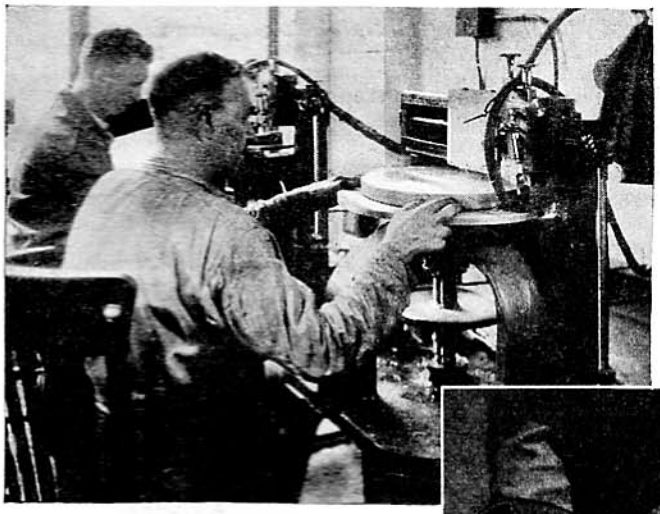
Frank Black, musical director of Sound Studios of New York, Inc., pianist and conductor of the Seiberling Singers

Recorded
What They Are

Think of It . . . Under the Best of Conditions Artists Appear Before the Microphone, Render Their Numbers, Which Are Mechanically Recorded on Specially Prepared Discs, and Then These Discs Are Sent to Various Stations to Be Put on the Air, Reproducing with Just as Fine Tone Quality as if the Artists Had Appeared Personally Before the Microphone of Each of the Stations. Broadcasters Have Not Been Slow to Realize the Great Economical Value of Such a System Which Permits Them to Broadcast Such Talent as Would Otherwise Be Unavailable

By **A. J. Kendrick***



Shaving the master wax record, so as to obtain an absolutely smooth and perfect surface upon which to engrave sounds with their overtones and harmonics for a realistic production at the broadcast studio

Contrasting a test pressing with an ordinary phonograph record. These test pressings are carefully examined for artistic and technical flaws. Upon their approval both "mother," "stamper" and final pressings are made. Unlike the commercial phonograph record, the radio recording disc plays from the center toward the rim. The vertical line on the large record indicates the point at which the selection starts

IN 1929 more than half the broadcasting stations in the United States lost money, and they lost more than the others made. As in drug stores and groceries, so too in broadcasting, the trend seems to be in favor of a few large stations rather than many small ones. Many stations, both independent and affiliated with the networks, were growing anxious concerning their future when the recorded broadcast program came to their rescue.

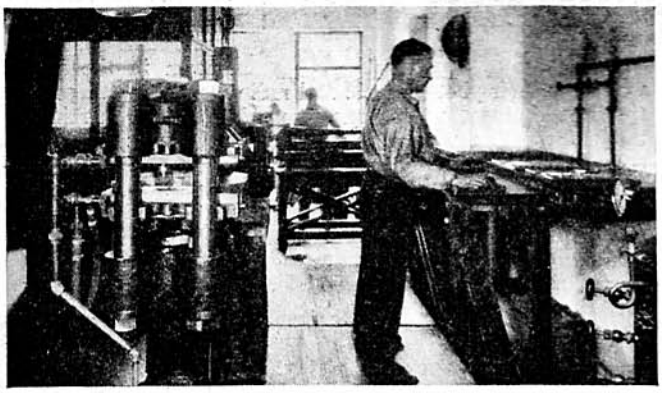
Of course, the earliest broadcast programs, back in 1920 and '21, consisted chiefly of records. But these were phonograph records, quite unsuited to broadcast needs. For this reason the program originating in the broadcast studio soon took the place of records. As the networks grew and time thereon became more and more expensive, sponsors realized that the value of using the networks depended on super-quality programs. The cost of the network was the same whether a poor or a good program was broadcast. Efficiency demanded fine material. The ever-increasing competition for listener interest also raised the quality of network programs. But these were expensive. The question arose how best to utilize these costly and beautiful programs, overflowing with good will potentialities, to the full. Certainly not by giving them but one performance, over the network. And so in December, 1928, the recorded broadcast program came into being. Since then the technique of recording and broadcasting these programs has been improved rapidly until today facilities are at hand by means of which programs may be faithfully recorded and adequately broadcast.

Before discussing the technique of recording let us review briefly the advantages of recorded broadcast programs. The broadcast station far removed from sources of entertainment talent cannot hope to compete with large-city stations in the matter of original programs. But by the use of recorded sustaining programs they may give their listeners the finest music, and entertainment of the finest talent throughout the country. The rental of the discs is far less than the cost of preparing a program, holding auditions, rehearsing and paying artists' salaries. And the programs are far superior. Station managers may receive recorded auditions or entire programs from which to choose the selections they desire. The wide range of talent thus available makes possible greater variety in program menus than might otherwise be had. The recorded program gives the station manager an opportunity to build balanced programs to suit all occasions, hours and audiences. The artistic building of sustaining features is facilitated.

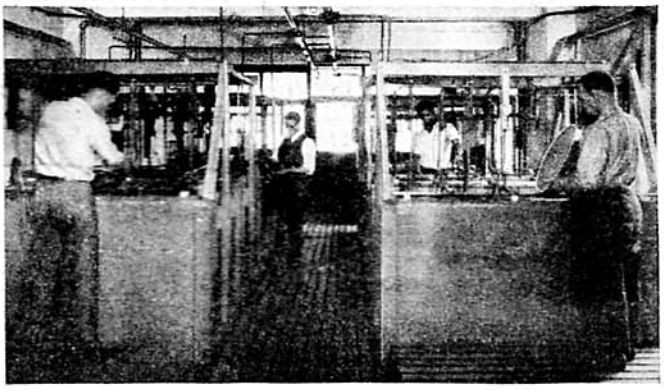
This leads to greater coverage or listener interest in the station, and increases the value of the station to the prospective sponsor. It also gives the public the finest of programs, whether the listener is tuned in to a network program or his

*President, Sound Studios of New York, Inc.

Programs— *and* How They Are Prepared



A view of the Pressing Department of the Sound Studios of New York, Inc., where test pressings are made. The earth wax compound is being heated at the right. To the left is the press, intense heat and pressure compound to make the pressing



A portion of the Galvano Department, where wax records are electroplated. The wax records switch back and forth through the baths on rods such as that held by the man at the right. To the right is a wax recently taken from the bath. In the rear, "the master," recently peeled from the wax, is being examined

local station, be it urban or rural. The public responds to the better programs with more-hours-per-day listening and in greater numbers than formerly.

Turning our attention to the sponsor, let us examine his problem. He is broadcasting over a large network at great cost for time and programs. However, he is well satisfied, the cost is more than paid for by increased sales. In fact, so enthusiastic is the sponsor for radio advertising because of his network results that he desires to increase his use of this medium. In the past he has been afraid to do so. He should have liked to use independent stations, but, on the other hand, after giving the public such fine network programs he was loathe to represent his firm and product over the air by any inferior material. His hands were tied. Much as he desired to use the independent stations, he could ill afford programs inferior to his network ones and the stations he desired to use could not furnish him with talent equal to that. So he let the matter drop.

Gustave Haenschen, music director of Sound Studios of New York, Inc., and director of the Palmolive Hour and the Champion Sparkers

Now the situation has changed. The sponsor still uses the network. But let us say that sales are not pulling in Texas, to which state the network does not reach. And, in addition, he is planning an intensive dealer campaign for Florida. He desires to supplement his network broadcasting with spot broadcasts from independent stations in these territories. The sponsor investigates the stations in these districts and finds that those with the greatest coverage are those who have facilities for broadcasting recorded programs and use them. He records his network program and the discs are played by the chosen stations in Texas and Florida. He has spent money for radio advertising which might otherwise have gone to newspapers or other media, or might not have been used at all.

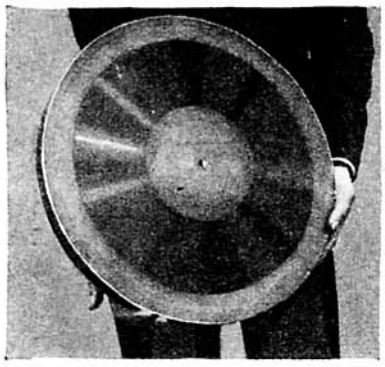
Another advantage of the recorded program is the ability to reach a coast-to-coast audience at the same hour despite time differences between the east and the west. The inability of network programs to do this is a tremendous handicap. The recorded program fills this need.

It might be thought that the recorded program would compete with the networks. This is not the case. Recorded broadcasts are not a substitute for the networks; they supplement the networks. Many potential network sponsors have remained away from broadcasting due to the fact that they have been unable to use the costly network programs for more than one performance, an economic waste if ever there was one. Now, networks have an added sales point, the fact that the prospective sponsor will be able to make full use of his network program by having it recorded and used for spot broadcasting from independent stations.

We might discuss the value of the recorded program for many pages. We will name but one more, the ability to edit the program. No matter how carefully a program is prepared, some untoward incident may slip into the performance to mar the effect. Artists and announcers are only human. They may mispronounce a name, give the wrong figures, open the program with "good morning" after dinner. Such things will happen. And when they do in the original program they cannot be recalled from the hundreds of thousands of loud speakers which reproduce the mistakes as they are made. In addition, an orchestra may play a selection slightly better on one occasion than on another, a singer may not be in the best of voice the evening of the program, someone may have a cold. These things cannot be avoided in the original broadcast.

But in the recorded program all mistakes are found and corrected before the discs are released for broadcasting. Vocalists may sing when their voices are at their best. Orchestras may play the selections several times and the best performances chosen for incorporation in the discs that are to be broadcast. One selection may be chosen from one performance, another from a second, to the end that the edited and final discs may represent only the finest work of soloists, orchestra and announcer.

At the left is the metal stamper from which the recorded broadcast program discs are stamped



At the right a huge slice of special wax which is shaved with the spiral groove representing the latent sound values

Let us turn our attention to the recording itself. We have said that ordinary commercial phonograph records are not suitable for broadcasting. For this reason the large electrical companies of the country have been working on methods by which broadcast programs might be recorded. Since the discs were to be broadcast by radio, the first step was to adopt radio technique to recording. Some of this technique is now also applied to the manufacture of phonograph records. The horn and mechanical pick-up were displaced by the microphone and electrical pick-up. The vacuum tube amplifier came into use and in general recording was made to follow as closely as possible the methods of radio.

The talkies, appearing about the same time as the beginning of the recorded broadcast program, lent added impetus to recording development. The Western Electric Company, for years pioneers in the field of sound reproduction and transmission, brought its tremendous research facilities, knowledge and experience in the field of telephone work to bear upon the problem. The result was the Vitaphone and the rapid development of talkie recording.

Having given sound pictures a good start, Western Electric, armed with the experience gained in this field also, turned its attention to radio. Its laboratories on the Pacific Coast helped. Another sound laboratory was established in New York City, the center of broadcasting activities. And several months ago Western Electric came forth with the announcement that it had perfected apparatus for the recording and broadcasting of programs.

The first step was to install the broadcasting apparatus in stations. It was found that many stations, having attempted recorded programs with inferior equipment, or having accepted for transmission discs that were poorly recorded, were prejudiced against recorded programs in general. However, when they were shown the perfection to which such presentations had attained at the hands of Western Electric they eagerly sought equipment. To date Western Electric has equipped about forty stations throughout the country, assuring itself in advance that the stations had trained and intelligent personnel, and requiring the stations to use the equipment to broadcast only quality discs. More stations are continually being equipped.

Then Western Electric sought recording companies as an outlet for its recording machinery. Again they sought firms whose experience, training and general qualifications warranted the installation of its recording facilities. Their first and to date their only license for the recording of broadcast programs has been issued to Sound Studios of New York, Inc., which was chosen after a careful investigation of recording companies throughout the country. This investigation showed that there exist many bootleg recording companies, who, working on obsolete and unlicensed equipment, recorded on large discs selections from phonograph records, while the sponsor thought he was having a program prepared especially for him and recorded from an original performance. For this reason Western Electric is issuing licenses, so that sponsors and stations may know what companies have been approved.

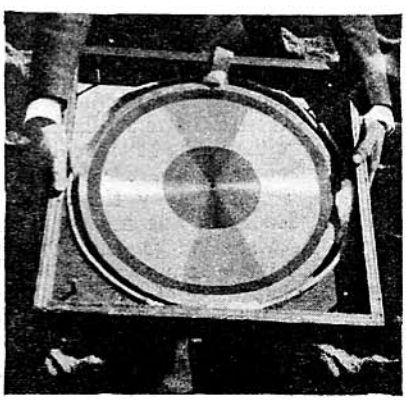
Let us take a visit to one of these companies, Sound Studios of New York, previously mentioned as the first Western Electric licensee. Here we find the programs especially prepared under the personal supervision of Gustave Haenschen and Frank Black, well known in the musical world for their phonographic and radio work. In the preparation of the program the sponsor's product is kept in mind and the audience he wishes to address. All music is specially scored, some taken from the huge library containing thousands of such pieces for every instrument and mood. Often numbers are composed to meet the requirements. Then the artists are chosen, rehearsed and the program is ready for network presentation. In this way Sound Studios of New York prepares the Palmolive and Ovaltine hours, the Wonder Bakers and the Chase and Sanborn Choral Orchestra, among other features.

The recording studios of Sound Studios of New York are in the same building as the other departments. They resemble any fine broadcasting studio, the walls, floor and ceiling made of sound-proof materials, scientifically ventilated and with the usual draperies by which to adjust room reverberation. The latest type condenser microphones are used. A double glass window looks into the monitor room, from which the microphone output is controlled, raised, lowered and blended to give the best effects. So far there is no difference between the recording and the broadcasting studio. But the recording studio has another room in which are the turntables and faders by which one turntable is set going while the other stops, permitting the transfer of a program f one disc to another without interruption. The speed of the turntables is kept absolutely constant by vacuum tube controls.

The placing of the orchestra and the microphone differs somewhat in recording as compared with broadcasting For in broadcasting the sound is converted into electricity, then back into sound again by the loud speaker at the radio receiving set. But in recording the sound is converted into electricity, then into mechanical energy in the stylus cutting the wax. These problems are studied by acoustic engineers and talent and microphone positions determined. For one thing, the strings must often be nearer the microphones for recording than for broadcasting.

When all is in readiness huge discs, called waxes—though they are really made of special soap material—are placed on the turntable. Let us say that it is to be a slow-speed record. The waxes, about 1½ inches thick, are placed on the 33 1/3 r.p.m. turntables and the pick-ups adjusted. These discs are of the lateral cut type, the grooves being of constant depth, and the vibrations of the stylus cutting the walls of the groove. This type of disc is in contrast to the "hill and dale" type, the name of which is self-explanatory. The pick-up is no ordinary phonograph affair. In the usual (*Continued on page* 170)

At the left are shown the bright metal stamper which stamps the records and a finished record ready for rebroadcasting purposes



At the right is the wax in a specially constructed case, lined with felt, and used in transportation from the recording studios to the Galvano Department

Recorded Programs

(*Continued from page* 110)

phonograph pick-up the fulcrum is at the end and the weight of the arm is on the point, which is so fine that the pressure is equal to about 50,000 pounds per square inch. The electrical pick-up of the recording machine is delicately balanced. In addition, to maintain the correct depth of the cut, an advance ball rolls lightly on the surface of the wax, supporting the stylus. Another peculiarity of the broadcast disc is that it plays from the center towards the rim, exactly the reverse of commercial records, which start at the rim and play towards the center. The director is in the studio, the monitor in the control room. Another man is at the amplifiers and a recorder is at the turntables. So the program is recorded.

For the sake of economy of time, and that more work may be done each session, the program is not usually recorded in the order in which it is to be released, any more than are the scenes of a motion picture filmed in their proper sequence. All the shots in a certain scene are filmed first, then all the scenes at another location. Then they are placed in their proper order. The same takes place in recording. The soprano does some of her numbers. Then the orchestra plays many of its selections. The quartet sings its pieces at one session.

The waxes having been cut, they are taken to the galvano baths. Great care must be taken that the delicate lines cut in the soft wax are not spoiled. To avoid any mishap in transportation, the galvano baths of Sound Studios of New York are located in a building adjoining the recording studios. The cut side is prepared for plating and the disc attached to the end of one of the long arms which are suspended about the baths. On the end of the pendulum-like rod it swishes back and forth through the baths, which coat the cut side with a copper plate. This is called the "master," and when peeled from the wax is a negative, the lines being raised above the surface, whereas in the wax they were indented. The copper master is then placed in the press preparatory to making two test pressings. These pressings are made of an earth-shellac material, which is heated to the consistency of dough and placed with the master. Then under enormous heat and pressure the test pressings are made. These are taken to the review room and played before all the interested parties. The director, either Mr. Haenschen or Mr. Black, listens for artistic flaws. Mr. Charles Lauda, chief engineer, listens for distortions or other technical shortcomings. The sponsor or his representative is on hand. The test pressings having been approved, we are ready for the next step.

It might be thought that the next step would be to make the final pressings from the master as the test pressings were made. But this procedure is not used. If, in the pressing, the master should for any reason be marred, no impression of the performance would remain from which more pressings could be made. For the wax has been spoiled when the master was taken from it, and has already been shaved for use in recording other programs. So the master is electroplated, the resultant copper disc being called a "mother." But this disc, like the wax, has its lines indented, having been made from the negative master. And since the final pressings also have indented lines, the mother cannot be used to produce the pressings. The master is filed for emergency or for filling future orders for discs of the same selections, and the mother is in its turn electroplated. The negative copper disc which this process produces is called the stamper. This is carefully ground and buffed and otherwise prepared.

Then the stamper is placed in the press, together with material for pressings, and the final discs are pressed out to the desired number. If many pressings are ordered, several stampers are made, since the use of one stamper for too many pressings lessens the clarity and sharpness of the discs after a time. These final pressings are then sent to the stations for broadcasting on Western Electric apparatus similar to that used at Sound Studios for recording. So the fidelity is preserved.

In addition to the procedure outlined above, there are all manner of variations by which odd effects are gained. A detailed discussion of all these methods would be endless, for these tricks of the trade, similar to trick photography in motion pictures, is a thing which is constantly being developed.

Suffice it to say that recording apparatus and technique has advanced to the point where by the use of licensed recording companies, the preparation of fine programs and recording on the latest Western Electric equipment, results may be obtained so perfect as to be undetectable from the original performance when both are heard through the radio loud speaker. And the editing and effects that may be gained by dubbing make the recorded program so flexible that almost any desired effect may be gained.

For this reason is the recorded program coming into its own as the perfectly controlled vehicle for the presentation of programs over the air.

Short-Wave Superheterodyne Receiver

(*Continued from page* 106)

ener would attempt. Such a receiver (commercially constructed) requires the skill of an experienced radio operator. Each and every inductance for each frequency band is shielded and the receiver takes up more room than two average size broadcast receivers. The tuning system is complicated and while the receiver is highly sensitive, it would be unsatisfactory for amateur or broadcast use.

Summing up and taking all these things into consideration, the task appears to be a hopeless one. The ideal type of receiver should embody many things and when these things are carefully set down, we find this list: Sensitivity, selectivity; ease of control; minimum controls (not more than two); to receive continuous waves as well as modulated waves and voice or music with good quality reproduction; smooth volume control; good mechanical design; good appearance; compactness and a receiver which can be moved from place to place if so desired. Certainly a large order! And yet, not so large when due consideration is given to the superheterodyne and the possibilities it presents. One of the very serious drawbacks of the short wave superheterodyne has been the difficulty of elimination of oscillation in the intermediate radio frequency stages of amplification. With the three element tubes, a variable resistor was provided to control oscillation. The voltage gain per stage was something between 6 and 8. Hence, everything that could be done made only for a fair receiver at the broadcast frequencies and considerably less than that at high frequencies. The screen-grid tube has been an answer, in a large measure, to all this.

At the lower frequencies a much higher gain can be obtained. For example, a voltage gain of 75 per stage is easily possible. Two such stages would give a total voltage gain of 5,625. The gain would be constant since the intermediate stages remain at some fixed frequency. This means a highly sensitive receiver and one which will be capable of picking up extremely weak signals which are not heard on the regular type of short wave receiver. The fidelity in reproduction should be better since no regeneration would have to be used. The intermediate stages can be made stable. For continuous wave reception, the use of a separate oscillator can be made to beat on the intermediate frequency—providing unmodulated or modulated reception at the flip of a switch. There need be but two controls, one for the detector and one for the oscillator. Volume control is not considered as being a part of the tuning control system.

The detector circuit in a superheterodyne receiver as in all other straight detector circuits, inherently is broad tuning. This can be sharpened to some extent by the addition of a preselection stage of radio frequency, untuned. The successful and efficient operation of a short wave superheterodyne most certainly hinges on the intermediate frequency amplifiers. Once this problem is thrashed out, it is only a question of careful assembly to complete a real receiver that has incorporated in it all the desirable things outlined above. This particular short wave superheterodyne receiver has these features:

It is highly sensitive, using a preselection radio-frequency stage ahead of the first detector.

The intermediate-frequency amplifiers have a gain of 69 per stage and there are two intermediate stages. The frequency is about 200 kilocycles (1,485 meters).

There are two tuning controls, detector

(*Continued on page* 176)