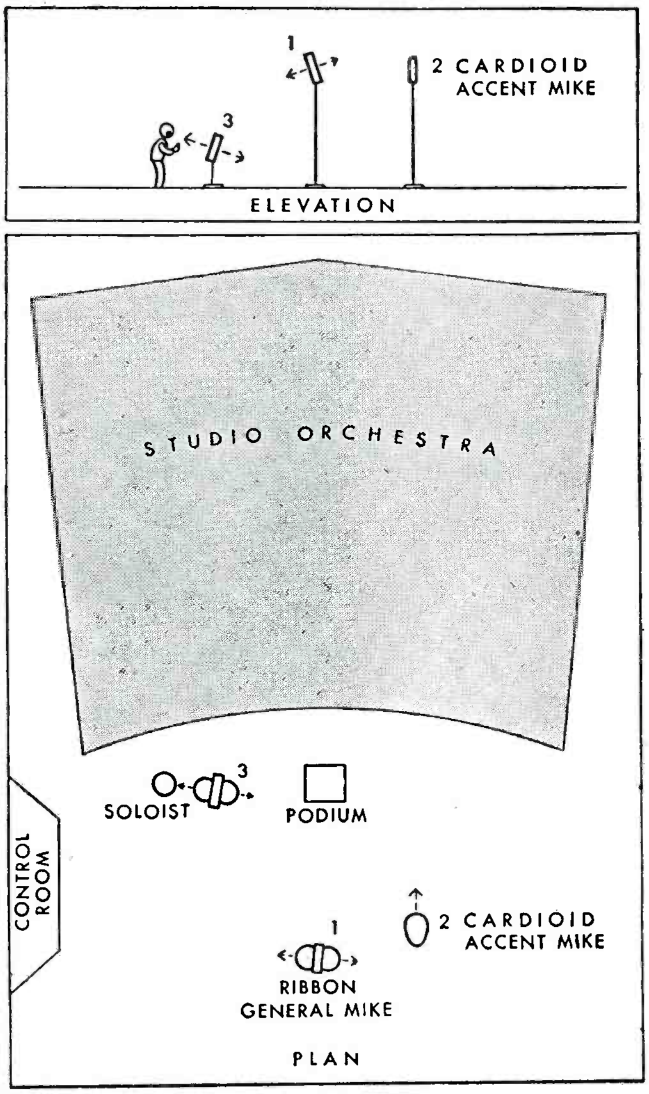


Figure 7—Plan and elevation of overcrowded studio.

erated at —12 db. Therefore, the setting would be 26 db on the attenuator dial of the accentuation mike.

It sometimes happens that this low setting of the accentuation microphone causes a blend of the sound which does not seem to have given the accentuation to the desired instruments. This usually indicates that the general mike has been placed in a poor spot and that the accentuation mike is being used to mask this trouble.

Therefore, seek a new location for the general mike as a first step of correction.

APPENDIX 2

Music Programs in Overcrowded Studio

Under these conditions it is usually impossible to place the general microphone at a sufficient distance from the front row of the orchestra. Therefore, a trick must be resorted to.

(1) Place a bidirectional microphone, such as "1", Figure 7, with its insensitive direction pointing toward the orchestra. In practice this microphone will act as if G_p (see Equations 1 and 2) had a value of 1/4 to 1/3.

(2) Place the necessary accentuation microphones in the standard manner except that bidirectional microphones must not be placed too close to the studio wall. Where the crowding is extreme the use of cardioid microphones for accentuation purposes is preferred.

(3) Use the minimum contribution from the accentuation microphones, necessary to obtain the desired effect. Too much accentuation does more damage under overcrowded than under normal conditions, and can easily push the pick-up into the region below the useful liveness range. You then obtain "absence" instead of "presence".

This article has attempted to describe a semi-quantitative sound pick-up technique. If followed as a general guide, experience has shown that these methods can almost insure programs with a new realism—programs that can give your station as much as 6 db gain in coverage and your listeners the sense of being in the presence of the living artists.

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Television and FM News

* FM Ass'n announces that there are now 206 FM stations on the air, compared with 66 last fall.

* RCA Exhibition Hall at Radio City, New York, has been opened to the public; television camera and receivers are in operation.

* Sarkes Tarzian, Bloomington, Ind., granted CP for commercial television, Channel 10, 192-198 Mc.

* Variety reports that physicist David Starkie (London) has developed a process of making plastic lenses that were impossible to make in glass. It is claimed that these plastic lens systems have been applied to British television receivers, and that they have already undergone extensive and successful field tests.

* NAMM (N'tl Ass'n Music Merchants) Convention, Chicago, witnessed a complete line of FM receivers by RCA-Victor; four were table models; two new television receivers were also shown by RCA-V.

* Coax television network rates have been filed with the FCC by AT&T; they are approximately $40 per circuit mile per month, for eight consecutive daily hours of programming—feeding in one direction only. Additional coax facilities must be rented to feed in opposite direction.

(Continued on Page Sixteen)

Neon-Glow Tube Sawtooth Generator

By Jordan McQuay

GAS-FILLED diodes are somewhat similar to high-vacuum diodes in structure: both contain a cathode or *emitter of electrons* and an anode or *collector of electrons* within a glass envelope. But, in operation and circuit application, gas-filled and high-vacuum diodes differ radically.

Current flow in high-vacuum tubes is determined entirely by the geometrical characteristics of the electrodes and the voltages which are applied to the electrodes. In gas-filled diodes, the magnitude of current flowing is not affected by relatively large changes in the shape or size of the electrodes.

In a high-vacuum tube the voltages on the electrodes retain complete control of the current flowing. But in a gas-filled tube, the voltages on the electrodes lose control as soon as conduction starts.

Ionization

At the time of manufacture: gas-filled diodes are filled to a low pressure with an inert gas—such as argon, nitrogen, neon, or helium. This gas is said to be *inert* because it will not combine with any of the metals used in the internal construction of the diode.

It is the presence of this inert gas which makes such a great distinction between these tubes and high-vacuum diodes.

During conduction of a gas-filled tube: electrons given off by the cathode are attracted to the anode because of the positive potential on the collector electrode.

The passage of billions of electrons between the two electrodes produces a strong negative field known as the space charge, which tends to cancel some of the positive field established in the close vicinity of the anode.

In a high-vacuum diode—containing no inert gas—this space charge effect reduces the ability of the anode to attract electrons, and is the reason that high-vacuum tubes cannot carry as large a current for their size as gas-filled diodes.

When a small amount of inert gas is injected into the tube (in manufacture), the interior of the glass envelope is occupied by gas molecules—which are large when compared with tiny electrons. And during the tube conduction, the high-speed negative electrons collide with the gas molecules, knocking out one or more free electrons.

The electrons released from the gas molecules join the original stream of electrons toward the anode, and may be capable of liberating other electrons.

Losing some of their negative electrons, the gas molecules assume a positive charge and are called ions. These ions neutralize most of the effect of the space charge in the tube, and thus permit more electrons to reach the collector anode.

This entire process is cumulative and is known as **ionization.** It is responsible for the large current-carrying capacity in *one direction* of the gas filled diodes.

Thus: an operating or conducting gas-filled diode has present within its glass envelope: molecules, ions, and free electrons.

Ionizing Potentials

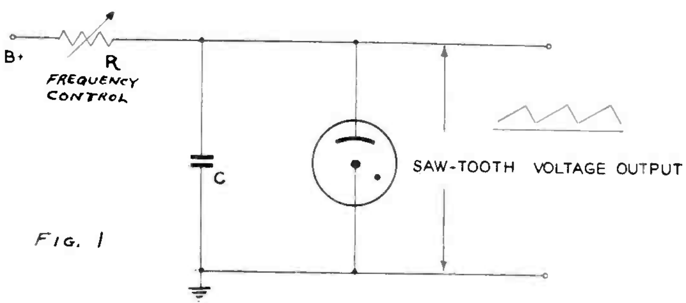
Energy required to dislodge electrons from the gas molecules (to produce ionization) is supplied by a voltage between the anode and the cathode of the gas-filled diode.

This anode or "plate" voltage is the principle voltage of the operating diode.

Beginning at zero and increasing this voltage slightly, there is a certain low value for any particular gas-filled diode at which ionization commences. And this voltage value is known variously as the *striking potential, striking voltage, firing point,* or *ionization potential* for the particular tube.

Striking potentials range between about 14 and 25 volts. The following values generally apply to all commercial types of gas-filled diodes: argon, 16 volts; nitrogen, 16 volts; neon, 22 to 23 volts; and helium, 25 volts.

Immediately that ionization takes place, extremely heavy current is passed by the diode. And this current remains unaffected by any slight changes, plus or minus, of the anode voltage.



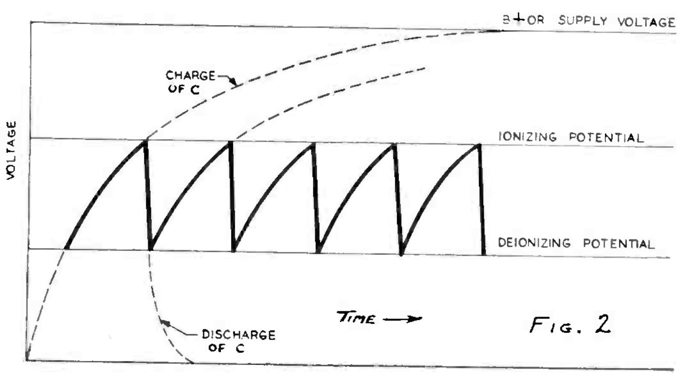


Figure 1 (Top) — Circuit of simple Neon Sawtooth Generator.
Figure 2 (Bottom)—Changes in condenser voltage during operation of Neon Sawtooth Generator.

Once conduction has started, the electronic action can actually be sustained at an operating or anode voltage *considerably lower* than that of the striking potential.

However, if the voltage is decreased below a certain minimum value, the gas de-ionizes and conduction stops. And this lower voltage is known as the *de-ionizing potential.*

Action of the gas-filled diode is therefore similar to an electronic switch. At a certain voltage it closes to permit a high current flow, and then opens at some lower value of voltage blocking all current flow.

During ionization the tube has very little resistance in a circuit. But when quiescent or inoperative, the gas-filled diode presents almost infinite resistance.

Summary Comparisons

There are some other important distinctions between high-vacuum and gas-filled diodes, which can be considered in summary.

High-vacuum types have large cathode-to-anode voltage differences, a high effective resistance to current flow, a need for large changes in operating voltage to obtain large current changes, and only a fair efficiency of energy transfer.

Gas-filled diodes, on the other hand, have small cathode-to-anode voltage differences, a low effective resistance to current flow, large changes in current with almost constant difference between cathode and anode, and a high efficiency of energy transfer.

One serious limitation of the gas-filled diodes, however, is that their control of power through the tube is not too smooth or continuous.

Also to be considered in the design of circuits using gas-filled diodes, is that the current drawn from the tube must not be greater than the saturation current for the cathode.

If an attempt is made to draw greater than saturation current, the voltage drop across the tube will increase rapidly and soon reach the point where positive ions are drawn into the cathode before they can recombine with electrons. Large positive ions striking the cathode actually strip emitting material from the heater and consequently ruin the tube. This destructive action is characterized by a brilliant shower of incandescent cathode material as it is torn from the supporting heater shell.

While the function of the gas-filled diode is largely limited to turning current on and off, similar to a switch or an electromagnetic relay, the tubes are much more versatile than the simple relay.

Diode Types

There are three principal groups of gas-filled tubes, classified according to the type of electron emission.

One group of gas-filled diodes employs thermionic emission, and thus contain "hot" cathodes. Such electrodes are usually oxide-coated, varying widely in structural form. Anode of the tube is made of metal or graphite, and must be large enough to operate without undue heating. The accepted name for a gas-filled hot-cathode diode is the *phanotron*. It is used mainly as a rectifier, where current requirements do not exceed about 30 amperes. It is also used as a d-c power supply for automatic battery chargers, magnetic separators, and other electronic devices of an industrial nature.

A second group—similar to the above—employs mercury-vapor instead of the more usual types of inert gas. Such tubes supply heavy-current rectification, and are sometimes called *ignitrons*.

The third group of gas-filled diodes are cold-cathode tubes requiring no application of heat to produce emission. Electrons are emitted from a cold surface by field emission and by bombardment of the positive ions. More popularly known as *neon-glow tubes* or neon lamps, their action is somewhat similar to the hot-cathode types previously described.

Principal difference between the hot- and cold-cathode diodes is their current carrying capacity. Cold-cathode diodes are capable of carrying only comparatively small currents.

In the cold-cathode gas-filled tubes there is no proportionality between the anode current and the anode voltage. The diode either conducts to the limit of its ability, or it does not conduct at all.

Both cathode and plate may be of the same size and construction, permitting conduction in either direction according to the polarity of the applied potential. Or, the cathode may be larger than the plate to allow conduction in only one direction.

Since the cathode is not heated, there is no electron emission to assist in the ionization process (as in the thermionic types). Thus, the firing potential for a neon-glow tube is somewhat higher than that for a tube in which a heated cathode is employed. And, more particularly, the neon tube is often erratic in that the firing potential actually varies during operation.

Passage of current through the neon-glow tube is indicated by a distinct glow of varying color—dependent upon the gasses mixed with the neon inside the tube. For applied d-c voltages, the glow always appears on the negative electrode or cathode. For a-c voltages, both electrodes will glow.

While useful in many industrial applications, the gas-filled cold-cathode diode is of especial importance as a generator of sawtooth wave forms,—providing a time base for cathode ray tube operation.

Sawtooth Generator

Use of a neon-glow tube in a very basic relaxation oscillator circuit, provides the simplest method of obtaining a sawtooth wave form. No timing circuits are employed. And the output consists of abrupt changes in voltage—in the nature of a sawtooth—brought about by charging or discharging a condenser through a resistance.

A circuit diagram of the simple generator is shown in figure 1.

A neon-glow tube is shunted by a fixed condenser C, and is connected to a d-c power supply through a high, variable resistance R.

Since the voltage across the condenser can be controlled by the electronic switch action of the neon-glow tube, this circuit (figure 1) is called a Neon Sawtooth Generator.

Application of a constant voltage to this circuit causes the condenser to charge through the resistor R. The voltage across the condenser rises from zero, and approaches the full supply voltage according to its characteristic R-C charging curve (figure 2). The slope of this curve will depend upon the *time constant* of the R-C circuit coupled to the neon-glow tube.

The voltage across the diode is the same as the voltage across the condenser C, because these elements are in parallel. The gas-filled tube acts as an open switch until the voltage across it reaches the firing point or ionization potential.

Then the neon-glow tube ionizes, forming a discharge path for the condenser C. The discharge is extremely rapid until the voltage falls to the deionizing potential of the gas-filled tube. Then conduction stops, and the neon tube becomes an open switch again.

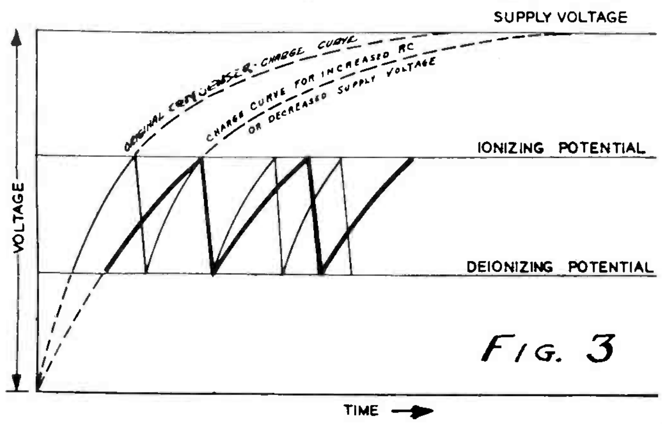
The condenser then begins to charge again—according to the R-C curve—toward the supply voltage. And the entire process of charge and discharge is repeated as long as the d-c voltage supply is maintained. This action is shown graphically in figure 2.

The form of the voltage output—taken from across the neon-glow tube—is that of a sawtooth wave.

The frequency of the sawtooth wave is the number of times the voltage rises and falls per second.

This frequency can be varied by changing the ionizing and the deionizing potentials, but this would mean a change in the characteristics of the neon-glow tube.

There are three simpler methods of frequency control,—accomplished by varying the value of resistor R, the value of condenser C, or the magnitude of the supply voltage.



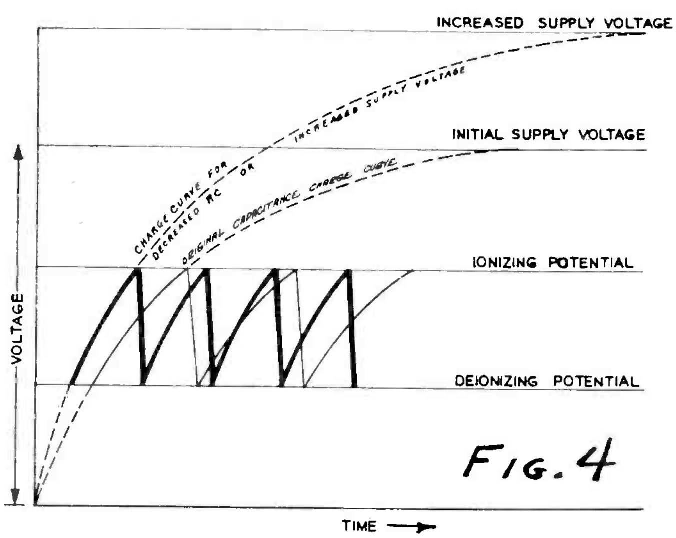


Figure 3 (Top)—Frequency of Generator can be DECREASED by: (a) increasing value of R (b) increasing value of C (c) decreasing the supply voltage.

Figure 4 (Bottom)—Frequency of Generator can be INCREASED by: (a) decreasing value of R (b) decreasing value of C (c) increasing the supply voltage.

Since the resistor and condenser form a *time-constant* RC circuit, an increase in the value of either element increases the time for a given amount of charge to be developed across the capacitor from a fixed source. Thus: a *lower* frequency will result from increased capacitance and/or resistance. A somewhat similar result may be obtained by decreasing the operating voltage.

These methods of decreasing the frequency of the sawtooth generator are shown in figure 3.

An *increase* in operating frequency results when condenser C charges more quickly to the given value of the firing or ionization potential. Thus, conversely, a decrease in the value of either element of the *time-constant* RC circuit, or an increase in the operating voltage, will result in a *higher* frequency, as shown in figure 4.

In practice: the magnitude of the supply voltage and the value of capacitance are rarely varied, and the chief method of frequency control becomes a variable resistor, as shown in figure 1.

Sawtooth generators of this type can be designed to function over a wide range of frequencies. It can produce frequencies as low as 1 cycle every 8 or 10 minutes, or as high as 10,000 cycles per second.

The lower limit of frequencies produced depends largely upon the use of large enough condensers. But practical difficulties are encountered when working with extremely low frequencies because of condenser leakage.

The upper limit of oscillations is determined by physical arrangement of the circuit elements. Such very high frequencies are usually obtained without a condenser, the tube electrodes and associated connecting leads supplying the necessary capacitance.

Television and FM News

(Continued from Page Twelve)

* RMA announces FM/AM and Television receiver production figures as follows:

Month	FM/AM	Telev.
January	51,000	5,400
February	53,000	6,200
March	67,000	6,600
April	112,000	7,800

* FCC announces that Television service to 39 cities in 25 states (including the District of Columbia) is proposed in current grants and applications. California leads all the States with a total of 13 grants or applications; followed by New York, Ohio and Pennsylvania in the order mentioned.

Lists of television licensees, construction permittees and applicants by States and cities follow:

Television Licensees

ILLINOIS (1)—*Chicago* (1): Balaban & Katz Corp. (WBKB).

NEW YORK (4)—*New York City* (3): Columbia Broadcasting System, Inc. (WCBS-TV); Allen B. DuMont Laboratories, Inc. (WABD), and National Broadcasting Co., Inc., (WNBT);—*Schenectady* (1): General Electric Co. (WRGB).

PENNSYLVANIA (1)—*Philadelphia* (1): Philco Television Broadcasting Corp. (WPTZ).

Television Construction Permittees

CALIFORNIA (11)—*Los Angeles* (6): National Broadcasting Co., Inc.; American Broadcasting Co., Inc.; The Times-Mirror Co. (*); Television Productions, Inc. (*); Dorothy S. Thackrey, and Earl C. Anthony, Inc.—*Riverside* (1): Broadcasting Corp. of America—*San Francisco* (3): American Broadcasting Co.; Chronicle Publishing Co., and Associated Broadcasters, Inc.—*Stockton* (1): E. F. Peffer.

DISTRICT OF COLUMBIA (4)—*Washington* (4): National Broadcasting Co., Inc. (*); The Evening Star Broadcasting Co.; Bamberger Broadcasting Service, Inc., and Allen B. DuMont Laboratories, Inc. (*):

(Continued on Page Twenty-three)

The 1947 Winter I. R. E. Meeting

Summaries of Technical Papers — Continued From Last Issue

By Ed Stolzenberger

No papers are available in preprint or reprint form nor is there any assurance that any of them will be published in the "proceedings of the I.R.E.," although it is hoped that many of them will appear in the subsequent issues.

ELECTRONIC CONTROLS AND APPLICATIONS

Chairman, V. M. GRAHAM
(Sylvania Electric Products Inc., Long Island City, N. Y.)

61. Electronic Control in Industry.

G. M. Chute
(General Electric Company, Detroit, Michigan.)

While electronic circuits are usually thought of as applying to low-power devices, they have in recent years been applied to the control of units developing thousands of kilowatts. The use of electronic circuits in motor control, welding, and similar applications is discussed, as is the operation of amplidyne-type circuits for control of large amounts of mechanical power.

62. Variable Radio-Frequency-Follower System.

R. F. Wild
(The Brown Instrument Company, Division of Minneapolis-Honeywell Regulator Co., Minneapolis, Minnesota.)

A novel type of follower system is discussed, operated by keyed variable radio frequencies. The wide-band characteristics of the tuned-radio-frequency discriminators are given. Design considerations are given pertaining to stability, freedom from drift, sensitivity, accuracy, choice of bandwidth and operating frequencies, and adjustment of zero setting and span.

63. Continuous Recording Sensitive Magnetometer.

R. F. Simmons
(Airborne Instruments Laboratory, Inc. Mineola, New York.)

A device of great value in geophysical prospecting consists of an airborne magnetometer capable of indicating a departure from the average value of the earth's magnetic field of one part in 100,000. The instrument described utilizes a saturated-core magnetometer maintained parallel to the ambient field by additional units of the same type.

64. Three-Dimensional Representation on Cathode-Ray Tubes.

C. Berkley
(Allen B. DuMont Laboratories, Inc., Passaic, New Jersey.)

A procedure for the representation of functions of a number of variables on the screen of a cathode-ray tube is developed. This may take the form of an oblique perspective picture. Applications in the fields of mathematics, radar, electronmagnetic theory, mechanical measurements, topographic surveying, and meteorology are described.

65. New Electronic Wiring Techniques.

C. Brunetti
(National Bureau of Standards, Washington, D. C.)

Several methods of printing electronic circuits are treated, including the silk-screen process, spraying, painting, stamping, photographic, and others. This comparatively new art utilizes well-known basic techniques. Performance of several types of printed circuits under various conditions of temperature, humidity, aging, and electrical loading is discussed.

AIDS TO AIR NAVIGATION AND TRAFFIC CONTROL

Chairman, A. F. VAN DYKE
(Radio Corporation of America, New York, N. Y.)

66. Trends in Air Navigation.

H. Davis
(Watson Laboratories, Red Bank, New Jersey)

This paper discusses the international progress of design and test of long- and short-range air navigational aids. The most important electronic aids, including distance-measuring equipment, ground surveillance radar, and the omni range, are described. The role of electronic aids in the philosophy of air navigation is discussed, and the status of international standardization is presented.

67. The Function of Air-Traffic Control.

W. D. White
(Airborne Instruments Laboratory, Inc., Mineola, New York.)

The need for air-traffic control as distinct from navigation aids and landing systems is discussed and some of the deficiencies of the present system of traffic control are reviewed. A brief outline of some of the functions which a satisfactory traffic-control system must provide is given.

68. Hazeltine Lanac System (Laminar Air Navigation Anti-Collision).

K. McIlwain
(Hazeltine Electronics Corp., Little Neck, Long Island, New York.)

Lanac, an integrated challenger-replier system for collision-avoidance and short-distance navigation, permits display optionally on L or PPI oscilloscopes or meters. Planes obtain their locations (distance, direction, and altitude) relative to ground stations and other planes, with controllers continuously apprised concerning equipped planes. Operational results in 30,000 miles of flights are discussed.

69. First Tests on Navar System for Aerial Navigation and Air-Traffic Control.

H. Busignies and P. A. Adams
(Federal Telecommunication Laboratories, Inc., New York, N. Y.)

The basic philosophy of navar consists of visually presenting aircraft movements with suitable identification and altitude information to the pilot and ground controller. Data will be presented on the omnidirection range and distance-measuring phases of navar, as revealed by flight tests of the first simplified experimental equipment.

70. The Application of Micro-Waves to the Guidance and Control of Aircraft.

J. Lyman and G. Litchford
(Sperry Gyroscope Company, Inc., Garden City, L. I., New York.)

Pulse and continuous-wave technique are compared as they apply to guidance, control, and surveillance of air traffic. Continuous-wave technique for securing distance and azimuth from a ground station to multiple aircraft are described. The resultant display provides a co-ordinate system for air-traffic organization and guidance to closely spaced landings.

MICROWAVE TECHNIQUES AND MEASUREMENTS

Chairman, R. BROWN
(Bell Telephone Laboratories, Inc., New York, N. Y.)

71. Precision Measurements of Impedance Mismatches in Wave Guide.

A. F. Pomeroy
(Bell Telephone Laboratories, Inc., New York, N. Y.)

A method is described for determining accurately the magnitude of the reflection coefficient caused by an impedance mismatch in wave guide by measuring the ratio between incident and reflected voltages. The novel feature consists of canceling all spurious voltages in the measuring equipment. The canceling voltage is introduced through a hybrid equipment. Reflection coefficients of

(Continued on Page Eighteen)

IRE Papers

(Continued from Page Seventeen)

any value less than 0.05 (0.86-decibel standing-wave ratio) can be measured to an accuracy of ±2.5 per cent.

72. A Coaxial-Line Support for 0 to 4000 Megacycles.

R. W. Cornes

(Sperry Gyroscope Company, Inc., Garden City, New York.)

Stub and spaced-bead center-conductor supports for rigid coaxial lines restrict the use of the lines to narrow frequency bands. The experimental and theoretical work done in designing a broad-band undercut bead support is described and a method given for calculating the bandwidth. A typical microwave application is discussed which has a voltage-standing-wave ratio of less than 1.025 for 0 to 4000 megacycles.

73. Power Loads at Very and Ultra-High Frequencies.

A. G. Kandoian and R. A. Felsenheld

(Federal Telecommunication Laboratories, Inc., New York, N. Y.)

Dummy loads for frequency-modulated, television, and radar transmitters are described which utilized distributed-circuit constants for power-dissipation elements. The application of resonators, antennas, and transmission-line principles results in simple, compact, and rugged loads capable of operation with high power dissipation and over a wide frequency band. With water cooling, average powers of the order of tens of kilowatts can be handled.

74. Direct-Reading Wavemeters.

G. E. Feiker and H. R. Meahl

(General Electric Company, Schenectady, New York.)

A line of direct-reading wavemeters operating over the wavelength range of 5 to 80 centimeters (the frequency range of 6,000 to 375 megacycles) is described. Two types of wavemeters are included: a laboratory-type searching wavemeter and a field-type precision wavemeter. The theory applicable to the major design features is also presented.

75. The Operational Behavior of a Magnetron Microwave Generator When Coupled to a Long Transmission Line.

W. C. Brown

(Raytheon Manufacturing Company, Waltham, Massachusetts.)

A simplified equivalent circuit of the magnetron and load is derived. The input impedance to the transmission line is examined as a function of frequency and terminating impedance. The reactive component of the impedance is then combined with the reactive components of the magnetron to determine the resonant frequency of the system. Under certain conditions, more than one resonant frequency is possible. The system performance which may result is discussed.

BROADCASTING AND RECORDING

Chairman, R. F. GUY
(National Broadcasting Company, New York, N. Y.)

76. Propagation Characteristics of the Ultra - High - Frequency (480 to 920 - Megacycle) Television Band.

W. B. Lodge
(Columbia Broadcasting System, Inc., New York, N. Y.)

Results are given of nine months of field tests to determine the coverage of the Columbia Broadcasting System color-television transmitter (W2XCS) operating on 490 megacycles in New York City. A general investigation of radio wave propagation characteristics at 490 and 700 megacycles was also conducted which proved the feasibility of rendering a satisfactory color-television broadcast service by use of frequencies in the 480- to 920-megacycle band.

77. Theoretical and Practical Aspects of Frequency - Modulation Broadcast Antenna Design.

P. H. Smith
(Bell Telephone Laboratories, Inc. New York, N. Y.)

The theoretical and practical considerations involved in the design of frequency-modulation broadcast transmitting antennas will be discussed. This will be followed by an explanation of the structural assembly, radiating elements, and associated feed system used in cloverleaf antennas. Both calculated and measured data on field-intensity patterns, array gain, and impedance-frequency characteristics will be shown.

78. Monitoring Equipment for Frequency - Modulation Broadcasting.

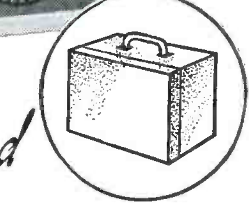
M. Silver
(Federal Telecommunication Laboratories, Inc., New York, N. Y.)

Equipment suitable for monitoring the performance of frequency-modulation broadcast transmitters in the band from 88 to 108 megacycles is described. Separate frequency and modulation monitors are employed. The equipment meets, and in many aspects surpasses, the Federal Communications Commission requirements. Noise and distortion measuring capabilities are 80 and 60 decibels, respectively, below the fully modulated condition. The frequency monitor will measure frequency variations to within 100 cycles under fully modulated conditions.

79. Ultra - High - Frequency Multiplex Broadcasting System.

A. G. Kandoian and A. M. Levine
(Federal Telecommunications Laboratories, Inc., New York, N. Y.)

(Continued on Page Twenty-four)



NABET National Representative Clifford L. Gorsuch

CLIFFORD L. GORSUCH was elected a National Representative of NABET at its 1946 National Council Meeting in Denver. As a means of introducing him to the membership and those with whom he will be doing business, we present herewith his brief biography.

Born April 27, 1917, in a Pittsburgh suburb. Educated at Swissvale Public and High Schools, followed by two years at Keystone Engineering Institute. He functioned as relief engineer at

C. L. GORSUCH

WWSW, Pittsburgh during 1937, and helped install WMBS at Uniontown, Pa., where he remained as studio and transmitter engineer until 1939. Gorsuch helped install WJLS, Beckley, W. Va., and remained as chief engineer. Next, to WCHS, Charleston, W. Va., as studio and transmitter engineer; helped install new 5 kw transmitter, and later set up the new WGKV in the same city. He then became chief engineer at WSLB, Ogdensburg, N. Y., until Nov., 1940. Then to Du Bois, Pa., to install the new WCED, which he supervised till June, 1941, when he left to install WISR, Butler, Pa., where he was chief engineer until he left to join Westinghouse, KDKA, in April, 1942. He was studio and field engineer until March, 1943.

Simultaneous with his employment at WISR and KDKA, Cliff Gorsuch was engaged in the ESMWT program, as Instructor; he taught math, and electrical theory and practice through Penn State Extension.

Gorsuch was commissioned in the Signal Corps, AUS; he was engineering officer on AAF ground installations, communications, etc. He was active in the Africa, Middle-East, and India-Burma theatres. He left the services January, 1946, and returned to KDKA as studio and FM transmitter engineer. He left this post Nov. 15, 1946, to assume NABET National Representative post. Cliff is ex-W8PGC, married, and believes that broadcasting and NABET are here to stay.

Effective July 1, 1947, Mr. Gorsuch has been designated NABET National Representative of the New York-New England area. He will service the Hudson, Engineering, and New York Chapters in New York City; the Schenectady, Rochester, Syracuse, Massena, and Watertown Chapters in New York; and the Springfield-Boston Chapters.

RAIN

(Too much is enough.)

When April come
An March he go
Beeg rain is start
Tak place of snow

The rain she start
But no can stop
We wish the boots
Have longair top

First three week
We no complain
For flowair in May
Need April rain

Then April go
And now com May
We wear the boot
Rain evair day

Sun show heez nose
When he can mak
But no can stay
More rain, more lake

Three week more
She come an go
We think dam rain
More bettair snow

Farmair swear
No plant the oat
Because on groun
They need the boat

Woodchuck is smart
Like one red fox
Him sleep all tam
Keep dry the socks

The bird and rabbit
Have to eat
So out in rain
Get wet the seat

May she go
An now come June
But rain all tam
No changum tune

Now wind he com
An lightning too
They bustum house
Tear barn in two

This ees no fonce
Sacre Bleu
With lake all roun
An no canoe

Then sun he com
Begin to smile
Now rain he go
Maybe leetle while

This mak frog sad
Also the duck
But me, I'm theenk
Is much good luck.

—Bateese

KFI—Ham Calls

W6KIP	W. H. Alexander
W6OTB	L. Benvenuto
W6RXI	R. W. Bull
W6ERC	C. C. Caves
W6VHD	V. L. Clark
W6BH	K. V. Dilts
W6IX	F. W. Everett
W6PBU	L. E. Fritzinger
W6KKZ	R. W. Grammes
W6YMD	W. B. Guimont
W6DOB	L. M. Jones
W6KYV	D. W. Kennedy
W6KL	H. M. McDonald
W6PC	L. W. Packard
W6GP	C. W. Seamans
W6LXS	W. G. Tokar
W6OMN	R. B. Walling
W6WGC	W. H. Wileman
W6GSZ	Ed Wood

Washington News

By L. A. McClelland

JOHN ROGERS, Marion (Mrs. John) Rogers, and their daughter, have returned from a Florida vacation. While in the Sunshine State, Johnny was reported to have spent much time in quest of the sailing yacht he is dreaming of. A rough description of the boat is: An able ketch about 40 feet long with accommodations for six, very fast under sail. The vessel should be planked with Honduras Mahogany and have Teak wood decks and the finest of hardware. To complete the picture, the craft should cost not over $800. Your Ed. would pay that, too! Just spendthrifts; Hi!

Speaking of vacations, Brother Robert Terrell, of the WRC Terrells, is well on his way toward Yellowstone Park where Bob has rented a cabin. He should have some excellent Kodachromes to show when he gets back. Kodachromes keep better than some of the fish we hear tell of, but never see. Those fishermen (they know who we are talking about) should be at least able to bring back a smell. Some of the fish stories do.

The five Studio Engineers who were transferred to New York in June of 1946 (seems like a long time ago) for Television training and who returned to WRC in January of this year have been transferred to WNBW, the NBC video outlet in the Nation's Capital. The five are John Rogers, Sam. E. Newman, William L. Simmons, James Weaver and L. A. McClelland.

F. Montague Morgan, S.E. (not the English financier) who during the war years was with WRC and who more recently was with WTAR, Norfolk, and WOL Washington, is again back in the NBC fold.

Another Studio Engineer who has returned to WRC is Mr. D. Boyd. Before his return he was with Frank McIntosh the well known consulting radio engineer of this City.

A new arrival in the NBC family is Nelson Rodgers, S.E. Glad to have you aboard; as they say in the Navy and in the production department.

Don Fisher of the WRC announcing staff leaves soon to take over the management of a station of which he is one of the owners. Sorry to see you leave Don, but the best of luck in your new venture.

The number of WRC men who are taking the Capitol Radio course is mounting daily, well almost daily, anyway. They now total seven.

WNBW, the NBC television station in Washington, can be spotted from almost anywhere in town by its tower on the Wardman Park Hotel. The tower rises almost 400 feet above the city and is topped by an airplane beacon which can be seen for many miles in clear weather.

The boating game has grown by leaps and bounds in Washington radio circles this Spring. Your correspondent would like to dwell on the subject but doesn't dare to, as someone might think he was looking for the job of "Yachting Editor" of the Journal. That's alright Newman, John Rogers will convert you yet.

It is of interest (very mild) to note that your correspondent is back on the job, writing this column because Chairman Hogan didn't have much luck in getting McClelland's name off of the roster of editors. McClelland resigned last Fall but the name remained. The only thing to be done about it was for him to start this line of drool again. Dribble, dribble, dribble.

NABET Activity

(Continued from Page Three)

National Office is now considering this last plan.

There have been several hearings in Detroit and Washington on the WXYZ case. The Ameriacn Broadcasting Company bought Radio Station WXYZ in April, 1946. However, before this deal was made public, IBEW had signed a contract with WXYZ, which did not expire until May of this year. NABET is taking the position that since ABC now owns WXYZ, that the engineers employed at this station should come under the network contract. However, ABC is still claiming that they do not own WXYZ. In this connection, we petitioned the NLRB in Detroit for an election, having first signed up the engineers at WXYZ. ABC and IBEW refused to go along on a consent election, which caused the Board to hold hearings in the matter. The results of these hearings have now been transferred to the National Board in Washington, D. C., and we are awaiting the decision of the Board as to whether there should be an election or whether the engineers employed at WXYZ are automatically under the ABC contract.

During the month of May, we added another station to our organization; namely, WRNY in Rochester, New York. An NLRB election voted unanimously to join NABET. We are now in the process of negotiating a contract for these men.

Your National Secretary-Treasurer, Mr. Hiller, has also been busy during the past few months, having participated at WWJ, Detroit, WABY, Albany and RCA-Victor, and is presently negotiating a new contract for MUZAK.

Our National Representative, Mr. Gorsuch, has executed and signed contracts at WOL, Washington, WHEC, Rochester, WMMN, Fairmont, and also participated in the negotiations at WWJ, Detroit.

(Signed) A. T. Powley
President

NABET President Powley has sent a strongly worded message to the White House, pointing out why the Taft-Hartley anti-labor bill would be detrimental to the best interests of amicable Management-Labor relations.

According to "Variety," CBS has effected a 5% increase in rates by reshuffling their discounts, which result in a 5% greater take for the Net.

From the Labor Information Bulletin:

A budget of $118,000,000 for Federal labor activities, including Labor Department, National Labor Relations Board and other operations, and added functions under anticipated new legislation, was proposed to Congress in President Truman's budget message January 10.

In the State of the Union message January 8, the President asked amplification and strengthening of the Labor Department's machinery for facilitating collective bargaining and expediting the settlement of labor-management disputes.

The budget message recommended appropriation of $3,000,000 for "new legislation" for administrative operations in collective bargaining and labor-management dispute settlements and for a new program of grants to States through the Labor Department to "foster safe working conditions." Noting that industrial accidents "reduce the productive capacity of the labor force," the Budget message said the new program should be administered by State labor departments under Federal standards.

For fiscal 1948, starting next July 1, $7,984,000 was recommended for the NLRB, as compared with approximately $5,000,000 this year. The Board backlog of unsettled cases, "in itself a cause of labor disturbance" was cited, with the comment that the proposed increase "should diminish the incidence of strike action by labor organizations, which is encouraged by tardy handling of cases."

For the public employment offices, $78,000,000 was recommended, compared with $90,000,000 this year. The difference represents increased costs under State operation and $11,000,000 of non-recurring terminal leave paid on the return of the offices to the States last fall, the message said.

Other recommendations in the budget message, which divided proposals on functional rather than bureau or departmental lines, included:

Mediation and regulation, Labor Department	$9,000,000
Mediation and regulation, other	4,000,000
Training and Placement, other than public employment offices	3,000,000
Labor information and statistics and general administration	14,000,000

The $118,000,000 total for all Federal labor functions compares with $124,000,000 estimated to be spent this year and $104,000,000 in fiscal 1946. In both 1946 and 1947, however, labor expenditures were supplemented by national defense funds, which are not provided in the 1948 budget for such activities.

NABET Elections

* NABET Elections reported—Congratulations to the newly elected Chapter Chairmen, reported as follows:—

HUDSON — Eugene Clark
ENGINEERING — Bill States
NEW YORK — C. Westover
CHICAGO — Art Hjorth
ROCHESTER — Ed. M. Lynch
PITTSBURGH — Oliver C. Beitel
LOUISVILLE — Charles L. Troutman
BALTIMORE — R. A. La Course
BOSTON — Wm. J. Flanders
OMAHA — Roy Glanton
MOHAWK — Don Morey
HOLLYWOOD — Jim Brown
ST. LAWRENCE — George Gebhard

To the Journal Associate Editors—the Journal closing date (deadline) is the first of every month; type is set and cuts made by the tenth, pages made up by the 15th, the issue is printed and bound by the 25th, and in the mail on the 27th—and naturally dated the following month. If this schedule is met all along the line, we can promptly get back to our former schedule of delivery coast-to-coast by the 4th of the month of issue. In the recent Journal Poll conducted by NABET President Powley, our Journal received an overwhelming vote of confidence; let us make every effort to continue to justify the trust placed in us. A *better* Journal means a more *effective* NABET.

NABET Certified Stations As of June 15, 1947

Akron, Ohio	WHKK
Albany, N. Y.	WABY, WOKO
Atlanta, Ga.	WAGA
Baltimore, Md.	WITH, WCBM
Boston, Mass.	WBZ
Bound Brook, N. J.	WNBI, WRCA, WNRE, WNRA, WNRI, WNRX
Chicago, Ill.	WENR, WLS, WMAQ, WAIT
Cleveland, Ohio	WHK, WTAM
Denver, Colo.	KVOD, KFKA, KOA
Detroit, Mich.	WWJ
Dixon, Cal.	KNBA, KNBC, KNBI, KNBX
Elmira, N. Y.	WENY
Fairmont, W. Va.	WMMN
Greensboro, N. C.	WBIG
Los Angeles, Cal.	KFI, KECA
Louisville, Ky.	WGRC
Massena, N. Y.	WMSA
New York, N. Y.	WOR, WJZ, WNBC, WNBC-FM, WNBT
No. Platte, Neb.	KODY
Omaha, Neb.	WOW
Philadelphia, Pa.	KYW
Pittsburgh, Pa.	WCAE, KDKA
Raleigh, N. C.	WPTF
Richmond, Va.	WRNL, WLEE
Rochester, N. Y.	WHAM, WHEC, WRNY, WHFM
Rockford, Ill.	WROK
San Diego, Cal.	KFSD
San Francisco, Cal.	KPO, KGO
Schenectady, N. Y.	WGY, WRGB
Springfield, Mass.	WSPR, WBZA
Syracuse, N. Y.	WOLF, WAGE
Washington, D. C.	WMAL, WOL, WRC
Watertown, N. Y.	WWNY

Additional Certified Units

New York City	NBC Sound Effects NBC Recording (Matrix) NBC Model Shop RCA/Victor Recording & Matrix Muzak Recording
Chicago	RCA/Victor Recording Universal Recording
Hollywood	NBC Air Conditioning

Television & FM News

(Continued from Page Sixteen)

FLORIDA (1)—*Miami* (1): Southern Radio & Telegraph Equipment Co.

ILLINOIS (4)—*Chicago* (4): American Broadcasting Co., Inc.; National Broadcasting Co., Inc.; and WGN, Inc.

INDIANA (1)—*Indianapolis* (1): William H. Block Co. *Bloomington* (1): Sarks and Mary Tarbian.

IOWA (1)—*Ames* (1): Iowa State College of Agriculture and Mechanical Arts.

KENTUCKY (1)—*Louisville* (1): WHAS, Inc.

LOUISIANA (1)—*New Orleans* (1): Maison Blanche Co.

MARYLAND (3)—*Baltimore* (3): The A. S. Abell Co.; Hearst Radio, Inc., and Radio Television of Baltimore, Inc.

"Hello, Taft — this is Hartley: I can report that harmonious collective bargaining relations have been established!"

MASSACHUSETTS (2)—*Boston* (1): Westinghouse Radio Stations, Inc.—*Waltham* (1): Raytheon Manufacturing Co.

MICHIGAN (3)—*Detroit* (3): King-Trendle Broadcasting Corp. (*); The Evening News Association, and The Fort Industry Co.

MINNESOTA (2)—*Minneapolis* (1): Minnesota Broadcasting Corp.—*St. Paul* (1): KSTP, Inc.

MISSOURI (1)—*St. Louis* (1): The Pulitzer Publishing Co. (*).

NEW JERSEY (1)—*Newark* (1): Bremer Broadcasting Co.

NEW MEXICO (1)—*Albuquerque* (1): Albuquerque Broadcasting Co.

NEW YORK (5)—*Buffalo* (1): WBEN, Inc.—*New York City* (4): Bamberger Broadcasting Co.; American Broadcasting Co., and News Syndicate, Inc.

OHIO (6)—*Cincinnati* (1): Crosley Broadcasting Corp.—*Cleveland* (2): National Broadcasting Co., Inc., and Scripps-Howard Radio, Inc.—*Columbus* (1): Crosley Broadcasting Corp.—*Dayton* (1): Crosley Broadcasting Corp.—*Toledo* (1) The Fort Industry Co.

OREGON (1)—*Portland* (1): Oregonian Publishing Co.

(Continued on Page Twenty-four)

Photo by Joe Conn

New York News

THE New York Chapter's 247 members have elected Mr. C. Westover of the NBC Studio Group, as Chapter Chairman, succeeding Mr. C. Bennis.

We all wish him luck, and have asked Westy to submit his biography and photo for the information of the members and the NABET National Councilmen who will meet him at the October National Council meeting. Here it is: Name: Clarence Westover. Called Westy by friends, many things by others. Born: Spring Valley, Minn., April 13, 1905. Grade and High School in Spring Valley and Rochester, Minn. Migrated to Chicago, 1922, testing fone equipment at W.E.-Hawthorne. Navy 1923-1927, introduced to radio at Hampton Roads in company with Ullman, NBC Washington, D. C., and Glasscock, recently of ABC-New York. May have no significance but C. L. Bennis, recent New York Chapter Chairman, left USS Boric shortly after Westy came on board. Broadcasting: CBS, 1929-1932. NBC, 1933 to date. Marital status: Married 1928, two children, Pat, 17, and Ellen-Jane, 12. Wife redheaded. Lives on Long Island, hates commuting. Hobbies: none, unless creating sawdust in work shop is a hobby. Has been known to cook, loves steaks grilled in the fireplace. Ambitions: To make NABET more effective, find time to produce more sawdust, build large fireplace outdoors capable of grilling some of the Hams we work with.

(A delay at the photographer prevented Westy's photo getting to us in time to make this issue; see next issue for rejuvenated New York News *plus* Westy's pix—Ed. S.)

Taft-Hartley Labor Law: We held up this issue with the intent of including the NABET Attorney's Report on this new law; on advice of the National Office, the Report was not published herein, and other material has been substituted. See next issue for summary of the Report.

Television & FM News

(Continued from Page Twenty-three)

PENNSYLVANIA (4)—*Johnstown* (1): WJAC, Inc.—*Philadelphia* (2): Triangle Publications, Inc., and William Penn Broadcasting Co.—*Pittsburgh* (1): Allen B. DuMont Laboratories, Inc.

RHODE ISLAND (1)—*Providence* (1): The Outlet Co.

TEXAS (2)—*Dallas* (2): Carter Publications, Inc., and KRLD Radio Corp.

UTAH (1)—*Salt Lake City* (1): Intermountain Broadcasting Corp.

VIRGINIA (1)—*Richmond* (1): Havens & Martin, Inc.

WASHINGTON (1)—*Seattle* (1): Radio Sales Corp.

WISCONSIN (1)—*Milwaukee* (1): The Journal Co.

Television Applicants

CALIFORNIA (2)—*Los Angeles* (1): Don Lee Broadcasting System; *San Francisco* (1): Don Lee Broadcasting System.

MASSACHUSETTS (1)—*Boston* (1): New England Theatres, Inc.

MICHIGAN (1)—*Detroit* (1): United Detroit Theaters, Corp. (*).

OHIO (2)—*Cincinnati* (1): Allen B. DuMont Laboratories, Inc.—*Cleveland* (1): Allen B. DuMont Laboratories, Inc.

PENNSYLVANIA (2)—*Philadelphia* (2): Daily News Television Co., and Pennsylvania Broadcasting Co.

TEXAS (1)—*Dallas* (1): Interstate Circuit, Inc.

(*) Stations on the air in addition to licensees.

* GE announces that it has a one-way microwave relay circuit ready for commercial television use between New York City and Schenectady, and will expand the service to Syracuse, if approved by FCC. System operates in region of 2000 Mc.

* New catalog sheets on television parts, antennas, and accessories, are available from the Renewal Sales Section of the RCA Tube Dep't.

* Vol. 8, No. 12 of the Philips Technical Review contains two items of interest: the first, the development of a non-magnetic high frequency core material called "Ferroxcube" which is claimed to have negligible losses and high permeability, and is readily molded. The second item deals with the use of a magnetron to attain DC voltage amplification, through the use of a magnetic field in place of the usual triode grid.

IRE Papers

(Continued from Page Nineteen)

An experimental eight-channel high-fidelity multiplex broadcasting system which has been developed and operated during the past year will be discussed. Multiplex operation is achieved by time-sharing pulse-time modulation. The operating frequency is 930 megacycles. The description and operating characteristics of the major components, including modulator, transmitter, antenna system, and receiver, will be given.

80. Field Measurements on Magnetic Recording Heads.

D. L. Clark and L. L. Merrill

(Stromberg-Carlson Company, Rochester, New York.)

A method is described for measuring relative values of the magnetizing force along the path traversed by the recording medium in passing through a magnetic recording or reproducing head. A method for calculating the frequency response of a reproducing head from field-distribution data is presented. Calculated and measured results are compared. The recording process is discussed, and correlation between field distribution and performance of a recording head is indicated.

(Continued Next Month)

Specify DAVEN

TRANSMISSION MEASURING SETS

To accurately measure transmission characteristics of audio systems and their components

These transmission measuring sets are accurately designed instruments for the measurement of the transmission characteristics of audio frequency communication systems. This equipment may be applied to measure gains or losses through amplifiers, repeaters, attenuating networks or communication lines without the use of laborious calculations, complex setups, or sensitive meters.

The sets shown here are sturdy compact units built to exacting specifications. Your further inquiry is invited. Technical questions will be answered by our Engineering Department.

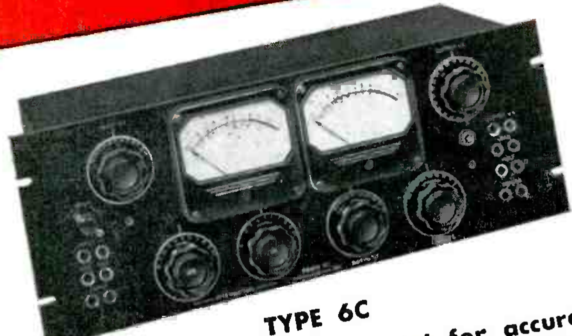
TYPE 8A

A portable battery operated set . . . weight 14 pounds.

TRANSMITTING SECTION: Contains an internal oscillator, operating at a frequency of 1000 cycles. Output impedance is 600 ohms either balanced or unbalanced to ground. Output levels are 0 DBM* and —20 DBM*.

RECEIVING SECTION: Frequency response is ±0.3 DB from 30 to 10,000 cycles. Input impedance is 600 ohms terminating, and 6300 ohms bridging either balanced or unbalanced to ground. Will measure levels of —30 to +10 DBM* at zero VU meter indication, when terminating a line.

DIMENSIONS: 9⅜" high x 6½" wide x 12⅞" long.



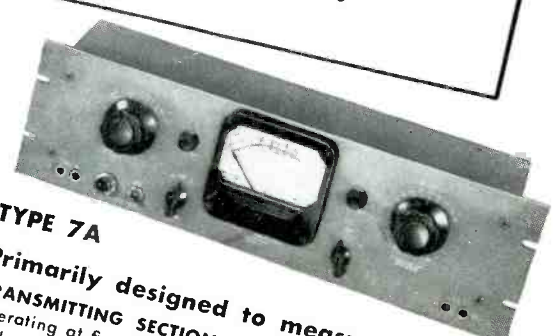
TYPE 6C

Primarily an instrument used for accurate gain and frequency response measurements. Must be used in conjunction with an external audio oscillator.

TRANSMITTING SECTION: Provides sending levels from —106 to +26 DB in steps of 1 DB for zero VU meter indication.

RECEIVING SECTION: Frequency response is ±0.3 DB from 30 to 17,000 cycles. Will measure levels of +4 to +42 DB in steps of 2DB for zero VU meter indication.

Input impedance is 600 ohms. Output impedance is 30, 50, 150, 200, 250, 500, and 600; 500 shunt and 600 shunt, either balanced or unbalanced to ground. Load impedance is 8, 15, 30, 50, 150, 200, 250, 500 and 600, either balanced or unbalanced to ground.



TYPE 7A

Primarily designed to measure losses.

TRANSMITTING SECTION: Contains an internal oscillator operating at fixed frequencies of 500, 1000, and 2500 cycles and will provide output levels of —13, 0, +4, and +10 DBM*.

RECEIVING SECTION: Frequency response is ±0.3 DB from 30 to 10,000 cycles. Will measure levels of —30 to +10 DBM* at zero VU meter indication when terminating a line.

Impedance is 600 ohms in both the transmitting and receiving sections.

* DBM is based on a reference of 1 MW into 600 ohms.

THE **DAVEN** CO.
191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY