

focuses the image of the illuminated slit upon the sound-track on the film, which in turn communicates the sound vibrations to the photo-electric cell in the form of intermittent light rays of varying intensity and duration.

The feeble current passing even when the cell receives maximum illumination has already been mentioned, and now the process of amplification begins. The high impedance of the photo-electric cell works best with a resistance coupling followed by one stage of transformer coupling. This compact amplifier styled 49A, is fitted with non-microphonic sockets, while the rubberised base is suspended on four spiral springs in its metal housing, which rests on rubber, the whole being compactly stowed away in the lower portion of the machine stand.

Stepping-up the Amplification.

ALL that has so far been described takes place in the "machine" itself, but further amplification is carried out upon a convenient metal rack upon which the subsequent amplifiers and regulating gear are placed.

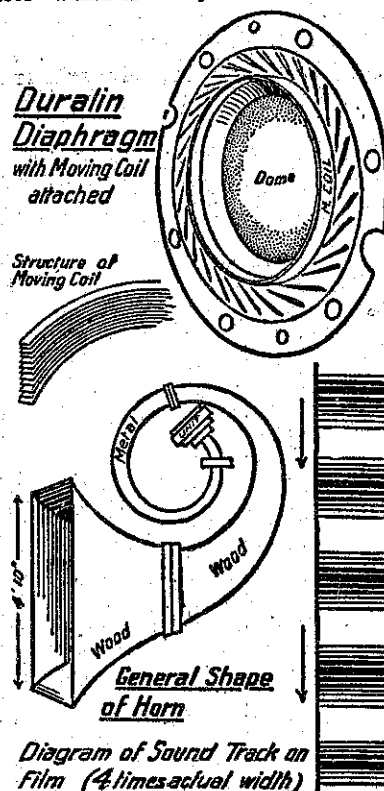
The output from the amplifier on the machine next passes through an "attenuator" or balancing resistances (wire-wound), their purpose being to balance the output of the two machines that are always installed, so that there will be no jump in volume when changing over from one machine to the other.

There is also a "fader," which is merely an electrical potentiometer, and is the main volume control for the loudspeakers. Then there is what is known as the "non-synchronous" panel, providing for switching on to the amplifier either the ordinary gramophone turntable or the switch on the machine which changes from synchronous disc to film record or vice-versa.

The first amplifier on the rack consists of three stages of resistance-coupling with "239" valves, having an impedance of 15,000 to 20,000 ohms and a 4-volt filament. A 12-volt accumulator is included in the plant, so the three

valves in this amplifier are wired in series to utilise the 12-volt supply and also obtain grid-bias from it, whilst the necessary plate current is drawn from the succeeding amplifier, which is entirely a.c. operated.

Here follows the "main gain control" which is really a volume control



with switch studs. Its use is to "calibrate" the theatre, or fix the available volume so that the "fader" has a range suited to the requirements of the building. Once set correctly, this control is not altered.

The next amplifier is known as the "42A," and consists of one stage of push-pull with a pair of 205D valves,

5-watt rating, with an impedance of 6000 to 7000 ohms (a valve approximately similar to the UX210). Two of these valves are also used as rectifiers, supplying a total of 57 m.a. to the two plates at 400 volts. The filaments take 1.60 amps. at 4 to 5 volts, or a mean of 4.4 volts. Special precautions in the form of filters and resistances are included to eliminate motor-boating and hum. This and succeeding stages are all transformer coupled, the transformer cores being made of "permaloid," a specially high-grade alloy suited to the purpose, and adding to the excellence of reproduction, whilst a further refinement is provided by allowing only the alternating component of the signal to traverse the primary windings of transformers, a coupling condenser being employed to divert the direct current through an audio choke or suitable resistance. This method applies to each push-pull stage.

The power output of this stage is 2.4 watts, and for a theatre containing 700 to 800 seats, is the final amplifier, completing the "2S" system.

For larger auditoriums a further push-pull amplifier known as the "43A" is required. This is also completely a.c. operated, and contains a pair of 211B valves as amplifiers, and another pair of rectifiers. The plate current taken by this stage is 125 m.a. The output now available to operate loudspeakers is 12 watts, and sufficient for the average theatre, being known as the "2SX" system.

For the largest theatres the 2SX system is used, with the addition of another 43A amplifier, which is wired in parallel with the one already provided, the output now being 24 watts, which operates six loudspeakers at full volume.

All the apparatus used is manufactured to suit a standard supply of 110 volts, so that where the supply is 230 or other voltage, a transformer is employed to supply 110 volts to the amplifiers.

An impedance-matching panel takes the output of the last amplifier in the system, which passes through an auto-transformer with tapings taken to switches on the panel. Each speaker unit is also connected to a switch, so that by selecting the correct tapings the impedance of each unit—all units are in parallel—is matched against the impedance of the system.

This feature of matching impedances throughout the circuit from photo-electric cell to loudspeakers is a large factor in the success of the system.

In the next issue the writer will describe in detail the huge loudspeakers that complete the talkie equipment.

two very large permanent magnets. It is light, being only slightly heavier than a good cone. The cone is suspended somewhat similarly to the dynamic, and as a result of the lateral movement between the pole pieces there is fully 3 in. play. The cone is 10 inches in diameter, and it is intended to be placed behind a baffle, which can quite conveniently be that of a dynamic speaker. The delicate moving parts are enclosed so that they will stand hard knocks, and it appears not easy to put the speaker out of adjustment.

For our tests the speaker was placed behind a baffle, and fed in turn by a power amplifier and an ordinary two-valve amplifier, by weak and strong signals, and by constant frequency notes from 43 to 8000 cycles a second. It was compared with both our standard moving coil and magnetic speaker. As a result the following data has been acquired:—

1. It will take at least four watts without distortion or rattle. As comfortable room strength is one to two watts, depending on the size of the room, it will handle ample power for most general purposes. In fact, at one stage an amplifier such as that used with small sound film plants was employed and the Farrand stood up to the output without signs of overload.

2. It is almost as sensitive as a cone and slightly more sensitive than our standard moving coil. It works satisfactorily from a two-valve amplifier on both broadcast and gramophone reproduction. Even when 90 volts are on the plate the speaker performs well.

3. The frequency range is from below 43 to 8000, a range consistent with excellent reproduction. The curve is practically flat between 50 and 6000 cycles with very few peaks. A range such as this is not usual. During the test at the lower frequencies the cone could be observed vibrating at least 1-8 inch, and yet there was room for further movement. We did not locate any resonance peaks.

4. The reproduction is both pleasing and natural, giving a freedom from boom and screech—a pleasing quality in these times when the tendency is grossly to over-emphasise the bass. Within the range, which includes that of all notes within the working musical range, there is even amplification. The instruments in both bass and treble are clearly defined, and there is an absence of mushiness.

The introduction of a speaker such as this will mean a great step forward in loudspeaker design.

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Laboratory Jottings

Farrand Inductor Dynamic Speaker

L. M. SILVER and Co. have secured the New Zealand agency for the Farrand Inductor dynamic speakers, the principle of which type was described last week. One of these speakers has been tested by our laboratory, and has put up a very creditable record.

In external appearance the Farrand resembles a magnetic cone unit with