Details of Talkie Reproduction

From Film to Loud-Speaker

(By "MEGOHM")

WITH the advent of the moving pictures, the public had to become accustomed to seeing and enjoying dramatic presentations stripped of what had previously been considered an indispensable portion—the speech. Certainly the accompaniment of good orchestral music, the frequent helping-out of the plot by paragraphs of lettering, and at the same time a rapid improvement in the all-round technique of picture production, made the loss of an important item less noticeable. The result was that audiences soon settled down to accepting conditions as they were. But such a state of things would not continue indefinitely, and so the problem of adding sound to the films has engaged the attention of inventive minds for many years.

First Performances.

AS early as 1903, a few public performances were given in which a gramophone behind the screen was synchronised as far as possible with the projected picture, but practically no further progress resulted from this experimenting. At that time only a single gramophone could be used, so that the volume was small, and quality extremely bad, judging by present-day standards. The means of recording sounds certainly existed, but the means of reproducing those sounds with sufficient volume and quality for purposes of entertainment was lacking.

With the advent of radio, a few keen minds quickly realised that the means they hoped to discover had arrived. But in its early days the radio amplifier gave no more quality or volume than the gramophone, and thus the production of sound films had to await drastic improvements in the radio amplifier and accompanying loud-speaker. A certain stage of development was reached, and the talking picture appeared everywhere with almost startling suddenness.

Installations in General.

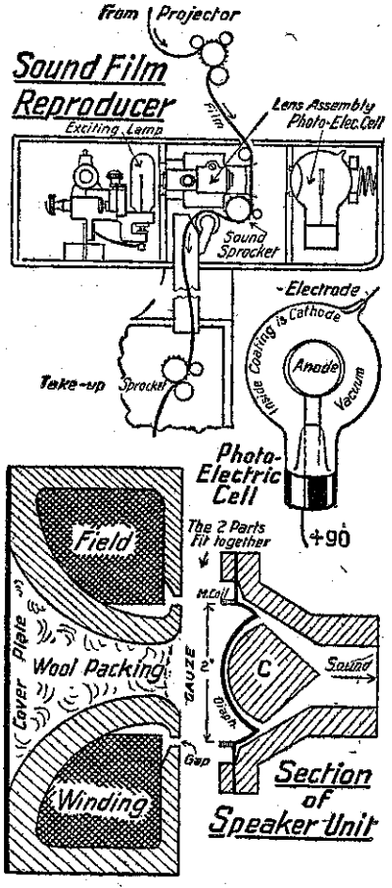
THAT an old-established and pioneer firm in matters pertaining to sound reproduction for telephones should have become deeply concerned in sound reproduction for moving pictures is not surprising, and for that reason a visit was paid to the head office of the Western Electric Co. (N.Z.) Ltd. in Wellington, to learn as much as possible about the portion of talkie reproduction that is of most interest to radio enthusiasts. There are already 61 installations of this system now operating in New Zealand.

The equipment directly associated with the picture projector consists of a special turn-table, an optical system, together with a photo-electric sound-reproducing unit and its accompanying amplifier, a film take-up mechanism, and an electric motor. A constant speed of 1200 r.p.m. is required in the motor, which is kept steady by a vacuum tube regulator. To ensure accurate synchronism and absence of vibration, all gear wheels are cut by a highly-accurate method, but even then more drastic means must be employed to prevent interference, chiefly mechanical, from reaching the amplifier or disc reproducer.

To effect this there are flexible couplings, mechnical filters of felt-covered springs, and a hydraulic damping action on the sound sprocket drive. The pick-up pivot is cushioned on rubber, and in addition the whole turn-table assembly is mounted on a soft rubber pad.

The whole of the apparatus mentioned is built compactly into the lower part of a metal stand, to the upper part of which any standard picture projector and arc-lamp may be attached.

In moving-picture reproduction it is necessary for the film to make a brief stop for each picture during the fraction of a second in which it appears on the screen, whilst for sound reproduction a continuous steady forward movement is required.



The recorded sound occupies a narrow strip about 1/10in. wide at one side of the film, but instead of the sounds belonging to a particular "frame" of the picture being situated in the adjacent margin, the sound record is 14½ inches ahead of the corresponding picture. Thus there is a small amount of slack film between the sound-reproducer and the projector, so that the jerky motion of projecting does not affect the steady movement of the sound reproducer, to which the film is fed by a smoothly-running sprocket-wheel.

A special turn-table incorporated in the machine has already been mentioned. This turn-table runs the "synchronous" disc records, which may be used when necessary to supply sound in place of a sound track record on the film. These disc records are different in many respects from the familiar type of record. They run at a speed of 33 1-3 revolutions per minute instead of the usual 78. They are 16 inches in diameter, and contrary to the ordinary custom, the record commences near the centre, terminating at the outside edge.

Ordinary or "non-synchronous" gramophone records are played upon a separate unit suited to the purpose, and wired to the controlling switch.

Two film-operating machines are invariably installed, so that there is no delay for the changing of spools.

Photo-Electric Track.

THE essential portion of the optical sound record is a track of varying photographic intensity, about one-tenth of an inch wide, running along one side of the film inside the sprocket holes, through its entire length. Owing to the number of pictures passing per second (24), the sound record is well stretched out, ¾in. being thus only required to register the sound occurring during 1-24th of a second. This lengthening of the sound record favours great accuracy. Actually, the sound vibrations are represented by fine lines or bands across the recording strip.

A diagram illustrates roughly the appearance of the sound-track when magnified, but there is actually a more gradual shading than can be shown diagrammatically—a gradual photographic shading interspersed with dark bands. It should be noted that the lighter spaces represent the louder sounds, and that dark bands represent brief intervals of silence, because the photo-electric cell only passes current when there is at least a small amount of light.

Inspection of a numb of enlargements shows a wide variety in the general appearance of the records. Single notes are represented by evenly-spaced dark lines between each vibration or cycle, with gradations in between representing the modulation.

When a strong light shines through the record and into a photo-electric cell, the latter passes current in proportion to the intensity of the light, so that when the current passed is amplified, the sound vibrations are reproduced. At this point it would be as well to describe briefly the photo-electric cell.

The Photo-Electric Cell.

THIS cell is a glass vacuum tube somewhat larger (for this particular purpose) than an ordinary radio receiving valve. In the centre is the anode, which is a circular ring of metal supported by two wires, and having a contact through the base. The other electrode or cathode is formed by first coating the inside of the bulb with magnesium, and over this a deposit of potassium salt, which is photo-sensitive.

Other light-sensitive alkali metals are lithium, sodium, rubidium, and caesium. A platinum connection through the upper part of the bulb contacts the silvered coating and thus the whole of the potassium lining. This electrode is connected to the negative of the battery supply, and the anode to the positive, in this case 90 volts. At one side of the bulb a clear glass space is left through which the operating-light may enter.

When no light enters the cell, no current passes, and when light enters, the current passed is directly proportional to the intensity of the light, so that doubling the strength of the light doubles the amount of current passed. It is this property that renders the cell so very useful for a number of purposes.

The current actually passing with a light of great intensity is extremely small—far less than that generated by a pick-up and too small to be heard in ordinary 'phones. Great amplification is therefore necessary, and in this particular system amounts to between one and two million times when it is delivered from the loudspeakers. The precise amount of amplification is decided by the size of the auditorium.

The action of the photo-electric cell depends upon the fact that when the anode or plate is positively charged, and the light-sensitive surface (cathode) on the inside of the bulb is negatively charged by connection to the respective poles of a battery, the negative electrons with which the cathode is charged cannot leave it until illuminated. The presence of light has the same effect as the heating of a valve filament, so that when the cathode receives a ray of light, electrons are driven off and rush to the positively-charged anode. This electron stream is exactly proportioned to the amount of light entering the cell.

Operating the Photo-Electric Cell.

AN exciting lamp is used to provide the light that passes through the sound record to the photo-electric cell. This lamp is specially made with a short, straight filament, and is rated at 50 candle-power. A miniature projecting system of lenses is provided in a tube about one inch in diameter. Near to the exciting lamp is the usual condensing lens which concentrates the light of the filament upon a narrow horizontal slit near the centre of the tube. The exciting lamp has adjustments in three directions, so that its correct position in relation to the slit may be easily found. In front of the slit is a small objective-lens which