United States Patent [19]

Boyer

[11] **3,923,266**

[45] **Dec. 2, 1975**

[54] **ENDLESS FILM WINDING OR UNWINDING DEVICE**

[76] Inventor: **Jean Paul Boyer,** Impasse Melies, 30 Redessan, France

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **242/55.16;** 352/128

[51] **Int. Cl.²** **G03B 21/00**

[58] **Field of Search** 352/128, 126; 242/55.16, 242/128, 126

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Primary Examiner—Billy S. Taylor

Attorney, Agent, or Firm—Haseltine, Lake & Waters

[57] **ABSTRACT**

An apparatus for the continuous winding and unwinding of an endless band adapted to be fed to a utilization device comprising simultaneously winding two lengths of the endless band in superposition on a first rotating reel while simultaneously unwinding two superposed lengths of the band from a second reel rotating in opposite direction. One length of the band is passed from the second reel to the first reel while the second length of the band from the second reel is passed to the utilization device and the length of film traversing the utilization device is passed to the first reel. In order to feed the band to the second reel when it becomes empty the length of the band traveling from the utilization device to the first reel is displaced onto the hub of the second reel to form a loop so that the band can now be wound in two superposed lengths on the second reel while being unwound from the first reel, the direction of rotation of the reels being reversed.

45 Claims, 31 Drawing Figures

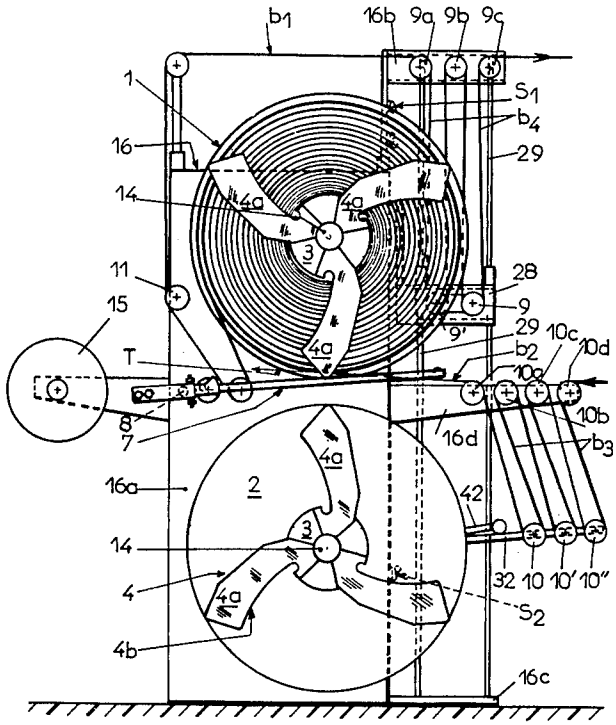
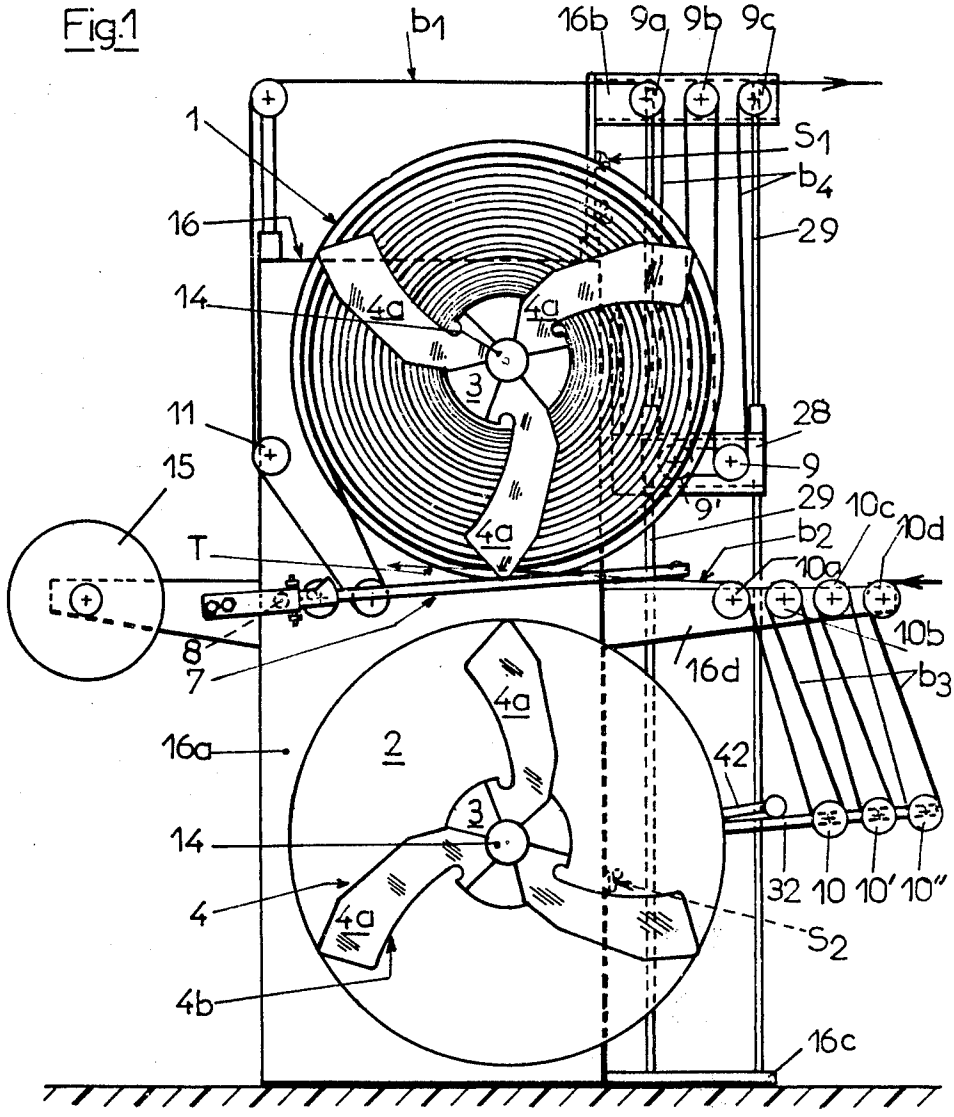


Fig.1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16b
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1
S1
b4
16
29
14
4a
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29
10c
10d
T
b2
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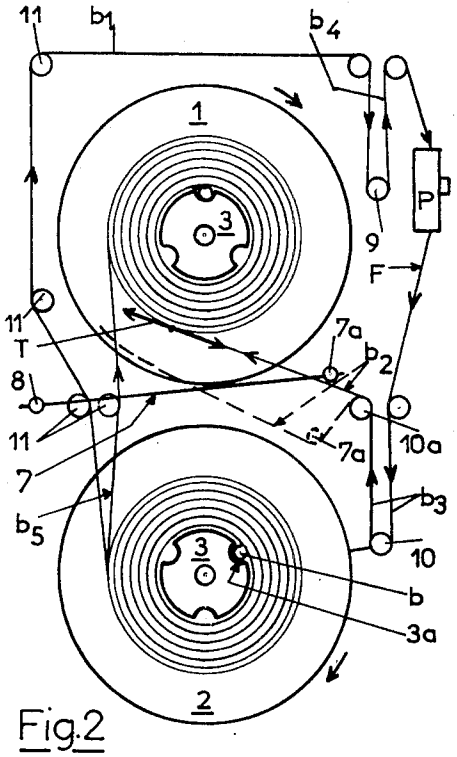


Fig.2

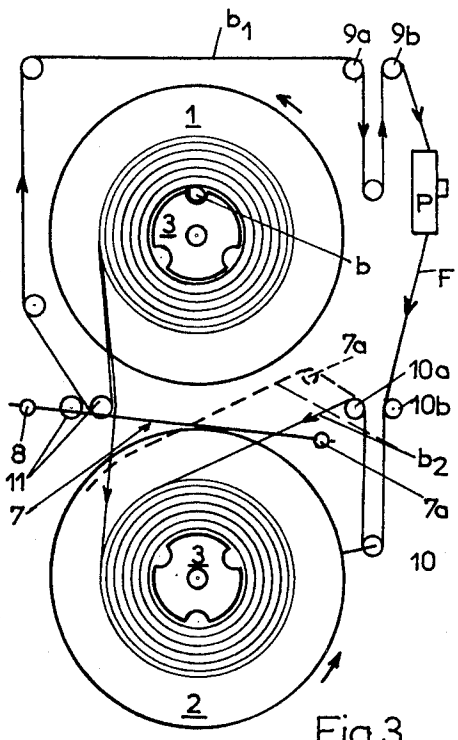


Fig.3

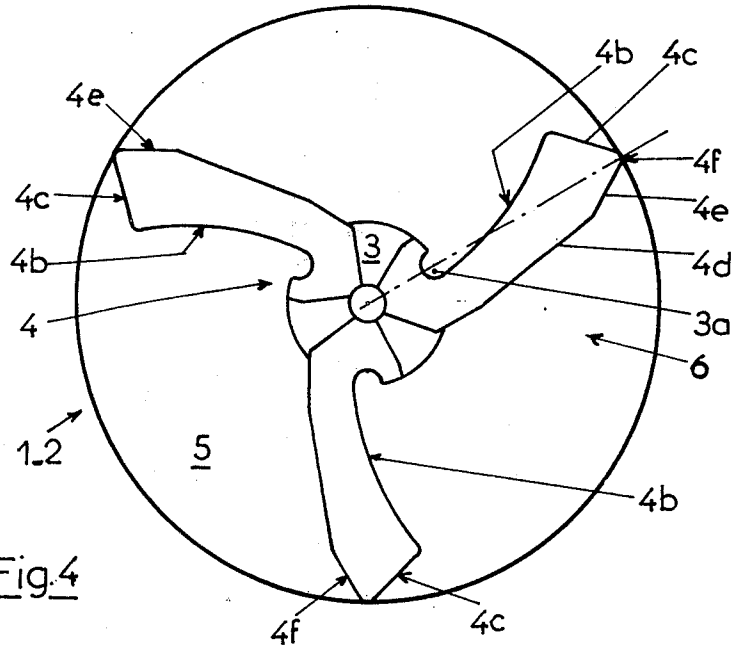


Fig.4

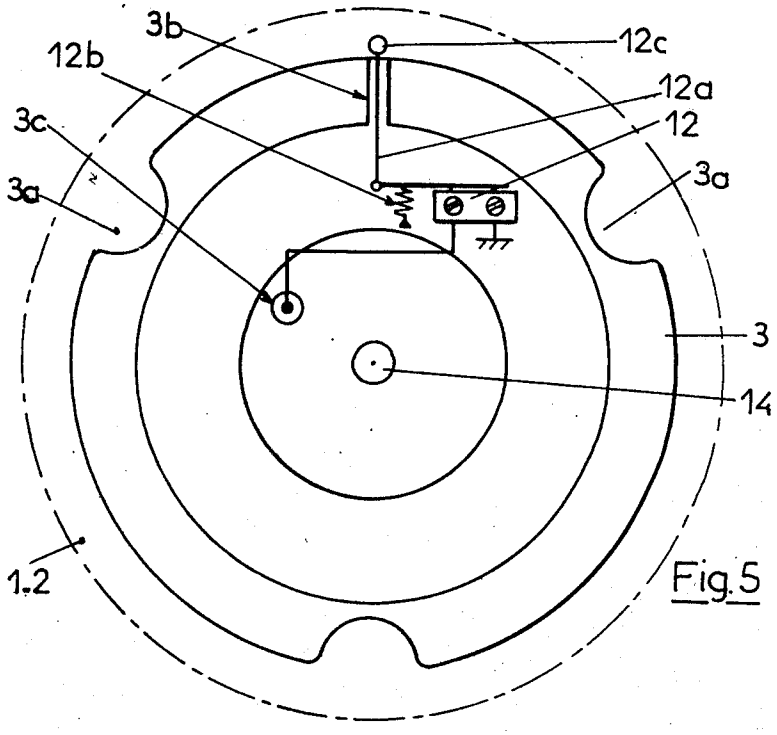
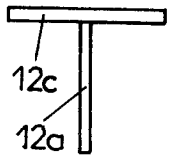


Fig.5



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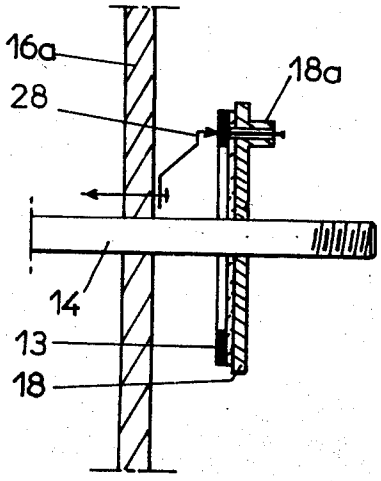


Fig.7

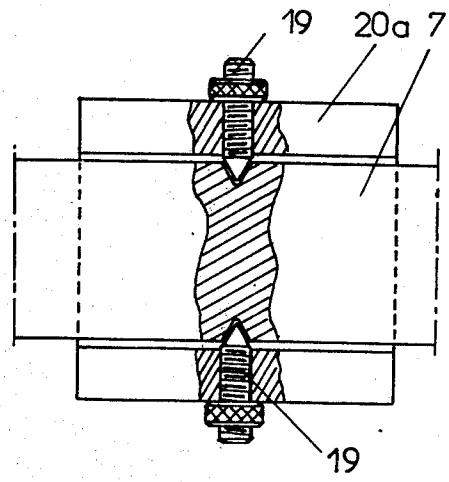
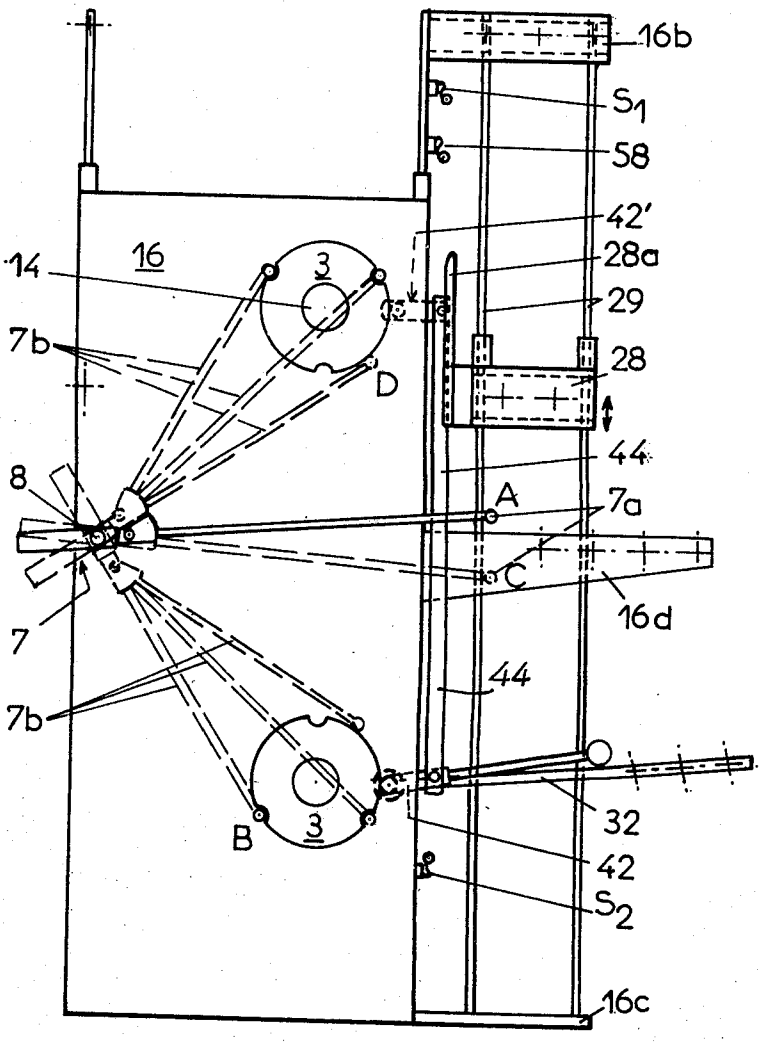


Fig.8

Fig. 9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S1
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42'
28a
29
28
44
A
7a
C
16d
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S2
16c
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7b
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8
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7b
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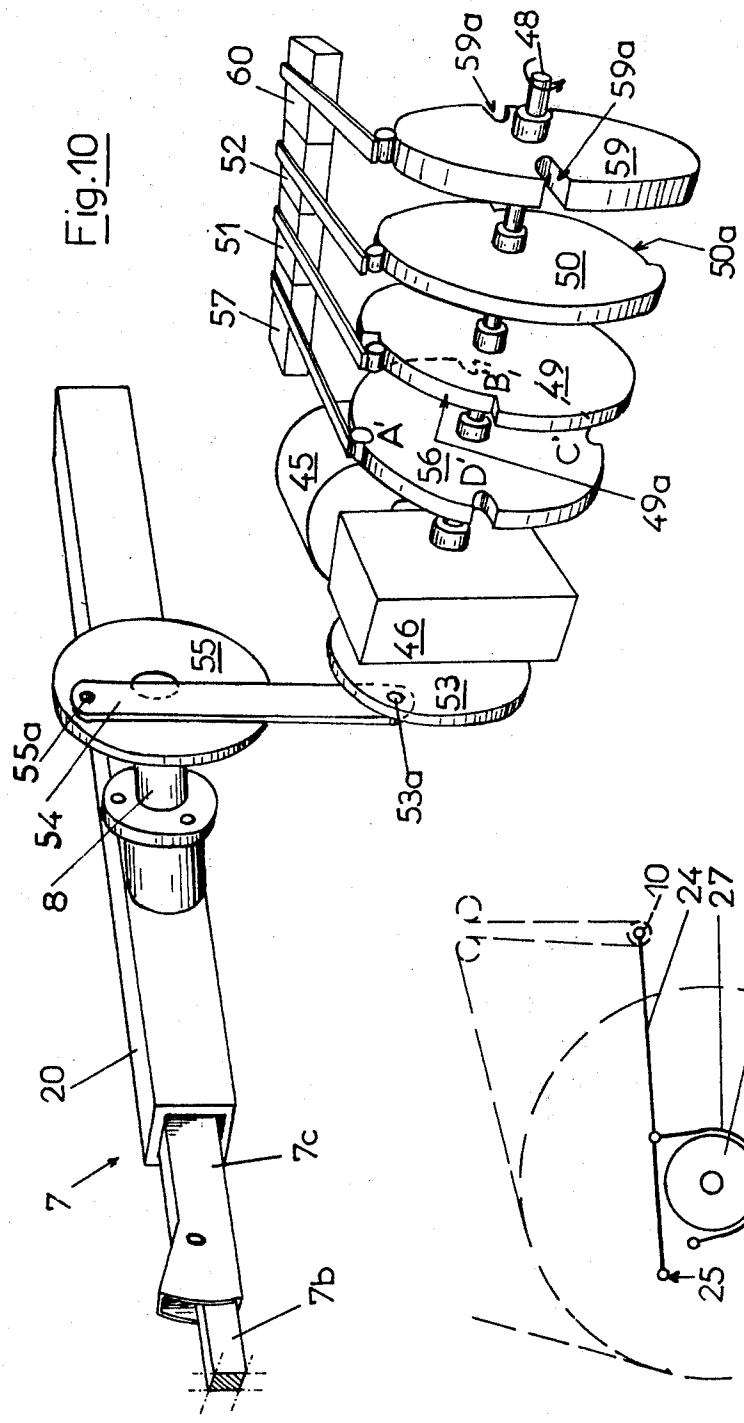
Fig.10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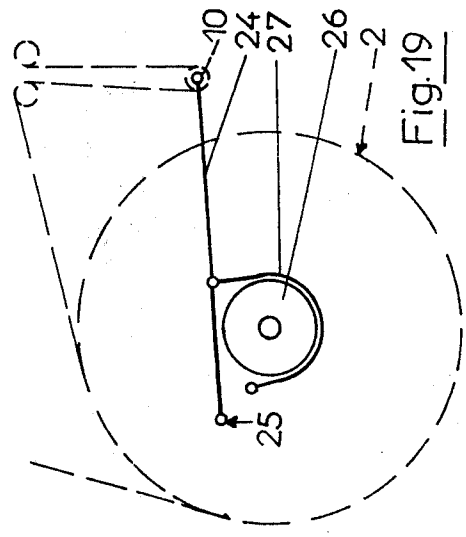
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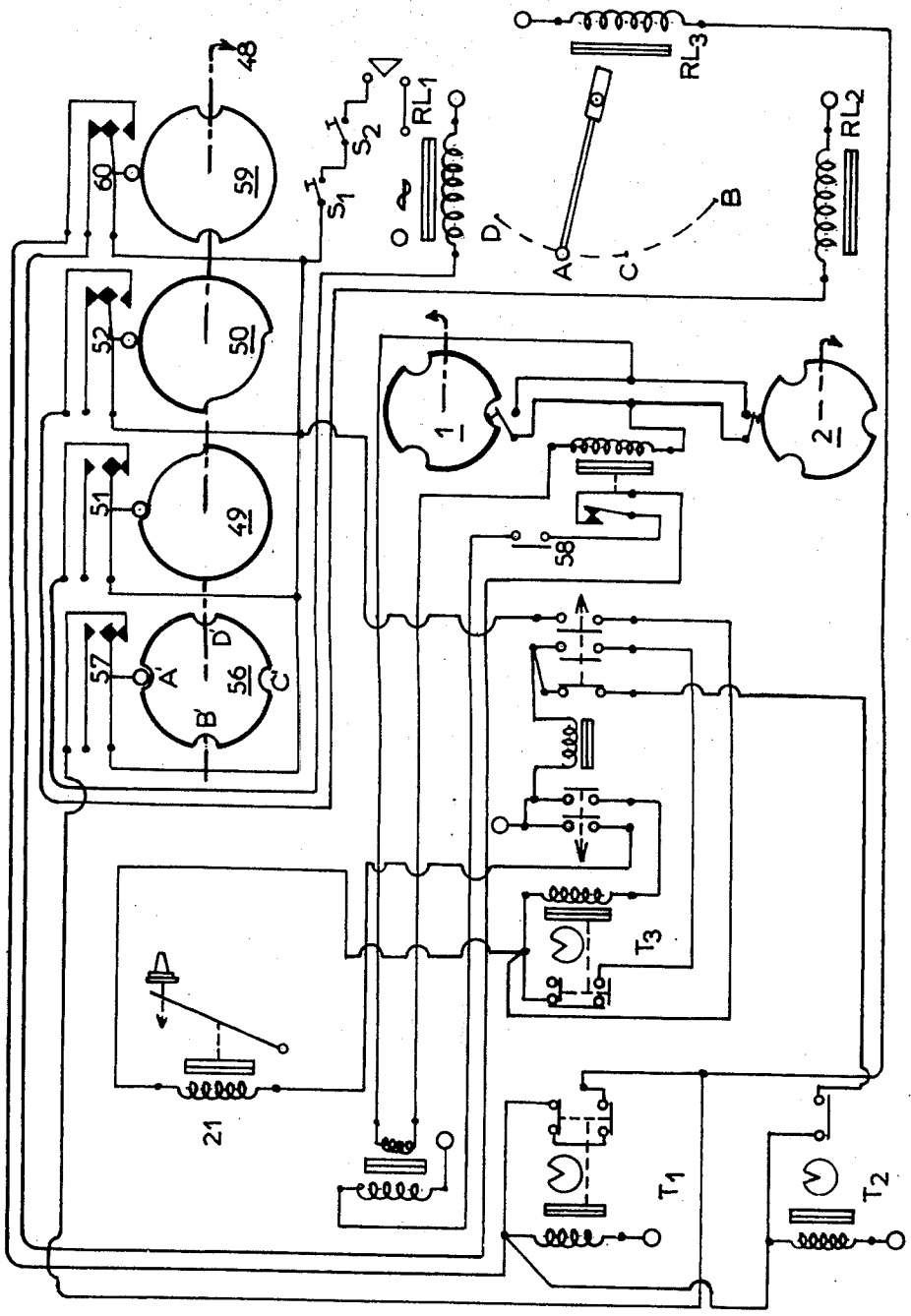
Fig.19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A'
B'
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T1
T2
T3
21

Fig.11

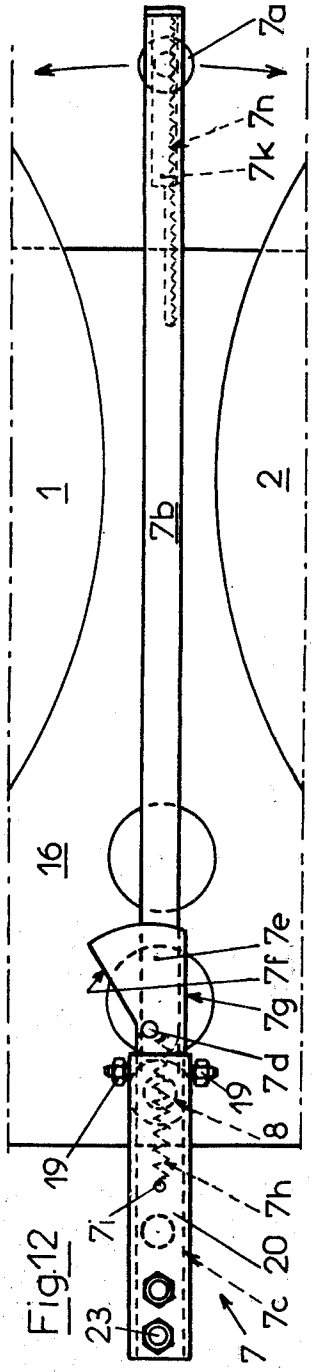


Fig.12

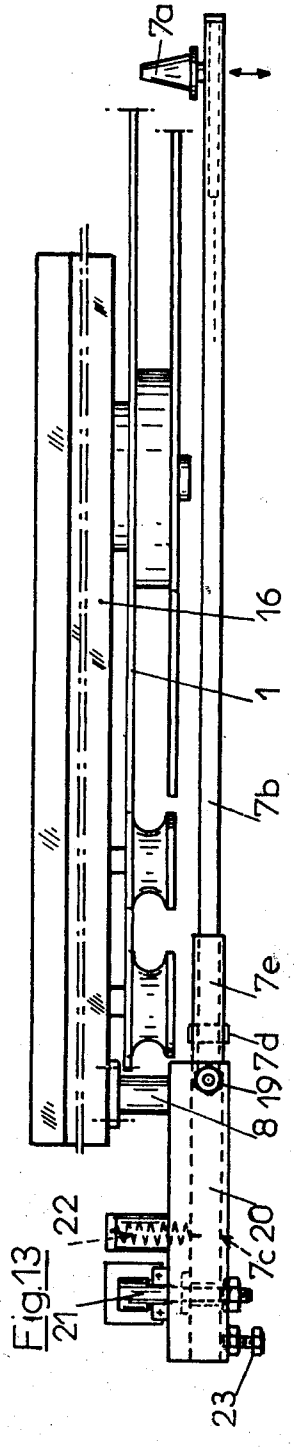


Fig.13

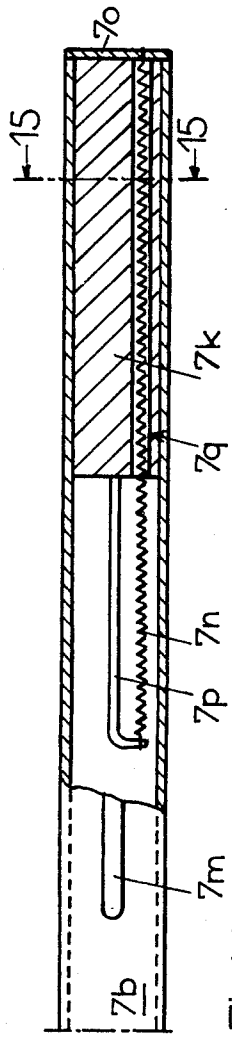


Fig.14

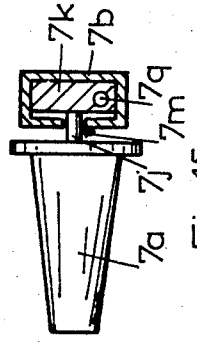


Fig.15

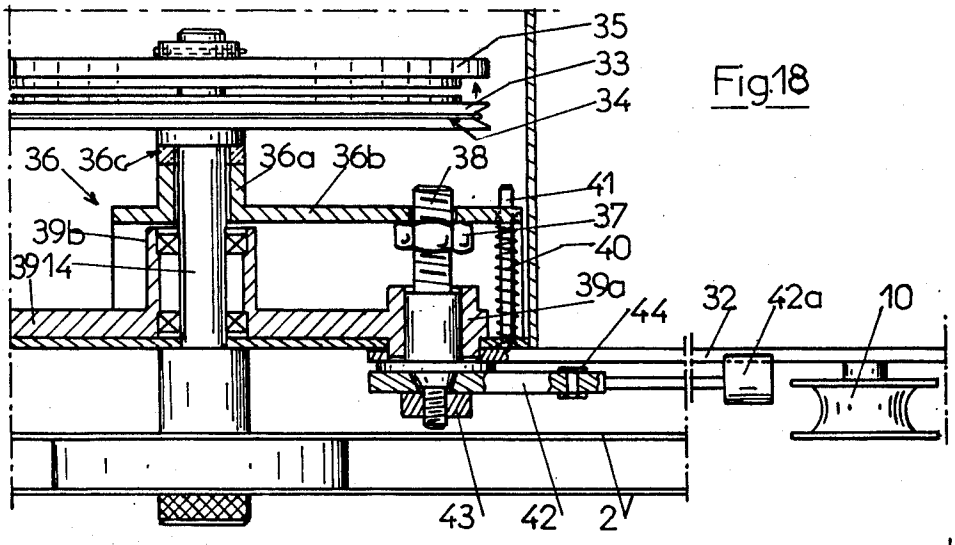
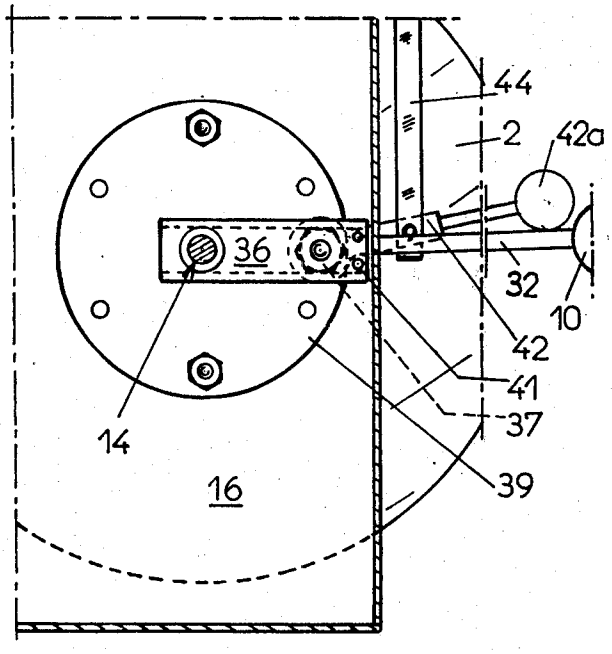


Fig.18



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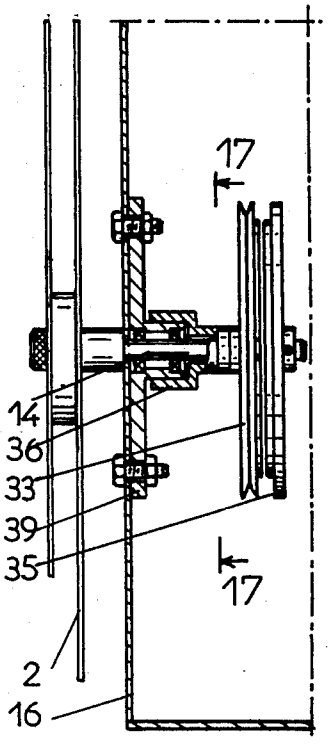

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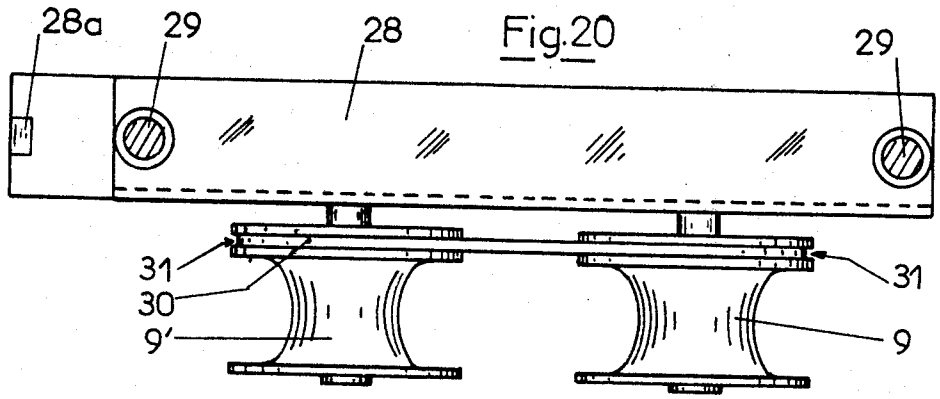
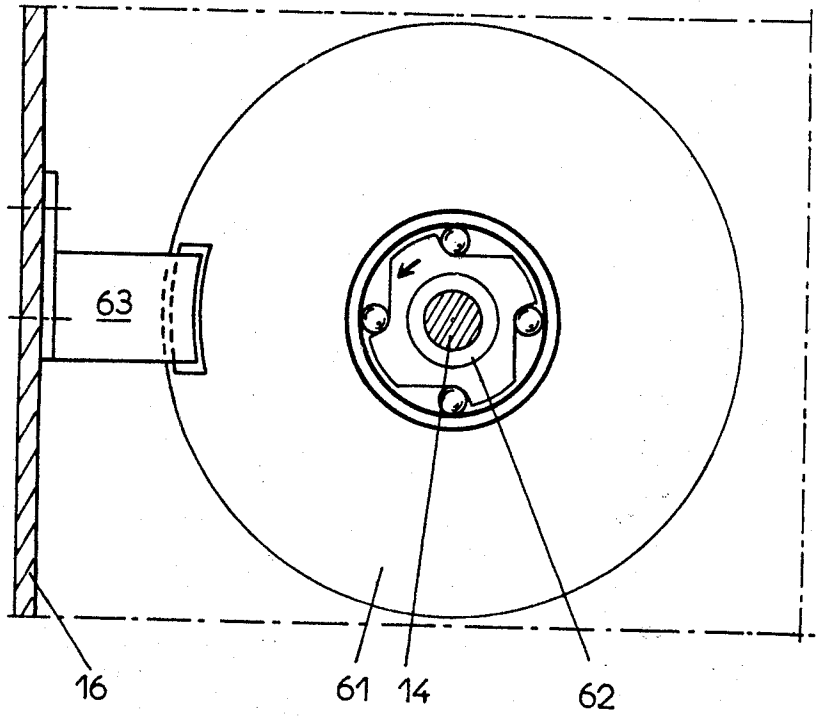


Fig.20



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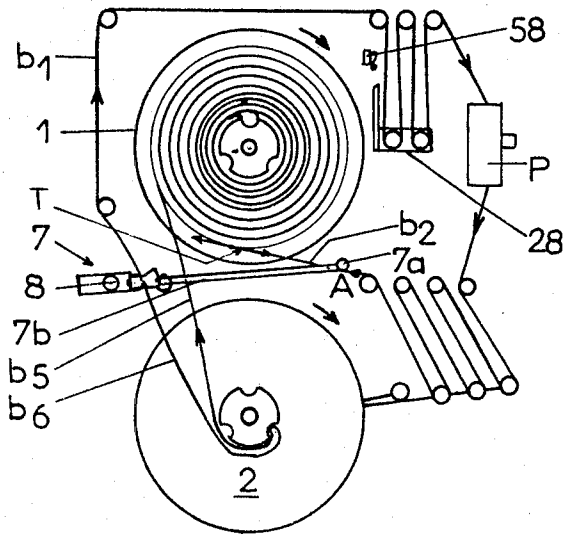
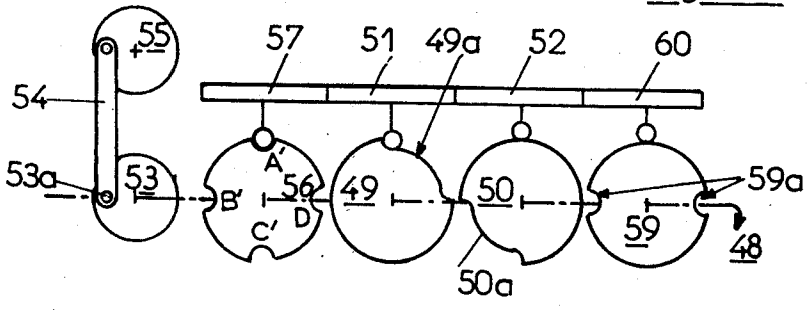


Fig.22

Fig.22a



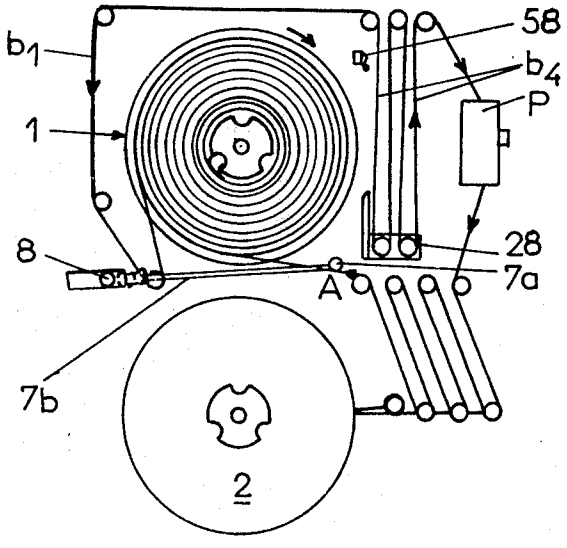
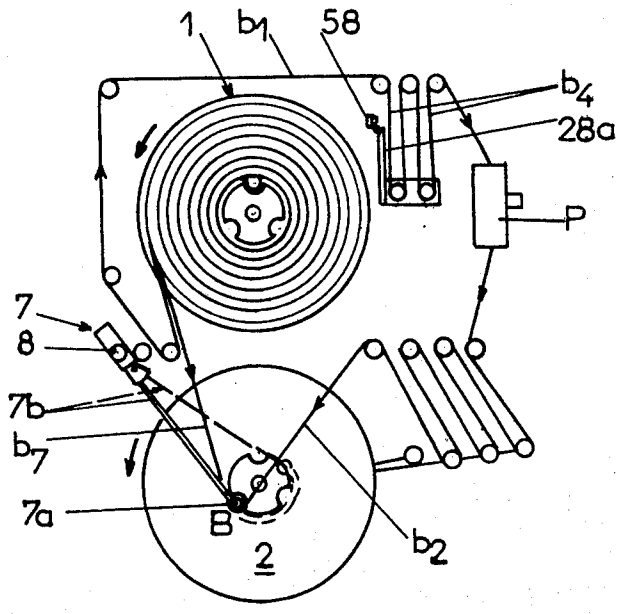


Fig.23

Fig.24



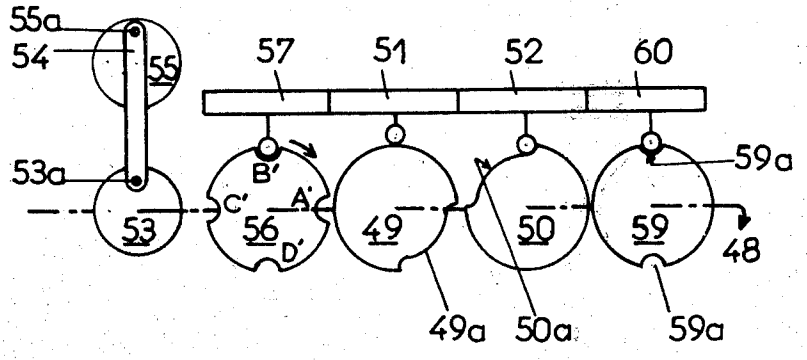


Fig.24a

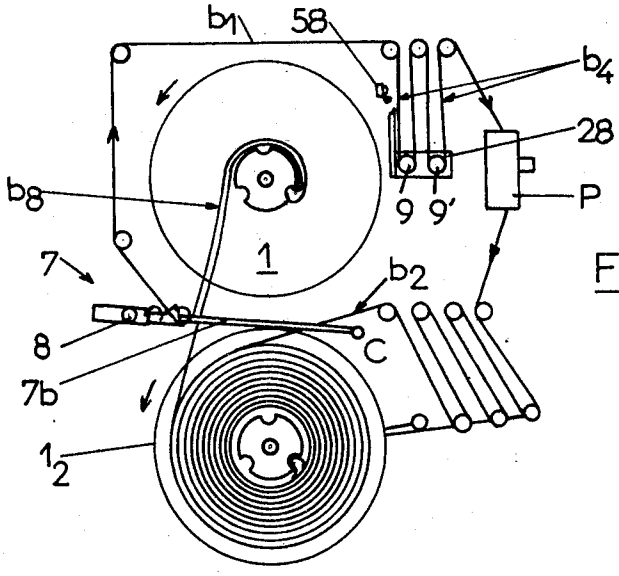


Fig.25

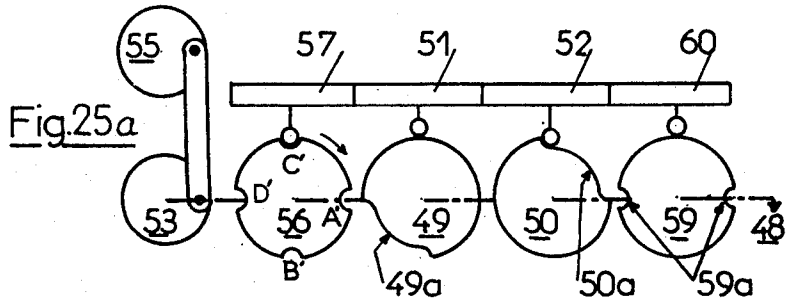


Fig.25a

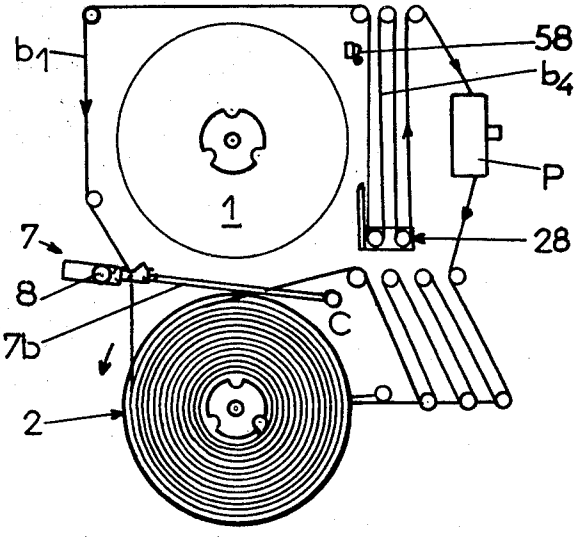


Fig.26

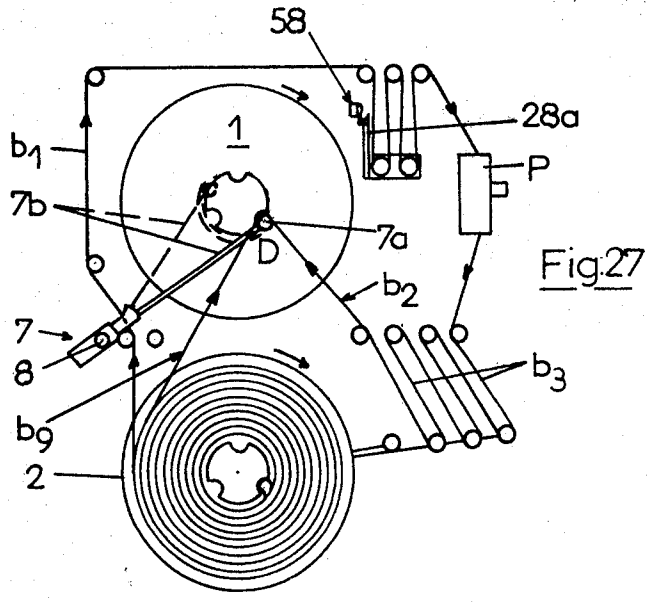


Fig.27

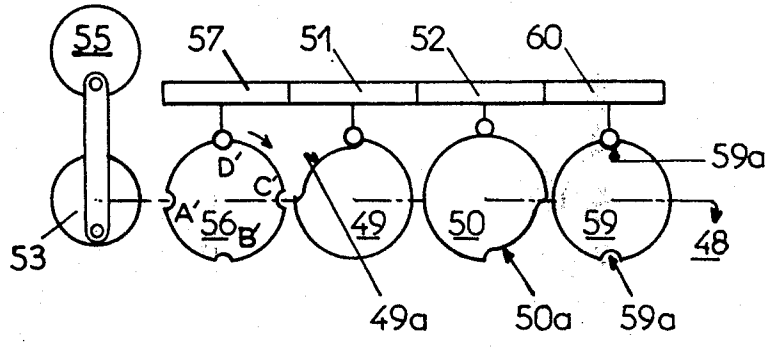


Fig.27a

ENDLESS FILM WINDING OR UNWINDING DEVICE

BACKGROUND

The invention relates to apparatus for continuous winding and unwinding of an endless band.

In a particular non-limitative embodiment, the invention is applicable to cinematographic projective apparatus and to magnetic reading apparatus.

In this exemplary embodiment, the objective of the invention is to permit cinematic projection or magnetic reading in continuous and automatic manner without it being necessary to reload the projector or the magnetic reader or to proceed with a rewinding of the film or bands.

In a general manner, the apparatus of the invention permit continuous and automatic feeding of an endless film or band of substantial length to a utilization or treatment apparatus.

By way of example, suitable utilization apparatus to which the invention is applicable are sound reproducing equipment, apparatus for controlling the operations of work machines and all types of apparatus capable of being utilized with tape or film of great length.

PRIOR ART

Various methods and apparatus have been proposed to effect passage of an endless band through a utilization apparatus such as a movie projector and avoiding the need for rewinding the film at the end of the program.

Certain of these methods and apparatus have not passed the theoretical stage as they cannot be put into practice.

This is the case with a procedure consisting of forming a small loop, then introducing this loop into a hollow central hub of a plate mounted for rotation on a support capable of turning around an axle and carrying a second plate identical to the first on the other side of said axle, the band being then wound over nearly its entire length on the hub of the first plate while forming windings of two superposed lengths. In order to pass the outer length of the superposed thicknesses of the band to the drive system of the utilization apparatus, i.e., to make it follow the path provided in the latter, another small loop was formed retained at a convenient location and introduced into the central hub of the second plate which thus becomes the take-up plate whereas the first plate constitutes a supply plate up to the time when the latter becomes empty and the retained loop escapes from its hub at which time the take-up plate takes the role of the supply plate by an **180°** rotation of the support. A suitable means is provided to rest between the two thickness of the band and to form a small retainer loop which is introduced into the central hub of the empty first plate which thus becomes the take-up plate, each plate being automatically rendered free when it alternatively supplies or takes-up following the position which it occupies.

Such procedure has not been put into practice as it is practically impossible to pivot the support carrying the plates by **180°** when one plate is empty and the other carries a complete film program whose weight can be several tens of kilograms. Moreover, such pivoting movement requires an excessive amount of space.

According to other methods and apparatus, the film whose extremities are joined to constitute a closed loop is wound in superposed turns on the middle of a hub. One length of film is unwound from the interior of the hub and is fed to the projector and after passage therethrough is wound onto the outer periphery of the film on the hub.

Such arrangement is well known notably in the region of amateur film apparatus, and it allows the utilization of film or tapes, optical or magnetic, of relatively small length.

When a film of great length is projected, such as a full length picture, the various segments of the picture are connected one after the other in their order of passage and the band, thus constituted, is wound in proportion, on an enormous plate. It is necessary to rewind the film and reload the projector at the finish of the picture.

To avoid this disadvantage, it has been proposed to dispose the film on a first plate of great diameter and to unwind from the interior. After passage in the projector, the film is wound on a second plate. It is therefore necessary to change the positions of the supply plates and take-up plates and their directions of rotation. No such satisfactory arrangement has been made which supports the industrial and commercial interest which it promises. Additionally, it is necessary to pass a protective band between the turns of the film in an attempt to limit the abrasive effects due to rubbing of the film lengths against one another.

SUMMARY OF THE INVENTION

An object of the invention is to provide an apparatus by which the disadvantages associated with the prior art are overcome.

A further object of the invention is to permit the mounting and projecting of a complete program, such as newsreels, cartoons, documentary film, commercial announcements and full-length feature film in succession on a single endless band having a substantial length of the order of **5,000–6,000** meters or more without any risk to the film and under ideal conditions of winding and unwinding without any interruption of the projector.

The invention is characterized in that there is wound simultaneously two lengths of an endless band of film on a reel disposed in the interior of the endless band and on a reel disposed externally of the endless band, the film traveling along a path in which one length extends between the external reel and the downstream end of the projector at the time of feeding the interior reel when the latter is empty, and between the interior reel and the downstream end of the projector at the time of feeding the external reel when the latter is empty.

More specifically the invention comprises simultaneously winding two lengths of the endless band in superposition on a first rotating reel, while simultaneously unwinding two superposed lengths of said band from a second rotating reel, passing one length of the band from the second reel to the first reel while passing the second length of said band from the second reel to the utilization apparatus and passing the length of film traversing the utilization apparatus to said first reel. The band travels along a closed loop between the reels and the utilization apparatus, one reel being in the interior of the loop, the other reel being external thereof.

In order to feed the film back to the supply reel after it has become empty, the invention further comprises diverting onto said second reel the length of the band

traveling from the utilization apparatus to the first reel after said second reel is exhausted of band to form a loop so that the band can now be wound in two superposed lengths on said second reel while being unwound from the first reel, the direction of rotation of the reels being reversed.

The apparatus according to the invention comprises a first rotatable supply reel and a second rotatable take-up reel, reversible drive means for said reels, said reels being arrayed with respect to the utilization device such that two lengths of the band are wound in superposition on both reels and extend between both reels and the utilization device, one length on said second reel extending to the first reel, the other length on said second reel extending to said utilization device and traversing the same, said first reel receiving the length of the band issuing from the utilization device, said band forming a closed travel loop between said reels and the utilization device, one of said reels being in the interior of said loop, the other reel being external thereof; and feed means for placing against the second reel the length of band extending between the utilization device and said first reel when said second reel is empty whereby by reversing the direction of rotation of the reels the first reel can now become the take-up reel and the second reel the supply reel.

In further accordance with the invention said feed means comprises a feed arm pivotably mounted between said reels, and a retractable finger adjustably mounted on said arm for longitudinal displacement therealong and spring means acting on said arm and finger for urging said finger to a rest position out of contact with said band.

In further accordance with the invention each reel includes a hub having a notch in the periphery thereof in which the band is introduced as a loop by said finger, and a cheek with a curved ramp positioned to guide the finger to the notch in said hub.

In further accordance with the invention there is provided guide means including at least one movable guide roller at said inlet and outlet of the utilization device for forming respective loops of compensating and reserve amounts of said band.

In further accordance with the invention there is provided a selector including control means for controlling the movement of said feed arm between a rest position between said reels and two active feed positions in contact with the respective reels, means for halting the drive means of the take-up reel and activating the drive means of the supply reel when the latter is empty, means for maintaining the arm in feed position on the hub of the take-up reel for a sufficient time to wind a number of turns of band in the take-up reel so that when the arm is removed the band will continue to be wound on the take-up reel, and means for rocking said feed arm and/or retracting said finger.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a diagrammatic side elevational view of the installation according to the invention;

FIGS. **2** and **3** are schematic views intended to facilitate a comprehension of the operation of the installation;

FIG. **4** is an elevation view of a reel used in the installation of the invention;

FIG. **5** is a diagrammatic elevation view showing the mounting of a microswitch in the hub of a reel;

FIG. **6** shows a control lever of the microswitch;

FIG. **7** is a schematic illustration in section of the rotatable support of the axle of a reel;

FIG. **8** is a detail view partly broken away and in section showing the articulation support of a feed arm of the installation;

FIG. **9** is a view similar to FIG. **1** in which certain elements have been omitted to reveal certain details of construction;

FIG. **10** is a perspective view of a selector apparatus controlling the operation of the installation;

FIG. **11** is a diagrammatic illustration of the principal elements of the selector apparatus showing their connection in a circuit diagram;

FIG. **12** is a front elevation view of the feed arm of the installation;

FIG. **13** is a top plan of the arm;

FIG. **14** is a rear elevation view of an extremity of the arm in partial section;

FIG. **15** is a sectional view taken on line **15—15** in FIG. **14**;

FIG. **16** is an end view, partly in section, apparatus for interrupting the drive of the reels;

FIG. **17** is a sectional view taken on line **17—17** in FIG. **16**;

FIG. **18** is a top plan view, partly in section and on enlarged scale, of the apparatus shown in FIGS. **16** and **17**;

FIG. **19** is a front elevation view diagrammatically illustrating a brake apparatus for the take-up reel utilizable in place of the apparatus in FIGS. **16–18**;

FIG. **20** is a plan view of a movable assembly for a reserve loop of film at the exit of the film banding apparatus;

FIG. **21** is an elevation view diagrammatically illustrating a means for braking rotation of the reels when they operate as supply reels;

FIGS. **22–27***a* are schematic views showing the apparatus in various stages of operation.

DETAILED DESCRIPTION

Reference will next be made to the drawings to describe an advantageous embodiment of an installation which is drawn in non-limitative manner to apparatus for cinematographic projection.

In this respect, the expression "projector" or "projection apparatus" which will be often employed hereafter should be taken as the equivalent of any suitable "utilization" apparatus or "operating" apparatus, while the term "film" should be considered as synonomous with the terms "tape" or "band".

The installation comprises two reels **1** and **2** which in characteristic fashion according to the invention are disposed one above the other and are mounted on respective axle supports permitting them to be driven in rotation by means of any suitable electric drive motor.

For this reason there is utilized hereafter terms such as "upper", "lower", "vertical", "horizontal" and so forth. For other utilizations however, different positions of the reels can be adopted without departing from the invention.

The cinematographic film F is constituted as a closed loop and is fed from one reel to the other while traversing a projector P as will be explained more fully later.

The frames of the film constituting a complete program are arranged one following the other in their order of passage and the extremities of a band of great

length, thus obtained, is assembled by a conventional adhesive. The endless band formed by such a complete program can thus have a very substantial length, for example, of the order of **5,000** to **6,000** meters or more.

According to a first characteristic feature of the invention, the winding hub of one of the reels is disposed in the interior of a closed loop which the film defines as it travels from one reel to the projector and back to the other reel as will be explained more fully later, while the winding hub of the second reel is external of the loop.

In the illustrated embodiment of the cinematographic projection apparatus, the reel disposed in the interior of the loop is reel **1** which will be called the "upper reel" hereafter. This arrangement is best seen in FIG. **26.**

The reel **2** which will be called the "lower reel" is disposed at the exterior of the loop as can be seen in FIG. **23.**

The reels **1** and **2** each comprise a winding hub **3** of generally cylindrical form and two cheeks, of which one is a front cheek **4** and the other a rear cheek **5,** both cheeks being solidly fixed to the winding hub.

The front cheek **4** has at least one notch **6** at the inner periphery thereof. The notch **6** registers with a cylindrical notch **3***a* formed at the periphery of the hub **3**; cylindrical notch **3***a* has an axis extending parallel to the axis of the hub. The front cheek **4** of each reel comprises one or more blades and preferably, as seen in FIG. **4,** three equally spaced blades **4***a* of particular form, this number suitably meeting conditions for mounting and utilization of the reels in the described application. The front and rear edges of each blade constitute two ramps of opposite inclination which join to form an angle whose apex is at the free extremity **4***f* of the blade.

With respect to the direction of rotation of the reels in their receiving function as the take-up reel, the front edge of each blade forms two ramps **4***b* and **4***c* of opposite inclination. The exterior ramp **4***c* is rectilinear and forms an acute angle with respect to a line joining the extremity **4***f* of the blade and the axis of the reel. The interior ramp **4***b* is of concave curved form and its internal extremity extends directly into notch **3***a* at the periphery of the winding hub **3** of the reel. Thus, at the periphery of the hub **3** of each reel there are three cavities or cells **3***a* which will be called "loop cavities" hereafter.

The rear edgeof each blade is constituted by two rectilinear ramps **4***d* and **4***e* of opposite inclination, the exterior ramp **4***e* also forming an acute angle with the line joining the extremity **4***f* of the blade and the axis of the reel. The interior ramp **4***d* has a length much greater than that of the exterior ramp **4***e*, and ramp **4***d* extends to the region of the hub **3** of the reel. Ramp **4***d* also has an oblique disposition with respect to the line joining the axis of the reel and the extremity **4***f* of the blade and preferably is not sharp or capable of effecting a shearing function.

This conformation of the front cheek of each reel is effected, on the one hand, so that nothing opposes a feed arm **7** which will have just occupied the positions following alternative advance and start of the drive motors of the reels and on the other hand, to drive the film loop presented by a finger **7***a* of the feed arm to one of the loop cavities **3***a*. The finger **7***a* is guided by the curved ramp **4***b* of one of the blades **4***a*, in a manner which will become apparent later.

According to a characteristic disposition, the reels **1** and **2** are driven in rotation in opposite directions in their respective operating functions.

In this respect when the upper reel **1** is the take-up reel it turns in clockwise direction, while the lower reel **2** is driven in the opposite direction as it unwinds and serves as the supply reel.

In these conditions, the curved ramp of the blades of the front cheek of one of the reels has an opposite disposition relative to the curved ramp of the blades of the other reel.

Accordingly, the portion of the length b_2 (FIG. **2**) of the film between the interior roller **10***a* of a group of rollers disposed at the entrance of the film handling apparatus and the tangent of winding T of this length on either one of the reels, effects a minimal angular inclination with respect to the limit positions of the feed arm **7.** The finger **7***a* of the feed arm can thus easily occupy a rest or waiting position next to length b_2 opposed to the side of the unwinding reel as will be seen hereafter.

In their receiving operation as take-up reels, the reels roll on an imaginary plane passing through the pivot axis of the feed arm, in a direction away from said axis.

The apparatus comprises a means for alternately controlling the feed to wind the film on one or the other of reels **1** and **2.**

According to a characteristic feature of the invention, this feed means is constituted by the pivoting arm **7,** at the free extremity of which is retractable finger **7***a*. The finger **7***a* is mounted for longitudinal adjustable movement with respect to shaft **8** which pivotably carries the arm **7.** The pivot axis of the arm is disposed at a level between the reels **1** and **2,** at a judicious distance from a plane passing throughthe centers of said reels.

Two groups of guide rollers are disposed respectively at the exit and at the entrance of the projector and the roller group at the entrance includes at least one tension and compensator roller **9** while the roller group at the exit includes at least one tension and compensator roller **10.**

The groups of rollers, the particular arrangement of which will be explained in more detail in the following description, provide for reserve loops or film b_3 and b_4 downstream and upstream of the projector P or other utilization apparatus. The group of rollers including the roller **9** serve for guiding the length of film b_1 towards the projector P, while the group of rollers including the roller **10** guides the length of film b_2 leaving said projector. Other return and guide rollers **11** can be advantageously disposed in proximity to the periphery of the upper reel, notable to avoid contact of the lengths of the endless band traveling in opposite directions.

According to another characteristic feature of the invention, the means for control of the drive disposition of the arm **7** and of the drive motors of the reels are lodged in the hubs **3** of the reels. These means comprise a microswitch **12** (FIG. **5**) connected to a collector **13** (FIG. **7**) disposed on the external face of the rear cheek **5** of the reel and on which rubs a brush carried by the frame of the installation, as will be explained hereafter.

The switch **12** of each reel is actuated when the last turn of the film leaves the reel as it is unwound. Other suitable control apparatus could be lodged in the hub

3 of the reels, such as a photo-electric cell or the like.

Each reel is mounted on an axle **14** turning in bearings (not shown) which can be provided in vertical partition **16***a* of frame **16** of the installation.

In order to effect the operation of the apparatus of the invention, considering that the cinematographic programs are delivered to the users in the form of rolls of film from **300** to **600** meters in length, the segments of the programs are secured edge to edge and the film must now be formed into an endless band as will be explained hereafter with reference to FIGS. **2** and **3.** The film whose extremities are not yet joined is wound on one of reels **1** or **2,** for example on the upper reel **1.**

When all the program is wound on reel **1,** the film is partially unwound from reel **1** and rewound on a third reel **15,** which is preferably disposed on one side of the frame **16.** This auxiliary reel **15** has a winding capacity which is at least one-half of the winding capacity of reels **1** and **2.**

When one-half of the program has been wound on reel **15,** the intermediate length of film is led against the hub of the lower reel on which are then simultaneously wound two lengths of the film, one of which is supplied by the upper reel, and the other by the auxiliary reel. Graduation marks provided on the front cheek of the reels permit determining with exactitude the median part of the film.

When the free extremities of the film have left the reels **1** and **15,** and the totality of the film is then wound on the lower reel; the film extremities are easily joined together to form an endless loop of which one length will be led, respecting the dispositions already described, against the winding hub of the upper reel.

It is nevertheless, evident that the development of the invention will lead distributors to deliver the cinematographic programs directly as closed loop of great length on a reel according to the invention, in order to avoid the preceding operation.

Referring to FIG. **2,** the upper reel **1** (disposed at the interior of the closed loop) winds simultaneously two lengths of the film of which one length (b_2) proceeds from the projector while the other is fed from the lower reel **2** (situated outside the closed loop). Reel **2** also unwinds length b_1 going to the projector P.

When the lower reel **2** is empty, the upper reel is disconnected from its drive motor and put in free rotation and the length b_2 situated between the upper reel **1** and the downstream end of the projector is displaced (as shown in dotted outline in FIG. **2**) by means of pivotal arm **7** and finger **7***a* against the hub of the lower reel to introduce a small loop *b* of film into a cavity **3***a* in said hub.

The lower reel is driven in rotation in a direction opposite to that when it served as the supply reel.

By holding the film several seconds in the cavity **3***a* of the hub of the lower reel, two lengths of the endless band are simultaneously wound on the hub. One of these lengths (b_2) comes from the projector P, while the second length is fed from the upper reel which simultaneously unwinds the length b_1 going to the projector as seen in FIG. **24.**

When the upper reel is empty, the lower reel is freely rotated and the length b_2 situated between the lower reel and the projector is fed (as shown in dotted lines in FIG. 3) by means of finger **7***a* on arm **7** against the hub of the upper reel which is now situated in the opposite direction. The finger **7***a* introduces a small loop of film in the cavity **3***a* of the hub of the upper reel and as described previously, two lengths of film are simultaneously wound on this hub. One length comes from projector P while the other is fed from the lower reel which also unwinds length b', to the projector P.

According to the apparatus described, it is understood that there are alternatively wound two lengths of the endless band on one of the reels while the second reel unwinds in continuous and automatic manner. Accordingly, the film travels via length *b*, in uninterrupted manner to the projector or other utilization apparatus.

The operation of the apparatus will be described hereafter with reference to details of the principal elements there of.

As previously described, a microswitch **12** is lodged in the winding hub **3** of each reel. This switch serves to send a signal to an electro-magnetic apparatus to effect displacement of the feed arm **7** and the control of the drive motors for the reels after the last winding of the film unwinds from the supply reel.

As seen in FIG. **6,** the switch has a control element of T shape with a vertical arm **12***a* and an upper horizontal branch **12***c* disposed parallel to the axis of the cylindrical hub **3.** The arm **12***a* is slidingly mounted in a radial bore **3***b* in the hub **3** and the control element is subjected to the action of a spring **12***b* urging the upper branch **12***c* outwardly from the bore as seen in FIG. **5.**

The control element is lowered in the bore when the film is wound on the hub **3,** and it is automatically raised as soon as the last winding is unwound from the hub.

As illustrated in FIG. **7,** the rotational drive of the reels is effected by means of a plate **18** secured on each shaft **14.**

The front face of each plate **18** is provided with at least one entrainment spur **18***a* adapted to engage in a cavity **3***c* provided in the front face of the winding hub of the associated reel.

The rear face of the plate **18** comprises an insulating section carrying a conductive contact ring or collector **13** on which rubs a brush apparatus **28** which can be supported, for example, by the vertical partition **16***a* of the frame of the apparatus.

The electrical contact between the collector **13** and the switch **12** is realized via the engagement of the spur **18***a* in the cavity **3***c*, to which conductors are respectively connnected and led to the collector **13** and the switch **12** as seen in FIG. **5.**

According to another feature of the apparatus it has already been noted that the finger **7***a* of the pivotal feed arm **7** is mounted for longitudinal displacement on the arm. Accordingly, as illustrated in FIGS. **12** to **15,** the distance between the finger **7***a* and the pivot axis through shaft **8** is variable.

The shaft **8** is carried by the vertical partition **16***a* of the frame and permits pivoting movements of the feed arm **7** between a rest position and a feed position, for each reel **1** and **2.**

The feed arm permits the introduction of a small loop of film into one of the loop cavities in the hub of one of the reels such that the rotation of this reel assures the simultaneous winding of two lengths of film on the hub. When a sufficient number of windings have been wound, the finger is retracted and the arm assumes again its rest position.

The retractibility of the finger **7***a* of the feed arm can be effected by a displacement of this finger parallel to its axis, for example by means of a suitable electromagnetic apparatus.

According to a preferred embodiment, the retractibility of the finger **7***a* is obtained by a lateral pivoting movement of arm **7** perpendicular to the direction of pivoting of arm **7** between the reels.

For effecting this lateral pivoting movement the arm **7** is pivotably connected at a suitable point remote from its free extremity, by means of pointed screws **19** (FIG. **8**). These screws are secured to two opposed walls **20***a* of a tubular support **20**; the support **20** is fixed to the shaft **8.**

The pivoting of the arm **7** is controlled by an electromagnetic apparatus constituted by an electromagnet **21** carried by the support **20** and capable of applying an attraction force on the front extremity of the arm **7** when it is energized.

One can advantageously use in this respect an electromagnet whose coils are carried by the support **20** and whose movable core is coupled to the arm **7.**

A spring **22** is interposed between the support **20** and particularly, between the edge of a solid member integral with said support and the arm **7** at a location rearwardly of the axis of articulation **19,** to automatically return said arm to its normal rest position when the attraction force applied by the electromagnet **21** is terminated.

A screw **23** is mounted in the front wall of the support **20** and rests against the front face of the inner portion of the arm **7** to regulate the degree of pivoting of the arm. It is to be understood that arm **7** has sufficient lateral clearance in support **20** to enable arm **7** to undergo sufficient lateral displacement to withdraw the finger **7***a* from the loop cavities. To facilitate its extraction from loop cavities **3***a*, the finger **7***a* has a conical form. The finger is constituted by a roller mounted for free rotation on an axle **7***j*.

As was previously indicated groups of rollers each including at least one stretcher and compensator roller **9** or **10** are disposed, respectively upstream and downstream of the projector P.

These rollers serve the function of providing a reserve loop of a length of film sufficient to avoid tension between the film handling apparatus and the projector or for absorbing supplementary lengths fed by the projector or by the film handling apparatus.

In the particular application of the apparatus for cinematographic projection, the roller **10,** in forming a compensating loop b_3 of film avoids tension in the length b_2 coming from the projector when the last winding of film is unwound by the supply reel, during the time necessary to stop the take-up reel and allow it to undergo free rotation in the opposite direction.

The roller **9** principally serves to absorb additional length of film resulting from the liberation of the last winding of film unwound by the supply reel in constituting a compensating loop or reserve of film b_4. (FIGS. **2** and **3**)

In order to provide a more substantial length to the compensating loops b_3 and b_4, there can be employed more than one stretching and compensator roller for each of the film reserves respectively at the exit and at the entrance of the projector. The roller group disposed at the exit of the film handling apparatus and upstream of the projector comprises for example, three upper rollers **9***a*–**9***b*–**9***c* (FIG. **1**) each mounted for free rotation on fixed axles supported by a bracket **16***b* fixed to the upper part of the frame **16** of the installation and two lower stretcher and compensator rollers **9**–**9**′. The rollers **9**–**9**′ are carried by a support **28** slidingly mounted on a guiding means, for example, constituted by two vertical columns **29,** fixed at their opposite extremities, on the one hand to the bracket **16***b* and on the other hand to a solid foot of the base of the frame of the installation.

As can be seen in FIG. **20,** the rollers **9**–**9**′ are coupled by a flexible member **30** advantageously constituted by a cable spring wound in a circular groove constituting a pulley **31** at the rear portion of the rollers. This arrangement permits braking the descent of the assembly of the support **28** and the rollers **9**–**9**′ at the time of liberation of the last winding from the supply or discharge reel.

The support **28** carries a bar or contact member **28***a* whose function will be explained later.

The axes of the upper fixed rollers **9***a*–**9***c* preferably have an adjustable orientation.

The group of rollers disposed at the entrance of the film handling apparatus and downstream of the projector comprises for example, four upper rollers **10***a*–**10***b*–**10***c*–**10***d* (FIG. **1**) freely mounted for rotation on fixed axles carried by a bracket **16***d* fixed at the median part of the frame of the installation and three movable lower stretcher and compensator rollers **10**–**10**′–**10**″.

According to a characteristic feature, the installation is provided with means for braking the speed of winding of the take-up reel if the tension of the length of the band coming from the projector becomes too great. Such means is controlled by the position of the stretcher and compensator rollers **10, 10**′, **10**″ disposed at the entrance of the film handling apparatus downstream of the projector.

According to one embodiment, one or more rollers **10, 10**′ and **10**″ are freely mounted for rotation at the extremity of a lever **24** (FIG. **19**) of a braking apparatus for the film. The lever **24** is pivotably connected at its opposite extremity on an axle **25** mounted in a vertical wall of the frame, as seen in FIG. **19.**

A belt **27** is applied on a pulley fixed in rotation on the lower reel **2** and one extremity of the belt is secured to the wall of the frame and the other extremity to lever **24.** The belt permits the application of friction to the pulley **26** when the lever **24** is pivoted upwardly.

With reference to FIG. **3** wherein the lower reel **2** is the take-up reel, it is understood that as soon as it produces a tension in the film length b_2 coming from the projector exceeding a normal value, this tension urges the roller **10** to move upwardly to diminish the length of the compensating loop b_3 between the fixed rollers **10***a*–**10***b*.

The ascending movement of the roller **10** corresponds to a pivoting movement of the lever **24** of the braking apparatus to apply a braking force on the pulley **26** to slow down the rotation of the lower reel **2.** The more the length of the compensating loop b_3 diminishes, the greater the value of the braking force.

This same apparatus provides for the application of a braking action on the upper reel when this becomes the take-up reel. As can be seen in FIG. **2,** in this situation, the length b_1 going to the projector is unwound from the lower reel which is now the supply reel, whereas the length b_2 coming from the projector is

wound on the upper reel **1**. Simultaneously, a second length b_5 unwinds from the lower reel and is wound on the upper reel. Under these conditions, if the tension of the length b_2 coming from the projector becomes too great, the braking apparatus acts, as already indicated, to slow the rotation of the lower reel which through the intermediary of the length b_5 of film, applies an equivalent braking action on the upper reel.

According to a preferred construction, however, the rollers **10–10′–10″** for the formation of the film loop b_3 are carried by a pivoting lever which can act on a disconnecting apparatus for the drive means of each of the reels.

The rollers **10–10′–10″** are, for example, mounted at the extremity of a lever **32** pivotably connected to the frame of the installation, in proximity to the axle of the lower reel.

When the length of the loop b_3 of the film at the entrance of the handling apparatus is less than a preestablished normal value, as ascending pivoting movement of the lever **32** acts on an apparatus for disengaging the drive means of the take-up reel.

Such means is illustrated in FIGS. **16** to **18** and comprises for each of the reels, a pulley **33** mounted freely rotatable on the axle **14** of the reel and on which pulley a belt is wound coupled to the drive pulley of the motor for driving the reel.

A clutch plate **35** is fixed on the axle **14** and consequently the axle **14** is driven from the drive motor by the pressure of the pulley **33** on said clutch plate.

The cooperating faces of the pulley **33** and of the plate **35** are provided, in known manner, with a lining of any suitable type of frictional material.

The pressure of the pulley **33** against the plate **35** is obtained by means of a clutch member **36** comprising a socket **36***a* slidingly mounted on the shaft **14** and a plate **36***b* of U-shape in which is lodged an axially movable nut **37** fixed in rotation by the walls of plate **36***b*. A ring **36***c* having a low coefficient of friction is advantageously interposed between the extremity of the socket **36***a* and the pulley **33**.

The nut **37** is mounted on a screw **38** having a large pitch and axially fixed such that its rotation causes longitudinal movement of the nut.

The screws **38** and the axle **14** of the reels are, for example, rotatably mounted in a brace element **39** coupled to the vertical partition **16***a* of the frame of the installation, the brace element comprising a bearing **39***a* carrying the screw **38** and a bearing **39***b* for the axle **14**.

Weak recall springs **40** are mounted on stems **41** and bear against an edge of the plate **36***b* and maintain the clutch member **36** in a position of equilibrium.

The plate member **36***b* slides on the shoulder of the element **39** carrying the bearings **39***b*.

The screw **38** is rigidly coupled to a lever **42** (lower reel) or **42′** (upper reel) by being fixed at one of its extremities by a nut **43** on a carrier whose outer surface is smooth and rides in bearing **39***a*.

As seen in FIG. **9**, levers **42–42′** are coupled to respective ends of an articulated connecting rod **44**.

The lever **42** of the disengaging apparatus of the lower reel has a greater length than that of the lever **42′** of the disengaging apparatus of the upper reel.

Additionally, the free extremity of the lever **42** carries a laterally transported joint constituted by a roller **42***a* resting on lever **32**. This roller is adapted to follow the lever **32** during ascending movements of lever **32**. The lever **32** can be advantageously freely articulated, on a shoulder constituted by the external surface of the bearing **39***a*.

When the reserve of film b_3 decreases below a preestablished normal value, for example, due to an excessive winding speed of the take-up reel the ascending pivoting movement of the lever **32** produces pivoting of lever **42** which transmits a rotation movement to the screw **38** which causes axial translation of the nut **37** which is displaced from the pulley **33**. The clutch member **36** is now released from the pulley which is now loose on the axle **14**. The take-up reel is thus no longer driven.

As the projector continues to feed film, the reserve loop of film b_3 is increased and the lever **32** is again lowered permitting the descent by gravity of lever **42**.

As the lever **42** again assumes its initial position, the pulley **33** is again pressed against the clutch plate **35** and the drive of the take-up reel is again effected.

It is to be noted that this action also concerns the lower reel as well as the upper reel as the lever **42′** is coupled to the lever **42** by the connecting rod **44**.

It is noted that the group of rollers **9–9′–9***a***–9***b***–9***c* are disposed in a vertical plane situated at the rear of the vertical plane containing the rollers **10–10′–10″–10***a***–10***b***–10***c***–10***d*.

According to an important characteristic feature of the invention, the control of the drive motor (not shown in the drawings) of each of the reels and the pivoting movements of the feed arm **7** from a rest position to a feed position and vice versa is effected by the intermediary of a selector apparatus illustrated schematically in FIGS. **10** and **11**.

The selector apparatus comprises an electric motor **45** which drives, via a reducer **46**, a shaft **48** on which are mounted cams **49–50** cooperating with respective microswitches **51–52**. The cams **49** and **50** have an identical profile and an inverse disposition. They present on their peripheries, respective notches **49***a***–50***a*.

As soon as the roller on a control arm of one of the microswitches **51–52** falls into the notch of the associated cam, it causes closing of the circuit feeding the drive motor of the reels and the energization of this motor.

In the following description it will be considered that the cam **49** and the microswitch **51** control the operation of the drive motor for the upper reel **1**, whereas the cam **50** and the microswitch **52** control the operation of the drive motor of the lower reel **2**.

The means effecting the pivotal movement of the feed arm **7** from a rest position to a feed position and vice versa, is constituted by a crank plate **53** secured on the shaft **48** and coupled, by the intermediary of a connecting rod **54** to the arm **7**, preferably by means of a second crank plate **55** secured to the rear extremity of the shaft **8** of the feed arm.

The rod **54** is articulated at its opposite extremities on respective crank pins **53***a* and **55***a* on the crank plates **53** and **55**.

According to another characteristic feature, a cam **56** is also secured on the shaft **48** and cooperates with a microswitch **57** to stop the motor **45** following the four positions A, B, C, D of the arm **7** as follows:

A — rest position in preparation for feeding the lower reel;

B — a feed position for the lower reel;

C — a rest position in preparation for feeding the upper reel;

D — a feed position for the upper reel.

The cam **56** has four notches A'–B'–C'–D' at its periphery corresponding, respectively to each of the positions as indicated above.

It is observed that the feed positions B and D are situated between the hubs **3** of reels **1** and **2.**

The starting of the motor **45** of the selector apparatus to move the arm **7** from the rest positions to the feed positions is controlled by the microswitch **12** lodged in the hubs **3** of the reels and operative when the last winding is unwound from the reel serving as the supply reel.

However, a time delay apparatus delays the starting of the motor **45** of the selector apparatus and consequently the pivoting of the arm **7** from a rest position to a feed position for the empty reel.

This apparatus is constituted by a microswitch **58** carried by the frame of the installation and disposed in the electric feed circuit of the motor of the selector apparatus. The switch **58** is normally in open position and is actuated to closed position by the solid contact member **28***a* of the movable assembly **28 – 9–9'** of the film reserve loop b_4 (disposed at the exit of the film handling apparatus) when this assembly is raised.

Means are provided to permit a rocking of the arm **7** when it reaches the feed position of a reel, for a short period of time for the winding of a few turns of film on the hub **3** of the reel.

To this effect, the arm **7** comprises two articulated elements **7***b*, **7***c* which are relatively pivotable in a vertical plane, i.e. in its plane of pivotal movement between the charge positions B and D.

The element **7***b* carries, in slidable manner the feed finger **7***a* at its free extremity, and element **7***b* is articulated at its opposite extremity, by means of an axle **7***d* to a shell **7***e*, in the form of a sector which is a part of the second element **7***c*.

The shell **7***e* is laterally closed at **7***f* and **7***g*, such as to limit the amplitude of pivoting of the element **7***b* with respect to the element **7***c*, said elements being advantageously constituted by tubes of suitable section.

In a rest position, the element **7***b* reposes on the lower wall **7***g* of the shell **7***e*.

A fixed spring **7***h* has one end connected to the internal extremity of the element **7***b* and the other end connected to an axle **7***i* lodged in the element **7***c*, at a judicious distance from said extremity, cooperating with respect to the position of rest of element **7***b*.

As seen in FIGS. **14** and **15,** the feed finger **7***a* is carried on a stem **7***j* rigid with a slide **7***k* mounted for longitudinal displacement in tube **7***b*, the tube **7***b* having a longitudinal slot **7***m* in which the stem is movably disposed.

In the rest position, the finger **7***a* and the slide **7***k* are at the extremity of element **7***b*, i.e. at the extremity of the arm **7.** An elastic means acts to urge the finger **7***a* and the slide **7***k* to this position.

Such elastic means comprises a traction spring **7***n* fixed at one end to a closure wall **7***o* at the extremity of tube **7***b* and at the other end to a projection **7***p* at the back end of the slide **7***k*. A longitudinal groove **7***q* in the slide **7***k* allows passage of spring **7***n*.

According to another feature, a cam **59** is also secured on shaft **48** and cooperates with a microswitch **60** to control, via a time delay T_1 the start of the motor **45** of the selector apparatus when the arm **7** is in one of the feed positions B or D.

To this end, the cam **59** is provided with two diametrically opposed notches **59***a* at its periphery. The notches **59***a* have a symmetrical disposition relative to those of notches B' and D' of cam **56.**

When the roller of the control arm of switch **60** drops into one of the notches **59***a* a signal is sent to the selector motor **45** via the time delay T_1. Simultaneously, a signal is sent via a second time delay T_2 to the electromagnetic apparatus **21** controlling the lateral displacement of the arm **7** and/or retraction of the feed finger **7***a*. The time delay circuit T_2 is adjusted to a lower time delay value than circuit T_1. The time delays are constituted by any suitable conventional device such as a time delay relay.

Additionally, a remote control circuit breaker T_3 with time delay or similar apparatus is connected between circuit T_2 and the electromagnetic apparatus **21.**

The time delay for breaker T_3 is released when the action of the circuit T_2 has ended. The time delay of circuit T_3 is greater than the difference between the time delays of circuits T_1 and T_2.

The circuit breaker T_3 operates to prevent the pivoting of arm **7** in a direction reverse to its preceding movement to a rest position.

FIG. **11** is a diagrammatic illustration showing the principal elements of the apparatus and the circuit diagram thereof for operating as described above.

Reference character S_1 illustrates a safety switch disposed on the upper part of the frame of the apparatus to halt the operation thereof. It is activated by contact element **28***a* when the length of film loop b_4 becomes lower than a critical minimum value. Reference character S_2 illustrates a second safety switch disposed at the base of the frame of the apparatus and is activated by contact element **28***a* when a breakage in the film occurs between the feed reel and the projector to cause the support **28** of the rollers **9–9'** to drop. Another safety switch can be disposed at the lower portion of the frame to be activated by the lever **32** in case of breakage of the film between the projector and the take-up reel, said lever **32** then being pivotably displaced. Reference characters RL_1, RL_2 and RL_3 respectively designate the coils of the drive motors of the upper reel, the lower reel and the motor **45** of the selector apparatus.

There will next be explained hereafter the operation of the installation just described with reference to FIGS. **22–27***a*.

With reference to FIGS. **22** and **22***a*, the upper reel **1** is the take-up reel. The reel **1** simultaneously receives one length of film b_2 from projector P and a second length b_5 being unwound from the lower reel **2** from which is simultaneously unwound film length b_1 going to the projector.

The arm **7** and finger **7***a* are in rest position A in which the finger is disposed on the side of length b_2 remote from reel **2** which serves as the supply reel. In this position:

the roller of the control arm of switch **51** is situated at the rear extremity of the notch **49***a* of cam **49**;

the roller of the control arm of switch **52** is situated in contact with the inoperative portion of the periphery of cam **50** at a distance from the front extremity of the notch **50***a* of this cam, said distance being equal to the value of the arc A^1 and B^1;

the roller of the control arm of switch **57** is disposed in notch A^1 of cam **56**; and

the roller of the control arm of switch **60** is in contact with the inoperative periphery of cam **59.**

When the last turn of film (constituted by two superimposed lengths) is unwound from the lower supply reel, the switch **12** lodged in hub **3** of this reel is closed. However, no signal is sent to the selector motor **45** because the switch **58** of the delay circuit is open during the necessary time for the absorption in loop b_4 of the extra film coming from a loop b_6 formed by the last turn, unwound from the lower supply reel. The increase of the length of the film in the reserve or loop b_4 results in the descent of the assembly of plate **28** and rollers **9, 9'**. The length accrued in the reserve loop decreases as a result of the continued feed of film length b_1 to the projector while the reel **1** continues in rotation as shown in FIG. **23.** The film reserve continues to diminish causing ascent of plate **28.** When the contact element **28***a* on plate **28** reaches switch **58** activate the same, motor **45** of the selector apparatus is energized. The shaft **48** is driven to carry with it all the elements which are supported thereon in a rotational movement as shown by the arrow in FIG. **24***a* over a distance determined by the angular distance of the arc between notches A^1 and B^1 of the cam **56.** The arm **7** is pivotably moved to feed position B (FIG. **24**) entraining, through the intermediary of finger **7***a*, the film length b_2 situated between the upper reel and the exit of the projector. The rotation of shaft **48** causes deenergization of the drive motor of the upper reel when the roller of the control arm of switch **51** leaves notch **49***a* of cam **49.** The motor of the lower reel is started when the control arm of switch **52** drops into notch **50***a* of cam **50** i.e. when the arm **7** arrives at feed position B. When the control arm of switch **57** falls into the following notch B^1 of cam **56** (corresponding to feed position B), the motor **45** is stopped. At the same time, the control arm of switch **60** falls into a notch **59***a* of cam **59** and closes the time delay circuit T_1 controlling restart of motor **45** and the time delay circuit T_2 controlling the pivoting of arm **7** and/or retraction of feed finger **7***a*. The time delay circuit T_2 is adjusted for a time delay in a range less than 2 sec up to the time delay of circuit T_1.

During the time of arrest of the control selector by the time delay circuit T_1, the film is maintained in a loop cavity **3***a* of the hub of the lower reel by the finger **7***a* of the feed arm while simultaneously winding two superposed lengths of the film thereon. One of the lengths comes from the projector, while the second b_7 is fed from the upper reel, the latter reel unwinding a second length b_1 to the projector. It is understood that the finger **7***a* follows the circular movement of the loop cavity of the reel in which it is lodged, which produces a rocking of the arm **7** as shown in dotted lines in FIG. **24.** Such rocking is possible by the construction of the arm **7** in two articulated parts **7***b* and **7***c*.

When the action of the circuit T_2 has terminated, the electromagnet **21** is energized to effect rocking of arm **7** and/or retraction of finger **7***a* from the loop cavity in which it is lodged. Simultaneously, the delay of the circuit-breaker T_3 is activated and it is adjusted to permit, several seconds after finish of the duration of the delay of circuit T_1, the reverse rocking of arm **7** towards rest position and opening the feed circuit of the electromagnet. At the end of operation of the time delay circuit T_1, whose delay corresponds to the winding of a sufficient number of turns on the take-up reel to insure retention thereon, a signal is sent to the motor **45** to restart the same. The different elements secured on shaft **48** are again entrained in rotation through an angular distance corresponding to the arc between notches B^1 and C^1 of cam **56.** This displacement assures pivoting of arm **7** to a rest position C. At the end of the duration of the time delay of circuitbreaker T_3, the latter permits the rocking of arm **7,** under the action of elastic means **22,** into the rest position C in which finger **7***a* is placed on the side of the film remote from supply reel **1** as shown in FIGS. **25** and **25***a*. In this position:

arm **7** is in rest position C;

the arm of switch **57** is in notch C^1 of cam **56;**

the arm of switch **51** is in contact with the inoperative portion of the periphery of cam **49** at a distance from the front extremity of the notch **49***a* corresponding to the value of the arc between C^1 and D^1;

the arm of switch **52** is disposed in the notch **50***a* of cam **50** at the rear extremity thereof; and

the arm of switch **60** is in contact with the inoperative portion of the periphery of cam **59.**

The reel **2** simultaneously winds one length of film coming from the projector and a second length from the upper reel, the latter feeding a second length to the projector.

The diameter of the film wound on the take-up reel increases while the diameter of the film wound on the supply reel decreases.

This produces an increase of the film loop b_4 causing a slight descent of support **28** sufficient to eliminate contact of member **28***a* on switch **58.**

When the last turn is unwound (constituted by two superposed film lengths) from the upper supply reel **1** (FIG. **25**) the switch **12** lodged in the hub of this reel is closed.

However, no signal is sent to motor **45** since the switch **58** remains open during the time necessary for the absorption of the extra length in the loop b_4 due to the supply of the length of a loop b_8 constituted by the last turn unwound from the upper reel **1.**

As noted previously, the increase of the length of loop b_4 is accompanied by descent of the assembly of support **28** and rollers **9** and 9^1. The length of loop b_4 then decreases since the length b1 continues its regular feed to the projector while the lower reel continues its rotation (FIG. **26**). The absorption of the extra length of loop b_4 causes ascent of the assembly of support **28** and rollers **9** and 9^1. Then the contact member **28***a* acts on switch **58,** and a signal is fed to motor **45** which is restarted and effects a new displacement to the elements secured on shaft **48.** The amplitude of the rotative movement of the shaft is determined by the angular distance of the arc between notches C^1 and D^1 of the cam **56.** The arm **7** is pivoted to feed position D to cause finger **7***a* to entrain against the hub of the upper reel the film length b_2 disposed between the lower reel and the downstream end of the projector (FIG. **27**).

The rotation of shaft **48** causes at the beginning of its movement the arrest of the drive motor of the lower reel at the time when the control arm of switch **52** escapes from notch **50***a* of cam **50.** The drive motor of the upper reel is re-started in opposite direction when the control arm of switch **51** falls into notch **49***a* of cam **49,** i.e. at the time when arm **7** arrives at feed position D. When the control arm of switch **57** falls in notch D^1 of cam **56,** the motor **45** is halted (FIG. **27***a*). At the

same time, the control arm of switch **60** falls in notch **59***a* of cam **59** and closes time delay circuit T_1 to restart motor **45** and circuit T_2 in the feed circuit of the electromagnet **21** controlling the pivoting of the arm and/or retraction of the finger **7***a*.

During the time of arrest of the selector controlled by the circuit T_1, the film is maintained in a loop cavity of hub **3** of the upper reel by the finger **7***a* of feed arm **7** and simultaneously two superposed lengths of film are wound on this hub. One of these lengths comes from the projector while the second b_9 is fed from the lower reel from which is also unwound a second length b_1 which goes to the projector. As previously indicated, the construction of the arm of two pivotably connected elements allows a rocking of element **7***b* carrying the finger **7***a* by reason that the finger lodged in a loop cavity of the upper reel undergoes a circular movement during the feeding of the reel (FIG. **27**).

At the time of cessation of the delay of circuit T_2 a signal is sent to the electromagnet **21** which causes rocking of arm **7** and/or retraction of the finger **7***a* from the loop cavity in which it is placed.

Simultaneously, a signal is sent to the circuit T_3. At the end of the action of circuit T_1, a signal is fed to motor **45** which restarts and produces a new displacement of the different elements carried by shaft **48**. When the control arm of switch **57** falls into the notch A^1 of cam **56**, the motor **45** is stopped and the different cams secured on shaft **48** re-assume the position illustrated in FIG. **22***a* which was the initial position described.

After rotation of shaft **48** by an angular amount corresponding to the distance between notches D^1 and A^1 of cam **56**, the arm **7** pivots to rest position A (FIG. **22**). At the end of the duration of the delay of circuit T_3, the latter permits reverse rocking of arm **7** (under the action of elastic recall means **22**) in rest position A in which finger **7***a* is placed on the side of the film remote from supply reel **2**. The operation cycle can then be repeated in the described manner; the cycle being susceptible of repetition as many times as desired as a function of the nature of the film and the apparatus for utilization or treatment.

In considering the application of the apparatus to cinematic projectors, it is understood that after complete passage of the program through the projector, a new showing can be made without stopping the projector and in all cases without any manual manipulations for rewinding or refeeding.

Similarly, the advance of the film can be interrupted at any desired time, for example, during an intermission in the program, and the resumption of projection can be effected at the end thereof without any preliminary intervention.

A means can be advantageously provided to brake the speed of rotation of the supply reel which increases in proportion to the reduction of the diameter of the film.

To this end, a plate **61** supporting a freely rotatable wheel **62** or other unidirectional entrainment means can be mounted on the shaft **14** of each reel. The plate **61** cooperates with a fixed friction member **63** carried by the frame **16** of the installation and the plate **61** is entrained in rotation in the direction of the arrow in FIG. **21** through the intermediary of the free wheel **62** solely when the reel serves as the supply reel.

In the opposite direction, when the reel is the take-up reel, the rotation of shaft **14** is not transmitted to plate **61** which therefore is immobilized by the friction means **63** which is, for example, constituted by a shell whose internal faces are provided with a suitable friction lining.

While the invention has been described with reference to specific embodiments thereof, it will be understood that numerous variations and modifications can be made within the scope and spirit of the invention as defined in the appended claims.

I claim:

1. Apparatus for the continuous winding and unwinding of an endless band through a utilization device, said apparatus comprising a first rotatable supply reel and a second rotatable take-up reel, each of said reels having a hub reversible drive means for said reels, means arraying said reels with respect to the utilization device such that two lengths of the band are wound in superposition on both reels and extend between both reels and the utilization device, one length on said second reel extending to the first reel, the other length on said second reel extending to said utilization device and traversing the same, said first reel receiving the length of the band issuing from the utilization device, said band forming a closed travel loop between said reels and the utilization device, one of said reels being external thereof; and feed means for placing against the second reel the length of band extending between the utilization device and said first reel when said second reel is empty whereby by reversing the direction of rotation of the reels the first reel can now become the take-up reel and the second reel the supply reel, said feed means including a feed arm pivotably mounted between said reels and engagement means on said feed arm for engaging the band to place the same against said second reel when the latter is empty.

2. Apparatus as claimed in claim **1** wherein said reels are disposed vertically above one another.

3. Apparatus as claimed in claim **2** wherein the reel disposed in the interior of the loop is the upper reel.

4. Apparatus as claimed in claim **1** wherein said engagement means comprises a retractable finger adjustably mounted on said arm for longitudinal displacement therealong.

5. Apparatus as claimed in claim **4** wherein said engagement means further comprises spring means acting on said arm and finger for urging said finger to a rest position out of contact with said band.

6. Apparatus as claimed in claim **5** wherein each reel includes a hub having a notch in the periphery thereof in which the band is introduced as a loop by said finger, and a cheek with a curved ramp positioned to guide the finger to the notch in said hub.

7. Apparatus as claimed in claim **6** wherein one cheek of each said reel further comprises at least one blade having front and rear edges with two surfaces of opposite inclination intersecting at the tip of the blade, said front edge defining said curved ramp.

8. Apparatus as claimed in claim **7** wherein said curved ramp extends directly into said notch in the hub.

9. Apparatus as claimed in claim **5** wherein said feed arm includes means for pivotal movement thereof in a direction perpendicular to the plane of pivotal movement between said reels to effect retraction of said finger from the hubs of said reels.

10. Apparatus as claimed in claim 9 comprising control means including an electromagnet for moving said arm from said rest position to active feed positions in contact with the hubs of said reels.

11. Apparatus as claimed in claim 5 wherein said finger has a conical shape.

12. Apparatus as claimed in claim 5 wherein said utilization device has an inlet and an outlet, said apparatus further comprising guide means including at least one movable guide roller at said inlet and outlet of the utilization device for forming respective loops of compensating and reserve amounts of said band.

13. Apparatus as claimed in claim 12 wherein one of said guide means is disposed in the region of the periphery of the reel disposed in the interior of the band loop and upstream of the utilization device.

14. Apparatus as claimed in claim 5 wherein said drive means drives said reels in respectively opposite directions, said reels rolling on imaginary planes passing through the pivot axis of said feed arm in a direction away from said axis.

15. Apparatus as claimed in claim 5 comprising a selector including control means for controlling the movement of said feed arm between a rest position between said reels and two active feed positions in contact with the respective reels, means for halting the drive means of the take-up reel and activating the drive means of the supply reel when the latter is empty, means for maintaining the arm in feed position on the hub of the take-up reel for a sufficient time to wind a number of turns of band on the take-up reel so that when the arm is removed the band will continue to be wound on the take-up reel, and means for rocking said feed arm for retracting said finger.

16. Apparatus as claimed in claim 15 wherein said control means of said selector comprise a shaft, cams fixed on said shaft for rotation therewith, and switches controlled by said cams and in turn controlling the drive means and feed arm.

17. Apparatus as claimed in claim 16 wherein said means for controlling movement of said feed arm comprises a crank plate secured on said shaft, and a crank shaft connected to said plate and coupled to said feed arm to move the same.

18. Apparatus as claimed in claim 16 wherein one of said cams has four operative positions, two corresponding to feed positions for the respective reels, the other two to rest positions.

19. Apparatus as claimed in claim 16 wherein the selector includes a motor for driving said shaft and delay means for delaying the starting of said motor and pivoting of the arm from the rest position, when the last turn is unwound from the supply reel.

20. Apparatus as claimed in claim 19 wherein said delay means comprises a switch controlling energization of said motor, and means for closing said switch when a reserve of said band at the inlet to said utilization device has absorbed the length of band coming from the last turn thereof on the supply reel.

21. Apparatus as claimed in claim 5 comprising means for permitting rocking of said arm in the feed position thereof as the band is wound on the reel.

22. Apparatus as claimed in claim 21 wherein said means permitting rocking of said arm is constituted by a construction wherein said arm includes two pivotably connected parts, one carrying said finger.

23. Apparatus as claimed in claim 19 comprising a delay circuit interposed between said motor and one of said cams so as to be operative when the arm is in a feed position.

24. Apparatus as claimed in claim 23 comprising a switch controlled by said one cam and connected to said delay circuit.

25. Apparatus as claimed in claim 23 comprising a second delay circuit controlling operation of said arm and having a time delay less than the first delay circuit and closed at the same time thereas.

26. Apparatus as claimed in claim 25 comprising a circuit breaker with a time delay connected to the second delay circuit, to be activated thereby at the cessation of its time delay restriction, reverse rocking of the arm for retraction of the finger in said rest position.

27. Apparatus as claimed in claim 12 comprising means for disconnecting said drive means from the take-up reel when the band length coming from the utilization device is subjected to excessive tension, and means for sensing said excessive tension including a movable assembly carrying said guide means and subject to displacement when said band is subject to said excessive tension.

28. Apparatus as claimed in claim 27 wherein the sensing means comprises a pivotal level, said guide means including rollers mounted on said pivotal level, said lever including means for acting on the drive means to disconnect the same.

29. Apparatus as claimed in claim 28 wherein said disconnecting means includes a control lever for each reel, and a connecting rod pivotably connected to the control levers of both reels.

30. Apparatus as claimed in claim 29 wherein said control lever includes a roller at the free end thereof, said roller resting on said movable assembly to follow movements thereof.

31. Apparatus as claimed in claim 12 comprising means for braking said drive means for the take-up reel when the band length coming from the utilization device is subjected to excessive tension, and means for sensing said excessive tension including a movable assembly carrying said guide means and subject to displacement when said band is subject to said excessive tension.

32. Apparatus as claimed in claim 31 wherein the sensing means comprises a pivotal lever, said guide means including rollers mounted on said pivotal lever, said lever including means for acting on the drive means to brake the same.

33. Apparatus as claimed in claim 13 wherein said guide means comprises a support for said guide roller and vertical columns guidably mounting said support for ascending and descending movements.

34. Apparatus as claimed in claim 33 comprising means for braking descent of said support for the guide roller.

35. Apparatus as claimed in claim 34 wherein said guide means includes a second roller and said means for braking descent of said support comprises an endless cable wound in grooves provided in said rollers of the guide means.

36. Apparatus as claimed in claim 5 wherein said arm is tubular, said feed means further comprising a slide member telescopically mounted on said arm and carrying said finger, said arm having a slot, a boss integral with said finger and slidable in said slot, and a traction

spring connected to said arm and to said slide member permitting return of said finger to rest position, said slide member being provided with a longitudinal passage for said spring.

37. Apparatus as claimed in claim **12** comprising safety switches positioned in the path of the guide means for stopping the drive means if said guide means travels beyond established limits.

38. Apparatus as claimed in claim **12** comprising a safety switch below said guide means for being actuated by said guide means upon fall thereof due to band breakage between the utilization device and the take-up reel.

39. Apparatus as claimed in claim **1** comprising braking means for exerting a braking force on the supply reel.

40. Apparatus as claimed in claim **39** wherein said braking means comprises a plate including one-way clutch means, said plate being coupled to said supply reel via said one-way clutch means when the reel is driven in the direction of rotation in which it serves as the supply reel, and a friction brake acting on said plate to oppose rotation thereof.

41. Apparatus as claimed in claim **7** wherein said one cheek includes three of said blades equally spaced on said hub.

42. Apparatus for the continuous winding and unwinding of an endless band through a utilization device, said apparatus comprising a first rotatable supply reel and a second rotatable take-up reel, reversible drive means for said reels each of said reels having a hub, means arraying said reels with respect to the utilization device such that two lengths of the band are wound in superposition on both reels and extend between both reels and the utilization device, one length of said second reel extending to the first reel, the other length on said second reel extending to said utilization device and traversing the same, said first reel receiving the length of the band issuing from the utilization device, said band forming a closed travel loop between said reels and the utilization device, one of said reels being in the interior of said loop, the other reel being external thereof; feed means for placing against the second reel the length of band extending between the utilization device and said first reel when said second reel is empty whereby by reversing the direction of rotation of the reels the first reel can now become the take-up reel and the second reel the supply reel, electromagnetic means coupled to said feed means and said drive means for controlling operation thereof, and a switch means for operating the electromagnetic means, said switch means including a control contact mounted in said hub of each reel.

43. Apparatus as claimed in claim **43** wherein said control contact comprises a lever mounted in a slot provided in said hub and a spring urging said lever outwardly from said slot at the periphery of said hub.

44. Apparatus as claimed in claim **43** wherein said lever is of T-shape and has an upper branch extending parallel to the axis of rotation of the hub.

45. Apparatus as claimed in claim **42** wherein said drive means includes a plate driven with each said reel and including a boss extending into a groove provided in said hub, said switch means including a switch carried by said hub and controlled by said control contact, and a circular collector mounted on said plate and connected to said boss such that electrical connection is established to said switch by the engagement of said boss in said groove, said collector being connected to said electromagnetic means.

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