

Nov. 13, 1934.

E. R. MORTON

1,980,220

INTERMITTENT FEED DEVICE

Filed Sept. 27, 1930

2 Sheets-Sheet 1

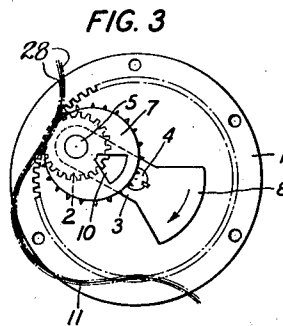
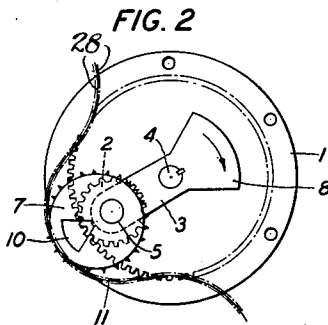
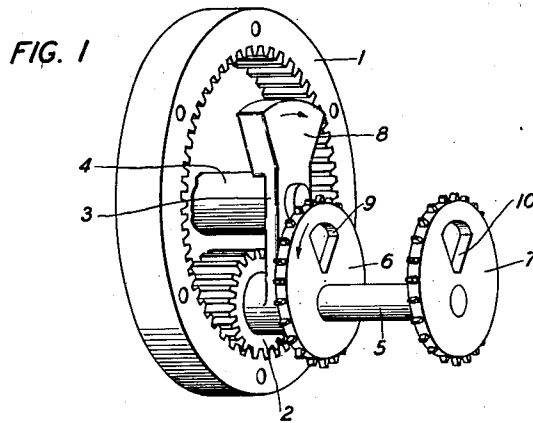
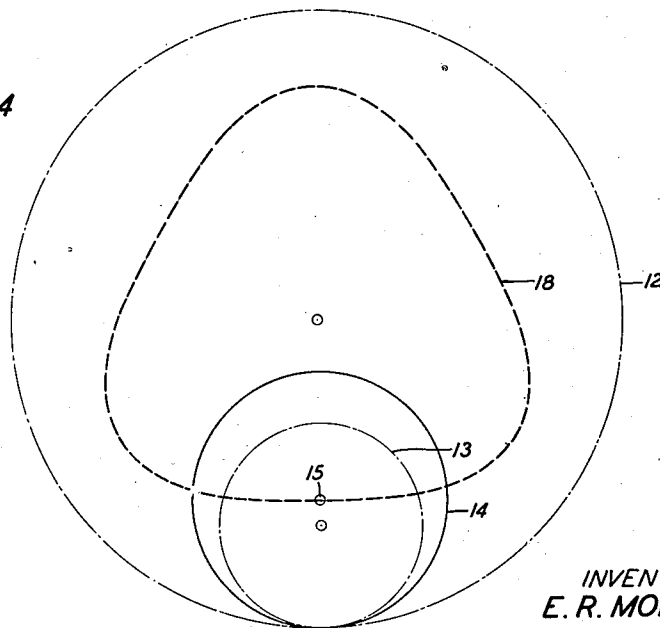


FIG. 4



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2 Sheets-Sheet 2.

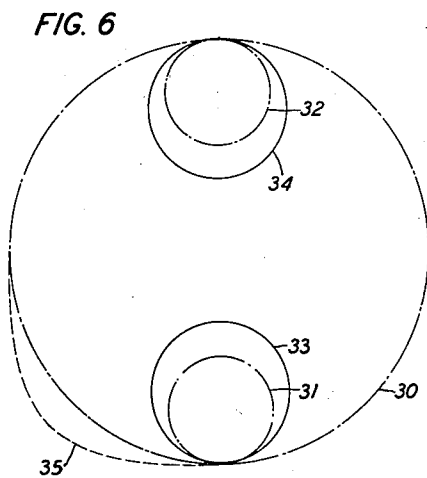
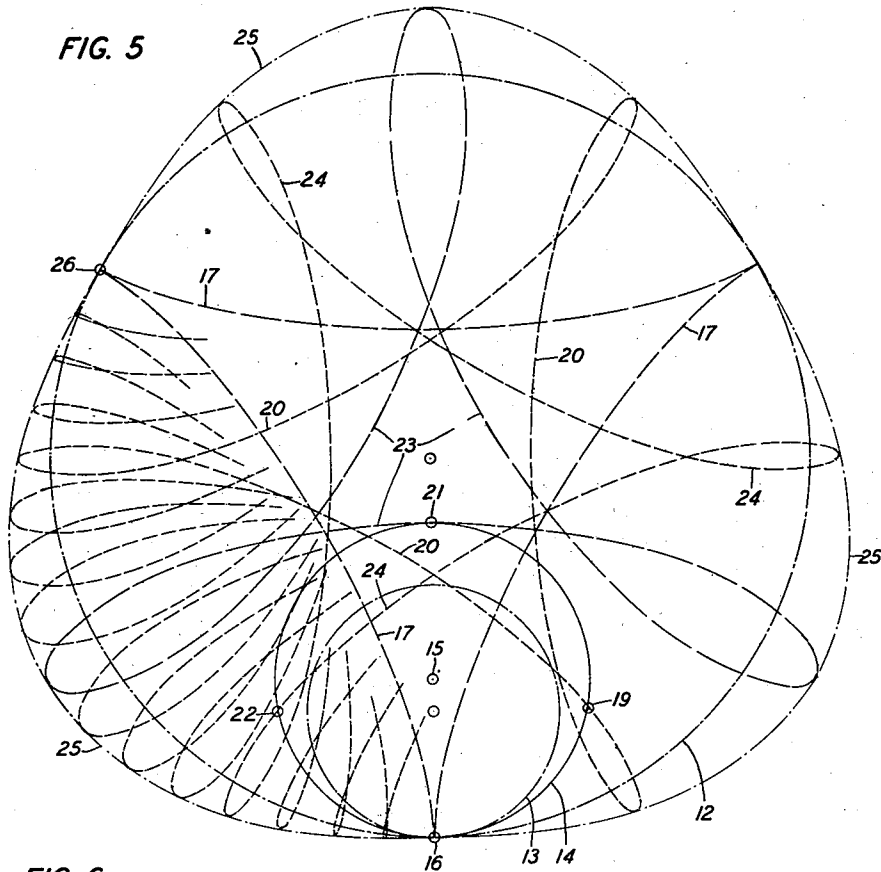
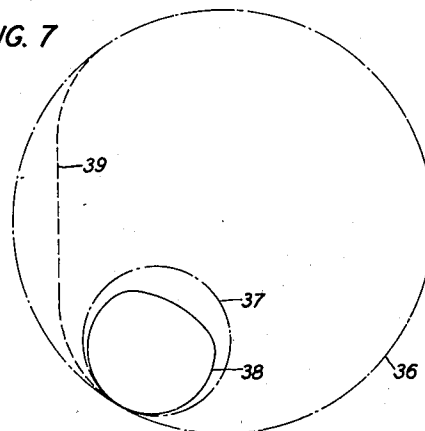


FIG. 7



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1,980,220

INTERMITTENT FEED DEVICE

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Application September 27, 1930, Serial No. 484,861

15 Claims. (Cl. 88—18.5)

This invention relates to motion picture apparatus and particularly to intermittent feed devices.

In the use of motion picture apparatus combined with sound recording or reproducing apparatus it is essential that every part be as silent in operation as possible. While that piece of apparatus familiarly known as "the intermittent" has in commercial apparatus in the past performed its function of intermittently impelling the film forward in a satisfactory manner, it is nevertheless and due primarily to the fact that it includes oscillating and reciprocating parts still a source of noise. Since the rate of operation of this device is about twenty-four cycles per second, it sets up vibrations and harmonics of this frequency which are difficult to suppress. While the audibility of the noise from the ordinary intermittent appears low, its carrying power is above that of other moving parts of the moving picture apparatus, and hence it becomes particularly desirable to provide a silent intermittent.

In accordance with the present invention, means are provided to positively engage and intermittently advance a strip of material such as a film, all moving parts of which have a uniform rotary movement and which may therefore be put in both static and dynamic balance.

A feature of the invention is an impeller which will engage the film at zero velocity, will move the film at a constantly changing rate including a period of acceleration followed by a period of deceleration, and will finally disengage the film at zero velocity. This velocity refers to the translational velocity of the film and the film driving means, a transverse velocity of the driving means being necessary to effect engagement.

In accordance with another feature of this invention the impeller is caused to move in a hypotrochoidal orbit. In the preferred embodiment the impeller moves in a curtate hypotrochoidal orbit.

In accordance with a further feature of this invention the strip to be impelled is guided along a path which may be defined as the envelope of all the hypotrochoids traced by the points on the periphery of the impeller. In one form this path may be specifically defined as the envelope of an infinite number of prolate hypotrochoids approaching and including a single common hypocycloid as a limit, traced by the points on the periphery of the impeller. In another form the path may be specifically defined as the envelope of an infinite number of curate hypotrochoids

approaching and including a single common hypocycloid as a limit traced by the points on the periphery of the impeller. It is at the point where the envelope touches the common hypocycloid and base circle that the impeller engages the strip or disengages the strip at zero velocity.

In the preferred embodiment of the invention the impeller is a true circle but it may be of any other desired shape in order to affect the shape of the path of the strip and the distance through which it is to be moved.

In the drawings,

Fig. 1 is a perspective of one form of the invention;

Fig. 2 is a side view of the intermittent showing the impeller in the position where it moves the film at its greatest velocity;

Fig. 3 is a side view of the intermittent showing the impeller in the position where it disengages the film at zero velocity;

Fig. 4 is a diagram to show the orbit in which the impeller moves;

Fig. 5 is a diagram showing the curves traced by the different points on the periphery of the impeller and the manner in which the shape of the film guide 28 is determined;

Fig. 6 shows in diagrammatic form a second species of the invention; and

Fig. 7 shows in diagrammatic form a third species of the invention.

The intermittent consists essentially of a fixed ring gear 1, a planetary gear 2, mounted on an arm 3 fixed to a constantly rotating shaft 4. As the shaft 4 rotates in a clockwise direction the planetary gear 2 meshes with the ring gear 1 and is thereby given a retrograde movement in a circular orbit. The shaft 5 of the planetary gear has fixed to it two eccentrically disposed impellers 6 and 7, which because of their eccentricity move in a non-circular orbit.

The arm 3 extends also in the other direction and carries a counterweight 8 and the impellers 6 and 7 by having properly designed cut out portions 9 and 10 are also effectively balanced. In this manner the whole mechanism may be put in static and dynamic balance.

As the impeller moves it will engage a film 11 and move it in a direction opposite to that of the shaft 4.

In Fig. 2, the impeller 7 is shown in engagement with a film 11 at the point where it is imparting the greatest movement to the film and in Fig. 3 the impeller is shown at the point where the film is being disengaged.

Through an arrangement of this nature the

impeller engages and disengages the film 11 at zero velocity and moves it longitudinally at a constantly changing velocity consisting of a period of acceleration followed by a period of deceleration.

The movements of the parts of the intermittent may best be understood by a consideration of Figs. 4 and 5.

In Figs. 4 and 5 the large circle 12 represents the periphery of the ring gear 1 and the small circle 13 represents the periphery of the planetary gear 2. The line 14, which in this instance is circular represents the periphery of the impeller 7 and the point 15 designated by a very small circle represents the center point of the impeller. Since the circle 13 is rolled about the inside of the circle 12, any point on its periphery such as the point 16 will describe an hypocycloid such as the curve 17. The point 15 being within the circle 13 will describe a curtate hypotrochoid such as the curve 18. Therefore, the impeller may be said to move in a curtate hypotrochoidal orbit.

From Fig. 5 it will be seen that one point on the periphery of the impeller 14 corresponds to one point on the periphery of the planetary gear 2, that point being designated by the very small circle 16. As before stated this particular point will move in a hypocycloidal path. Another point such as 19 on the periphery of the impeller will move along a curve 20. Since the point 19 is without the generating circle 13, the curve 20 will be a prolate hypotrochoid. Other points as 21 and 22 will move in paths 23 and 24 respectively.

It will thus be seen that the impeller 7, represented by its periphery 14 will describe a curve 25 which is the envelope of an infinite number of prolate hypotrochoids approaching (and as shown in Fig. 5 including) a single common hypocycloid as a limit.

From a theoretical standpoint the impeller 7 should have at least one point coinciding with one point on the periphery of the planetary gear for it is at such a point only that the impeller has no forward or backward movement with respect to the ring gear. Under such conditions the impeller will engage the film 11 at the point 16 at zero velocity and while moving it longitudinally along the curve 25 will first accelerate the film, then decelerate the film and finally disengage it at the point 26 at zero velocity.

In commercial practice it may not be necessary to engage the film at an absolutely zero velocity and hence the film track 25 may be described as an envelope of an infinite number of prolate hypotrochoids approaching a common hypocycloid as a limit.

The shape of the film guide 28 is determined by the envelope of the prolate hypotrochoids traverse by the periphery of the impeller shown by curve 25. This guide maintains the position of the film unchanged after the film is released by the impeller. The film perforations are thus in position to be engaged by the impeller sprocket teeth upon the next cycle of rotation in the ring gear.

Figs. 1 to 5, inclusive, show one form of the invention wherein the impeller is effective in moving the film during 120° of the complete cycle of the planetary gear 2, that is the film will remain stationary for two thirds of a cycle and will move during one third of a cycle of the intermittent in a longitudinal direction through

film guide 28 during its engagement with the impellers 6 and 7.

By properly proportioning the ring and planetary gears this timing may be changed. Fig. 6 for instance shows an arrangement where the length of the period of movement of the film is equal to the length of the stationary period. In this arrangement the ring gear is shown as 30 and there are two planetary gears, 31 and 32 attached to the opposite ends of an arm like arm 3. The counterbalance such as 8 is not needed in this instance. Here the circles 33 and 34 represent the impellers and the curve 35 represents the path taken by the film during the time it is engaged by either impeller.

Fig. 7 shows another species of the invention. In this case the ring gear is shown as line 36, the planetary gear as 37 and the impeller as 38. Here the impeller is smaller than the planetary gear and since all the points on its periphery (with the theoretical exception of one) are within the generating circle 37, the film track 39 may be described as the envelope of an infinite number of curtate hypotrochoids approaching (and in the theoretical case including one) common hypocycloid as a limit.

Fig. 7 also shows a non-circular impeller 38 designed to produce a straight line as the middle portion of the curve 39 which may be used as the portion of the film to be exposed to the light. Thus the impeller may be of various shapes to produce any desired shape of film track.

In practice a film guide will be provided having the contour of the film track so as to prevent beating.

What is claimed is:

1. In an intermittent feed device, an elongated strip, means for holding said strip in an arcuate field in the form of the envelope of an infinite number of prolate hypotrochoids, an eccentrically mounted impeller, means on said impeller for gripping said strip, and means to move said impeller in a retrograde rotary movement in a hypotrochoidal orbit for intermittently gripping said strip at zero velocity and moving said strip longitudinally through said arcuate field.

2. In an intermittent feed device comprising a plurality of balanced rotating elements including an eccentrically rotating impeller, arranged to cause the periphery of said impeller to travel in the path of an envelope of an infinite number of prolate hypotrochoids from one hypocycloidal point to another, an elongated strip to be impelled, a guide for holding said strip in the form of said envelope and in the path of said impeller, and means on the periphery of said impeller for intermittently gripping said strip at zero velocity for moving it longitudinally at velocities equal to the tangential velocity of the periphery of the impeller.

3. In an intermittent feed device, an elongated strip, a stationary ring gear, a planetary gear rotatable in said ring gear, an impeller mounted eccentrically on said planetary gear and having a retrograde rotary movement in a hypotrochoidal orbit, means for holding said strip in the path of the portion of the periphery of the impeller which describes a hypocycloid, means to rotate said impeller to intermittently grip said strip at zero velocity and move said strip longitudinally through an arcuate field constituting the envelope of an infinite number of hypotrochoids, uniformity accelerating and decelerating the velocity of said movement.

4. In an intermittent feed device, a stationary

- ring gear, a planetary gear meshed with said ring gear, impeller wheels, an elongated strip, a shaft connected through the axis of said planetary gear and rotatable therewith extended to operate as the axle of said impeller wheels mounted eccentrically thereon with the periphery of said wheels nearest the axis coincident with the periphery of the planetary gear, means to rotate said planetary gear within said ring gear, thus causing the outer edges of said wheels to trace a curve constituting the envelope of an infinite number of hypotrochoids to seize said strip at zero velocity and move said strip through the path of said envelope.
5. In an intermittent feed device, a stationary ring gear, a planetary gear meshing with said ring gear, an impeller eccentrically fixed to and rotated by the shaft of said planetary gear, an elongated strip, means on the periphery of said impeller for fixedly engaging said strip, a guide for holding said strip in the arcuate path circumscribed by the rotating periphery of said impeller, and means to rotate said impeller for intermittently gripping said strip and moving it in a longitudinal direction throughout the progress of the impeller in said arcuate path.
6. In an intermittent feed device, an elongated strip, a guide for holding said strip in the form of the envelope of an infinite number of prolate hypotrochoids, a stationary ring gear, a planetary gear meshing with said ring gear, a rotatable impeller, a shaft extending through the axes of the planetary gear and the impeller, said impeller being eccentrically mounted thereon, means to rotate the periphery of the impeller through said envelope, and means on the periphery of said impeller for gripping the strip and feeding it in a longitudinal direction throughout the progress of said impeller in said envelope.
7. In an intermittent feed device, a stationary ring gear, a planetary gear meshing with said ring gear, an elongated strip, a guide for holding said strip in the form of the envelope of an infinite number of prolate hypotrochoids approaching common hypocycloids as limits, said limits approximately coinciding with the path of the periphery of the planetary gear, a rotatable impeller, a shaft extending through the axes of the planetary gear and the impeller, said impeller being eccentrically mounted thereon, means on the periphery of the impeller for gripping the strip, and means to rotate the periphery of the impeller through said envelope for gripping the strip at zero velocity and feeding it in a longitudinal direction throughout the progress of the impeller in said envelope.
8. In an intermittent feed device comprising a plurality of balanced rotating elements including a stationary ring gear, a planetary gear rotatable in said ring gear and a circular impeller mounted eccentrically on said planetary gear, an elongated strip to be intermittently impelled, means on the periphery of said impeller for gripping said strip, means for holding said strip in the path of the portion of the periphery of the impeller which describes a hypocycloid, and means to rotate said impeller for intermittently gripping said strip at zero velocity, uniformly accelerating and decelerating the velocity of said movement and disengaging said strip at zero velocity.
9. In an intermittent feed device for intermittently moving an elongated strip, a stationary ring gear, a planetary gear meshing with said ring gear, impeller wheels, means on the periphery of said impeller wheels for gripping said strip, a shaft connected through the axis of said planetary gear and rotatable therewith extended to operate as the axle of said impeller wheels, said wheels being mounted eccentrically thereon, with the periphery of said wheels nearest the axis coinciding with the periphery of the planetary gear, means to hold said strip in a position to be gripped at zero velocity by the gripping means nearest the axis of said shaft, means to rotate said planetary gear, within said ring gear, thus causing the periphery of said wheels to trace a curve constituting the envelope of an infinite number of hypotrochoids to grip said strip at zero velocity and move said strip at velocities equal to the tangential velocities of said impeller periphery.
10. In an intermittent feed device, a stationary ring gear, a planetary gear meshing with said ring gear, a sprocket wheel eccentrically mounted on the shaft of said planetary gear, an elongated strip associated therewith having perforations therein, means for holding said strip in the path of the portion of the periphery of the sprocket wheel which describes a hypocycloid, means to rotate said planetary gear within said ring gear causing the retrograde rotary movement of said sprocket wheel and causing the sprocket teeth on the outer edge of said wheel to intermittently engage the perforations of said strip and propel said strip through an arcuate field constituting the envelope of an infinite number of hypotrochoids.
11. In an intermittent feed device, a stationary ring gear, a planetary gear meshing with said ring gear, a sprocket wheel eccentrically mounted on the shaft of said planetary gear, an elongated strip associated therewith having perforations therein, means for holding said strip in the path of the portion of the periphery of the sprocket wheel which describes a hypocycloid, means to rotate said planetary gear within said ring gear causing a retrograde rotary movement of said sprocket wheel and causing the sprocket teeth on the outer edge of said wheel to intermittently engage the perforations of said strip at zero velocity and propel said strip through an arcuate field constituting the envelope of an infinite number of hypotrochoids at uniformly accelerate and decelerate velocities.
12. An intermittent feed device comprising a stationary ring gear, a planetary gear meshing with said ring gear and an impeller eccentrically mounted on the shaft of said planetary gear with the periphery of the impeller encompassing the shaft, an elongated strip, means for holding said strip in the path of the portion of the periphery of the impeller which describes a hypocycloid, and means for rotating said planetary gear in said ring gear thereby imparting a plurality of rotations to said impeller for each cycle of rotation in said ring gear, one rotation in each cycle bringing said impeller into engagement with said strip to grip said strip and move it longitudinally along the envelope of an infinite number of curtate hypotrochoids.
13. In an intermittent feed device, an elongated strip, a plurality of eccentrically rotating impellers arranged to successively follow each other in the same hypotrochoidal orbit for causing the periphery of said impellers to travel in the path of the same envelope of an infinite number of prolate hypotrochoids from one hypocycloidal point to another, and means on the

periphery of each impeller for moving said strip longitudinally over the path of said envelope.

14. In an intermittent feed device, a stationary ring gear, a plurality of planetary gears meshing with said ring gear, an impeller eccentrically fixed to and rotated by the shaft of each planetary gear; an elongated strip, a common drive for rotating said planetary gears in said ring gear thus causing the plurality of impellers to follow each other in the same hypotrochoidal orbit and the peripheries of said impellers to travel in the path of the same envelope of an infinite number of prolate hypotrochoids from one hypocycloidal point to another, and means on the periphery of each impeller for moving said strip longitudinally over the path of said envelope.

15. In an intermittent feed device, an elongated strip, means for holding said strip in an arcuate field in the form of the envelope of an infinite number of prolate hypotrochoids, a plurality of eccentrically rotating impellers, circular devices which roll upon the inside of a single circular device for driving said impellers in the same hypotrochoidal orbit causing the periphery of said impellers to travel in the path of said envelope from one hypocycloidal point to another, and means on periphery of each impeller for moving said strip longitudinally over the path of said envelope.

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