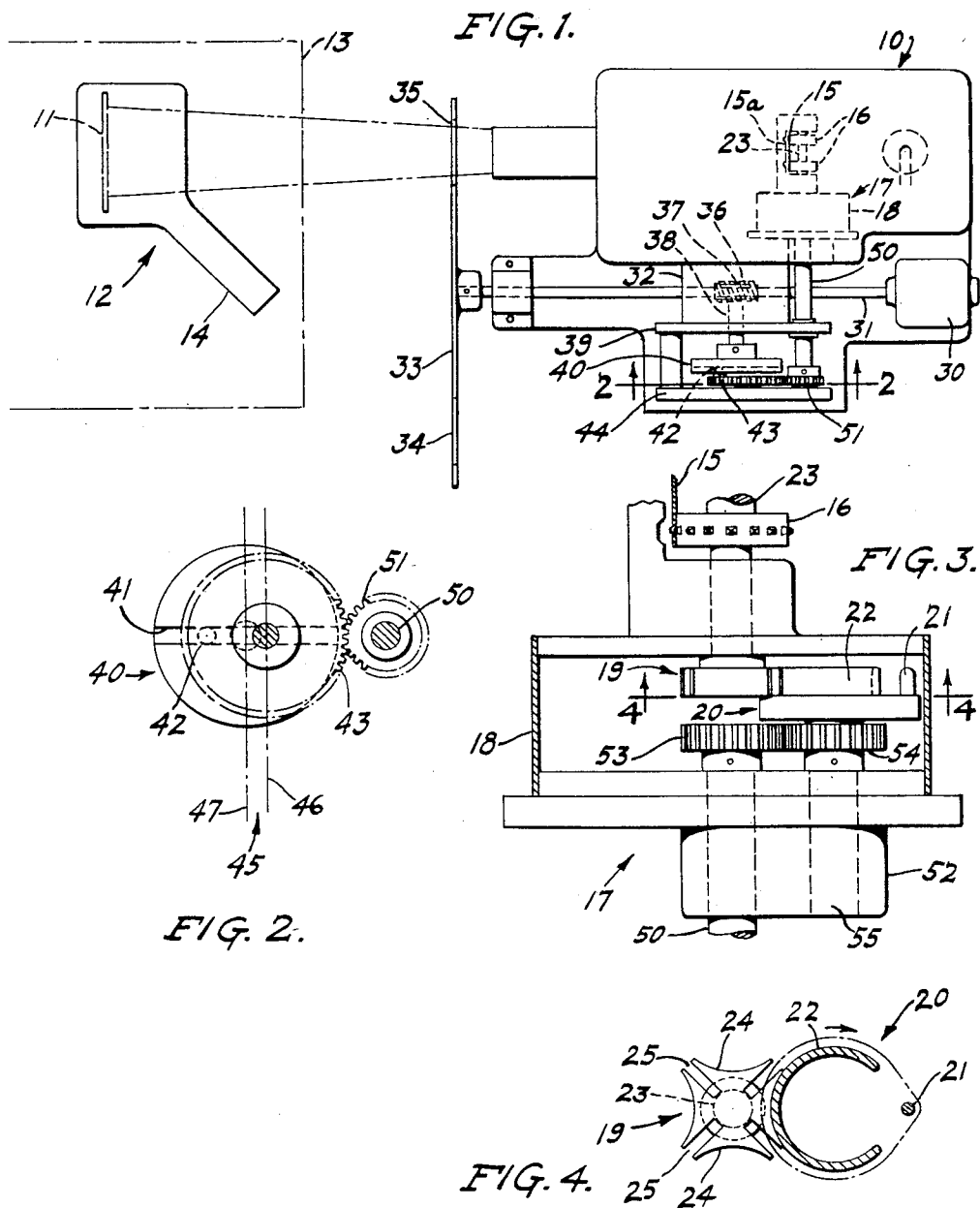


Aug. 24, 1948.

F. J. BINGLEY

2,447,839

DRIVE MECHANISM FOR THE INTERMITTENT MOVEMENT
IN A TELEVISION MOTION PICTURE PROJECTOR
Filed Sept. 11, 1945



INVENTOR.

FRANK J. BINGLEY

BY HIS AGENT

Carl H. Lynne

UNITED STATES PATENT OFFICE

2,447,839

DRIVE MECHANISM FOR THE INTERMITTENT MOVEMENT IN A TELEVISION MOTION-PICTURE PROJECTOR

Frank J. Bingley, Philadelphia, Pa., assignor, by mesne assignments, to Philco Corporation, Philadelphia, Pa., a corporation of Pennsylvania

Application September 11, 1945, Serial No. 615,671

5 Claims. (Cl. 88—18.3)

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This invention has to do with television and particularly with motion picture projectors adapted for use in television broadcasting systems.

For various reasons known to those skilled in the art, television cameras are designed to generate television signals at the rate of 60 fields per second, interlaced, or, in other words, 30 complete frames per second. On the other hand standard motion picture projectors are designed to expose 24 frames per second. Therefore, when transmitting standard motion picture film by television, it is necessary to do so by some method whereby the scanning rate of the television system is correlated with the normal exposure rate of the film so that a desirable reproduction will appear at the television receiver.

There are several methods by which this may be accomplished, only one of which, however, so far as applicant is aware, makes use of intermittent film motion for advancing successive frames into position to be projected upon the screen of the cathode ray tube. Such intermittent motion is employed in interlaced systems of scanning, and it is with this type of apparatus that the present invention is primarily concerned.

Such a system is the subject of Patent No. 2,082,093, issued June 1, 1937, to A. V. Bedford, and also of an article entitled "Application of motion-picture film to television," by E. W. Engstrom et al., and appearing, beginning with page 48, in the RCA Review, volume 4, 1939-40. The system disclosed in these publications has been adopted in the art as being the best previously known method for broadcasting standard motion picture film by television. Its operation, however, depends upon a modification of the well known "Powers" intermittent movement. This movement has proved disadvantageous because of its unreliable operation and high manufacturing cost.

When used in standard motion picture projection machines the "Powers" cam has only one lobe for turning the film sprocket, which is moved one-quarter of a revolution for each complete revolution of the cam. This quarter of a revolution is accomplished at high speed and moves the next frame into position to be projected upon the screen at the time the solid portion of the shutter is passing through the light beam of the projector. The high speed is necessary to permit each frame to remain at rest in projection position for as long a period of time as possible. Thus we see that an unmodified "Powers" intermittent movement normally exposes one picture

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frame for each complete revolution thereof and, as stated above, at the rate of 24 frames per second, when employed in motion picture practice.

To correlate the different rates of scanning and projection, as between the television camera and the motion picture projector, respectively, Bedford makes use of a varying rate of exposure for successive film frames. To accommodate the 60 fields per second scanning rate of the television projector to the 24 exposures per second of the motion picture projectors, he projects (at the rate of one projection for each one-sixtieth of a second) an image of each odd motion picture frame twice in succession upon the mosaic screen of the cathode-ray, or camera tube, and an image of each even frame three times upon the screen, all during stationary periods of the film.

Correct timing of these projections upon the screen, as taught in the "Bedford" system, is accomplished by modifying the "Powers" intermittent movement to include on the cam two lobes spaced 144 degrees apart. Thus for each single revolution of the cam, two frames will have moved into position for projection necessitating a reduction in the R. P. S. of the intermittent movement to twelve instead of the normal twenty-four. For each revolution of the intermittent movement two frames are exposed or projected for scanning, one of which is scanned twice (consuming two-sixtieths of a second) during the time the follower is passing through the 144° angle between the lobes, and the other is scanned three times (consuming three-sixtieths of a second) during the time the follower is passing through the remaining angle of 216°. Therefore, at the end of each twelve revolutions of the cam, and at the end of each second, a total of sixty fields have been scanned for each twenty-four frames of motion pictures exposed.

One of the chief faults found in this system is the necessary reduction by one-half in the number of revolutions per second, which increases two-fold the pull-down time for moving each successive frame into position for projection and decreases to an undesirable degree, the working tolerances, i. e., the time between pull-down and exposure.

The "Powers" intermittent movement is no longer widely used in motion picture projectors. Its use in television has been tolerated, heretofore, only for want of a better system in which the more desirable intermittent movements may be incorporated, and hence, with the foregoing in mind, it is an important object of the present invention to provide an improved motion picture

projector for use in television broadcasting systems.

Another important object of the invention is the provision of such a projector in which standard, unmodified, intermittent movements may be employed.

A further object of the invention is to provide such a projector which is characterized by its simplicity and its efficient mode of operation.

To the foregoing general ends the present invention proposes to use an unmodified intermittent movement, but to modulate the velocity of its driving shaft so that, while its average rotation is the normal 1440 R. P. M., or 24 R. P. S., successive revolutions are faster and slower, respectively, with the result that pull-downs will occur at appropriate intervals, permitting two projections of the odd frames upon the mosaic screen of the camera tube during the fast revolutions, and three projections of the even frames upon the screen during the slow revolutions, at the rate of sixty projections per second of twenty-four picture frames.

It will now be well understood that, prior to this invention, television transmission of standard motion picture film, as far as the intermittent film-motion types are concerned, has been completely dependent upon the aforesaid modified "Powers" intermittent movement, but that with the introduction of the present invention the necessity for using this modified intermittent movement is eliminated, and the use of the more desirable intermittent movements, such as, for example, the well known and superior "Geneva" movement, is made possible. It should be further understood however, that, as a result of the present invention, any of the well known intermittent movements, including the unmodified "Powers," may conveniently be used in the projector of the instant invention. When the "Powers" movement is employed, in conjunction with the apparatus of the present invention, the necessity of reducing the normal R. P. S. by half, is obviated.

In the drawings:

Figure 1 illustrates diagrammatically the preferred embodiment of the invention;

Figure 2 is a sectional view on an enlarged scale, taken substantially as indicated by the line 2—2 in Figure 1;

Figure 3 is a fragmentary view on an enlarged scale, and partially in section, illustrating the preferred "Geneva" type of intermittent movement; and,

Figure 4 is a sectional view taken substantially as indicated by the line 4—4 in Figure 3.

More specifically, and with particular reference to the details in Figure 1 of the drawings, the numeral 10 designates a motion-picture projector adapted to project successive picture images intermittently upon a photo-sensitive screen 11 of a cathode ray, or camera tube 12, positioned within a television camera 13. Each of these images is scanned in the usual well known manner by a moving beam of electrons, developed in the electron gun 14 of tube 12, thus to generate the necessary picture signals for broadcast by the transmitter (not shown).

As pointed out heretofore, when broadcasting standard motion picture film by television it is necessary to correlate the exposure speed of 24 frames per second for normal motion picture projection with the scanning rate of 60 fields per second for television systems. In the present invention this correlation is accomplished in the novel manner hereinafter described.

The motion picture film 15 is moved into projection position in the film gate 15a, intermittently, at the rate of twenty-four frames per second by a pull-down sprocket 16 which is operated by a standard intermittent device 17. As illustrated, this device is of the highly desirable "Geneva" type, although it should again be clearly understood that any suitable standard intermittent movement may be used, such as, for example, the standard unmodified "Powers" type above referred to. These intermittent movements are well known in both the motion picture and television arts and it is believed that a detailed description thereof is unnecessary to a complete understanding of the present invention. However, a brief description of the "Geneva" type illustrated, will serve to point out its salient features as related to the present invention.

With particular reference to Figures 3 and 4, which illustrate the type of "Geneva" intermittent movement best serving the purposes of the invention, the numeral 18 designates the housing therefor, while the intermittent movement itself consists of a "Maltese" cross 19, more commonly referred to as the "star," and a cam 20 upon which is mounted a master pin 21, adapted to drive the star. This cam is also provided with a flat circular surface, or cam ring 22, by means of which the star, and therefore the intermittent sprocket 16, both of which are mounted upon shaft 23, are locked in a fixed position while the star is not being driven by pin 21, that is, during the interval the frame is in alignment with the aperture in position to be projected upon the screen 11.

The action of the movement is as follows:

The cam carrying the master pin is continuously rotated as long as the projector is in motion, as will be more fully explained hereinafter. During the major portion of the operating time the star is maintained motionless, by virtue of contact between one of its four curved surfaces 24, and the adjacent surface of the cam ring 22. Under this condition it is evident the star cannot be rotated. It must, in fact, remain perfectly still until the two surfaces are released. In this condition the movement is said to be "on the lock." Remembering that the cam rotates continuously in the direction indicated by the arrow, it is evident that presently the pin will engage one of the slots 25 in the star and, at that instant, surface 24 will be out of contact with ring 22 and free to rotate under the control of pin 21.

As the pin enters one of the star slots 24 it moves the star one-quarter of a revolution. The movement is very rapid but, nevertheless, movement of the star and the associated sprocket are initiated slowly, the speed gradually being increased to maximum. The star and sprocket then slow, gradually, to a full stop, whereupon surface 24 and ring 22 re-engage, locking the star. The picture is projected and the cycle of action is repeated.

In particular accordance with the present invention, the intermittent movement is driven at the rate of twenty-four revolutions per second with alternate, or odd revolutions, of shorter duration than the even ones. As stated heretofore, television cameras are designed to scan sixty fields per second and, therefore, in my apparatus the faster revolutions are preferably of two-sixtieths of a second duration, while the slower revolutions are of three-sixtieths of a second duration. Thus it is seen that of the twenty-

four frames scanned by the camera, twelve are scanned twice, or for two-sixtieths of a second each, which equals twenty-four-sixtieths of a second, while the remaining twelve are each scanned three times, or for three-sixtieths of a second each, which equals thirty-six-sixtieths of a second. From these figures it is obvious that for each second of time twenty-four motion picture frames, which is the standard practice in motion picture art, are scanned sixty times, which is in accordance with television practice.

It is now evident that the different operating speeds normal to each of these arts may be thus correlated, by properly modulating the velocity of the shafting which drives the intermittent movement.

Means for driving the intermittent movement in the desired manner is provided by the associated mechanism illustrated in the drawing and now to be described.

With reference to Figures 1 and 2, a motor 30 is provided for driving a shaft 31 which extends through a gear box 32 and has attached to its free end the usual shutter 33 provided with a pair of opposed apertures 34 and 35. Also attached to the shaft 31, on the portion within the gear box, is a worm 36 adapted to rotate an associated pinion gear 37 mounted on a shaft 38. Shaft 38 extends transversely through a bearing block 39 and has a disk 40 attached to its other end.

Disk 40 is provided with a transverse slot 41 into which one end of a pin 42 (which is secured to the side wall of a gear 43) is adapted to fit for transverse slidable movement therein. Gear 43 is journaled in another bearing block 44 at a point offset from axial alignment with shaft 38, as shown at 45 (Figure 2) by the extended parallel lines 46 and 47 passing through the centers of disk 40 and gear 43. By reason of this offset of the centers of rotation of disk 40 and gear 43, when the disk is rotating, the angular velocity of the gear is modulated as described heretofore. In other words, for each revolution of disk 40, at a constant speed, gear 43 will rotate through substantially one-half revolution at a speed greater than that of the following half.

Mounted adjacent one end of a shaft 50, and intermeshed with gear 43, is a gear 51 having a diameter equal to one-half the diameter of gear 43 and providing a resultant two-to-one ratio between the driving and driven shafts. For each complete revolution of gear 43, gear 51 will revolve twice and, as the speed of rotation of gear 43 has been velocity-modulated as described, gear 51 will move through one of its two revolutions at a greater velocity than will obtain during the succeeding revolution.

Shaft 50 passes through a bearing 52 on housing 18 and into the interior of the intermittent movement 17. A gear 53 is attached to the end of the shaft and is intermeshed with a similar gear 54 to which is secured the intermittent cam 20. A shaft 55, upon which gear 54 and cam 20 are mounted for rotational movements, is also journaled in bearing 52.

It will now be clearly understood that shaft 50, and consequently gear 53 attached thereto, are being driven with modulated velocity, the duration of successive revolutions alternating between two-sixtieths and three-sixtieths of a second. The intermittent movement is, of course, driven correspondingly, through gear 54 to which the cam 20 is attached. Thus the desired variation in interval between successive pull-down actua-

tions is achieved in a novel and advantageous manner.

It will be evident that shutter 33 is rotating normally at 1800 R. P. M., or thirty R. P. S., and is timed so as alternately to present the opposed apertures 34 and 35 in the path of projection, during the time the film frames are in position for projection.

Thus it may be seen, from the foregoing, that the present invention provides a simplified, efficient and improved motion picture projector in which standard intermittent movements may be advantageously employed.

As employed herein, the words "standard intermittent movement" are intended to denote those types commonly employed in motion picture projectors and normally constructed and arranged to effect film pull-down at equal time intervals. Both the "Geneva" movement and the so-called unmodified "Powers" movement, referred to hereinabove, are exemplary of the class of devices covered by the term.

It should be borne in mind that while the velocity variation, or modulation, of the present invention enables the use of standard unmodified intermittent movements, and is therefore advantageous; in a broader aspect the modulation taught is not limited in applicability to use with such movements only. However, it will be understood that such applications of the invention and modifications therein are contemplated, as may come within the terms of the appended claims.

I claim:

1. In a motion picture projector, film advancing means, and actuating means for operating said film advancing means so as intermittently to move successive film frames into position for projection, said actuating means including: a continuously rotating member, an element discontinuously rotated thereby, velocity modulating means for causing successive complete revolutions of said continuously rotating member to occur at faster and slower rates, alternately, whereby correspondingly to vary the time interval between successive discontinuous rotations of said element, and means drivingly interconnecting said discontinuously rotated element and said film advancing means to effect movement of successive frames into position for projection after intervals of greater and less duration.

2. In a motion picture projector, film advancing means, and actuating means for operating said film advancing means so as intermittently to move successive film frames into position for projection, said actuating means including: a continuously rotating member, an element discontinuously actuated thereby once for each revolution of said continuously rotating member, velocity modulating means for causing successive complete revolutions of said continuously rotating member to occur at faster and slower rates, alternately, whereby correspondingly to vary the time interval between successive discontinuous actuations of said element, and means drivingly interconnecting said discontinuously actuated element and said film advancing means to effect movement of successive frames into position for projection after intervals of greater and lesser duration.

3. A construction in accordance with claim 1 and further characterized in that the successive complete revolutions of said continuously rotating member are completed in time increments alternating between two-sixtieths and three-sixtieths of a second.

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4. In a motion picture projector for use in television broadcast systems, film pull-down means, an intermittent movement coupled to said film pull-down means and effective to operate said means so as to move successive film frames intermittently into position to be projected for scanning, said movement including a continuously rotating element and a film-actuating member discontinuously operated thereby upon completion of each revolution of said continuously rotating element, a substantially constant speed prime mover, and variable speed apparatus coupling said prime mover to said continuously rotating element and so driving said element that successive complete revolutions thereof occur at alternately greater and lesser velocities.

5. In a motion picture projector for use in television broadcast systems, film pull-down means, a "Geneva"-type intermittent movement coupled to said film pull-down means and effective to operate said means so as to move successive film frames intermittently into position to be projected for scanning, said movement in-

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cluding a continuously rotating cam and a film-actuating star wheel discontinuously operated by said cam upon completion of each revolution thereof, a substantially constant speed prime mover, and variable speed apparatus mechanically coupling said prime mover to said cam and effective to drive said cam so that successive complete revolutions thereof occur at alternately greater and lesser velocities.

FRANK J. BINGLEY.

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