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(54) FILM HANDLING APPARATUS

(71) We, KARL VOCKENHUBER, of 118 Potzleinsdorferstrasse, Vienna 18, and RAIMUND HAUSER, of 2 Goldeggasse, Vienna 4, both Austria, both of Austrian Nationality, 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 film handling apparatus such as a film projector in which the film is advanced frame-by-frame, that is to say intermittently rather than continuously, through a film gate. More particularly the invention is concerned with providing such apparatus with different modes of operation each corresponding to a different motion of the film. These different modes produce appropriate changes in the drive characteristics of a traction device used to produce the frame-by-frame advance of the film so that, for example, in one mode the film is advanced forwardly at a particular frame frequency while in another mode the film may be advanced at a different frequency or may be driven frame-by-frame in the reverse direction at the same or at a different frequency.

The invention provides film handling apparatus having a traction device operating to advance a film frame-by-frame, a drive shaft providing drive to the device and being rotatably connected to at least one camming surface for controlling the drive of the traction device, rider members mounted at fixed spaced locations on a movable carrier for transferring movement from the at least one camming surface to the traction device, and a mode selector for moving the carrier between different positions at each of which the motion of the traction device is controlled by a different combination of the at least one camming surface and the rider members.

The camming surfaces may be provided by a set of cams which may be coaxially or radially spaced from one another and mounted to revolve around a common axis of rotation. The carrier preferably comprises a plate which may be pivotable or slidable to different positions and may be formed with the traction device as a part of it. Suitably

the carrier moves normally to the common axis of rotation of the camming surfaces to enable the mode of operation to be changed.

The invention will now be described in more detail, by way of examples, with reference to the accompanying drawings, in which:—

Figure 1 is a side view of parts of a drive mechanism associated with a film advance claw and having axially spaced camming surfaces;

Figure 1a is a plan view of Figure 1;

Figure 2 is a longitudinal section through a second embodiment again with axially spaced camming surfaces;

Figure 2a is a cross-section taken on the line and in the direction indicated by the arrows a-a in Figure 2 and shows also additional parts;

Figure 2b is a developed view of part of the periphery of a cylindrical rotatable turret shown in Figure 2;

Figure 3 shows a modification which may be made to the apparatus of Figure 1a;

Figure 4 shows another embodiment having camming surfaces arranged concentrically rather than axially;

Figure 5 is a cross-section through Figure 4 taken on the line and in the direction indicated by the arrows V-V in that figure;

Figure 6 shows in plan a further embodiment using a traction claw device which is a part of a carrier having spaced cam riders which can be selectively engaged with a common set of camming surfaces;

Figure 7 is a cam diagram of Figure 6 and illustrates the drive characteristics imparted by the camming surfaces in different modes of operation and related to time;

Figure 8 shows in plan a modification of the mechanism shown in Figure 6;

Figure 8a shows in longitudinal section a detail of Figure 8;

Figure 8b is a lever diagram illustrating the principle of operation by the modification of Figure 8;

Figure 9 is a second cam diagram this time associated with Figure 8;

Figure 10 shows in plan a further embodiment;

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Figure 11 is a cam diagram associated with Figure 10;

Figure 12 shows yet a further embodiment in side elevation and partly in section;

5 Figure 13 shows in plan another embodiment;

Figure 14 shows in plan a further embodiment;

10 Figures 15 to 17 are further timing cam diagrams;

Figure 18 is a perspective view of a projector embodying the invention;

Figure 19 shows another timing cam diagrams;

15 Figure 20 is a plan view of a final embodiment; and,

Figure 21 is a section through Figure 20 taken on the line and in the direction indicated by the arrows XXI-XXI in Figure 1.

20 Figure 1 shows a part of film handling apparatus which is constructed as a sub-standard format film projector. The projector has a drive shaft 1 driven by a belt pulley 2 and driving a shutter 3 and a cam 4 controlling movement of a film traction claw. The cam 4 has a cam surface 5 formed on its rim and controlling transport movement of the claw, and a second cam surface 6 formed on its front face for controlling engaging lift of the claw i.e. movement of the claw towards and away from sprocket holes provided in the film. The claw is shown schematically at 7 in Figure 1a.

25 A worm 8 is provided on the main shaft 1 and drives a cam shaft shown in broken outline and having an axis of rotation 10. The cam shaft is driven by a worm wheel 9. Three axially-spaced cams 13, 14 and 15 are each also capable of influencing the engaging lift of the claw 7 with respect to the sprocket holes 11 of a film, by acting on cam riders 24, 25 and 26 which are provided at fixed spaced positions on a carrier plate 16. An extension 17 provided on the carrier plate 16 is able, as shown in Figure 1a, to lift one end of the claw 7 away from the cam surface 6 which controls its engaging lift so that the claw 7 is prevented from entering the sprocket holes 11 in a film 12.

30 The cams 13, 14 and 15 are so profiled that they lift the claw 7 away from the cam surface 6 for different lengths of time. The cam 13 is arranged to lift the claw 7 away from the cam surface 6 during every second revolution of the main shaft 1; the cam 14 lifts the claw away during two of every three revolutions of the main shaft 1, and the cam 15 lifts the claw away during five of every six revolutions of the main shaft. Thus if the main shaft rotates at 18 revolutions per second and a frame of the film is advanced through a film gate (not shown) once for each revolution of the main shaft 1, in the absence of any of the cams 13, 14 and 15 being effective, the film is advanced 18 times

per second. If the cam 13 is effective the frame frequency is reduced to 9. If the cam 14 is effective the frame frequency is reduced to 6. If the cam 15 is effective the frame frequency is reduced to 3 frames per second.

70 A changeover lever 18 shown in Figure 1 determines with its position which of the cams is effective. The lever 18 has an operating key 19 at one end and moves about a fulcrum 20 at the other end as the key 19 is brought opposite each of the five positions shown in Figure 1 and lettered, in descending order, "18", "9", "6", "3" and "St" on a scale. Intermediate its ends the lever 18 has attached to it one end of a tension spring 21 whose other end is attached to a pin 22 extending through an elongated slot 23 and attached to the carrier 16.

80 The cam riders 24, 25 and 26 which are associated with respective cams 13, 14 and 15 are spaced across the carrier as shown in Figure 1a and lengthwise of the carrier as shown in Figure 1. A tension spring 27 urges the carrier 16 towards the cams 13, 14 and 15.

90 The upper end of the carrier 16 has an inclined tip 28 which cooperates with an inclined face of a stop surface 29 when the carrier is in its uppermost position. When these two inclined faces are in contact, none of the riders is in contact with the cams and the frame frequency is determined solely by the shaft 1 and is therefore 18 frames per second. The lateral movement applied to the carrier 16 in Figure 1 when its upper end is in engagement with the stop 29 is against the bias of the spring 27.

100 If the changeover lever 18 is depressed to the position shown in Figure 1, that is to say opposite the "9" on the scale, the cam rider 24 engages the cam surface 13 which interrupts the contact of the claw 7 with the lift engaging cam surface 6 once every two revolutions. Thus the frame frequency is reduced to 9 frames per second. Likewise the other frame frequencies of 6 and 3 are obtained by moving the carrier 7 bodily downwards to bring the cam riders 25 and 26 into respective contact, individually, with their corresponding cams 14 and 15.

115 As shown in Figure 1 the carrier plate 16 carries a stop 30 which is capable of engaging a fixed stop 31 having a camming surface 32 when the cam rider 26 lies opposite the cam 15. This corresponds to a frame frequency of three frames per second. The stop 31 prevents the carrier 16 being moved down beyond the three frames per second position if the cam 15 has its radially outermost part in contact with the cam rider 26 so that the extension 17 is disengaged from the claw 7 which therefore may be engaged with a sprocket hole 11. The stop 30 is pulled by the spring 27 out of abutment with the block 31 and into sliding contact with the 130

cam surface 32 of the block, when a recessed part of the rim of the cam 15 lies opposite the projection 24. Simultaneously with this occurring, the carrier extension 17 pulls the claw out of engagement with the sprocket hole 11 in the film 12. The lever 18 can then be moved down to the position "St", corresponding to "still" when all three cam riders 26 are out of contact with their respective cams and the carrier plate 16 is moved as far as possible to the right, as viewed in Figure 1, under the influence of the spring 27. This movement to the right of the carrier plate is transferred by the extension 17 to the traction claw 7 which therefore assumes permanently the position shown in Figure 1a at which it is disengaged from the film sprocket hole 11 to allow the same frame to be projected for as long as the hand lever 18 is in the position marked "St". The operation of the stops 30 and 31 in practice act to prevent the claw 7 being lifted from the sprocket hole 11 until the end of its traction movement so that there is no risk of a "still" being projected of two half film frames. It will be appreciated that the profile of cam 15 is such as to prevent this from happening.

It is possible to modify the arrangement of Figure 1 so that the cams 13, 14 and 15 each behave individually as engagement cams and the claw is then integral with the carrier 16. With such an arrangement each of the cams 13, 14 and 15 can be arranged to adapt the projector or camera for another film format or for a forward or reverse run of the film.

In Figure 2 parts having the same function as in Figure 1 are correspondingly referenced.

In Figure 2 the main drive shaft 1 is shown carrying a worm 8 which meshes with a worm wheel 34 provided at one end of a cup-shaped block 33 mounted on a shaft 10 and carrying four cams 36, 37, 38 and 39. Three of these cams correspond to the cams 13, 14 and 15 in the previously described embodiment. The block 33 has a stepped portion 35 between the cams and the worm wheel.

Rotatably mounted on the block 33 is a carrier turret 40 whose inner rim fits over the stepped portion of the member 33 and is rotatable with respect thereto. The carrier 40 is made of plastics materials and, as shown in Figures 2a and 2b, is integrally formed with cam riders 41, 42, 43 and 44 which are each arranged at the end of respectively four tongues 45, 46, 47 and 48 cut out of the carrier material. The periphery of the carrier 40 is also provided with axially extending grooves 49, 50, 51 and 52 which respectively overlap the ends of slots cut through the carrier 40 and in which the tongues 45 to 48 are resiliently pressable towards respective cam surfaces 36 and 39. A

third groove 53 which does not project across any of the cam riders is provided on the periphery of the carrier 40 as shown in Figures 2a and 2b. The carrier 40 has its wall portion 54 between the grooves 49 and 53 of uniform thickness as clearly shown in Figure 2a.

A sensing lever 55, having its fulcrum at 57 and biased in a counterclockwise direction by a compression spring 56 as shown in Figure 2a, has a nose 58 at one end shaped to fit into the grooves formed in the turret periphery and extending parallel to them. If this nose enters a groove containing one of the cam riders, it is pressed by the nose 58 into engagement with the periphery of the corresponding cam 36 to 39. The selection of the groove which is to lie opposite the nose 58 is made by rotating a crown wheel 59, shown in Figure 2, which meshes with a crown gear provided on the lower outer rim of the turret carrier 40.

A film traction claw 7 shown in Figure 2a has its engaging or lift motion controlled by a cam face 6 provided on a claw cam 4 shown very diagrammatically and having a rim 5 which controls film traction as has already been described. The opposite end of the lever 55 to the nose 58 carries a toe which, when the lever 55 is in the position shown in Figure 2a, holds the claw 7 out of engagement with the film sprocket hole 11.

As is clear from Figures 2 and 2a, the angular position of the turret 40 determines which of the cams 36 to 39 is to influence the movement of the claw 7. When the turret 40 is rotated, the nose 58 runs over the circumference of the turret and, until it locates in one of the grooves 49 to 53, the toe of the lever 55 is held away from the claw 7 which is therefore controlled solely by the transport cam 4. In Figure 2a the frame frequencies provided by each of the grooves is denoted in small numbers and it will be noted that when the nose 58 is engaged with the groove 53, the claw 7 is held away from the film sprocket holes by the toe of the lever 55 to enable stills to be projected.

As is clearly shown in Figure 2a, the natural resilience of the tongues 45 to 48 holds the cam riders 41 to 44 out of engagement with their respective cams 36 to 39.

Figure 3 shows a modification of the arrangement shown in Figure 1a, in which the carrier 16 is influenced simultaneously by more than one of the cams 13, 14 and 15 so that more complicated frequencies of film transport may be obtained. Between the cam riders 24 and 25 a single broad cam rider 60 is provided and likewise a second cam rider 61 is provided between the cam riders 25 and 26. The cam rider 60 senses simultaneously the profiles of the cams 13 and 14 while the cam rider 61 senses simultaneously

the profiles of the cams 14 and 15. The cam riders 60 and 61 are not only arranged between the cam riders 24, 25 and 26 as illustrated in the plan view in Figure 3 but are also disposed between the cam riders as viewed from the side in Figure 1. The mode control determined by the position of the lever 18 may then be provided with two further positions corresponding to the cam riders 60 and 61 being in their respective operating positions.

In the embodiment shown in Figures 4 and 5 the traction claw 7 is controlled partly by a transport cam, not shown, with which coporates a cam rider 62 arranged on the claw 7, and partly by a selected one of four concentrically arranged camming surfaces 64, 65, 66 and 67 provided on a cam disc 63. Four cam riders 68, 69, 70 and 71 are respectively associated with the four camming surfaces and are equi-angularly arranged with respect to one another at different radii on a selector disc 72. Each of the cam riders is arranged as a double-ended piston axially slidable in an opening in the disc and retained in the opening by collars 80 as shown in Figure 5.

The claw 7 extends radially with respect to the cam 63 and the selector disc 72 is arranged between the claw 7 and the cam 63. The peripheral portion of the selector disc 72 is knurled and an arcuate section of its periphery protrudes through a wall 73 of the projector to enable it to be turned in the direction of the arrows 74 shown in Figure 4. The disc 72 is located in each of its four operating positions by means of a detent spring 76 which snaps into one of four peripheral notches formed in the disc 72 when one of the cam riders 68 to 71 lies directly beneath the claw 7. A lateral flange 77 extending along one side of the claw is obliquely inclined to guide the piston cam riders 69-71 to their operating positions beneath the claw 7 as shown for the cam rider 68 in Figure 5. It will be appreciated that if it is desired to rotate the selector disc 72 in both directions, inclined flanges 77 can be provided on both sides of the claw 7. During movement of the claw 7 it is held against one end of the cam rider in use by means of a compression spring 79 coiled around a shaft 78 passing through one end of the claw 7 as shown in Figure 4.

In the previously described embodiments the claw motion is dictated by a transport cam separate from the camming surfaces controlling the mode of operation of the claw, i.e., the direction of traction or the frame frequency. In the embodiment shown in Figure 6 the traction claw is formed as a lever 7 which is integral with the carrier and has an angularly offset arm 81. A cam rider 82 is provided on the claw lever 7 and a second cam rider 83 is provided on the

end of the arm 51. These two riders 82, 83 can selectively engage the periphery of a transport cam 5 and a further cam rider 84, shown in broken outline, additionally rides on the lift or engaging cam surface 6. The claw lever 7 has a fulcrum provided by a shaft 78 extending through an aperture in the carrier and providing a fulcrum for a mode selector lever 86. The carrier is provided with an arched slot 88 which is arcuate around the shaft 78 and contains a pin 87 fixed to one end of the mode selector lever 86. A double-legged coil spring has two offset legs of which one leg 89 is shown engaging the pin 87 while the second leg engages a second pin 90 fixed to the claw lever 7.

The distance of the cam rider 82 from the centre of the shaft 78 is referenced *b* and is equal to the distance from the shaft centre of the cam rider 83. The two cam riders 82, 83 are offset by 120° with respect to one another in relation to the centre of the shaft 78.

The cams 82, 83 controlling lift of the claw lever 7 are selected by movement of the mode selector lever 86 to the position referenced *V* to the position referenced *R*. With the parts in the position shown in Figure 6 the bias of the spring is forcing the cam follower 82 into contact with the rim of the transport cam 5 whereas when the selector lever 86 is moved to the position *R*, the pins 87 and 90 act on the opposite legs of the spring which therefore rotates the claw lever in a clockwise direction to bring the cam rider 83 into contact with the transport cam 5. Turning now to Figure 7, curve 5*a* is that produced by the abutment of the cam rider 82 with the transport cam 5 whereas the curve 5*b* is that produced by the abutment of the cam rider 83 with the transport cam 5. The curves 5*a*, 5*b* are angularly displaced by 120° and are identical to one another as the cam riders 82, 83 are identically spaced from the fulcrum shaft 78.

The lowermost set of curves 85 correspond to a light interrupting phase of the optical path by the shutter. The portion *c* in the curves 5*a* and 5*b* correspond to the transport movement of the claw lever in the forward and reverse mode respectively. This is because an indentation in the cam 5 passing beneath the cam rider 84 causes a counter-clockwise movement of the claw lever 7 whereas the same indentation passing beneath the cam rider 83 causes a clockwise rotation of the claw lever 7. There is therefore a reverse lift of the claw with the reverse run of the film 12.

To enable the claw lever 7 to cooperate with the film in both positions of the section *c*, the cam surface 6 controlling engagement or lift of the claw must have the surface profile indicated in the third curve of Figure

7. As is apparent, the claw lever 7 is held in engagement with the sprocket hole 11 during 180° revolution of the transport cam 4. However, to prevent the claw executing any movement outside of the section *c* during these 180°, the profile of the camming surface 6 is flat beyond the section *c*, at least as far as it falls within the 180° of engagement lift shown in Figure 7. The claw is disengaged from the film relatively quickly in section *d* of the curves. This enables a reversal of the transport direction of the film to be obtained. To prevent frame misalignment occurring when the film is driven in the reverse direction, the cam rider 83 is displaced a short distance *s* from the portion of the transporting cam surface of largest radius. Thus when the cam rider 83 is engaged with the camming surface 5, it has first to cover the small distance *s* which is such that the claw lever performs the necessary movement to obtain a frame correction.

Figure 8 shows a modification of Figure 6 to enable different film formats to be used. To make this possible the distance *b* of the cam rider 82 from the axis 78 is different from the distance *e* of the cam rider 83 from the same point. The ratio of the distances *b:e* corresponds, at least approximately, to the lift ratios of the claw necessary to suit two different formats.

As shown in Figure 8 the transport and lift engaging camming surfaces 91 and 92, respectively, are differently shaped from the camming surfaces 5 and 6 shown in Figure 6. In Figure 9 the shape of the developed profile of the camming surface 91 produces the curve 91*a* and corresponds to the movement of the cam rider 82, while the curve 91*b* denotes the movement derived from the cam rider 83 when following the same surface. The engaging lift of the camming surface 92 is chosen to occur first during the first light interrupting phase 85, shown at the bottom of Figure 9, but does not recur again until after the cam has rotated through 240° from starting as is apparent from the third curve in Figure 9. During the forward transport-movement section *f* of the curve 91*b* corresponding to the reverse transport-movement section *f* of the curve 91*a* the claw is held away from the film which does not move. However, during the reverse transport-movement section *c* of the curve 91*b* corresponding to the forward transport-movement section *c* of the curve 91*a*, the engaging lift of the camming surface 92 causes the claw to engage with the film and transport it. In Figure 8 the small distance *s* is once again necessary to control framing correction when running in the reverse sense.

When changing over to a different film format a change in the centre of the sprocket holes of the film often results. On the left-hand side of Figure 8 in the detailed draw-

ing is shown a sprocket hole displayed by *g* and *h* from the sprocket hole shown in full outline of another film format. The correction distance *s* is unable to compensate for large discrepancies in the spacing between sprocket holes of different formats as it cannot correct for the framing distance *h*. To take account of this, the axis provided by the shaft 78 may be arranged to be eccentric with respect to a fixed axis 93 as shown in Figure 8*b*. The mode selector lever 86 moves about the axis 93 and, during such movement, displaces the fulcrum of the claw lever 7 to the right in Figure 8 to compensate for the distance *g*. Thus as is clear from Figure 8*b* the provision of a movable fulcrum before the lever claw 7 enables the compensation of both the distances *h* and *g* to be performed. By selection of the distances *s* and the eccentricity of the shaft 78, it is possible to adjust the mechanism to suit a wide range of film formats each corresponding to a different mode.

Figure 10 shows an embodiment in which not only is claw movement to compensate for different film formats possible but also to take account of forward and reverse running of the film. In Figure 10 the changeover from one format to another is achieved by rocking the mode selector lever 86 which transfers the influence on the claw lever 7 from the cam rider 82 to the cam rider 83.

In addition to the transport camming surface 91, the cam 91 has two separate engaging cam surfaces 92*a*, 92*b*. The developed surfaces of these two camming surfaces in relation to one another are shown in the third and fourth curves in Figure 11 and, as is apparent from this figure engagement of the claw with the film occurs optionally in the sections *c* or *f* of the transport camming surface 91 in accordance with the direction of movement of the film. Section *f* of the curve 91*a* corresponds to super-8 film format while the corresponding section, *f* and the curve 91*b* corresponds to forward transport movement of a normal 8 film.

For changing over from forward to reverse running an additional changeover lever 95 is provided which has a cam rider 84 riding on one or other of the camming surfaces 92*a*, 92*b* in accordance with the transport direction being in a forward or reverse direction.

In the variation shown in Figure 12 only the camming surface 6 of a transport cam combined with a shutter 3 is illustrated, there being also a transport camming surface to produce traction of the claw 7 but this is not shown. In place of two cams to control lift of the claw in forward and reverse running, only the single engaging camming surface is used and, instead, the reverse movement of the claw 7 is achieved by using a lever 96. This lever can be slid longitudinally

by a bar 98 providing the lever fulcrum and it carries at one end a double stud 84, 99, and at the other end a single stud 100 the stud 84 acting as a cam rider. In the position illustrated in Figure 12 the profile of the engaging camming surface controls the lift of the claw 7 by abutting a bearing surface 101 on a claw. If now the bar 98 is moved downward in Figure 12 to the position shown in broken outline—this displacement occurring while still maintaining the stud 84 in contact with the camming surface 6—the stud 99 is now positioned clear of the abutment surface 101 and, instead, the stud 100 at the other end of the lever 96 is brought opposite the position of a second abutment surface 102. Projecting portions of the cam profile now produce a reversal in the direction of lift of the claw 7 by virtue of the lever action.

In the modification shown in Figure 13 the transport cam 4 is provided with a transport camming surface 5 and an engaging camming surface 6. Two cam riders 84a, 84b are provided on respective arms of a carrier 103 which is pivoted for movement around the fulcrum of a lever claw 7. The two riders 84a, 84b are at diametrically opposite positions with respect to the axis of the transport cam 4 and, by movement of the carrier 103, may selectively be brought into engagement with the engaging cam surface 6 so that the profile of the camming surface 6 as it revolves is imparted to produce the required lifting motion of the lever claw 7. As the two cam riders are displaced by 180° the phase shifting between transport movement and engaging lift of the lever claw 7 is correspondingly changed so that engagement of the claw 7 with the film occurs at the return lift instead of the forward lift when the cam motion is switched from one cam rider to the other.

Figure 14 shows an arrangement where tilting of plate claw 104 is used which rocks about an axis defined by two balls 105 while simultaneously being displaceable in the direction of the axis in order to transport the film 12.

The plate claw 104 is provided with a cam follower 106 which rides on the rim of one or other of the transport camming surfaces 107, 108 which are radially spaced from each other. For a changeover from one film format to another, the cam rider 106 is shifted from the camming surface 107 to the camming surface 108 by means of a changeover lever 109 having its fulcrum at 110. A pin 113 at the end of the changeover lever 109 overlying the plate claw 104 is engaged by one end of the crossed spring 111 which is coiled around the pivot shaft 110 and has its other end engaging a pin 112 formed on the claw plate 104. Depending on the position of the changeover lever 109, one or other

of the legs of the spring 111 abuts the pin 112 while the other abuts the spring 113. These abutments are reversed when the changeover lever 109 is moved clockwise to changeover the engagement of the cam rider 106 with the two camming surfaces 107, 108.

The shape of the camming surfaces is shown in Figure 15 where their developed profiles are references 107 and 108. Each camming surface has a section *c*, corresponding to forward transport movement of the film 12, and a section *d* corresponding to reverse transport movement of the film 12. Both of the sections *c* and *d* occur during light interruption phases 85 of the shutter shown in Figure 14.

To change over from forward run to reverse run the engaging lift of the claw lever 104 must be changed from section *d* to the section *c*. This involves shifting the phase position of the lift by 120°. The engaging lift movement obtained by the cam rider 84a when on the engaging lift camming surface 114 is shown in Figure 15 at 114a, and the engaging lift movement applied by the cam rider 84b when on the camming surface 114 is shown at 114b. The two cam riders 84a and 84b are mutually displaced about the axis of rotation of the cam by 120° so that movement of the changeover lever 103 of the carrier automatically produces the 120° phase shift necessary to switch the claw movement from forward traction to reverse traction.

Figure 16 shows developed camming surface profiles of an arrangement not illustrated. A camming surface 115 is shaped to provide different transport movements of a claw during zones in which the shutter cuts off the light path. Section *i* is designed to suit transport movement for one film format and the section *j* is designed to suit transport movement for a second film format. Other transport movements for further film formats could be incorporated into the cam profile but it will be appreciated that the transport movements corresponding to respective sections of a cam profile must coincide with light interrupting phases. Should more than three transport movements be obtained from a single cam it is best to use a four-bladed shutter or, alternatively, to assign two transport movements to a single light interruption phase. This is particularly possible with cinematograph cameras.

The engaging lift necessary for each of the sections *i* and *j* is denoted by the two curves 114a, 114b. In accordance with the selection of the engaging lift corresponding to the curves 114a, 114b, one or other of the sections *i* and *j* of the transport camming surface 115 are selected. During the transport movement produced by the unselected section of the curve 115, the claw is held out of engagement with the film.

The two engaging lift curves 114a, 114b may be produced in different ways. They may be obtained by using two separate camming surfaces. Alternatively, a single camming surface and a change in the phase position of the engaging lift by means of a changeover lever 103 of the type shown in Figure 14 may be used.

Figure 17 shows a modification of the arrangement described with reference to Figure 16 in that the single cam profile 116 provides in sections *i* and *j* the transport movement for two separate film formats but the section *i* corresponds to forward running of one format whereas section *j* corresponds to reverse running of a different format. Apart from this distinction the curves shown in Figure 17 are the same as those shown in Figure 16.

Figure 18 shows a film projector 217 for film with substandard format. The projector has a screen 218, a keyboard 219, a projection lamp 220, a film gate 221 and a schematically illustrated drive claw 222. Two turntables 223, 224 for receiving reels 225 226 are provided, one reel being the film supply reel and the other the take-up reel. Turning to Figure 17, if the section *i* of the developed cam profile 116 of the transport cam is designed for super-8 film, and the section *j* for normal 8 film, it is only necessary to put the supply reel containing the super-8 film on a turntable 223 so that the film is transported from the reel 225 to the reel 226. If it is desired to show a normal 8 film then the reel is supplied to the turntable 224 so that the film is transported from the turntable 226 to the turntable 225. Depending on the film format, the transport direction is reversed. The projector may also be provided with an arrangement for setting the adjustment of the engaging lift to suit the direction of film travel in accordance with whichever of the turntables is loaded with a full reel. This selection results in the appropriate cam diagram 114a or 114b being selected. If the wrong cam diagram for controlling the claw lift is chosen the operation of the projector can be arranged to be automatically interrupted.

The cam diagrams of Figure 19 provide a transport cam profile 117, in developed form, having in the section *i* the transport movement for super-8 film format whereas the section *j* provides for the reverse transport movement of this film. A further section *k* is provided for the forward transport movement of a normal 8 film and the section *l* is provided for the reverse transport movement of the normal 8 film. The engaging lift 118 which is shown opposite the position of the forward transport movement for super-8 format can be transferred by suitable means from the position shown in full line in Figure 19 to any of the other three posi-

tions shown at 118a, 118b and 118c which are shown in broken outline. It will be noticed that each of these positions corresponds to a selected one of the transport movements which takes place in one of the light interrupting phases, shown at 119, caused in this case by a four-blade shutter.

The arrangement shown in Figures 20 and 21 can be used to obtain the effects illustrated in the cam diagram 19. A cam disc 120 has a camming surface 131 shaped to provide claw lift, i.e., the "bows" 118 shown in Figure 19. The carrier 121 is mounted between the cam disc 120 and a claw plate 122 which receives its transport movement by the transport cam 123 driven from the shaft 126. The claw plate 122 is movable axially of the cam 123 against the bias of springs 127 by pusher pins 68, 69, 70 and 71 which can be individually brought to an operating position where it runs on the camming surface 131.

As shown in Figure 20, the carrier 121 is rectilinearly movable in directions determined by the lobes of "rosette" guide crosses 125. These are shown in chain outline and are slightly resilient so that each lobe 125 provides a position in which pins 124 attached to the carrier 121 positively locate. Thus the carrier 121 can be brought to four extreme positions or can be allowed to remain in the mid position shown in Figures 20 and 21 at which no engaging lift movement is applied to the claw plate 122.

Each of the pusher pins 68 to 71 is provided with a holding collar 80 to hold it in position in the carrier plate 121 which can be moved rectilinearly by means of two handles 128, 129. This movement is guided rectilinearly by means of the rosette shaped guide crosses 125.

The cam riders 68 to 71 are mutually phase shifted by 90° with respect to one another and thus their effect on the claw are phase displaced likewise so that one of the four positions 118, 118a, 118b, 118c shown in Figure 19 is selected automatically by movement of the carrier 121 so that its pins 124 enter one of the lobes of the crosses 125.

It will be noticed that the cam disc 120 has a bevelled edge 132 which guides the end of the selected pusher pin onto the camming surface 131. In practice, the operation of the handle 128 selects film format in the forward run and the operation of the handle 129 selects the different film formats in the reverse run. As it is impossible to move the carrier 121 to a new position without first passing through the mid position by the centre of the rosette shaped guide crosses, some unintended displacement from one mode of operation to another without an intermediary rest position is impossible. In the intermediary rest position no movement

in the engaging lift direction of the claw 122 occurs and this therefore corresponds to stationary projection of a film frame.

WHAT WE CLAIM IS:—

- 5 1. Film handling apparatus having a traction device operating to advance a film frame-by-frame, a drive shaft providing drive to the device and being rotatably connected to at least one camming surface for controlling the drive of the traction device, rider members mounted at fixed spaced locations on a movable carrier for transferring movement from the at least one camming surface to the traction device, and a mode selector for moving the carrier between different positions at each of which the motion of the traction device is controlled by a different combination of the at least one camming surface and the rider members.
- 10 2. Apparatus as claimed in Claim 1, in which the traction device is driven by a transport cam arrangement and the combination selected by the mode selector position interrupts, cyclically, the drive connection between the arrangement and the device.
- 15 3. Apparatus as claimed in Claim 2, in which the traction device comprises a film pull-down claw which engages sprocket holes in the film, and the interruption of the drive connection between the arrangement and the device is effected by displaying a cam follower, controlling lift-engaging movement of the claw, from an engaging cam face provided on the arrangement.
- 20 4. Apparatus as claimed in any one of the preceding claims, in which there is a plurality of the camming surfaces provided by respective rims of a stack of cams coaxially mounted and driven in unison.
- 25 5. Apparatus as claimed in claim 4, in which the cam stack is driven via speed reduction gearing from the drive shaft.
- 30 6. Apparatus as claimed in claim 4 or claim 5, in which the rider members are cam riders and the carrier is displaceable to different positions to bring the cam riders selectively into engagement with the respective cams.
- 35 7. Apparatus as claimed in claim 6, in which the carrier is displaceable tangentially of the rotational axis of the cam stack by the mode selector, against a resilient bias.
- 40 8. Apparatus as claimed in claim 7, in which the carrier is displaceable by the mode selector through a range of positions between two extreme positions at one of which the drive connection to the traction device from the drive shaft is permanently interrupted, and at the other of which such drive connection is permanently established.
- 45 9. Apparatus as claimed in claim 6, claim 7 or claim 8, in which at selected positions of the carrier the cam riders are acted upon by more than one of the camming surfaces.
- 50 10. Apparatus as claimed in claim 4 or

5, in which the carrier comprises a turret encircling the cam stack and provided with peripherally and axially spaced cam riders as the rider members which, by appropriate rotation of the turret, are brought selectively opposite a resilient pusher which deflects the selected cam rider against its corresponding camming surface and simultaneously controls the drive connection between the drive shaft and the traction device in accordance with the camming surface profile.

11. Apparatus as claimed in claim 10, in which the cam riders are formed by resilient portions of the turret which is slotted and axially grooved in the vicinity of the cam riders, and a nose on the pusher extending the length of the grooves is locatable therein and is resiliently biased against the turret which is formed with one groove which does not span across the position of any of the cam riders.

12. Apparatus as claimed in claim 10 or claim 11, in which the camming surfaces are formed by peripheral bands on a plastics member fixed to a spindle and driven from the drive shaft by a worm gear having the worm wheel integrally formed with the member, the turret carrier fitting over the major part of the plastics member and having a peripheral gearing which meshes with a pinion rotatable by the mode selector to change the angular position of the turret.

13. Apparatus as claimed in claim 1, in which there are a plurality of said camming surfaces mounted on a rotary camming member and the traction device is a film pull-down claw element having its lift engaging motion controlled by the selection of one of a plurality of cam riders as rider members mounted in the movable carrier positioned between the rotary camming member driven by the drive shaft and part of the claw element, the carrier movement being controlled by the mode selector and the cam riders comprising pusher pins slidable in apertures formed through the carrier and one of which is brought between one of the camming surfaces of the camming member and the claw element part at a corresponding position of the mode selector.

14. Apparatus as claimed in claim 13, in which the carrier is a plate rotatable about the rotational axis of the camming member which has radially spaced rings of camming surfaces, and the pusher pins are provided on the carrier at different radii each corresponding to one of the rings of camming surfaces.

15. Apparatus as claimed in claim 14, in which the claw part extends radially of the rotational axis of the carrier and is resiliently biased towards the carrier.

16. Apparatus as claimed in claim 15, including an inclined flange on the claw part to guide one end of a pusher pin beneath



in the engaging lift direction of the claw 122 occurs and this therefore corresponds to stationary projection of a film frame.

WHAT WE CLAIM IS:—

5 1. Film handling apparatus having a traction device operating to advance a film frame-by-frame, a drive shaft providing drive to the device and being rotatably connected to at least one camming surface for controlling the drive of the traction device, rider members mounted at fixed spaced locations on a movable carrier for transferring movement from the at least one camming surface to the traction device, and a mode selector for moving the carrier between different positions at each of which the motion of the traction device is controlled by a different combination of the at least one camming surface and the rider members.

20 2. Apparatus as claimed in Claim 1, in which the traction device is driven by a transport cam arrangement and the combination selected by the mode selector position interrupts, cyclically, the drive connection between the arrangement and the device.

25 3. Apparatus as claimed in Claim 2, in which the traction device comprises a film pull-down claw which engages sprocket holes in the film, and the interruption of the drive connection between the arrangement and the device is effected by displaying a cam follower, controlling lift-engaging movement of the claw, from an engaging cam face provided on the arrangement.

35 4. Apparatus as claimed in any one of the preceding claims, in which there is a plurality of the camming surfaces provided by respective rims of a stack of cams coaxially mounted and driven in unison.

40 5. Apparatus as claimed in claim 4, in which the cam stack is driven via speed reduction gearing from the drive shaft.

45 6. Apparatus as claimed in claim 4 or claim 5, in which the rider members are cam riders and the carrier is displaceable to different positions to bring the cam riders selectively into engagement with the respective cams.

50 7. Apparatus as claimed in claim 6, in which the carrier is displaceable tangentially of the rotational axis of the cam stack by the mode selector, against a resilient bias.

55 8. Apparatus as claimed in claim 7, in which the carrier is displaceable by the mode selector through a range of positions between two extreme positions at one of which the drive connection to the traction device from the drive shaft is permanently interrupted, and at the other of which such drive connection is permanently established.

60 9. Apparatus as claimed in claim 6, claim 7 or claim 8, in which at selected positions of the carrier the cam riders are acted upon by more than one of the camming surfaces.

65 10. Apparatus as claimed in claim 4 or

5, in which the carrier comprises a turret encircling the cam stack and provided with peripherally and axially spaced cam riders as the rider members which, by appropriate rotation of the turret, are brought selectively opposite a resilient pusher which deflects the selected cam rider against its corresponding camming surface and simultaneously controls the drive connection between the drive shaft and the traction device in accordance with the camming surface profile.

11. Apparatus as claimed in claim 10, in which the cam riders are formed by resilient portions of the turret which is slotted and axially grooved in the vicinity of the cam riders, and a nose on the pusher extending the length of the grooves is locatable therein and is resiliently biased against the turret which is formed with one groove which does not span across the position of any of the cam riders.

12. Apparatus as claimed in claim 10 or claim 11, in which the camming surfaces are formed by peripheral bands on a plastics member fixed to a spindle and driven from the drive shaft by a worm gear having the worm wheel integrally formed with the member, the turret carrier fitting over the major part of the plastics member and having a peripheral gearing which meshes with a pinion rotatable by the mode selector to change the angular position of the turret.

13. Apparatus as claimed in claim 1, in which there are a plurality of said camming surfaces mounted on a rotary camming member and the traction device is a film pull-down claw element having its lift engaging motion controlled by the selection of one of a plurality of cam riders as rider members mounted in the movable carrier positioned between the rotary camming member driven by the drive shaft and part of the claw element, the carrier movement being controlled by the mode selector and the cam riders comprising pusher pins slidable in apertures formed through the carrier and one of which is brought between one of the camming surfaces of the camming member and the claw element part at a corresponding position of the mode selector.

14. Apparatus as claimed in claim 13, in which the carrier is a plate rotatable about the rotational axis of the camming member which has radially spaced rings of camming surfaces, and the pusher pins are provided on the carrier at different radii each corresponding to one of the rings of camming surfaces.

15. Apparatus as claimed in claim 14, in which the claw part extends radially of the rotational axis of the carrier and is resiliently biased towards the carrier.

16. Apparatus as claimed in claim 15, including an inclined flange on the claw part to guide one end of a pusher pin beneath

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it when the carrier is rotated towards a position determined by the mode selector and in which it is positively indexed.

17. Apparatus as claimed in any one of claims 13 to 16, in which transport motion is imparted to the claw by a separate cam rider positionally controlled by a transport camming surface.

18. Apparatus as claimed in claim 13, in which the carrier is rectilinearly movable along perpendicular co-ordinates from a mid-position, at which no lift engaging motion is imparted to the claw element, to one of four extreme positions as determined by the movement of two pins in respective rosette-shaped guide slots.

19. Apparatus as claimed in claim 18, in which the rotary camming member has a single circular camming face and the carrier has four equiangularly spaced pusher pins which, when the pins are in the centres of the guide slots, are out of contact with but symmetrically arranged with respect to the axis of rotation of the camming member, the lengths of the guide slots being such that movement of the carrier to any one of four extreme positions brings a respective one of the pusher pins to a position lying between the camming face and the claw element part which is arranged to move parallel to itself to accomplish lift engaging motion of the claw.

20. Apparatus as claimed in claim 19, in which transport motion of the claw is obtained by a rotatable transport cam mounted within an opening in the claw part and which, during cam rotation, moves the carrier in its own plane to effect transport motion of the claw, the thickness of the transport cam being such as to allow lift engaging motion of the claw under the influence of the pins to take place simultaneously with the transport motion.

21. Apparatus as claimed in claim 1, in which the carrier and the traction device, which is formed as a film pull-down claw, form part of the same component which is both rockable and tiltable about a fulcrum to produce the desired motion of the claw.

22. Apparatus as claimed in claim 21, in which the rider members are cam riders and rocking of the components about the fulcrum brings cam riders individually into engagement with an annular camming surface controlling lift engaging movement of the claw, such cam riders being angularly displaced around the rotational axis of the annular camming surface.

23. Apparatus as claimed in claim 22, in which a two-legged arcuately movable spring movable about the fulcrum has its legs co-operating with a first pin fixed to the carrier and a second pin fixed to an arm angularly movable by the mode selector about the fulcrum; the arm, spring and pins being so

arranged that movement of the arm to a first position displaces the spring in a direction which holds one cam rider in contact with a transport camming surface while movement of the arm to a second position displaces the spring and interchanges the engagement of the legs with the pins so that the spring moves the claw and carrier component to a position at which the spring resiliently presses another cam rider against the transport camming surface.

24. Apparatus as claimed in claim 23, in which the second pin extends through a slot in the carrier arcuate about the fulcrum.

25. Apparatus as claimed in claim 23 or claim 24, in which the two cam riders are the same distance from the fulcrum but have a small difference in spacing from the transport camming surface rotational axis.

26. Apparatus as claimed in claim 23 or claim 24, in which the fulcrum of the carrier and claw component is provided by a shaft fixed to the arm and rotatable about an axis which is parallel and eccentric with respect to the fulcrum axis.

27. Apparatus as claimed in claim 26, in which the two cam riders for engaging the transport camming surface have different spacings from the fulcrum.

28. Apparatus as claimed in claim 27, in which the two cam riders have different spacings from the rotational axis of the transport camming surface.

29. Apparatus as claimed in claim 1, in which the traction device comprises a film pull-down claw forming part of a plate which is tiltable and rockable about a fulcrum around which the carrier is also rockable, the plate overlying a rotatable camming arrangement providing transport and lift-engaging camming surfaces, and the rider members being two cam riders on the carrier selectively engageable between the lift engaging camming surface and the plate and positioned on diametrically opposite sides of the rotational axis of said surface so that rocking movement of the carrier in one direction brings one cam rider into operation and rocking movement of the carrier in the opposite direction brings the other cam rider into operation.

30. Apparatus as claimed in claim 1, in which the traction device comprises a film pull-down claw which forms part of a plate tiltable about a hinge axis provided by two spaced balls and reciprocable lengthwise of said axis, the plate overlying annular camming surfaces of different diameters and controlling lift-engaging motion and transport motion of the claws, a cam follower on the plate controlling transport motion and engaging the rim of a transport camming surface, and the rider members comprising cam riders on the carrier selectively interposable between a lift engaging camming



surface and the plate by rocking of the carrier about a fulcrum.

31. Apparatus as claimed in claim 30, including two transport camming surfaces and a system for displacing the plate along the hinge axis to bring the cam follower selectively into engagement with the transport camming surfaces.

32. An apparatus as claimed in claim 31, in which the system comprises an arm rockable about the carrier fulcrum and having a pin engaged by one leg of a two-legged rotatable spring encircling the fulcrum, the second leg of the spring engaging a pin on the plate and the arrangement of the pins spring and arm being such that when the arm is in one position the spring presses the cam follower against one transport camming surface and when the arm is rocked to a second position the spring presses the cam follower against the second transport camming surface.

33. Apparatus as claimed in claim 1, forming part of a projector having two reel turntables adapted, respectively, to accept reels having a different film formats, the mode selector controlling the direction in which the film runs in accordance with the format of the film.

34. Film handling apparatus as claimed in claim 1, in which the traction device is a film pull-down claw and the carrier is a rockable lever which is bodily displaceable to bring a cam rider of the rider members fixed to one side of the carrier to two fixed spaced locations at each of which it engages a different radial portion of one said camming surface, the lever also having at opposite ends and on the opposite side of the carrier to the cam rider two spaced studs of the rider members, and the claw having two abutment surfaces spaced lengthwise of the claw by a distance equal to the permitted displacement of the carrier plus the spacing between the two studs, whereby in one position of the carrier a lift engaging motion is imparted to the claw by one of the studs engaging one of the abutment surfaces, and in the other position of the carrier an opposite lift engaging motion is imparted to the claw by the engagement of the other stud with the other abutment surface.

35. Film handling apparatus substantially as herein described with reference to any one of the embodiments shown in the accompanying drawings.

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