RADIO NEWS

JANUARY
1946
35c
In Canada 40c

Broadcasting from an army plane high in the clouds, this field engineer is part of the vast crew which brought America "on the spot" reports during the war.

FROM STUDIO TO MASTER CONTROL

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The versatile technical skill, speed, and cooperation required of all broadcast engineers has made possible the development of present-day commercial broadcasting.

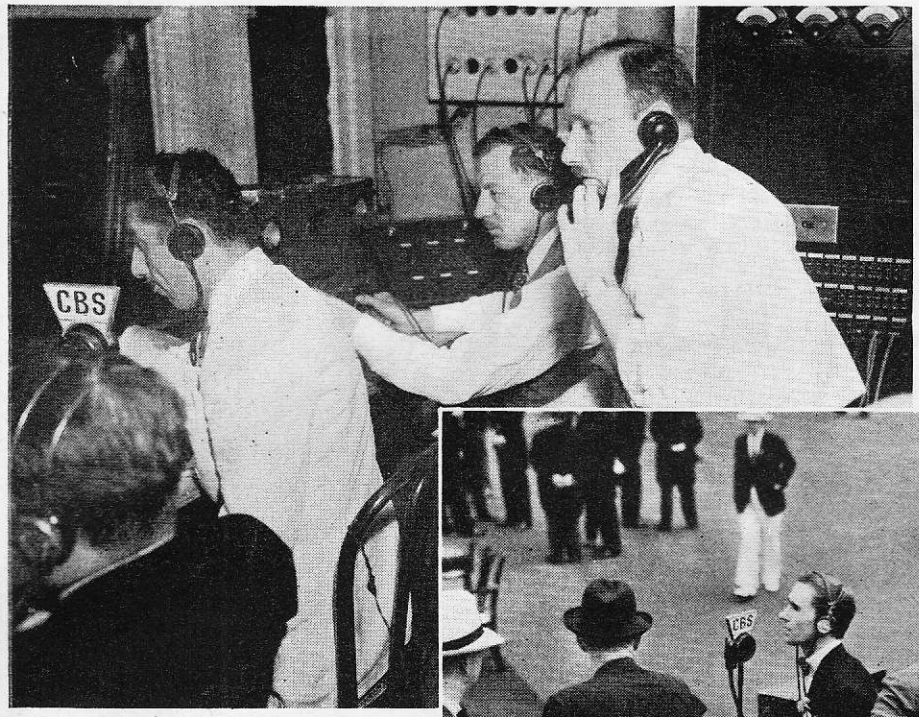
THE broadcast engineer of today is the product of long years of self application and patience expended in the crude workshop, attic-hamshack, and basement laboratory of a decade or so ago. He is the result of unselfish devotion to a progressive science which will undoubtedly advance humankind far beyond any conception we may hold on the subject today.

Within the past quarter of a century we have seen the broadcasting industry grow from a relatively obscure position into the vast, complex organization it now represents. It is, therefore, only natural that the men who are most intimately associated with this industry, the broadcast engineers, grow in like manner, developing the skillful efficiency, decisiveness, and rapid co-ordination so characteristic of today's engineers.

Although this varies for certain sections of the country, not a large number of technical broadcast personnel possess an accredited college engineering degree. A greater majority have, at one time or another, pursued similar, though not equivalent, courses in specialized radio home study correspondence courses. In addition to the basic requisite, a radiotelephone first class ticket, many men have radiotelegraph licenses by virtue of their past experience.

Complementing a good theoretical background, most engineers have between five and ten years of practical work in kindred fields such as telephone long-lines operation, radio servicing, and amplifier design, to mention a few. It is also interesting to note that over ninety per-cent of them were at one time quite active in radio amateur circles. Fully one-half of today's broadcast engineers continue to design, build, and service equipment as an avocation to their regular daily work.

Modern broadcasting demands of its practitioners not only a comprehensive electronic background but also a good practical operational ability in utilizing the various pieces of equipment from studio transcription turntable and microphone to transmitter and transmitting antenna. A broadcast engineer may be called upon one day to operate a fast, tricky record show while the very next day may find him at some remote point setting up microphones, amplifiers, and such equipment as is necessary for field operations. At still other times he may be assigned to operate the master control board or work at the station's transmitter.



Equipment for a remote broadcast depends upon the program to be aired. Here the field engineers are seen using the "fixed location" equipment to bring the radio audience an important event.

Given less than an hour's notice, the field engineer can assemble, transport, and set up his equipment so that he is ready to go "on the air" with an eyewitness account of news in the making.

No technical limits can be placed on the varied duties an engineer may be called upon to perform. This fact becomes even more apparent during an emergency, which, by the way, always manages to arise at the most inopportune time. However, it is a rule of the larger companies to adhere to more or less a fixed schedule of technical operations, instead of a daily or weekly shifting of personnel. In this manner the various engineers are assigned to certain definite groups such as *studio, field, master control, maintenance, or transmitter*. Years of experience have proved that this procedure not only makes for ease and familiarity of assignments but also has the more pertinent benefit of reducing operating errors to a minimum.

Whether transcriptions or live talent is used, studio operations, with various programs, constitute the nucleus of broadcasting. This is the center of gravity around which all other departments revolve, each contributing their combined efforts to fulfill whatever requirements the public or commercial advertiser may demand. Studio operations embrace a wide variety of programming. Basically, however, a radio show is dramatic in either style or music and it may even combine the characteristics of both, as most programs do.

Although the acoustical properties of the studio greatly affect the quality of speech or music, their natural reproduction depends on the type of microphone used and its placement with regard to the source of sound. Invariably it is the studio engineer who determines the type, number, and placement of these. It is, therefore, his duty to combine in a harmonious balance, with regard to intensity and quality, the various sounds picked up by the studio microphones.

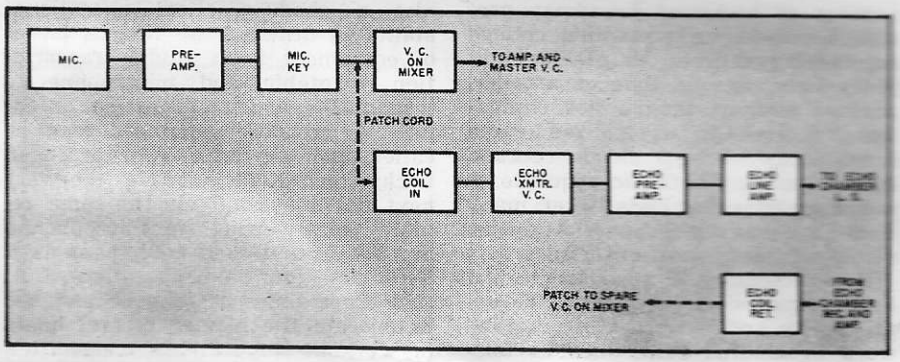
A good musical balance between instruments comprising a modern dance orchestra is at times a difficult thing to achieve, especially in view of the fact that most of today's band leaders were once musicians themselves and naturally tend to favor certain types of musical instruments.

In many instances this over-emphasis of a certain orchestral section over others is actually what is sought for and this must always be kept in mind by the engineer at the mixer (Fig. 3). It is an interesting study in contrasts that whereas a dance orchestra requires from two to four microphones for sectional pick-up, a symphonic group may use but one for complete coverage.

The wide popularity that certain dramatic shows enjoy depends a great deal on their liberal application of unusual sound and vocal effects. In this regard the engineer works in close accord with the sound effects man to produce anything from a voice in the spirit world to the shattering roar of a prehistoric monster.

At some portion of the program, the script may call for a reverberant vocal effect. As seen in Fig. 1, the equipment necessary to produce this is rather simple, consisting of a loudspeaker mounted at one end of a low, long hallway, at the other end of which a microphone is placed. A noticeable echo effect is obtained depending upon the distance between the two. However, the degree of echo is controlled by the engineer through

Fig. 1. Block diagram of a typical broadcast studio echo set-up.

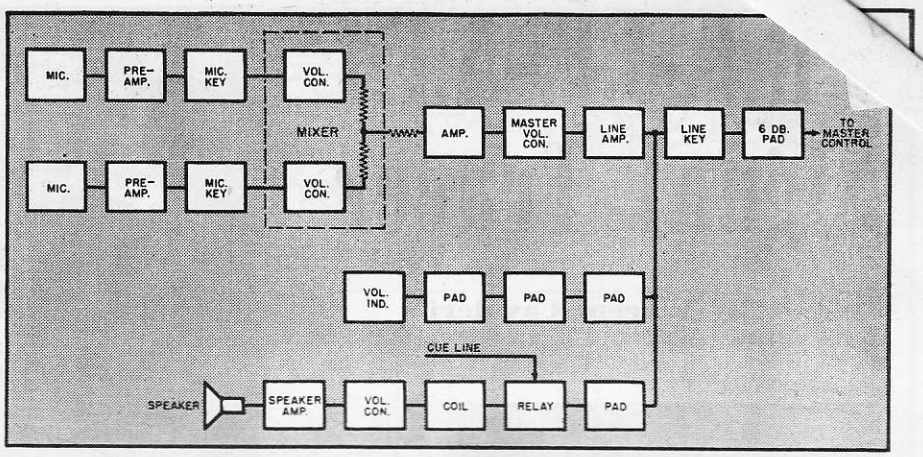


the use of attenuators located on both echo transmitting and receiving lines, the latter of which naturally terminates in the studio control booth. Where space is at a minimum, effects such as these may even be accomplished electronically by means of time delay circuits operating inside a small box-like affair.

Variable filter networks designed to cut off various frequencies within the audio range are also mounted within easy reach and their frequent use is a daily occurrence. Combinations of both filter and echo result in extraordinary effects, dear to the hearts of program directors.

Another quite important phase of broadcast operations, in so far as most of the smaller stations are concerned, is the work of the turntable operator. It is not at all unusual in his type of work to fade in and fade out portions of dissimilar recordings while closely following an announcer's cues. He must also change turntable speeds and switch in the correct amount of filter to accommodate the wide variety of transcriptions in use at the time. During these octopian-like motions a normal level must somehow be maintained on the line going to master control.

Most people when listening to recorded music, especially of the symphonic and operatic type, have the erroneous impression that an entire selection is contained on but one recording. In some instances this might be so, but in most cases the very ordinary type of album transcription is used. In playing these for broadcast purposes an engineer plays them in their true consecutive order using two or three transcription turntables during the process. By switching from one to the other, the listener is given an impression of orderly symphonic sequence just as if he were attending the concert in person.



Block diagram of broadcast studio microphone sequence.

Exclusive of playhouse programs, *spot-broadcast, remotes, nemos* are all similar terms associated with the field department of technical operations and serve to signify any broadcasting done some distance away from the station's master control. These distances may vary from a few city blocks, for a local night club pick-up, to a few hundred or even a thousand miles or more. In the latter case, however, the network facilities and station affiliates of the larger companies are advantageously utilized.

In a non-technical sense hundreds of radio listeners are all too familiar with field broadcasts of important political and military personalities, movie stars and business executives, made from country air fields, ocean going liners, and modern banquet halls. Yet, very few of them realize the enormous amount of labor, speed, and co-operation which these programs entail. Field engineers will sometimes be given less than an hour to assemble, transport, and set up their equipment; not to mention the fact that each piece of apparatus must be thoroughly checked before going on the air. Small wonder, therefore, that this type of work attracts the more adventurous engineer, the chap who craves excitement and always manages to get it, whether he's riding gain at a thrilling college football game or keeping a sharp eye on the plate meter while hurtling through the clouds at four hundred miles-per-hour.

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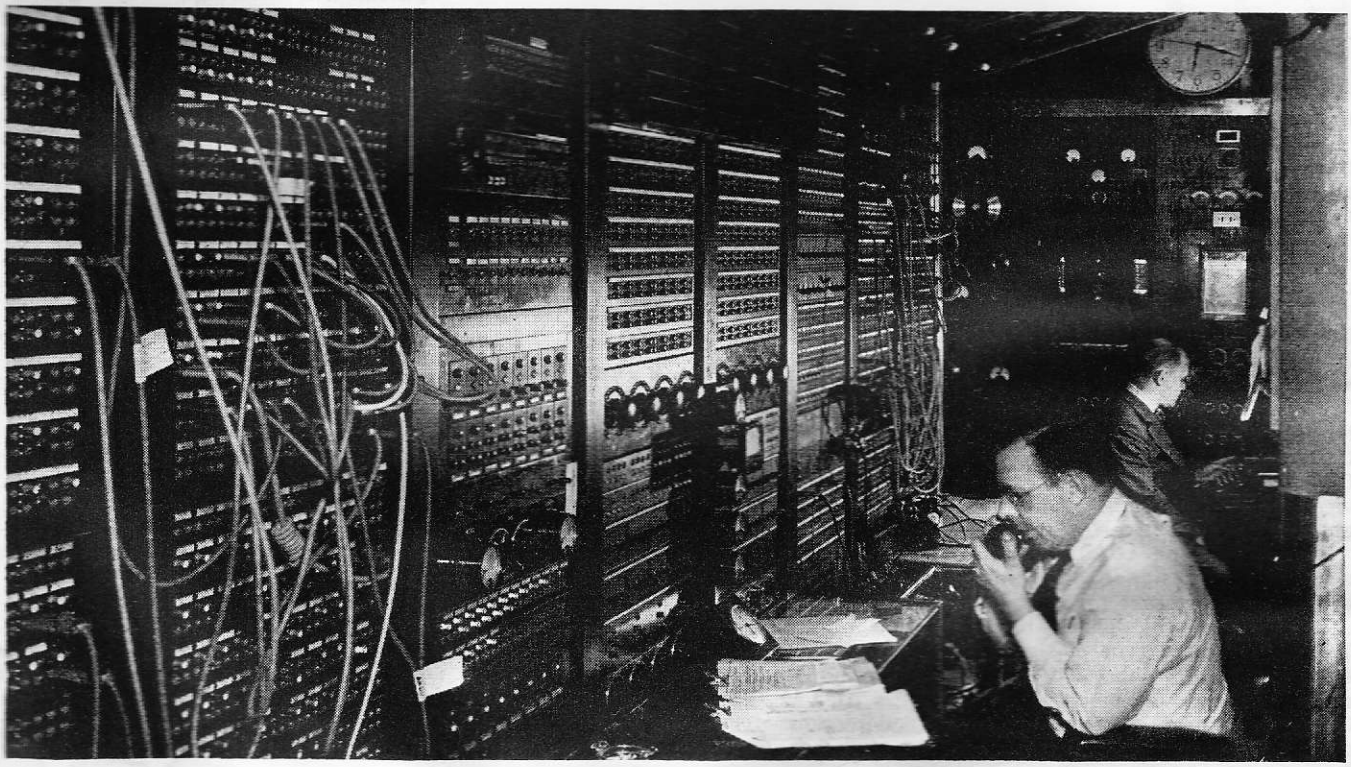
Operator at work on the central master control board of a major network. Here incoming programs are integrated, checked, and channelled off into lines feeding transmitters, small master controls of outlying stations, and various recording companies.



fed through a coaxial cable to the receiver input connector, where it is coupled to a crystal detector. In the crystal detector stage the r.f. signal is beat against an oscillator frequency from an oscillator which is 16 mc. lower or higher than the received signal. The resulting 16-mc. intermediate frequency from the crystal detector is then fed through seven stages of i.f. amplication. The output of the seventh i.f. stage is then coupled to the detector. The positive-going output pulses from the cathode of the detector are fed through three cascade two-stage pulse limiters. These limiter stages function to remove noise and other objectionable amplitude-modulated signals, resulting in a signal of constant amplitude. The limited pulses are then fed through a coupling stage and pulse output stage to the receiving multiplex. The alarm control stage is biased past cut-off by the video pulses, causing an alarm relay to be de-energized and alarm buzzer to remain inoperative. Loss of signal causes the alarm buzzer to sound. A rectifier tube provides +270 volts and —10 volts d.c. for operation of the receiver circuits.

Well, there are the new sets. But what advantages do they offer? Here is the Signal Corps' answer:

1. The same facilities as wire circuits, with the same or better quality.
2. Reduction of installation time from weeks or months to hours or days.
3. Reduction in weight and volume of equipment, for example, from 94,000 pounds to 17,000 pounds for a 100-mile system, 2700 cu. ft. to 700 cu. ft.
4. Reduction of repeater stations in some cases from four to one every 100 miles.
5. Reduction of sabotage in hostile territory — improvement of military security.

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Studio to Master Control

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Equipment for a remote broadcast depends on the size and nature of program to be aired, area of operations, and, what is most important, whether or not the actual broadcasting will be done from a fixed location or while in transit.

Special type microphones of rugged construction are used in conjunction with battery powered amplifiers exclusively designed for field operations. In addition to this standardized sequence, a five minute transit nemo may require the use of a compact high quality short-wave transmitter, communications type receiver, impedance matching units, headphones, spare tubes, batteries, and necessary maintenance equipment.

In spite of all precautions taken to insure continuous operation of remote equipment, it is, however, an unwritten law amongst broadcasters to route any and all remote shows through a stand-by studio nearest the point of origination. Then in the event of trouble, the stand-by studio fills with appropriate music until normal transmission can once again be established with the remote point.

Field engineers have broadcast from swift bombers high in the clouds, from spray-swept decks of speeding PT craft, and lately one intrepid para-trooper covered his own descent using light weight para-talkie gear!

The war has already given birth to a new species of engineer, namely, the communications-correspondent. Men such as these have risked their lives to make recordings of actual V bomb attacks, spot-broadcast real battle engagements, and hit the beach with the first wave, armed only with tape recorder and microphone.

True to his creed, "Whatever it is, wherever it is, we'll air it," the field engineer assuredly occupies an extremely important role in introducing the vast, invisible radio audience to circumstances and events closely affecting their future and destiny.

In broadcasting, as well as associated industries, probably the least romantic yet vitally important job is that of maintenance engineer. Upon his tolerant shoulders rests the sole responsibility of servicing, checking, and maintaining a wide variety of complicated broadcast equipment.

For him the day may begin with the delicate job of replacing a new ribbon

in a ribbon-type microphone. Perhaps an hour or two later master control may call on the emergency phone. Within a few seconds the maintenance engineer, tool bag streaming behind, is whizzing down the hallway anxious to knock some sense into a few stubborn relays. The close of day may find him busily engaged taking noise and distortion measurements on some newly purchased monitor amplifiers.

With the exception of maintenance, very few engineers, even those of many years seniority, are entirely familiar with the back of an ordinary studio control room rack. There, between jack field and terminal block, in an intricate pattern of colored wire run innumerable connections linking microphone to pre-amp, pre-amp to mike key, and so on until the final termination line to MC is reached. As if to make the job-repair more difficult, fixed pads, attenuators, and bridging coils appear at most unexpected places. It is, therefore, no wonder that the indefatigable maintenance man sometimes breathes a prayer of gratitude to the gods of like impedances.

Aside from being on emergency duty twenty-four hours a day, maintenance engineers adhere to a fixed schedule of procedure which includes a systematic check on all technical facilities essential to operations. On the so-called dog watch, which occupies the late evening and early morning hours, complete audio quality and continuity checks are given to both studios and master control. Maximum efficiency is thereby achieved during the following day's operations.

Psychologists have proved that men who like to know how, why, and wherefore, usually are the best mechanics in any technical field. Such persons are alive with the desire to comprehend and, if possible, to improve the object of their interests. However, some engineers who seek to augment a decided theoretical background with additional practical experience at times request a transfer to the maintenance division. In certain cases at least two years experience in this field is a must even before considering an applicant for employment.

Master Control in the neophyte engineer's eyes is the Valhalla of the elite, the dwelling place of absolute personal efficiency, integrity, and knowledge. Actually, this seeming image of perfection is the result of close co-operation, double checking and minute observance to even the slightest details.

The human brain with its complex pattern of nerves has often been compared with the central master control of a major network. Programs coming in from many sources are here integrated, checked, and channelled off into lines feeding transmitter, smaller master controls of outlying stations, recording companies, and other portions of the system's vast network.

Discounting feeds for recording purposes, sometimes as many as six different air programs will be passing

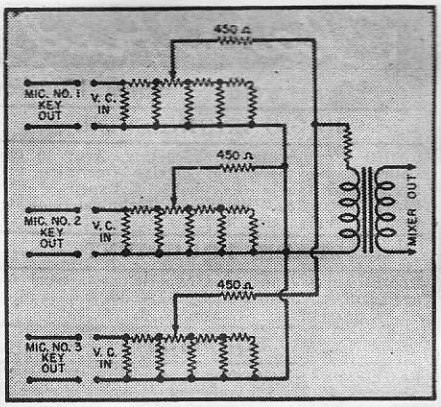

Fig. 3. Ladder type mixer.

through the hands of the MC operator, to points both near and far. It is easy to understand, therefore, that large sums of money are involved and the slightest error on the part of the man at the operating board can easily disrupt the entire nationwide network.

Line failures, the bugaboo of early broadcasting, are today quickly isolated and tracked down by telephone company and MC engineers working together. Should any piece of MC equipment fail or go bad while on the air, it must immediately be patched out manually and an emergency piece substituted instead; for time is money and any time lost is money lost, not to say anything of operating prestige involved.

To sustain uniform transmission and, at the same time, uncover any losses on incoming as well as outgoing lines, a close check is kept on the standard level of +8 VU. Programs are also monitored for line noises, distortion, and hum. Should these occur they are included in the daily operational report together with any technical errors or operational difficulties.

Audio frequency runs covering the range from 30 c.p.s. to 10,000 c.p.s. are given to both emergency and regular transmitter lines by the night crew. Application of this procedure is also observed on both remote and recording lines.

Practically every switching action performed on the MC board is preconceived, not only in the light of what is supposed to happen when a certain relay is actuated but also what should be done in case this relay fails to operate. On more complex switchovers, the case of the relay not operating is just a minor consideration to be taken into account.

Ramifications such as these are the MC engineer's daily subsistence. In time he even develops an uncanny ability to see the major portions of the entire network operating with a machine-like precision.

For a likely impression of master control in operation, imagine for a moment five good sized loudspeakers mounted overhead with each one of them carrying a different program. At once the shrieking of a soprano somewhere on the west coast will

seemingly contest with the dull thud-thud-thud of a hot New York jive band. From another source may come bursts of staccato laughter interspersed with loud hand clapping in the vicinity of +20 VU or thereabouts. By now the symphonic show is going full blast with one of Beethoven's protestations against life while the dull orator from studio X drones on and on.

In between the telephone jangles discordantly demanding your attention, advice, and good humor; if there is any left by now. All in all though the MC engineer learns to take these things in his stride, maintaining however a quality of vigilance and almost instantaneous reaction in case something should go amiss.

After a somewhat strenuous 8 hour day, one would naturally expect the MC engineer to be relaxing on the porch with the evening newspaper. Instead he is more likely to be found puttering around the basement, putting the final touches on the new amplifier which he swears is flat ±1 db. from 10 to 18,000 c.p.s.

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Radio Operated Airplane

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remote-control box on the ground and are employed in guiding the plane, which was used during the war as a flying target for antiaircraft gunners. The fifth radio frequency holds the parachute in its true position for an ultimate landing of the plane. This fifth frequency is automatically in operating position while the other four frequencies are being used. When the pilotless flight is terminated, a switch at the control box on the ground cuts off the audio-frequency tones and thus releases the trapdoor of the parachute, also stopping the engine.

The launching catapult of this dwarfed airplane functions on the principle of a slingshot. It is composed of a metal-tubed length with top rails, and a group of helical springs. As the miniature airplane departs from the firing end of the catapult, the assembly is arrested by a snubber shock cable and the target plane continues its flight into the air. The 8-horsepower engine generates a staccato noise which is said to blanket the semi-tropical, jungle-like countryside of that vicinity of Florida.

The seven-man ground crew of Lieutenant Eugene M. Applebaugh hide their time as the lieutenant, beside the mobile radio-controlled apparatus on a three-quarter-ton Army truck, maneuvers by radio the catapulted craft into a steep climb and short bank. Only a stone's throw away are teams of anti-aircraft gunners practicing a simulated defense (even in peacetime) against the pseudo-marauder in the threat of this radio-guided airplane target.

The helmeted crews, with quick pre-