How Movie Film Switches "Sound" Discs

Automatic Switch of New Double Turntable Effects Continuous Operation with a Single Projector

By A. WYETH*

ONE of the primary rules of good showmanship decrees that the show shall proceed continuously and without avoidable interruptions. In order to meet the above requirements to the letter, in the case of a regular theatre's sound-picture performance, two projectors are necessary; while one projector is in operation the other projector is being threaded with the successive reel of film to be shown. At a predetermined time (indicated either on the film or by means of a cue sheet accompanying the film) the operator starts the second projector and, when the machine is up to full speed, a shutter is dropped in its line of projection and a like shutter is removed from the line of projection of the incoming machine. The shutter operation takes place instantaneously; with the result that it is practically impossible to detect the changeover from one machine to the other. Since there is no recorded sound corresponding to the extreme beginning and end of each reel of film, there will be no break in the reproduction when switching the amplifier to the incoming projector. (*See the articles on modern sound projection, in the Feb. to June,* 1930, *issues of* RADIO-CRAFT.)

Notwithstanding the advantages of a double-projector installation, there are thousands of single-projector installations scattered throughout the world. These small installations are generally in clubs and private homes in this country, but abroad there are many small theatres having but one projector. If the customary type of sound-on-disc reproduction attachment is installed on a single-projector installation, it becomes necessary to re-thread the projector and change records at the end of each 1,000-foot length of film. Now, since the quantity of sound which may be recorded on a 16-inch record corresponds in running time to approximately this length of film, it is obvious that, for a feature picture consisting of about 10,000 feet of film, the showing would be interrupted ten times merely for the purpose of changing records and reels.

These frequent interruptions could be avoided if some method could be devised for automatically changing from one to another synchronous turntable at the end of each 1,000-foot reel of film. (The showing of the picture could then be carried on continuously as long as film remained in the upper projector magazine).

The double turntable automatic changeover described here and pictured in Fig. A automatically accomplishes the changeover from disc to disc; and the length of one uninterrupted showing therefore depends on how many 1,000-foot lengths of film, *cemented together to make one large reel,* can be accommodated in the projector film magazine.

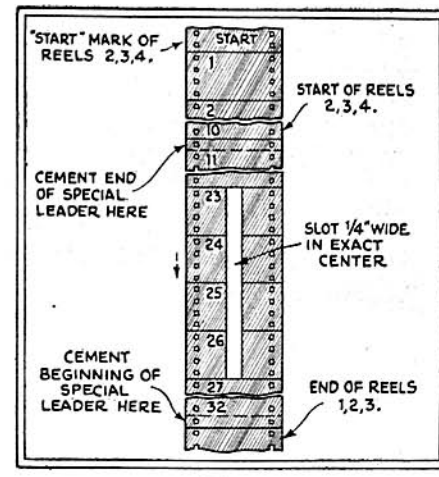

Fig. 1

Successive reels of film are patched with a "leader," the slot in which permits an electrical contact to be closed through a relay.

Fig. A

The double turntable carrying incoming and offgoing sound discs; the change is made automatically as a reel of film goes off, by the mechanism between the turntables, shown in detail on the opposite page.

Large standard magazines are of such size as to accommodate 4,000 feet of film, which length takes slightly over forty minutes to run through the projector at the prescribed speed of ninety feet per minute. On this basis then, only two interruptions are necessary in the showing of a ten- or twelve- reel feature picture, compared with as many interruptions as there are records when the ordinary single synchronous turntable is used.

For the sake of clarity, it may be well to outline briefly at this point the operation of the double turntable. Short strips of slotted "leader" (length of blank film) are cemented between the four 1000-foot lengths of film (See Fig. 1) and, as these slotted portions pass over a specially constructed roller in the projector, (diagramed in Fig. 2) an electric circuit is closed through a magnetic-clutch mechanism (Shown at 1, Fig. B.). The actuation of the clutch immediately causes the incoming turntable to start up in exact synchronism with each succeeding 1,000-foot length of film. The electrical circuit by which this is accomplished is shown in Fig. 3. As soon as the changeover has been completed, the outgoing turntable is then manually disengaged from its driving source and allowed to stop in order to change the record and place the pickup needle at the "starting point" in readiness for the next changeover.

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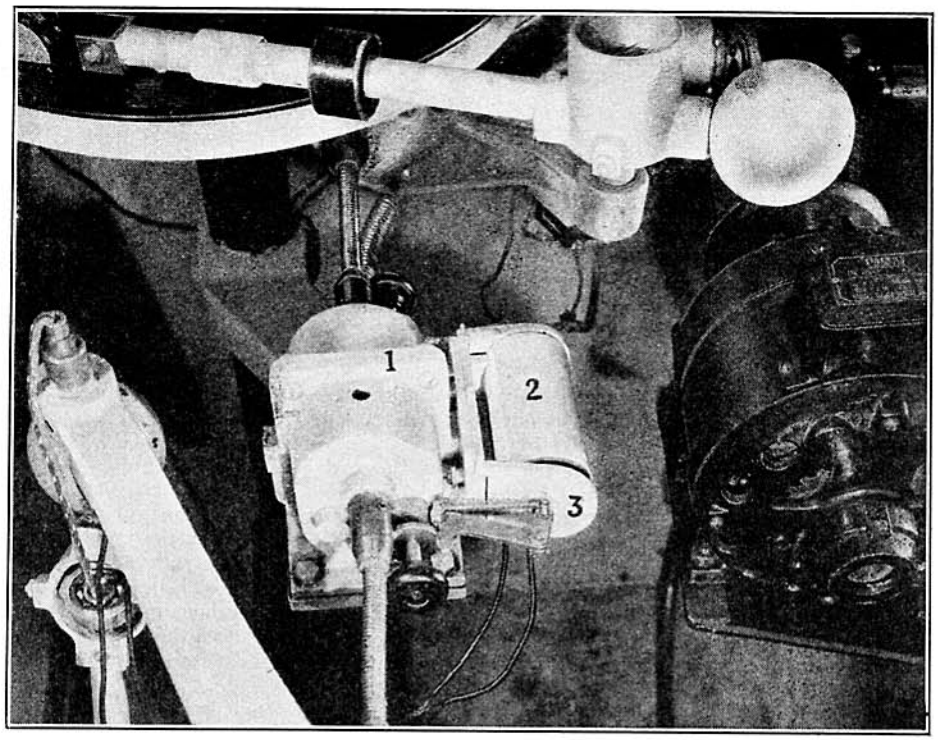

Fig. B (above)
A close-up of the clutch-release mechanism which starts the "incoming" turntable.

Right, the manner in which the slotted film is used as a switch.

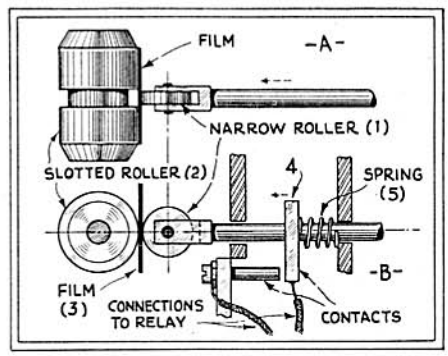

Fig. 2

The process of changing from one disc to another, as outlined, is continued until the four 1,000-foot strips of film, which were previously cemented together with the three slotted-strip sections, have been run through the projector. It is then necessary, of course, to stop the projector, remove the reel of film which has been shown and re-thread the machine with the succeeding 4,000-foot composite reel. Next, the following record to be played is placed on one of the turntables and the pickup properly located before restarting the projector.

Fig. A is a view of the double automatic synchronous turntable and driving mechanism. The two turntable discs are alternately driven by means of a flexible-shaft drive extending to the projector gearbox, which may be seen directly behind the counterbalance weight of the farther pickup arm. The shaft extending from the right of the gearbox drives the projector, and the shaft projecting from its left side drives the turntables through a specially designed clutch mechanism; a closeup view of which is shown in Fig. B. To the right of the picture may be seen the projector driving motor. From the opposite ends of the clutch housing extend spiral-wound turntable driving shafts which terminate at the turntable gearboxes. Mounted on the right side of the housing is the clutch release magnet 2 which is energized at the instant of change-over. At each end of the electromagnet is a hinged armature provided with a grab hook (See Fig. 3). Normally a spring holds the armature away from the magnet in the position shown at 3, Fig. B. When the knob and the plunger are in the position illustrated, the nearer turntable is mechanically disengaged from the continuously revolving gear system within the housing. The plunger is held in the disengaged position by the grab hook and may be released when the armature is drawn toward the magnet.

Operation by Slotted Film

Assume that the projector has been threaded in the usual manner, and the pick-up on the turntable to be used first has been placed at the starting point of the record. The turntable drive shaft is next engaged with the flexible drive shaft from the projector gearbox, by manually pulling out the knob which, in this position, engages the clutch mechanism. Before the projector motor is started, the second turntable is disengaged from the driving source by pushing its clutch knob all the way in and allowing the grab hook to catch the edge of the plunger collar. While the projector is in operation, the succeeding record to be played is placed on the second turntable and the pickup properly located.

When the end of the first 1,000-foot length of film has been reached, the slotted leader passes between the rollers shown in detail in Fig. 2. The narrow roller (1) projects through the slotted portion of the film (3) during its passage, thus bringing together the two contacts shown in the picture and closing a primary circuit through a relay. The operation of the relay causes the clutch magnet to be momentarily energized which trips the armature; thus allowing the clutch shaft to spring back and cause the incoming turntable to start. Since the slotted strips of film are cemented in a given relation to the "start frames," the incoming turntable will commence revolving at the same instant that this frame is passing through the picture gate. Accurate synchronization between the disc and film is thus assured.

Fig. C is a closeup view of the special film rollers and film switch assembly, which

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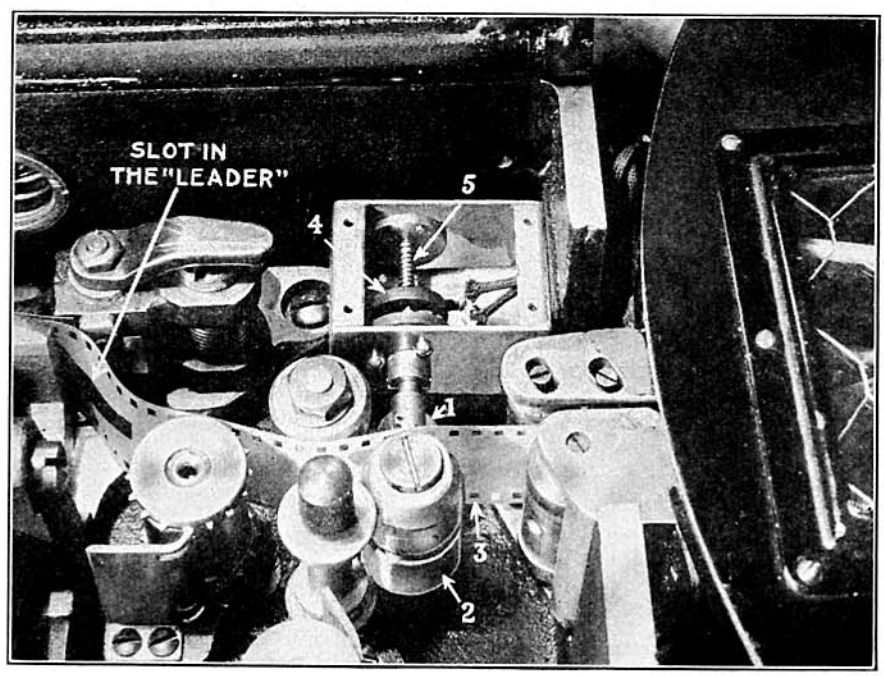

Fig. C
A view of the film-rollers between which contact is effected, as shown in diagram form above in Fig. 2 (The figures in the two diagrams correspond). At the left will be seen the central slot, in the vertical film, by which the mechanism shown in Figs. B and 3 is started.

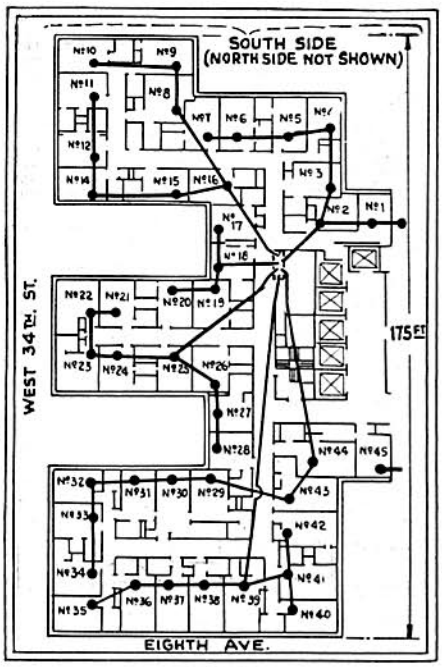

Fig. 1

The south half of a typical floor of the Hotel New Yorker, showing radio distributing system.

two stations broadcasting such events, if we assume that the entire house will listen on either of these two channels, our average maximum should be 1250 listeners on each channel.

Now, if provision is made for additional power output for such occasions, it should be possible to reduce the size of the regular amplifier. Therefore let us take as an average working value a number somewhere between our assumed minimum and maximum values; 800 is an excellent figure which should fit the final solution. Having decided on 800 as our average number of speakers, we must next realize that our speaker impedance must be fairly high in order to have negligible effect when a group is thrown on or off the line. The actual design of such a loud speaker is beyond the scope of this article; but an impedance of 1000 ohms is satisfactory.

Distributing the Load

Now if we put 800 speakers all in parallel, and each speaker's impedance is 1000 ohms, then our total impedance is 1.25 ohms (1000 divided by 800).

An output transformer with a secondary of 1.25 ohms would have to be built with a fairly heavy wire. If, however, we could double the total output impedance not only could we decrease the size of the wire but the impedance value itself would be much easier to match in the transformer.

To double the output impedance we must either cut our total average number of speakers down to 400 or increase the individual speaker's impedance from 1000 ohms to 2000 ohms. Either way will accomplish our purpose, but the most logical and best method however would be the former. That is, we build two amplifiers, each of which would supply 400 speakers; then, by connecting the inputs together, it is possible to supply the load with the same input. This is the method used here.

Our total output impedance should now be that of 400 speakers in parallel, or 2.5 ohms; which is just twice the value with 800 speakers. So that we have broken our output into two equal branches, each having an impedance of 2.5 ohms. Let us now suppose that our line is fully loaded, or that 400 speakers are in use; and that, suddenly, 100 speakers are thrown off the line, leaving the remaining 300 still connected. Our impedance variation will be from 2.5 to 3.33 ohms, which is negligible in effect. The loud-speaker load in the hotel can be compared to that of an ordinary electric lighting system, where the actual load is fairly constant except during peak hours. This is due to the fact that, as one load speaker is thrown on another is thrown off.

The frequency response of the installation is excellent; the most important reason for this is that with line impedance of such a low value, the impedance variation with frequency change is very low. This results in a uniform distribution with surprisingly good reception. Also the fact, that almost the entire load may be thrown on or off the line with little if any effect on the reception, helps the response-characteristic to "keep its figure".

Tests made on the type of loud speaker used here indicate that 50 milliwatts is ample power for the average hotel room. Therefore, since our unit amplifier must supply 400 speakers, each must have a power of twenty watts. Since there are four channels, and as each channel requires two 20-watt amplifiers, a total of eight are used to supply the entire load.

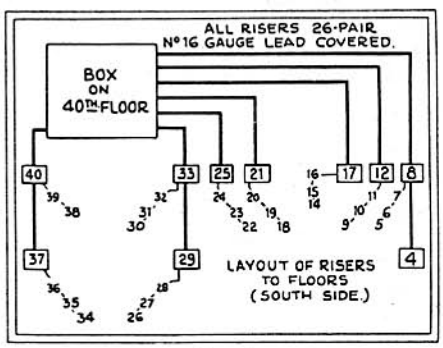

Fig. 2

The risers to different floors branch off from the shaft as shown.

(To be continued)

Double Turntable

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are shown diagrammatically in Fig. 2. The narrow roller (1) which rides over the surface of the film (3) is partly visible behind the large slotted roller, (2). The former roller is held in contact with the film by means of the spiral spring (5) visible in the film switch assembly. This spring pushes the narrow roller into the slotted leader, thus allowing the contacts of the film switch to come together.

Fig. 3 shows the electrical connections of the film switch, relay, and clutch magnet. Since the current necessary for the operation of the magnet is too great to be handled by the delicate contacts in the film switch,

a relay is provided and connected as shown in the diagram.

Fig. 1 shows the slotted leader. The slot is a quarter of an inch wide and extends along the center of the film for a distance equal to four picture frames. The total length of the leader is equivalent to twenty-two picture frames, or a little over sixteen inches. One end of the leader is cemented to the end of the first 1,000-foot length of film, and the opposite end is cemented to the beginning of the second reel—exactly ten picture frames ahead of the "start frame." Successive leaders are cemented between reels in the same manner as described above.

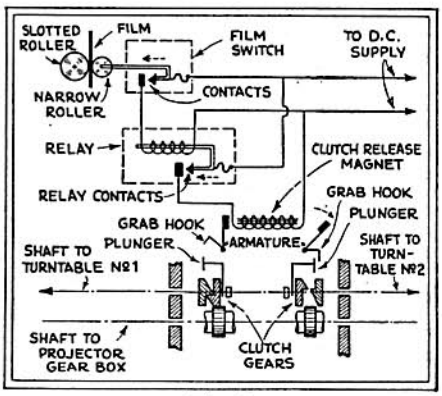

Fig. 3

The slot in the film serves as a switch to operate the relays shown, which change over discs.

The double turntable is economical in first cost and is readily attachable to any standard-make projector (using any size of film from 16 to 32 mm.). By its use, the purchasing of an additional projector and associated sound reproduction attachments are rendered unnecessary, since the results obtained will be more than satisfactory for all small installations. The double unit may be used in connection with a sound-on-film attachment, if this added feature is desired.

SEVEN-METER TELEPHONY

THE radio-telephone apparatus to be used in the new ultra-short-wave system, linking the Hawaiian Islands, represents the highest-frequency equipment yet utilized outside of the laboratory; and special construction is necessitated by tropical climates. Eight stations, on the island of Oahu (the "central"), Hawaii, Maui and Kauai, serve as links in the wire system of Hawaii, which also has a radiophone connection to the Bell System lines on the continent. They will operate between 7 and 8 meters (43 to 37.5 million cycles) and, because of the peculiar phenomena of extremely short waves which travel only in a horizontal plane, it will be necessary to erect the apparatus on the summits of extinct volcanoes in order to secure sufficient elevation to overcome the earth's curvature.

The transmitting and receiving apparatus are enclosed in specially-insulated cases to protect the mechanism from tropical insects, moisture and volcanic gases. Most of the metal parts are of brass to prevent rusting, and the condensers are made of a special alloy with a zero temperature-coefficient, so that varying temperatures will not affect the delicate tuning adjustments.