

PATENT SPECIFICATION

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(54) A METHOD OF AND APPARATUS FOR TRANSPORTING CINEMATOGRAPHIC FILM

(71) We, KARL VOCKENHUBER, of 118 Potzleinsdorferstrasse, Vienna 18, Austria, and RAIMUND HAUSER, of 2 Goldeggasse, Vienna, 4, Austria, both Austrian citizens, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a method for transporting cinematographic film and to apparatus for carrying out this method.

When projecting cinematographic films it is often desired to drive the film either quicker or slower than the shooting speed. The resulting effect is generally known as a fast motion or slow motion effect. It is evident that the same result may be attained if the shooting speed varies and the projection speed is kept constant.

Generally speaking, the transport velocity of the film on shooting differs from the transport velocity on projection.

The change and the control of the driving velocity of the film can be accomplished by an electro-magnet, e.g. a solenoid, or by mechanical auxiliary means, e.g. cams. For a reduced film transport speed the cams or the electro-magnets cause a disengagement of the film drive from the film for one or more film frames at constant intervals. This procedure may be expressed by the equation

$$f_s = f_n / n$$

wherein f_s represents the frequency of transport steps with magnets or cams preventing film transport, f_n represents the frequency of transport steps of the film at normal transport velocity (i.e. the frequency of drive steps which is constant), and n represents any integer. For example, with a normal film transport speed of 18 frames/second, i.e. $f_n = 18$, the reduced film transport speed, f_s , equals 9, 6, 3 frames/second when $n = 2, 3$ or 6 respectively. In other words $1/n$ represents the fractional speed of the films, i.e. $\frac{1}{2}, \frac{1}{3}$ speed etc. Furthermore, the rate of transport of the

film is constant, i.e. consists of a single frequency, between transport steps. For example, when $n = 3$ there is one transport step for every three drive steps, and when $n = 6$ there is one transport step for every six drive steps.

The invention provides a method of transporting a cinematographic film by periodically actuating a film-moving device to engage successive sprocket holes and transport successive frames of the film within a predetermined recurring period, wherein the speed of transport of the film is reduced by preventing predetermined actuations of the film-moving device so that the film is transported at at least two different frequencies in the said period.

Conveniently, two different frequencies of film transport are produced by preventing actuations at non-uniformly-spaced intervals.

The invention further provides apparatus for transporting a cinematographic film comprising a film-moving device, means for actuating the film-moving device to engage successive sprocket holes and transport successive frames of the film within a predetermined recurring period, and control means adapted to prevent predetermined actuations of the film-moving device so that the film is transported at at least two different frequencies in the said period.

By providing at least two different frequencies of transport of the film, n ceases to be an integer and becomes an improper fraction, e.g. f_s is ten frames per second when n is $9/5$. In this way it is possible to obtain a much greater number of film transport speeds than previously possible.

The invention will now be described in more detail, by way of example only and with reference to the accompanying diagrammatic drawing, in which:

Figure 1 represents mechanical control, and Figure 2 represents electrical control of a film/drive; and

Figures 3a and 3b show two different transport frequencies for the film drive.

Referring to Figure 1, a main shaft 1 is provided in a cinematographic equipment, not shown in detail, for example in a substandard

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format film projector. This main shaft 1 is driven by driving means, likewise not shown. Connected to the main shaft 1 are a shutter 2 and a claw cam 3. The claw cam 3 has a cam 5 controlling the transport movement and the engaging lift of a claw 4.

On the main shaft 1 there is further provided a worm wheel 6, which drives a worm 8 fixed to a cam shaft 7. On this cam shaft 7 there are provided four axially spaced cams 11, 12, 13 and 14, each cam preventing at different rates the claw 4 engaging in sprocket holes 9 of a film 10. The cams are, for instance axially shiftable on the shaft 7 by means of a wedge-groove guide (not shown). One of these cams 11 to 14 can optionally be sensed by a cam follower 15. This cam follower 15 is a part of a bent carrier 16, which bears upon the claw 4 by means of an operating extension 17, and lifts the claw in dependence on the cam form of the cams 11 to 14 from the cam 5, and so preventing an engagement in the sprocket holes 9.

The arrangement can be so designed that the cam 11 causes a frame frequency of nine frames per second, the cam 12 a frequency of six frames per second, the cam 13 a frame frequency of three frames per second and the cam 14 a frame frequency of $1\frac{1}{2}$ frames per second. As the cam follower has now sensed the cam 12 during one revolution of the cam shaft 7, an axial shifting of all of the cams 11 to 14 takes place, so that for the next revolution of the shaft 7 the cam follower 15 comes into engagement with e.g. the cam 13. For clearness sake a device causing axial shifting of the cams is not shown in Figure 1. However, it is necessary that the cams 11 to 14 are so fixed on the shaft 7 that in a determined position their contours have the same radial distance from the axis of the shaft 7, so that upon moving-over of the cam follower from one cam to the other there is no step between the cams. For attaining varying frame frequencies it would alternatively be possible for the cam 11 to withdraw the claw 4 once after two lifts caused by the control cam thereby providing two transport frequencies of 18 and nine frames per second and an average transport speed of twelve frames per second. The cams 12 to 14 would control other frame frequencies.

In the above-described arrangements a suitable transmission ratio (by means of the worm wheel 6 and the worm wheel 8) between the shafts 1 and 7 must be selected to obtain the required transport frequencies, bearing in mind that the speed of the shaft 1 is normally constant, e.g. 18 revolutions per second.

Figure 2 shows an arrangement similar to that shown in Figure 1, and parts with the same function bear the same reference numerals. Instead of the cam follower 15 which controls the claw 4 by means of an extension 17, the claw 4 is connected with an

armature 20 controlled by a solenoid 21. The claw could instead be made of ferro-magnetic material and attracted on energization of the solenoid 21. The energization of the solenoid 21 is controlled by an impulse generator 22, whose impulse frequency may be adjusted by a rheostat 23. The impulse generator 22 is connected to a voltage source (not shown) by means of a terminal 24 and a switch 25.

The mode of operation of the arrangement shown in Figure 2 is as follows: with magnet 21 not energized, that is when the rheostat 23 is so adjusted that no impulses are delivered, the film 12 is transported by the claw mechanism in known manner. If for example the switch 25 is closed and the electromagnet 21 is energized with a frequency set by the rheostat 23, the claw frame is kept in a position out of mesh with the perforation during the periods of energization thereby reducing the film transport speed. In order to prevent the claw 4 being removed from the perforation 9 by the solenoid 21 during a transport step of the film, it is useful to synchronise the phase position of the impulse beginning and end with the control cam 5. This could for example be executed by means of contactors 26, 27 and a contact path 28. The rheostat 23 may now be so adjusted that the solenoid 21 is energized once after two lifts caused by the cam 5 during the period of a lift at standard step frequency, then preventing a transport of the film. If for example the standard step frequency amounts to eighteen frames per second, twelve frames per second will be transported, the two different frequencies of transport being eighteen and nine frames per second.

The examples in Figure 3a and 3b show possibilities of different partial frequencies, whereby the average frequency is obtained from a combination of the standard frequency and one or more other partial frequencies.

On the abscissa of these diagrams the frame frequency has been traced, and the ordinate shows on the positive side the engagement of the claw with the film perforation, on the negative side the claw out of mesh with the perforation.

Figure 3a shows for instance a possibility to move ten frames per second at a standard frequency of eighteen frames per second. This average frequency is obtained as follows: After a single transport lift (diagonal hatched area) an idle lift of the claw is carried out (vertical hatching), so that after one second only nine frames would be transported. After two such transport lifts and idle lifts, i.e. at a transport frequency of nine frames per second, an impulse causing an idle lift is not supplied to the claw, so that a transport frequency corresponding to eighteen frames per second has been simulated due to the two adjacent transport lifts. Each of these sets of two adjacent

transport lifts is again followed by an idle lift, which is then followed by the whole transport sequence starting from the beginning. After this second transport sequence there follow alternately one transport lift and one idle lift for two periods. In total, ten frames are transported per second, whereby the particular partial frequencies interchange with each other.

10 A further quite irregular transport sequence is shown in Figure 3b. Here eight frames per second are transported, whereby the claw is again driven with three different partial frequencies of eighteen, nine and six frames per second within a second.

15 These two examples show that an unlimited number of transport frequencies can be attained by this method. At the projection of moving picture films the threshold at which the change of the transport frequency becomes perceptible in the movement of the taken object has of course to be taken into consideration.

WHAT WE CLAIM IS:—

25 1. A method of transporting a cinematographic film by periodically actuating a film-moving device to engage successive sprocket holes and transport successive frames of the film within a predetermined recurring period wherein the speed of transport of the film is reduced by preventing predetermined actuations of the film-moving device so that the film is transported at least two different frequencies in the said period.

2. A method as claimed in claim 1, wherein two different frequencies of film transport are produced by preventing actuations at non-uniformly-spaced intervals.

3. A method of transporting a cinematographic film substantially as herein described with reference to Figure 1 or Figure 2 and Figures 3A and 3B of the accompanying drawing.

4. Apparatus for transporting a cinematographic film comprising a film-moving device, means for actuating the film-moving device to engage successive sprocket holes and transport successive frames of the film within a predetermined recurring period, and control means adapted to prevent predetermined actuations of the film-moving device so that the film is transported at at least two different frequencies in the said period.

5. Apparatus as claimed in claim 4, wherein the control means comprise a plurality of cams and a follower selectively engageable with any one of the cams to produce different transport speeds.

6. Apparatus as claimed in claim 4, wherein the control means comprise an electromagnet which when actuated prevents actuation of the film-moving device.

7. Apparatus for transporting a cinematographic film substantially as herein described with reference to Figures 1 or 2 and Figures 3A and 3B of the accompanying drawings.

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