

May 5, 1936.

S. A. MURDOCK

2,039,735

SYNCHRONIZED TALKING PICTURE SYSTEM

Filed Feb. 2, 1934

4 Sheets-Sheet 1

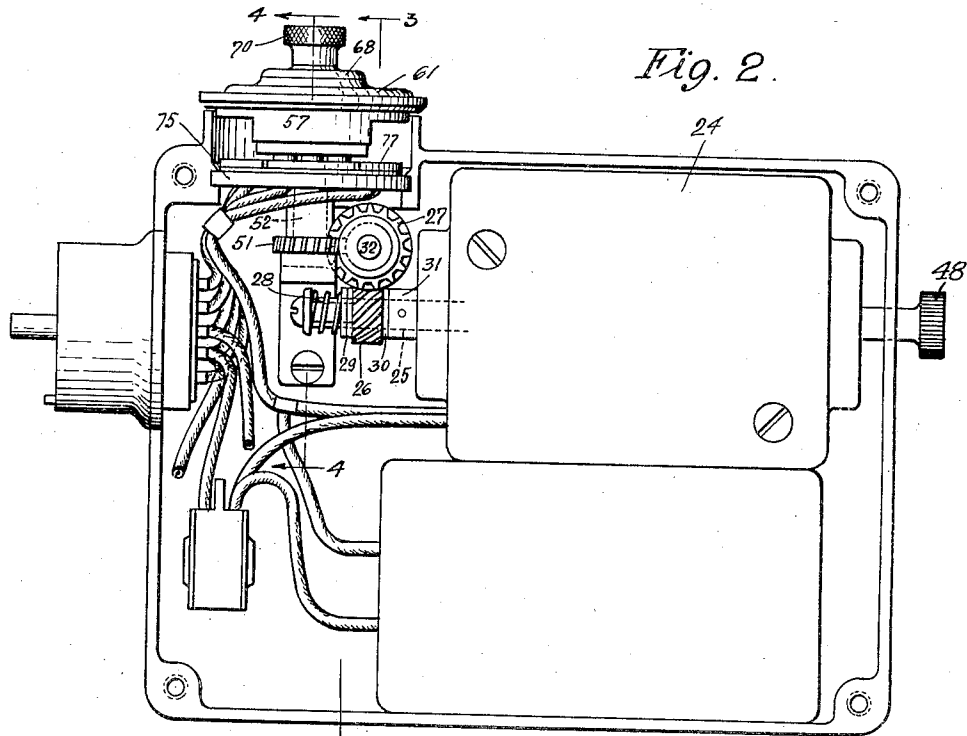


Fig. 2.

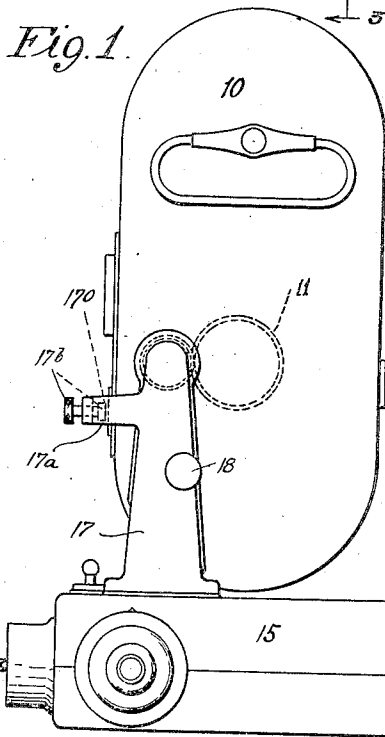


Fig. 1.

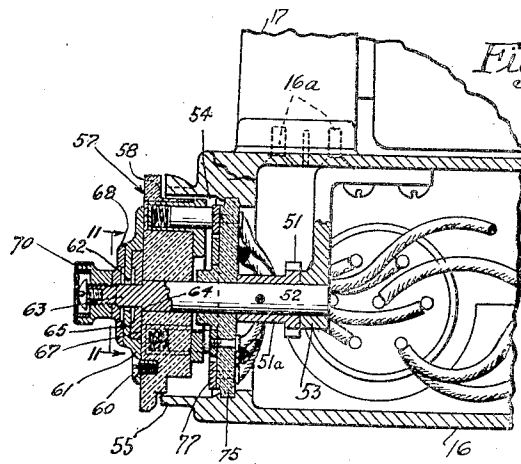


Fig. 4.

Fig. 12. 68a 68 63
Inventor: Sidney A. Murdock.

Fig. 13. 67a 67
Attorney.

May 5, 1936.

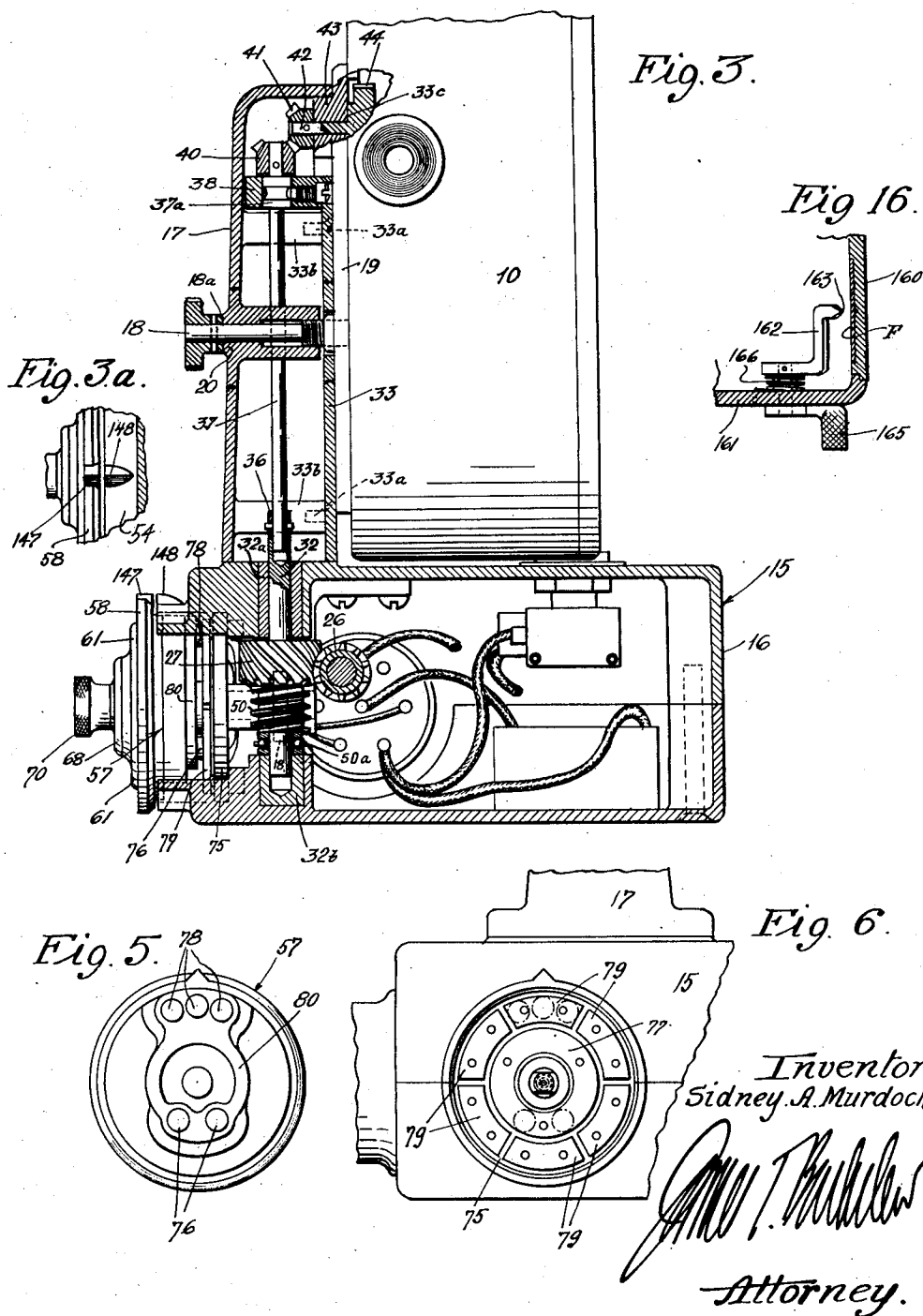
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SYNCHRONIZED TALKING PICTURE SYSTEM

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4 Sheets-Sheet 2



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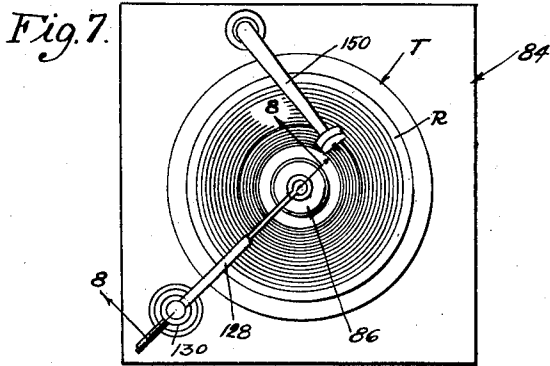
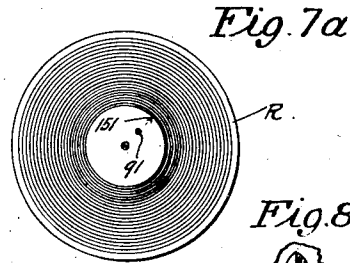
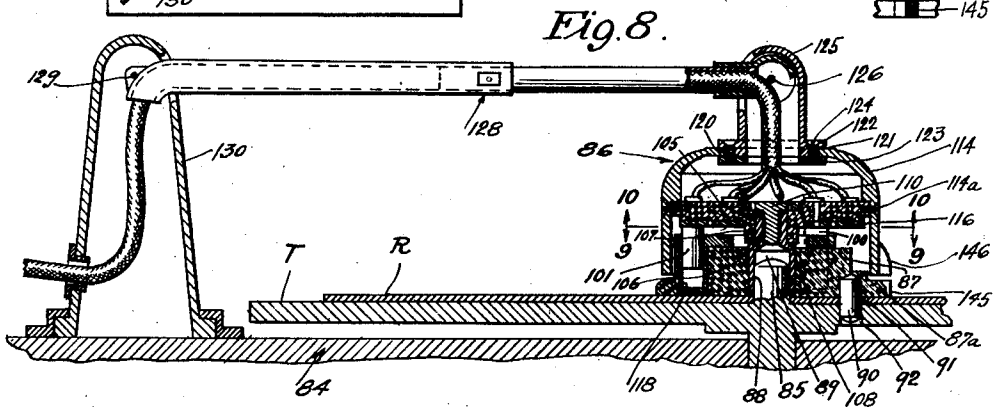
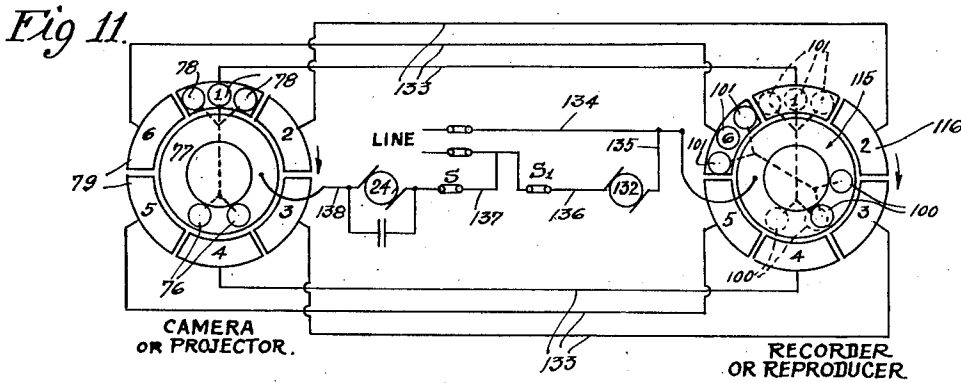
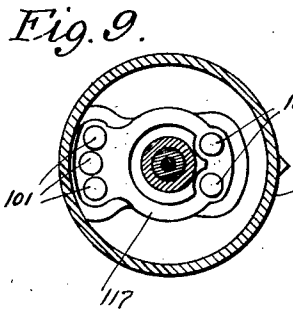
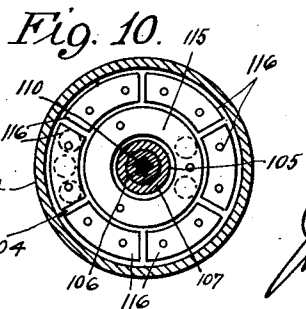
S. A. MURDOCK

2,039,735

SYNCHRONIZED TALKING PICTURE SYSTEM

Filed Feb. 2, 1934

4 Sheets-Sheet 3



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2,039,735

SYNCHRONIZED TALKING PICTURE SYSTEM

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4 Sheets-Sheet 4

Fig. 14.

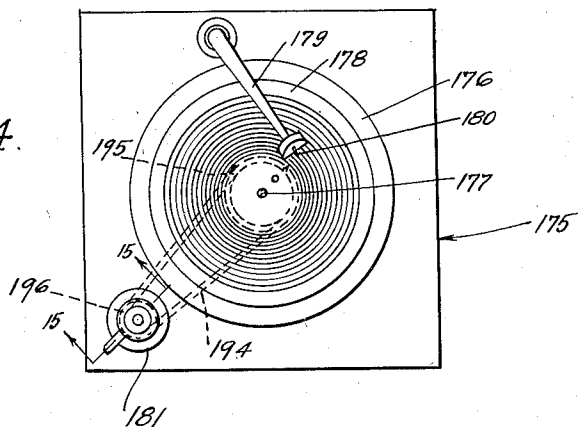
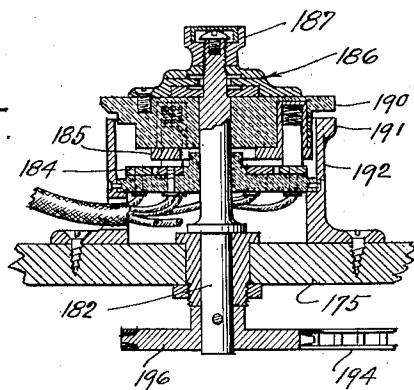


Fig. 15.



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Sidney A. Murdock.

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UNITED STATES PATENT OFFICE

2,039,735

SYNCHRONIZED TALKING PICTURE
SYSTEM

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by mesne assignments, to Syncro Sound, Inc.,
Los Angeles, Calif., a corporation of California

Application February 2, 1934, Serial No. 709,448

5 Claims. (Cl. 88—16.2)

This invention has to do generally with syn-
chronization of two machines, and more par-
ticularly with the synchronization of motion pic-
ture cameras and projectors with sound re-
corders and reproducers. The present invention
may be considered as an improvement upon the
devices shown in my prior Patent No. 1,736,323,
dated November 19, 1929, and my copending ap-
plication entitled Synchronized talking picture
system, filed August 22, 1933, Ser. No. 686,218.

The devices of said prior patent and applica-
tion involved certain operations in the procedure
of so setting the sound and picture machines
that the sound record disc and film would start
in exact synchronism with each other, which re-
quired the expenditure of considerable time and
attention to detail, and which was tedious and
difficult for the average user to perform.

It is accordingly a primary object of the pres-
ent invention to provide a synchronous setting
means for a talking picture system of the type in
question, which is most simple and convenient to
understand and operate.

A further object of the invention is to provide
an improved camera attachment synchronizing
device which may readily be attached to a stand-
ard camera and which may be utilized as a base
and support for the camera.

It is a further object of the invention to provide
an improved synchronizing attachment for the
sound recorder, or reproducer, as the case may be.

The invention will now best be understood
without further preliminary discussion by refer-
ring to the following detailed description of a
present preferred embodiment thereof, refer-
ence for this purpose being had to the accom-
panying drawings, in which:

Fig. 1 is a side elevation of a typical motion
picture camera with the synchronizing attach-
ment device secured to it and serving as a camera
mounting and base;

Fig. 2 is a view looking upwardly into the
camera attachment shown in Fig. 1, the base
member of said attachment being removed;

Fig. 3 is a section taken on line 3—3 of Fig. 2;
Fig. 3a is a detail plan view of index points
on the device shown in Fig. 3;

Fig. 4 is a section taken on line 4—4 of Fig. 2;

Fig. 5 is a detail view looking at the inner face
of the rotating brush holder of Fig. 3;

Fig. 6 is a view looking at the commutator
segment plate of Fig. 3 after removal of the ro-
tating brush holder plate;

Fig. 7 is a view typifying either a sound re-

corder or reproducer, and being a plan view
looking toward the record table of such a device;

Fig. 7a is a view of a sound record such as used
on the recorder;

Fig. 8 is a section taken on line 8—8 of Fig. 7;

Fig. 8a is a detail elevational view of register-
ing index points on the device of Fig. 8;

Fig. 9 is a section taken on line 9—9 of Fig. 8;

Fig. 10 is a section taken on line 10—10 of
Fig. 8;

Fig. 11 is a diagram illustrating the electrical
circuiting of the system;

Fig. 12 is a detail section taken on line 11—11
of Fig. 4;

Fig. 13 is a detail elevation of a clamping
washer;

Fig. 14 is a plan view of a sound record ma-
chine showing a modified arrangement of the in-
vention;

Fig. 15 is a section on line 15—15 of Fig. 14;
and

Fig. 16 is a sectional detail view of a portion
of the camera, showing a film indexing device.

It will be understood that the present syn-
chronizing system is applicable both to syn-
chronization of the camera and sound recorder
during initial taking, and to a motion picture pro-
jector and sound reproducer during subsequent
reproduction. The invention will here be prin-
cipally illustrated as applied to the case of syn-
chronization of a camera and sound recorder, it
being obvious that this typification will serve to
fully disclose the invention as applied to syn-
chronization of sound reproducers and pro-
jectors as well. For the purpose of the claims,
the expression "sound record machine" will be
used to denote either a sound recorder or repro-
ducer and the expression kinetograph will be used
to denote either a camera or projector.

In Figs. 1 and 3 the motion picture camera is
indicated generally by numeral 10, and this cam-
era may be any motion picture camera, still pro-
vided, if desired, with its own usual spring motor
operatively in place. The camera motor is not
shown in the drawings, although a driving gear
which may be understood as directly connected
through suitable gearing to the camera motor,
and film moving means, is indicated in dotted
lines at 11 in Fig. 1, and this gear 11, which will
be understood as being a part of the original
driving mechanism of the camera, will be a suffi-
cient illustration of that driving mechanism for
the purpose of a disclosure of the present inven-
tion.

Numeral 15 designates generally the synchro-

nizing camera attachment unit, which contains a synchronizing motor, commutator and other parts to be described. The case 16 of this unit 15 is in the present instance of rectangular form and is adapted to rest flat down on a horizontal surface. Mounted on the upper side of this case is a vertical standard 17 which is adapted to engage and support camera 10 in a position immediately above unit 15, in the manner clearly shown in Figs. 1 and 3. Standard 17 is provided with a clamping screw 18 which is adapted to screw-thread into an adapter plate 19 attached to the side of the camera, shoulder 18a of the screw engaging a boss 20 on the standard when the screw is threaded home to secure the camera tightly against the standard.

Within casing 16 is mounted an electric driving motor 24 (see Fig. 2), which is preferably series wound and adapted for operation on alternating current. The shaft 25 of this motor carries a spiral gear 26 which meshes with a spiral gear 27. In the embodiment here shown gear 26 is loose on its shaft and is frictionally but yieldingly held against rotation thereon by means of a spring 28 which presses against washers 29 bearing against one side of said gear, the other side of this gear bearing against a washer 30 and which in turn bears against a collar 31 pinned on the shaft. Gear 27 is fast on a vertical shaft 32 mounted in upper and lower bearings 32a and 32b, respectively, mounted in the upper and lower sides of casing 16, and provided with a suitable thrust bearing to be described later.

Shaft 32 is in vertical alignment with the aforementioned vertical standard 17, which standard comprises a hollow casting, open at the bottom and along its side adjacent the camera, and is fastened down to case 16 as by screws 16a. The standard 17 is provided on its open side with a closing plate 33 adapted to come face to face against camera plate 19, plate 33 being affixed to standard 17 by means of screws 33a which screw-thread into bosses 33b in standard 17. Plate 33 terminates short of the upper end of the open side of standard 17 so as to leave an opening 33c adjacent the camera, through which is received a certain shaft and gear mounted on the camera, as shortly to be described.

The upper end of shaft 32 is drivingly coupled at 36 to a vertical shaft 37 that extends upwardly through standard 17. Near its upper end shaft 37 is formed with an enlarged portion 37a which is provided with a bearing 38 formed on the upper end of closing plate 33, and on the extreme upper end of shaft 37 is pinned a bevel gear 40. Gear 40 meshes with a similar bevel gear 41 mounted on the outer end of a shaft 42 which is journaled in a suitable bearing 43 formed on the upper end of adapter plate 19, the inner end of said shaft 42 having a spur gear 44 which meshes with the aforementioned camera driving means gear 11.

Thus the motor 24 mounted in attachment unit 15 and the driving mechanism of the camera are drivingly interconnected. The driving mechanism of the camera, usually a spring motor, is not ordinarily sufficiently powerful to drive the gearing described in the preceding paragraph, whereas motor 24 may be sufficiently powerful to drive said gearing and the camera driving mechanism. As a result, the camera can operate only at the speed permitted by the speed of rotation of motor 24. The camera mechanism may then operate, under the power of its own motor, at the speed determined by the speed of motor 24

in unit 15, or, if desired, motor 24 may be made sufficiently powerful to actually assume the drive of the camera mechanism, the camera motor then no longer being depended upon for power in such operation. As shown in Fig. 2, the shaft of motor 24 extends outwardly through the side wall of case 16 and has on its outer end a knurled operating knob 48 by which the described mechanism may be manually operated to move the camera mechanism in adjusting the position of the film therein.

Mounted on the vertical shaft 32 immediately below spiral gear 27 is a worm gear 50 that meshes with a worm wheel 51 on horizontal commutator shaft 52. A thrust bearing 50a may be placed between gear 50 and the upper end of bearing 32b. Commutator shaft 52 rotates in a bearing 53 mounted within casing 16, and extends outwardly from said bearing through a circular opening 54 formed in the side of casing 16, opening 54 being defined by an outwardly projecting annular flange 55. Rotatably mounted on shaft 52, near the outer end thereof, is a brush carrying disc 57 of insulating material. This disc is received partially within the opening defined by flange 55, but has an outer flange or rim 58 immediately outside of flange 55 which is of slightly larger diameter than the diameter of said flange, all as clearly shown in Fig. 4.

As stated in the preceding paragraph, disc 57 is rotatably mounted on shaft 52. Means are then provided for quickly and conveniently clamping disc 57 to shaft 52 to rotate therewith. Fastened to the exterior surface of disc 58, as by screw 60, is a disc 61, said disc having a central circular opening 62 for passage of the flattened extremity 63 of shaft 52. Mounted on flattened shaft extremity 63 immediately adjacent shaft shoulders 64 and disposed within a counter-sink 65 formed in the inner side of disc 61 is a clamping washer 67, which has a flattened opening 67a receiving the flattened shaft section 63, and mounted on said shaft section 63 immediately adjacent the outer surface of disc 61 is a second clamping washer 68, also having a flattened shaft receiving opening 68a. Both washers 67 and 68 are thus non-rotatably mounted on the shaft, whereas the opening 62 of disc 61 is of sufficient diameter that disc 61 is free to rotate on the shaft. A thumb nut 70 is then screwed on the screw-threaded extremity of shaft 52, and the inner end of said nut 70 is adapted to engage washer 68 and press it and disc 61 against washer 67 and shaft shoulder 64, thus clamping disc 61, and therefore also brush carrying disc 57, against rotation on shaft 52. When it is desired to rotate disc 57 with reference to shaft 52, it is then only necessary to back off thumb nut 70 a fraction of a turn, which frees the brush carrier for rotative adjustment on the shaft. After such adjustment, which is made in the manner hereafter to be described, a simple turn of nut 70 locks the brush carrier in synchronous starting position on its shaft 52. Since both washers 67 and 68 are prevented from rotation on shaft 52, it is impossible to disturb the setting of disc 57 when tightening or loosening thumb nut 70.

Mounted on insulating brush carrier 57 are two sets of brushes which are adapted to wipe on certain electrical contacts mounted on an insulating commutator disc 75 mounted in the casing. This disc 75 also serves as a second bearing for shaft 52, and the sleeve 51a of gear 51 mounted on shaft 52 comes against the inner surface of disc 75 and so holds shaft 52 against end play.

The pair of brushes 76 are set in such a position on brush carrier disc 57 as to wipe over the stationary collector ring 77 on disc 75, while the three adjacent brushes 78 are set in such position as to wipe over the six stationary commutator segments 79 on said disc. All five brushes 76 and 78 are electrically interconnected by conductive plate 80 with which the sockets of the several brushes are in conductive engagement. The segment contacting brushes 78 are spaced so as to span a distance somewhat less than the circumferential length of a segment, but so that the leading brush will move into engagement with the next segment very soon after the following brush has completely left engagement with the second segment behind. This will be readily understood from the consideration of Fig. 9.

In the particular mechanism here illustrated as typical motor 24 is wound to rotate at a speed of 2160 revolutions per minute. Gears 26 and 27 are then provided with 10 and 15 teeth respectively so that shaft 28 rotates at 1440 revolutions per minute. The ratio between worm 50 and worm wheel 51 is then made 18 to 1, so that commutator or brush carrier shaft 52 rotates at 80 revolutions per minute, which is the normal speed for a phonograph table for reproducing or recording.

The sound recorder (or reproducer) machine 84 (see Figs. 7 and 8) has a usual record table T which is driven at constant speed from a usual motor through a vertical drive shaft 85. A mechanical record disc R is shown on table T in Fig. 7. The machine illustrated in Fig. 7 is shown without the usual feed-screw grooving device, and, in practice, unless such a device is provided, pre-grooved record blanks will of course be used.

A synchronizing commutator attachment 86, having a rotary brush carrier adapted to be synchronized with the rotation of the camera attachment brush carrier, is then provided and arranged to rotate in unison with record table T. Preferably, though not necessarily, this latter attachment is rested directly on record R. As shown in Fig. 8, attachment 86 includes an insulating brush carrier 87, which is adapted to be removably supported on record R, there being provided means whereby the record and brush carrier are releasably held against relative rotation and lateral displacement so that they revolve as one when the record table is rotated. For instance, brush carrier disc 87 is rigidly mounted on a central spindle 88 having a coaxial socket 89 which opens downwardly to take the end of drive shaft 85, the carrier being thereby centered on the record. Positioned pin 90 extends downwardly from the lower face of carrier 87 through record aperture 91 and into table aperture 92, and provides connective means whereby the carrier is driven by record rotation. It also prevents the record from changing its position on the turn table due to the drag of the recording stylus.

The upper side of carrier disc 87 carries two sets of brushes 100 and 101 which may be similar to the sets of brushes 76 and 78 on the camera attachment brush carrier, and these brushes wipe on collector ring and commutator segment elements mounted on the lower side of an insulating commutator disc 104. Disc 104 has a central bore 105 which receives the reduced upper end 106 of spindle 88, and has a central depending boss 107 which is engaged and supported by spindle shoulder 108, disc 104 being mounted on reduced spindle section for free relative rotation

thereon. A flat headed screw 110 screwthreaded into the threaded bore of spindle section 106 confines disc 104 in position on the spindle member, in the manner clearly shown in the drawings, but does not bind disc 104 on the spindle. Commutator disc 104 is mounted within a cap or shell 114, being secured thereto as by screws 114a, and this shell has a mounting, to be detailed hereinafter, which prevents commutator disc 104 from rotating with the brush carrier.

Brushes 100 are set in such a position as to wipe over the stationary collector ring 115 which is mounted on the lower side of disc 104, while brushes 101 are set in such position as to wipe over the six stationary commutator segments 116 mounted on the lower side of disc 104. The several brushes 100 and 101 are electrically interconnected by a conductive plate 117 with which the sockets 118 of the several brushes are in conductive engagement. The segment brushes 101 are again spaced apart so as to span a distance somewhat less than the circumferential length of a segment, but so that the leading brush will move into engagement with the next segment soon after the following brush has completely left engagement with the second segment behind.

The upper portion of cap or casing 86 is turned inwardly, and its upper edge defines an annular opening 120, said upper edge being received within an annular groove 121 formed between upper and lower clamping plates 122 and 123, respectively. These clamping plates are clamped together to secure the upper edge of casing 86 tightly between them as by means of screws 124, and it will be evident that by loosening said screws the casing 86 may be rotatively adjusted with reference to plates 122 and 123. Plate 122 is formed on the lower portion of and integral with a mounting casting 125, to which is pivotally connected, by means of horizontal pivot pin 126, a telescopic mounting arm 128, the rear end of said arm having a horizontal pivot mounting at 129 on a suitable support 130 mounted on the sound recorder to one side of the record table. It will be evident that this support for the attachment permits it to be raised bodily from the record table to change records, and when placed in position, with table drive shaft 85 received within socket 89 and registering pin 90 inserted in apertures 91 and 92, then rotation of record table T and record R will cause rotation of brush carrier 87, while the described mounting for the commutator disc 104 and its casing 125 prevents that portion of the unit from rotating with the record and brush carrier.

I refer now to Fig. 11, which is a wiring circuit of the system. The camera attachment brush carrier driving motor is shown at 24 in Fig. 11, and a motor 132 is shown for the drive of the recorder turntable and hence of the recorder attachment brush carrier. The commutators on the camera and recorder attachment have the same number of segments, in the present instance having six segments each. If the segments are numbered from 1 to 6 in the order of rotation, as they are in Fig. 11, then the correspondingly numbered segments are interconnected by the circuit wires 133. The brush system of each commutator makes a connection between the collector ring and one or more of the commutator segments. One side of the line is connected by lead 134 directly to collector ring 115 of the recorder attachment. Recorder motor 132 is shown connected by lead 135 with said lead 134, and by a

lead 136 which includes a switch S_1 to the other side of the line. The latter side of the line is connected by a lead 137 to one side of the camera attachment commutator motor 24, lead 137 including a switch S , and the other side of motor 24 is connected by a lead 138 to the collector ring 77 of the camera attachment. Assuming first that the brush carriers 57 and 87 of the two commutators are in such position that the segments contacting brushes 78 and 101 are in contact with their respective No. 1 commutator segments (as shown in full lines on the camera attachment commutator and in dotted lines on the recorder attachment commutator in Fig. 11), and assuming further that all switches shown in Fig. 11 are closed, there is a circuit formed from one side of the lines through lead 134 to collector ring 115, and thence through brushes 100 and 101 to the segment No. 1 of the recorder commutator, from segment 1 through connecting wire 133 to segment 1 of the camera attachment commutator, thence through brushes 78 and 76 to collector ring 77, thence by way of lead 138 to camera attachment motor 24, and from the other side of camera attachment motor 24 through switch S and lead 137 to the other side of the line. With the parts in this position current will be supplied to camera attachment motor 24 that will cause it to run ahead, and if the recorder brush carrier is stationary, for instance if switch S_1 is open and current is so cut off from recorder motor 132, motor 24 will run ahead just far enough to carry the brushes 78 of the camera attachment commutator off of segment 1 and onto segment 2, when the motor circuit will be broken and the motor stopped. If, however, the recorder commutator is also in motion, as by the circuit feeding motor 132 being closed at switch S_1 , brushes 101 will arrive at the recorder commutator segment 2 at about the same time that camera attachment brushes 78 arrive at their corresponding segment 2, so that the motor circuit is then closed through those segments. It will be readily understood how the motor circuit is thus kept closed continuously so long as the two brush carriers rotate in unison.

Camera attachment motor 24 is thus energized, when the recorder attachment brush carrier is rotated, through successive pairs of commutator segments 1, 2, 3, etc., its energizing current being interrupted whenever it tends to run ahead. In order to prevent motor 24 and the camera attachment brush carrier from lagging behind, motor 24 is preferably so designed as to have a constant tendency to run ahead; and, having this tendency, and its current being interrupted whenever it does actually get ahead, there is positive assurance that the camera attachment motor 24 will run in synchronism with the operation of the recorder driving motor. And since motor 24 controls the speed of the camera mechanism, the camera and recorder are effectively interlocked to run in synchronous relation with each other.

It will be at once apparent that provision must be made so that the sound recorder and camera will not only run in synchronism after being once started, but will start exactly together. For instance, if no provisions for starting together were made, the camera attachment motor would be energized whenever the recorder brush carrier reached a point to send current through the particular segment on which the camera attachment brushes then rested, and this might occur substantially at once, or just as likely not until nearly a revolution

of the sound record had occurred. In the case of 80 revolutions per minute for the sound record table and 90 feet per minute for the film, which is a common standard, there are eighteen picture frames per record revolution, and the film could accordingly start eighteen frames out of step with the sound record. This would obviously be a fatal disability, and means are accordingly provided for simply and conveniently setting the brush carrier devices in a predetermined synchronous starting position from which the camera and recorder always start together when the proper switches are operated. The synchronous starting position for the brushes is shown in the full lines of Fig. 11, the camera attachment brushes being in contact with a given segment, and the recorder attachment brushes being in contact with the segment which is electrically one step behind, as are contacts 1 of the camera commutator and 6 of the recorder commutator in Fig. 11. The brushes being placed in this position, with setting switch S closed and running switch S_1 (which energizes the recorder motor) open, it will be obvious that no current will flow through the circuit that energizes motor 24; but when switch S_1 is closed, motor 132 will start rotation of brushes 116, which will at once contact the adjacent segment 1, and hence at once cause energization of motor 24 to start the camera. From the described starting position, therefore, the camera and recorder pick up and begin operation in proper synchronous relation when switch S_1 is closed.

To place the brush carriers in the described starting position, certain indexes are provided. As shown in Figs. 8 and 8a, the lower edge of commutator disc casing 114 is disposed adjacent brush carrier disc flange 87a, and said flange 87a is provided with an index point 145 which is adapted to register with an index point 146 on the lower edge of casing 86 when the brush carrier and brushes of the recorder commutator are in the position relative to the commutator segments as illustrated in Fig. 11; while the rim 58 of the brush carrier disc of the camera attachment is provided with an index point 147 which is adapted to register with an index point 148 on the flange 54 of casing 16 when the brush carrier and brushes of the camera attachment commutator are in the position relative to the commutator segments and to the recorder brush carrier as illustrated in Fig. 11. It will be noted that the characteristic of this indexed starting position is that the segment contacting brushes of the controlling unit (here the recorder) are in contact with a segment which is electrically one step behind the segment contacted at that time by the segment contacting brushes of the other unit (here the camera and its attachment).

In order to align these pairs of index points, it is only necessary for the operator, in the case of the recorder, to turn the record table until the index points 145 and 146 register, and in the case of the camera attachment to loosen thumb screw 70 to free the brush carrier disc for rotative adjustment on its shaft 52, and then to grasp the brush carrier disc by its rim 58 and rotate it about shaft 52 until the index points 147 and 148 are registered, after which screw 70 is retightened.

The procedure for taking a talking picture is as follows: Switches S and S_1 being open, a record blank R is first placed on the record table of the recorder, and the recorder attachment then placed down on it, with its offset registering pin 90 in-

serted in aperture 91 which is provided in the record to one side of the usual central opening which receives the center drive shaft of the table. The recorder is provided with the usual cutting stylus and swinging supporting arm, as indicated at 150 in Fig. 7. The record table is rotated until index points 145 and 146 are in register, and the cutting stylus is then lowered into engagement with the record at the beginning of the recording area. In the present instance, the recording stylus may be considered as beginning to cut at the inside of the recording area and working outwardly. Preferably, for reasons of practical convenience, though this is not essential, arrangements are so made that the offset record aperture 91 is located in a line with the record center and with the stylus when the index points are registered and the apparatus is ready to start. This will result in a record such as shown in Fig. 7a, where the beginning point 151 of the record groove is located in direct line with the two record apertures. This relation is achieved by loosening screws 124 that clamp the commutator disc casing 114 against rotation with relation to mounting member 125, and then rotating casing 114 to a position whereat registration of index points 145 and 146 on it and on the brush carrier will bring register pin 91 and record disc aperture 90 into the line defined by the record center and the point 151 at which the cutting stylus engages the record, or in other words in line with the beginning point of the record groove, as shown in Fig. 7a. This rotatable adjustment of casing 114 on its mounting being once made when the machine is first assembled, no further adjustment of this kind is ordinarily ever required, and screws 124 may be permanently set up. Assuming index points 145 and 146 of the recorder attachment to have been registered and the cutting stylus to have been lowered at the proper point, the next step is to set the camera attachment brush carrier, and this is done, as has previously been described, by first loosening thumb screw 70, then rotating carrier disc 57 manually to register index points 147 and 148, and finally retightening screw 70. The system is now in the condition indicated by the full line brush positions of Fig. 11, and the camera and recorder will pick up and run in step when switches S and S₁ are subsequently closed.

Preferably, the film in the camera is given some index marking at the start of the picture. For instance, the camera being threaded with the film, a punch mark may be made in the film at a given distance back of the exposure aperture before the picture is taken, and this may be done with any convenient punch means, which is preferably mounted permanently in the camera and operable from outside the camera case. Fig. 16 is a detail view of such a device, 160 being the front wall of the camera and 161 the side wall thereof, while the punch arm 162, having a sharp point 163 adapted to punch a small hole in a film F traveling downwardly back of wall 160 toward the exposure aperture a given distance below, is pivotally mounted in side wall 161 and is operable by a thumb piece 165 outside the side wall. A torsion spring 166 normally holds the punch arm out of engagement with the film.

The film being so marked, and the brush carriers of the two commutators being set in accordance with their indices, switches S and S₁ are closed, in order, whereupon the camera and recorder start as described and run in synchronism.

If it is desired that the usual spring motor of

the camera shall serve to drive the camera mechanism, under the control, of course, of synchronizing system motor 24, its spring motor must of course be wound before operation begins. In order to hold down the usual spring motor release button of the camera, indicated at 170, in Fig. 1, there is provided on standard 17 and arm 17a having a thumb screw 17b which is adapted to engage button 170 and hold it down in the spring motor release, or "run" position. (This release means, in the case of the usual camera, must be held down to permit the camera to operate regardless of whether or not the usual spring camera motor is utilized for the drive of the camera, as will be appreciated by those familiar with cameras of the type in question). Thus by first winding the spring motor, and then setting up screw 17b, the spring motor will be in condition to run ahead and drive the camera mechanism when permitted by rotation of its control motor 24. If, however, a motor 24 is chosen which is sufficiently powerful, it will drive the camera mechanism without assistance from the usual camera spring motor, and the latter need not be wound. It must be remembered, however, as explained above, that even in the latter case it is necessary to depress the camera release button 170 before the camera can be driven.

In the form of the invention previously described, the commutator of the sound record machine was rested directly on the record disc. Fig. 14 is a plan view of a sound record machine in which the commutator is not placed on the record, but rather is mounted separately but is drivably connected thereto. The sound record machine is here indicated at 175, and is shown with a record table 176 having a usual center drive shaft 177, a record disc 178 being shown on the table. A tone arm 179 having a cutting stylus 180 is shown in operative relation with the record, the stylus (or reproducer needle, as the case may be) engaging the beginning point of the record groove. To one side of table 176 is the commutator device, which is designated generally at 181. Fig. 15 shows the commutator device in section, mounted on its driving shaft 182. The device may be substantially the same as that shown on the camera attachment, involving a fixed, segment-carrying commutator disc 184, which rotatably receives the shaft 182, and having rotatably mounted thereon the brush carrier disc 185, clamping means 186 actuated by thumb screw 187 serving to lock disc 184 to shaft 182. Index points 190 and 191 are provided on the brush carrier disc and on stationary ring 192, respectively, and these index markings are so related that when in register the brushes of disc 184 and the segments mounted on the commutator are in the synchronous starting positions such as illustrated in the full lines of Fig. 11.

The drive shaft 177 of the record table is then drivably connected with the commutator shaft 182, and I have diagrammatically indicated such means in Fig. 14 as comprising a chain 194 connecting sprockets 195 and 196 on shaft 177 and 182, respectively. I have here chosen, though without intention of limiting the invention, to illustrate a case wherein the record table rotates at a speed less than that of the brush carrier; for instance, the record table of Fig. 14 may be considered as rotating at 33½ revolutions per minute, whereas the brush carrier disc is to rotate, as before, at 80 revolutions per minute. To accomplish this, the sprockets 195 and 196 are

made with diameters in the ratio of 12 to 5.

It will now be evident that the sound record machine may be set by turning the record table until the cutting stylus engages the beginning point of the record groove, and then adjusting the rotatable brush carrier to bring index points 190 and 191 into register. The brush carriers of the sound record and picture machines will then be in the synchronous starting position of Fig. 11, and the sound record and film will start together and run in synchronous relation when the switches are closed.

The foregoing describes the procedure and operation in recording the sound and taking the picture. In reproduction and projection the system is substantially the same. In this case the record disc is placed on the record table of the same machine used in recording, or one similar, in exactly the same way, the commutator index marks are registered, and the reproducing needle engages the sound record at the beginning point of the record groove. The projector is equipped with a commutator having a rotatably adjustable brush carrier which, except for suitable mechanical changes, is just like that described for the camera attachment, and the projector commutator and brush carrier are wired just like the corresponding devices on the camera attachment. There is just one possible substantial difference between the camera and projector attachments, and that difference arises from the fact that the standard projector is ordinarily equipped with an electric motor which will serve as the controlled motor 24 of the wiring system of Fig. 11, thus eliminating the necessity for providing a separate motor in the projector synchronizing attachment as is done in the camera attachment. It will of course be understood that in any case where the camera is provided with an electric drive motor, of sufficient power to assume the drive of the commutator attachment, the situation is the same as in the case of the projector, and a separate motor in the commutator attachment will not be required. In threading the film in the projector, the punch mark on the film is noted and the film arranged with this mark the same distance back of the projection aperture in the projector as it was back of the exposure aperture in the camera before the picture was taken. This may conveniently be done by providing an index mark in the projector a distance back of the projection aperture equal to the distance between the punch point and the exposure aperture in the camera, and the film is accurately set by arranging it with its punch mark opposite this index mark in the projector. This precaution being taken, it will be assured that in projection, if the brush carriers on the reproducer and projector are set by their respective index marks, the picture and sound records will start properly and run in synchronism.

I claim:

1. The combination of a rotating sound record machine manually adjustable to place the record in a predetermined starting position, a kinetograph mechanism manually adjustable to place the film in starting position, an electric motor for driving the kinetograph mechanism, a rotatable commutator mechanism drivingly connected with the kinetograph mechanism and manually rotatably adjustable with reference to the kinetograph mechanism while the kinetograph mechanism is stationary, to take a predetermined marked starting position, index means providing starting marks establishing the last named position, a rotatable

commutator mechanism drivingly connected with the rotating sound record and arranged to take a given starting position relative to the marked starting position of the first named commutator mechanism when the sound record is rotated to its predetermined starting position, and electrical connections between the two commutator mechanisms including a source of electricity and said electric kinetograph motor.

2. The combination of a rotating sound record machine manually adjustable to place the record in a predetermined starting position, a kinetograph mechanism manually adjustable to place the film in starting position, an electric motor for driving the kinetograph mechanism, a rotatable commutator mechanism drivingly connected with the kinetograph mechanism and manually rotatably adjustable with reference to the kinetograph mechanism while the kinetograph mechanism is stationary, to take a predetermined marked starting position, index means providing starting marks establishing the last named position, a rotatable commutator mechanism drivingly connected with the rotating sound record and manually rotatably adjustable with reference thereto to take a given starting position relative to the marked starting position of the first named commutator mechanism when the sound record is rotated to its predetermined starting position, and electrical connections between the two commutator mechanisms including a source of electricity and said electric kinetograph motor.

3. The combination of a rotating sound record machine manually adjustable to place the record in a predetermined starting position, a kinetograph mechanism manually adjustable to place the film in starting position, an electric motor for driving the kinetograph mechanism, a commutator mechanism comprising a plurality of segments and a rotatable brush carrier provided with a brush adapted to contact successively with the commutator segments, a rotatable shaft on which said brush carrier is relatively rotatably mounted, quick release manual means for releasably setting said brush carrier in rotatably adjusted position on said shaft, means operatively connecting said shaft to rotate with the kinetograph mechanism, a second commutator mechanism comprising a plurality of segments and a rotatable brush carrier provided with a brush adapted to contact successively with the commutator segments, means operatively interconnecting said brush carrier to rotate with the rotating sound record, electric leads, connecting corresponding segments of the two commutators, an electric circuit, including a source of electricity and said electric motor, connected between said two brushes, and index means associated with the two rotatable brush carriers establishing coordinated starting marks for said brush carriers.

4. The combination of a rotating sound record machine manually adjustable to place the record in a predetermined starting position, a kinetograph mechanism manually adjustable to place the film in starting position, an electric motor for driving the kinetograph mechanism, a commutator mechanism comprising a plurality of segments and a rotatable brush carrier provided with a brush adapted to contact successively with the commutator segments, a rotatable shaft on which said brush carrier is rotatably mounted, quick release manual means for releasably setting said brush carrier in rotatably adjusted position on said shaft, means operatively connecting said shaft to rotate with the kinetograph mechanism,

a second commutator mechanism comprising a plurality of segments and a rotatable brush carrier provided with a brush adapted to contact successively with the commutator segments, a rotatable shaft on which said brush carrier is rotatably mounted, quick release manual means for releasably setting said brush carrier in rotatably adjusted position on said shaft, means operatively interconnecting said last mentioned shaft to rotate in a ratio other than one to one with the rotating sound record, electric leads connecting corresponding segments of the two commutators, an electric circuit, including a source of electricity and said electric motor, connected between said two brushes, and index means associated with the two rotatable brush carriers establishing coordinated starting marks for said brush carriers.

5. In combination, a sound record machine having a vertical drive shaft and a mechanical disk

record turntable mounted thereon, a shaft journaled for rotation on said machine, an operative interconnection between the last mentioned shaft and the drive shaft of the turntable, said operative interconnection gearing said shafts together in a ratio other than one to one, a brush carrier disk mounted on said shaft near one end thereof, a brush carried by said disk, a plurality of commutator segments adapted to be contacted by said brush, manually releasable means for frictionally clamping said brush carrier on said shaft in rotatably adjusted position thereon, and index marks, one on the brush carrier and one stationary with reference to the sound record machine, placed to indicate when the brush is in contact with a given one of the commutator segments.

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