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(54) FILM HANDLING APPARATUS

(71) We, KARL VOCKENHUBER, of 118 Pötzleinsdorferstrasse, 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:—

This invention relates to film-handling apparatus having a light interrupter, operated in synchronism with a film transport claw, and rotary camming surfaces driven in synchronism with the interrupter and controlling film transport motion of the claw along a film gate and film engaging motion of the clam transversely to the film gate.

Apparatus of the above kind has become known in numerous embodiments; the light interrupter being generally a rotary shutter, although it may also be formed by stroboscopically flashing lamp or the like.

The aim of the invention is to produce apparatus of the above kind cheaply.

The invention provides film-handling apparatus including a film gate and an associated film transport claw which is driven in synchronism with an interrupter operated to blank-off, intermittently, a light path extending through the film gate, the claw movement having a component in a direction through the gate for film engagement and determined by an engagement cam and a component extending along the gate for port cam having a cam profile with two angularly-offset camming portions of different shape to produce successively two different film transport motions of the claw during respective blanked-off phases of the light path, the choice of which film transport motion is to be used in the film engagement position of the claw being determined by a control element having two operational states at each of which a different one of the transport motions of the claw occurs while the claw is advanced by the engagement cam into its film-engagement position in the film gate whereby a film may be moved by the claw.

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

Figure 1 shows graphically in sketches *a*, *b* and *c* development diagrams of cam profiles for producing film transport and film engagement motions of a claw, related to the movement of a shutter used to interrupt an optical path by way of which light enters a film handling apparatus;

Figure 2 is a plan view of a rotary, eared, shutter disc and illustrates how a claw is guided by one arrangement of cams;

Figure 3 is a plan view of a second way of driving a claw in synchronism with a rotary, eared, shutter disc and using a different cam arrangement;

Figure 4 corresponds to Figures 2 and 3 but shows a third way of carrying out the invention;

Figure 5 is a diagrammatic side view of a modified version of Figure 3;

Figure 6 corresponds to Figures 2, 3 and 4 and shows a fourth way of carrying out the invention;

Figure 7 is a development diagram corresponding to Figure 1 and of the cam profiles shown in Figure 6;

Figure 8 shows very diagrammatically indeed a fifth way of carrying out the invention; and

Figure 9 is a development diagram of the cam profiles and operating characteristics of parts shown in Figure 8.

According to Figure 1*a* a transport cam developed profile has a camming portion *a* defining a film transport movement for a first film format, for example a super-8 film, and a camming portion *b* defining a transport movement for a second film format, for example a normal-8 film. These two transport movements are assigned to respective light interrupting phases *ac*, *bc* of Figure 1*c*. In order to let alternatively one or the other transport camming surfaces become effective, the transverse film engaging motion is selectively assigned to the camming portion *a* or to the camming portion *b*. The motion of the claw to and

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from the plane of film engagement is referred to as claw lift.

In Figure 2 two types of film 1 of different perforation pitch respectively, are transported by a tooth of a claw 2 integrally formed with carrier 3. The carrier 3 is guided by means of slot entrained balls 4 in a straight-line movement and is tiltable about an axis passing through the centres of balls 4. The carrier 3 is formed with a cam follower 5, which cooperates with a transport cam 7 mounted on a drive shaft 6. A three-eared shutter 8 having ears 9, 10, 11 is rotated by the shaft which also carries concentrically with the transport cam 7 two camming surfaces 12, 15 controlling claw lift and at different radial distances. The camming surfaces 12, 15 are selectively engageable by a rider 14 located between the carrier 3 and a cam 13 on which the two angularly spaced raised cam surfaces 15, 16 are formed. A spring, not shown, presses the carrier 3 firmly but resiliently towards the surface of the cam 13.

The transport cam 7 has a curved edge section within an angle α which corresponds to the camming portion *a* in Figure 1a. It also has a second curved edge section within an angle β which corresponds to the camming portion *b* of Figure 1a. As is apparent, the cam follower 5 comes into the range of the angle α as soon as the ear 9 moves an image of the film 1. Thus this edge section is assigned to the light interrupting phase caused by the shutter ear 9. It is also apparent that largely within the subtended angle of the shutter ear 9 is formed the camming surface 15 causing claw engagement with the film necessary during advance of the film and illustrated in Figure 1b. Likewise the camming surface 16 provides the film engaging motion of the claw assigned to the camming surface *b* of Figure 1b. The camming surface 16 lies largely in the subtended angle of the ear 10.

The rider 14 is displaceable radially of the cam 13 by rocking a change-over lever 17 and a change-over means for the film gate may also be connected to operate at the same time i.e. when changing from one film type to another.

Although the above arrangement is used for only two different film formats, it is evident that according to the light interrupting phases per revolution of the shaft 6 a corresponding number of different transport movements may be provided to suit an equivalent number of film formats.

Referring now to Figure 3 parts having the same function as in Figure 2 bear the same reference numerals. Here again a transport cam 7 has two differently curved edge portions providing the camming portions *a* and *b* and is provided on the shaft 6. In this case only a single cam 18 controls

the claw lift for which purpose it has one camming surface 19 (not illustrated but positionally identified). The rider 14 cooperates with the cam 18 and is carried by a change-over arm 20 centred on, and rotatable around the shaft 6. The arm 20 can be moved arcuately by a diametrically opposite extension arm 21 being swung around the shaft axis. To change the phase of the lift to suit a selected camming portion of the transport cam 7, the arm 21 is rotated to the position 21¹ indicated in dash-dotted lines, so that the rider 14 assumes the position 14¹ marked in dash-dotted lines. The same effect as is obtained in Figure 2 is realised without the provision of two separate camming surfaces to control lift.

Figure 4 shows an arrangement in which a single cam controls claw lift but a lever used to change the phase of the lift to suit the camming surface of the transport cam in use, does not require the length or range of movement necessary in the Figure 3 arrangement. The lift control cam is referenced 22, which however differs from the cam 18 of Figure 3 in that instead of the camming surface being raised, it is provided by a recess 23. Also, the carrier integrally formed with the claw 2 and referenced 24 is formed on the opposite side of the carrier tilt axis defined by the balls, with an extension margin which, as shown, overlies two riders 25, 26 which are selectively insertable between the lift cam 22 and the extension margin of the carrier 24. The riders 25, 26 are arranged on a three-armed angle lever 27, which serves for the change-over of one film format to the other. Depending on the position of the angle lever 27 one or other of the riders 25, 26 which are mutually displaced around the shaft axis by 120° controls the engaging lift of the claw tooth 2. The angular distance of 120° corresponds to the mutual angular displacement of the shutter ears 9, 10, 11. As well as the movement of the lever 27 being small the engagement of the claw tooth 2 in a sprocket hole is only resiliently controlled, so that the claw is not forced into the film border to perforate it upon wrong threading of the film 2.

The resilient control stems from the use of a bias spring (not shown) to urge the extension margin of the carrier 24 towards the riders and thus the claw tooth towards the film perforations or sprocket holes.

If space precludes the mounting of the changeover lever 27 beside the cams the construction according to Figure 5 may be used. Here again parts having the same function bear the same reference numerals. The transport cam 7 in this arrangement is broader than is necessary solely for the control of the claw carrier 3. The cam 130

5 follower 5 engaging the transport cam 7 is designed as a small bar projection fixed to the carrier 3. In this figure the engaging or lift movement of the claw tooth 2 is controlled by an engaging cam 18 similarly shaped and arranged to that shown in Figure 3, but separate from the transport cam 7 although mounted on the same shaft 6. A rider 29 for transferring the lift motion to the claw tooth 2 from the cam 18 is formed as a push rod which is a sliding fit in a stationary guide 28.

15 The engaging cam 18 is axially movable along the shaft 6, by means of a spiral spline 30 on which the cam is slidable. The length of the spline around the shaft 6 is such that the angle between its ends corresponds to the angular displacement around the transport cam 7 of the two transport camming surfaces.

20 To change-over the claw lift from one format to the other the shaft 6 is displaced with the transport cam 7 in the direction of the arrow 31. Stationary guides 32, 33 prevent the cam 18 from also moving in the direction of the arrow 31. Due to the spiral nature of the spline 30, the cam 18 turns through an angle corresponding to the phase shift necessary to suit the claw lift to the transport camming surface to be used.

30 In the embodiment of Figure 3 it is not essential to arrange the arm 21 so as to rotate on the shaft 6. It could equally well be arranged eccentrically of the axis of shaft 6 and beyond the periphery of the cams so that only its rider overlapped the engaging cam 18.

40 Turning now to Figure 6, in this embodiment, where again parts operating as already described are correspondingly referenced, there is shown a three-eared shutter 8 and a cam disc fastened to the driving shaft 6. The cam disc provides a transport cam 7 with the rim of a raised central portion, and an engaging cam 106 with its portion around the central portion. A claw carrier 3 is provided adjacent the cam disc and it is shiftable for transport motion, bodily along an axis provided by two balls 4 which allow the carrier to tilt about the axis for claw lift. The plate-like carrier 3 has two claw teeth 110, 111, which cooperate with the perforations of the film 1 and transport it a distance corresponding to the movement of the carrier.

55 On the carrier 3 is a cam follower 5, which is pressed against the transport cam 7 by a tension spring 14. The cam follower is also pressed against the engaging cam 106 by a second spring, not shown, which is a compression spring and acts on the carrier 3 in line with the thrust of the compression springs.

65 Adjacent the carrier, which is made of ferromagnetic material is an electro-magnet

16, whose coil is energised by an impulse transmitter 117.

70 The rim of the transport cam 7 shows in its development in Figure 7 two different transport camming portions. In the range *a* there is provided a larger transport movement, for example for super-8 films, and in the range *b* a smaller transport movement suitable, for example, for normal-8 films. To these two transport camming portions are assigned respective film engaging motions formed as recessed portions on the engaging cam 106, one 118 lying in the range *a*, and the other 119 lying in the range *b*, as shown in Figure 7 curve II. Thus the claw performs successively a transport lift for the super-8 format and then a transport for the normal-8 format.

85 In order to ensure only a single film format is transported at a time, one of the two lifts in the range *a* or *b* is prevented from moving the carrier 3, by energisation of magnet 116. In the illustrated embodiment it is the engaging lift which is prevented when the magnet 116 is energised to attract the carrier 3. This prevents the engagement of the cam follower 5 with the engaging cam 106. At the same time the teeth 110, 111 are held out of mesh with the perforations of the film 1. If now for instance a normal-8 film is to be transported, the impulse transmitter 117 is switched on and so operates that the magnet 116 receives an energisation impulse 118¹ (diagram III Figure 7), while the range *a* of the transport cam 7 passes the cam follower 5 (Figure 7). If on the other hand the transport of super-8 films is desired, the phase of the impulse is shifted, so that the impulse 119¹ (diagram IV Figure 7) in the range *b* is fed to the electro-magnet 116. As is apparent, the ranges *a* and *b* are assigned respectively to two of three light interrupted phases of the shutter, these three phases being indicated by the reference numerals 8*a*, 8*b* and 8*c* in Figure 7, diagram V.

115 As already mentioned above it is only necessary to prevent one of the two transport motions. In the illustrated embodiment this is carried out by preventing the claw engaging the film. It is of course also possible to disengage the transport motion itself by the use of the electro-magnet.

120 The invention is not only applicable to different film formats, but also to forward and reverse movement of the same film. This is apparent from Figure 8, in which the parts of the same function as previously described bear the same reference numerals. Referring to Figure 9, diagram I, the transport cam 7 is provided with a camming surface profile causing a forward transport movement in the range *a*, while a reverse transport movement is produced by the cam 130

profile in the range b^1 . To each of these two movements there is assigned a claw engaging camming surface on the engaging cam 106. A mechanical impulse transmitter is formed by two cams 120, 121, which selectively provide a fulcrum for a lever 123 movable round a pivot shaft 122 at one end. The other end of the lever 123 engages beneath an extension margin of a plate-like carrier 3 which is provided with the cam follower 5 for the transport motion, and a rider 124 for controlling the engaging or claw lift motion. The cam 120 and the lever 123 cooperate to lift the carrier 3, as viewed in the drawing, and thus the rider 124 from the engaging cam 106, while simultaneously the claw tooth 110 is removed from the perforation. The profile of the cams 120, 121 is apparent from diagrams III and IV of Figure 9, the cam 120 preventing the lift of the carrier in the range b^1 , whereas the cam 121 prevents the lift in the range a .

For the change-over of the lever 123 from one cam to the other, the pivot shaft 122 is shifted axially by a handle 125, and is locked in its new position by a lock element 126. The drawing of Figure 8 is not to scale and in practice the engagement of the lever 123 with the carrier 3 is out of the range of the cams 106 and 7.

As the lever 123 can be relatively long, the vicinity of the carrier 3 can be kept free from moving parts to a large extent. The space required for the change-over of the lever 123 from one mode of operation to the other is relatively small, as illustrated. In case of need the arrangement can be designed so that instead of the lever 123 being moved for changeover, the cams 120, 121 are displaced instead in the direction of their common drive shaft.

The construction according to Figure 4 can be modified to suit more than two film types. All that is necessary is for there to be a corresponding number of riders on respective arms and for the angle lever 27 to be able, in addition to its turning movement, to be shiftable in the plane of the engaging or lift cam 22. Further it is possible in the embodiments of Figures 3 to 5 to provide several engaging or lift cams for changing-over to further film formats instead of just one. In this case the change-over lever should incorporate a mode selector for changing from one engaging cam to the other as necessary.

WHAT WE CLAIM IS:—

1. Film-handling apparatus including a film gate and an associated film transport claw which is driven in synchronism with an interrupter operated to blank-off, intermittently, a light path extending through the film gate, the claw movement having a com-

ponent in a direction through the gate for film engagement and determined by an engagement cam and a component extending along the gate for film transport and determined by a transport cam having a cam profile with two angularly-offset camming portions of different shape to produce successively two different film transport motions of the claw during respective blanked-off phases of the light path, the choice of which film transport motion is to be used in the film engagement position of the claw being determined by a control element having two operational states at each of which a different one of the film-transport motions of the claw occurs while the claw is advanced by the engagement cam into its film-engagement position in the film gate whereby a film may be moved by the claw.

2. Apparatus as claimed in claim 1, in which the claw has a carrier tiltable about an axis defined by a pair of balls to carry out engagement motion of the claw, and displaceable in the direction of the axis to carry out transport motion of the claw.

3. Apparatus as claimed in claim 1 or claim 2, in which the engagement cam has two annular camming surfaces and the control element has rider which is selectively interposable between the two annular camming surfaces and a part of the claw.

4. Apparatus as claimed in claim 3, in which the control element is a rockable lever and the two annular camming surfaces are concentrically arranged tracks on the engagement cam.

5. Apparatus as claimed in Claim 1 or Claim 2, in which the engagement cam is formed with a single annular camming surface effective for both transport motions, and the control element includes a rider selectively positionable at angularly displaced positions on the annular camming surface to transmit its motion to the claw for film engagement with the desired phase relationship with respect to the desired film-transport motion of the claw.

6. Apparatus as claimed in claim 5, in which the control element comprises an arm arcuately movable about the rotational axis of the engagement cam.

7. Apparatus as claimed in claim 5, in which the control element comprises a lever having two riders arranged at angularly displaced positions with respect to the engagement cam periphery and selectively locatable, by rocking the lever, between the engagement cam and the claw.

8. Apparatus as claimed in claim 7, in which the lever is arcuately movable around the engagement cam in addition to being rockable.

9. Apparatus as claimed in claim 7 or claim 8, in which the lever has more than two riders.

profile in the range b^1 . To each of these two movements there is assigned a claw engaging camming surface on the engaging cam 106. A mechanical impulse transmitter is formed by two cams 120, 121, which selectively provide a fulcrum for a lever 123 movable round a pivot shaft 122 at one end. The other end of the lever 123 engages beneath an extension margin of a plate-like carrier 3 which is provided with the cam follower 5 for the transport motion, and a rider 124 for controlling the engaging or claw lift motion. The cam 120 and the lever 123 cooperate to lift the carrier 3, as viewed in the drawing, and thus the rider 124 from the engaging cam 106, while simultaneously the claw tooth 110 is removed from the perforation. The profile of the cams 120, 121 is apparent from diagrams III and IV of Figure 9, the cam 120 preventing the lift of the carrier in the range b^1 , whereas the cam 121 prevents the lift in the range a .

For the change-over of the lever 123 from one cam to the other, the pivot shaft 122 is shifted axially by a handle 125, and is locked in its new position by a lock element 126. The drawing of Figure 8 is not to scale and in practice the engagement of the lever 123 with the carrier 3 is out of the range of the cams 106 and 7.

As the lever 123 can be relatively long, the vicinity of the carrier 3 can be kept free from moving parts to a large extent. The space required for the change-over of the lever 123 from one mode of operation to the other is relatively small, as illustrated. In case of need the arrangement can be designed so that instead of the lever 123 being moved for changeover, the cams 120, 121 are displaced instead in the direction of their common drive shaft.

The construction according to Figure 4 can be modified to suit more than two film types. All that is necessary is for there to be a corresponding number of riders on respective arms and for the angle lever 27 to be able, in addition to its turning movement, to be shiftable in the plane of the engaging or lift cam 22. Further it is possible in the embodiments of Figures 3 to 5 to provide several engaging or lift cams for changing-over to further film formats instead of just one. In this case the change-over lever should incorporate a mode selector for changing from one engaging cam to the other as necessary.

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ponent in a direction through the gate for film engagement and determined by an engagement cam and a component extending along the gate for film transport and determined by a transport cam having a cam profile with two angularly-offset camming portions of different shape to produce successively two different film transport motions of the claw during respective blanked-off phases of the light path, the choice of which film transport motion is to be used in the film engagement position of the claw being determined by a control element having two operational states at each of which a different one of the film-transport motions of the claw occurs while the claw is advanced by the engagement cam into its film-engagement position in the film gate whereby a film may be moved by the claw.

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3. Apparatus as claimed in claim 1 or claim 2, in which the engagement cam has two annular camming surfaces and the control element has rider which is selectively interposable between the two annular camming surfaces and a part of the claw.

4. Apparatus as claimed in claim 3, in which the control element is a rockable lever and the two annular camming surfaces are concentrically arranged tracks on the engagement cam.

5. Apparatus as claimed in Claim 1 or Claim 2, in which the engagement cam is formed with a single annular camming surface effective for both transport motions, and the control element includes a rider selectively positionable at angularly displaced positions on the annular camming surface to transmit its motion to the claw for film engagement with the desired phase relationship with respect to the desired film-transport motion of the claw.

6. Apparatus as claimed in claim 5, in which the control element comprises an arm arcuately movable about the rotational axis of the engagement cam.

7. Apparatus as claimed in claim 5, in which the control element comprises a lever having two riders arranged at angularly displaced positions with respect to the engagement cam periphery and selectively locatable, by rocking the lever, between the engagement cam and the claw.

8. Apparatus as claimed in claim 7, in which the lever is arcuately movable around the engagement cam in addition to being rockable.

9. Apparatus as claimed in claim 7 or claim 8, in which the lever has more than two riders.



10. Apparatus as claimed in claim 7, claim 8 or claim 9, in which the claw is tiltable by each rider, when engaged with the engagement cam, about an axis defining the direction of displacement of the claw during its film transport motion, the cam engagement position of each rider is disposed on the side of the axis remote from a tooth on the claw which engages the film perforations, a recessed portion of the engagement cam provides a camming surface which is engaged by the rider when the tooth is in its film transport position, and a resilient bias acting on the claw presses it against the rider and towards the camming surface of the engagement cam.

11. Apparatus as claimed in claim 1 or claim 2, in which the engagement cam is mounted on a spiral spline and is formed with a single annular camming surface effective for both transport motions, a push rod bearing on the singular annular camming surface at one end and on the claw at the other end produces claw motion in the engagement direction as the engagement cam rotates, and the control element operates by producing relative motion between the engagement cam and the spiral spline whereby the engagement cam is rotated by the spline through an angle corresponding to the angle between the two camming portions of the transport cam.

12. Apparatus as claimed in claim 11, in which the spline is formed on a drive shaft fixed to the transport cam which controls the film transport motion with its rim and which is thick enough to displace bodily with the shaft in an axial direction when the control element is operated without influencing the drive to the claw from the transport cam.

13. Apparatus as claimed in claim 2, in which the engagement cam has two camming portions respectively associated with the two camming portions of the transport cam, and the engagement of a rider fixed to the claw selectively with the camming portions of the engagement cam is controlled by an electromagnet connected to receive pulses which are phase changeable and which determine, by their phase, which of the camming portions of the engagement cam is effective to produce film-engaging movement of the claw.

14. Apparatus as claimed in claim 13, in which the rider is attached to the claw and is resiliently urged by springs towards contact with the camming portions of both cams.

15. Apparatus as claimed in claim 14, in which the claw comprises a bodily displaceable tiltable plate formed with two teeth for engaging film in the film gate simultaneously at two spaced positions dis-

posed, respectively, at opposite ends of the film gate, a tension spring acting on the plate urges the rider sideways against the transport cam, a second spring acting on the plate urges an end of the rider against the engagement cam, and the rider and electromagnet are disposed at the opposite side of the tilt axis of the plate to the claw teeth.

16. Apparatus as claimed in claim 1 or claim 2, in which the engagement cam has two camming portions respectively associated with the two camming portions of the transport cam, and the engagement of a rider fixed to the claw selectively with the camming portions of the engagement cam is controlled by a mechanical rocking mechanism acting on the claw and driven in synchronism with the cams, a device being provided to change the phase of the movement of the rocking mechanism with respect to the rotation of the cams.

17. Apparatus as claimed in claim 16, in which the rocking mechanism comprises a lever which is rocked selectively by one of two control cams driven in unison and having phase-displaced projections formed on them.

18. Apparatus as claimed in claim 17, in which the device operates by moving the control cams.

19. Apparatus as claimed in claim 17, in which the device apparatus by moving the rocking mechanism between two positions at each of which it is locked in position.

20. Apparatus as claimed in any one of the preceding claims, in which the two camming portions of the transport cam produce transport movements of the claw of different lengths respectively, to suit different film formats.

21. Apparatus as claimed in any one of the preceding claims 1 to 19, in which the two camming portions of the transport cam produce film transport movements of the claw in forward and reverse directions, respectively.

22. Apparatus as claimed in any one of the preceding claims, in which the interrupter is a rotary shutter fixed to rotate coaxially with the transport and engagement cams and having opaque intercepting portions which interrupt the light path during transport motion of the claw.

23. Film handling apparatus arranged and adapted to operate substantially as described with reference to any one of the embodiments shown in the accompanying drawings.

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