March 18, 1930. F. COWIE 1,751,192

FILM WINDING MECHANISM FOR CINEMATOGRAPH APPARATUS

Filed March 8, 1928 2 Sheets-Sheet 1

Fig 1

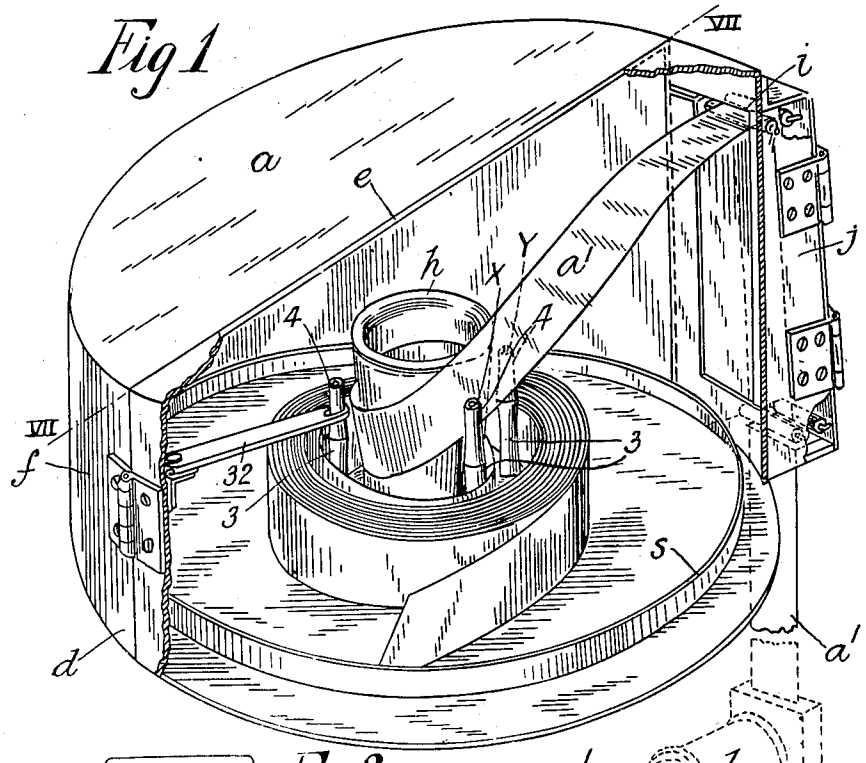


Fig 4

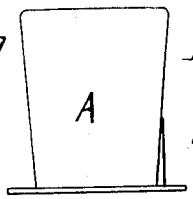


Fig 5.

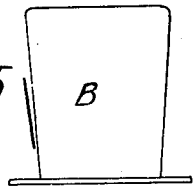


Fig 6.

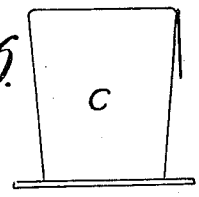


Fig 3

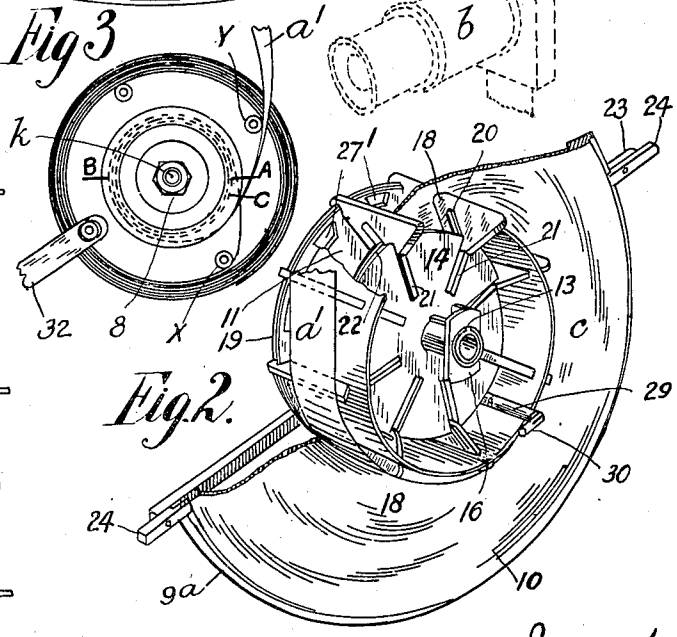


Fig 2.

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FILM WINDING MECHANISM FOR CINEMATOGRAPH APPARATUS

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Fig. 7.

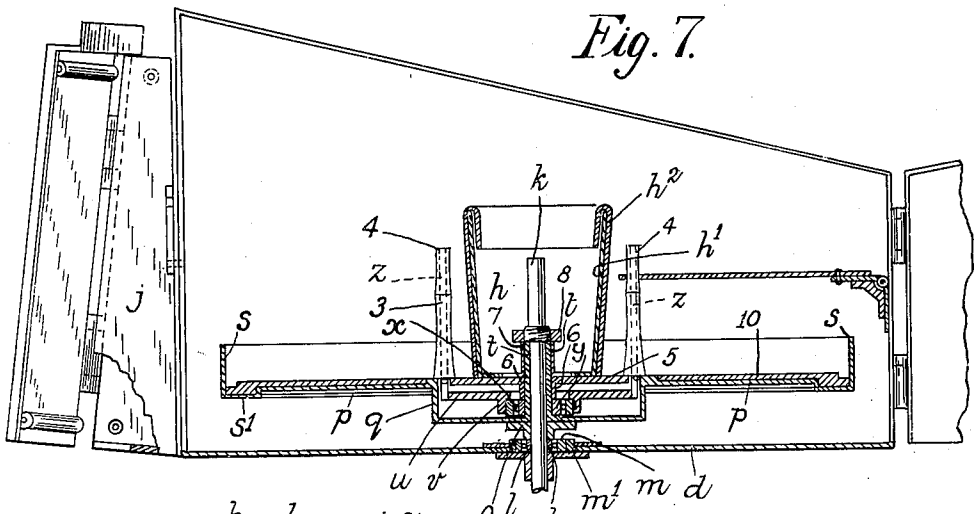


Fig 9

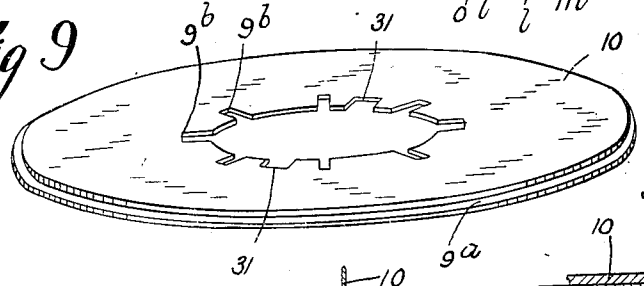


Fig.8.

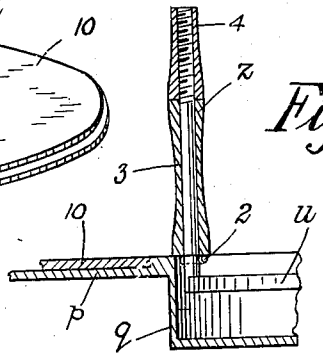


Fig 11

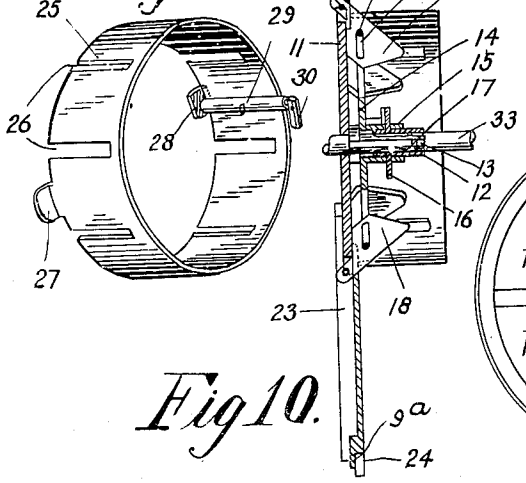
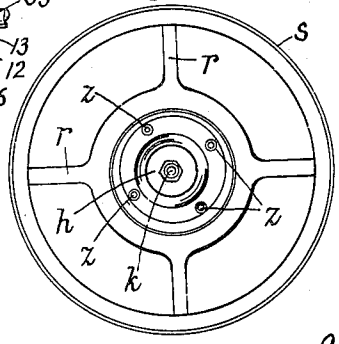


Fig 10.

Fig 12



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UNITED STATES PATENT OFFICE

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FILM-WINDING MECHANISM FOR CINEMATOGRAPH APPARATUS

Application filed March 8, 1928, Serial No. 260,181, and in Great Britain June 13, 1927.

This invention comprises improvements in the film winding mechanism of cinematograph apparatus and is concerned with that class of winding mechanism in which the film roll is arranged in a horizontal position upon a delivery film carrier and is unwound from the inner end of the roll. The unwound film is then taken through the projector and is wound onto a collapsible hub or spool revolving in a vertical plane on a horizontal axis. When the full length of the film has been wound on the receiving spool, the hub of the latter is collapsed for enabling the newly wound film roll to be transferred to a delivery carrier for a fresh projection. This system of unwinding from the inner part of the roll and winding onto a collapsible hub or spool enables the process of rewinding for each exhibition of the film to be dispensed with. It also minimizes the amount of handling suffered by a film. The result is that the useful life of a film is increased and its good condition is not liable to be impaired as it is in systems in which re-winding is necessary. An important object of these improvements is to construct the delivery carrier so that the film may be unwound therefrom with a minimum of frictional resistance and with no liability to be scratched or damaged by contact with working parts. As it is desirable to unwind the film solely by the pull on the film, the anti-frictional and protective expedients provided by these improvements are essential for the practical working of winding mechanisms of the class referred to. A further object of these improvements is to provide auxiliary devices for use in connection with the winding-on spool whereby the completed film roll may be removed, transported, and inserted into a delivery carrier with ease and without handling or liability to disturb the appropriate disposition of the convolutions constituting the roll.

According to this invention, the delivery carrier is constructed to run on anti-friction bearings and guiding devices supported thereon are constructed and disposed so that only rolling surfaces are, and can be, touched by the film whilst being wound and passed out of the delivery carrier. As the film unwinds from the inner convolutions and before making its exit through the throat of the delivery casing, the film passes around a central guiding device and a conical formation is given to this device in accordance with these improvements, whereby the film makes only edge contact therewith so that any chafing of a face of the film is completely avoided. The collapsible hub or spool on which the film is wound is provided with a secondary hub and a tray, the secondary hub serving for restraining the inner convolutions of film when the primary hub is collapsed and the tray serving for supporting the flat roll of film when the latter is removed from the hub or spool and is being transported and inserted into a delivery carrier. The secondary hub is made readily detachable from the tray, as such hub is not required when the roll of film is to be unwound in a delivery carrier.

In order to enable the invention to be readily understood reference will be made to the accompanying drawing, illustrating one practical construction for carrying the invention into effect in which drawing:—

Figure 1 is a perspective view of the delivery carrier or film-unwinding device.

Figure 2 is a perspective view of the receiving device comprising a collapsible hub or spool for the film after passing through the projector.

Figure 3 is a plan of the central portion of Figure 1.

Figures 4, 5 and 6 are diagrams showing how the film makes contact with the central member at the points A, B and C respectively of Figure 3.

Figure 7 is a central vertical section with parts in elevation, the section being taken on the plane VII—VII Figure 1.

Figure 8 is a sectional view to a larger scale of one of the pillars shown in Figure 7.

Figure 9 is a perspective view of a supporting tray for the film.

Figure 10 is a side elevation with parts in section of the receiving spool device.

Figure 11 is a perspective view of a sec-

ondary hub part after detachment from the device in Figure 10.

Figure 12 is a plan to a smaller scale of a pan or carrier seen in Figure 7.

Referring to Figures 1 and 2, and dealing quite generally with the parts, *a* indicates the unwinding device or delivery carrier from which the film *a'* passes down to the projector *b* and so to the winding or receiving spool *c*. The last-named is positively driven by suitable gearing or motive power in the usual way but the delivery carrier parts are revolved solely by the pull transmitted by the film itself. The delivery device *a* comprises a casing *d* in which the film roll is supported in the horizontal plane and so as to revolve about a vertical axis. This casing may be covered by a sloping top *e* and it may have a hinged side wall *f* for facilitating the introduction of the film roll. As will be seen from Figure 1, the film roll is unwound from the centre and the unwinding film is carried around a central guide member *h* from which it passes to a delivery throat *i*. Anti-friction rollers in the throat enable the film to be passed downwardly from the throat to the projector *b* and this downward run of film is protected as far as possible by means of a protective shield *j*.

It will be convenient to describe in detail, first of all the delivery carrier and afterwards the receiving spool device, and finally the complete operation of film-winding and the functions of these parts in such operation.

Referring to Figure 7 which is a sectional view of the delivery carrier, a central spindle *k* extends upwards through the bottom of the casing *d* and has a collar which forms the inner race *l* of a ball or roller bearing, the outer race ring *m* being seated in a socket *m'* in the bottom of the casing *d*, a flanged collar *o* is fixed to the spindle *k* just above this bearing and supports a pan or carrier *p*, the central portion of such pan being depressed to form a recess or cup *q*. The pan or carrier may be of skeleton form, as shown, that is to say, the recess or cup may be connected with the outer peripheral portion by radial spokes or arms *r*, see Figure 12. The peripheral portion may be formed with an upstanding flange *s* and with an annular depression or channel *s'* for purposes to be described. A central sleeve *t* formed or fixed in the bottom of the pan takes loosely over the spindle *k* and serves for the mounting of the central member *h* as hereinafter described. A disc *u* has a central hole surrounded by a flange *v* on the underside of the disc, this flange having fixed within it the outer race *w* of a ball bearing *x* comprising an inner race ring *y* which rests on an annular seating around the foot of the sleeve *t*, the said seating serving for elevating such race ring above the floor of the recess *q* of the pan *p*. Four vertical pillars *z* are erected equidistantly around the periphery of the disc *u*, one of these pillars being shown in detail in Figure 8. A pin 2 is passed diametrically through the foot portion of each pillar and a revoluble sleeve 3 is passed over each pillar to rest on the pin 2. A sleeve nut 4 screwed on to the top end of each pillar prevents the sleeve 3 from rising on the pillar but does not interfere with its freedom to revolve thereon. If desired, the sleeves 3 could be mounted on ball bearings on the pillars *z*. The central member *h* comprises a disc 5 carried by a sleeve comprising a short portion 6 beneath the disc and a longer portion 7 above the disc. The sleeve 6, 7 is slipped on to the sleeve *t* and the lower end of the portion 6 comes to rest on the inner race ring *y*, a nut 8 being screwed on to the upper end of the sleeve *t* to keep the sleeve 6, 7 hard down on such race ring *y*. The central member indicated generally by *h* is composed of an inner sheet metal shell *h'* in the form of an inverted truncated cone fixed on the disc 5 as by soldering and an outer sheath h^2 of rubber or other gripping or soft resilient material or substance. The pan or carrier *p* is adapted for receiving a tray 10, hereinafter more particularly described with reference to Figure 9, upon which tray is supported a roll of film to be unwound.

The construction of the collapsible receiving spool for the winding on of the film will now be described with reference to Figures 2, 10 and 11. In this spool construction a disc 11 is carried by a sleeve 12 formed along its length with a key or feather 13. A disc 14 of smaller diameter is carried by a short slotted sleeve 15 which is adapted to slide over the sleeve 12 with its slot engaged with the key 13. On the sleeve 15 there is revolubly mounted a finger disc 16 for enabling the sleeve to be pulled out or pushed in. The central hole in the disc 16 has a shallow notch at one point for sliding over the key 13 and the latter is formed near its outer end with a notch 17, Figure 10, capable of receiving the thickness of the finger disc 16. Thus, when the latter is pulled from the position in Figure 10 to the outward position in Figure 2, it arrives over the notch 17 in the key 13, whereupon a slight turn of the finger disc 16 will carry its thickness into the notch 17 in the key and prevent the disc 16, sleeve 15 and disc 14 from moving out of the locked position until the disc 16 has been reversely turned to bring its notch into alignment with the key 13 and so unlock the fastening. The periphery of the larger disc 11 is formed with a number of regularly spaced nicks in which are pivoted the angular ends of somewhat triangular small plates 18. In the example illustrated, the periphery of the disc 11 is encircled tightly with a wire 19 and those portions of such wire which extend over the nicks serve as pivot pins for the small plates 18.

Each of the plates 18 is formed with a slot 20 extending from near the said angular end to near another of the angles, and such slots 20 serve for pivotally connecting the plates with the periphery of the smaller disc 14. In the example illustrated, the smaller disc 14 is formed with radial slots 21 extending from the periphery inwards and the periphery is tightly encircled with a wire 22 so that those portions of the wire 22 which extend over the ends of the slots 21 serve as pivot pins for engaging in the slots 20. It will be seen from Figure 10, that when the disc 14 is in the inward position and close to the disc 11, the pivot pins formed by the wire 22 lie at one end of the slots 20 and the small plates are inwardly folded so that they lie with one edge flat against the disc 11. When the disc 14 is pulled to the outward position seen in Figure 2, this being performed by the aid of the finger disc 16 which locks the parts in such outward position as already explained, the plates 18 are moved to an outward or expanded position, the pivot pins formed by the wire 22 moving to the opposite ends of the slots. In this position, the plates 18 form an expanded skeleton hub suitable for the winding thereon of the film a'. Before this winding takes place, however, further expedients must be adopted in order to make the subsequent removal and transport of the roll of film easy and not liable to mishap. From Figures 2 and 10 it will be seen that the disc 11 is fitted with two arms 23 extending diametrically from its periphery, and at the outer end of each arm 23 there is a small swivel clip 24. An annular disc 10 which has been referred to as a tray and which is separately illustrated in Figure 9, is passed over the collapsible spool and laid flat against the arms 23, whereupon the clips 24 are turned to clip and retain the tray 10. It will be noted from the figures that the tray has a rim formation presenting a depressed lip 9^a and it is over this depressed lip that the clips 24 are engaged, so that there is no obstructive projection outstanding from the plane of the tray. The edge around the central hole in the tray is formed with radial nicks or slots 9^b to permit of the movements of the angular pivoted ends of the small plates 18. A cylindrical shell which has been referred to as a secondary hub and which is shown separately in Figure 11, consists of a cylinder of sheet metal 25 formed with longitudinal slots 26 extending from one end to near the opposite end. The diameter of this shell is such that it can be passed with its slotted end over the smaller disc 14 and secured to the tray 10. Thus, the slotted end of the shell 25 may be formed with a projecting foot 27 at one point and fitted at a diametrically opposite point with a revoluble foot 28, the latter being carried by a pin capable of turning within the sleeve bearing 29 fixed to the interior of the shell, the said pin having at its outer end a small handle 30 for enabling it to be turned. The tray 10 is formed at two diametrically opposite points around its inner edge with two wide notches 31 adapted for giving entry to a foot 27 or 28 and the plate 11 of the collapsible hub is formed with holes 27′ into which the feet 27, 28 are received. The secondary hub shell 25 is advantageously attached to the tray 10 before mounting the latter on the arms 23. For this purpose, the shell 25 is applied to the tray 10 and tilted so as to insert the foot 27 into one of the notches 31, the foot 27 then taking under the tray beyond such notch 31. The shell is then put flat against the tray and when concentric therewith, the revoluble foot 28 will be found in the diametrically opposite notch 31, whereupon a partial turn of the handle 30 will cause the foot 28 to take behind the tray so that the shell 25 is secured concentrically thereto with its slots 26 aligned with the notches 9^b of such tray. In applying the tray and shell to the collapsible hub, the slots 26 and notches 9^b pass over the plates 18 and permit freedom of the latter in the pivotal movements from the collapsed position to the expanded position or vice versa.

The advantageous functions of the various parts will be explained in the description of the operation now to be given. Assume that a roll of film rests upon a tray 10 which in turn rests upon the pan or carrier p, and that the pillars z lie within the roll so as to act as a fence for preventing the inner convolutions from crowding against the central device h, as shown in Figure 1. An empty tray 10 is seen in the pan p in Figure 7 and the removal of an empty tray and introduction of a tray loaded with a roll of film will be explained at the end of this description of the operation. The pillars z and their carrier disc u are prevented from revolving by turning down an arm 32 hingedly mounted on the interior of the casing d so that a perforation in the end of such arm engages with the upper end of one of the pillars z as shown in Figure 1. The inner end of the film is now taken and led between the two pillars situated beneath the letters X and Y and it is then passed around the inner circle within the ring of pillars or fence so that it rises spirally or helically in contact with the central device h, which functions in a similar manner to a capstan. Having made one turn around the capstan device h, the end of the film is taken out from the inner circle through the gap between the same two pillars X and Y and passed through the delivery throat i. From the last named, the film is passed down through the projector b and so to the collapsible hub or spool, the plates 18 of which are in the expanded condition and project through the slots 26 in the shell 25, as seen in Figure 2.

The collapsible hub or spool device, with the shell 25 and tray 10 mounted thereon in the manner described, is fixedly mounted on a spindle 33 which is driven by a suitable motor in the usual manner. A few turns of film are wound around the expanded hub sufficient for withstanding the pull at the start and the motor is then started to drive the spindle and wind on the film, the tray 10 acting as a guide flange to ensure the flatness of the roll produced by such winding on. The pull on the film causes the roll on the tray 10 in the casing *d* to be unwound at the appropriate speed, and such unwinding is due to the revolution of the roll, tray and capstan or central device *h* produced by the tensioned film being lapped around such central device *h*. In this respect, it is to be noted that the film does not make a flat surface contact with the device *h* but, owing to the conicity of such device, an edge contact is made as will be understood by examining Figures 4, 5 and 6 in conjunction with Figures 1 and 3. The film is assumed to leave the device *h* at the point C in Figure 3 and as seen from Figure 6 the top edge of the film is in contact at this point. At an intermediate point in its lapping around the device *h* such as the point B in Figure 3, the lower edge of the film is in contact with the device *h* as seen in Figure 5. At the point A in Figure 3 where the film first makes contact with the device *h* after unwinding, the top edge of the film makes contact with the device *h*, as seen in Figure 4. This change in the incidence of contact from the top edge to the bottom edge and back again to the top edge is due to the spiral or helical lapping of the film around the inverted cone. Owing to this edge contact, the surface of the film is saved from any rubbing or scratching action and even the edge portions of the film are protected against any injurious action owing to the presence of the resilient or rubber sheath h^2 enclosing the shell h' of the central device *h*. The fence of pillars *z* prevent the inner convolutions of the roll from crowding against the turn lapped round the central device but the film suffers no harm due to the roll revolving in relation to the stationary pillars, for the film is in contact with the anti-frictional revoluble sleeve 3 of the pillars. From Figures 7 and 8 it will be seen that owing to the fact that the disc *u* supporting the pillars *z* is in the central depression or dishing *q* of the pan or carrier *p* it is possible for the lower ends of the revoluble sleeves 3 to be level with the upper surface of the disc 5 and the floor of the pan *p* and tray 10 upon which the roll of film rests. Consequently, it is not possible for the unwinding film to make contact with any part of the pillars below the anti-frictional sleeves 3 and the film cannot slip between the pan and the pillars as the latter extend over the surface of the pan and the disc 5. The weight of the film and revolving parts of the carrier, tray, etc., is supported by the ball bearing *l m* and there is also the ball bearing *x* between the revolving parts and the disc *u* which is prevented from revolving by the fixed arm 32 engaging one of the pillars *z* on such disc. This anti-frictional mounting of the parts enables their revolution to be produced by the pull of the film without imposing any considerable or excessive tension on the film. The non-slip contact between the edge of the film and the rubber sheath on the central device *h* is very advantageous for producing revolution of the parts in the delivery casing. A governor device may be provided on the end of the spindle projecting through the casing for preventing over running of the revoluble parts of the unwinding device.

When the entire length of film has been unwound, passed through the projector *b* and wound on to the collapsible hub, the latter is collapsed by turning the finger disc to unlock the sleeve 15 and pressing the latter and the disc 14 back to the position seen in Figure 10 in which the plates 18 are moved inwards to pass through the slots 26 and lie within the shell 25. The inner convolutions of the roll now contract around the secondary hub constituted by the shell 25. The clips 24 are then turned to release the tray 10 from the arms 23, and the tray 10 with its secondary hub 25 loaded with the roll of film is removed from the collapsible hub and spindle 33. The tray is now turned to a horizontal position and the roll of film can be taken away on the tray with safety and no liability to disturbance. If it is desired to give a second exhibition of the film, for example, the empty tray in the casing *d* is removed from the latter and the loaded tray is inserted in its place, the secondary hub passing easily over the ring of pillars *z* as its diameter is greater than the diameter of such ring. The revoluble foot 28 is then turned to the released position seen in Figure 11 and the shell 25 is tilted so as to enable the foot 27 to pass from beneath the tray whilst withdrawing the shell 25 from the middle of the roll. The inner convolutions are now free to contract around the ring of pillars *z* and the inner end of the film is taken hold of and dealt with as explained in the earlier part of this description of the operation. The outer convolutions of film are prevented from spreading beyond the periphery of the tray by the upstanding flange *s*, as will be apparent.

I claim:—

1. In cinematograph film winding apparatus, a horizontal revoluble pan formed with a central circular depression and adapted for carrying a roll of film to be unwound, a central vertical capstan device upstanding above the plane of said pan and supported

by the latter, a ring fence of pillars surrounding said capstan at a fixed radial distance therefrom, revoluble sleeves on said pillars, a carrier for said pillars said carrier being disposed within the depression of said pan, and anti-friction bearings between said pan and its support and between said pan and the fence carrier substantially as set forth.

2. In cinematograph film winding apparatus, a horizontal revoluble pan adapted for carrying a roll of film to be unwound, a central vertical capstan device of inverted conicity erected in fixed connection with said pan and adapted for being lapped by the innermost convolutions of the film roll in the passage of the film from the roll to the delivery throat, a sheath of resilient material enclosing said capstan and adapted for affording a non-abrasive grip to the lapped film convolution, a non-expansible ring fence supported centrally within said pan and operative for limiting contraction of inner convolutions of said film roll, whilst permitting of passage of the film to said capstan device, holding means engageable with said ring fence to prevent revolution thereof, and anti-friction bearings between said pan and its support and between said pan and the supporting means of said fence substantially as set forth.

3. In cinematograph film winding apparatus, the combination of a horizontally supported revoluble pan adapted for supporting an unwinding film roll, a central vertical capstan device on said pan, a non-revoluble ring fence composed of spaced pillars concentrically encircling said capstan at a fixed radial distance therefrom, the revolution of said pan being produced by the grip of tensioned film lapped around said capstan device and passing to the delivery throat, and said fence being operative for preventing inner convolutions of the film roll from crowding against said capstan whilst permitting of passage of film from the roll to said capstan substantially as set forth.

4. In cinematograph film winding apparatus, the combination of a capstan device revoluble around a vertical axis and adapted for the reception of the unwinding film roll, a non-revoluble concentric fence device surrounding the capstan and operative for preventing inner convolutions of the film roll from crowding against said capstan, a collapsible hub revoluble around a horizontal axis and adapted for the winding on of the film, a tray device applicable at one time to the collapsible hub as a guide flange for the film wound on the latter and at another time to the capstan device as a supporting base for the unwinding film roll, and a secondary hub of greater diameter than said concentric fence said secondary hub being removably mountable concentrically on said tray and adapted for permitting the collapsible hub members to expand and contract through it substantially as set forth.

5. Cinematograph film winding apparatus comprising a delivery casing, means for guiding the inner end of a roll of film to the delivery throat of said casing ball bearings mounted between the revoluble and non-revoluble members contained in said delivery casing and a winding device comprising a collapsible hub, a secondary hub adapted to lie within the circle of the winding hub when expanded but outside of the winding hub parts when collapsed and a tray device mountable on the said collapsible hub and adapted to be released with the said secondary hub as a carrier for the wound film roll and insertable into the delivery casing substantially as set forth.

6. Cinematograph film winding apparatus comprising a delivery casing, means for guiding the inner end of a roll of film to the delivery throat of said casing, ball bearings mounted between the revoluble and non-revoluble members contained in said delivery casing, and a winding device comprising a collapsible hub, a secondary hub adapted to lie within the circle of the winding hub when expanded but outside of the winding hub parts when collapsed, and a tray device mountable on the said collapsible hub and adapted to be released with the said secondary hub as a carrier for the wound film roll and insertable into the delivery casing and catch means for releasing said secondary hub from said tray after insertion into the delivery casing substantially as set forth.

7. Cinematograph film winding apparatus comprising a delivery casing, revoluble means for guiding the inner end of a roll of film to the delivery throat of said casing, a non-revoluble device for restraining the inner convolutions of the roll of film, ball bearings mounted between said non-revoluble and revoluble devices and a winding device comprising a collapsible hub and a secondary hub adapted to lie within the circle of the winding hub when expanded but outside of the winding hub when collapsed, a tray device mountable on the said collapsible hub and adapted to be released with the said secondary hub and passed over the guide members of the unwinding device and means for releasing the secondary hub from said tray substantially as set forth.

8. In cinematograph film winding apparatus, a horizontal revoluble delivery carrier presenting a plane surface for the support of a film roll, a central capstan member fixed on said carrier and adapted to be lapped by the innermost convolution of said film in its passage from the roll to the delivery throat, a non-revoluble concentric fence device comprising pillars upstanding from a support beneath said surface and at a fixed radial distance from said capstan member, and anti-

friction bearings between said carrier and its support and between said carrier and said fence device.

9. In cinematograph film winding apparatus a horizontal revoluble delivery carrier presenting a plane surface for the support of a film roll, ball bearing supports for said carrier, a central capstan member fixed on said carrier and adapted to be lapped by the innermost convolution of said film in the passage of said film from the roll to the delivery throat, a non-revoluble concentric fence device comprising pillars upstanding from a support beneath said surface and at a fixed radial distance from said capstan member, a ball bearing for said support on the hub of said carrier, and holding means adapted for engaging said fence device to prevent revolution thereof.

10. In cinematograph film winding apparatus, a revoluble horizontal pan adapted for carrying a film roll to be unwound, said pan being formed with a central depression, a hub supporting said pan, a ball bearing for said hub, a central capstan member supported on said hub and adapted to be revolved by a convolution of the film in its passage from the roll to the delivery throat, a concentric non-expansible fence device adapted for limiting contraction of the inner convolutions of the said roll, said fence device being disposed within said depression, a ball bearing support for said fence device on said hub, and holding means adapted for engaging said fence means to prevent revolution thereof.

11. In cinematograph film winding apparatus, a horizontal revoluble pan for carrying a film roll to be unwound, a ball bearing support for said pan, a vertical capstan member supported centrally on said pan and adapted to be revolved by a convolution of the film in its passage from the roll to the delivery throat, a ring fence of pillars surrounding said capstan at a fixed radial distance therefrom and adapted for limiting contraction of the inner convolutions of the film roll, a carrier for said pillars, a ball bearing for said carrier in said pan, and holding means adapted for engaging and preventing revolution of the ring of pillars substantially as set forth.

12. In cinematograph film winding apparatus, a horizontal revoluble pan for carrying a film roll to be unwound, a central vertical capstan device upstanding from said pan, a ring fence of pillars surrounding said capstan at a fixed radial distance therefrom, a carrier for said pillars, anti-frictional bearing supports for said pan, an anti-friction bearing between the fence carrier and said pan, and holding means operative for preventing revolution of said carrier.

13. In cinematograph film winding apparatus, a horizontal revoluble pan for carrying a roll of film to be unwound, a central vertical capstan device upstanding from said pan, a ring fence of pillars surrounding said capstan at a fixed radial distance therefrom, revoluble sleeves on said pillars, a carrier from said pillars, anti-friction bearings between said pan and its support and between said pan and the fence carrier, and releasable holding means operative for preventing revolution of said fence carrier substantially as set forth.

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