July 30, 1935. W. V. D. KELLEY 2,009,847

INTERMITTENT MECHANISM

Filed March 18, 1933 3 Sheets-Sheet 1

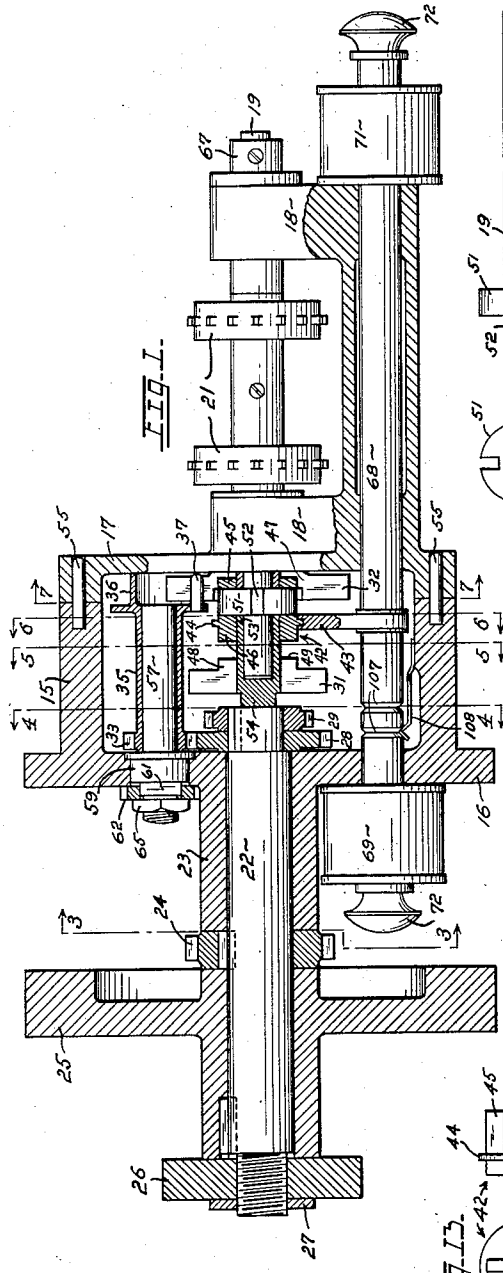

FIG. 1.

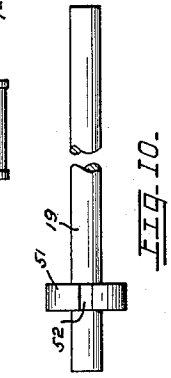

FIG. 10.

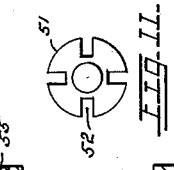

FIG. 11.

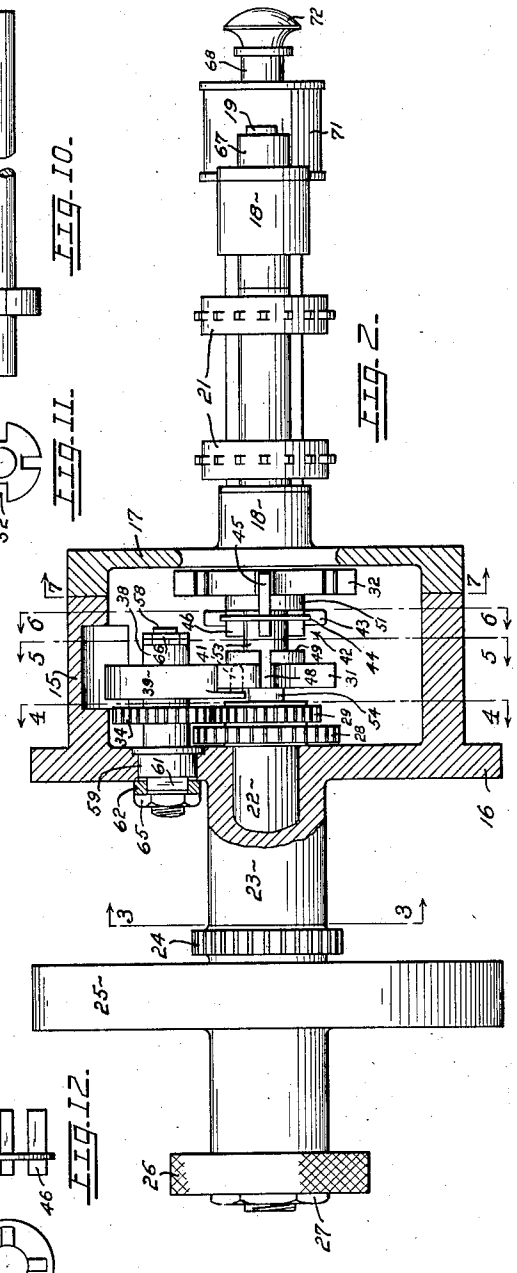

FIG. 2.

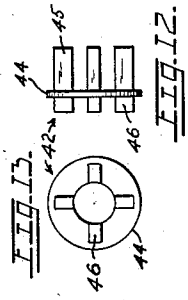

FIG. 12.

FIG. 13.

Inventor;
William V D Kelley,
per Arthur J. Farnsworth.
Attorney.

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INTERMITTENT MECHANISM

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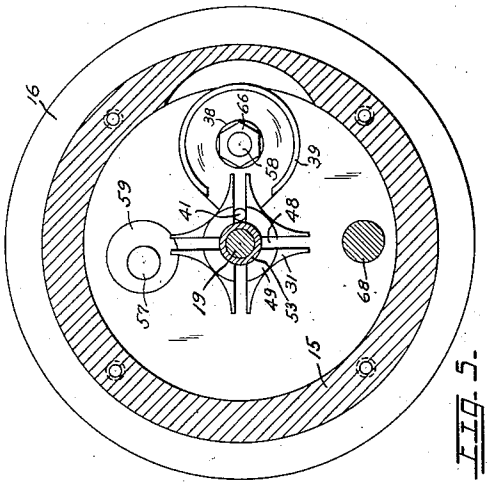

FIG. 5.

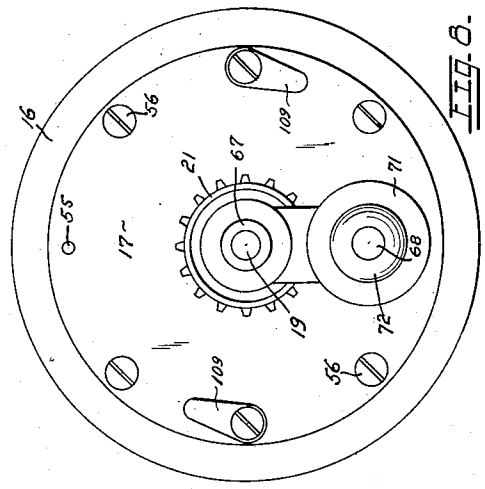

FIG. 8.

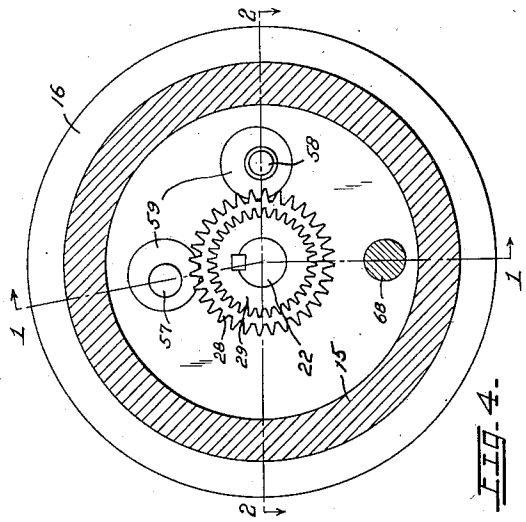

FIG. 4.

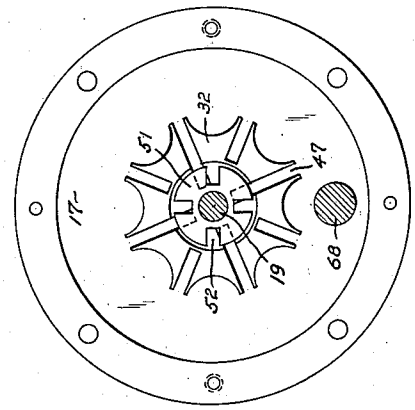

FIG. 7.

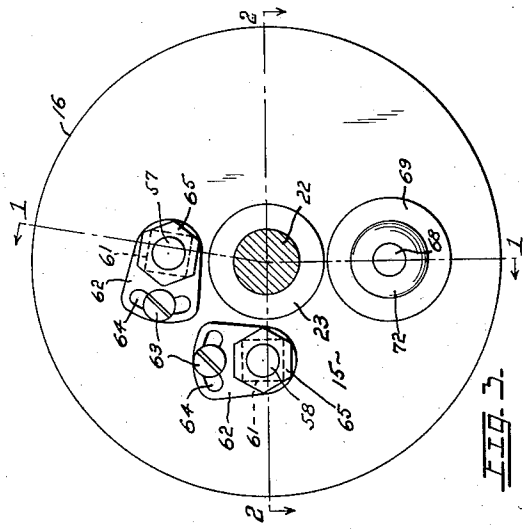

FIG. 3.

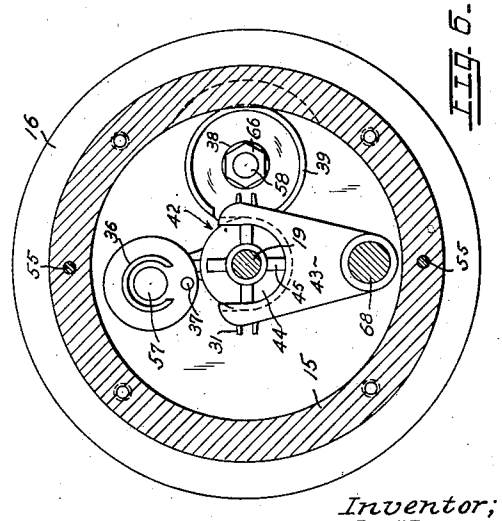

FIG. 6.

Inventor;
William V. D. Kelley,
per Arthur J. Farnsworth.
Attorney.

July 30, 1935. W. V. D. KELLEY 2,009,847

INTERMITTENT MECHANISM

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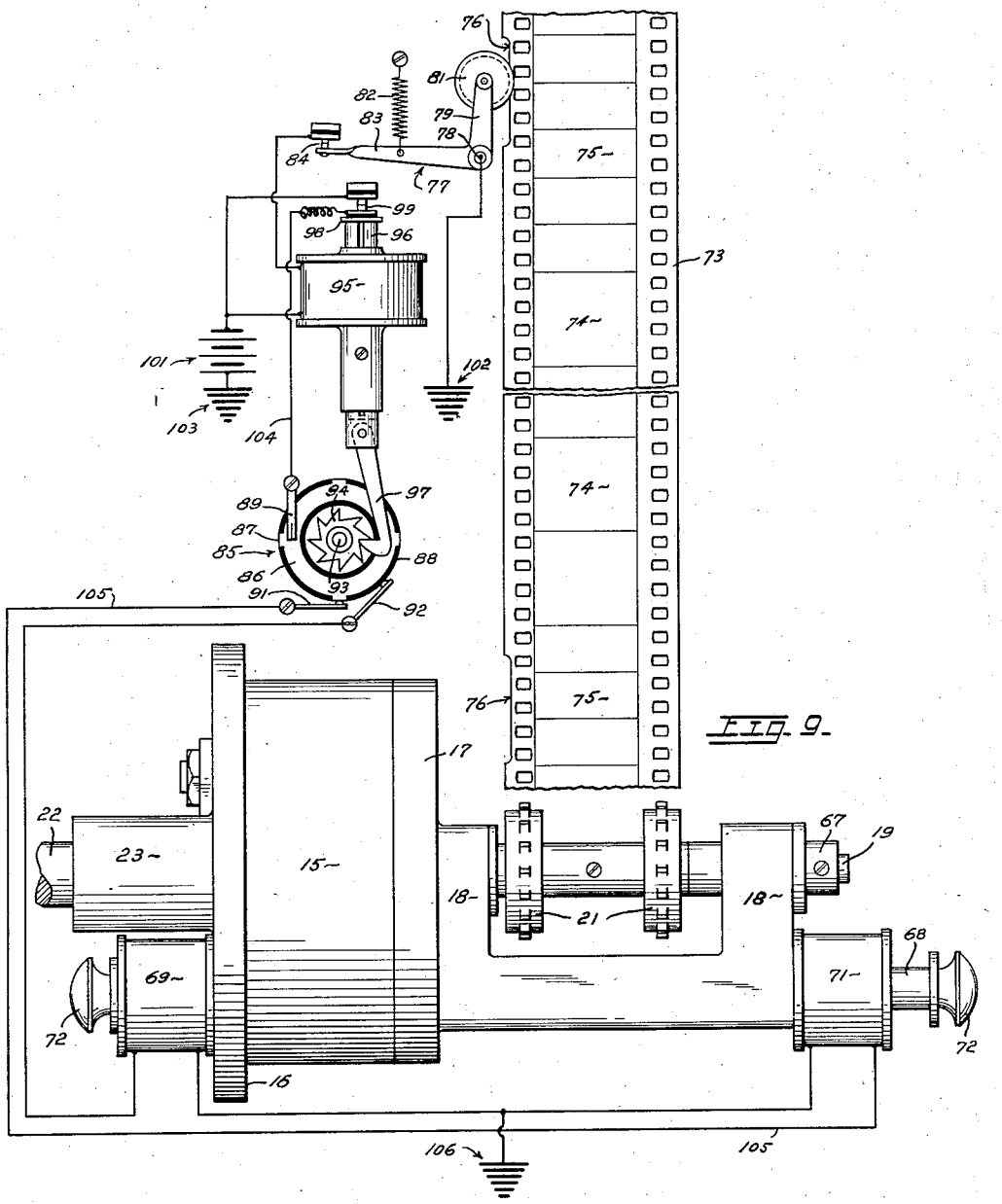

FIG. 9.

Inventor;
William V D Kelley,
per Arthur J. Farnsworth.
Attorney.

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UNITED STATES PATENT OFFICE

2,009,847

INTERMITTENT MECHANISM

William V. D. Kelley, Los Angeles, Calif., assignor to Color-Photo, Inc., Los Angeles, Calif., a corporation of California

Application March 18, 1933, Serial No. 661,439

10 Claims. (Cl. 88—18.3)

In this specification, and the accompanying drawings I shall describe and show a preferred form of my invention, and specifically mention certain of its more important objects. I do not limit myself to the forms disclosed, since various changes and adaptations may be made therein without departing from the essence of my invention as hereinafter claimed; and objects and advantages, other than those specifically mentioned, are included within its scope.

My invention relates to two-speed intermittent mechanisms, and particularly to such of these as are adapted for motion-picture machines. Among its principal objects are; first, to provide a selective two-speed intermittent mechanism of standard dimensions, that is interchangeable with intermittent mechanisms now in general use; second, to furnish a two-speed intermittent mechanism having the above characteristics and a further capacity for being selectively operated at either intermittent speed at will at any time, even while in actual use; third, to provide automatic means, cooperative with a motion-picture film, whereby the intermittent speed may be changed instantly, to conform to the momentary requirements; and, fourth, to accomplish the above, and other objects that will appear from a study of the specification set forth below, by very simple, convenient, and practical means.

My objects are attained in the manner illustrated in the accompanying drawings, in which—

Figure 1 is an elevation in central section of my improved mechanism, certain parts being shown in full elevation for greater convenience of disclosure;

Figure 2 is a plan view of this mechanism in central section, with certain parts shown in full form for the reason just mentioned;

Figure 3 is an elevation of the front or power end of the mechanism, in partial section taken on the plane 3—3 of Figs. 1 and 2;

Figure 4 is a cross-sectional elevation taken on the plane 4—4 of Figs. 1 and 2, after the removal of certain parts that would otherwise appear in this view;

Figure 5 is a similar cross-sectional elevation taken on the plane 5—5 of Figs. 1 and 2, with certain parts removed;

Figure 6 is a cross-sectional elevation of the device taken on substantially the plane 6—6 of Figs. 1 and 2;

Figure 7 is a cross-sectional elevation of the device taken on the plane 7—7 of Figs. 1 and 2;

Figure 8 is an elevation of the rear or film end of the mechanism;

Figure 9 is a side elevation of the complete apparatus, after certain parts at the forward or power end have been removed, showing how the intermittent speed shift may be automatically operated by a film strip that is prepared for that purpose;

Figure 10 is a side elevation of the shaft whereby the film sprockets are intermittently rotated;

Figure 11 is an end elevation of the element just mentioned;

Figure 12 is a side elevation of a two-way clutch element, whereby the intermittent speed of the device may be selectively controlled; and

Figure 13 is an end elevation of the last mentioned element.

Similar reference numerals refer to similar parts throughout the several views.

The drawings show a structurally operative and practical mechanism in substantially proportional size, adapted for interchanging with standard intermittent mechanisms; but detail dimensions have, in a few places, been exaggerated for convenience of disclosure. It is to be considered that the upper left-hand portion of Figure 9 is largely diagrammatic; and, although it represents the general character of apparatus that is suitable for carrying out the purposes to be subserved, it shows only one of the many ways in which this may be done.

In the development of the motion-picture industry, it often has been found desirable to have means for instantly changing the speed of the intermittent mechanism. This is particularly true in the projection of certain types of colored films, wherein alternate frames are given complementary colorings and it is desired to utilize the well-known effect of persistence of vision to make the projected pictures appear to be fully colored. In such cases as this, pairs of adjacent pictures are projected in the time ordinarily required for projecting a single picture; and it is common practice, in such cases, to make the picture frames half the normal height. Such a film, carrying a series of half height pictures, should be run as a whole at normal speed; but the intermittent mechanism must work at twice the normal speed; and the film must be pulled down half the normal distance twice, in the interval ordinarily required in the case of films carrying standard height frames. By utilizing this principle, no change need be made in the speed of the film as a whole; and thus, if the film carries a sound record, there will be no difficulty in reproducing the sound correctly.

As the motion-picture art has developed, it is desirable at times to have a series of half-height pictures on a film that carries another series of full-height pictures; and there may be several of one kind of such series combined with one or more series of the other kind. Obviously it would be impractical, during the running of a film, to stop and change the intermittent mechanism as a whole, when it is desired to change the intermittent speed. My invention provides means

for instantaneously changing the intermittent speed whenever it is desirable or necessary to do this, without interfering with running the film as a whole; and, moreover, it provides automatic means for changing the intermittent speed, where it is not desired to rely upon hand control. Such automatic means is controlled by the film itself, after certain alterations or adaptations have been made therein.

In carrying out the development of my invention for practical purposes, I have utilized standard elements that practice has demonstrated to be the most suitable for the purpose; and I have arranged these elements in a housing of standard dimensions, in such manner that the device is interchangeable with standard types of intermittent mechanism now in general use.

In the particular form of my invention that has been selected for illustration, I have shown a cylindrical housing at 15. This housing is of the ordinary motion-picture type, and is provided with the customary flange 16 at the driving end. It has a removable cover-plate 17 at the film end. This cover-plate is provided with integral bearing blocks 18, for shaft 19 that carries the film sprocket-wheels 21.

Power for driving the intermittent mechanism is supplied to a main driving shaft 22. This is rotatable within a bearing 23 at the power end of the device, and the shaft carries a driving gear 24 outside of the casing, by means of which power may be applied. A fly-wheel 25, having a relatively heavy rim, keeps the speed of the mechanism substantially constant throughout its cycle. To take up end play, a knurled nut 26, and a lock nut 27 are provided. A pair of spur gears 28 and 29 are affixed to the inner end of drive shaft 22.

For securing the intermittent motion, at either speed, I employ the well known type of Geneva star-wheels and cams, this type of mechanism having been found to be eminently desirable for the purpose. The device illustrated shows two such wheels, one of them being a four-point star-wheel shown at 31, and the other an eight-point star-wheel shown at 32, since, in the form selected for illustration, a mechanism having a two to one speed ratio is illustrated.

Spur-gears 28 and 29 are meshed respectively with driven pinions 33 and 34. The former of these pinions is made integral with the sleeve 35 of a special Geneva cam 36, adapted to operate the eight-point star-wheel through a driving pin 37. Driven pinion 34 is made integral with the sleeve 38 of a special Geneva cam 39, for driving the four-point star-wheel through driving pin 41.

In the mechanism just described, both star-wheels operate continuously but intermittently, and the pitch diameters of the gears and pinions are so chosen that the speed of revolution of the cam for the eight-point star is twice that of the cam for the four-point star. These two star-wheels are rotatably mounted so as to be coaxial with each other, and with the shaft 19 of sprocket wheels 21. They are slightly spaced from each other, and an intermediate coaxial clutch member 42 is arranged to selectively engage either of the star-wheels, in such a manner that it may be utilized to drive the sprocket-wheels. For this purpose, clutch member 42 may be shifted axially whenever desired, by means of a fork 43 cooperating therewith, and permanently engaging a circumferential flange 44 of the clutch member.

Clutch member 42 is provided with a series of projecting teeth at each side, as shown at 45 and 46. These are respectively adapted to engage the inner ends of radial slots 47 of the eight-point star, and radial slots 48 in the hub 49 of the four-point star. Obviously the spacing of the star-wheels, and the length of the teeth on member 42, should be made such that only one of the star-wheels can be thus engaged at a time. Thus, in the intermediate position of clutch member 42, both star-wheels are operated as idlers; but either of them may be utilized for driving sprocket-wheel shaft 19.

Within the housing, sprocket-shaft 19 is formed with an integral flange 51. This flange is radially notched as at 52. Teeth 45 of clutch member 42 are in constant engagement with these notches, and are adapted for longitudinal axial motion therethrough. Thus, if the clutch member engages either of the star-wheels, it will serve to transmit their intermittent motion to shaft 19, and thus operate the film engaged by sprocket wheels 21. Flange 51 also serves to longitudinally position shaft 19, as well as both star-wheels. Thus, this flange constantly engages the inner face of the eight-point star, and the right-hand end of a sleeve 53 extending from the four-point star. On the left-hand side of the four-point star there is a boss 54 abutting against the inner end of main driving shaft 22, and thus the four-point star is positioned against axial motion.

It will be obvious that the mechanism described must be accurately made and fitted; and that means must be provided for taking up wear where it is most likely to give trouble, so that the mechanism may be maintained with very little back-lash. To accomplish this, cover-plate 17 is definitely positioned by means of dowel pins 55; and after this positioning it is held in place by countersunk screws 56. The main driving shaft 22 is closely positioned longitudinally by means of knurled nut 26 and lock-nut 27. The cams of the star-wheels are rotatable about shafts 57 and 58 respectively. These shafts are provided with integral flanged hubs 59, and the axes of the shafts are slightly eccentric with respect to the axes of their hubs. The outer ends 61 of these hubs, extend beyond the surface of the housing, and are squared. Adjusting plates 62 engage these squared outer ends and, by this means, back-lash and wear of the Geneva mechanism can be taken up and closely adjusted. When the adjustment is made, the plates are held in the desired position by means of cap-screws 63 passing through circular notches 64 in the plates. Lock nuts 65 further assist in maintaining the adjustment against displacement.

Geneva cam 36 is positioned longitudinally by making its overall length very slightly less than the distance between the inner face of the housing and that of the cover-plate. Geneva cam 39 is positioned longitudinally upon its shaft by means of a pair of lock-nuts 66. Sprocket shaft 19 is kept from moving outwardly by means of its flange 51, and may be kept from moving inwardly by having its length such as to bottom within an axial bore of hub 49 of the four-point star. It may, however, be more desirable to make use of an exterior collar 67 for the latter purpose.

Clutch fork 43 is moved and positioned by means of a longitudinally slidable clutch shaft 68. This shaft extends outwardly from each end of the device, and its outer ends pass through solenoid coils 69 and 71 respectively, the coils being permanently mounted upon the housing and the

extended portion of the cover-plate respectively. The extremities of the clutch shaft are provided with nobs 72, for manual operation, when such is necessary or desired. At the extreme left-hand end of the clutch-shaft travel, clutch 42 will engage the four-point star, and this will cause an intermittent rotation of sprocket wheels 21. At the extreme right-hand end of the longitudinal motion of the clutch shaft, the clutch will engage the eight-point star, as shown in Figs. 1 and 2, and also will impart an intermittent motion of rotation to sprocket wheels 21; but there will be twice the number of intermittent motions per revolution, and each of these will be of half the number of degrees. The pitch diameters of gears 28 and 29, in relation to their driven pinions 33 and 34, is so chosen that the star-wheels will be driven at the same overall speed of rotation. That is to say, each star-wheel will make the same number of revolutions per minute. However, star-wheel 31 will impart a total of four intermittent motions to the sprocket wheels for each of its revolutions, and star-wheel 32 will impart eight intermittent motions during each of its revolutions.

In practical operation, the speed of the film ordinarily is determined by the speed required for properly reproducing such sound records as may be made thereon. In the use of my apparatus, at either intermittent speed of which it is capable, the ultimate overall velocity of the film can be made whatever is desired for the reproduction of sound or otherwise. If the film carries picture frames of standard height, the four-point star-wheel is placed in operation, so as to result in four intermittent motions for each revolution of the sprocket wheels. If the film carries picture frames of half the normal height, the eight-point star-wheel is utilized, and eight intermittent motions are imparted to the film for each revolution of the sprocket wheels.

In modern practice, and particularly when certain type of colored motion pictures are to be run, it may be desirable to employ a series of standard-height picture frames, and a series of half-height picture frames, upon the same film. In some cases there may be several series of full-height frames, combined with several series of half-height frames. Such a film is illustrated at 73 in Fig. 9, the full-height frames being shown at 74 and the half-height frames being shown at 75. In running such a film it will, of course, be necessary to shift the intermittent mechanism, as between the four-point and eight-point stars, at the exact instant when the portion of the film that is passing the exposure apparatus changes from a full-height series of frames, to a half-height series of frames, or vice versa. It would be very difficult to accomplish this manually in an entirely satisfactory manner, and my invention provides means for doing this automatically.

The automatic means for shifting the intermittent mechanism as between the four-point star and the eight-point star, is illustrated diagrammatically in Fig. 9. The shifting is accomplished by causing one of the coils 69 or 71 to be energized, the clutch shaft 68 being made of magnetic material, so that the energizing of the coil will cause the clutch mechanism to shift.

Referring to Fig. 9, I have indicated notches at 76, in one edge of film 73, at points where it is desired to have the intermittent mechanism shift. It will be understood by those familiar with the art, that the notches are not necessarily positioned where a series of full-height frames joins a series of half-height frames; but they must be so positioned that the intermittent motion will change co-incidentally when a change of frame height passes the exposure mechanism.

In Fig. 9, I have shown a small and light bell crank lever, at 77. This is pivotally mounted at 78. Its arm 79 carries a small flanged pivoted roller 81 at its extremity, and this roller is caused to remain in engagement with the edge of the film, by means of a light tension spring 82. When a notch in the edge of the film comes along, the roller will move thereinto. The other lever arm 83 is adapted to make or break an electrical circuit, through contact points 84. The length of film notches is made such as to cause sufficient time for the necessary series of operations. Roller 81 will be forced to the left whenever it passes out of a notch in the edge of the film, thus moving bell crank lever counterclockwise, and breaking the circuit through the contacts 84.

At 85 I have shown, diagrammatically, a special form of commutator switch. This consists of a circular contact plate 86; having four radial projections 87, and arcuate insulating sections 88 between the radial projections. A brush 89 bears against plate 86; and brushes 91 and 92 each bear against insulating sections 88 and projections 87 alternately, as the commutator is rotated; one of them being always in contact with one of the projections, and the other being always in contact with one of the insulating sections. The commutator switch is mounted upon a rotatable shaft 93, and the latter may be turned by means of an eight-point ratchet wheel 94.

For operating the commutator switch, I have shown a solenoid coil at 95. This is equipped with a vertical core-rod 96, carrying a pivoted pawl 97 at its lower end, the pawl being adapted to operate ratchet wheel 94. At its upper end, the core-rod carries a collar 98 to limit its downward motion, and an insulated contact point 99 which limits its upward motion; and the travel of the core-rod is thus adjusted so that pawl 97 will engage ratchet wheel 94, and move the latter one-eighth of a turn for each stroke of its cycle.

The electrical devices described are connected up to two independent circuits; one of these being purely a control circuit, actuated by roller 81 and film notches 76; and the other circuit being adapted, with its included apparatus, to operate clutch shaft 68. A single source of electrical energy, as the battery 101, may be utilized for operating both circuits, the latter being connected to the battery in multiple. The arrangement shown permits the battery to remain idle except when the intermittent mechanism is to be shifted from one of its speeds to the other.

The operation of the automatic shifting means may now be described, reference being had to Fig. 9. It will be observed that roller 81 is shown as having dropped into a notch in the edge of film 73, thus closing the contacts 84. This establishes a circuit from battery 101, through solenoid coil 95, contact points 84, and lever arm 83 to ground at 102, and back to the battery through its ground connection 103. Coil 95, now being energized, has pulled its core-rod 96 to the upper limit of its travel; thus moving ratchet wheel 94 one-eighth of a turn; and closing a circuit through contact point 99. Current from battery 101 will now flow through the contact points at 99, wire 104, brush 89, contact plate 86, brush 91, wire 105, coil 71, to ground at 106, and thence back to the battery. The energizing of coil 71

is shown as having pulled clutch shaft **68** to the right-hand extreme of its travel; thus putting the eight-point star-wheel into operation, as shown in Figs. 1 and 2.

As soon as roller **81** has passed out of its film notch, the control circuit will be opened at contact points **84**. Solenoid **95** is then unenergized, and its core-rod **96** will drop. Pawl **97** will then engage the next ratchet point of wheel **94**, ready to pull it upward for the next shift of the intermittent motion. When it does this the commutator switch will be turned one-eighth of a revolution, brush **92** will contact a projection of plate **86**. Brush **91** will rest upon an insulating section **88**. Left-hand coil **69** of the intermittent shift will then be energized, and pull clutch shaft **68** to the extreme left-hand end of its travel for putting the four-point star-wheel into operation.

From the foregoing description it will be apparent that my invention provides automatic means for properly running a film having picture frames of two different heights. Slight variations in design will permit of having intermittent ratios, other than the two to four ratio selected for illustration.

For actuating the shifting mechanism automatically, many other means will suggest themselves to those skilled in the art; for instance, in place of film notches **76**, roller **81**, and bell crank lever **77**, use could be made of small metallic contact buttons on one edge of the film strip, for establishing the circuit for alternately energizing solenoid shifting coils **69** and **71**.

In the drawings I have shown circular notches **107** in clutch shaft **68**, and a spring **108** adapted to engage these notches. The purpose of this device, obviously, is to prevent the intermittent shifting mechanism from moving, until it is desired to have it do so. In Fig. 8 the wing clips **109** are a convenience for retaining the casing of the device in a projection machine. Any suitable source of power may be utilized for operating the device, such as a small constant speed electrical motor, connected by gearing to driving gear **24**.

Having thus fully described my invention, I claim:

1. Intermittent mechanism comprising; a rotatable power shaft; a driven shaft, co-axial with the power shaft; and clutch means mounted for adjustment to a plurality of positions, in at least one of which positions the power shaft can not drive the driven shaft, and in a plurality of which positions the power shaft can impart to the driven shaft intermittent rotations; said intermittent rotations being of different frequency.

2. Intermittent mechanism comprising; a rotatable power shaft; an independently rotatable driven shaft, co-axial with the power shaft; and means for causing uniform rotation of the power shaft to impart to the driven shaft, selectively, intermittent rotations of different frequency and the same overall speed of revolution.

3. Intermittent mechanism comprising; a rotatable power shaft; an independently rotatable driven shaft, co-axial with the power shaft; a pair of star-wheels of different angular pitch, adapted for being intermittently rotated at the same overall speed of revolution by uniform rotation of the power shaft; and means for causing either of said wheels, selectively, to impart its intermittent rotation to the driven shaft.

4. Intermittent mechanism comprising; a rotatable power shaft; an independently rotatable driven shaft, co-axial with the power shaft; a pair of Geneva wheels of different angular pitch, adapted by cooperants for being intermittently rotated at the same overall speed of revolution by uniform rotation of the power shaft; and clutch means for causing either of said wheels, selectively, to impart its intermittent rotation to the driven shaft.

5. Intermittent mechanism comprising; a rotatable power shaft; an independently rotatable driven shaft, co-axial with the power shaft; a pair of spaced Geneva wheels of different angular pitch, co-axial with said shafts and adapted by cooperants for being intermittently rotated at the same overall speed of revolution by uniform rotation of the power shaft; a clutch element intermediate the Geneva wheels, co-axial therewith and adapted to engage them singly; and means for shifting said clutch element axially, for selectively engaging either of said wheels; said clutch element being in constant engagement with said driven shaft.

6. Intermittent mechanism comprising; a rotatable power shaft; an independently rotatable driven shaft, co-axial with the power shaft; means for causing uniform rotation of the power shaft to impart to the driven shaft, selectively, intermittent rotations of different frequency and the same overall speed of revolution; and means operable by the driven shaft for imparting an intermittent motion of translation to a cinema film.

7. Intermittent mechanism comprising; a rotatable power shaft; an independently rotatable driven shaft, co-axial with the power shaft; means for causing uniform rotation of the power shaft to impart to the driven shaft, selectively, intermittent rotations of different frequency and the same overall speed of revolution; and sprocket means on the driven shaft whereby an intermittent motion of translation may be imparted to a cinema film.

8. The construction set forth in claim 6 in combination with automatic means, controllable by the running position of the film, for selecting said intermittent rotations.

9. The construction set forth in claim 6 in combination with automatic means, comprising spaced abnormalities upon the film, for selecting said intermittent rotations.

10. Intermittent mechanism comprising; a rotatable power shaft; an independently rotatable driven shaft, co-axial with the power shaft; a pair of spaced Geneva wheels of different angular pitch, co-axial with said shafts and adapted by cooperants for being intermittently rotated at the same overall speed of revolution by uniform rotation of the power shaft; a clutch element intermediate the Geneva wheels, co-axial therewith and adapted to engage them singly; electromagnetic means for shifting said clutch element axially, for selectively engaging either of said wheels; means operable by the driven shaft for imparting an intermittent motion of translation to a cinema film; and automatic means, adapted for actuation by spaced abnormalities upon the film, for causing said electro-magnetic means to function; said clutch element being in constant engagement with said driven shaft.

WILLIAM V. D. KELLEY.