

How Broadcast Programs

Careful Study and Painsstaking Operators "Behind the Scenes"

By G. C.



THE general conception of the method of broadcasting a program, entertained by the average listener, is that a microphone is placed before a performer and somehow or other the music goes out on the air from the transmitting antenna and is received by his set. The intermediate steps through which the electrical energy goes, between the time the artist performs before the microphone and the time the signal reaches the transmitting antenna, are varied and interesting, though not popularly understood.

It is common knowledge, of course, that during these steps the energy is magnified to an enormous extent, but that is not the entire story by any means. Let us consider the various processes which must be gone through between the time it is decided to

broadcast a program and that when the transmitting antenna is energized.

ARRANGING THE PICK-UP

As an example, let us trace the operations necessary for the broadcasting of orchestral music from a night club in New York City over WEAf and its chain of stations, the Red Network. First of all, an engineer must install the microphones (two of which are used in an ordinary orchestral broadcast) in such a way that every instrument in the ensemble will be picked up with the proper volume. This placement is very important; for if the microphones are placed so that the saxophones are too close to them, for instance, then the music from these instruments may drown out that of the violins.

The quality of the music is, of course, affected by the surroundings. In some cases it becomes necessary to "dampen" the hall by hanging draperies about to cut down the echo. In other cases no hangings are required; for a certain amount of echo is needed to give naturalness to the music. In the case of a large orchestra there must be in the music "brilliance," provided by the string instruments, and the microphones must be so placed that these high tones are not impeded in any way.

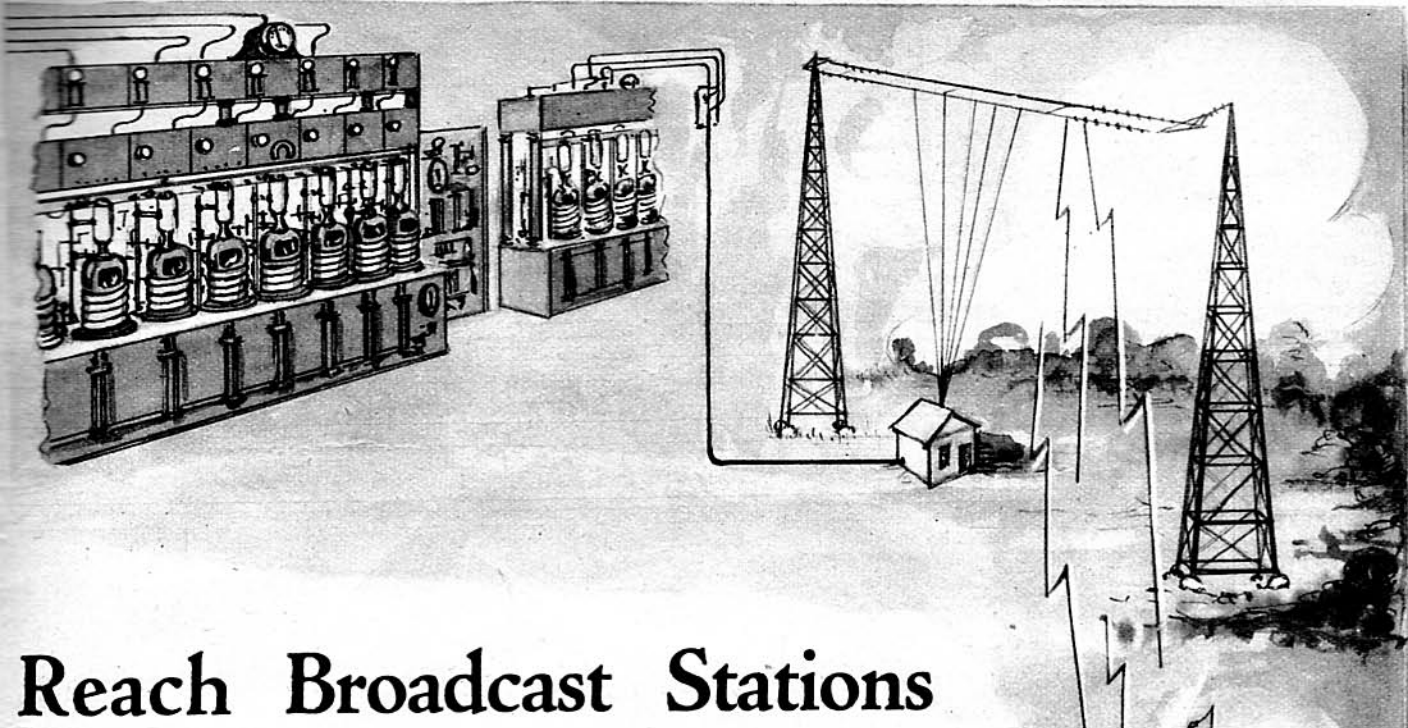
When the proper position for the microphones has been found the amplifier and the microphone mixer are placed so that their operator will have an unobstructed view of the orchestra leader.

TESTING THE LINES

Then the telephone lines from the night club to the National Broadcasting Company's building at 711 Fifth Avenue are tested to see that they will carry the entire range of frequencies required in the proposed transmission. This test is not made with music or by ear, because of the deceptive variation of human hearing. Different

Below, the scene of "remote control"—a night club in New York. Follow the pictures around.





Reach Broadcast Stations

Attention Required of Unheard
From Studio to Transmitter

B. Rowe

notes are introduced into the lines by an oscillator, giving a range of frequencies covered by an average orchestra's program; these frequencies are measured by a meter. These tests show also whether the lines will carry the necessary frequencies at equal volume; which is an important point for the same reasons as those given above for the proper placing of the microphone.

In the microphone mixing panel the proper proportioning of the frequencies is made for the particular "set-up." The amplifier, which is connected with the mixing panel, is used to "boost" the output of the microphone, so that there is a high ratio between the volume of the music and the noises on the telephone lines. On the output side of this amplifier is a galvanometer, which functions as a volume indicator, and it is at this point that programs can be made or marred.

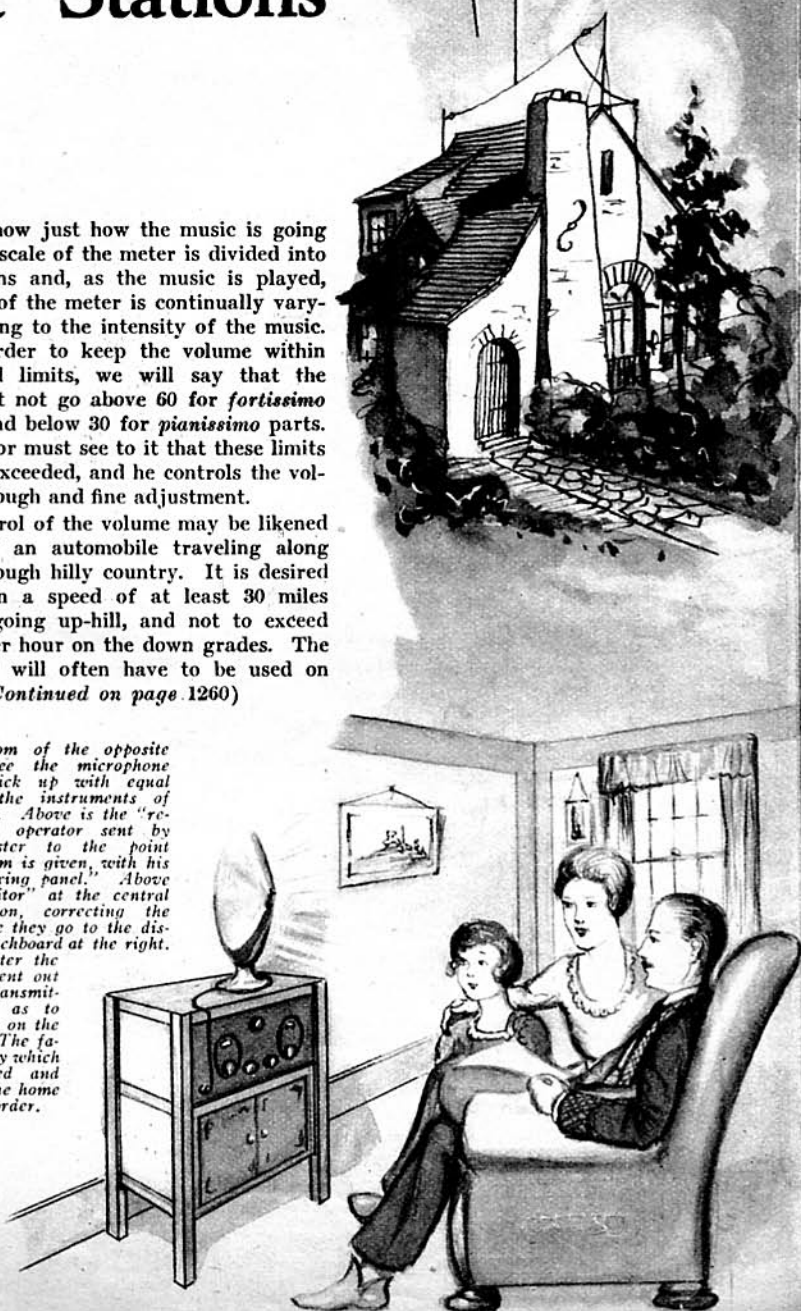
To make this point clear, it is necessary to digress for a moment. It has doubtless been the experience of the reader, when listening to a large orchestra, to have certain passages that are played *fortissimo* ring in his ears. On the other hand, some portions of the same selection were played so softly that it was almost impossible to hear them at all. In other words, there is a ratio between *fortissimo* and *pianissimo* of approximately fifty to one: that is, the loud parts are approximately fifty times louder than the soft parts. (This ratio, of course, varies with every selection played.) When music is broadcast this ratio must be greatly reduced; as the average receiving set has a ratio of selective audio reproduction amounting to only six or eight to one. This means that, if the volume of the music at the place of pick-up were undiminished, it would blast at the loud speaker and be greatly distorted.

meter to show just how the music is going over. The scale of the meter is divided into 100 divisions and, as the music is played, the needle of the meter is continually varying according to the intensity of the music. Now, in order to keep the volume within the desired limits, we will say that the needle must not go above 60 for *fortissimo* passages and below 30 for *pianissimo* parts. The operator must see to it that these limits are never exceeded, and he controls the volume by a rough and fine adjustment.

The control of the volume may be likened to that of an automobile traveling along a road through hilly country. It is desired to maintain a speed of at least 30 miles per hour going up-hill, and not to exceed 60 miles per hour on the down grades. The accelerator will often have to be used on

(Continued on page 1260)

At the bottom of the opposite page, we see the microphone placed to pick up with equal fidelity all the instruments of the orchestra. Above is the "remote-control" operator sent by the broadcaster to the point where program is given, with his portable "mixing panel." Above is the "monitor" at the central control station, correcting the signals before they go to the distributing switchboard at the right. From the latter the program is sent out to the local transmitter, as well as to other stations on the same chain. The familiar steps by which it is radiated and received in the home follow in order.



CONTROLLING THE VOLUME

It is the function of the volume-indicator



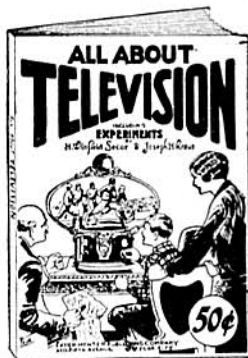
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and your minions loading the contraband cases aboard your yacht; and how they will applaud this final scene, in which you are neatly foiled!"

Diavolo gasped. He turned wildly, but saw only menacing faces. Dare turned to the government official. "Officer, do your duty." Drawing from his pocket a set of strong steel handcuffs, the officer snapped them upon Diavolo's wrists. "At last, Diavolo, you are caught in the toils of justice. Now we must search the yacht."

Dare took the lead. They found nothing of suspicious importance until they came to the last cabin. The door was locked, but dauntless Harold Dare was not to be deterred. "Break down the door, men," he

commanded. Diavolo paled. Before the onslaught of two brawny sailors the panels splintered, the lock broke, and the men were sent flying into the room. Harold Dare stood transfixed with amazement. There was a ripple of feminine laughter—he looked into a face he knew full well.

"Rose!" he gasped.

"Harold, my hero!" cried the girl.

And, as if before the clicking cameras, Harold Dare and Rose Blush fell into a splendid, soul-satisfying clinch. And again the arch-villain, in his soul-searing despair, realized that fate holds few favors for him who flouts the forces of justice, and that to the brave alone belongs the fair.

How Broadcast Programs Reach Broadcast Stations

(Continued from page 1213)

up-grades to maintain the minimum speed, and the brakes used when going down hill, to keep the car from going faster than 60 miles per hour.

The up-hill part of the analogy is the pianissimo minimum of a scale reading of 30 and the down-hill part is the fortissimo maximum of 60. It can be understood that, just as there are hills of different grades, necessitating either more braking or acceleration, so also there are different volumes of music-making power necessary, more or less, as the case may be, to maintain and observe the limits of 30 to 60 on the volume indicator.

This constant adjustment of the volume indicator necessitates a familiarity with the musical selections on the part of the operator at the pick-up point. He must know when there is to be a crescendo, so that he can reduce the volume at the proper time; when an incidental violin solo is in the selection he must be aware of the fact, and bring up the power so that the music will register in the loud speakers.

AT THE CENTRAL STATION

As mentioned previously, the night club is connected by telephone lines to the central broadcasting building. Before these lines are led to the switchboard, which distributes the music to the transmitter, they go to another amplifying system, similar to the one at the night club. In addition to this is an instrument called a "pad", which also plays an important role in keeping the quality up to a high standard. This pad has the function of *reducing* the volume of the "line noises" just after the program comes from the telephone line.

It seems safe to assume that every reader of RADIO NEWS has at some time or other used a telephone and, therefore, knows that there is always a certain amount of line noise superimposed on the conversation. This happens in the land lines connecting the night club to the main building, but not to as great an extent as in most telephone circuits; for these special lines are very carefully balanced to take out as much of this noise as possible.

Now the amplifier at the night club amplifies only the music; but, by the time the signal reaches the central building, it has superimposed on it some of the land-line

noises. If this combination were amplified again and put on the air the audience would hear in their loud speakers an extra amount of noise and conclude that "the static is awful tonight." The pad mentioned above has the ability to filter out the line noises; so that when the signal is again amplified the line noises are practically eliminated and only the music is amplified.

AT THE TRANSMITTER

At the central building there is also a volume-indicating meter, which is synchronized with the one at the night club. This is constantly observed by an operator; but the control is left entirely to the man at the pick-up point. After being again amplified, the signal comes to the switchboard, where it is routed to Bellmore, Long Island, the location of WEAF's transmitter (and also to the different stations in the network chain) by means of plugs and jacks, such as are used in an ordinary telephone exchange.

When the land lines have finally carried the signals to the transmitting station, they are again amplified before they modulate the carrier-wave of the station; i.e., before they are combined with the high-frequency current that is generated at the transmitter. It is the frequency of this carrier wave that determines the wavelength of a station. The modulated carrier current is then amplified many times and is finally led to the transmitting antenna, from which the wave leaps off into space.

Exactly what occurs between the time the wave leaves the antenna at the transmitter and the time it energizes the antenna at the receiving end is too technical to go into in this article (and, confidentially, not too well understood, even by experts). Let it suffice to say that series of electromagnetic waves are set up in the ether and these act on the receiving antenna system; so that electrical currents are set flowing in the radio-frequency amplifier of the listener's set, are detected and then amplified further at audio frequencies. These audio currents are finally turned into sound energy by the loud speaker.

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made at pick-up points, such as Roxy's Theatre, The Capitol, etc., from which programs are regularly broadcast. For example, in the former theatre, as many as twelve microphones, scattered about the stage, footlights and in the orchestra pit, are sometimes used. These microphones are connected to a microphone mixing panel, where the output of each pick-up can be regulated. This is necessary for several reasons. In the first place, let us suppose that the full orchestra is accompanying a singer, and that it is desired to broadcast the combination. In the majority of cases the musical accompaniment almost drowns out the singer's voice; but when this is broadcast the output of the microphones in the orchestra pit is toned down so that the accompanying music takes its rightful place, in the background of the singer's voice. Thus, we actually hear better results over the radio than if we were sitting in the theatre.

This theatre has also a studio from which

various programs are broadcast, and it is a simple matter to switch on the microphone in the studio instead of those on and about the stage. Instruments similar to those previously described for picking up a program from some remote point are permanently installed. They are the same, with the exception of the microphone mixing panel, which is more complicated, as there are more microphones to adjust.

When a program is put on the air from one of the station's studios in the central building, the steps taken are almost identical, the only exception being that one less amplifier and operator are required. The operator controlling the volume output from the studio is situated in a room adjoining the studio, and he can observe everything that occurs therein. The output from this amplifier goes to the switchboard room where it is routed to the transmitter at Bellmore, L. I., and any other stations that are putting on the same program.

Coming—A Program Pool?

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CAN THEY GET TOGETHER?

Ignoring its commercial implications, and taking into account only the fact that the Radio Corporation is the chief owner of the National Broadcasting Co., this arrangement can be properly, if narrowly, viewed as a substantial step toward the ultimate creation of a plan under which all manufacturers would contribute to a common pool for the financing of broadcasting; and hence of one by means of which the listener would pay for programs indirectly through the purchase of receiving equipment.

As to the practical factors involved in putting such a scheme into operation, the first necessity is, obviously, that it include all those interests which profit directly from broadcasting; not only the manufacturers of receivers and such accessories as tubes, loud speakers, parts, power devices, batteries and cabinets, but also the electrical utilities (since it is well known that they enjoy augmented revenues from the growing use of power-operated receivers) together with the telephone interests, whose lines are employed in chain hookups. At first glance this would seem to present insurmountable obstacles, but closer inspection reveals that such should not be the case.

There are already national trade associations representing most of the groups affected. The Radio Manufacturers Association, the radio division of The National Electrical Manufacturers Association, and The National Electric Light Association, to mention only a few. Representing the stations, there is also the National Association of Broadcasters. So the setting up of suitable machinery, which would serve as a common medium for all, would seem to depend only on the desire of these various groups to cooperate, one which has already been demonstrated in convincing fashion. (Once the plan were well launched, too, practical pressure would virtually force in any "slackers.")

The matter of payment offers somewhat more involved difficulties. In the case of manufacturers, this could, of course, be pro-rated on the basis of sales; while for such

interests as the utilities it might better be estimated. Allowance, too, should be granted those radio interests which maintain stations. But the spirit of cooperation again could well be relied on to iron out the details.

OPERATING METHODS

As to operation, whether the pool should take over stations or merely supply the bulk of programs, after the manner of the chains, presents a nice question for discussion. It would seem desirable that stations, particularly of the better sort, should be permitted some latitude for individual efforts; also that the pool's facilities be made available to non-radio organizations for programs whose quantity and character are compatible with the best interests of broadcasting. There are, too, a number of broadcasters who would, no doubt, prefer to operate independently of the pool. Once more, however, these details offer no difficulties which could not be solved.

Now as to what such a pool offers:

First: it would cause the listener to pay for programs; the very obviousness of that should not obscure its desirability. There is no doubt that leaders of the industry and fair-minded fans have agreed from the beginning that this is precisely as it should be.

Our European cousins have taken the straight line toward payment by the listener, through the licensing system previously referred to, but such an arrangement can never be put into successful operation in the United States, because of the traditional resentment at anything suggesting direct taxation. Accordingly, the fact that a pool would permit the listener to pay, and indirectly, should constitute the most telling argument in its favor.

WHO IS SHIRKING?

Second: the proportional cost would probably be no greater than, if as large as that of the present system. For example, on the basis of \$500,000,000 gross sales (the volume approximated by the industry during