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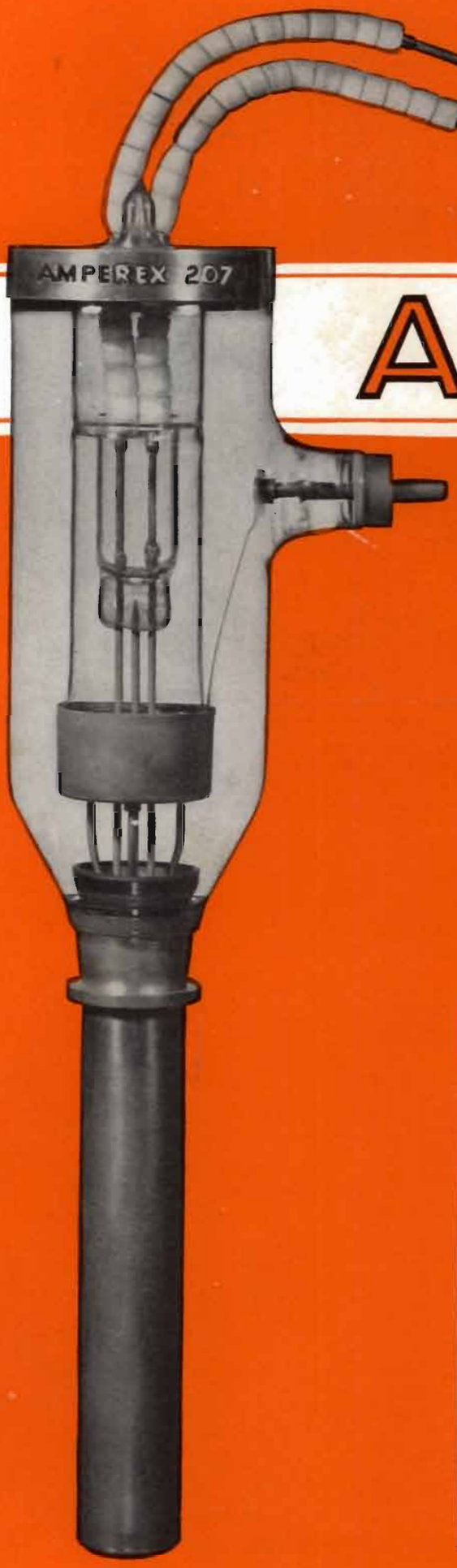
SEPTEMBER
1937



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COMMUNICATIONS

Member of Audit Bureau of Circulations

RAY D. RETTENMEYER • Editors • W. W. WALTZ

CONTENTS FOR SEPTEMBER

Cover Illustration: Depicting various phases of Communications. Photo courtesy Le Materiel Telephonique, Paris, France.

VOLUME 17 NUMBER 9

BRYAN S. DAVIS
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Published Monthly by the
BRYAN DAVIS PUBLISHING CO., INC.
19 East 47th Street
New York City
New York Telephone: PLaza 3-0483

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SANFORD R. COWAN
Eastern Advertising Manager

A. B. CARLSEN
Circulation Manager

Chicago Office—608 S. Dearborn St.
Telephone: Wabash 1903.

Wellington, New Zealand—Te Aro Book Depot.
Melbourne, Australia—McGill's Agency.

Entered as second class matter August 26, 1931, at the Post Office at New York, N. Y., under the act of March 3, 1879. Yearly subscription rates: $2.00 in the United States and Canada, $3.00 in foreign countries. Single copies: twenty-five cents in United States and Canada, thirty-five cents in foreign countries.

WITH THE EDITORS

IT IS WITH a degree of pride, not unmixed with a sense of deepened responsibility, that the publisher and editors present this first issue of COMMUNICATIONS. We hope that our pride is not misplaced; the responsibility is also evident, for COMMUNICATIONS has set a goal neither impossible of achievement nor one which will permit any slackening of pace. That goal is: To enable our readers to say, "We saw it first in COMMUNICATIONS!"

The consolidation which was effected, with COMMUNICATIONS as the result, was more or less inevitable. That this is so is immediately apparent from even a cursory examination of the vast industry which has grown up around the one-time communication art.

It is not too much to say that civilization has followed communication—trade may follow the flag, but it is not until reliable communication has been established between them that two nations can be said to be enjoying the full meaure of civilized intercourse.

Communication has been, from the beginning of time, an essential factor of the common defense. From the war-drums of the savages to the ultra-high-frequency radio of modern times lies a path through history, a path pointing always to one objective, the maintenance of communication. Britain did not become mistress of the seas because her men wanted to spend years away from home on some disease-ridden sailing vessel; but until the day of the ocean cable, and later, the radio, the very existence of the empire depended upon the communication lines maintained by those ships.

From national defense to national convenience was but a step. Once it was established that rapid communication could serve all of the people rather than the comparatively few in the military and naval forces, the growth of the art was assured.

We, too, are a part of that background. For over seventeen years *Radio Engineering* has been known and respected wherever the art penetrated, and *Communication & Broadcast Engineering*, and *The Broadcast Engineer*, likewise enjoyed a high degree of well-deserved popularity as entirely authoritative sources of material pertinent to their particular fields.

But these fields, or if you wish, phases, are definitely becoming inescapably linked. The home receiver designer functions with one eye on what the broadcasters expect to do—not next year but perhaps five years hence. The telephone and telegraph engineers envisage, in this year's equipment designs, the traffic which they will be handling a decade from now, and how they will be handling it. It just isn't possible any longer to say "Each to himself." It is, for similar reasons, impossible to say whether radio has attached itself to navigation—air or sea—or whether navigation has swallowed radio. Newspapers started out by fighting radio; now, while the support may not be self-evident, it is at least tacit, and few papers or news-gathering associations could attempt to cover the world's events without material dependance upon the newest members of the communication family—radio and facsimile transmission.

COMMUNICATIONS, as the name implies, has a field as broad and as inclusive as its editors care to make it. What the editors do will depend finally upon the readers. It is, after all, the readers who make a magazine and we would like *you* to feel that this publication is for your benefit exclusively. In this case, "you" means quite a few thousand engineers, executives and other personnel in the communications industry. You can't be in communications in this day and age and be indifferent to what the man next to you is doing. Neither can you afford the time to "look over his shoulder." COMMUNICATIONS expects to do the necessary investigating to bring to you the important events taking place in the industry, the new discoveries, and the personalities without which any field of endeavor is a lifeless thing.

Thus, we give you COMMUNICATIONS, dedicated to the furtherance of knowledge of the art whose name it bears.

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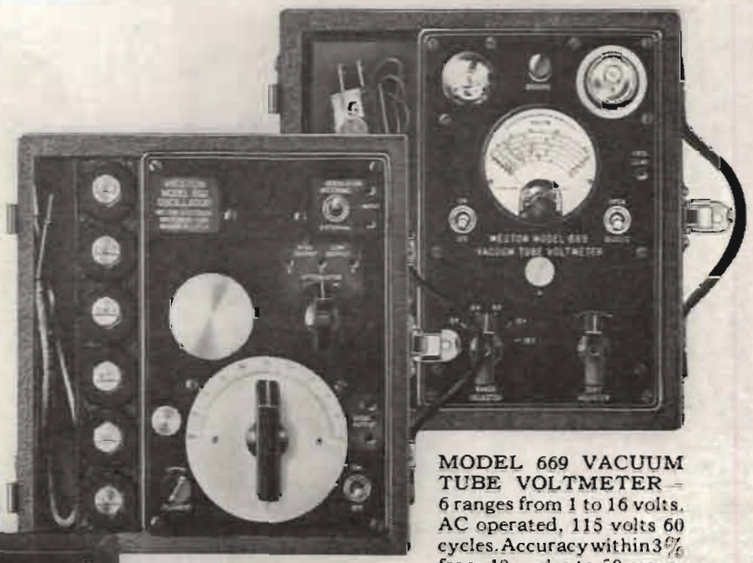
choose dependable instruments



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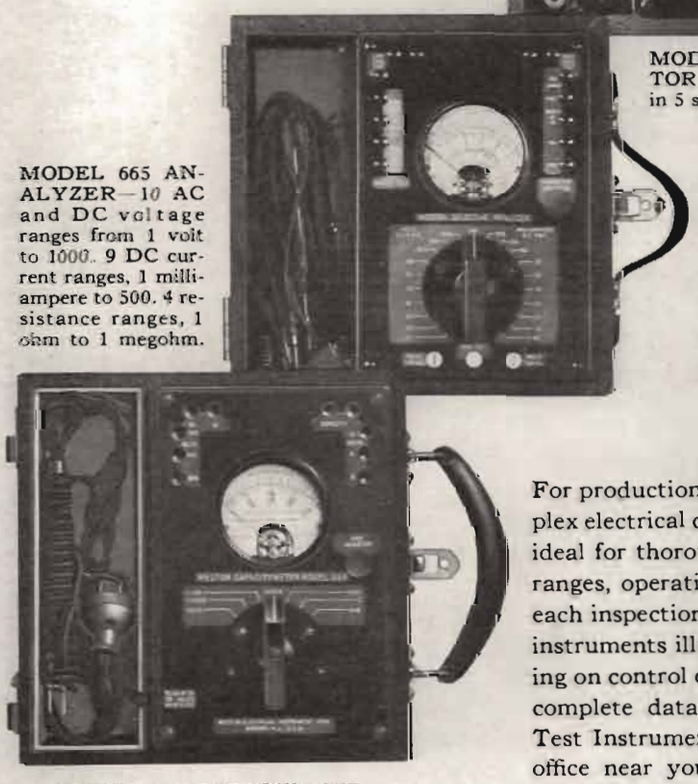

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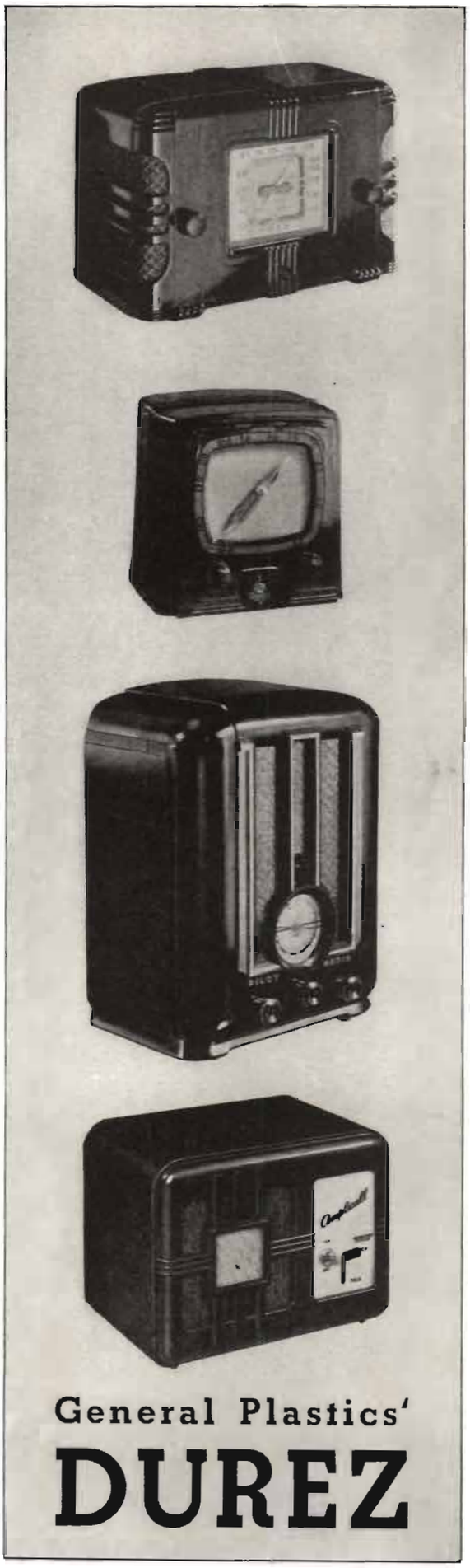

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"THEY CAN'T WEIGH SO LITTLE"

So exclaims many a manufacturer when first introduced to Durez cabinets. But remarkable lightness is only *one* of Durez' major advantages. It's strong, moisture-resistant, self-insulating. The satiny surface never chips or dents . . . always feels pleasantly warm to the touch. (*Shown is the Pilot table radio.*)

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Durez cabinets come from the mold formed and completely finished even to lugs, holes, inserts and the *final* lustrous surface. No grinding, japanning, etc., is necessary. And the finish can never show signs of wear . . . it extends all through the piece, is not just applied. (*This is case for the Amplicall inter-office communication system.*)

No matter what your problem, Durez can probably help you to solve it. For further information and free monthly "Durez News" write General Plastics Inc., 199 Walck Road, North Tonawanda, New York.

CENTRALAB ····· WILL STAY QUIET

U. ELGIN CHANDLER
Radio Sales and Service
1392 94 Bardstown Road
Louisville, Ky.

June 9th, 1937

CENTRALAB,
Milwaukee, Wis.

Gentlemen:

The writer first became acquainted with your Volume Controls in 1925, and since that time has used them almost exclusively.

Each time, I have gone back to Centralab, because it is the only control that I have ever found that will stay quiet.

Here in our shop we make every effort to avoid "call backs", and we have found that the use of your volume controls means one hundred percent satisfaction.

Both yourselves and the local service men are fortunate in having a distributor who promotes your merchandise as does P. I. Burks & Co., of Louisville.

U. Elgin Chandler

U. Elgin Chandler
Radio Sales and Service
Louisville, Ky.

The QUIET CENTRALAB CONTROL

offers maximum resistor length for case diameter . . . close uniformity between resistors . . . accurate tapers . . . uniform current distribution . . . better power dissipation and longer life.

Fine phrases seldom fool a radio man. Graphs, curves and self-praise may read well . . . but customer complaints put a "negative-bias" on such bouquets.

So, when an "old timer" like Mr. Chandler writes . . . "Since 1925 I've used your controls almost exclusively; in fact, each time I have gone back to Centralab, because it is the only control that I have ever found that will stay quiet." . . .

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HIGH SURGE VOLTAGE?

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* An example *

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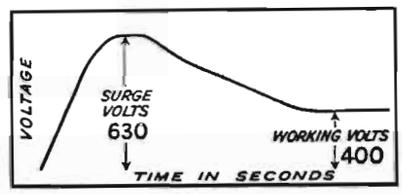
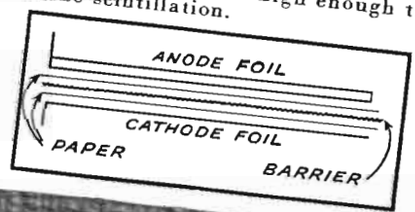


. . . and why this is possible

Theoretically surge voltage failure in either wet or dry electrolytic capacitors is caused by the ignition of a minute quantity of mixed gases sometimes accumulating at the anode during severe overload, and where scintillation is encountered. If the gases cannot combine, surge voltage failures will not occur. Since one of these gases is generated at the anode side, and the other at the cathode side of the electrolyte, the use of this special high density material, as part of the separator, acts as a barrier and retards their mixture.

Compared to other types of separator material, capacitors having non-fibrous cellulose separators will have a much longer life even though repeatedly subjected to overloads high enough to cause scintillation.



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COMMUNICATIONS

FOR SEPTEMBER, 1937

DISC RECORDING

Production and the Studio

By T. L. DOWEY

BESIDES the familiar and long-established home-entertainment field, there exists, today, another commercial application of disc recording which is rapidly becoming very important. This is the relatively new field of electrical transcription. During the few years since its introduction in its present form, experience has made it obvious that electrical transcription is an invaluable element of the broadcasting business, chiefly because of the many important advantages that accrue from the ability to broadcast programs from records.

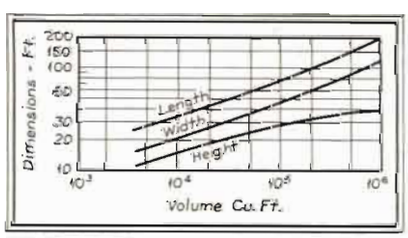
Of those two outstanding applications of the disc recording at the present time, the home-entertainment field is, of course, pre-eminent as regards the number of copies run off from each recording; however, it is in transcription work that the majority of the most interesting recording-engineering developments of recent years have had their first practical application, particularly those having to do with the refinement of quality. This is largely because of certain special conditions associated with transcription work, such as the necessity for maintaining high-quality standards, the desirability of having copies ready very soon after recording, and the availability of skilled engineering personnel to operate the reproducing equipment. The present discussion will, therefore, deal with disc recording primarily from the electrical-transcription standpoint.

FIELD OF ELECTRICAL TRANSCRIPTION

While the majority of communication engineers have become familiar with the significance of the term "electrical transcription" and are aware that the practice plays an important part in present-day broadcasting, the subject is such a special one that few people outside the industry appreciate the considerations that have led to the prevailing extensive use of electrical transcriptions.

The most important factor that has influenced this situation is the fact that better results can practically always be secured by the use of electrical transcription than would be possible with direct pickup, provided that the program is one which permits of repetition or rehearsal. The reason is, of course, that, no matter how many previous rehearsals have taken place, mistakes made after a direct broadcast has begun can never be corrected, while with a transcription the program can be repeated, if this seems desirable, in order to obtain the best results possible from an artistic or technical standpoint. The making of corrections is, we may remark, greatly facilitated by the high development of disc-recording technique, which permits of inserting, rearranging or removing parts when re-recording, much as a cutter edits a sound-picture film.

FIG. 1
In determining the shape of the studio the following ratio have been found to yield the best results.



A secondary consideration which is worth mentioning is that it is frequently desirable for a number of reasons—commercial, legal, technical, or artistic—to have a permanent record of many programs which are put on the air. In this case a high-quality recording of the program as it passes through the studio bus bars furnishes exactly the type of document required.

HOW TRANSCRIPTION WORK IS ORGANIZED

In the operation of the electrical-transcription industry, there are recognized the same two types of program which are familiar in direct broadcasting; namely, the sponsored program which is paid for by the advertising agency and which is put on the air by buying the necessary station time, and the sustaining program which the transcription organization maintains as a service to those stations desiring it, by means of its record library. The first step in the origination of a sponsored program occurs, of course, when an advertising agency approaches the sales department of the transcription organization with a statement of its needs. It is the function of this department to analyze the problem presented by the customer, and after a satisfactory agreement has been reached as to the nature of the program, a broadcast date is set. This is forthwith communicated to the shipping department which, from its knowledge of the time which will be required for distribution of the records to the stations through which the broadcast will be made, is able to work back and set a dead-line date by which the

production department must make its record pressings available.

It may also be noted that sometimes a departure is made from the system described above for establishing dates, in that the broadcast date may not be finally set until the pressings have been approved. The decision to proceed in this manner might be made, for example, if the program were of a novel kind which might require revision, or if there was a possibility that the client's plans might change.

After these essential preliminaries, the details relating to the actual requirements of the program are determined and are transmitted to the recording department in terms which establish the type of orchestra being employed, the musical requirements, the length of the program, etc. A date is also set on which the recording is to take place; this naturally is determined with reference to the distribution dead-line date previously mentioned.

As soon as the length and type of program have been decided upon, it becomes the function of the recording department to select a suitable stage and schedule it for the assigned date. It is also, of course, necessary to make sure that the required number of recording machines will be available. Whenever a program is to last longer than a single disc, for example, longer than fifteen minutes, it becomes necessary to use at least two machines. This constitutes what is termed "overlap" recording, which, by alternating machines, may be continued to carry a program of any desired length. When such a program is reproduced, it becomes necessary to establish a cue at the end of each record, to indicate the instant at which the reproducing turntable with the oncoming record must be started in order to produce the necessary continuity of effect. Depending very largely on the extent to which the program is capable of rehearsal or repetition and the expense which would be involved by this, it may also be decided to make parallel takes, with the object of guarding against the possibility of loss through accident or error during the recording or processing. Sometimes it is considered justifiable to use all available machines for this purpose. It may also become necessary to resort to parallel takes if a large number of copies of the recording will be required in a short time, as this means that several masters will be available and several record presses may be producing simultaneously without waiting for duplication of the master to stampers.

There are several necessary details which must also be attended to with an eye on the date set for the recording, such as, the provision of the required recording wax blanks, the operation of the air-conditioning system, the provision of personnel in the required numbers and assurance that sufficient processing capacity will be available. Studio routines should be such as to automatically take care of these factors.

After the recording is made, it immediately becomes important to have a test pressing available as soon as possible. This test pressing is first checked by the production department's test man, and sometimes by the monitor man. For a sustaining program, these are usually all the approvals that are required; but in the case of a sponsored program, the test pressing is rushed to the sponsor for his approval before any production pressings are made.

The number of production copies required may vary from one to several hundred, depending on the distribution which it is intended to give the program. Air express may be resorted to when the time available for distribution is limited.

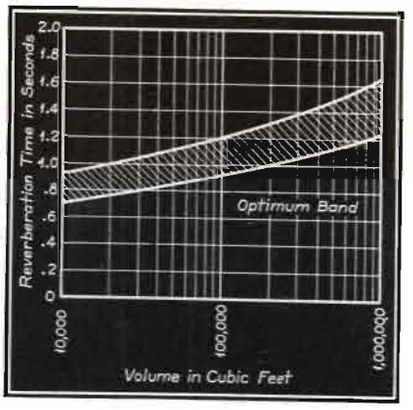


FIG. 2
Showing a relation between optimum reverberation time and volume.

STUDIO ACOUSTICS

Since one of the objectives of electrical transcriptions is to produce a program indistinguishable from a direct broadcast, the studio-acoustic and pickup technique is in many ways the same as for broadcasting. However, since there are usually more possibilities of repetition and correction than with a broadcast program, the transcription studio has also many points in common with a scoring studio for motion-picture work, and in fact is more closely related to the latter than to a typical broadcast studio.

While it is sometimes said that it is the function of broadcasting to take the artist or entertainment into the home, at other times the idea is expressed that the listener should be transported to the studio or to the imagined scene of the action. As a matter of fact, both statements are true if qualified with reference to the type of program; where it is of the intimate "fireside talk" variety, it is desirable to have pickup acoustics of the type that are said to bring the program "into the home"; where the program employs a large orchestra or is supposed, for example, to come from a battle-field, the aim should be at the opposite effect. In either case, however, the studio acoustics should simulate the effects and conditions natural to the type of entertainment.

It is well recognized today that the acoustics of a room are a definite part of the sound, particularly music, produced in it. It has been shown that a larger part of the acoustic energy affecting the ear reaches it by reflection from the various surfaces, than by direct transmission from the instruments, and the need for sound-reflecting surfaces in the vicinity of an orchestra has long been known. The proper control of reverberation is therefore a factor of paramount importance in the acoustics of studios for making electrical transcriptions. Furthermore, since this sound is to be reproduced in a second room, the reverberation at this second point also enters the picture. However, contrary to a common opinion held in the earlier days of reproduction, it has been found, in all recent experience using improved pickup and reproducing equipment, that the effect of combining the reverberation of two rooms is not additive and consequently the reduction of reverberation at the source is not required. In practice, it has been determined that the most natural and pleasing conditions obtain where the apparent reverberation to the listener is largely that of the source room, sufficient liveness being present in the receiving room to blend naturally and heighten the imaginative impression of being present at the source. Insufficient reverberation in the source room causes the reproduction, in a room of moderate or greater liveness, to sound cramped and as if issuing from a small point rather than an extension of the listening room. Consideration must also be given to the apparent added liveness of monaural pickup. One explanation of this condition is the existence of an interference pattern which is reduced in effectiveness by the cancelling effect of two ears. In the present state of the art, the most feasible means of compensating for the added liveness of monaural pickup is the creation of a zone acoustically more dead than the average reverberation period of the total enclosure. Fortunately, this coincides with accepted theories of the best arrangement for listening to music; namely, live surroundings for the mu-

(*Continued on page* 68)

CONSOLE TYPE SPEECH-INPUT EQUIPMENT

By JOHN P. TAYLOR

COMPLETE speech-input assemblies built into small console-type cabinets are a development of the last two years; and, in fact, have come into widespread use only in recent months. All previous speech-input design was based on the accepted convention of rack-mounted panel-type units. Such an arrangement, having the obvious advantages of flexibility and standardization, was—and probably still is—the best system for larger stations and network studios. On the other hand it was—and, to a lesser degree, still is—an expensive consideration for smaller stations.

The question of why less expensive equipments did not make their appearance sooner is probably answered by the economics of the situation. Until recent years sales of equipment to larger stations made up such a large percentage of the business (dollar volume) that designs were inevitably pitched to their standards. However, with a steadily increasing number of smaller stations and, even more important, higher incomes for most of these, this field has of late become one which the manufacturers could not afford to overlook. As a result, equipments particularly fitted for small stations have been appearing in increasing number. The several special low-power transmitter designs recently described[1] are a case in point. Console-type speech equipments are another.

In practice, console equipments have other advantages, in addition to the price differential. Since placement of mixers and controls in some type of console is now almost universal practice, the use of rack-mounted amplifiers necessitates inter-unit wiring. Thus console equipments represent a saving in installation cost—also, since they are "factory assembled and tested," there is usually a saving in installation time. Moreover, racks are clumsy, and require floor space; consoles are of convenient size, mount on almost any kind of a table or desk, and do not add to the required floor space.

Use of console equipment is not necessarily a prerogative of small stations. In larger studio installations, where separate control booths for each studio are the practice, they should find a convenient application. The equipments ordinarily specified for such booths make up what is commonly known as a single-channel assembly. These new console assemblies consist, basically, of the same units—and should, therefore, be ideal for this use. They lack, of course, the ease of servicing of the deluxe speech-input panels, and they do not conform to the "build up" idea. However, the other advantages may often outweigh these latter.

Despite these possibilities in larger stations, the main application of these equipments is bound to be in smaller stations. Apparently with this in mind, the manufacturers have obviously devoted considerable attention to the development of switching and control systems which would increase the flexibility of these equipments to the point where they would suffice to meet all the speech-input requirements of small stations. Thus, by various ingenious arrangements, they have extended the ordinary functions, of what are actually single-channel layouts, in such degrees that they handle microphones in two studios, transcriptions and remote lines with convenience—and, in some instances even provide talkback, auditioning and remote cueing. The best idea of the possibilities, as well as the limitations, of these stratagems is obtained by briefly reviewing the features of the standard models announced to date.

TYPE 12H

The Type 12H speech-input assembly furnishes a striking illustration of the extent of the facilities that can

[1] "The Low-Power Transmitters," by J. P. Taylor, *Communication and Broadcast Engineering*, June-July, 1937.

Fig. 2. Block diagram of the Type 12H speech-input assembly.

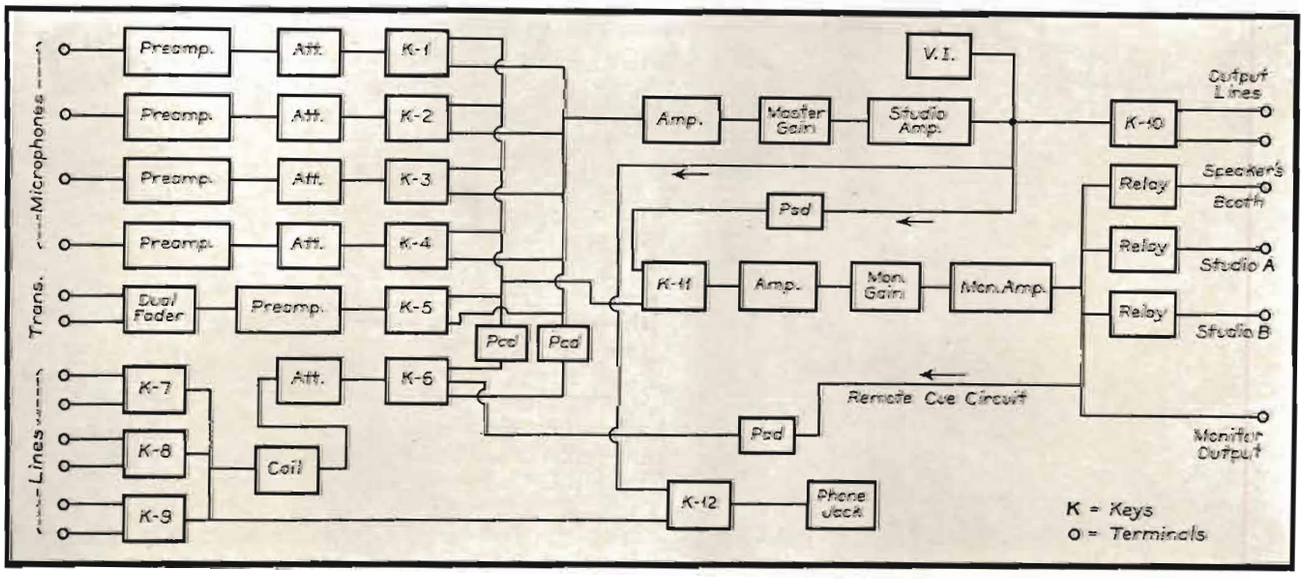


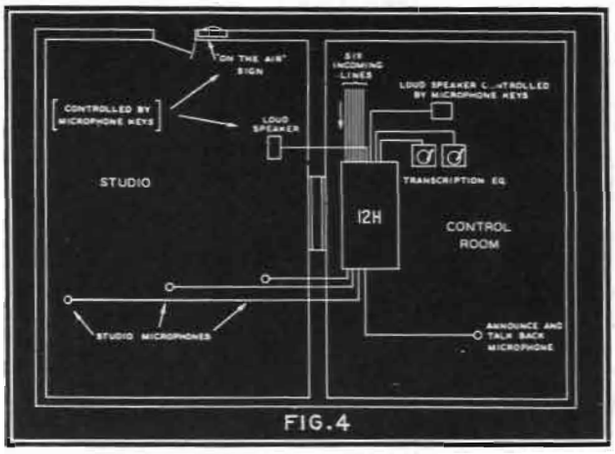
FIG. 1. Front view of the 12H speech-input assembly for studio applications.

be built into a small-sized equipment. There are four microphone inputs, two transcription inputs and six line inputs; five pre-amplifiers—four in the microphone inputs and one following the dual faders, in which the transcription inputs are combined; no less than six mixers—one being especially reserved for handling remotes; and a switching system providing auditioning, talkback, remote cueing and other conveniences. These, of course, are in addition to the usual master gain, main amplifier, volume indicator, monitoring system and accessories—also a complete interlocking control system.

Referring to the front view of the Type 12H equipment (Fig. 1) the six mixers will be seen ranged along the bottom of the control panel. The main gain is slightly higher, in the center of the panel. At the left and right of the V. I. meter are the V. I. range switch and the monitoring gain control. Above each of the six mixers is a two-position key switch. These are the "audition"-"program" switches. As they are an unusual feature they deserve a further explanation. Referring to the block diagram of the 12H (Fig. 2) these six switches—K-1 to K-6—will be seen to be associated with the six mixer positions. When one of these switches is set at "program," the mixer which it controls is connected to the program circuit. If it is set at "audition," the monitor key (K-11) is also set at "audition." The mixer and associated input circuit is connected direct to the monitoring system (which is disconnected from the program circuit by the operation of K-11). This is the setup for auditioning simultaneously with program. Any of the six input circuits can be used alone, or in combination, for auditioning, while any of the remaining ones are used on program. There are, of course, limits to this arrangement. For one thing, program monitoring must be done by V. I. alone—or with headphones. Also the practical difficulty of mixing two programs at once may arise. However, remembering that most small stations use transcriptions much of the time, and that most regional stations depend largely on "chain," it seems likely that this arrangement will ordinarily suffice.

The remainder of the circuits of this equipment will be fairly clear from the diagram. Switches K-7, K-8 and K-9 allow choice for any six remote lines, for which terminals are provided; switch K-10 for choice of two output lines. Switch K-12 allows use of phones for program monitoring, or monitoring of incoming remotes. An interesting feature, in this connection, is that when switch K-6 is in the center position, cue may be fed to a remote point. Relays are provided, as shown, for interlocking speakers as desired.

The mechanical design and appearance of the Type 12H assembly will be fairly evident from the several views shown. The finish of both the housing and panel is crystalline gray. Overall dimensions are 35" long by 11" high by 15½" deep. In addition there is a small external unit which contains the power supply. Connections between this and the main unit, as well as the microphone connections, are of the plug-in type. All are ordinarily hidden from view by the end sections of the cabinet, which are easily removable. Looking inside the unit, the amplifier components are found to be arranged on four cushion-mounted chassis. From left to right (Fig. 3), these consist of: First, the four microphone preamplifiers; second, the main amplifier; third, the monitoring amplifier; and, fourth, the relays and filter components. The fifth preamplifier—the one in the transcription input—is a small unit mounted on the rear of the panel at the extreme right.



Arrangement utilizing a console-type equipment in a single-studio installation.

The efficient application of a console equipment, such as the Type 12H, to simple studio requirements is illustrated in Fig. 4 and Fig. 5—which are, respectively, typical arrangements for single-studio and two-studio installations. The console is placed on a table or desk just in front of the studio observation window—so that the operator looks over it into the studio or studios. One microphone and one loudspeaker are placed in the control room or booth. One of the relays is connected so that operation of the key which connects this booth microphone cuts out the booth speaker—thereby automatically forestalling danger of feedback. The remaining microphones are placed in the studio—or divided between the two studios. Loudspeakers are also placed in the studios and the remaining two relays so connected as to cut these off when microphones in the same location are "live." "On-the-air" signs at the studio

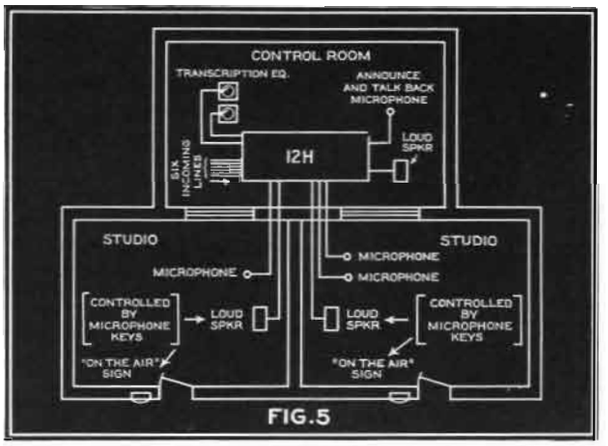
FIG. 8. The Type 23A speech-input console set up in a control booth of the Mutual Broadcasting System.

doors can be operated by the same relays. The transcription equipments are located in the booth so that transcription programs can be handled by a single operator-announcer. These facilities, together with the switching facilities provided for the incoming remotes, are all that are required in small stations.

TYPE 12L EQUIPMENT

The Type 12L console assembly is a new equipment of quite different characteristics. While any of the console equipments described here might be used at the transmitter, the Type 12L is the only one especially designed for this particular use. It provides inputs for lines from the studio, for a local announce microphone, for transcription equipments and for a connection from the r-f monitoring circuit of the transmitter. In addition, it contains an equalizer circuit, a standard volume indicator, and switching circuits adapted to this type of use. There are also controls which may be used as extensions of the transmitter control circuits, and a lamp which may be connected with the peak indicator on the modulation monitor.

Generally speaking the Type 12L equipment is an adaptation of the 12H, which has been described above. The construction and mechanical design are identical.



Arrangement utilizing a console-type equipment in a two-studio single-control-room installation.

The appearance (see Fig. 6) differs only in the arrangement of controls. Since fewer mixers are needed, the monitor gain control and the equalizer loss control replace two of the mixers along the bottom of the panel. Thus there is provided a space at the upper right of the panel in which have been placed the peak flash lamp and on-off switches for transmitter control. Looking inside the console, the only change is the removal of two of the microphone preamplifiers, and the small transcription preamplifier, which were used in the 12H equipment.

The arrangement of components, and of the switching circuits, of the 12L are markedly different. The block diagram (Fig. 7) illustrates the general layout. Since the relay circuits in this instance have a definite application, their action has been indicated by dotted lines which connect each relay with the associated key. Referring to this diagram, it will be seen that there are four input-mixer circuits which may be fed into the line amplifier. The first of these four circuits accommodates the two lines from the studio. A two-position key switch, K-1, in the circuit is so connected that when the input from line 1 is utilized a telephone is connected to line 2, for use in talking to the studio. When the key is in position 2 the program is received over

FIG. 6. Front view of the type 12L speech-input assembly for transmitter control.

line 2; the telephone is then out of circuit but operation of line 1 can be checked with headphones through switch K-6. The second input circuit provides for handling a local source of pickup; this will only be used in special cases. The third input circuit accommodates a local announce microphone. This circuit includes a preamplifier so that a high-quality microphone may be used. The fourth input circuit provides for local origination of transcription programs, emergency or test record programs, etc. By means of the associated mixers any of the four inputs may be used to feed the transmitter.

The monitoring system is so arranged that operation of switches K-5 and K-7 will allow monitoring across the output of the mixer circuit, the output of the line amplifier, or from the r-f rectifier in the transmitter. The last is the normal connection—since it provides continuous aural check on the operation of the whole installation. A relay in the output of the monitoring amplifier cuts off the monitoring speaker automatically for local announcements. There is another relay which may be similarly used in connection with the local input circuit. Finally, there is an arrangement such that in case of failure of the line amplifier, the monitoring amplifier may be instantly substituted. This is made possible by switch K-7, which in the one position connects the monitoring system to the output of the mixers and simultaneously operates a relay which places the transmitter line across the ouput of the monitoring amplifier.

TYPE 23A EQUIPMENT

The Type 23A speech-input assembly is another equipment which has become very popular and is in widespread use. Intended primarily for high-quality studio use, the emphasis in this equipment is placed on attaining high-fidelity in a relatively simplified setup. The facilities provided are approximately the same as

FIG. 3. Interior of the Type 12H speech-input assembly.

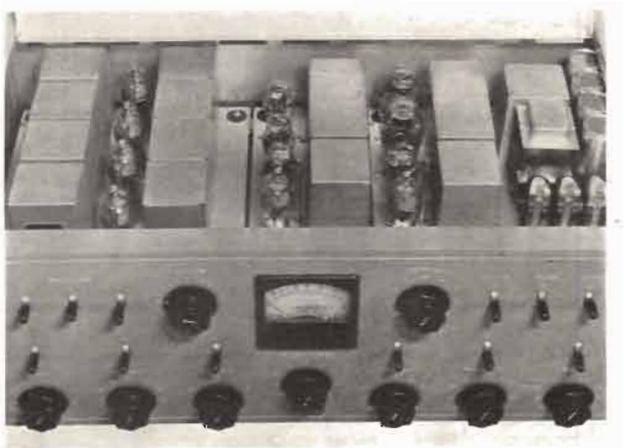


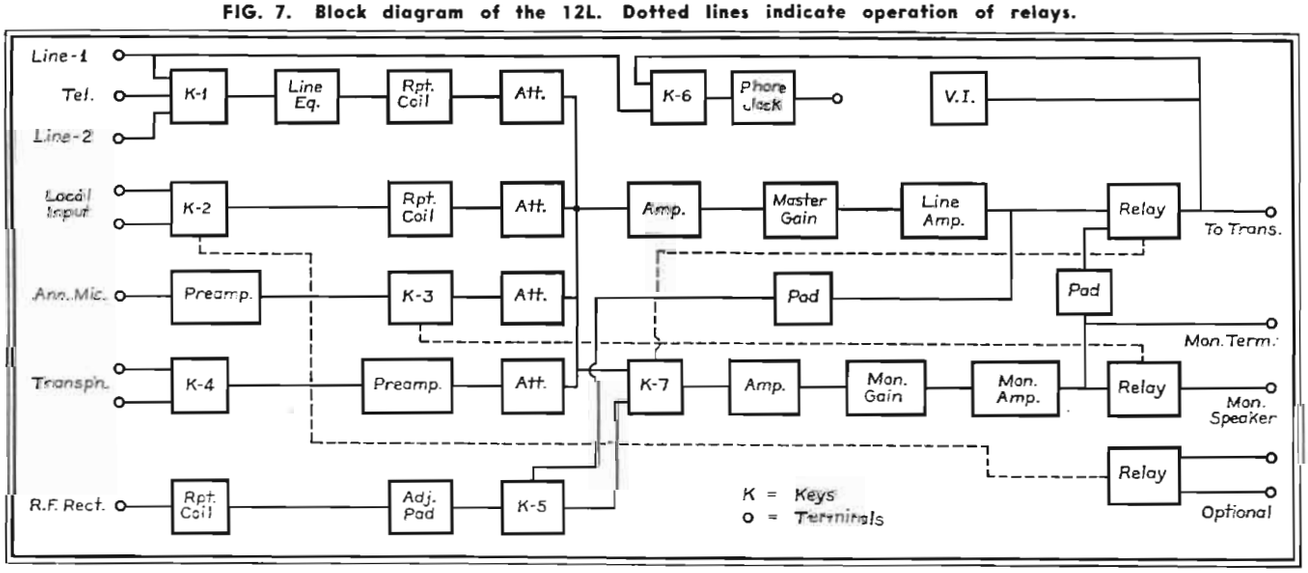
FIG. 11. Front view of the 76-A speech-input console.

in the first equipment described above, although the switching facilities are quite differently arranged. Inputs are provided for eight microphones or transcription equipments, for an announce or talk-back microphone, for four line inputs, and for an external cue or monitoring input (as, for instance, from the transmitter). There are switching facilities providing for talkback to either of two studios, and for a particularly convenient method of handling incoming remotes. In addition, of course, there are the usual master gain, main amplifier, volume indicator and monitoring units. Also an interlocking control system, a means for checking plate currents, and provision for a signaling circuit.

The dimensions of the Type 23A equipment, 34" wide by 10" high by 14" deep, are practically the same as those of the equipments previously described—these apparently being the most convenient with respect to the particular placement required of an equipment of this type. The appearance of this unit is, however, quite different. The upper part of the metal housing is divided into three sections, with the main control panel located on the center section and sloped for convenient observation of the volume indicator. Also located on this panel are the monitoring gain control, the master gain control, the output and input keys, and the talkback and cue keys. The other operating controls are located on a vertical panel extended across the width of the equipment. At the left, the four program line keys; in the center, the five mixers; and, at the right, the signaling, plate current, and power switches, also the test and monitoring jacks.

The arrangement of circuits and the operation of the Type 23A equipment are illustrated in the block diagram (Fig. 9). As will be seen, there are four preamplifier input circuits. Each preamplifier is preceded by a two-position switch (K-1 to K-4), so that eight microphone and transcription inputs are provided. This arrangement is not intended for switching of microphones which are in use, but merely for setup purposes. Thus, as ordinarily connected, switches K-1, K-2, and K-3 in the up position connect to microphones in Studio A, and in the down position to microphones in Studio B, while switch K-4 is reserved for transcription inputs. There is an additional switch K-5 which brings into the circuit a microphone located in the control booth. This may be used for announce purposes (on transcription programs) or for talkback to either studio. A fifth mixer is reserved for handling incoming remotes. The method provided for handling these is a unique feature of this equipment, and is unusually convenient. Each of the incoming line inputs is brought into a three position switch. In the up position these switches connect the input into the mixer—as for program transmission. In the down position they connect the input to a terminal which can be arranged to feed directly into the monitoring system. In the center position they are, of course, dead. This arrangement allows the program—as for instance a network program—which is coming in to be monitored over the regular monitoring system up until the moment at which the remote program is to go on the air, at which time operation of a single switch transfers it to the program circuit. The selection of the circuit to be monitored is made by means of switch K-11 which places the monitor system either on the incoming line circuit (as previously mentioned), across the output of the main amplifier, or across an input which may be variously used for external cue or for a line from the transmitter monitor or the like. The monitoring system follows the standard arrangement, consisting of a separate monitoring gain control, a monitoring amplifier and output connections through relays for three monitoring loudspeakers. The relays may be connected to the microphone input keys as desired in order to obtain automatic speaker cut-off in each of the studios as well as the booth. The program circuit is also conventional, consisting of a low-level amplifier followed by the master gain control and the main amplifier, with a volume indicator (illuminated meter) bridged across the output. A minor difference is that the monitoring system is fed at a relatively high level. Thus the pad usually placed in the program monitoring line is, in this instance, placed in the line to the transmitter. It is fol-

FIG. 7. Block diagram of the 12L. Dotted lines indicate operation of relays.



owed by the usual two-position switch for choice of utput lines.

TYPE 23B EQUIPMENT

The Type 23B speech-input assembly is identical to he Type 23A assembly in all respects except the plac- ng of the main gain control. Referring to the descrip- ion of the Type 23A, it will be noted that the five nixers are lined up on the lower center panel—while the nain gain control is at the upper right of the sloping anel. This arrangement is of maximum convenience vhere the respective mixers are used not only for mixing ut also for riding gain—that is, where the main gain s used only for occasional rough adjustments. The Type 3B equipment, on the other hand, places the main gain ontrol at the right of, and on a line with, the four nicrophone mixers—that is, in the place occupied by he line mixer on the 23A. The line mixer is placed at he upper right of the sloping panel. This arrangement s more suited to the requirements of stations where perators ride gain principally by the use of the main ain contol, and use the mixer controls only for ad- ustment of relative levels, and for cutting in or out he microphones and other program sources. This seem- ngly small difference is one which becomes of con- iderable importance in operation—since an awkward rrangement will greatly increase operator fatigue.

TYPE 76-A EQUIPMENT

The Type 76-A consolette—so called by the manufac- urer—is a console-type speech-input equipment gen- rally similar in function and operation to the studio-type quipments described above. The facilities included are pproximately the same, although here again the switch- ng arrangement provided shows a rather marked dif- erence. There are input connections for six studio nicrophones, for a talkback microphone, for eight line r transcription inputs, and for an external cue or moni- oring input; three preamplifiers; a three-position mixer, lus a fourth independent input mixer circuit; and an nusual switching arrangement providing for audition- ng, talkback, and convenient handling of remotes. Also, f course, a master gain, main amplifier, volume indi- ator, monitoring system and relays for automatic cut- ff of monitoring speakers. The block diagram (Fig. 0) indicates the arrangement of components and circuits n the Type 76-A equipment. Immediately noted will

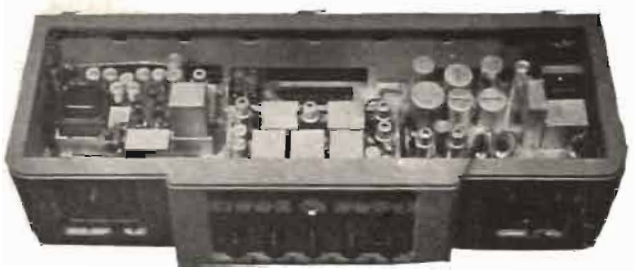


FIG. 12. Interior of the 76-A. Note use of standard rack-type chassis units.

be the fact that these more closely approximate, than do any of the other equipments, the usual arrangement of units in rack-mounted equipment. As a matter of fact, the three main units of this equipment, that is, pre- amplifier-mixing system, main amplifier-V. I. system, and monitoring amplifier, are simply rack-type units mounted in a console of convenient dimensions. By means of an ingenious switching system these units perform not only the usual functions of a single-channel studio equipment, but also provide for an additional studio, for talkback, for handling of remotes, and for limited auditioning. The method of accomplishing this should be evident from a study of Fig. 10. The three pre- amplifier input circuits are extended to handle micro- phones in two different studios by the same stratagem as employed in the previously described equipment—that is, by the placing of two-position key switches in each input, so connected that in the No. 1 position they con- nect to microphones in one studio and in the No. 2 posi- tion to those in the other studio. Still greater flexibility is gained by carrying this process a step further and placing three two-position switches following the pre- amplifiers—that is, in the inputs to the three associated mixers. These provide for bringing in 250-ohm lines either from remotes or from transcription equipments. Two-position switches (K-7 to K-9) in these three lines provide for switching of six input pairs. In addition to these inputs, there are two other pairs which, through K-10 feed into a fourth independent mixer control. Through operation of switch K-11 in this circuit, or switch K-12 in the program circuit, either of the two may be connected to either the monitoring circuit or the program circuit. This provides a means of carrying on

(*Continued on page 50*)

FIG. 9. Block diagram of the 23A.

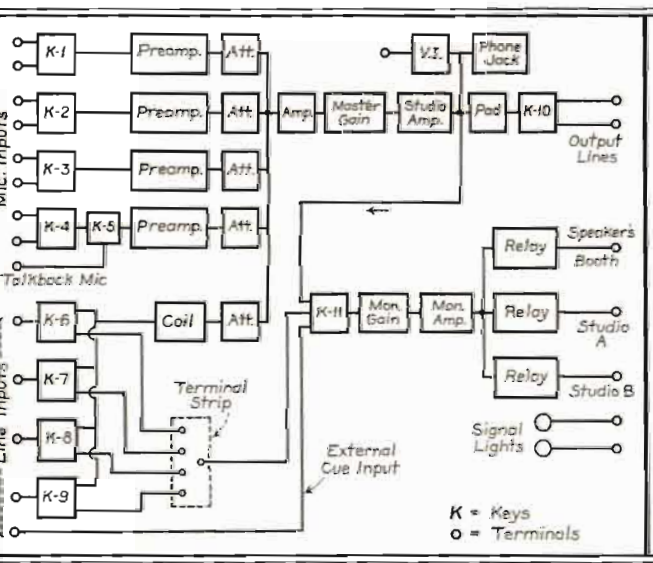
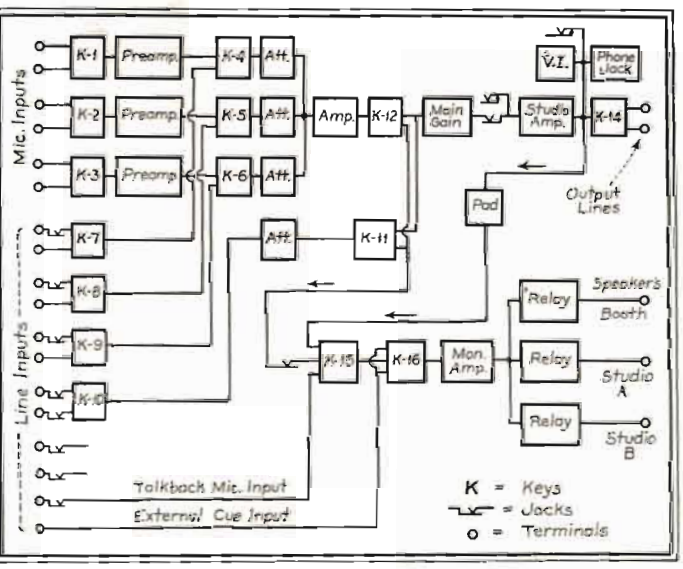


FIG. 10. Block diagram of the 76-A.



SPECIAL EMERGENCY STATION

By MAURICE E. KENNEDY
Radio Engineer
LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

THE FREQUENCIES of 2726 kilocycles for A-3 emissions and 3190 kilocycles for A-1 emissions are set aside by the Federal Communications Commission as communication channels on which to operate Special Emergency Stations. Very little has been written concerning the possibilities of an emergency radio system and inasmuch as the Los Angeles County Flood Control District has recently established such a network, it will, no doubt, be of interest.

The problem of flood control and water conservation in an area the size of Los Angeles County with its 1592.1 square miles of rugged mountain country and 1165.5 square miles of densely populated valley lands is far from a simple task. The responsibility of construction, operation, and maintenance of the elaborate system of dams, debris basins, concrete channels, and percolation grounds falls on the Los Angeles County Flood Control District. With the engineering and dispatching offices located in the heart of downtown Los Angeles, it is only natural that communication plays an important part in the control and operation of the system.

For a number of years the District was limited to the use of telephone and teletype communication over a private telephone system, but even the most rugged line construction often fails during storm periods when communication is most essential. It was during such a time of flood and paralyzed communication that the radio section was organized. From a few small stations the radio system has grown to an elaborate communication network that parallels the private telephone lines with auxiliary radio stations both fixed and portable.

In addition to the two-way units, the cars and trucks driven by the field engineers and foremen in charge of emergency crews are equipped with 2726-kilocycle, fixed-band receivers. The hydraulic engineers have special converters adapted to standard auto-radio receivers to give them the 260-kilocycle airway-weather stations and our 2726-kilocycle band in addition to the broadcast band. With this equipment the field men are constantly informed of storm changes, weather conditions, emergencies in all parts of the county, and what information is desired from their districts. Dispatching of emergency crews by radio is much faster than the older method of calling for orders when near a telephone.

KIIY, the central station of the network, is located in a modern, sound-treated operating room adjacent to the hydraulic engineering offices of the Flood Control District in downtown Los Angeles. The 500-watt transmitter has just been completed and, in respect to the taxpayer who supports us, the materials used in its construction were mostly California products. The transmitter was designed and built in our own shops, and is modern in every detail. Refinements that are seldom found in stations interested in communication at voice frequencies may be seen in the accompanying photographs.

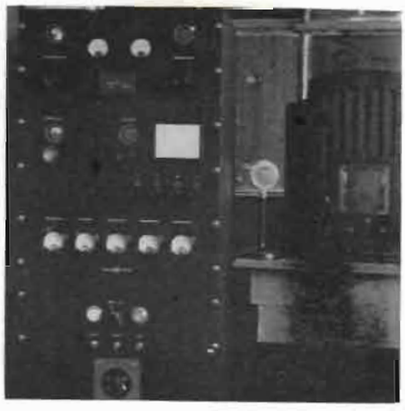
The KIIY transmitter is located on the fourth floor of a modern office building with the concentric-fed vertical radiator and radial counterpoise perched atop the elevator penthouse on the roof of the building. This type of installation offers both convenience in the operating-room location and efficiency in the radiating system. The concentric feeder is entirely inside the building being laced to conduit and water pipes in a small duct intended for electric-conduit pipes and running to the roof.

The quarter-wave vertical radiator with loaded-top section was built of welded sections of galvanized water pipe. The mast tapers from a six-inch diameter at the lower section to a four-inch diameter at the top. The outrigger at the extreme top was made from twelve-foot lengths of one-inch diameter water-pipe with the ends connected together by steel rods. All joints are welded. The mast is equipped with a large steel pulley mounted just below the outrigger and a heavy hemp rope for the staff to make trips to the top for adjustments, painting, etc. A copper strip was spot-soldered over the entire length of the mast.

KINT and associate equipment for portable use.

The 500-watt transmitter designed and built by the author.

KIIW—The 175-watt station of San Gabriel Dam No. 2.

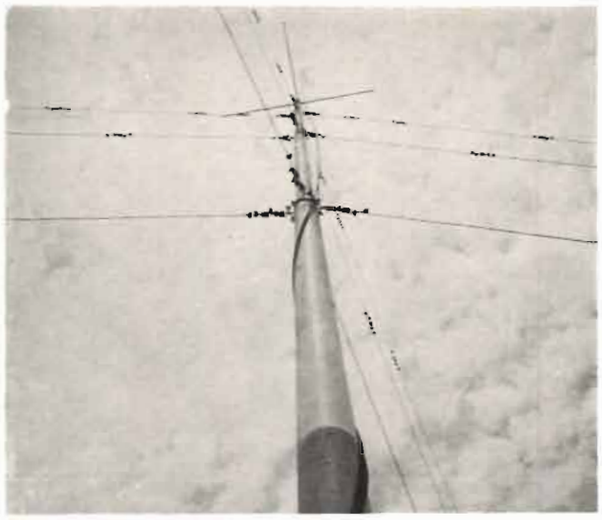


The station at San Gabriel Dam No. 2 (KIIW) is shown in an accompanying illustration. A Collins type 30 FXC transmitter, modified for 2726- and 3190-kilocycle operation, is located in the valve-control house for the dam. This station is located on one of the most remote dams in the county, and even though separated from KIIY by two high mountain ranges and fifty miles of rugged country, the stations have no difficulty in maintaining two-way communication at any hour of the day or night.

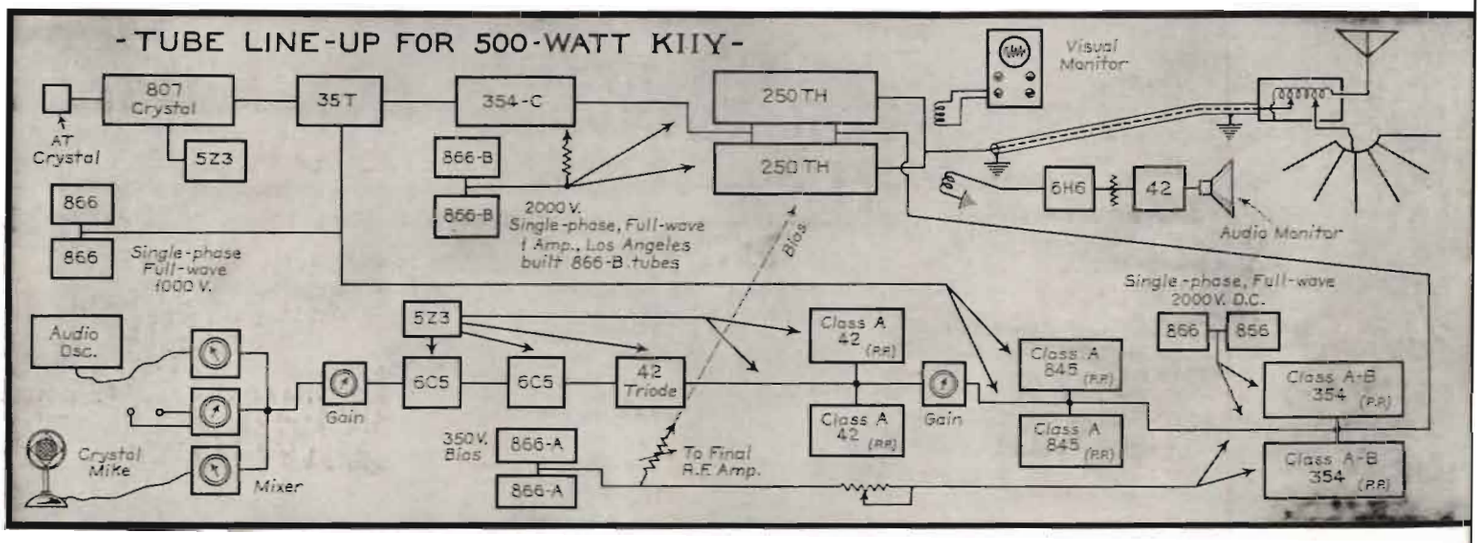
The men who handle the field stations have also studied hydraulics and act as radio operators and assistant engineers on the dams.

Also shown is KINT, a portable unit, ready to be loaded in the emergency truck and taken to a temporary location to relay important information from a section of isolated telephone line or flood devastated lowlands.

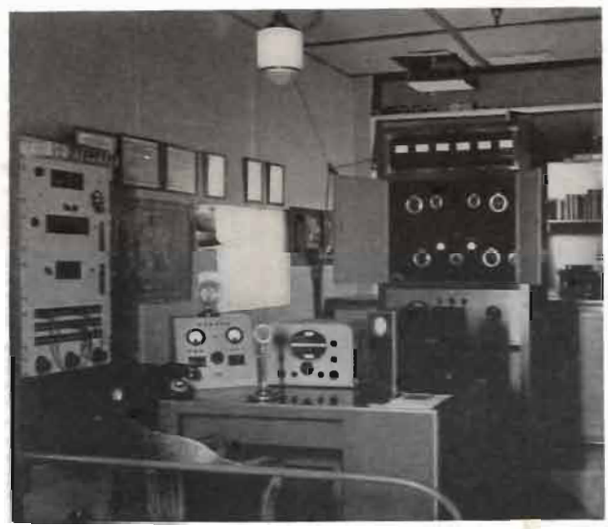
The KIIY vertical radiator which is mounted on top of the building.



This equipment will be self-contained with 110-volts a-c from the generator geared to the truck's engine. Collapsable dural masts are carried with portable stations for use as vertical radiators or supporting masts. The advantage of the station located permanently in a truck will be the speed in which it may go into service from distances greater than it is possible to use the mobile type of ultra-high-frequency transmitters.



We have under construction a complete 50-watt portable station to be located in a small, panel delivery truck.

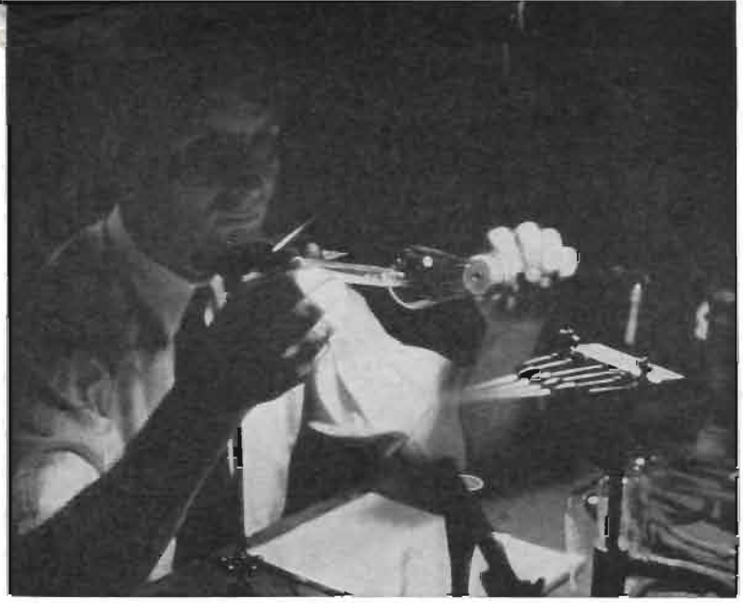


The operation room of the main station KIIY.

The 110-volt, 660-watt, a-c generators used to supply power to portable receivers and transmitters are built from old Dodge automobile generators and have proven highly satisfactory under long periods of continuous use. These generators are driven to full output by a small ¾-h.p. single-cylinder gasoline engine, or they may be geared directly to a truck or car engine.

We have found the intermediate frequencies more suitable for this type of service than the ultra-high channels due primarily to the type of country over which it is necessary for us to transmit signals. The ultra-high frequencies have shown possibilities in the more open sections of the county, and we hope to eventually use two-way communication to the cars operating in the valley division.

Deft fingers put the delicate filament in its suspending frame as an early operation in assembling the elements of a tube.



A temporary glass tube is sealed onto the bulb, for convenience during certain manufacturing operations. Later it will be melted off and discarded.

THE MANUFACTURE

The glass bulbs get a "Turkish bath" to remove the last traces of possible impurities before the elements are inserted.

The finished vacuum tubes must go through the "aging" process at the factory before they take their final test.

The heavy soldering copper is suspended so that the operator may hold the comparatively light vacuum tube up to it in the process of soldering the leads into the base pins.

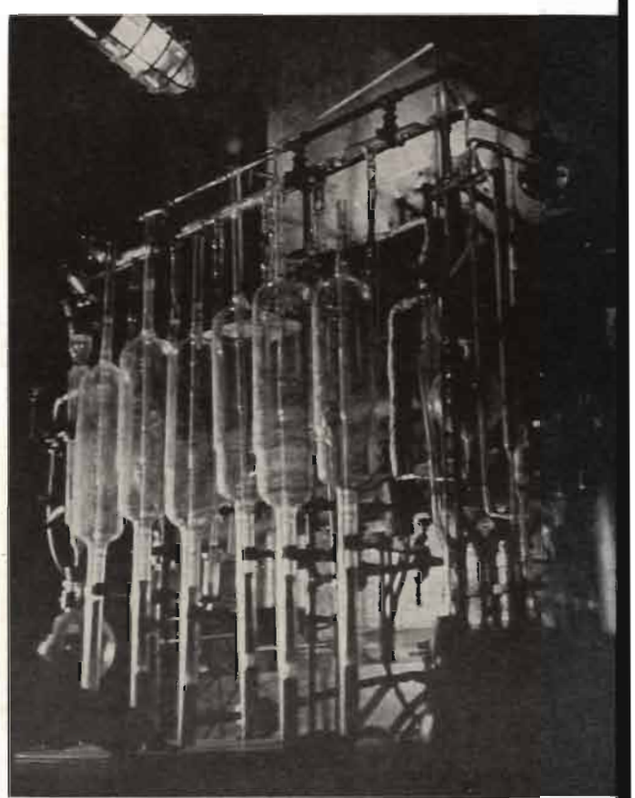
The diminutive ultra-short-wave transmitting tube gets special attention in the hands of an expert technician.

OF VACUUM TUBES

Experienced artisans spot-weld the various parts together to form the assembly which is sealed into the glass envelope of a tube.

The final proving ground. Every tube must pass the rigid requirements of the test rack. Those passing the test are released for service; the rest are destroyed.

A labyrinth of tubing and bulbs comprise the glass-blower's creation for preparing and bottling pure carbon monoxide used in processing certain vacuum tubes.



The copper-to-glass seal of a water-cooled type transmitting tube is made by mounting the tube in a device similar to a lathe. As the tube rotates, the gas-flame "tool" unites the materials.

INDIANA'S POLICE-RADIO SYSTEM

CRIMINALS are finding Indiana less a mark for successful efforts on their part nowadays, according to authorities of that state. Development of modern, scientific methods in combatting and ferretting out crimes is responsible, Indiana State police officials say. Not the least of these facilities is a chain of police-radio stations which has been established by the Indiana State police. And much of the credit for the establishment of these stations, according to Indiana authorities, has been earned by the Works Progress Administration. Because the WPA was available to supply funds for the employment of workmen, the Indiana police-radio program was given sufficient impulse to overcome financial obstacles from the State's point-of-view.

With sufficient money for materials, the State police-radio department secured the approval of the Federal Emergency Relief Administration for a project to supply the required labor. Ground for the central station—WPHE, in the Indiana State Fairgrounds in Indianapolis—was broken in October, 1934. While the station was being erected the department was granted the use of the radio facilities of the Indiana Naval Militia unit in Indianapolis. Temporary broadcasting stations also were established at Culver, Columbia City, Seymour and Jasper.

The Indianapolis station was completed in 1935. This station has the distinction of being the first fortified radio station to be erected in the United States. Constructed of Indiana brick, as are all the other units in the system, the Indianapolis station is in reality a modern "blockhouse." It is surrounded by a barbed-wire fence of the prison type, and the gate that affords the only entrance to the enclosure is operated electrically from inside the building. The door to the station is protected by grilled iron bars, with a bullet-proof partition inside the door. At night the grounds surrounding the station are illuminated with eight flood lights. The tower—vertical radiator—which is at the rear, is 220 feet high.

State police-radio station No. 3 at Columbia City, recently completed, also is fortified and was constructed from the same plan as used for the Indianapolis station. The Columbia City station was the second to be established in its permanent quarters. The closest police post is situated at Ligonier.

The other northern Indiana station is being erected at Chesterton by WPA workers and is expected to be completed late this summer or early fall. This building is to be a combination radio station and police post, and will take the place of the Culver station. None of the combination buildings is fortified. An unusual feature of the Chesterton station is that two 154-foot towers are to be used instead of one 220-foot tower, with which the other four stations are equipped. The two towers are to be employed as a reflector-type directional system so that messages can be deflected back over Indiana instead of going out over Lake Michigan. With the exception of the two towers, an identical combination radio station and post has just been completed at Seymour, in the southern part of the state, and the transfer from temporary quarters practically affected.

WPA employees likewise are erecting another identical combination station and post at Jasper, also in southern Indiana. When completed, either this summer or fall, the radio station temporarily set up in the Jasper academy will be moved to this structure along with the temporary police post now at Evansville. It is possible, however, that a sub police post may be established at Evansville following the transfer of the men now quartered in a former airport building in that city.

Two permanent police posts are under construction at Pendleton and Putnamville. The post at Pendleton when completed will take the place of the one near Anderson, while the Putnamville post, when finished, will be substituted for the Rockville post. Both buildings are being erected from the same plan, as will be permanent posts to be constructed at Ligonier, West Lafayette and perhaps Rushville.

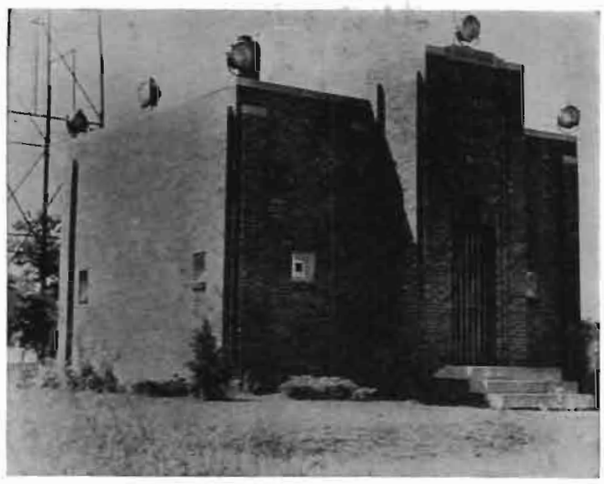
Situated in the State House, several miles away, the "nerve center" of the Indianapolis broadcasting unit is the dispatcher. A direct wire is maintained at all times between the dispatcher and the Indianapolis station at the State Fairgrounds.

By means of the system, the dispatcher, is charged with the task of correlating the activities of all law-enforcement agencies in Indiana and adjoining states during a manhunt. The dispatcher's office is connected by a two-way loudspeaker system with every other department in the State House from which information pertaining to all types of crime can be gathered immediately.

Departments which can be contacted immediately by the dispatcher include the vehicle license division, the title division, the bureau of identification and records, the bureau of penal institutions, and the motor theft bureau. Approximately 365 messages are dispatched each month.

As soon as the dispatcher's office is moved to its permanent position in the State House, what is believed to be the largest map ever made of Indiana is to be erected directly in front of his desk. The map, already constructed, was made by hand and shows every highway, secondary road and nearly every cross road in the state.

Small electric lights have been placed on this map at regular intervals on the lines representing each road to enable the dispatcher to establish immediate blockade by law-enforcement officers of



Indiana police radio headquarters station at Indianapolis.

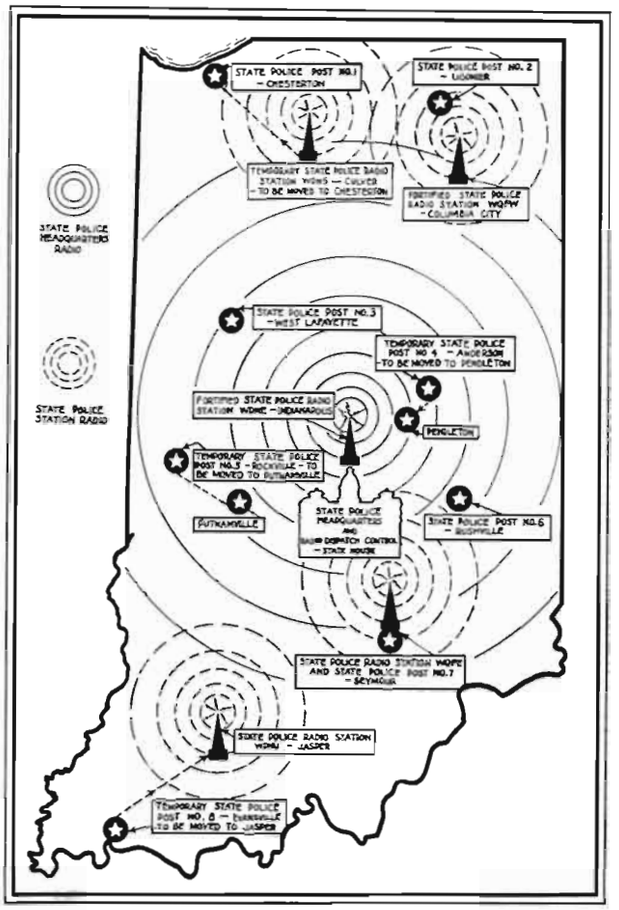
a given area. It a crime is committed in a city and the report reaches the dispatcher fifteen minutes later, he adds five minutes to the time and proceeds to set up a twenty-mile blockade around that city. Establishing a blockade at this distance is based on the theory that a fleeing bandit car ordinarily travels at a speed of approximately sixty miles an hour.

A description of the manner in which the State police get on the job after a crime has been committed is illuminating. Local law-enforcement authorities notify the closest State police post or radio station and supply the officer in charge with all available details. If a post is the first to receive the information the officer receiving it immediately reports the crime and its details to the closest State police-radio station. Say that the station to receive the report is the one at Columbia City. The operator there relays the information to the dispatcher in the headquarters in the State House. At that point the magnitude, time, and details of the crime determine the extent to which the report is broadcast. If a minor offense and the perpetrator is likely to still be in the vicinity in which the crime was committed, dispensing of the information is limited to that area. If a major crime, in which the whole State and even adjoining states may be affected, or interested, the dispatcher orders the report broadcast from all five stations, and may also request the aid of police and commercial stations in sending out the information. If the blockading of a certain area is ordered, it is the duty of the dispatcher to direct all State police cars and other cars taking part in the chase to positions in the specified area. This is done by means of the receiving sets on the cars. The dispatcher continues to direct the cars throughout the duration of the hunt.

The Indiana State police-radio system is headed by Sergt. Frank W. Morrow, who reports that such systems have accomplished, more than any other one factor, the task of breaking down State lines in relation to criminal pursuit and apprehension. According to Sergeant Morrow the Indiana stations are in constant communication with those of highly developed systems in Michigan, Ohio and Illinois, and it is not uncommon for any of these states to send officers across the boundaries of neighboring states in event of manhunts. When officers cross State lines they are automatically recognized by officers of the neighbor State as deputies of their own service, thus enabling them to effect arrests outside their own territory.

Together with Michigan, the pioneer in State police-radio work, and Ohio, which followed closely after, the five

Showing the location of Indiana's police radio stations.



station Indiana State police system is figuring prominently in the plans of several states, as they contemplate the setting up of their own modern systems. California, Virginia, West Virginia, and Kentucky are foremost among this list.

In addition to Indiana, thirteen states have State police-radio facilities in one form or another. They are California, Virginia, Missouri, Delaware, Maryland, Iowa, Massachusetts, Minnesota, Pennsylvania, Michigan, Ohio, Illinois, and Oregon.

The five Indiana stations are equipped with 1,000-watt transmitters. Not once during the two years of its operation has the system failed to function efficiently due to severe weather conditions.

Receiving sets locked at the State police frequency of 1634 kilocycles have been installed in the ninety-two sheriff's offices in the State, in fifty police-department headquarters, in all State police posts and motor equipment, as well as in a great number of banks, garages, filling stations, and in the headquarters of numerous town authorities.

Cities in Indiana which are operating radio stations capable of working two-way communication with the State system are: Indianapolis, Fort Wayne, South Bend, Kokomo, Huntington, Bluffton, Muncie, Richmond, Connersville, Peru, Lafayette and Frankfort. Cities contemplating an early installation of such equipment, are Valparaiso and LaPorte. Michigan City also is considering such an addition to its police protection.

Other State cities are operating ultra-high-frequency radio systems, capable only of listening to the State system, but use telephone or telegraph facilities in replying. They are: Evansville, Hammond, Gary, Vincennes, Terre Haute, Whiting and East Chicago.

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SUPERPOWER FOR W2XAD and W2XAF

GENERAL ELECTRIC'S short-wave stations W2XAD and W2XAF will become the strongest in America upon completion of a new 100-kilowatt transmitter, permission for the erection of which has been granted by the Federal Communications Commission.

The new equipment will involve a cost of more than $100,000 and will increase the signals to more than twice their present strength.

W2XAD now broadcasts approximately 220 hours a month, and W2XAF 290 hours. It is expected that this time will be increased as the result of the greater range of the new transmitter.

MIDGET REMOTE AMPLIFIER

By LOYD C. SIGMON

Chief Engineer
KCMO

WITH THE DEVELOPMENT in the last few years of smaller tubes, transformers, and similar parts, much smaller amplifiers[1] and other equipment can be constructed. The over-all characteristics in some cases can even be improved upon in the smaller units.

The midget remote amplifier to be described was made possible through the use of acorn tubes, compact high-fidelity audio transformers, and other high-quality compact radio parts.

The following factors were first considered, and included in the design of the nine-pound midget remote amplifier: first, high fidelity; second, low harmonic distortion; third, low noise level; fourth, high gain per channel; fifth, three microphone channels; sixth, a-c or d-c operation; seventh, simplicity of operation; eighth, light weight; ninth, small size.

Measured characteristics of the completed midget remote amplifier are: frequency response within plus or minus two decibels from 50 to 9,000 cycles per second; harmonic distortion 0.15 percent rms at 0.006 watt output power; background noise and hum level minus 45 decibels; gain per channel with output pad in, 107 db; size, 9¾x6¾x6½ inches; weight 9 pounds; a-c or d-c operated.

Fig. 1 shows the remote amplifier compared in size to a microphone. The three microphone gain controls are at the left, and the right-hand control is the master gain control.

The circuit diagram of the remote amplifier is shown in Fig. 2, and with a few exceptions it is self-explanatory. Any type of input impedance may be used with minor changes, depending of course, upon the type of microphones to be used.

All input circuits are very carefully shielded, and the input transformers placed so as to avoid any feedback. The chassis layout may be seen in Fig. 4. All input transformers feed directly into a simple potentiometer. The potentiometers are mounted in such a way that they may be easily replaced when they become noisy.

Electron mixing is employed for the mixing of microphones into the second audio stage through the master gain control. All the d-c plate current is blocked out of the T-1 transformer primary to assure a linear characteristic, and low phase shift. It is important that the d-c plate current of each tube of the push-pull 955s be matched in the primary of the output transformer. If the 955 tubes are not matched, there will be a noticeable falling off in frequency response below 100 cycles, as well as an increase in distortion.

In using the acorn tubes for audio work it was found necessary to select the tubes carefully, as there was a noticeable variation in tubes as to plate current and microphonic noises. It was found impossible to use some of the 955s even after cushioning, because of microphonic noises. Cushioning of the second and third audio stages of the amplifier did away with any noticeable microphonic noise after selecting the acorn tubes.

The T-2 output transformer works directly into a 5-db pad to prevent line reflection back into the secondary of the output transformer. A meter is connected directly across the output pad for the volume indicator, as is the monitoring phone jack.

Fig. 3 shows the back of the amplifier, and the compact connectors. Name plates are mounted over each

[1]Another interesting acorn-tube amplifier was described in "The Acorn Tube on the Remote Job," by W. E. Stewart, *Communication and Broadcast Engineering*, p. 9, February, 1937.—Editor.

FIG. 1. The midget remote amplifier.

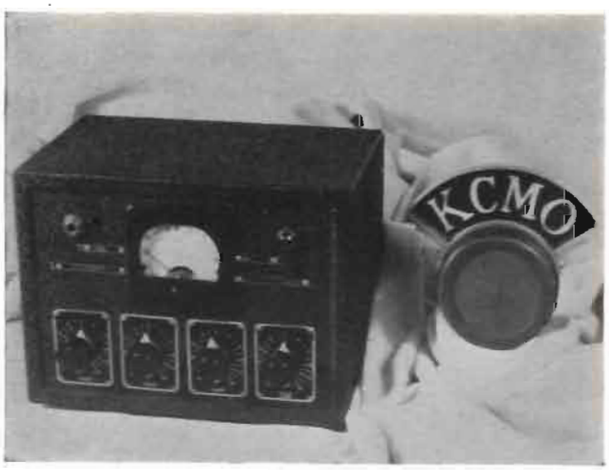
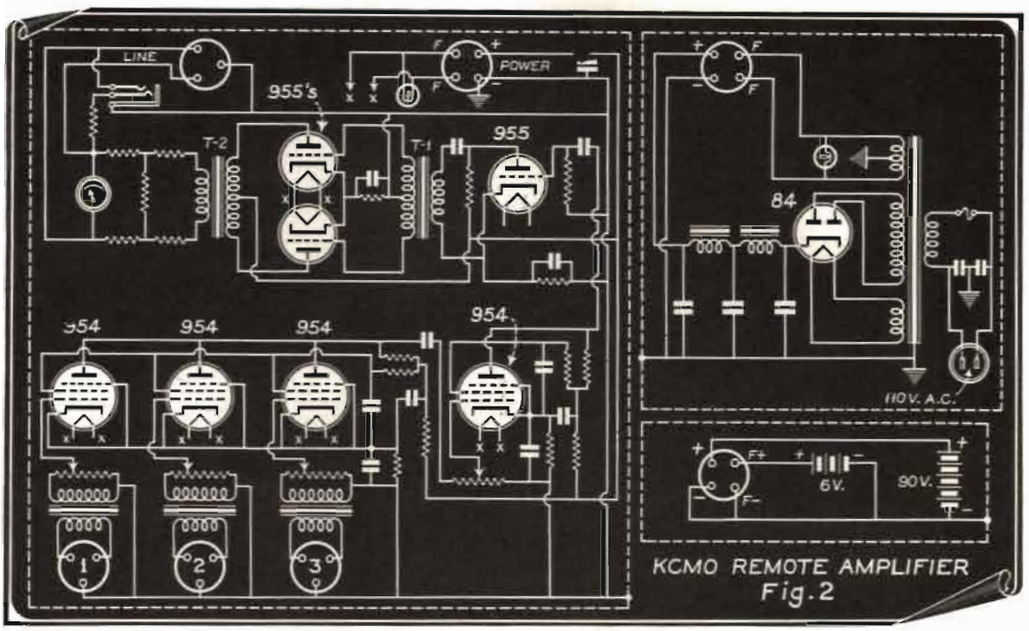


FIG. 3. Showing connectors on back of amplifier.



connector to designate the connectors. A 12-foot program line cable is carried as part of the equipment; one end of the cable carries the male plug that goes to the amplifier. The other end has two clips mounted on a bakelite strip that connects to the program line. The power connector is of the four-contact type.

The case of the amplifier is built of 22-gauge cold-rolled steel. Fig. 4 shows the chassis of the amplifier which slides out of the case from the back. Four self-tapping screws hold the chassis firmly in place. The front and back panels are permanently fastened to the chassis. The inside of the case is sprayed with aluminum paint. The outside of the case is finished in crystalline black enamel. Four rubber feet are mounted on the bottom of the amplifier.

The a-c power supply may be seen in the bottom of the carrying case, Fig. 5. The power-supply circuit is of the conventional type, with the exception of high filtering. Fig. 2 shows the circuit of the power supply as well as the circuit for battery operation. The same design was carried out in the construction of the power supply case as in the amplifier case.

The carrying case was designed so that all remote equipment could be carried in one case. Fig. 5 shows the carrying case open and on end. The lid contains 200 feet of microphone cable, headphones, and all connecting cables. There is a removable door in the lid to hold the cables in place. The lid of the carrying case is detachable from the bottom for easy packing. The bottom of the carrying case is divided into three compartments. One for the power supply, middle for the remote amplifier, and the other compartment contains three microphones, two extra acorn tubes, and one 84 tube. The carrying case was made by a local trunk manufacturer. It is lined with purple velvet.

The midget remote amplifier has been in use at KCMO for several months, and has proven its merits over the older and more cumbersome types. The time required to set the remote equipment up for operation is less than five minutes.

FIG. 4. Chassis of the remote amplifier.

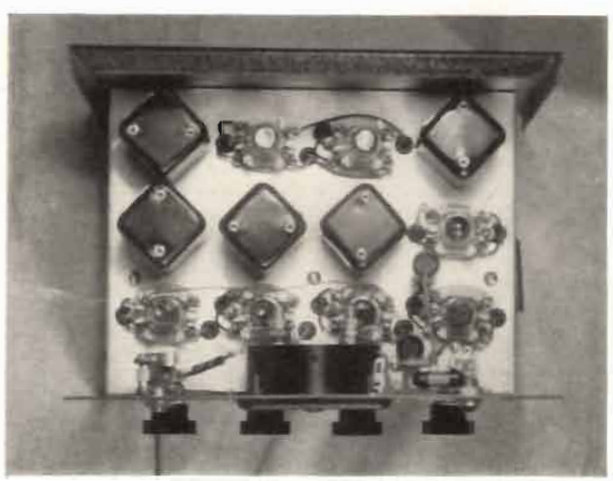


FIG. 5. Showing amplifier in carrying case.

TO THE EDITORS

Leslie F. Muter, President, RMA.

THE RMA ENGINEERING DIVISION welcomes any moves in the publication field that will increase the knowledge of engineers practicing in the radio and communication arts. The Engineering Division has attempted over a period of a number of years to keep the engineers of its member companies thoroughly informed as to the progress of standardization work and other items important to the industry. The activity of the Engineering Division continues to expand with greatly increased value and usefulness to the member companies of the RMA.

The work on standardization of component parts is one of the activities that has been expanding and it seems reasonable to expect savings to the radio industry of comparable magnitude to those effected by the automobile industry with its standardization program.

O. B. Hanson, Chief Engineer, NBC.

W. R. G. Baker, Chairman, Engineering Division, RMA.

As an example of the forward looking policy of the RMA Engineering Division, it will be noted that half of the papers presented at the Rochester Fall Meeting this year will be on the subject of television. The RMA Engineering Division, for the last two years, has been co-sponsor of this meeting and has been exerting every effort to have an advanced program of interest to broadcast receiver engineers.

DR. W. R. G. BAKER,
Chairman,
RMA Engineering Division

Albert F. Murray, Chairman, RMA Television Committee.

ELECTRICAL COMMUNICATIONS as an applied science has peculiar advantages. Because communication can make use of devices which are small it can also make use of devices which are young. Therefore, principles which are discovered in the field of pure science can most frequently be applied first to communication problems. Hence the communication engineer is fundamentally a pioneer. He must be aware of what is new in science, and quick to adapt it to his problems. In this he serves not only his own field but many others. As the scientific children which he nurtures grow up, they will find many other ways they can serve. An excellent example of this is the vacuum tube, which for many years was solely a communication device, but which has now grown in size and usefulness so that it can no longer be claimed exclusively by one group.

Alfred N. Goldsmith, Consulting Industrial Engineer.

In such a field where the engineer must constantly coordinate science and application, many means are necessary for the exchange of ideas. I congratulate COMMUNICATIONS upon its opportunity to serve a professional group whose members have shown that they are eager for and able to make use of new ideas and are unselfish in sharing their discoveries.

PROF. W. L. EVERITT,
Chairman, AIEE
Communication Committee

WE LIVE in an age of mechanism, the social use of which, in the best interests of all groups, has not yet been fully mastered. The same devices which can

W. L. Everitt, Chairman, AIEE Communication Committee.

bring comfort and prosperity to nations can unfortunately be used to carry destruction and financial ruin to the peoples of the world. In a sense, the path of civilization is a race between better personal, group and national relationships on the one hand, and suicide on the other.

The most powerfully constructive and integrating force which our machine age has as yet evolved is communication in its broadest sense. This includes not only speedy transportation of the individual physically, but also the instantaneous transmission of his thoughts in words or pictures to the ends of the earth. The rapid interchange of ideas should, at least in the course of time, ameliorate conditions which have threatened world welfare particularly in the

L. C. F. Horle, Consulting Engineer.

Twentieth Century. Accordingly, we should welcome any important addition to the literature of communication. The new periodical COMMUNICATIONS is, therefore, not only a scientific and engineering publication, but a part of one of the most potent world movements along constructive lines and a factor of importance in the face of dangerously destructive elements. Its success should be anticipated and desired.

DR. ALFRED N. GOLDSMITH,
Consulting Industrial Engineer

IT IS A COMMONPLACE to point out that technicians stand at the very heart of broadcasting, radio's greatest branch.

F. B. Jewett, President, Bell Telephone Laboratories.

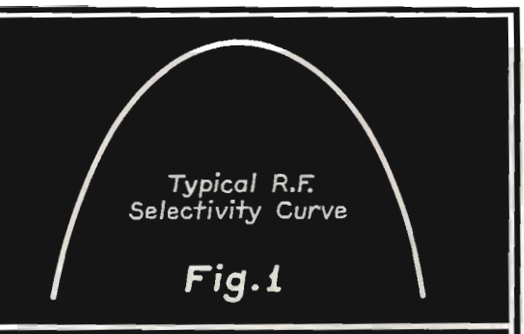
Charged with the responsibility of delivering entertainment and information

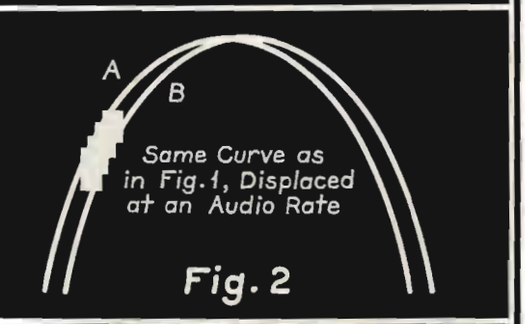
(*Continued on page 59*)

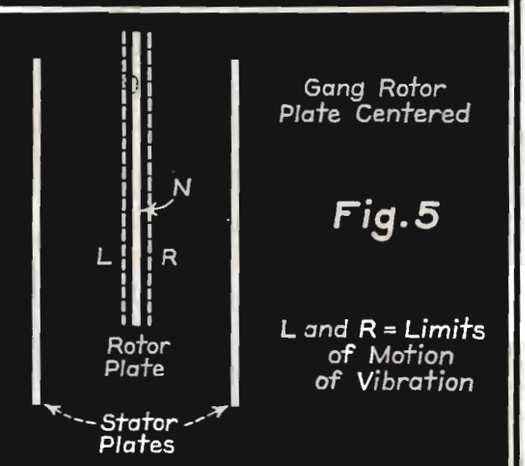
Harold P. Westman, Secretary, IRE.

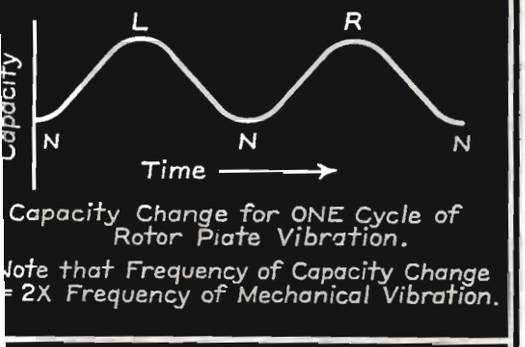
METHODS OF ANALYZING

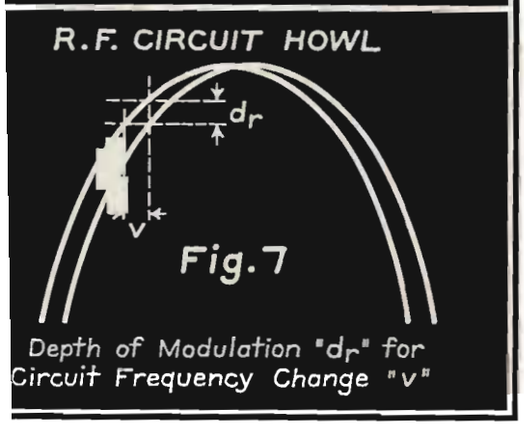
By C. O. CAULTON











DURING the past few years it has come to the writer's attention that the general subject of howl is little understood and many analyses of particularly troublesome units result in incorrect conclusions as to the cause. This is due, no doubt, to the fact that many simple treatments, especially mechanical-coupling changes such as cabinet bracings, are effective on a given sample, but when applied to a model in general will make as many sets howl as they will cure. This need of a multiplicity of tests on every potential cure, plus the evasiveness of the cause, will often prevent any quick relief, especially in a model already "tooled up."

Historically the familiar howl was first observed as a simple audio-circuit howl from the filament-type audio tubes excited by the loudspeaker, especially when placed on top of the receiver, which was ordinarily of the t-r-f type. The cure was to add attenuation in the acousti-mechanical system—ordinarily in the form of rubber-mounted tube sockets, or by re-locating the speaker at a greater distance from the receiver. The improvement was considerable, even if the cure was not complete. This simple method of treatment became ineffective with the introduction of unit receivers, superheterodynes, heater-type tubes, increased gain in output, and the increased popularity of short waves.

Condenser-plate vibration as a source of microphonic trouble was recognized by set engineers back in the early days of superheterodyne development. The trouble was found to be caused in two ways: (1) mechanical transmission of vibration to the condenser through the chassis and cabinet structure; (2) acoustic transmission from the speaker to the condenser plates through the air. When faced with the problem of placing a dynamic speaker in the same cabinet with the radio chassis as a unit, they found that special mountings and constructions of the condensers were necessary to reduce the tendency to howl.

It must be realized that howl is caused by the feedback of audio vibrations from the speaker to some preceding portion of the circuit and can exist only if the attenuation from speaker to circuit element is less than the gain from that element to the speaker. It may not exist even then, however, if the phase relation is not correct. Reversing the phase (of the speaker, for instance) does not always effect a cure, as will be pointed out later.

TYPES OF HOWL

It is customary to call a howl by the name of the portion of the circuit in which it originates. Accordingly there are four types as follows: (1) radio-frequency, (2) oscillator, (3) intermediate-frequency, and (4) audio-frequency howl.

Of these, the one most often encountered is the oscillator howl. This is because a given vibration in that circuit appears as a higher percentage modulation at the second detector than the same vibration in any other portion of the circuit. These four types will now be considered separately.

AUDIO-FREQUENCY HOWL

This type of howl is relatively well understood and the cures are simple, although at times expensive, if tools are already made. The source of trouble is practically always a microphonic tube. Audio-circuit howl is less often encountered today than previously because of lower a-f gains and heater-type tubes. The one exception is in battery receivers where the audio-circuit type of disturbance is most important due chiefly to the type of tubes used.

Methods of treatment are usually as follows: flexible sockets and/or weights on the offending tube, damping is also effective in some instances, re-location of tube on stiffer part of chassis; reduction in acoustical or mechanical coupling outside the chassis by a change in speaker location, acoustical shield between speaker and chassis, or rubber mounting of speaker and/or chassis—if acoustical coupling is direct to the chassis and not through the cabinet a reduction in howl tendency is sometimes effected by stiffer chassis mounting, although this treatment may give rise to other feedbacks; reversal of speaker phase. Radio-frequency input

INTERMEDIATE-FREQUENCY HOWL

This type of disturbance is very similar to the r-f howl just discussed except that it is normally less troublesome due to the fact that the various circuit elements are better shielded acoustically, more rigid mechanically and, in general, present smaller surfaces to be acted upon by sound waves. The higher "Q" usually found in the i-f stages will partially counteract the gain due to these three factors. The possible percentage of modulation and therefore the howl tendency is again directly proportional to the sharpness of the individual circuits. The two most common causes of trouble in the i-f circuits are filament-type tubes and vibrating leads, especially those in the coil. Other common troubles are compression-type trimmers and loose coils in shield cans.

Treatment of the on-resonance howls is the same as elsewhere and should not be overlooked because of the widespread but erroneous impression that tubes late in the amplifying chain are but slightly subject to vibration transfer.

The off-resonance or asymmetric howl in the i-f circuits should be treated in a manner similar to those in the r-f circuits. All comments as to the method of treatment may be applied here.

The most serious trouble from sustained feedback is in the oscillator circuit. Probably over 90 percent of all howl originates in this portion of the circuit. The reason for this can be readily seen by considering the following. The oscillator furnishes a single frequency which is fed into the i-f amplifier. Now this i-f amplifier has an overall selectivity curve which is sharper and steeper on its sides than any of the individual circuits. This i-f signal frequency (controlled by the oscillator frequency) then is subject to very great amplitude modulation, with but small changes in oscillator frequency due to the steepness of the sides of the i-f selectivity curve. A clearer picture into the cause of the great difference between oscillator and r-f or i-f howls may perhaps be seen by visualizing the following. In the latter two types a single-tuned circuit with limited selectivity is vibrating back and forth across the carrier while an oscillator howl results from the carrier (i-f frequency) vibrating back and forth across all the selectivity that follows. Diagrammatically the two types are approximately as shown in Figs. 7 and 8 where v = frequency shift of tuned circuit and d = depth of modulation.

The sources most troublesome are gang and tube vibration. The tube may cause on- or off-resonance howl while the gang howl will be off-resonance only. From the on-resonance standpoint the oscillator tube is probably no more troublesome than any other tube. Off-resonance howls from the oscillator tube are worse, however, than from other tubes for the reason just described. Likewise the severity of the howl will vary in a direct ratio of the radio signal frequency—unlike i-f howl which is not changed by signal frequency.

In the analysis of a howling receiver the author has found that having the previous facts in mind and operating the receiver while asking himself the following questions and performing the following tests will usually reveal the source of difficulty. (After that a remedy is usually apparent, though in these days of high gain, short waves, high selectivity, and greater signal strengths, the cure may not be so simply applied.)

(1) *Is it necessary that a carrier be present?* (2) *Does the volume control affect it?* (3) *Does it occur on- or off-resonance?* (4) *If off-resonance, on how many sides?* (5) *What does reversing the speaker phase (voice-coil connections) do?* (6) *At what radio-frequency does it exist? Gang meshed or not?* (7) *At what audio frequency is the howl?* (8) *Is the transmission of vibrations to the chassis acoustical or mechanical? (This can be determined by means of various conditions of chassis, speaker and cabinet.)* (9) *Is any excessive vibration apparent to sight or feel?* (10) *Are the flexibly mounted units flexible or is there an accidental binding?* (11) *Is the gang condenser relatively well centered or is it definitely off center?* (12) *If the howl is off-resonance and with the tuning condenser unmeshed—are the coil leads restricted from vibrating, especially those in the oscillator coil; are there other leads which are so wired as to permit of vibration; and does changing tubes effect the howl?*

A most effective tool in searching out howl is an ordinary doctor's applicator which is a wooden stick about six inches long and a scant sixteenth inch in diameter. This has sufficiently low capacity so as to affect tuned circuits little if at all. By using it as a prod it is usually easy to find the offending vibrating element except when that element has great mass. The receiver is placed in the "just howling" condition before using the applicator. When the vibrating element is located, touching it will kill the howl very quickly except as before noted. Confusion should be avoided between touching the actual part and other parts adjacent to it where the effect is not so marked. Another test is to place the receiver in the "just not howling" condition and "plucking" the suspected parts. The offending part will emit a tone similar to the howl. The exact frequency can be checked by an oscillator and speaker. It is, of course, necessary to avoid any detuning when the applicator is in the proximity of the circuit and any feedback to the signal generator which may be microphonic. When checking units under the chassis it is necessary to have it accessible and yet retain the tendency to howl in the same manner as when the chassis is in its normal position. A stroboscope is valuable in some instances, but ordinarily the amplitude of vibration is too small to be easily visible.

There are two general methods of measurement of howl. The first is the more usual and the shorter one, while

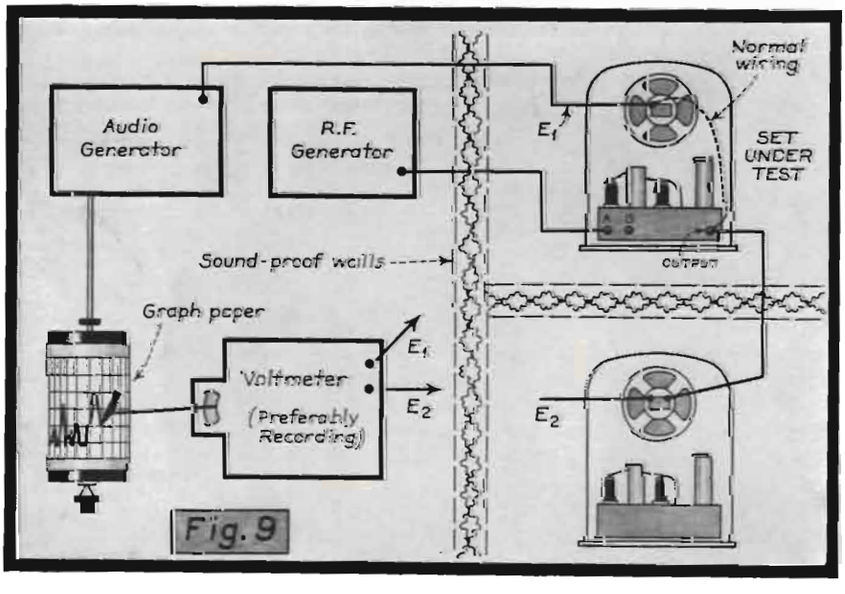
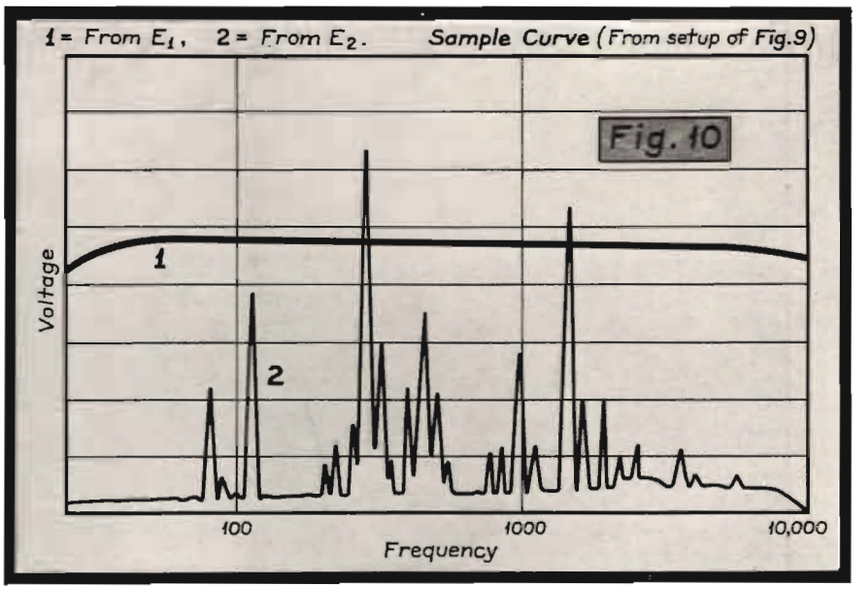


Fig. 9

the second is more of a laboratory tool and much more powerful.

In making a check by means of the first type, the subsequent procedure is followed. The receiver under test is supplied with an unmodulated carrier of the frequency at which the test is to be made. The strength of this carrier should normally be about equal to the strongest signal available in that frequency band. The set is then made to howl and the volume control gradually reduced while adjusting the tuning so as to carry the howl down on the volume control as far as possible. For the extreme conditions of howl variations in tone controls, set placement with respect to its surroundings, and selectivity controls should be checked. The object is to get the volume control reduced as far as possible before the howl stops. When this point is reached modulation to a depth previously decided on is applied and the set tuned to resonance. The output is then measured and this figure used as the maximum output before howl may occur. Many variations are possible such as making the test with modulation on, various degrees of modulation depth and different carrier strengths. The best procedure is to establish one set of conditions and stick to them, since there are already many variables in the howl picture. While making this test it is, of course, essential that the signal generator be isolated acoustically sufficient to prevent feedback through it. To place the generator in another room is usually sufficient but several generators have been found that were so microphonic that this was not even sufficient. It is well worth a check before any measurements are made. In working for a cure of howl in a given type receiver, hasty decisions are dangerous—all measurements must be repeated many times and tried on at least five or ten sets. This is because of the complexity of the path of energy transfer between speaker and critical element. A change that will cure one set may make another one worse.

The second method of test requires more time, care and equipment, but tells a much more complete story. Briefly, the method is as follows. It is first necessary to have a second speaker and acoustical system (cabinet), or its impedance equivalent. The output of the set under test is disconnected from its own speaker and connected to its equivalent, but acoustically isolated from the chassis. Unmodulated r-f is supplied to the chassis from a signal generator which is also acoustically isolated. An audio oscillator is connected to the speaker which is in its normal position in the cabinet with the chassis (see Fig. 9). Two curves are then drawn of voltage versus frequency with the voltmeter first across the speaker, fed by the oscillator, and then across its equivalent which is connected to the output of the chassis. The first curve will be normally flat, say one volt, all across the frequency range. The second curve will be a measure of the voltage fed the second speaker (or equivalent) by the chassis which is modulated by the vibration from the first speaker when it is fed with, say, one volt (see curves 1 and 2 in Fig. 10). Now if this second voltage is equal to or greater than the first voltage there is the possibility of the chain of vibrations—electrical and acousti-mechanical — sustaining itself. Its similarity to regeneration will be apparent. If the two curves are drawn on one sheet as in Fig. 10 and to the same scale, howl may exist at any point where curve 2 crosses curve 1. Note here that howl *may* exist depending on phase conditions. These phase conditions are changing rapidly around resonance. When drawing the second curve it will need be drawn very slowly since it is a picture of mechanical resonances which are very sharp. It will be found quickest to draw the curve first at a moderate speed and then carefully check the height of each peak. For these measurements it is, of course, necessary to have the receiver in the condition of maximum-howl tendency. This can usually be done by setting the oscillator to one of the stronger howl peaks (found by ear or meter) and detuning for maximum height of peak. It is sometimes necessary to check the more important peaks a second time varying both tuning (of set to unmodulated signal) and audio frequency. This system has been found most valuable for any detailed study of howl, especially from a quantitative standpoint when seeking ways of improvement.



In conclusion it must be pointed out this is a very sketchy survey of howl, but contains the fundamentals which, if clearly understood and remembered, should make most howl analyses simple. A warning against confusing flutter with howl may not be unwarranted. Cures will usually be forthcoming, although to carry them out may involve difficulties. But most important is the danger of improperly founded decisions due to insufficient tests.

•

WLW TO BUILD MILLION DOLLAR BROADCASTING CENTER

CULMINATING a plan which has been in the process of execution for two years, when the first portion of a huge hilltop site was purchased, Powell Crosley, Jr., president of The Crosley Radio Corporation, announced that work will soon start upon the construction of a million dollar broadcasting center for Cincinnati.

The new structure will be devoted exclusively to the activities of WLW and WSAI.

The building, of modern architecture, will be one of the most beautiful in Cincinnati, and one of the finest broadcasting plants in the United States. The structure is to be erected on Clifton Heights overlooking the city, at the intersection of Warner and Chicasaw streets.

Because of the strategic location and an ingenious system of flood lighting, the studio building will be visible day and night for miles throughout the Cincinnati and northern Kentucky areas.

Design . . NOTES AND

CO-AXIAL IN THEATER INSTALLATIONS

AT THE PRESENT time many new theaters are being constructed in England, and considerable thought and time has been devoted to the development of equipment for the highest quality sound reinforcement as well as modern architectural design. Apparently the English theater goers as well as the managements are so appreciative of good quality that every precaution is taken in the design of the building to insure a successful and permanent sound system installation. Provisions are made, according to "Brush Strokes," for the proper location of the loudspeakers. Careful consideration is given to the location of the control position as well as the microphone outlets on and off stage.

A typical installation might be described as follows. The main amplifier equipment is located at the rear of the theater in or near the projection booth. Outlets are provided on the stage for proper location of on and off stage microphones. Six to ten Brush type microphones are in each of these installations. The wiring system between the various microphone outlets and amplifier arrangement consists of permanently installed co-axial cable. The outstanding advantage of this cable, of course, is its exceedingly low capacity, which permits longer transmission lines with less loss. The connecting cables between outlets and microphones, being very short in length, are of the conventional type of microphone cable.

The oscillator used in connection with the distortion meter.

According to Mr. R. A. Rothermel of Rothermel House, London, manufacturer of radio and electrical equipment, this type of installation is most satisfactory for many reasons. The use of the co-axial cable permanently installed sufficiently reduces transmission losses so that preamplifiers are not required, as is sometimes the case with other types of cable. The location of the amplifier and controls in the rear of the house is very advantageous because from this point the operator can make a more intelligent adjustment of the output level. Typical acoustical problems are minimized because sufficient consideration is given to the interior design from the standpoint of acoustics.

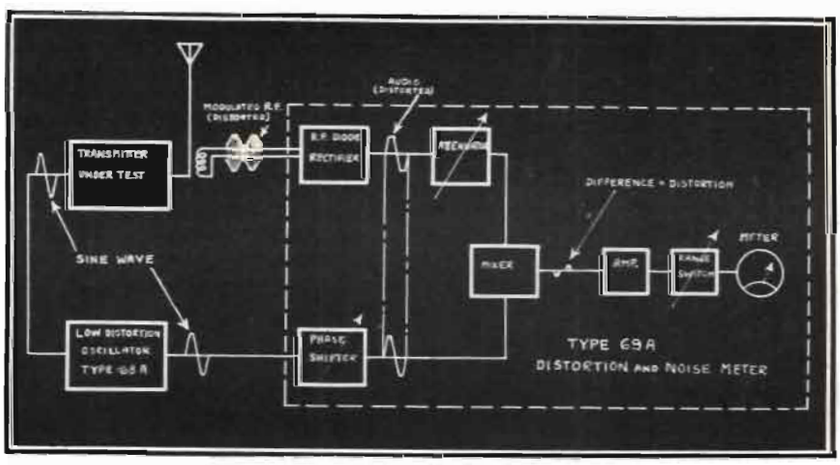
DISTORTION METER

NOTEWORTHY ADVANCES have been made in the past few years toward increased fidelity in broadcasting and the other sound-transmission arts. Wide frequency range, low noise level and low distortion, the three criteria of good reproduction, have each received their share of attention and achievements have been made in meeting each of these requirements.

The progress of all developments is greatly dependent upon the ease with which accurate measurements can be made, and advances in the measurement of the quality of transmission are reflected in accelerated progress toward higher fidelity. It has been recognized that to meet the increasing demand for high-quality programs and to facilitate the proper adjustment of equipment an instrument for measuring distortion at many different frequencies was needed. The distortion and noise meter described here has been developed to fill this need. This instrument is capable of measuring the distortion in the output of broadcast transmitters and audio equipment at any frequency from 50 to 7500 cycles; it provides for measurements of rms total distortion from 0.3 percent to 100 percent and measurements of noise levels down to —85 db below 12.5 milliwatts.

The distortion meter, as shown by the functional diagram, Fig. 1, consists of a diode detector by means of which a modulated radio-frequency signal may be demodulated, a resistance network to attenuate the audio output of the detector, a phase-shifting network, a mixer stage to combine the output of the attenuator and the output of the phase shifter, an amplifier to which the output of the mixer stage is connected, a range attenuator which varies the gain of the amplifier, and a meter which indicates the value of the amplifier output. When the equipment is used to test audio-frequency apparatus the diode

Functional diagram of the distortion meter.



COMMENT . . *Production*

The distortion and noise meter.

detector is removed from the circuit by means of a switch which provides for connection through a balanced input transformer for measurements on balanced audio circuits or for connection directly to the input attenuator for use with unbalanced circuits.

In operation a sine-wave signal, taken from the same source which supplies the input signal to the equipment under test, is introduced into the phase-shifting network and there adjusted to be exactly in phase with the output signal taken from the equipment being measured. This output signal is adjusted in amplitude by the input attenuator so that its fundamental frequency component is exactly equal to the output of the phase shifter. Each of these two signals is impressed on the grid of one of the two mixer-stage tubes, whose plates are connected in push-pull by means of a transformer. The secondary voltage of this transformer is proportional to the difference between the two input signals and consequently will be at a minimum value when the distorted and undistorted signals are adjusted in phase and amplitude to have minimum difference. It can be shown that when this condition is obtained the fundamental frequency component of the distorted signal is exactly cancelled by the sine-wave signal, and that the difference voltage contains only the distortion components. This difference voltage is then amplified and applied to the meter. Since the fundamental frequency is cancelled out and only the distortion components, having other frequencies, remain, the meter reads rms total distortion directly. Cancellation of the fundamental frequency is readily obtained by adjusting the amplitude and phase controls for minimum meter reading. By means of the range switch the sensitivity of the meter may be increased until the remaining distortion produces a readable deflection. Full-scale ranges of 1, 3, 10, 30 or 100 percent may be selected to suit the amount of distortion encountered.

It will be seen that the instrument operates without filters and consequently indicates true distortion factor, since only the fundamental frequency component is suppressed; all other components are measured regardless of frequency. Thus the distortion meter may be considered equivalent to an infinitely sharp band-elimination filter, enabling such distortion components as cross-modulation products between signal and hum to be measured just as effectively as the harmonics.

Provision is made for the distortion and noise meter to be used with three types of input circuits; modulated radio frequencies from a small pickup coil, balanced audio lines up to 600 ohms, or unbalanced audio circuits up to 20,000 ohms may be used. Loading effects upon the equipment being measured will in all cases be negligible. Noise levels can be measured to —85 db below 12.5 milliwatts on audio lines and to —95 db below 100 percent modulation on broadcast transmitters. Distortion measurements may be made at any level down to —15 db. With this degree of flexibility the operation of all broadcast equipment, lines, amplifiers, and transmitters can be readily checked over the entire operating range of frequency and output, and the adjustments necessary for maximum operating efficiency made with ease and accuracy. Standard jacks are provided for connecting the distortion meter to the oscillator and to balanced audio circuits so that the necessary connections can be made in the mininmum amount of time.

For proper operation of the distortion meter a variable-frequency source having extremely low distortion is necessary for supplying the input to the equipment under test and the cancelling signal. These requirements are met by the low-distortion oscillator which has a frequency range from 20 to 17,000 cycles, with distortion under 0.2 percent (arithmetic sum) at all frequencies above 100 cycles. This unit, as well as the distortion and noise meter, is completely a-c operated requiring 110 to 120 volts at 25 to 60 cycles.

An accessory to this equipment is the attenuator panel by means of which the output of the oscillator may be attenu-

(Continued on page 50)

The attenuator panel.

MOBILE P-A REQUIREMENTS

By AARON NADELL

MOBILE uses for p-a equipment can be classified conveniently according to the type of vehicle involved. Mobile apparatus is used in automobiles, in trucks, in motorboats and in airplanes. The nature of the equipment and the operating specifications to be met differ substantially from those encountered in fixed installations. The outstanding differences lie in the loudspeaker requirements, physcial strength and rigidity needed, and power supply; minor differences are encountered in connection with sound input sources, particularly the microphone and the record player.

USES FOR MOBILE EQUIPMENT

Consider first the uses of mobile installations. Automobile sets find their greatest application in advertising work, but are also employed by police officials for traffic control. Truck installations fall into two categories: (1) a truck system which is essentially a large automobile system, used for advertising only and inseparable from the truck; and (2) a truck system which, in addition to performing the functions mentioned, is semi-detachable, and may be regarded as a fixed installation rendered portable for easy transportation. Truck systems of the latter type are the most popular and the most useful. The moving truck attracts an audience and leads it to some point of assembly. There the microphones and loudspeakers (or some of the loudspeakers) are set up on the platform, the amplifier and its power supply remaining within the truck and connecting through suitable cables.

Motorboat systems are used for advertising at water-front resorts of all kinds. Many of these boats work all year round, north in the summer and south in the winter, moving along inland waterways in pursuit of the crowd.

Airplane installations are the most expensive to use, and hence the least popular. Their primary function is advertising, and they are still sufficiently unusual to compel attention; they are favored by country fairs, traveling carnivals and other enterprises appealing to rural districts which are hard to cover by more ordinary means.

CAR INSTALLATIONS

Automobile installations are of necessity small and offer relatively low power. The loudspeaker or speakers are equipped with projector-type baffles in order to secure sufficient coverage at a reasonable distance; output power ranges from about 12 to 20 watts. Since the automobile functions chiefly in town or city streets, sound volume is reinforced by reverberation from pavement and buildings. However, the sound is obliged to compete with traffic noise, and must be loud enough to convey an intelligible message to persons standing still or walking slowly, while the car and loudspeakers move swiftly. In other words, the audible range should be at least half a city block, helped by reverberation and opposed by traffic noise.

The more important physical requirements include the following: baffles of sufficient length to protect the diaphragms of the speakers against weather—or use of weatherproof diaphragms; means for preventing rupture of a diaphragm by air pressure when a speaker points forward and the car is driven at high speed—that is, either provision for covering the trumpet opening, or for pointing the trumpet backward when occasion requires; construction of amplifier and all component parts sturdy enough to withstand the effect of bad roads.

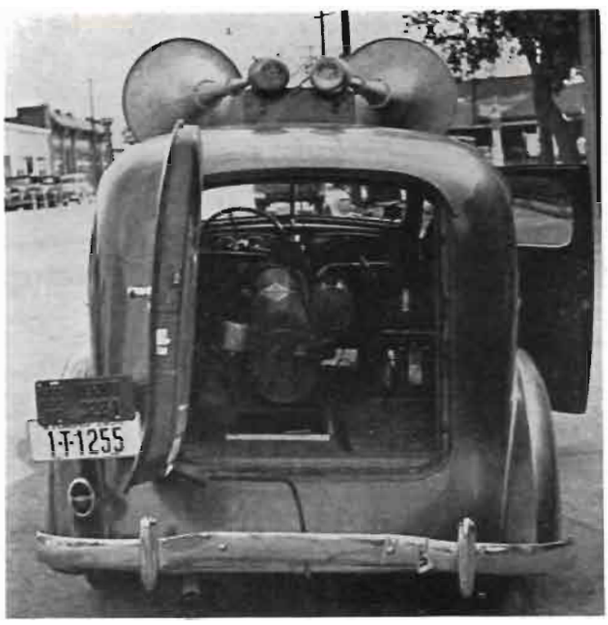
Power supply is usually a rotary converter which is driven by 6 volts d-c, and delivers high voltage d-c directly to the plates of the tubes. The converter is built into, and is a part of, the amplifier. In some installations an a-c generator belted to the fan pulley of the car is used to drive a conventional a-c amplifier. However, these generators do not have good enough

(*Continued on page* 65)

A sound truck installation.

Rear view of sound truck shown at left.

Photos courtesy Paul Huber, Jr.



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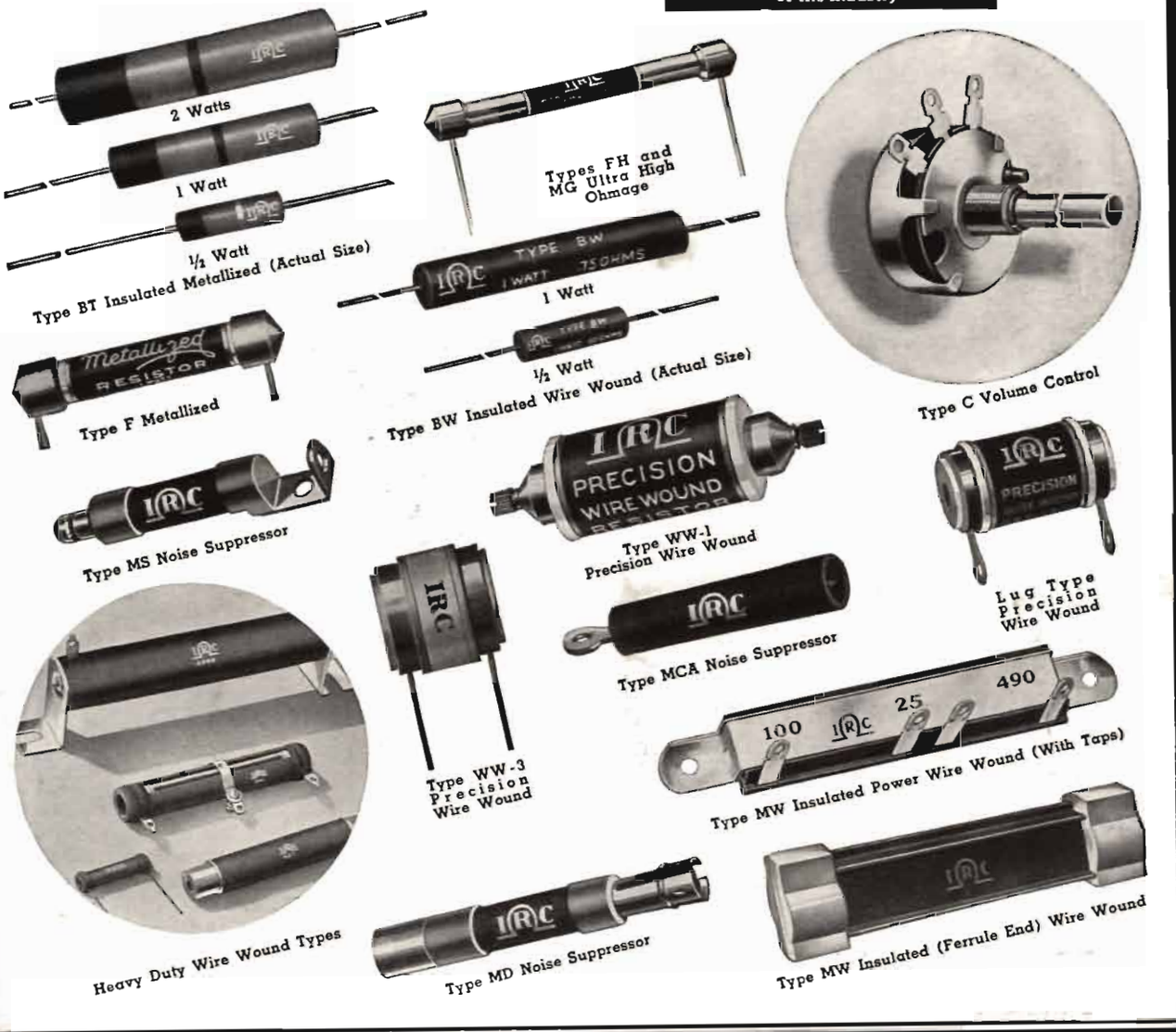

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"So it would be a rash economist who predicted any limit to the tangible results of scientific thought in the form of new goods and services placed at the disposal of mankind. In fact, it is only by a constant development of new goods and services that we may expect to re-engage the man-power released by technological improvements in established industries. The market for every new commodity eventually reaches a saturation point and becomes primarily a replacement market, so that a more efficient technology reduces the number of workers needed in that field.

"But science is simultaneously creating new employment, both by the modernization of established industries and by the creation of new ones. In our own generation we have seen the automobile, the airplane, the motion picture, and the radio provide totally fresh fields of activity for millions of men and women. Many of our older industries have engaged scientists, with notable success, to develop new and remodel old products to meet the needs of a modern era.

"The industry which has not learned how to employ scientists to make it new, and keep it new, is doomed. Few industries are so stagnant as not to be aware of this; but there are some so conservative that the scientist is called upon to turn salesman and show them how modern science can rejuvenate them to meet present-day realities and survive."

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MERRILL-LAMBIE COMMERCIAL TRANS-ATLANTIC FLIGHT

Dick Merrill climbing out of cockpit of "Daily Express". Note antenna. Photo by Paul Ivano, Monogram Studios, Hollywood.

By T. C. McCLARY

EASTERN AIR LINES' pilots Dick Merrill and Jack Lambie made the five-day New York-London round-trip flight a milestone in aviation and radio. It was the first heavier-than-air commercial trans-Atlantic flight. It was made regardless of weather, and on schedule.

When Merrill took off from Floyd Bennett field on May 9, he had no doubt about his plane. His twin-motored Lockheed Electra carried a safe margin of extra fuel. Jimmy Gerschler, Lockheed engineer, had drawn a graph of speed and fuel consumption along the course. Nothing less than a steady eighty-mile headwind or hours of continuous sleet and snow could endanger the ship—except bad radio.

It is nineteen hundred miles from Newfoundland to Ireland. Between four hundred miles off each coast is some of the most eccentric atmospheric area in the world.

A rushed 12-hour radio installation was made simultaneously with final adjusting of the motors. Larry Campbell, EAL technician, modified the WECO 13C transmitter. A year earlier he had studied results of the Richman-Merrill flight tuned on 6590 kc, 6210 kc and 500 kc. For the coronation flight, the bands 6590 kc, 500 kc and 333 kc were chosen.

The crystal-controlled, three-frequency-channel transmitter employed five tubes ordinarily capable of a carrier power of fifty to seventy-five watts, but modified to one hundred watts for the occasion. The cw operation necessitated keying screens of the r-f tubes and having the oscillator running continually. A carbon microphone was used for telephone communications.

A transmitter switch carried the antenna from receiving to sending, with a side tone provided to allow voice monitoring during transmissions. Power was supplied by a WECO 4B unit, a dynamotor supplying 1050 volts for the transmitter tubes. A fifty-ampere generator driven by the engines kept batteries charged. No hand generator was carried.

A 12A revised receiver was used for two-way communication, powered by a small dynamotor. It operated on two frequencies by crystal control. The receiver was stationed aft in the plane and remote controlled from the cockpit.

Beacon signals were received on a tunable WECO 14A type, ranging from 200 kc to 400 kc. Also a superhetrodyne, it was located on rubber shock mounts beneath the right-hand pilot's seat, and controlled from the panel.

An 8B type box located in the cockpit housed transmitter switches and controlled both receiver volumes, providing an output from either receiver or mixed output for either or both pilots. A jack box behind each pilot held headphones and microphones.

A 4B power unit under the left-hand pilot's seat housed two battery-driven dynamotors. The transmitter dynamotor developed 1050 volts at 0.400 ampere, the smaller dynamotor developing 200 volts at 0.085 ampere. A cockpit-controlled RCA radio compass was located in the ship's nose. A streamlined, shielded loop was mounted on the underside of the fuselage at the forward end.

The 6590-kc "V" antenna 28 feet 4 inches long extended topside from a mast at the front center to the two rudder fins. About one third of the way from the tail, a stub feeder connected with the antenna just above the transmitter station. The two antennas for beacon and radio compass were located beneath the fuselage at the forward end. There had been some discussion as to type of antenna for the 6590 band, the "V" type finally being selected.

Near the tail assembly on the underside was the 250-foot trailing antenna wire used at wavelengths corresponding to the two lower transmitter frequencies. There was no set rule for length over mid-Atlantic, the length apparently being a matter of local weather conditions and long range behaviour at the two lower frequencies. Although the eastward flight was made at high altitude and the westward at low, no conclusions as to the altitudes of best reception could be drawn as weather conditions during the two flights were not the same.

Changing the antenna trailing length was considered inconvenient. The antenna wound on a manual reel amidships due to crowded space in the cockpit. Every change of length required scrambling back over the crowded cabin fuel tanks. A low-impedance antenna-coupling system was modified to between 1500 and 2000 ohms.

Merrill and Lambie considered one of the most important factors the shielding of the ship. All wiring of the ship itself and engine magnetos, plugs, generators, etc., were all shielded to prevent interference from ignition.

No means was found prior to the flight to carry off static accumulated by the plane. Extensive research in this direction and reported in late June by H. M. Hucke of UAL will be carefully studied before any future distance hops.

The shielded anti-static loop for receiving DOC beacon signals was found satisfactory on both east and west crossings. This type of loop may be rotated from the cockpit and used as a compass bearings finder, and is considered effective against most normal rain, snow and dust static. The full streamlined housing is almost foolproof against icing up, but the recent UAL tests seem to indicate that elimination of snow static will ultimately require that planes have absolutely smooth surfaces.

With their equipment bench tested and installed, Merrill and Lambie took off for London, Lambie handling most radio contacts on prearranged schedules.

(*Continued on page* 62)

TELECOMMUNICATION

PANORAMA OF PROGRESS IN COMMUNICATIONS

BOXING THE ELEMENTS

THE EFFECT of wind, rain, sleet, snow, arctic and tropical temperatures, six-mile altitudes and power dives upon aeronautical transmitting radio equipment can all be duplicated within a few hours by radio engineers at the General Electric Company, in two new rooms recently completed for radio test purposes.

The walls of the two steel rooms where the tests are carried out are 18 inches thick, supported by 12-inch steel beams. One-half inch steel plate covers the exterior with a sheet steel interior protecting insulation of cork and glass wool. Large portholes of one-inch glass permit operators to study the equipment without being subjected to the same strains as are placed upon the apparatus being tested.

The temperature in the "flying room" may be dropped to 40 degrees below zero and raised to 160 degrees above zero. An automatically controlled humidity plant permits the injection of live steam into the room where the effect of a relative humidity from 30 to 100 percent upon the transmitters may be observed.

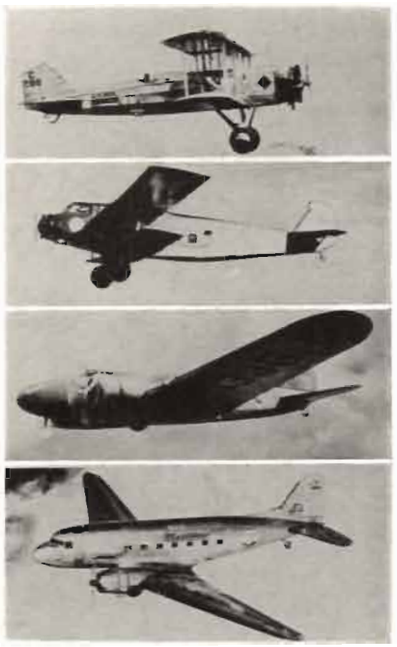
The air pressure at 30,000 feet elevation is about four pounds per square inch, as compared to 15 pounds at sea level. This high altitude pressure is created by the use of vacuum pumps which reduce the pressure as desired. The outside air pressure against the room, when the interior has been set to duplicate an altitude of 30,000 feet, is 370 tons, necessitating the heavy, thick steel walls. A pressure of 25 tons is forced against the doors, two feet thick, leading into the rooms.

Near the "flight room" is a newly-constructed "shaking machine" for testing the effects of vibration upon aviation radio equipment. The new machine, one of the largest ever built for such purposes, affords precision adjustments of both frequency and amplitude of vibration.

A stroboscope is used with the machine in the vibration tests. By synchronizing the light with the vibration, various parts of the radio apparatus can be studied in motion.

DECADE OF AIR TRANSPORTATION

A DECADE after the first commercially operated mail-passenger planes flew



Ten years of coast-to-coast flight. Top to bottom: 1927, 33 hours; 1930, 30 hours; 1933, 20 hours; 1937, 15 hours. Radio has played an important part in commercial air transportation.

their inaugural schedules over the New York-Chicago-California airway, the tenth anniversary of commercial coast-to-coast air transportation was celebrated on September 1.

Perhaps the most potent advance that has been made in the first ten years of commercial air transportation has been the adaptation of radio to airplanes.

Pioneered in 1919 and 1920 by mail planes of the Postoffice Department, United's airway had a background of more than seven years of operation before the predecessor divisions of United Air Lines linked the Atlantic and Pacific with the nation's first cross-continent commercial service.

Historically, this route is indeed interesting because its ancestry goes back through the Postoffice pioneering days to the first traces of the old Overland Trail—more than a hundred years ago. Laid out by Government experts in 1919 as the most advantageous transcontinental route and one which should be developed at a time when the country could support only one major New York-California line, it closely follows the path of the Covered Wagon, the Pony Express, the Iron Horse, the first coast-to-coast telegraph and the first transcontinental highway.

Once the New York-California airway was functioning smoothly, there started a steady forward movement along technical lines that established air transportation in the United States as foremost the world over in operating excellence. The first major project was the development of plane-to-ground voice radio to fill a great need. The increasing importance of aircraft radio was next evidenced by the development of a directional airway beam which greatly increased efficiency of air navigation. The two-way voice radio and the airway beam result in transmitter and receiving set installations in airplanes and at ground stations from coast-to-coast.

A separate communications department was established and, as United completes its first decade, the radio laboratory has expanded its activities into one of the most complete in the world. As this is written a Boeing 247-D transport has been withdrawn from regular service to become a "flying lab." Already interesting advances have been made towards the elimination of snow static.[1] This same ship has been intensively used for successful development of an instrument-landing beam which enables pilots to make airport landings without seeing the ground by the use of radio beams and aircraft instruments.

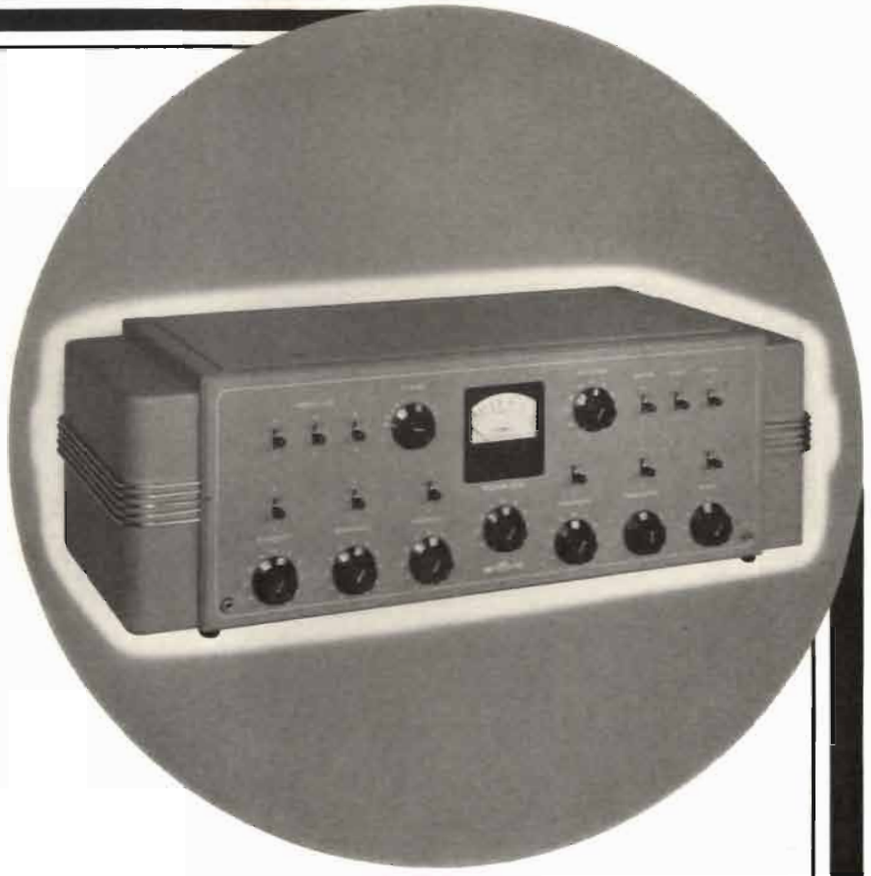
Supplementing the Federal airway directional beams came the localized beam which has been installed at key United terminals where the airway beam station is not located at the airport. This system of localized beams permits pilots to proceed via directive signals directly to their airport destinations. Radio, as applied to airplanes, has changed the "art" of flying to the "science" of flying.

In the not-too-distant future four-engined transports for coast-to-coast service will take a bow and the radio equipment aboard this type of ship will be the most complete in the history of air transportation. Engineers are already busy shaping plans for the radio installation on these giant airliners. Airports throughout the country are being conditioned to care for the increased ground facilities that will be required by the new equipment.

[1] "Snow Static Effects on Aircraft," by H. M. Hucke, *Communication and Broadcast Engineering*, p. 7, July, 1937.

COLLINS

12H



SPEECH INPUT CONSOLE

Since its first appearance the Collins 12H has grown so popular that it is now accepted as the most dependable and finest speech console and is being adopted as standard equipment in more and more broadcast stations.

Although the 12H is the preferred console for most studio installations, other console models similar in appearance are available to meet special needs.

●**12Q** Console, a modification of the 12H, accommodates eight studio microphones, one talk-back microphone, two transcription inputs and six remote line inputs.

●**12N** is a single studio control console, handling one talk-back and three studio microphones, transcription, network and remote line inputs. Relay circuits provide program control and studio interlock at duplicate control points.

●**12L** extends the console idea to transmitter speech input service. Facilities are included for controlling and equalizing studio program lines, for originating programs locally, and for controlling the power circuits of the transmitter.

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NEW PRODUCTS FOR THE COMMUNICATIONS FIELD

SYLVALOY

A new manganese-free silicon-nickel named Sylvaloy is now being supplied to tube manufacturers. Minimizing chipping and flaking of the coating, this alloy is said to be popular for oxide-coated filament tubes, particularly the 80 type rectifiers. The new alloy also permits operation at lower temperature, thereby contributing to the life of tubes.

Further information may be secured from the *Wilbur B. Driver Co.*, 150 Riverside Ave., North Newark, N. J.—COMMUNICATIONS.

BEAT-FREQUENCY OSCILLATOR

The Model 108 beat-frequency oscillator is an instrument said to be engineered particularly to the requirements of production speaker testing, both of the speaker manufacturer and the radio-receiver manufacturer.

Special consideration has been paid to the dial and frequency-range layout so that the principal resonance of the speaker may be quickly located and the entire audio spectrum swept in examining for voice-coil rubs, cone flutter, loose voice-coil wires, speaker rattles, etc. In view of the fact that the characteristics of many speakers vary with the power impressed on them during test, a voltmeter, indicating the amplitude of the test signal at all times, is incorporated. The same meter gives a sharp visual indication when the primary resonance of the speaker is crossed. Minor resonances may be observed on this meter, as well, and the reading of the meter gives an indication of the relative speaker impedance over the frequency spectrum.

The vernier drive on the "zero-set" control allows accurate initial adjustment of the instrument. The electronic-eye circuit is so arranged that precise frequency calibration may be obtained by heterodyning the output of the oscillator against the line at 60 cycles or any multiple thereof, as well as by the usual zero-beat method.

More detailed information may be secured from *The Clough-Brengle Co.*, 2815 W. 19 St., Chicago, Illinois.—COMMUNICATIONS.

HAND-I-MIKE

The unit shown in the accompanying illustration is said to be one of the smallest complete velocity microphones ever made. It is complete with output transformer of either the high- or low-impedance type. It can be used as a hand microphone as well as on a desk or floor stand. A standard 5/8-27 inch thread is provided in the bottom of the handle.

In spite of the small size of the unit, the Hand-I-Mike is said to have a flat response from 60 to 7500 cps and an output only 3 db below the regular standard size velocity.

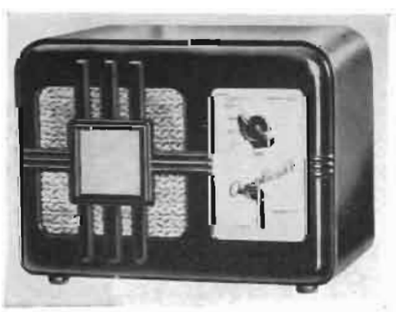
This microphone is a product of the *Amperite Corporation*, 561 Broadway, New York City, N. Y.—COMMUNICATIONS

PAGING SYSTEMS

This new paging system, Model FC-7R, was especially designed for use in small-size factory call systems, or for small hotels, institutions, noisy business installation, etc. It is a further extension of the intercommunicating systems, this time using a full seven-watt amplifier. Sensitivity of the speakers has been improved until return speech can be made from a distance of 20 to 40 feet.

In operation, the master station can call any one of 5 stations or can call all 5 stations at once. Any station can reply to the master station. If desired, a separate switch arrangement at the speaker will permit that station to call the master station.

The Webster Company, 5622 Bloomingdale Ave., Chicago, Illinois, will gladly furnish information.—COMMUNICATIONS.



SHIELDED-LOOP ANTENNA

A shielded-loop antenna, designed to work in connection with a three-band receiver, has recently been announced. Directional bearings are obtainable from 200 to 400 kc, from 550 to 1500 kc, and from 2400 to 6500 kc. The complete shielded loop weighs 7¾ pounds and has two loop antennas inside the shell. The loops are mounted at right angles to each other.

This loop is a product of *Lear Developments, Inc.*, 121 West 17th Street, New York City.—COMMUNICATIONS.

BATTERY-CHARGING RELAY

The Exide TVR voltage relay is designed to meet the demand for a voltage responsive device for the automatic control of storage-battery charging. The relay is self-compensating for ambient temperature variations thus obviating one of the principal effects which may result in a seriously overcharged battery. The relay is particularly adaptable to service with signal-system batteries.

Complete details are available from the manufacturer, *The Electric Storage Battery Company*, Allegheny Avenue and 19 Street, Philadelphia, Pa.—COMMUNICATIONS.

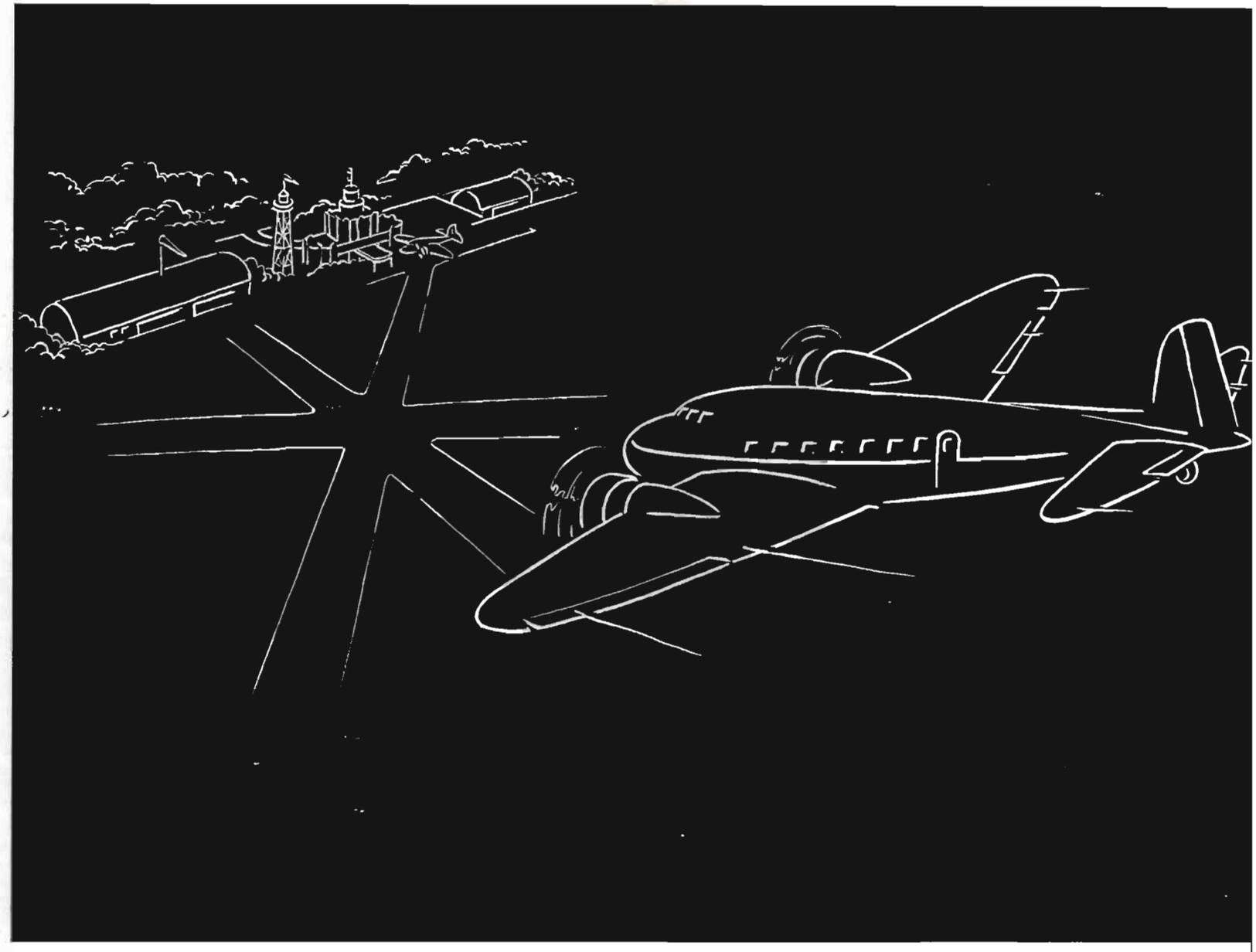
MODERNISTIC PANEL INSTRUMENT

The accompanying illustration shows a new panel instrument with illuminated dial that has recently been produced. The dial is made of a non-warping translucent material with a convenient 6-volt lamp which gives a well-diffused lighting.

A feature of the instrument is the bridge-type construction and soft iron pole pieces which is claimed to give it greater accuracy and added stamina to retain its accuracy. It is available in both d-c and a-c voltmeters, milliammeters and microammeters, as well as thermocouple ammeter and milliammeters in all conventional ranges. The rectangular face of the instrument measures 3 inches in width and 3⅛ inches in height.

A bulletin describing the instrument is available from the *Simpson Electric Company*, 5218 West Kinzie St., Chicago, Illinois.—COMMUNICATIONS.

SAFELY ACROSS THE SKY



AS the great commercial planes wing their way across the sky, the radio beacon keeps them safely on their course through rain, fog, or starless night. Guided to landing fields by invisible radio waves, the planes glide gently down the track to deposit their cargo of human lives in safety at their destination. Perfect functioning of radio equipment is essential to that safety — and Isolantite ceramic insulators contribute their share in assuring the highest efficiency of operation... In transmitting and receiving equipment at the field, in every radio circuit aboard the plane, Isolantite insulators minimize dielectric losses and insure dependability of the entire system.

Long experience in the problems of ceramic insulator design enables Isolantite to place at the service of its customers its specialized knowledge of radio requirements. In all questions of insulator design or selection, Isolantite engineers will give their full cooperation.

ISOLANTITE INC.

CERAMIC INSULATORS

Factory: Belleville, N. J. • Sales Office: 233 Broadway, New York, N. Y.

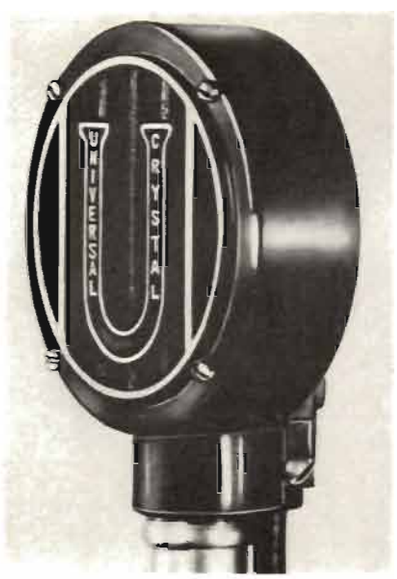
REMOTE P-A MIXER

The remote electric mixer is something new in standard sound installations. With it the operator may control volume from a strategic position in an auditorium or other gathering place and regulate it according to changing audience conditions, at will. Heretofore, the operator has had to work at the amplifier, which is usually behind the scenes. Remote mixing with the equipment is accomplished electrically in the amplifier rather than in the signal circuits, thereby reducing the necessary wiring, eliminating the need for shielding and avoiding other difficulties ordinarily encountered. Noise from the unit itself is avoided because the control circuits handle d-c potentials that are not critical. The remote-mixer unit measures only 3⅛ by 4½ by 2½ inches, weighs two pounds and is finished in chrome. There are two controls for mixing the input of as many microphones, and more may be added if desired. Due to proper circuit and mechanical design it is not necessary to clean the pads periodically for quiet mixing, it is stated.

This remote mixer is a product of the *RCA Manufacturing Co., Inc.*, Camden, N. J.—COMMUNICATIONS.

CRYSTAL MICROPHONES

Universal Microphone Co., Inglewood, Calif., is announcing a line of crystal microphones under patents of the Brush Development Co. The illustration shows the exact size of the crystal stand model.



MEGOHM BRIDGE

The Type 544-B megohm bridge is an improved version of the Type 544-A megohm meter. The circuit is that of a conventional Wheatstone bridge with a vacuum-tube voltmeter used as the detector. The bridge is balanced by means of a logarithmic dial and a multiplier switch. A microammeter in the plate circuit of the vacuum-tube detector serves as a null indicator.

The useful range of measurement is 0.1 megohm to 10,000 megohms, which is covered by an effective scale length of 35 inches. Resistances up to one mega-megohm (10^{12} ohms) can be detected.

Provision is made for the measurement of 3-terminal samples using guard electrodes. The voltage across the sample is 90 volts and is practically constant during balance. Terminals are provided for applying up to 500 volts to the bridge from an external source.

This bridge is useful in measuring the insulation resistance of cables and electrical machinery, the leakage resistance of condensers, and the volume resistivity of insulating materials. Since volume resistivity is sensitive to small traces of moisture, measurements with this bridge can be used as a measure of moisture content.

The accuracy of measurement is ±3 percent between 0.1 megohm and 100 megohms, and is ±6 percent between 100 megohms and 10,000 megohms. Accuracies of better than 1 percent can be obtained by using an external decade-resistance box.

The Type 544-B megohm bridge is a product of the *General Radio Company*, 30 State Street, Cambridge, Mass.—COMMUNICATIONS.

LAFAYETTE AMPLIFIERS

The new line of Lafayette amplifiers, one of which is shown in an accompanying illustration, has protective covers finished in platinum gray, set off by a red plastic and chrome handles. Chassis and control panels are finished in slate gray.

Among the features of these units are "reverse" feedback, automatic volume expansion, photo-cell input, individual bass-treble controls, and variable automatic volume control. Included in the complete line are units ranging from 5 to 90 watts.

Additional information regarding these amplifiers may be obtained from the *Wholesale Radio Service Co., Inc.*, 100 Sixth Ave., New York City.—COMMUNICATIONS.

AUTOMATIC WIRE STRIPPER

The E-Z automatic wire stripper, shown in the accompanying illustration, is designed for wire with insulation from 0.050 inch. It is provided with a lever which stops the return of the arms until the wire is removed after stripping, then it is snapped quickly back to normal. The lever will not operate unless wire with insulation 0.050 inch or larger is inserted between the grippers. When no wire is inserted the lower gripper moves upward when handles are squeezed pushing trigger and lever up and out of action.

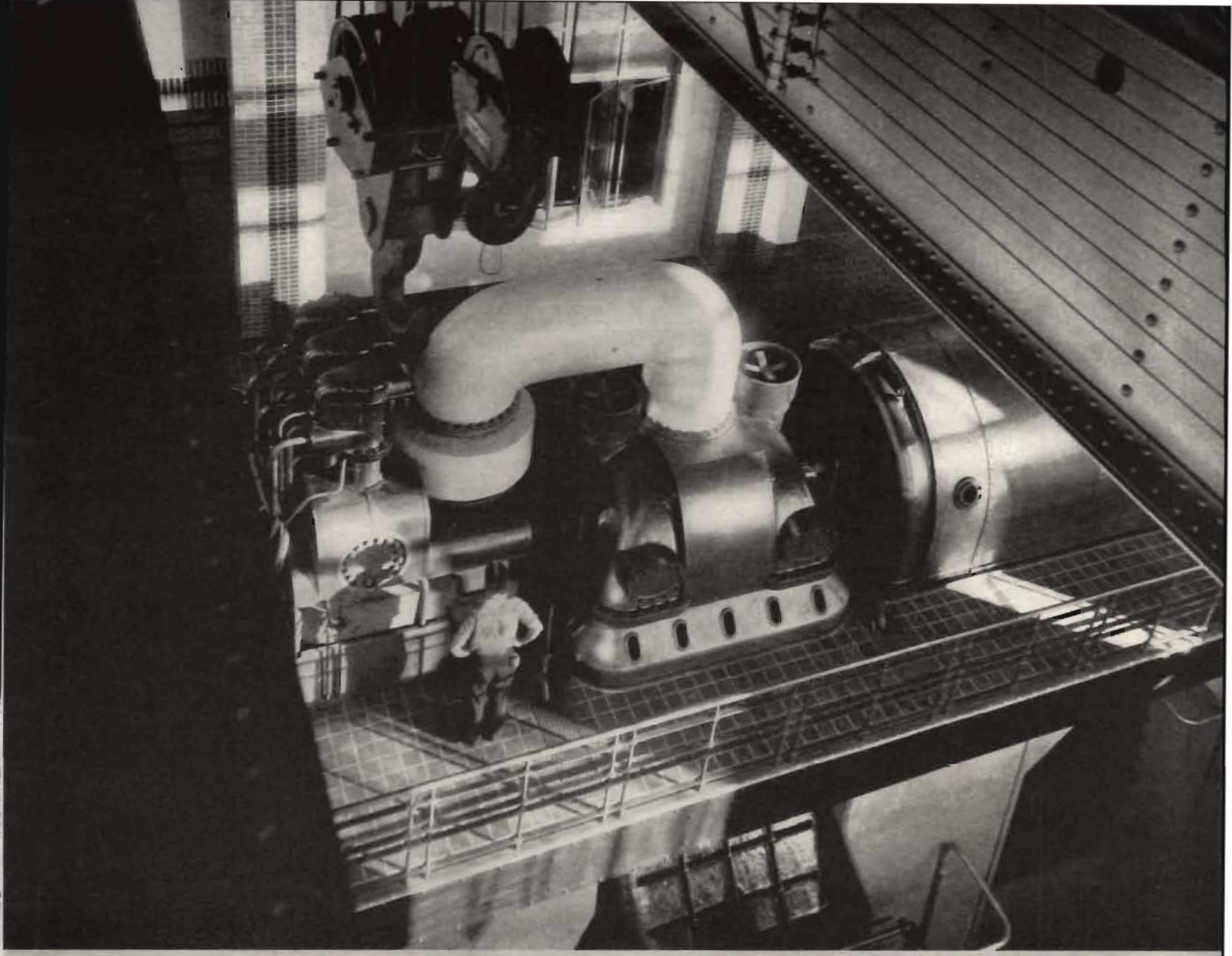
For complete information write to *Pyramid Products Co.*, 2309 South State St., Chicago, Illinois.—COMMUNICATIONS

CONVERTER TEST OSCILLATOR

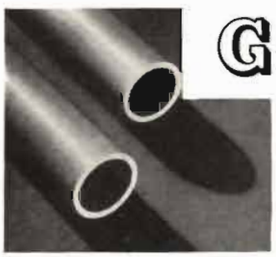
The Type 10-A converter test oscillator has been designed to determine the performance of the oscillator sections of converter tubes. The method employed in this instrument consists of varying the resonant impedance seen by the tube between its grid and cathode terminals. A calibration of this impedance in ohms is supplied with the instrument. The frequency at which measurements are made is approximately one megacycle. The Type 10A converter test oscillator is intended to be used in conjunction with the typical tube bridge normally a part of radio laboratory equipment. It may, however, be operated independently when connected with the necessary batteries and meters.

Literature may be secured from the *Boonton Radio Corporation*, Boonton, N. J. —COMMUNICATIONS.

(*Continued on page* 52)



POWER NEEDS PROTECTION



GENERATORS, great sources of electrical energy, would work in vain without adequate insulation. *Synthane* plays its part. *Synthane* protects—protects the flow of energy from generator to bus bar to substation to point of use. . . . *Synthane* has many other applications. . . . *Synthane* Bakelite-laminated is a uniformly dense, solid material possessing a combination of useful physical, chemical, mechanical and electrical characteristics. It is tough, strong and light in weight; one of the most effective dielectric materials; chemically inert and corrosion resistant. It is easy to machine. The uses for *Synthane* are countless. . . . *Synthane* is a type of material indispensable in insulating electrical products. It may similarly be of material assistance in the manufacture of your product. Write for "*Synthane* for Mechanical Applications". (Please indicate your requirements in your request) . . . *Synthane* gives you *Material Satisfaction.*

SYNTHANE CORPORATION, OAKS, PENNSYLVANIA

SHEETS • RODS • TUBES • FABRICATED PARTS • SILENT STABILIZED GEAR MATERIAL

SYNTHANE
Bakelite— laminated

OVER THE TAPE . . .

NEWS OF THE COMMUNICATIONS FIELD

IRE ROCHESTER FALL MEETING

The 1937 Rochester Fall Meeting of the Institute of Radio Engineers will be held on November 8, 9, and 10 at the Sagamore Hotel, Rochester, N. Y. While the program has not yet been made available, interesting technical sessions are anticipated. The usual engineering exhibit of component parts, tubes, test equipment, etc., will of course be held.

TWA CONTRACT CARRIER FOR RAILWAY EXPRESS

Effective September 1, 1937, Transcontinental & Western Air became one of the contract carriers for the Air Express Division of the Railway Express Agency. Establishment of a new TWA route to San Francisco where a connection can be made with planes for Hawaii and the Orient, and the advantage of a direct connection in New York with the routes soon to be established across the Atlantic Ocean are among the principal reasons for TWA becoming a part of the Air Express Division of the Railway Express Agency.

OPERADIO BULLETIN

A bulletin describing the Operadio line of intercommunicating systems is now available from the Operadio Manufacturing Co., St. Charles, Illinois. Complete descriptions and technical data are given.

CENTRALAB CATALOG

Centralab has just published an attractive 12-page catalog covering their complete line of volume controls, fixed resistors, selector switches, and auto-radio noise suppressors. Many of the items in this catalog are brand new—never listed previously—and exclusive with Centralab. Those wishing a copy of the catalog should write Centralab, 900 E. Keefe Ave., Milwaukee, Wisconsin.

DATA ON ALL-PURPOSE OSCILLOGRAPH

An attractive two-color bulletin illustrating and describing the many features of the DuMont 5-inch all-purpose oscillograph, Type 168, is available by addressing the Allen B. DuMont Labs., Inc., Upper Montclair, N. J. In addition to many new features, this oscillograph includes the sweep-expanding amplifier whereby the wave pattern may be stretched out across the screen for critical study.

NEW OFFICES FOR STANDARD ELECTRICAL PRODUCTS CO.

The Standard Electrical Products Co., have announced the removal of their new offices and factory to 317 Sibley Street, St. Paul, Minnesota. They are developing and shortly will begin manufacture of a line of variable voltage transformers for industrial and laboratory use.

SUBSCRIPTIONS

Subscribers to *Radio Engineering* and/or *Communication & Broadcast Engineering*: Your subscriptions are being transferred to COMMUNICATIONS and will be continued as of the former rate. This means, of course, that subscribers to one or both of the former publications will be continued on the lists to the expiration of the *total* number of months to which they are entitled.

RADIO PARTS TRADE SHOW

The New York Radio Parts Trade Show will be held at Commerce Hall, New York City, on October 1, 2 and 3. This show is sponsored by the Radio Parts Manufacturers National Trade Show with headquarters at 510 North Dearborn Street, Chicago.

CROSSLEY RECEIVES APPOINTMENT

The appointment of Alfred Crossley as special consulting engineer to its engineering staff is announced by the Belden Manufacturing Company, 4689 W. Van Buren Street, Chicago.

Mr. Crossley has been active in the radio field for over 25 years. He is well known for his past activities as chief engineer of a number of prominent radio manufacturers. He has had extensive service as radio officer in the Navy and has received a number of patents on radio devices in the United States and in foreign countries.

RADIOCOMPASS BULLETIN

A 12-page bulletin describing the Models AVR-8D and AVR-8E is now available from the Aviation Radio Section, RCA Manufacturing Co., Inc., Camden, N. J. This bulletin contains complete descriptions, specifications and typical installation data on these units.

Wilbur B. Driver, pioneer electrical alloy manufacturer, who has just returned from a European trip.

SMPE CONVENTION

The 1937 Fall Convention of the Society of Motion Picture Engineers will be held in the Hotel Pennsylvania, New York City, from October 11-14 inclusive.

An attractive program of technical papers and presentations is being arranged by the Papers Committee. All technical sessions, apparatus symposiums, and film programs will be held in the *Salle Moderne* of the hotel, on the eighteenth floor.

There will be no general appartus exhibit, but those who have developed new equipment during the past year are invited to submit technical descriptions of it to the Papers Committee for possible inclusion in the apparatus symposium.

CHEMICAL CATALOG

The 136-page spiral wire bound Catalog No. 4, listing and describing chemical, bacteriological, engineering, electrical and general scientific and other technical books of American and British publishers, offered to technical workers, by the Chemical Publishing Co. of N. Y., Inc., 148 Lafayette St., New York City, met with such a great demand that it is now out of print. Catalog No. 5 is now ready and will be mailed to any technical worker sending 10c in stamps or coin to cover mailing.

HOLLYWOOD SOUND CO. TO MANUFACTURE LEICHNER CAPACITORS

The manufacture of the Leichner line of capacitors has been taken over by the Hollywood Sound Company who will produce these condensers in capacities ranging from 0.00005 to 0.002 microfarads with voltage ratings from 2500 to 7500 volts. Literature is available. Write to the Hollywood Sound Company, 3930 South Wayne Avenue, Fort Wayne, Indiana.

LAPP BULLETIN

Lapp Insulator Co., Le Roy, N. Y., have made available an interesting 14-page bulletin entitled "Lapp Radio Specialties," describing their line of porcelain water coils and antenna structure insulators. Complete data and specifications are included. Write for Bulletin No. 137.

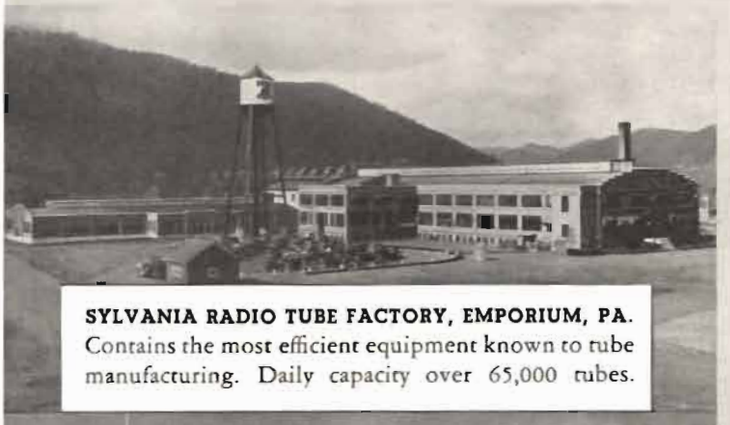
COLE ELECTED RMA DIRECTOR

S. I. Cole, president of the Aerovox Corporation, has been chosen by the Parts Division of the Radio Manufacturers Association as one of the four new directors. The other three directors named by the Division were Jerry Kahn of Standard Transformer Corp., H. E. Osmun of Centralab, and Ray F. Sparrow of P. R. Mallory Co.2 These directors were elected for one-year terms ending with the next RMA Convention in 1938, since all Parts Division Directors are limited in their terms to one year. Mr. Cole was also appointed to the Membership Committee by President Muter.

(*Continued on page* 48)

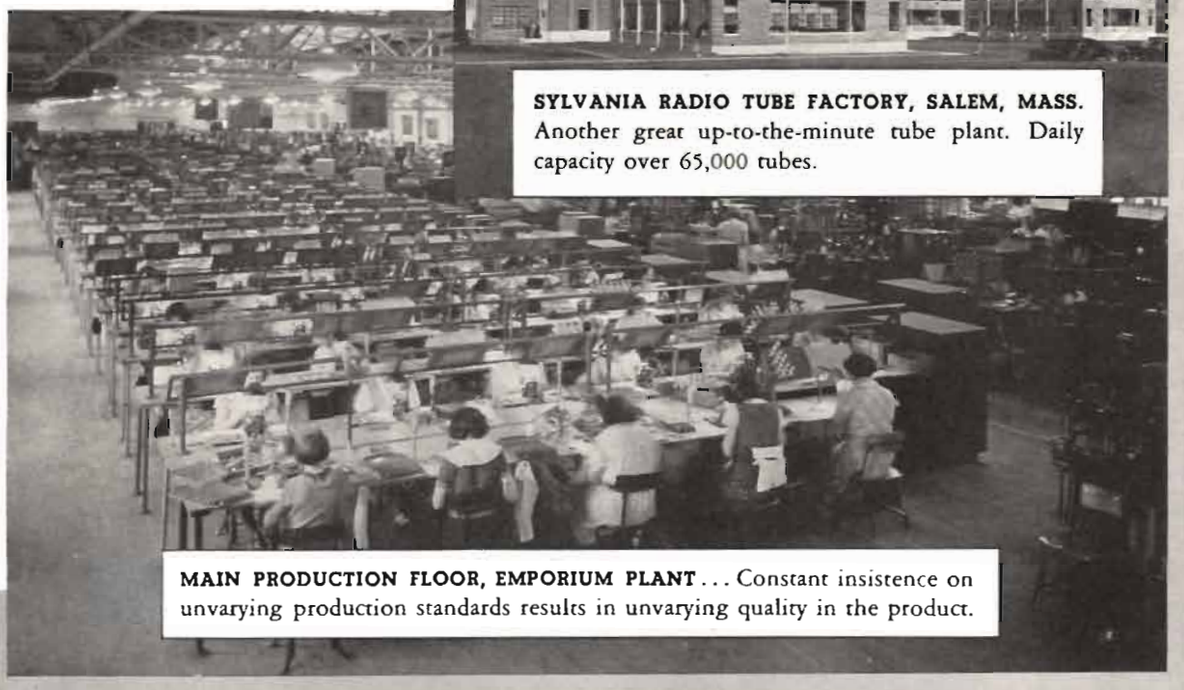
An institution of service to the radio industry

The radio industry...the American radio audience . . . and 119 foreign countries of the world now receiving increasingly large Sylvania shipments . . . all know Hygrade Sylvania as an organization whose amazing growth is the direct result of good and faithful service to the whole radio industry—from the manufacturer right down to the consumer.



SYLVANIA RADIO TUBE FACTORY, EMPORIUM, PA. Contains the most efficient equipment known to tube manufacturing. Daily capacity over 65,000 tubes.

SYLVANIA RADIO TUBE FACTORY, SALEM, MASS. Another great up-to-the-minute tube plant. Daily capacity over 65,000 tubes.



MAIN PRODUCTION FLOOR, EMPORIUM PLANT . . . Constant insistence on unvarying production standards results in unvarying quality in the product.

SYLVANIA SET-TESTED RADIO TUBES

OVER THE TAPE

(*Continued from page 46*)

EISLER CATALOG

Catalog 38W, entitled "Electric Spot and Butt Welding Machines," has recently been issued by the Eisler Engineering Co., 750 South 13 Street, Newark, N. J. Numerous illustrations, specifications and descriptions emphasize the important features of the spot and butt welders as well as wire portable and special welders, high-frequency and brazing and soldering machines, spot welding timers and miscellaneous welding accessories, and also showing a number of electric welding machines for parts as used in tubes in sending and receiving sets.

SPAULDING BOOKLET

A 4-page bulletin on "Spauldo," a motor slot insulation of high dielectric strength, is now available. Write to the Spaulding Fibre Company, Inc., 310 Wheeler Street, Tonawanda, N. Y.

CIRCUIT-BREAKER DATA

Facts regarding the protection of electrical equipment are contained in an 8-page illustrated folder obtainable from Heinemann Electric Co., Trenton, N. J. This literature deals particularly with the protection afforded by the non-thermal magnetic Re-Cirk-It breaker, available in instantaneous-trip and time-delay actions.

SHURE DATA SHEET

Shure Brothers Company, 225 West Huron St., Chicago, recently released Data Sheet No. 145. This sheet includes application, installation, operation, and technical data on the Shure Model 85A crystal sound-cell microphone.

NEW COIL WINDING COMPANY

Orland Murphy, president, announces the organization of Electrical Windings, Incorporated, 16 North May Street, Chicago, to specialize in the design and manufacture of all types of transformers, solenoids, chokes, magnets, etc. The new company is set up to design coils and mountings for any specific purpose, or to work from manufacturers' specifications.

Mr. Murphy was formerly associated with Utah Radio Products and Standard Transformer Corporation, and has recently been chief engineer for Robertson-Davis.

R. R. DAVIS PROMOTED

R. R. Davis, formerly apparatus advertising manager, Westinghouse Electric & Manufacturing Company, has been appointed assistant to the general advertising manager of the company. His appointment is announced by S. D. Mahan, general advertising manager.

AMPEREX BOOKLET

"Amperex Transmitting Tubes" is the title of an interesting and instructive 51-page booklet just released by Amperex Electronic Products, Inc., 79 Washington St., Brooklyn, N. Y. Considerable space is alloted to general information and applications notes on the various tubes. Complete operating characteristics and specifications are of course included. Of special interest is the rectifier circuit data used in the section devoted to mercury-vapor rectifier tubes. The booklet may be obtained from the above organization.

STANCOR CATALOG

A new "Hamanual" is announced for distribution October 1 by Standard Transformer Corporation, 852 Blackhawk St., Chicago. It is a combination amateur catalog and construction manual. It contains 16 new transmitter circuits. The circuits range from 5 watts to 1 kw and have all been tested in Stancor Laboratories.

JEFFERSON BULLETIN

Jefferson Electric Company, Bellwood, Illinois, have recently issued a 4-page bulletin describing their line of Ferro-tube mercury contacts. These contacts are said to be non-breakable and uniformly cylindrical. Specifications and prices are included.

ARMCO APPOINTMENT

Marvin Marsh, special ARMCO sales representative in the Kansas City territory since January 1, 1935, has been named manager of the company's newly created district office at 7100 Roberts Street, Kansas City, Mo., according to W. W. Sebald, vice-president in charge of commercial activities of The American Rolling Mill Company, Middletown, Ohio. Mr. Marsh will be assisted by a competent staff.

UNITED ELECTRONICS CATALOG

A new and complete catalog and specification book has been issued by the United Electronics Company. This book covers some 34 models of electronic tubes designed for all types of transmitting equipment such as used in professional and amateur broadcasting stations, aeroplanes, police departments, motion picture, industrial and electro-surgical applications. A copy can be obtained by writing on your business letterhead to the company at 42 Spring Street, Newark, N. J.

THE C-D CONDENSER

A new and interesting magazine for the amateur, engineer and experimenter is maintained by the Cornell-Dubilier Electric Corporation. The publication, entitled *The C-D Condenser*, is printed in digest form and mailed free of charge.

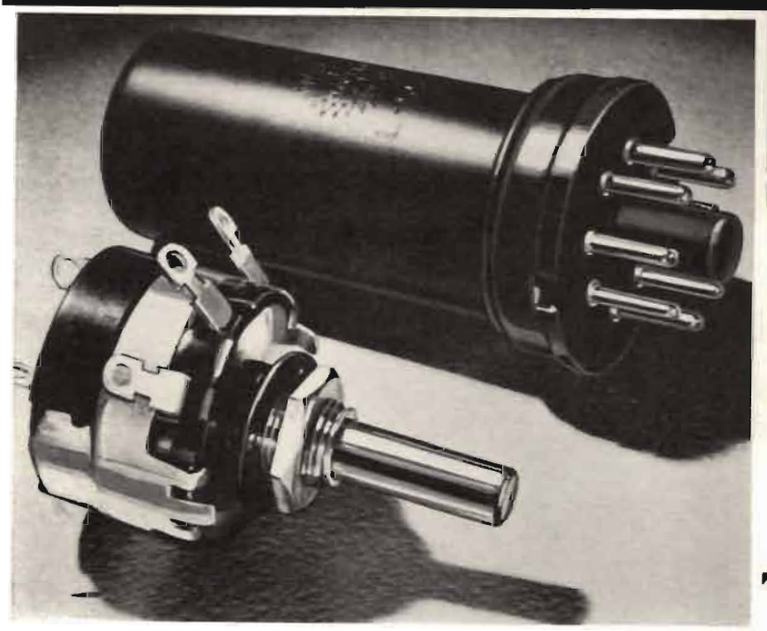
Highlights of the magazine include articles on technical subjects, biographies of personalities well known in the radio industry, a reading guide to current radio magazines and "The Radio Trading Post," a free market place where sellers, buyers, swappers, job-offerers and job-seekers can meet.

To receive copies of "The C-D Condenser," released bi-monthly, send your name and address to *The CD-Condenser*, Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

NEW EQUIPMENT FOR KTHS

KTHS, NBC outlet at Hot Springs, Arkansas has just completed installation of complete new control-room equipment by its engineering staff under the direction of James Moran chief engineer. The set-up includes control console, remote amplifiers, microphones and turntables. A new volume-limiting amplifier has been installed at the transmitter. The work was done without program interruption.

Let CLAROSTAT Solve YOUR RESISTANCE PROBLEM



Midget Controls *for* Trouble-free Service

featuring:

1. Smoothest operation. Full 300 degrees of effective rotation.
2. Very, very quiet. Suitable for use even in most critical circuits.
3. Permanent resistance values even after long and hard service.
4. Composition element exceptionally immune to high humidity and severe climatic conditions.
5. Tinned terminals. Adequately spaced. Readily soldered connections. Solder can't get inside.
6. Any desired ohmage, taper, taps, with or without switches, single or tandem units.
7. Fully competitive prices, yet providing a quality and performance which we believe is well above competition.

FOR almost a year past, our engineers have been developing, testing and perfecting a MIDGET CONTROL. Our aim has been to produce an entirely new and better control, rather than a mere abbreviation of the larger sized jobs. And now we have a genuine MIDGET CONTROL, designed from scratch, of which we are really very proud. • We invite your examination, test, comparison and consideration. • Samples on request to manufacturers.

Loose-Leaf DATA . . . .

Write on your business letterhead for engineering data on new Midget Controls. And if you do not have our looseleaf engineering catalog, ask for your copy.

CLAROSTAT Manufacturing Co. Inc.
285-287 NORTH SIXTH STREET
BROOKLYN, NEW YORK, U.S.A.
• OFFICES IN PRINCIPAL CITIES •

CONSOLE TYPE SPEECH-INPUT EQUIPMENT

(*Continued from page* 17)

auditions simultaneously with programs, provided that the programs are from transcriptions or from remote points —in other words that they may be brought in through K-10 and K-11 to the program circuit, while the audition program goes through K-12 and K-15 to the monitoring circuit. Switch K-15 is a three-position switch which allows the monitoring system to be placed across the output of K-11 or K-12 (as above), across the main amplifier output, or to be fed from the talkback microphone input. Switch K-16 allows an external cue or a connection from the transmitter monitor to be fed to the monitoring system or the studio.

The appearance and construction of the Type 76-A equipment are shown in Figs. 11 and 12, the front and interior views. The main operating controls are placed on a sloped center panel along with the volume indicator. Two small panels, at the left and right contain the auxiliary controls. Looking inside of the cabinet, the three main units are easily distinguished. These are the preamplifier-mixer in the center, the main amplifier at right, and the monitoring amplifier at the left. These three chassis units are almost the same as the rack-mounted units of this same line. The use of these without change is made possible by the somewhat greater dimensions of this equipment—52" wide, 12" high, and 20" deep. Whatever disadvantage the slightly larger size may incur is probably offset by the use of standard units, easily serviced and, in general, interchangeable with rack-type units of similar function. Another advantage of this arrangement is that the system provides gain to spare—which, in turn, makes possible the flexibility achieved. The controls of this equipment naturally resemble closely those of a standard rack equipment, with, of course, the exception of the added number of switches. All of the mixers and gain controls are of the large finger-grip type and are provided with plainly marked scales. Other details of this equipment are similar to provisions of standard rack-mounted units. For instance, a miniature jack panel—with twelve jacks—is mounted at the left of the equipment. In addition to greatly increasing the flexibility of the equipment, these jacks are of convenience in case of failure—since the operation of the system may be checked at a number of points. Also valuable in this latter respect is the provision of a switching system which allows the V. I. meter (of the illuminated type) to be used for checking individual plate currents—a considerable convenience and time saver in locating defective tubes.

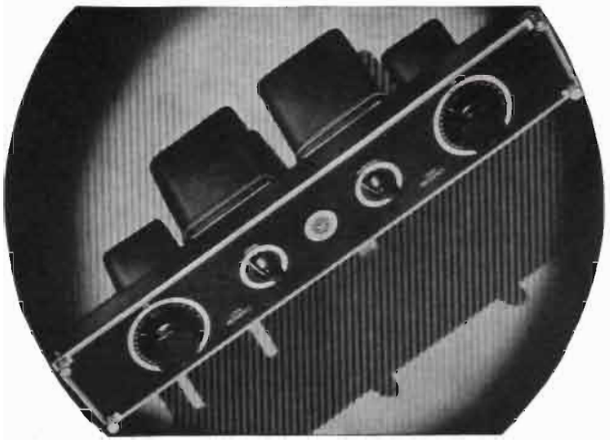
NOTES AND COMMENT

(*Continued from page* 33)

ated to the proper level to suit the equipment under test. A power-level indicator, incorporated in this panel, may be used to measure the input to the attenuator system or the output of the amplifier being tested. Output levels obtainable from this panel range from +10 db to —83 db while the power-level indicator range is from +10 to —8 db. The output impedance may be adjusted to 500, 250, or 50 ohms to suit the equipment to be tested. All connections to the attenuator panel are brought out to standard jacks for maximum ease of operation.

With these three units, the Type 69A distortion and noise meter, the Type 68A low-distortion oscillator, and the Type 89-A attenuator panel, complete information on any broadcast transmitter or audio-frequency equipment as to frequency characteristic, gain, noise level, and distortion at any output level and at any frequency, can be obtained rapidly and conveniently and adjustments to improve its operation made with ease and precision. The importance of proper adjustment of broadcast equipment cannot be over-emphasized since lower distortion and lower noise levels result in wider volume range and higher average modulation, the equivalent of increased transmitter power.

GILBERT SWIFT,
RCA Mfg. Co., Inc.



UTC MODEL 3A

EQUALIZER

The UTC 3A equalizer is an ideal universal equalizer for broadcast and recording service. It combines tap switches and pad controls permitting accurately controlled equalization up to 25 DB at both low and high frequencies. This unit will equalize telephone lines, pick-ups, cutting heads, sound on film, and other applications of similar nature. Net price to broadcast stations **$85**

Linear Standard Transformers

UTC linear standard transformers are available in sizes from minus 130 DB operating level to 50 kw. All standard units are guaranteed to be ± 1 DB from 30 to 20,000 cycles. The UTC LS-10 input transformer illustrated, incorporates trialloy magnetic filtering, which, combined with the UTC hum balanced coil structure, assures lowest hum pickup ever attained in an input transformer.

UTC has been supplying hum-balanced power supply equipment to Western Electric, Electrical Research Products, and other organizations for over three years. The use of hum-balanced construction *plus the UTC high permeability cast shield* reduces external flux to extremely small values. All UTC *Linear Standard* ***power supply*** components can be obtained in this form of construction at a 30% increase above normal list prices.

VARITRAN*

VOLTAGE CONTROL UNITS

FEATURES
- ★ Smooth control
- ★ High efficiency
- ★ Excellent regulation
- ★ Low cost

APPLICATIONS
- ★ Motor control
- ★ Heat control
- ★ Rectifier control
- ★ Light control
- ★ Line voltage control

The UTC VARITRAN makes possible continuously variable output voltage, using a sliding contact riding over the turns of an auto-transformer.

Standard units are designed for 115 volts input, 0-130 volts continuously variable output.

Model V-1. 570 Watts—5 amp. maximum rating, complete with cord, plug and switch, net. . **$10.00**

Model V-2. Same as V-1, but uncased, with terminal strip for rack or panel mounting, net. . **$9.00**

Model V-3. 850 watts maximum rating, 7.5 amps., uncased, with terminal board and provisions for mounting, net **$14.00**

Model V-4. 1250 watts—11 amps. maximum rating, uncased, net **$20.00**

Model V-5. 2000 watts maximum rating, 17.5 amps., uncased, net **$32.00**

Other sizes

Automatic VARITRANS are available to maintain line voltage constant. Details and prices on rquest.

UNITED TRANSFORMER CORP.

72 SPRING STREET • NEW YORK, N. Y.

EXPORT DIVISION 13 E. VARICK STREET NEW YORK, N.Y. CABLES: ARLAB

THE MARKET PLACE

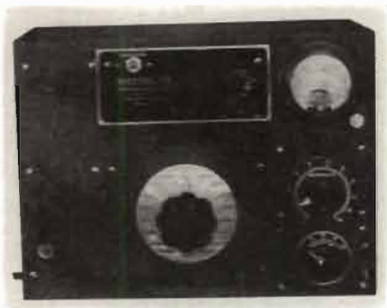
(*Continued from page* 44)

MODEL 20A MICROVOLTER

The Model 20A microvolter, shown in an accompanying illustration, has been designed for testing radio receivers on the factory production line.

Instead of the usual coil-switch and variable condenser, 18 fixed frequencies are provided, any one of which can be chosen by means of the selector switch on the front panel. This arrangement greatly speeds up testing as no calibration or curves are needed and only one motion is necessary to set to any desired frequency. Any 18 frequencies within the range 150 to 20,000 kilocycles can be supplied.

An unusual circuit arrangement, employing a master oscillator with an untuned amplifier, is used to make this feature possible without undue complication.



The master oscillator circuit is so arranged that an 18-point, single-pole switch selects the desired one of the 18 coils.

The Model 20A microvolter is a product of *Ferris Instrument Corp.*, Boonton, N. J. —COMMUNICATIONS.

TELEVISO PRODUCTS

Complete line of b-f oscillators, audio and medical amplifier and preamplifiers, null indicators and public-address systems has just been announced by the Televiso Co. One of the leaders in the new line is the VC-1 beat-frequency oscillator, a custom-built unit claimed to have an essentially flat frequency response, to be hand-calibrated, to have pure sine-wave output at 500 ohms, and encased in a solid walnut cabinet.

For additional information, write direct to the *Televiso Company*, 127 North Dearborn St., Chicago, Illinois.—COMMUNICATIONS.

HIGH-VOLTAGE OIL CAPACITORS

After numerous tests, the high-voltage oil capacitor shown in an accompanying illustration has been made available. The unit is housed in very small square steel cans, and is provided with high-tension pillar insulator terminals. The rolled-seam steel can is said to insure perfect hermetic sealing. Units are available in d-c working voltages of 600 to 2000, and in capacities of 1, 2 and 4 mfd.

The manufacturer is the *Aerovox Corporation*, 70 Washington St., Brooklyn, N. Y.—COMMUNICATIONS.

MULTIRANGE ANALYZER

In the Model 320 Multirange analyzer, a foundation meter having a 50-microampere movement, is connected to perform a-c or d-c voltage, d-c milliampere, and resistance measurements. The ranges are as follows: d-c volts, 0/3/15/30/150/300/600 (at 20,000 ohms-per-volt); a-c volts, 0/3/15/30/150/300/600 (at 2000 ohms-per-volt); d-c mils, 0/30/300—amperes 0/3; resistance, 0/500 ohms, 0-150,000 ohms, 0-20 megohms.

This analyzer is made by the *Triumph Manufacturing Co.*, 4017 W. Lake Street, Chicago, Illinois.—COMMUNICATIONS.

(*Continued on page* 58)

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

MARCONI MEMORIAL

The Veteran Wireless Operators Association are in receipt of a check for $100.00, a donation to the Marconi Memorial Fund being sponsored by the Association, from Mr. Alfred J. McCosker, president of WOR and chairman of the board of the Mutual Broadcasting System. J. R. Poppelle, life member of the VWOA and chief engineer of WOR has cooperated with the VWOA and offered many worthy suggestions.

An intensive campaign is about to be launched in behalf of the Memorial Fund the purpose of which is the establishment of a suitable memorial tribute commemorating the ideals and achievements of Guglielmo Marconi. The VWOA invite the co-operation and support of all branches of the communications industry.

The officers of the Association will be the officers of the Fund. George Clark, junior past president of the Association will serve as executive secretary of the Fund.

The exact nature of the memorial and it's location will be determined by a committee composed of prominent members of the communications industry. Mr. David Sarnoff, life member of the Association and president of the Radio Corporation of America will be Chairman of this committee.

Contributions and communications should be mailed to the Marconi Memorial Fund, Veteran Wireless Operators Association, RCA Building, 30 Rockefeller Plaza, New York, N. Y.

VWOA MEETING

The October meeting of the New York group of the Veteran Wireless Operators Association will be held at Bonat's Restaurant, 330 West 31st Street, New York City. The date is October 4, the time 6 p.m.

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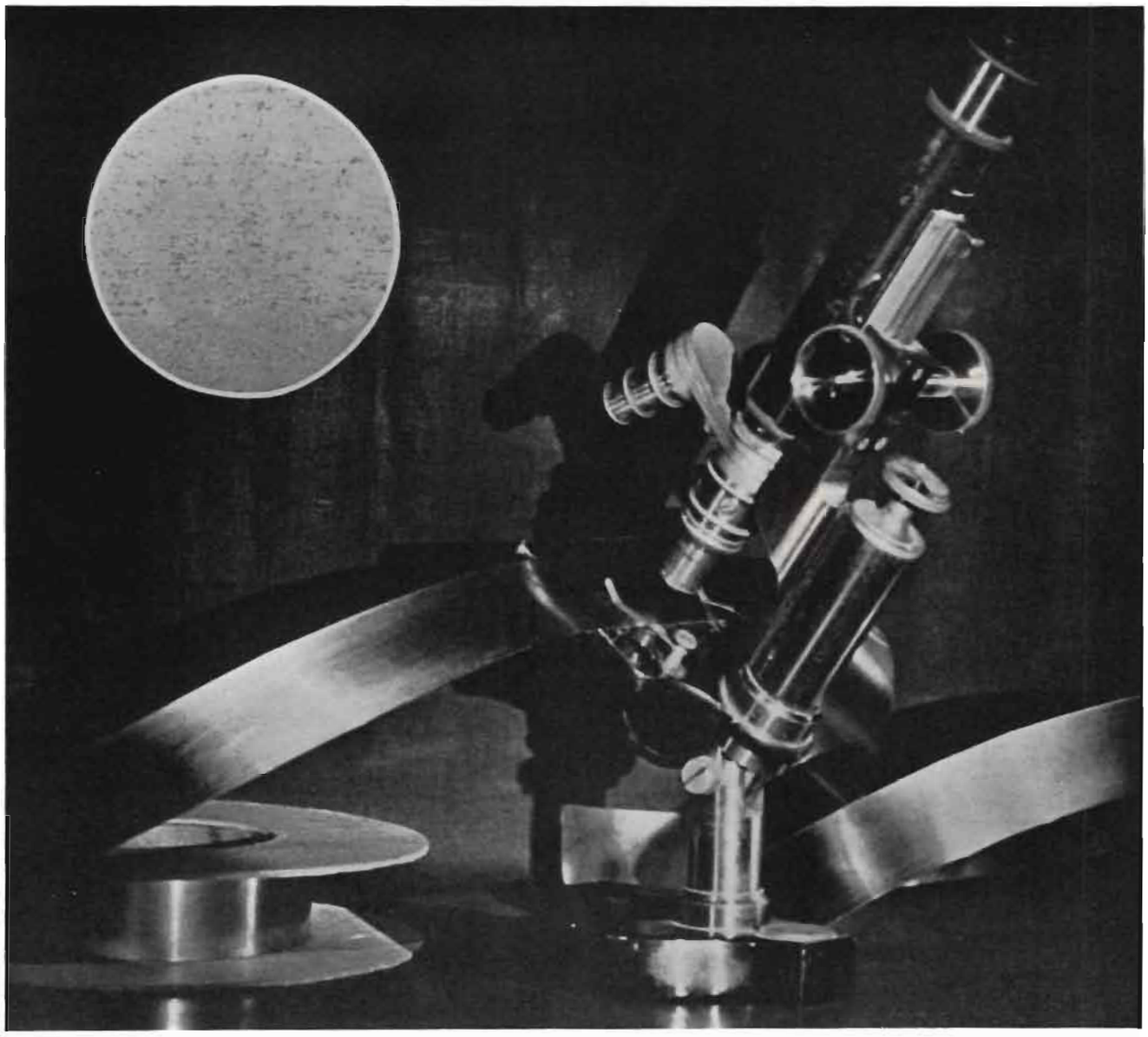
JANETTE LITERATURE

The Janette Manufacturing Co., 556-558 West Monroe St., Chicago, have just made available two interesting bulletins. Bulletin 227 covers the Janette line of rotary converters, generators, motor generators, motorized speed reducers, etc. Bulletin 23-25 is devoted to a-c and d-c gasoline electric plants, giving both specifications and prices.



Unretouched photograph—inset a photomicrograph

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RMA BOARD OF DIRECTORS MEET

President Leslie F. Muter of the RMA has arranged a meeting of the Association's Board of Directors Wednesday, September 29, at the Hotel Roosevelt in New York City. This is the regular fall meeting of the RMA directorate to plan the Association's service and working program for the coming year, and is the first meeting since the new Board was enlarged to twenty-five members by election of three more set and four more parts manufacturing executives.

The September 29 meeting of the RMA Board will immediately precede the National Parts Show in New York, October 1-3, which is sponsored by RMA and the Sales Managers Club. During this period there will be many meetings of RMA parts committees, now being arranged by Arthur Moss of New York, chairman of the RMA Parts and Accessory Division and a director of the Association. A meeting of the Executive Committee of RMA will be held on September 28, preceding the Board meeting, and a meeting of all members of the RMA Tube Division also may be arranged during the fall gathering of industry executives in New York.

Merchandising practices, sales promotion work by the Association, and many other important industry problems will be considered by the RMA Board. The Miller-Tydings retail price maintenance act of Congress, the Robinson-Patman Act, and other matters present merchandising problems of immediate importance.

RMA ENGINEERING ORGANIZATION

The engineering organization of RMA for the ensuing year and following the Association's annual meeting has been completed by Dr. W. R. G. Baker of Bridgeport, Conn., chairman. Much important engineering work for the coming year has been outlined and meetings arranged, including a meeting of the Vacuum Tube Committee, of which Roger M. Wise of Emporium, Pa., is chairman, in New York on September 22. One of the new RMA projects which has been most heartily received is the new publication "The RMA Engineer" which is concluding its first year of technical service and in which there is wide foreign as well as domestic interest.

During the coming year the Standards Section of RMA engineering will be continued under the chairmanship of Virgil M. Graham of Emporium, Pa. A new chairman of the Safety Section and representing the industry with the Underwriters' Laboratory, is L. C. F. Horle of New York. The RMA Service Section also has a new chairman in H. A. Crossland of Bridgeport, Conn.

Committees of the Standards Section and chairmen who are continued follow: Broadcast Receiver, E. T. Dickey of Camden, N. J.; Vacuum Tubes, Roger M. Wise of Emporium, Pa.; Sound Equipment, Hugh S. Knowles of Chicago, Ill.; Television, A. F. Murray of Philadelphia, Pa.; Component Parts, L. C. F. Horle of New York; Automotive Radio, J. H. Pressley of Philadelphia, Pa.; Special Receivers, L. F. Curtis of Long Island City, N. Y., and Facsimile, E. W. Engstrom of Camden, N. J.

INCREASE IN TELEPHONES

There was an increase of 55,100 telephones in service in the principal telephone subsidiaries of the American Telephone and Telegraph Company included in the Bell System during the month of August, 1937.

● Radio engineers choose Alsimag 196 as the most advanced insulating medium of the day for high frequency work, because it achieves the combination of very low dielectric loss, mechanical strength, density and versatility of sizes and shapes.

● By constant Laboratory development, American Lava seeks to lead in producing new steatite ceramic materials of outstanding merit.

● There is now available a table of characteristics, giving facts about Alsimag in useful data. If you do not have a copy, let us have your request.

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THE MARKET PLACE

(Continued from page 52)

MONARCH MULTIVIBRATOR

The Monarch Model 20 multivibrator is a special instrument designed to simplify the procedure of aligning a radio receiver. The alignment operation with the multivibrator is said to be a convenient and rapid one. When the alignment is completed the sensitivity if desired may be checked with a signal generator. The switch, which is located on the upper left-hand corner of the multivibrator panel, merely changes the type of output coupling used and it can be left in the position which gives the best results. The only other adjustments are an on-off switch and an output control.

For further information write to the *Monarch Manufacturing Co.*, 3341 Belmont Ave., Chicago, Illinois.—COMMUNICATIONS.

UNIVERSAL REPLACEMENT ELECTROLYTICS

The Type UM series of universal replacement electrolytics for a-c/d-c sets are shown in the accompanying illustration. Only three units are needed to meet the replacement needs in any a-c/d-c receiver.

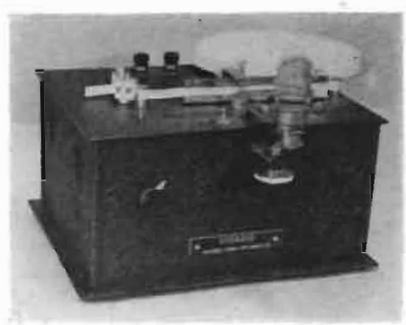
Leads are color coded, with color key clearly stamped on the label.

A complete listing of these units can be found in Catalog 151-A, which may be obtained by writing to the *Cornell-Dubilier Electric Corporation*, South Plainfield, N. J.—COMMUNICATIONS.

TAPE RECORDER

The new model V-5 Visasig automatic tape recorder is shown in an accompanying illustration. The recorder, recorder amplifier-limiter, and variable-speed synchronous tape-puller motor are mounted in a black crackle aluminum cabinet 6 by 10 by 12 inches. The weight is 30 pounds. It will record at any speed up to 200 words per minute. This recording equipment is designed to connect to the output of any radio equipped with a beat-frequency oscillator.

Complete information may be secured from the *Universal Signal Appliances Co.*, 64 West 22 St., New York City.—COMMUNICATIONS.



COMMUNICATIONS MICROPHONE

A communications-type microphone, incorporating a grip-to-talk switch, is shown in the accompanying illustration. This new combination microphone and desk stand is designed for use in the better type communication systems. The combination includes the B-104 with improved frequency response especially appropriate for communication in all types of commercial applications. The 'grip-to-talk' switch is so designed that a light grip on the standard will cut the microphone in; release grip and the unit is cut out, eliminating possibility of the microphone being on

when not in use. Standard equipment includes desk-mounting, grip-to-talk switch and eight feet of rubber covered cable.

Complete information is available from the *Astatic Microphone Laboratory, Inc.*, 830 Market St., Youngstown, Ohio.—COMMUNICATIONS.

TO THE EDITORS

(*Continued from page 27*)

nearly eighteen hours a day to millions of American homes, they must search the entire field of radio for assistance in bettering radio's service.

We, in the technical divisions of broadcasting, fully realize our dependence on other branches of radio. In the course of our day's work we conduct the ultimate tests for most of the practices and devices developed in the industry. In our laboratories and studios they either prove their worth or quickly find their way to technical limbo.

To bring our equipment and practices to the highest technical standard we must borrow heavily from other fields of radio. In the solution of the almost infinite number of problems in television, recently added to our domain, we shall be forced to draw more than ever before on the resources of allied sciences and arts.

Any journal, therefore, that can bring us, under one cover, the news of all branches of the radio art is most welcome. Consolidation of technical papers, so long as service is unimpaired, is a blessing to the busy engineer.

O. B. HANSON,
Chief Engineer,
The National Broadcasting Company.

MAY I OFFER my congratulations to the management and the editorial staff of COMMUNICATIONS on this, the first issue of their new publication. It is indeed gratifying to note that this new periodical, extending as it does into the fields of all types of transmitter and receiver problems, expresses recognition of the need for more intimate cooperation and more highly coordinated engineering effort in these many fields. It has been both the ill and the good fortune of the radio science and industry that so high a degree of compartmentalization has characterized them as in the recent past; ill fortune in that the lack of intimate cooperation between engineers concerned with the problems of general communications and those concerned with the problems of broadcasting has made the problems of both more difficult than they need have been; and good fortune in that the intense concentration of so many phases of American industry on the problems of broadcasting equipment design and production has resulted in the almost endless array of economic and scientific accomplishments which are now available to all communications fields.

It is, thus, most timely to recognize that the development of all radio communication has reached the stage in

(*Continued on page 60*)

TO THE EDITORS

(*Continued from page* 59)

which the solution of its future problems requires an increasing consideration of these problems not only in their individual "systems" aspects but as parts of a nationally and internationally coordinated whole.

And it is on the implication of the recognition of this fact that you are to be especially congratulated.

L. C. F. HORLE,
Consulting Engineer

WHAT WE RECOGNIZE today as the vast industry of electrical communication originated rather less than a century ago with the invention of the electric telegraph. The telephone came next, to be followed by radio in its various forms, and now television has been developed technically and is on the horizon of commercial adaptation.

It is interesting to measure in dollars and also in manpower how much importance we of today set upon the word and thought of the moment. For it is with the word and thought of the moment that electrical communication is concerned. Estimates of this sort must, of course, be rough, but even so are significant. In round numbers nearly half a million persons earn their livelihood directly by their capacity to meet the demands of the United States for instantaneous transmission of thought. If the enumeration were to be complete we should of course add additional thousands who are engaged in the supply of raw materials and general equipment. The tasks of communication workers vary from those of the telephone and telegraph linemen in manholes and aloft on poles to those of the radio operator at sea, and from those who in laboratories are searching for better instrumentalities of communication to those who entertain us through broadcast programs. Behind this army of loyal workers is electrical plant valued at more than $5,500,000,000.

Here indeed is a world of itself. And it is to the affairs of this specialized world and its relations with the larger world outside that a new journal—COMMUNICATIONS—will concern itself. We who are denizens of the world of electrical communication welcome it and wish it every success.

DR. F. B. JEWETT,
President, Bell Telephone Laboratories, Inc.

THE RADIO INDUSTRY of today knows that an important part of the radio industry of the future will be television. More and more interest is evidenced in the progress being made by the RMA Television Committee in formulating Television Standards. These standards for the U. S. A., when officially approved, will make possible the reception of any transmitter by any receiver within range. Much work, however, remains to be done before the path leading to commercial television is cleared of obstructions, such as, agreement on the remaining standards, frequency assignments, and the like.

A great help in these matters has been the space given to the subject of Television Standardization in the publications which are now combined under the new title COMMUNICATIONS. Speaking for our RMA Committee on Television I thank the editors for past—and future—interest and support in presenting our problems and progress directly to the individuals of the radio industry—their readers.

ALBERT F. MURRAY,
Chairman,
RMA Television Committee

THE CONSOLIDATION of *Radio Engineering* and *Communication and Broadcast Engineering* into your new magazine COMMUNICATIONS should prove very beneficial to the expanding radio industry.

The background of *Radio Engineering* with its long record of distinguished service to the industry will no doubt prove beneficial in expanding this same industry interest in COMMUNICATIONS.

LESLIE F. MUTER,
President, RMA

DURING THE PAST few years, the trend in radio publications has persistently increased the number of journals which the active engineer is compelled to scan in order to cover all important developments in the field. No publication is so sharply specialized as to permit a worker in another branch of the field to risk neglecting it entirely and this has seriously handicapped engineers in keeping abreast of developments. Much of their reading time is wasted in perusing material of little interest merely to make certain that important information is not being overlooked.

(*Continued on page* 62)

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● The uniform high quality and dependability of all Holyoke wire products is well known to the world's leading radio, electrical and communications equipment manufacturers. (Many have been Holyoke customers for over a quarter of a century.)

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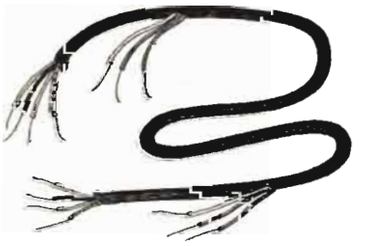

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NEW YORK OFFICE: 29 W. 36th STREET

TO THE EDITORS

(*Continued from page 60*)

The combining of *Radio Engineering, Communication and Broadcast Engineering,* and *The Broadcast Engineer* is a very helpful step in conserving the engineer's time. Because of its wider scope, the new publication COMMUNICATIONS should become even more valuable than the journals it now unites.

It is regrettable to note the passing of *Radio Engineering,* which has had a place on radio bookshelves for seventeen years, a long time in the history of radio periodicals. Seventeen years that have witnessed a greater development of equipment and theory than any other equal period in the history of electrical communications. The rapidity of technical developments makes it evident that COMMUNICATIONS must need proceed at a fast pace not only to justify its heritage but to serve its readers effectively.

HAROLD P. WESTMAN,
Secretary,
Institute of Radio Engineers

MERRILL-LAMBIE TRANS-ATLANTIC FLIGHT

(*Continued from page 38*)

WOR stayed on 800 meters throughout the full flight to give radio compass bearings by playing phonograph records. Droitwich, England, had a regular daylight schedule.

Huntington, navigation man of EAL, had plotted the constant magnetic course and Jack Lambie the Lindbergh circle. The latter meant shifting bearings every twenty or twenty-five minutes, but had the *Daily Express* been flying with visibility and sufficient sky for celestial navigation, the shorter Lindbergh circle would have been followed.

On the outset of the flight, communication was by voice over the 6590 band. Four hours out of Floyd Bennett, voice transmission began to distort and break and communication was switched to code over the same band. Neither the 500-kc Marine emergency nor 333-kc International Aircraft frequencies were used much, the range being found too short for clear transmission. As the same condition existed on the return flight, it led the pilots and Larry Campbell to believe that the higher frequencies will prove most effective.

On the eastward flight the *Daily Express* ran into solid "soup" over Newfoundland and Merrill and Lambie decided to follow the constant magnetic course.

Flying blind between 4,000 and 8,000 feet all the way across, they had only brief periods of visibility. There was no violent atmospheric disturbance, but there were solid cloud layers heavily charged and a series of minor storms. About 500 miles off Newfoundland, KHMER's signals were missed by most U. S. stations for nearly three hours after, although "hams" in many parts of the world picked up 6590-kc signals during that period.

KHMER, however, received clear signals on 6590 kc until the plane was 800 miles off Newfoundland when reception on that band went dead, around 1:00 a.m. EST. For 700 miles, KHMER could only pick up occasional

Checking on Dick Merrill and Jack Lambie during the eastward crossing.

weak and intermittent signals on the two lower frequencies. Merrill and Lambie think the chief difficulty was the lack of sufficiently powerful land stations. This period of no reception lasted until the plane was 350 miles off Ireland when they picked up British signals on 6590 kc which came in clearly thereafter.

Had Merrill and Lambie known it, they could have relayed messages through ships-at-sea. Al Lodwick of Curtiss Wright, technical supervisor of the flight, had made arrangements with eleven steamship companies to have 22 ships at sea listen in hourly for KHMER. Arrangements had been completed after departure.

Coming over Ireland, the *Daily Express* found British beacons operating much as in the U. S. and followed a beam directly to London. Arriving at Croydon Airdrome 21 hours 2 minutes from Floyd Bennett, they had averaged 175 m.p.h. through 14 hours of absolute blind flying, and an additional 3 hours of low visability flying entirely on instruments.

Returning, about the same transmission and receiving conditions prevailed except that KHMER was received spottily in the U. S. at 6:00 a.m. and between 8:00 and 10:00 a.m. EST. The pilots followed radio beacons out of Ireland, dropping British signals about 550 miles off the coast.

Flight headquarters had been established at the Waldorf-Astoria in New York where Wall Streeter, Ben Smith (who made the flight possible), Al Lodwick and Dick Stoddart sat glued to a receiver. Many messages came through clearer here than anywhere else, including the most powerful stations. Through headquarters were cleared a constant stream of messages and advice coming from big stations and amateurs on three continents. Mackay Radio, RCA Communications, Radio Marine and Coast Guard stations around the world kept a constant check on messages and strength of signals, phoning through data to the Waldorf. Occasional messages were relayed from ships at sea.

Throughout both trips, Riverhead, Chatham and Southampton stood by. Regular communication was hourly, but during its period of dead reception, KHMER signalled every fifteen minutes, and was picked up at some point on the globe. EAL stations at Newark, Washington, Miami, Atlanta and New Orleans were held open with varying success. At one time, when the *Daily Express* was over mid-Atlantic, none of the eastern stations could pick up KHMER, but New Orleans received the signals clearly. When east of mid-Atlantic, KHMER was picked up most consistently at Atlanta. Rockaway got the most powerful reception at times.

The communications industry represents one of the world's major markets, with sales totaling well over a billion dollars annually. Nearly ten thousand concerns manufacture the many types of communications equipment and accessories, while countless others are engaged in the operation and maintenance of such apparatus. That's the worldwide market served by COMMUNICATIONS — a highly profitable market responsive to intelligently directed advertising.

COVERAGE:

Engineers, executives and other personnel engaged in the design, manufacture, installation, operation, service and maintenance of radio and wire communications; broadcast stations; police, marine, aeronautical, and other point to point services; sound recording and projection; public address; television and picture transmission; and in the making of all equipment, accessories, components and instruments used in these fields.

Probably your product has its application in the communications field. Why not discuss it with us? You can be assured of an intelligent analysis of your problem.

*Advertising per proved prospect costs less in COMMUNICATIONS than in other trade journals.

MOBILE P-A REQUIREMENTS

(*Continued from page* 34)

regulation for a Class B circuit, or enough power to provide sufficient output from a Class A circuit. A few automobile installations use a gasoline-driven generator mounted in the spare-tire compartment.

Since automobile systems are the cheapest of all mobile arrangements, they are often operated by one man, in the interests of economy—that is, by the driver. The microphone is so mounted that the driver can use it without inconvenience. Hand microphones are common, but a suspension mounting above the wheel is preferable. Inasmuch as from 12 to 20 watts are emitted by loudspeakers, which cannot be located more than five or six feet distant, exceptional care must be taken to guard against acoustic feedback. The most effective precaution is, of course, the use of equipment, and particularly loudspeakers, that are really flat in their response.

Where a record player is used, it is commonly mounted or placed on the seat beside the driver who can then change records and even needles while the car is in motion, and also replace the needle in the groove if it has been jarred off by a bump in the road. There are special spring-tension pickup mountings designed to secure steady reproduction of a phonograph record in a mobile installation, but the majority of users still depend on watchfulness and careful driving.

Automobile installations are often rented for special advertising campaigns, rather than bought outright by their user. Persons engaged in the business of renting sound equipment naturally find it advantageous to use amplifiers that can, if occasion demands, be driven by line a-c instead of 6 volts d-c.

THE TRUCK JOB

Truck installations are essentially overgrown automobile installations with several notable differences in detail. A truck loudspeaker system may combine projector baffles with flat baffles—for the latter, the speakers are mounted directly upon the body of the truck, and the sides of the truck then serve as the baffle. Speakers are often so mounted that some or all of them are readily removed, and set up on floor stands at a convenient distance.

Truck power output may run from 20 to 100 watts. Up to 30 watts can be obtained by using the truck storage bat-

(*Continued on page* 66)

MOBILE P-A REQUIREMENTS

(*Continued from page 65*)

tery to drive a rotary converter, as in the common automobile p-a set. For greater audio power, two 30-watt amplifiers of the same type may be used in parallel, an extra storage battery being carried as a parallel or a substitute source.

For high-power truck work, however, the gasoline-driven generator is favored. Where it is used, there is no need to advance the generator of the truck to a higher charging rate, no need for charging the spare battery, and consequently no worry about batteries running down. At 30 watts output, the battery and rotary converter constitute the most economical method of power supply; at 60 watts output, the gasoline-driven generator is perhaps equally desirable; above 60 watts, the gasoline generator is undoubtedly to be preferred.

Truck equipment must be able to withstand even rougher handling than car equipment, since truck springs are seldom as good as automobile springs. The truck, however, commonly carries two men—driver and sound operator—and is less exacting with regard to input sources. A hand microphone is commonly supplied for the operator, and supplemented by floor-stand microphones that are carried to the tail of the truck, or to a speakers' stand or platform, as occasion requires. The record player is sometimes spring-mounted, but in spite of such precautions the needle usually requires watching as long as the truck is in motion.

SEA-GOING AND AIRCRAFT INSTALLATIONS

The motorboat system is essentially a truck system. The fact that sound is projected over water results in two surprising complications. Reverberation from water is so great that much less output is needed than might be supposed to cover a given distance and area. A 20-watt system operating offshore may deliver ample volume to a beach half a mile away. But the water also has the effect of encouraging acoustic feedback. It is a convenience, wherever possible, to use the microphone in a relatively sound-proof cabin. The same cabin cannot, of course, contain either the boat motor or the motor of the gasoline generator that supplies sound power.

Motorboat systems in general favor the use of a generator rather than a storage battery, since facilities for recharging are seldom easily available.

Inland systems working on smooth water need no special physical precautions, but small boats operating on a large lake or river, and large boats working in the open ocean are more heavily handicapped than a truck on a rough road. A separate operator may be needed to give exclusive attention to the record player, and may have to keep his hand on the reproducer continuously in even a relatively mild sea.

Airplane systems need high power. They work, generally, from heights of not less than a thousand feet; their output must compete with the drone of motors and propellers; they are used only to secure coverage over large areas, and they receive very little help from reverberation, most of their output being lost in the upper air. One hundred watts represents perhaps the absolute minimum of power that is of any use in an airplane system. Baffles must be of a directional type, pointing downward—multiple projectors that spray the ground with a cone of sound are usually preferred.

The operating power needed is seldom less than half a kilowatt—often twice as much—hence the gasoline generator is favored as weighing less than any bank of storage batteries that could be counted on to provide continuous service during the average flight. The generator also avoids the inconvenience of pulling out the storage batteries and substituting a new set each time the plane comes to earth.

The microphone is of an extreme close-talking type; planes with sound-proof cabins are not often used for p-a work and no other type of microphone would offer reasonable immunity to the sound of the propellers, motors and gasoline generator. Rough air requires even sturdier equipment, and even closer attention to the phonograph needle, than is needed in a truck or motorboat.

In all four applications—cars, trucks, boats and planes—mobile equipment is largely rented rather than bought outright. In such cases it is difficult to overstress the advantage of choosing apparatus that can also be used for other purposes. A rental amplifier designed for 6-volt operation should always be convertible to a-c power supply. In all small and medium-power systems permanent-magnet speakers may be preferred, not only as easily convertible to other services, but also because they impose no additional drain on the mobile power source. Convertible phono equipment is commonly available; a 6-volt universal motor is driven directly by the storage battery or through a step-down transformer when the power is a-c.

Mobile equipment should always be over-powered. It must encounter highly changeable conditions of background noise and of sound reflection

(*Continued on page 68*)

MOBILE P-A REQUIREMENTS

(*Continued from page* 66)

or absorption. It is planned to cover the desired area or audience under the least favorable circumstances; under other conditions it will be found to possess fifty or seventy-five percent more power than is actually needed at the moment. However, the use of unnecessarily high volume must always be avoided as it provokes unfavorable public reaction which has already led, in a number of communities, to drastic police regulation.

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DISC RECORDING

(*Continued from page* 12)

sicians and relatively dead surroundings for the listener.

Summarizing the above factors, we find that the studio must have an amount of reverberation suitable to simulate conditions expected to surround the entertainment produced and to permit proper creation of music, and it must contain a zone sufficiently dead to compensate for the added liveness of monaural pickup. The accomplishment of these requirements is related to studio design by a determination of the size, shape, reverberation, and distribution of absorbing materials.

Ideally, the size of a studio should be determined by the character of program which will customarily be produced. For music there is a relationship between the number of musicians and the size of the enclosure which, within limits, should be adhered to for best results.

The feeling that a certain size of room should be associated with a certain type of music may be partly due to our being accustomed to hearing orchestras in halls whose size bears a certain relationship to the number of instruments, but it seems that a more important cause may lie in what is termed "space effect," which may represent audible perspective to the ear as "depth" in a picture represents perspective to the eye. Thus, direct sound from the source reaches the ear surrounded by general reflections or reverberation of a character influenced by the nature of the surrounding room. Lack of this effect largely destroys the apparent ability to visualize an orchestra, the component parts of which are separated in space, and thus the size of the orchestra is materially under-estimated, since only individual parts of the music may be heard, with diminished sense of a number of instruments playing each part. The space effect may be destroyed by lack of sufficient reverberation, by improper frequency characteristic, by the wrong mode of decay and even in proper surroundings by improper pickup. Even if the pickup is flawless, the tone mixture from several instruments playing the same note may convey only a partial impression of the number of instruments.

As the number of instruments tends to exceed the expressed limiting numbers for a given size of studio, the impression of added orchestral size is not proportional. Where the number of instruments is less than the specified limit for the studio, it is possible with proper pickup to give the effects of numbers in excess of those actually employed.[1] In considering the economics of building a large studio, consideration should be given to this factor.

The shape of a studio is important in obtaining best results. References to ideal shapes have been made with such frequency as to preclude references to many sources. However, certain ratios of length, width and height with respect to volume have been found to yield most desirable results (see Fig. 1, which is reproduced from Messrs. Stanton and Schmid's paper referred to previously). Increases in length beyond these ratios complicate the arrangement of performers and the securing of a satisfactory pickup. Widths in excess of these ratios may somewhat complicate pickup and generally result in a reduced space effect of the room. The heights shown with respect to length and width represent reasonable minimums for each condition, since as a practical matter it is desirable to reduce the required height. Certain unusual shapes of studios have been proposed in which directional effects of inclined or curved walls are employed or in which irregular wall surfaces are used. The desirability of the former appears questionable except for very unusual conditions. The desirability of the latter is unquestioned and has for some time been a feature of the best studio practice.

With the size and shape of the studio fixed, the degree and amount of reverberation is the next consideration.[2] Fig. 2, which is reproduced from the paper by D. P. Loye, just cited, shows a relation between optimum-reverberation time and volume, based on a large amount of experience. These values were determined under conditions approximating those most desirable; that is, relatively live surfaces surrounding the music with the microphone located in a relatively dead region. All of these values refer to time of reverberation in seconds at 512 cycles.

It is of equal if not greater importance that the relative amounts of reverberation for the different frequencies

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be properly balanced. If this reverberation be such that sounds of equal loudness at the different frequencies decay to the threshold in equal times,[3] a condition satisfying a theoretical requirement for ideal balance is reached. In small studios, consideration must also be given to the phenomenon of air resonance. In the small studio, the frequencies of maximum resonant response are in the register of the bass instruments. It is not improbable, and some experience seems to indicate, that in addition to the actual prolongation of reverberation time at these resonant frequencies, there is sufficient reaction at the source to cause an increased energy radiation at this frequency. In determining the absorption characteristic of materials to be employed in a small studio, careful consideration should be given to compensating so far as practicable for the resonance effect. Also, a tendency to over-bass may make desirable a further reduction in the actual reverberation time at low frequencies. It is, of course, assumed that the construction of the floors, walls, and ceilings is such as to avoid sharp resonance in these structures.

With the amount of absorption at the various frequencies pre-determined by the selected reverberation time and characteristic, it is necessary to consider the distribution to be made of the absorption. The shape and size of the studio, together with the necessity for correct liveness for the production of music and the minimum interference at the point of pickup, will determine this distribution. Allowance should be made for the acoustic absorption presented by the musicians or performers in the location which they occupy. The remainder of the absorption is customarily located upon walls, ceilings and to some extent on the floors. Obviously, the absorbing areas must be of sufficient size to accommodate the requisite amount of absorption to give the desired reverberation period, and be distributed about the studio so as to provide an unbalance of liveness between the performance and pickup ends of the studio.

The desired absorption coefficient is best determined after the location of treatment is decided. With the areas to be made absorbent and the total amounts of absorption known, the necessary coefficient for each frequency is determined. The departure from the exact areas considered desirable for treatment is determined by the degree of agreement obtainable between the coefficient of a suitable material, and the ideal coefficient. The departure of the actual from the desired coefficients will require further re-balance between desired reverberation time and desired areas to be treated.

As the foregoing summary indicates, the successful acoustic treatment of studios involves the coordination of many factors and the application of a large amount of experience, and is therefore a highly-specialized function which should be referred to a responsible group of acoustic consultants familiar with this class of work.

In recording orchestral music it is desirable, wherever possible, to use one microphone at a time rather than two or more connected through a mixer to the recording channel. By suitable placement of the microphone a desirable balance can be attained between the various instruments of the orchestra. Those instruments that should be most prominent should, of course, usually be the closest to the microphone. This applies also when a soloist and chorus are present as well as an orchestra. When the orchestra is used for accompaniment, the soloist is usually placed nearest the microphone, the chorus next, and the orchestra somewhat farther back. Acoustic-perspective control can be achieved to some extent by adjusting the relative distances from the microphone of the soloist, chorus, and orchestra. The use of a single microphone probably represents the most natural arrangement, the microphone taking the place of the listener. When sufficient time is not permitted for rehearsals and adjustments, auxiliary control methods may be used, which involve the use of more than one microphone. However, although the use of more than one microphone introduces many complications, the necessary conditions which must be fulfilled in order to obtain satisfactory results with two microphones, have been elucidated by D. P. Loye.[4] Among the outstanding features established by Mr. Loye's work, is the very marked interference effect produced when the two microphones are rather close together and near the source of sound. This leads to the conclusion that the difference in distance between each microphone and the sound source should be at least ten feet, that they should not be too close to the source, and that the sound volumes picked up by them should be adjusted to differ as widely as practicable.

[3] "Acoustics of Broadcasting and Recording Studios" by G. T. Stanton and F. C. Schmid, *Journal of the Acoustical Society of America*, July, 1932.

[4] "Acoustic Considerations in the Construction and use of Sound Stages" by D. P. Loye, *Journal of the Society of Motion Picture Engineers*, September, 1936.

[5] "Optimum Reverberation Time for Auditoriums" by W. A. MacNair, *Journal of the Acoustical Society of America*, January, 1930. (Part 1.)

[6] "Acoustic Considerations in the Construction and Use of Sound Stages" by D. P. Loye, *Journal of the Society of Motion Picture Engineers*, Vol. XXVII, No. 3, 1936.

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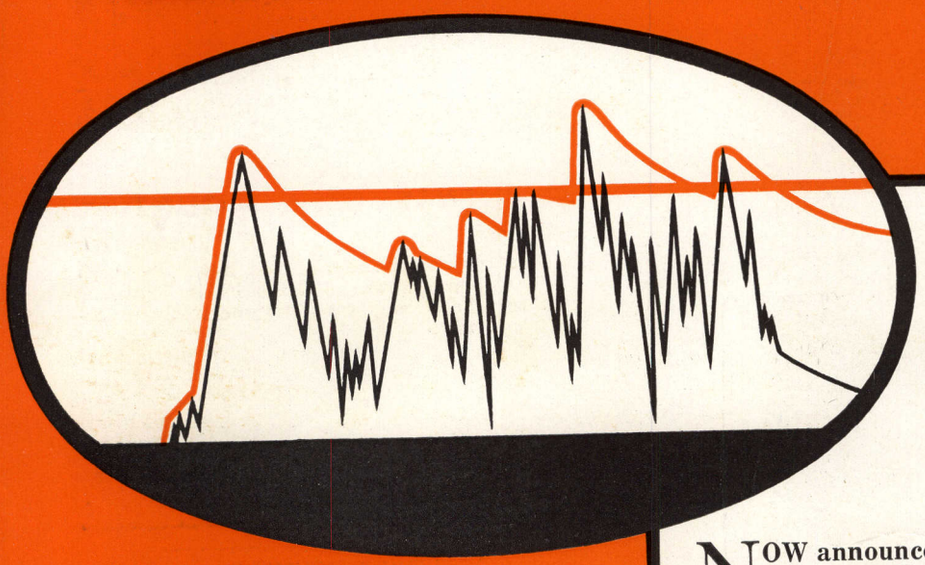

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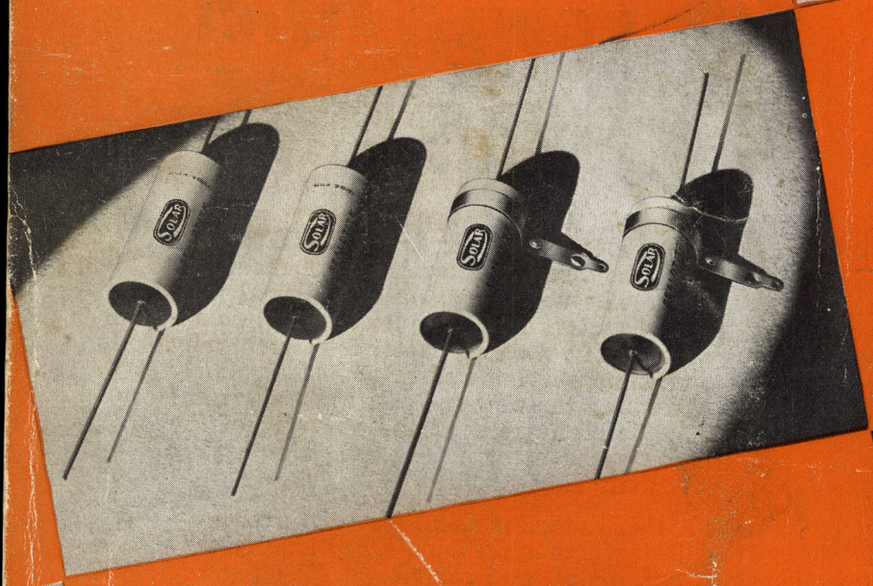

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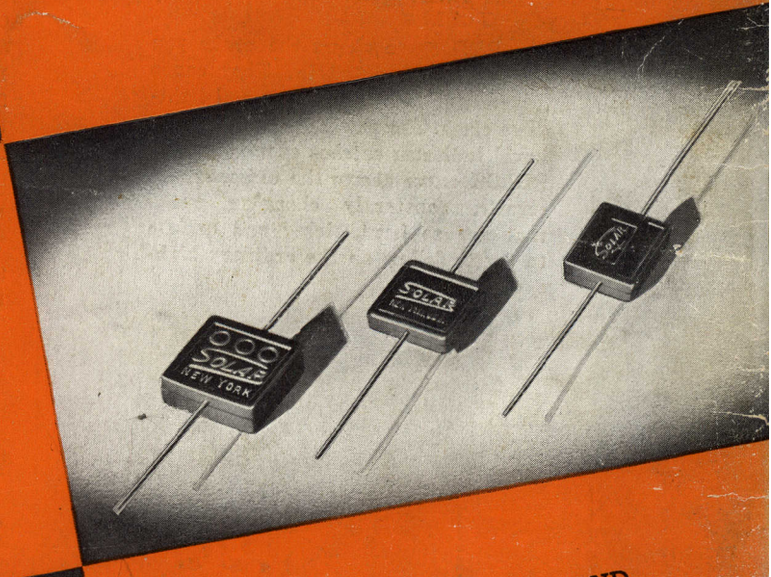

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