Progress in sound-picture recording

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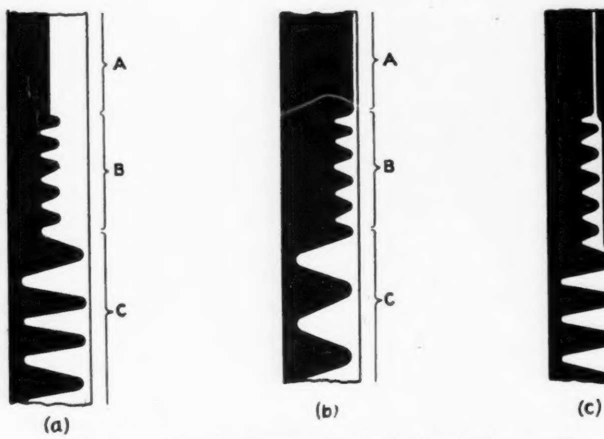

Fig. 1—(a) Represents typical "variable area" sound track while (b) and (c) illustrate methods of obtaining anti-ground noise recording by blanking off clear portion of track

THE advances of the past year in sound picture recording, such as the introduction of microphone booms, are now taken as a matter of course. This is a normal line of development of technical devices. In the first stage, no one can see how a problem is to be solved; in the second stage, it is solved, although the solution often enough is disparaged by those not responsible for it; in the third stage, it is generally accepted and improvements are made in it; in the fourth stage, it is taken as a matter of routine and people assume that it has always been in use. Talking movies are now old enough so that some of the equipment has graduated into the last stage.

However, numerous other products of technical progress are coming to the fore. Some of these have reached the point where their characteristics may be discussed and their value estimated. Among these are a number of methods of anti-ground noise recording.

Figure 1(a) illustrates a variable area sound track on film. The upper part of this record (Section A) shows a condition of no modulation, with half the width of the track black and the other half clear. This means that with the recording mirror at rest, half the track is exposed to light and the other half remains unexposed, the dividing line between the exposed and unexposed portions being the median line of the track. When modulation begins, this straight median line breaks up into the familiar serrations of the variable area track which, as drawn in Fig. 1(a), are first of small amplitude in the section marked B, and then increased to the full width of the track in Section C.

In reproduction light passing through the transparent portion of the track encounters irregularities, such as dirt and scratches on the film. With the subsequent amplification, this results in the familiar rush or ground noise, which, under the conditions of Sections A and B in Fig. 1(a), when modulation is low or absent, may be very annoying. Moreover, the reproducing photocell, when excited by light, adds a certain increment of noise. Even if the modulation is at times high enough to dominate the total noise, the presence of the disturbance in the intervals constantly reminds the audience that it is listening to a mechanism. Hence the elimination of ground noise is a very desirable development.

In the case of the variable area track, a marked reduction in ground noise may be secured by the method shown in Fig. 1(b) which dates back several years. The dividing line between the dark and transparent portions of the film, it will be noted, is no longer always in the middle of the track, but goes over toward the edge of the track as far as possible. When there is no modulation, as shown in Section A of Fig. 1(b) the black portion of the print goes almost all the way over to the edge of the track. Hence very little light will get through to reproduce irregularities on the film or excite the photocell. When, as in Section B of Fig. 1(b), modulation sets in, the center line of the modulation moves over far enough so that the peaks will be accommodated on the track. When full modulation is reached, as shown in Section C of this figure, the center line of the modulation moves over all the way and once again coincides with the median line, thus utilizing the maximum volume carrying capacity of the track.

The apparatus accomplishing this was devised some years ago by C. R. Hanna, of the Westinghouse company, and C. W. Hewlett, of the General Electric Company. It is shown in a general way in Fig. 2. A part of the audio output of the recording amplifier is diverted, subjected to further amplification, rectified, and then used to bias the recording galvanometer obversely. That is, when the output of the recording amplifier is small, the galvanometer is biased to such an extent that almost the whole width of the positive track is black. As the audio output of the recording amplifier increases, the bias changes correspondingly until, for full modulation, the mirror is in the position which it would occupy in ordinary variable area recording.

This is a simple and effective method. Its only drawback is that low modulation is close to the edge of the track, and if in reproduction the scanning beam is incorrectly located, the modulation might not come through at all. Hugh McDowell, of RKO Radio Pictures, has devised a method whereby the serrations always remain in the middle of the track, but the clear portion of the print is matted out by the action of an auxiliary light-blocking device. The McDowell method is outlined in Fig. 3. As in the preceding system, a portion of the output of the recording amplifier is rectified, but instead of being applied to the recording galvanometer, it actuates an electromagnetic or other form of motor, which moves a small shutter and interposes it an appropriate distance into the recording beam. The appearance of a variable area positive track recorded by the McDowell anti-ground noise method is shown in Fig. 1(c). A mat of variable width follows the modulation closely, with a clearance of about five mils, keeping out the greater part of the ground noise.

The RKO-McDowell system of silent recording was described and demonstrated before the Academy of Motion Picture Arts and Sciences in Hollywood in January, 1931. It has been applied commercially in RKO Radio Pictures' "Dixiana," "Half Shot at Sunrise" and other current releases.

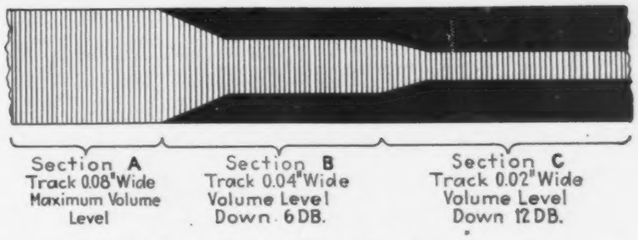

Fig. 4—Illustrates method of automatic volume control by "squeeze track" method, applicable to variable density recording

Biased light valve recording

The variable density recording experts have likewise been busy on ground noise reduction. In a paper presented by H. C. Silent of Electrical Research Products, Inc., before the Academy of Motion Picture Arts and Sciences in Hollywood Dec. 5, 1930, the biased light valve was described.

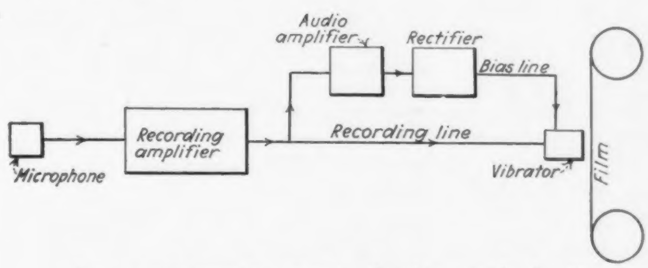

Fig. 2—Schematic circuit showing method of diverting part of output of recording amplifier to bias recording oscillograph

This method takes advantage of the fact that when the light transmission of the film is low, the ground noise is also low. However, when the sound track is printed in this way with a high density, modulation must also be kept low, since in this case the volume carrying capacity of the film is also low. (There is a particular value of density or transmission which allows the greatest volume range to be secured from the emulsion without photographic overloading), hence a recording valve which varies the light transmission in accordance with the envelope of the audio input will act as an anti-ground noise device. The usual light valve method used for recording in the Western Electric system is described in a paper by Donald McKenzie: "Sound recording with the Light Valve," *Transactions of the Society of Motion Picture Engineers,* Volume 12, No. 35, September, 1928. Briefly, the valve consists of a pair of ribbons normally spaced 0.001 in. apart. The sound currents cause these ribbons

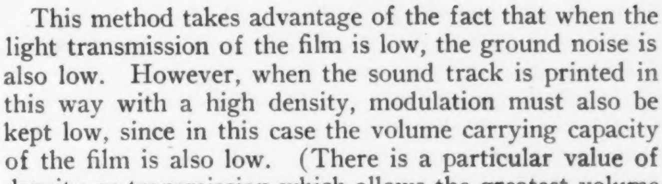

Fig. 3—Further modification in method of biasing oscillograph in order to keep serrations (for low modulation) in center of sound track

to vibrate, slightly for weak currents and a correspondingly greater distance for higher inputs. Therefore, for weak currents which correspond to the intervals when ground noise is most annoying, the spacing of 0.001 in. is considerably greater than is necessary and, if reduced, will result in lower ground noise. The biased light valve moves the ribbons close together for small recording amplitudes and draws them apart to the full spacing of 0.001 in. only when the amplitude is great enough to require this. The average spacing of the ribbons follows the envelope of the modulation. Hence the general density of the print is high during intervals of low modulation and less during intervals of high modulation. Of course, some margin must always be retained so that the ribbons will not touch even when the modulation is low.

The electrical method whereby the ribbons are moved closer together, or further apart, is substantially the same as in the variable area systems above described. A noise reduction amplifier follows the envelope of modulation and biases the valve to the proper degree. A decrease in ground noise of about 10 db. is claimed and it is probable that greater reductions will become possible with further development.

Increasing total volume range

All methods of reducing ground noise are, to some extent, automatic volume controlling methods. As is well known, space or photographic limitations on the film set an upper level of amplitude, while ground noise, whether in recording or reproduction, sets a lower limit. The space between these limits, which is of the order of 25 db. in film recording (sometimes more, under favorable conditions) is not sufficient to accommodate the full range of amplitudes encountered under natural conditions. This may be as high as 60 db. for orchestral music or, say, 40 db. for dramatic speech. It is customary, both in talking picture recording and in the broadcasting field, by varying the amplification manually, to compress the volume range of the original performance within the allowable limits of the recording medium. But if the ground noise level, which sets the lower limit, is reduced by, say, 20 db., part of this added leeway may be used for additional volume range in recording and reproduction. For example, the recording may be carried 10 db. lower for speech. If, then, the reproducing amplifier is set at a level 10 db. higher than normal, the reproduced volume will remain the same, but the full amplitude of the track will be reproduced 10 db. louder than before, thus affording louder and more effective crescendos.

A discontinuous method of automatic volume control applicable to the variable density track was developed earlier in 1930 by the Metro-Goldwyn-Mayer Studios and described by Wesley Miller: "Volume Control by the Squeeze Track," in the *Journal of the Society of Motion Picture Engineers* for July, 1930. The squeeze

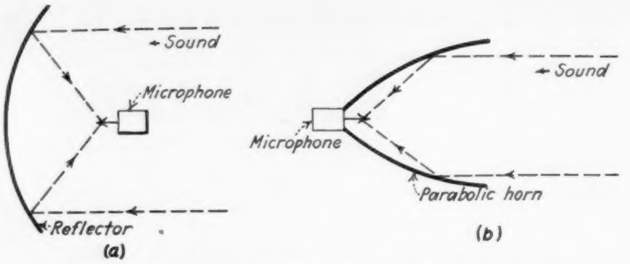

Fig. 5—(a), (b) Two types of beam microphone concentrators used in sound picture recording

track method is shown in Fig. 4. Section A shows maximum volume. When it is desired to reduce the volume, the variable density track is matted out at the sides, changing from the maximum track width of 0.080 in. down to 0.020 in., as in Section C, a range of 12 db. is secured. This is added to the normal volume range of the variable density striations. The squeeze matting is taken care of in printing. As the track is narrowed, the surface noise is reduced in proportion so that with the full extent of squeezing, there is no added ground noise. Of course when the reproducing amplification is raised, there is always danger of running into noise interference from the projection apparatus itself. This, however, is equally the case with other methods of automatic volume control which utilize a higher projection gain. The remedy is to improve the reproducing equipment so that it will be quiet in operation even at high gains.

The above methods of ground noise reduction and automatic volume control have been applied commercially with considerable success. There is no doubt that progress will continue to be made in this field and that ultimately sound picture projection will cover a wide range of volume with an immaterial amount of ground noise at the lower limit. Talking movies are eliminating their own static.

Microphone developments

Among microphone developments is the reflector type of pickup described by the writer in the *Journal of the Society of Motion Picture Engineers* for January, 1931: "Microphone Concentrators in Picture Production." Fig. 5(a) shows the method in outline. A parabolic or ellipsoidal sound mirror, 3-5 feet in diameter, picks up sound, sometimes at a considerable distance from the source, and concentrates it on a microphone placed at or near the focus of the curve with its back to the action. Sounds of wave lengths small in comparison to the dimensions of the bowl gain about one stage in amplification. This, it will be noted, is secured acoustically instead of electrically, entailing certain advantages in that the process of electrical amplification is started at a higher level, and extraneous sounds and reverberation on the set are partially suppressed. The device is directional and permits picking out significant dialogue from traffic noise, etc., with considerably more effectiveness than the human ear or an unaided microphone. Thus, in a scene taken in a railroad roundhouse, the concentrator microphone picked up intelligible dialogue at a distance of about 12 feet from the speakers, whereas an open microphone 3 feet from the same speakers was ineffective because of the locomotive noise and other disturbances. Not only is it possible with the concentrator microphone to make spectacular shots which could not be secured conveniently in any other way, but it also considerably increases speed of shooting and hence lowers cost of production. Because of reverberation, its use is more limited indoors and, up to now, the principal commercial applications have been in outdoor shooting.

An earlier type of microphone concentrator was developed by RCA Photophone in the form of a metal horn, as shown in Fig. 5(b). This type of concentrator is described by Olsen and Wolff: "Sound Concentrators for Microphones," in the *Journal of the Acoustical Society of America*, April, 1930. The amplification in the treble and upper audio range is not as high as that of the bowl type of reflector, but the horn functions as an acoustic amplifier for the lower frequencies.

The addition of reflectors to microphones contains many possibilities for improving pickup and it is probable that a great deal of work will be done in this field during the next few years. By means of microphone reflectors sound pickup approaches the flexibility of camera technique, with its panning, dolly shots, and changing of lenses. It is interesting to follow the evolution of the microphone from its original immobility, inherited from the broadcast field, and its subsequent release through the development of the microphone boom and acoustic concentrating adjuncts.

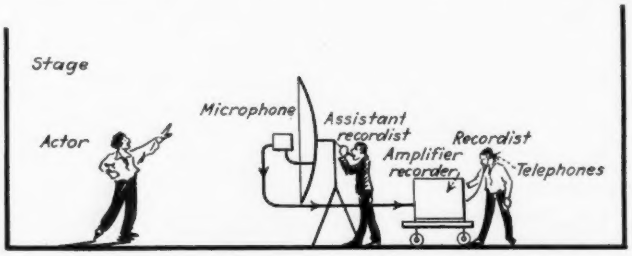

Fig. 6—Sketch showing possible simplification of recording equipment for future studio use, monitoring booths and recording rooms not required

This increase in recording mobility is likely to continue, and it is not confined to the microphone. The need for mobility was not at first recognized in talking picture installations. Engineering tradition plays a great part in the form which early apparatus in any field assumes.

In the earlier installations a separate monitoring room adjacent to the stage, and which was large enough to simulate the acoustics of a theater, was considered necessary. The recording rooms are usually located at some distance from the stage. The next step in development provided a somewhat simple layout with the large monitoring room replaced by a portable monitoring booth, containing the necessary amplifier and film recorders and located directly on the stage.

It may be that the developments of the future will produce a system like that shown in Fig. 6. Here the recordist in charge is on the stage as close to the action as the cameras. An assistant, under his immediate supervision, manipulates a microphone concentrator, while the first recordist stands by the recording amplifier, the output of which he hears through high quality head receivers. The sound camera, enclosed in a sound insulating blimp like the picture cameras, is also directly under his observation. The point is that the recordist in charge is in direct and constant touch with the director, the first camera man, and the sound assistants; he sees all the action clearly and supervises the recording without having to work through intermediaries at a distance. This may not be feasible now, nor for a number of years, but it represents a goal toward which the development of the art is tending.