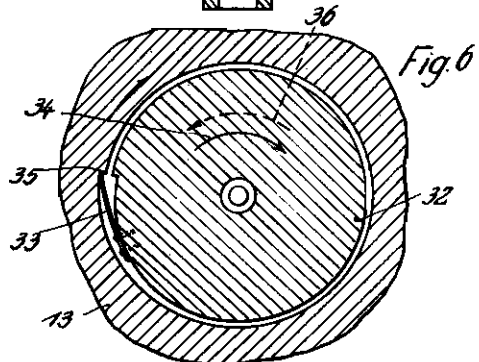
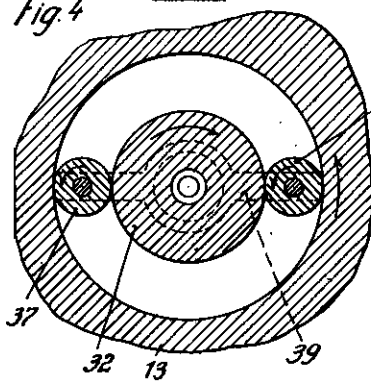
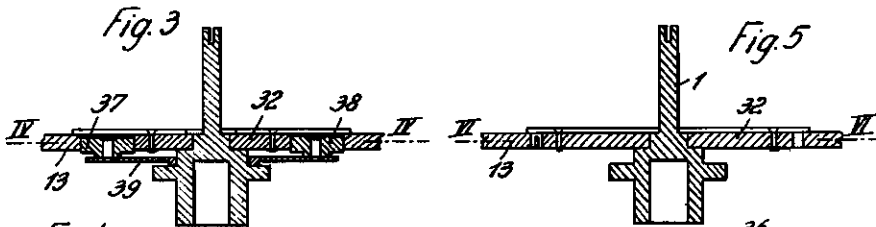
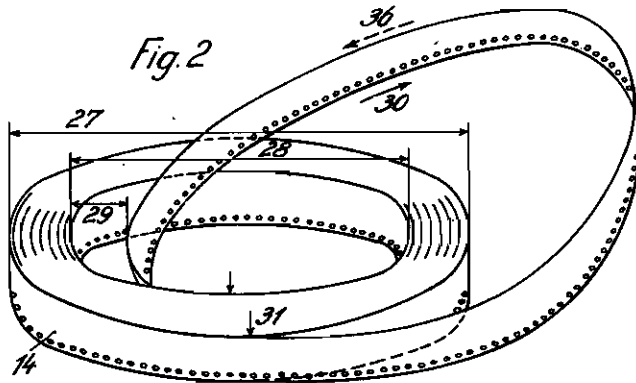
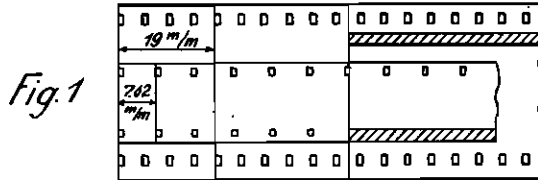


PUBLISHED
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2 Sheets-Sheet 1



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Fig. 7

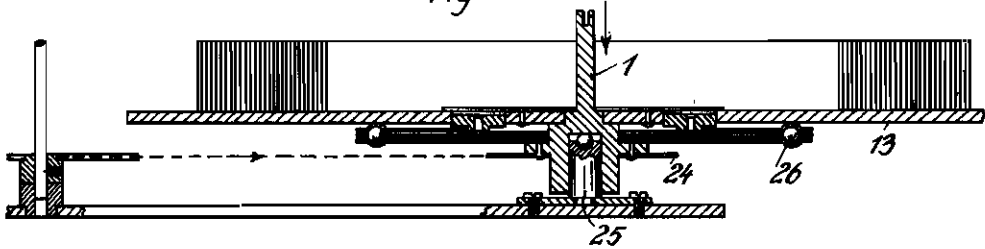


Fig. 8

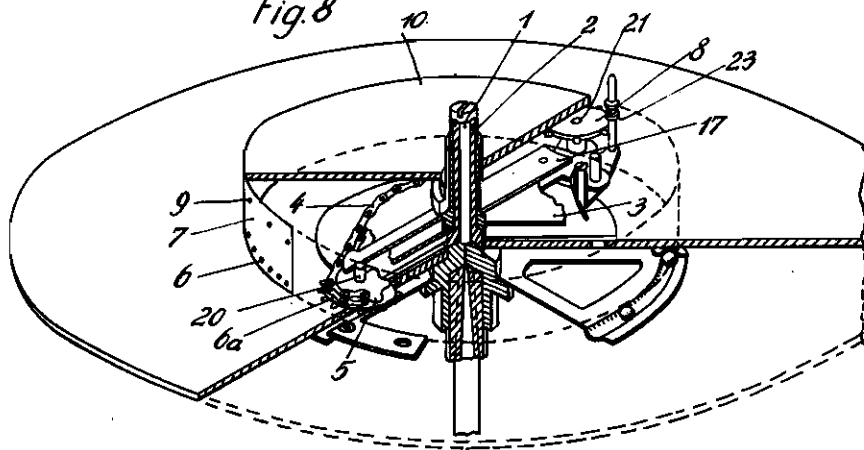
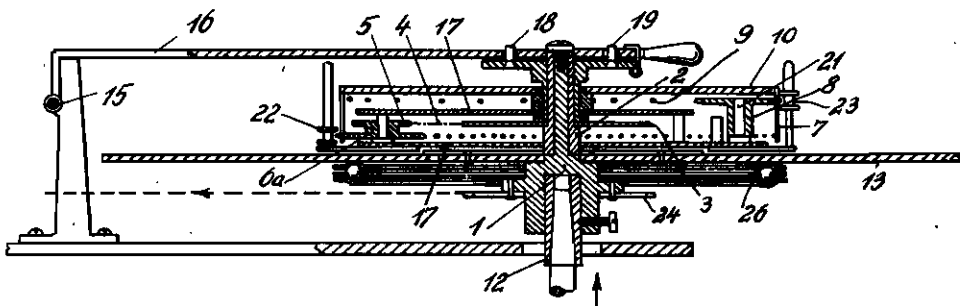


Fig. 9



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ALIEN PROPERTY CUSTODIAN

APPARATUS FOR UNWINDING AND WINDING UP AN ENDLESS FILM

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vested in the Alien Property Custodian

Application filed February 2, 1940

The present invention relates to a device for unwinding and winding up films and more particularly relates to a device for unwinding and winding up an endless film running in a forward- and rearward direction respectively.

The winding device according to the invention is not to be compared with ordinary winding devices in which the film always is drawn off from one spool and wound upon a second spool. For the purpose of the invention it is essential that the unwinding and winding up is effected from and upon a single core member respectively provided in the centre of the spool, whereas a second roller only guides the running in and out loop of the film.

If in the cinema technics a film, for instance a film for advertising purposes is to be permanently projected, it is common practice to connect the ends of the film to obtain an endless film band which is unwound from and wound up special devices. This unwinding from the interior to the exterior of a film of a certain length is not accompanied by any difficulties, because the film may easily be unwound from the interior and wound up from the exterior. Devices, however, are also known which particularly for longer films allow winding from the exterior to the interior.

In present days the endless film is used particularly with sound film apparatus playing for a long period of time. In particular with such apparatus the film must be calmly wound up and unwound and the demand of power must remain small especially if a motor is used to drive the entire apparatus. Fluctuating loads as experienced with the hitherto known devices for winding up and unwinding endless films, in particular films having a length useable for the practice, in connection with sound reproducing apparatus cause undesired changes in the speed of the film which result in a howling reproduction of the sound. If on the other hand uniform unwinding of the film is to be ensured, exceedingly strong motors free of slip are required which cause breakage of the film if the winding operation is hindered.

As far as in known devices perforated films are fed by positively operating toothed drums, one and the same device may only be used to unwind and wind up a single kind of film having the same perforation. In the film technics, however, two internationally standardized perforations for standard films and small films are employed. The small film carrying a photographed sound record is provided with a perforation along one

edge only. For special purposes it is desired to be able to project such differently standardized films as endless films by the same apparatus as well. Apparatus upon which such differently standardized endless films may be unwound and wound up have hitherto not yet been built. Simultaneously it is also necessary that the same apparatus may be used to wind the film, for instance an instruction film, running in a rearward direction for repeatedly projecting a rather interesting scene before the entire film is unwound. In a similar manner with a dictation machine operating with a ribbon this running in a rearward direction may be effected with the new apparatus to repeat for instance the last sentence.

According to the invention the unwinding and winding up of the film is effected in such a manner, that the film in the interior of which a core member is present is positively driven by means of a toothed drum together with the core member of the plate. If the film occupies a horizontal position, a special film plate serves for supporting same. For these film plates a special support is provided, so that the speed of rotation of the plate may automatically be assimilated to the unwinding of the film resting upon same. If now unwinding and winding up is effected in such a manner that the film is unwound from the interior and wound up from the exterior, then the plate is positively driven. In this case the film plate has a circular concentric cut out in which a disc or the like, rigidly connected to the axis of the core, is arranged which rotates the film plate in the desired direction of rotation by means of a spring abutting against a recess formed in the cut out of the film plate. If, however, the unwinding and winding up of the film is effected in opposite direction, then the film supporting plate either runs freely or may slightly be braked or, as tests have proved, completely be arrested respectively because the friction at the supporting face in each case is very small. The device described may be used, if films having a length up to about 100 m are to be unwound and wound up. If, however, longer films are to be handled, the conditions are different. In such a case a planet wheel gear is arranged between the film plate and the axis of the core which gear, in a compensating manner, rotates in dependence on the friction of the film resting upon the plate.

According to the invention, moreover, the film plate and the associate core member of the plate, lying in the interior of the film reel, may be ar-

ranged in vertical or horizontal as well as in any desired intermediate position. In the first case the film preferably rests upon the core member of the plate, whereas in the second case the film plate serves as support.

In this preferred modification of the invention the toothed drum serving for driving the core member of the plate and the film is connected to a drive in between the core member and is journaled in the latter. The drive is effected in such a manner that the teeth of the toothed drum engage in correspondingly formed holes or recesses of the core member of the plate and extend through these recesses into the perforations of the film resting upon the plate. Hereby a positive drive of the core member of the plate and of the film is essential.

To allow unwinding and winding up of films having different perforations, a second toothed drum is arranged in the interior of the apparatus. Whereas the first toothed drum preferably serves for driving standard films, the second toothed drum is determined for the drive of small films. A supposition for the operation of the apparatus is that rolling off of the circular pitches of the two toothed drums used leaves no remainder at the circumference of the surface of the core member of the plate. With the apparatus of the invention it is possible to find for this purpose a dimension of the surface of the core member of the plate which corresponds to the useable magnitudes. Preferably the perforations for the two toothed drums are so arranged that the perforation for the standard film for instance is provided at the one edge and the perforation for the small film at the other edge of the surface of the core member of the plate. The drive of the central drum preferably may be so effected that the toothed drum for the standard film is driven by a chain wheel, whereas the toothed drum for the small film is rotated by the associated perforations in the surface of the core member of the plate. It is, however, also possible to provide a chain for the drive of the toothed drum acting upon the small film.

Now, if for instance for special purposes a film without perforations is to be unwound and wound up, then, instead of a toothed rim, a smooth roller also may be used. The drive then is effected by friction. In the technics the friction drive generally is not considered to be a positive drive. In the present field and related fields of the technics however, a positive rotation may be obtained by a friction drive. As has been mentioned already above the drive of the toothed drum for the standard film is effected by way of a chain running over a chain wheel mounted upon the axis. The drive of the axis of the core may be effected in various manners. So for instance the end of the driving shank may be so formed that it may be placed upon the driving shaft of a disc record apparatus which then acts as drive for the unwinding and winding up apparatus. The driving shank, however, may also be constructed in a manner to be rotatably mounted upon the pivot of a cinema projector in which case the drive is effected from the shaft of the cinema projector. Finally the drive may also be effected by means of a driver fixed above the unwinding and winding up apparatus.

Due to the flat construction of the unwinding and winding up apparatus according to the invention it is possible to mount the apparatus in a drum ensuring protection against fire in case an inflammable material is used, as the new ap-

paratus is only slightly higher than the largest unwindable width of standard films. This arrangement simultaneously suffices official regulations.

In the accompanying drawings the invention is shown by way of example.

In these drawings:

Fig. 1 shows broken away views of a standard film and a small film,

Fig. 2 is a perspective view of a film rolled together to an endless reel,

Fig. 3 is a section through the planet wheel gear arranged in the plate,

Fig. 4 is a section on line IV—IV of Fig. 3,

Fig. 5 shows a sectional view of the driver arrangement for rotating the plate carrying the film,

Fig. 6 is a section on line VI—VI of Fig. 5,

Fig. 7 is a section through the apparatus without the core of the plate, showing two driving possibilities from above and from the left hand side respectively of the apparatus running upon a fixed bolt,

Fig. 8 is a perspective view partially in section of the apparatus shown in Fig. 7 without the holding device for the driving aggregate within the circle of the plate, and

Fig. 9 is a section through the entire apparatus showing the drive from below and unwinding from the axis of the core.

To allow unwinding and winding up of films having different perforations the toothed rim 5, driven from the axis of the core 1, 2 by means of a chain wheel 3 and a chain 4, is provided with standard film pitch of 4.74 mm. This toothed rim engages the perforations 6 of the surface 7 of the core and drives the latter, whereby, in turn the toothed rim 8 with the toothing of small film pitch of 7.62 mm (Fig. 1) is driven by way of the perforations 9 in the surface 7 of the core. The circumference of the surface 7 of the core is so chosen that rolling off of the two different tooth pitches at the circumference leaves no remainder. It results according to the invention that the diameter of the core 10 of the plate cannot be chosen as desired. A dimension useable for the practice lies between 100 and 150 mm which prevents the plate to become too large for operating purposes. For the feeding of a standard film 80 perforations are provided in the surface of the core so that this surface will be of a diameter

$$\frac{\text{number of perforations} \times \text{pitch}}{3.14} = \text{diameter of the core} =$$

$$\frac{80 \times 4.75}{3.14} = 121.0 \text{ mm}$$

and for small film perforations =

$$\frac{50 \times 7.62}{3.14} = 121.3 \text{ mm}$$

The difference of 0.3 mm is of no importance and is not perceptible in a disturbing manner.

If the unwinding and winding up apparatus is to remain universally in use the standardizing of the speed of the unwinding film also is to be considered. The following then results: As the speed of the unwinding film is fixed to 45.6 cm per second for a sound film, the number of revolutions of the core 7 of the plate must have this speed at its circumference. With a diameter of the core of the plate of 121 mm with a circumferential length of about 380 mm the core 7 of

the plate must perform 1,2 revolutions in a second or 72 revolutions in a minute.

The toothed rim 6a has 16 teeth which corresponds to a standard toothed rim in the cinema technics and, therefore, this rim has a circumference of $16 \times 4,75 = 76$ mm or a diameter of 24,2 mm. Herewith also corresponds the dimension of the toothed rim 8 for the small film having 10 teeth which corresponds to a circumference of $10 \times 7,62 = 76,2$ mm or a diameter of 24,2 mm. Corresponding to 72 revolutions of the core of the plate for the speed of the film of 45,6 cm per second the toothed rims 6a and 8 perform $80:16 = 5$ or $50:10 = 5$ revolutions per rotation of the core of the plate respectively or $5 \times 72 = 360$ revolutions per minute. They are driven by way of chain wheels 3, 5 and a chain 4 the two chain wheels having a ratio of 1:4,6. This means that the wheel 5 has only 10 teeth and the wheel 3 has 46 teeth, so that they, as far as their diameter is concerned, still may be arranged in the core of the plate. With this gear ratio the axis of the core 1, 2 performs 78 revolutions per minute which corresponds to the standard number of revolutions of the plate of a disc record.

If instead of toothed drums, for instance for a film band without perforations, smooth rollers are used as positive drive, then the diameter of the core member of the plate may be changed as desired in between practically useable limits.

It is evident which possibilities of use of the construction of the unwinding and winding up apparatus according to the invention are given in the photo film and sound record technics. The numerous possibilities, however, are only possible by the fact that the existing international standardizing for the perforations have been considered and also that useable dimensions for the individual parts could be found, whereby the standardized magnitudes of the technics of photo films and sound records in connection with films and record discs were brought into a proper proportion to each other. The unwinding and winding up apparatus, therefore, may, as will be seen from the following example, be used in the most different combination with known apparatus without altering its elements. So the apparatus

(1) For example according to Fig. 9 may be placed upon a normal record disc apparatus serving as drive since by inserting an intermediate member 12 having a conical bore the unwinding and winding up apparatus is placed upon the record disc apparatus instead of the plate carrying the record disc. Hereby the holder stirrup 16, serving for the exchange of the film reel 14 resting upon the film plate 13 (Fig. 2) and swingably mounted about the point 15, holds the bridge 17 by means of pins 18, 19. The toothed rims 6a and 8 are rotatably mounted about pivots 20, 21 provided at this bridge 17 and, moreover, the press rollers 22, 23 also are carried by the bridge 17. By means of a chain or in another suitable manner the toothed rim 24 then drives a drum not shown which guides the film along a taking device or a projection device respectively for taking a picture- and/or sound record or for projecting the picture and/or sound record.

(2) The unwinding and winding up apparatus may also, as may be seen from Fig. 7, be rotatably mounted upon a pivot 25 provided for instance at a cinema projector without using an intermediate member 12. The apparatus then is driven from the projector by a shaft making 180 or 360 revolutions per minute respectively in connection with a standard film using a re-

duction gear of 2,3:1 or 4,6:1, or by a shaft of the taking or projecting apparatus in a corresponding suitable proportion in connection with a small film in dependence on the standardized speed of the film of 183 mm. per second.

(3) Finally the drive may also be effected by means of a driver fixed above the unwinding and winding up apparatus to the axis of the core 1 (see Fig. 7). Hereby it is then possible to exchangeably arrange the unwinding and winding up apparatus below the apparatus used.

It is of course also possible for special purposes to construct to toothed rim 6a as a smooth roller i. e. for instance if a film band without perforations is used. In this case the toothed rim 8 and the press roller 23 are superfluous. The film is then moved at 6a by friction between press roller 22, the surface 7 of the core and the smooth roller.

As may be seen from Figs. 7, 8 and 9 the film supporting plate 13 is journalled separated upon the ball bearing 26 and may first of all be rotated independent on the core axis 1, 2 and the core member 7, 10 of the plate, because the film reel 14 must, corresponding to its larger outer diameter 27 (see Fig. 2), adjust itself with regard to the smaller inner diameter 28 as the speed of unwinding and the speed of winding up are equal. If for instance the length of the reel is 100 m and if the inner diameter 28 is 140 mm corresponding to a required space 29 for the press rollers 22, 23, then the film reel consists of about 200 windings and with a thickness of film of 0,3 mm would have an outer diameter 27 of about 300 mm. The circumference of the outer diameter 27 then is 942 mm and that of the inner diameter 28 is about 565 mm. The circumference of the outer diameter 27, therefore, is about 387 mm longer than the circumference of the inner diameter 28. This length, however, must be compensated during unwinding and winding up of the endless film band. If the unwinding of the film is effected in the direction of the arrow 30, i. e. from the interior to the exterior, then, after about 200 revolutions of the film reel 14, the point 31 of the film will reach the inner circumference 28. Therefore, per revolution of the film reel a displacement of the windings relatively to each other occurs of about 387 mm difference in length: $200 = \text{about } 1,9$ mm. As the core axis 1,2 performs 1,3 revolutions per second and the film reel 14 for instance is to rotate with the same number of revolutions the displacement of the film layers relatively to each other is effected with $1,9 \text{ mm} \times 1,3 = 2,47$ mm per second. The displacement of the film layers relatively to each other, therefore, is very small, but this value is only to be considered as an average value, because at the outer circumference of the film reel this value is largest and more and more decreases towards the inner circumference to become nought with the last layer of film.

With this unwinding and winding up of the film from the interior to the exterior the plate 13 carrying the film reel 14 may be rigidly connected to the core axis 1, 2 because then the larger circumferential speed of the outer portion of the reel always draws the film and due to the braking effected by the pull of the film at the outer circumference causes continuous compensation of the difference of length between the outer and the inner circumference of the film reel. It is still to be observed that the supporting surface of the plate must be as hard and smooth as possible so that the friction of the film

edge bearing against this plate is not great. In this case the arrangement shown in Figs. 5 and 6 serves for driving the plate 13 by the axis of the core 1, 2. As may be seen from these figures a disc 32 having a spring 33 is fixed to the portion 1 of the axis of the core. In the direction of rotation 34 the spring 33 rotates the plate 13 by abutting against the recess 35.

If the film is unwound and wound up from the exterior to the interior as shown by the arrow 36 the conditions are different. The plate then is freely running and rotates with the speed of the film unwound at the outer circumference. The film being wound up in this case is positively shifted by the toothed rims 6a and 8 respectively upon the inner circumference.

For films of greater length than 100 m the device according to Figs. 5 and 6 preferably is replaced by the device shown in Figs. 3 and 4 according to which the planet rollers 37, 38 with

their holder 39 freely moving about the core axis 1 are inserted between the disc 32 and the film plate 13. Compensation between the rotation of the film reel and that of the film plate in this case is automatically determined by the friction of the film reel 14 resting upon the film plate 13 (Fig. 7) and for the purpose of reducing the total friction loss is assisted by drive from the core axis 1 by way of the disc 32.

The reduction of the total friction loss may eventually be enhanced also by utilizing the slight pull of the film band occurring during winding and unwinding for braking or releasing the planet holder 39 which results in an acceleration or a slowing down of the revolution of the film plate 13 respectively which has a correspondingly favorable effect upon unwinding of very long film reels free of objection.

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