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Yamada

[11] **3,771,745**

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[54] **FILM FEED MECHANISM FOR MOVING THE FILM IN NORMAL AND REVERSE DIRECTIONS**

[75] Inventor: **Hiroshi Yamada,** Ichikawa, Japan

[73] Assignee: **Kabushiki Kaisha Ricoh,** Tokyo, Japan

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **242/204,** 274/11 D

[51] **Int. Cl.** **B11b 15/32,** G03b 1/04, G11b 3/00

[58] **Field of Search** ..... 242/67.4, 201–204; 274/4 D, 11 D

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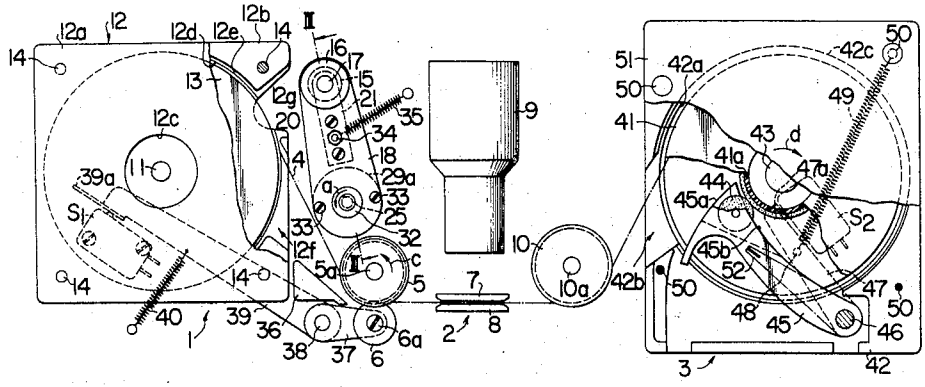
Primary Examiner—Leonard D. Christian

Attorney—John J. McGlew et al.

[57] **ABSTRACT**

The mechanism is arranged to move film between a film supply reel and a film take-up reel each mounted on and rotatable with a respective shaft. A respective drive wheel is mounted on each shaft, and a one-way clutch is interposed between each drive wheel and its associated shaft, with reversible driving means being operatively connected to both drive wheels to rotate the same simultaneously in the same selected direction. Each one-way clutch couples its drive wheel to its shaft only when its drive wheel is driven in a direction to wind film on the associated reel, and disconnects its drive wheel from its shaft when its drive wheel is driven in the direction to unwind film from the associated reel. A respective brake wheel is mounted on each shaft and is engaged by an associated brake shoe, and a second one-way clutch is interposed between each brake wheel and its associated shaft. The one-way clutches associated with each brake wheel are effective to brake the associated shaft when the latter is being rotated in an unwinding direction, and to uncouple the brake wheel from the shaft when the latter is being driven in a film winding direction.

9 Claims, 7 Drawing Figures



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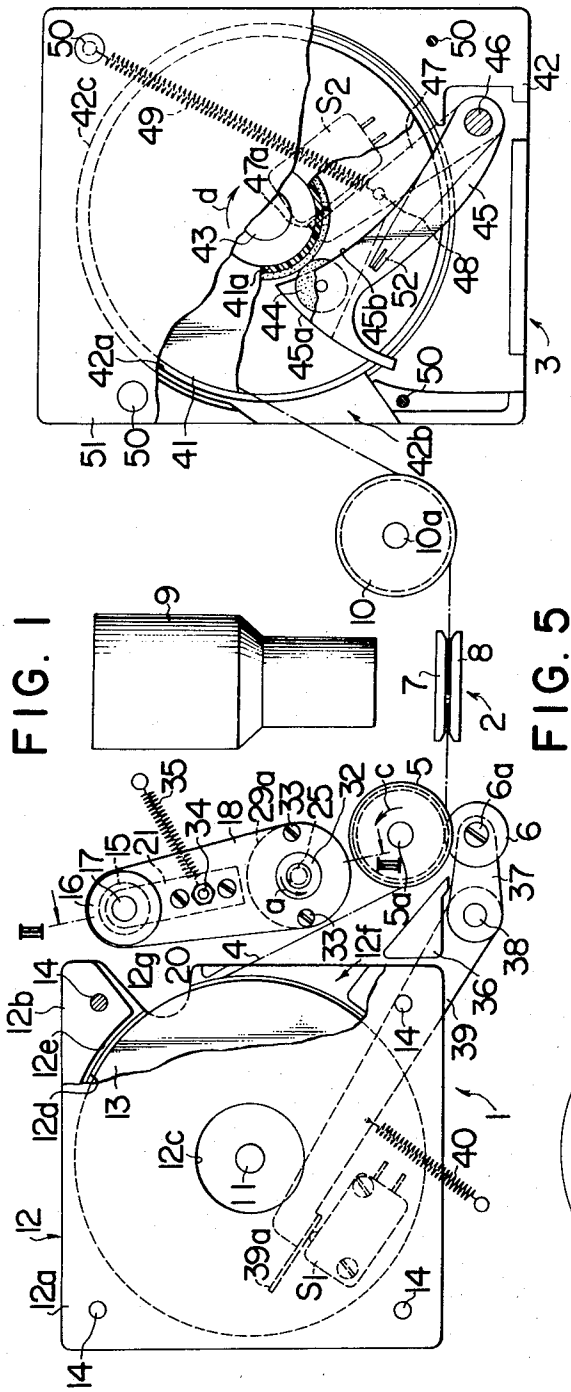


FIG. 1

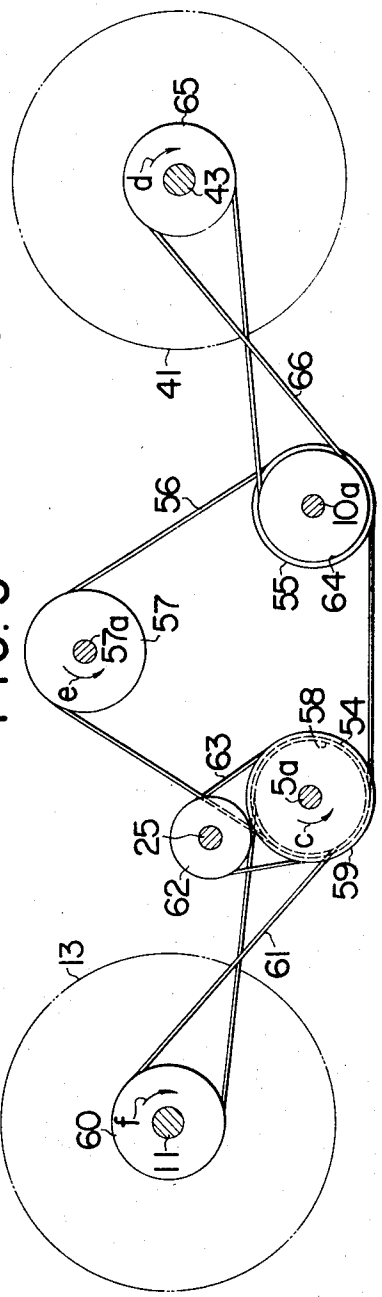


FIG. 5

INVENTOR
HIROSHI YAMADA

BY John J. McGlew

ATTORNEY

FIG. 2

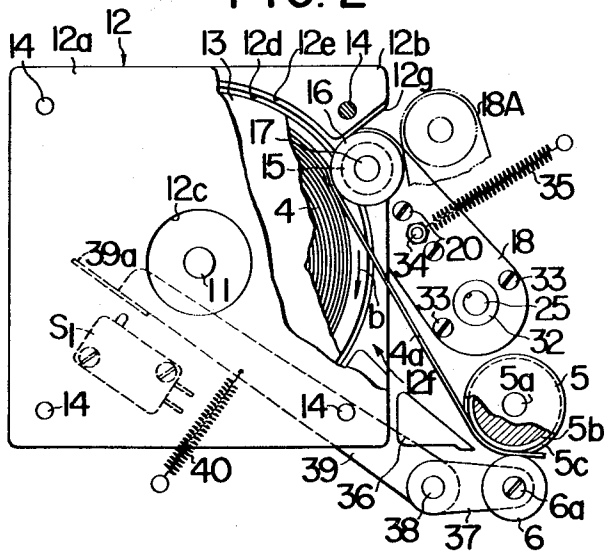
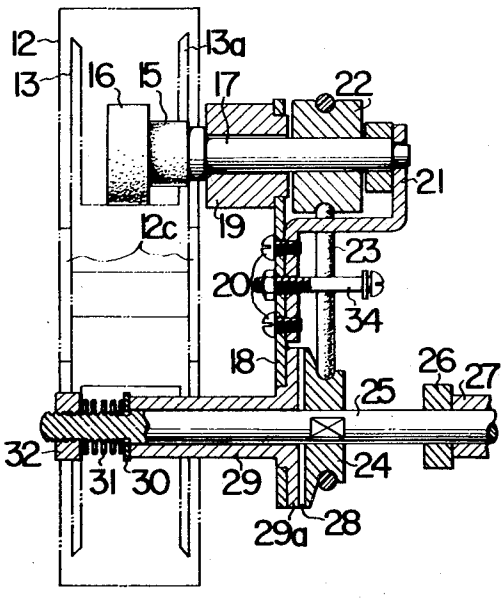


FIG. 3



INVENTOR
HIROSHI YAMADA

BY John J. McGlew
ATTORNEY

FIG. 4

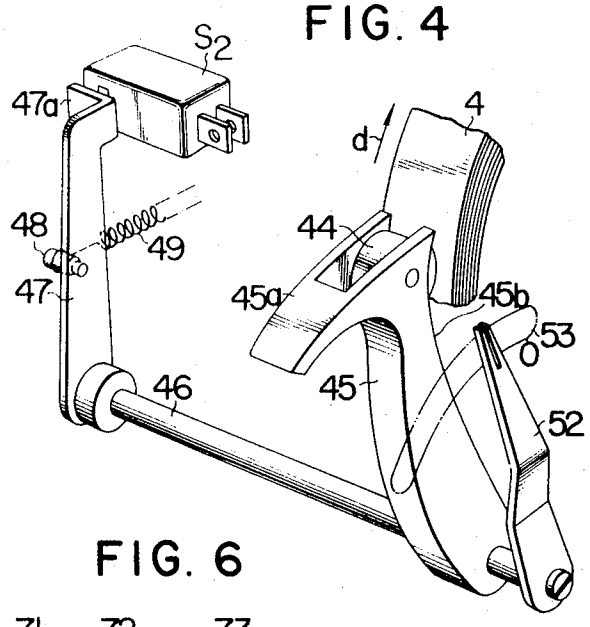
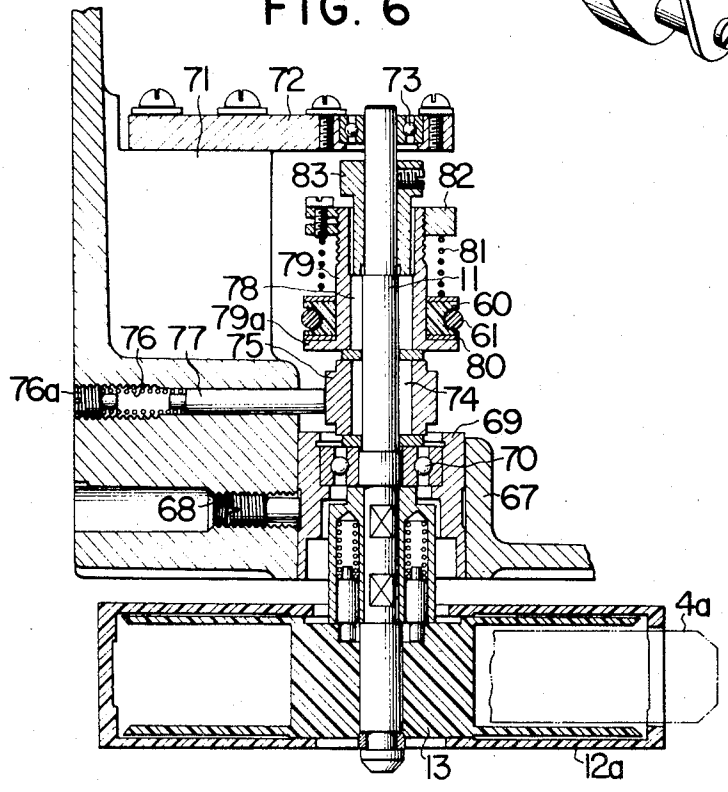


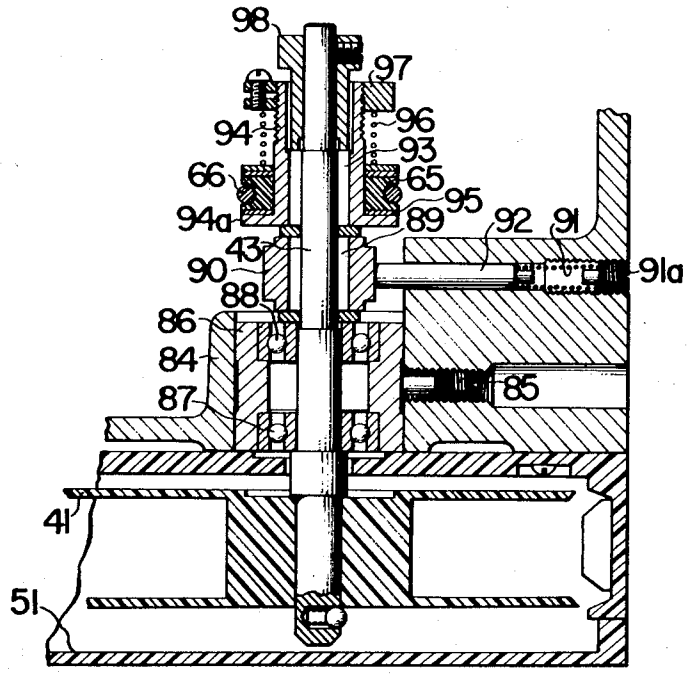
FIG. 6



INVENTOR
HIROSHI YAMADA

BY John J. McGlew
ATTORNEY

FIG. 7



INVENTOR

HIROSHI YAMADA

BY John J. McGlew

ATTORNEY

FILM FEED MECHANISM FOR MOVING THE FILM IN NORMAL AND REVERSE DIRECTIONS

FIELD OF THE INVENTION

This invention relates to film feed mechanism and, more particularly, to an improved and simplified such mechanism for moving film in normal and reverse directions while maintaining a selected tension on the film and preventing slackness in the film, without overtensioning the film.

BACKGROUND OF THE INVENTION

Projection of film by a movie projector, while the film is being moved in the normal direction, or feeding of microfilm by a microfilm projector, while the microfilm is being moved in the normal direction, has been effected by driving the film take-up reel shaft in the film take-up direction while permitting the film supply reel shaft to rotate freely. On the other hand, in both film projectors and in microfilm projectors, when the film is being moved in the reverse direction, the film supply reel shaft is driven in the rewind direction while the film take-up reel is allowed to rotate freely. These arrangements require additional means for transmitting a driving force to a selected one of the two reel shafts, while no driving force is transmitted to the other reel shaft, and additional means for reversing the directions in which the two reel shafts are rotated.

For this purpose, it has hitherto been the usual practice to provide a friction wheel on each of the shafts and to provide a drive friction wheel in a shifter for each of the shafts. The drive friction wheel of the shifter of a selected one of the two shafts is brought into engagement with the friction wheel of the associated shaft so as to move the particular shifter to transmit a driving torque to one of the two reel shafts while the other shaft remains freely rotatable. These known prior art devices are complicated in construction and unreliable in performance.

Particularly in a microfilm projector, it is necessary to move the microfilm in both the normal and the reverse directions for feeding the microfilm to locate a required frame. Switching between the normal and reverse directions thus occurs very frequently, and movement of the microfilm should be interrupted, so as to index accurately the required frame at a predetermined position, without deviation. The devices mentioned above and other prior art devices known hitherto have been unable to carry out these operations satisfactorily and without error.

SUMMARY OF THE INVENTION

The objective of the invention is to provide a film feed mechanism, for moving the film in normal and reverse directions, and comprising a drive wheel and a brake wheel mounted on a film supply reel shaft and also on a film take-up reel shaft. Respective one-way clutches are interposed between each drive wheel and each brake wheel and its associated shaft. The drive wheels are simultaneously rotated in the same selected direction by reversible drive means which are externally controllable, so that the film can be moved in either the normal direction or the reverse direction without any slackening of the film by merely selectively switching the direction of rotation of the drive means between the normal and reverse directions.

In the film feed mechanism of the invention, film can be moved in either direction, or the movement of the film can be interrupted, quite readily merely by switching the direction of rotation of the drive means between normal and reverse or by interrupting rotation of the drive means. The mechanism of the invention thus eliminates switching means, such as shifters mounted in conventional devices, which require a relatively high operating force, thereby making it possible to obtain an overall compact size and a simplified construction in equipment in which the invention mechanism is used.

The mechanism forming the subject matter of the invention does not include any floating intermediate member disposed between the film supply reel shaft and its drive wheel and between the film take-up reel shaft and its drive wheel, for switching the direction of rotation of the associated shaft between the normal and reverse directions. This is conducive to very accurate performance of the mechanism in switching between the two directions, and very quick response to switching commands.

An object of the invention is to provide an improved film feed mechanism for moving film between a film supply reel and a film take-up reel.

Another object of the invention is to provide such a mechanism which is selectively operable to move the film in either a normal direction or a reverse direction, or to interrupt movement of the film.

A further object of the invention is to provide such a mechanism in which there is no slack in the film between the two reels, irrespective of the direction of film movement, and likewise no excessive tension on the film in moving between the two reels.

For an understanding of the principles of the invention, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a plan view, partly broken away, of a microfilm projector having incorporated therein a film feed mechanism, for moving the film in either the normal or the reverse direction, and embodying the invention;

FIG. 2 is a partial plan view, broken away, of the microfilm projector and illustrating the manner in which film is automatically drawn out from a supply reel cartridge;

FIG. 3 is a sectional view taken along the line III—III of FIG. 1;

FIG. 4 is a perspective view illustrating a switch control mechanism provided on the film take-up reel side of the microfilm projector;

FIG. 5 is a plan view illustrating one embodiment of drive means for rotating the film supply and film take-up reel shafts simultaneously in the same selected direction;

FIG. 6 is a horizontal sectional view illustrating the arrangement of elements of the mechanism, embodying the invention, mounted on the film supply reel shaft side of the microfilm projector; and

FIG. 7 is a view similar to FIG. 6 but illustrating the mechanism elements mounted on the film take-up reel shaft side of the microfilm projector of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The figures of the accompanying drawing illustrate a microfilm projector incorporating the film feed mechanism for moving the film in normal and reverse directions, in accordance with the invention, and the invention will be explained with reference to its use in such a microfilm projector. However, it is to be understood that this is merely by way of example, as the invention is applicable equally not only to microfilm projectors but also to movie projectors as well as to any other equipment utilizing an information recording medium in tape form. Stated differently, the terms "microfilm" or "film," as used in the following description, should be understood as being equivalent to the term "tape," or, alternatively, the term "information recording strip."

Referring first to FIG. **1**, the microfilm projector or reader therein illustrated comprises a microfilm supply section **1**, a projection section **2** and a winding section **3** as its main component parts. A microfilm **4**, supplied from supply section **1**, is gripped between a capstan roller **5** and a pinch or counter roller **6** pressing against roller **5**. Capstan roller **5** is driven by suitable drive means (not shown) so that rollers **5** and **6** are rotated to advance microfilm **4** until it is introduced into a space between gate plates **7** and **8** of projection section **2**. A lens tube **9**, having a built-in optical system for projection, is disposed on one side of gate plates **7** and **8**, and a light source, which has not been shown, is disposed on the other side thereof. Frames of microfilm **4** are projected successively on a screen (not shown) by the projection optical system, for a projection through a reflector, if necessary. After passing through gate **7**, **8**, the microfilm passes over an idler roller **10** to winding section **3**.

Microfilm **4** can be fed either automatically or manually, as desired, by controlling rotation of capstan roller **5** in a manner such that the direction of rotation thereof is switched between the normal and reverse directions, the rate of rotation can be switched between high and low rates, and the rotation can be interrupted at will. When a frame containing an image of the desired information is disposed in gate **7**, **8**, the microfilm **4** is held stationary so as to project the image on the screen. The foregoing description relates to the general construction and operation of the microfilm projector or reader, and film supply section **1** and winding section **3** will now be described in detail.

In supply section **1**, as shown in FIG. **1**, a film supply reel shaft **11** is mounted in a predetermined position, and a cartridge **12** is illustrated as comprising two square plates **12***a* and **12***b* of identical shape and size, each formed with an annular recess in its inner surface. Plates **12***a* and **12***b* are assembled with their inner surfaces facing each other, and are secured together by four pins **14** so as to provide therebetween an annular space for housing a reel **13**. Reel **13**, which is rotatably housed in the annular space, has a central portion formed with a mounting opening adapted to receive snugly supply shaft **12**. Cartridge **12** is formed, on opposite sides thereof, with circular openings **12***c* having a diameter larger than that of the mounting opening of reel **13**, and openings **12***c* are concentric with the mounting opening in reel **13**. Cartridge **12** is attached firmly to supply section **1** by fitting shaft **11** in the mounting opening of reel **13**, and by fixedly securing the cartridge against rotation, by suitable means.

The annular space within cartridge **12** is defined by peripheral walls **12***d* adapted to serve as a guide when the leading end of microfilm **4**, wound on reel **13**, is drawn out from cartridge **12**, as described hereinafter. These peripheral walls are formed with respective peripheral grooves **12***e*, so as to prevent damage to the surface of microfilm **14** by frictional drag, which might otherwise be caused when microfilm **4** is guided by peripheral walls **12***d*. Reel **13** is mounted on shaft **11** by suitable means in a manner such that it is detachable from this shaft but rotates as a unit therewith. On the other hand, shaft **11** is connected to drive means, described hereinafter, through a one-way clutch or clutches also described hereinafter, and which are of a suitable type so that shaft **11** may be driven by the drive means only when microfilm **14** is to be rewound thereon or moved in a reverse direction. Thus, reel **13** is free to rotate in cartridge **12** in slaved relation to the microfilm when the microfilm is moved in the normal direct.

An aperture **12***f*, of relatively large angular extent and communicating with the reel chamber defined by the annular recess in cartridge **12**, is fomed on the right side of the cartridge as viewed in FIG. **1**, and oriented toward capstan roller **5**. A cutout **12***g* is formed in plate **12***b* adjacent aperture **12***f*, and this cutout extends slightly inwardly of the periphery of the flange or flanges of reel **13** and toward the center of the reel. The cutout has a width sufficiently large to permit a reel drive roller **15**, or a tape draw-out roller **16**, to enter thereinto when these rollers are pivoted toward cartridge **12** as described hereinafter.

Reel drive roller **15** and tape draw-out roller **16**, whose diameter is larger than that of roller **15**, as best seen in FIG. **3**, are positioned adjacent cutout **12***g*. These rollers are constructed of a material having a high coefficient of friction, such as rubber or the like, and are mounted on a common shaft **17** rotatably supported, again as shown in FIG. **3**, by a bearing **19** secured to a pivotal arm **18**, and a bent or offset support **21** secured to arm **18** by two screws **20**.

A pulley **22** is secured on shaft **17** between bearing **19** and support **21**, and is connected, through an endless belt **23**, to another pulley **24** secured to a drive shaft **25** which is journaled by a bearing **27** disposed to the right of the collar **26**, as viewed in FIG. **3**. A friction disk **28** and a sleeve **29** are slidably and rotatably mounted on an outer end portion of drive shaft **25** adjacent pulley **24**. A washer **30** and a compression coil spring **31** are mounted on a minor diameter portion at the outer end of drive shaft **25**, and are retained in position by a stop ring **32** threaded onto this outer end of shaft **25**. Spring **31** biases sleeve **29**, through washer **30**, toward pulley **29**, so that flange **29***a* of sleeve **29** presses against an end surface of pulley **24** through frictional disk **28**, so that pulley **24** and sleeve **29** are maintained in frictional engagement with each other.

In the illustrated embodiment, pivotal arm **18** has its base fitted over sleeve **29**, and secured by two screws **33** to the outer end surface of flange **29***a*, as shown in FIG. **1**. A pin **34** is secured to arm **18**, and has connected thereto one end of a tension coil spring **35** biasing arm **18** to pivot clockwise about shaft **25**, as viewed in FIGS. **1** and **2**. Drive shaft **25** is connected, through an electromagnetic clutch (not shown), to drive means

which will be described hereinafter, and is driven in the direction of an arrow *a* shown in FIG. 1 when the electromagnetic clutch is engaged.

If a main switch (not shown) is closed to energize a motor (not shown) and to engage the electromagnetic clutch, drive shaft **25** will begin to rotate in the direction of arrow *a*, and pulley **24** will also begin to rotate in the same direction as shaft **25.** Rotation of pulley **24** is transmitted through friction disk **28** to sleeve **29** and, as a result, pivotal arm **18** is swung in the direction of arrow *a*, shown in FIG. **1**, against the bias of spring **35.** Thereby, rollers **15** and **16** are shifted, together with arm **18**, and introduced into cutout **12***g* in cartridge **12**, so that reel drive roller **15** is pressed against the periphery of a flange **13**a (FIG. **3**) of reel **13** and tape draw-out roller **16** is disposed in a position in which part of its periphery is disposed between the two flanges of reel **13**, as shown in FIG. **2.**

When reel drive roller **15** is positioned against the periphery of flange **13***a* of reel **13**, the force pivoting arm **18** toward cartridge **12** is absorbed by the frictional connection between sleeve **29** and pulley **24.** However, since drive shaft **25** is still rotating, arm **18** is still biased counterclockwise, and roller **15** is maintained pressing against the periphery of flange **13***a* of reel **13.**

Also, rotation of pulley **24** is transmitted, through belt **23** shown in FIG. **3**, to pulley **22**, so that shaft **17** and rollers **15** and **16** rotate as a unit in the same direction as drive shaft **25.** Rollers **15** and **16**, which are thus shifted toward reel **13** while rotating, continue to rotate even after roller **15** is engaged with flange **13***a*. When roller **15** engages the periphery of flange **13***a*, reel **13** is driven by roller **15** and begins to rotate in a direction in which microfilm **4** is moved in a normal, or clockwise, direction about reel shaft **11**, which direction is shown by the arror *b* in FIG. **2**, as viewed in FIG. **1.**

A taper leader **4***a*, shown in FIG. **2** and of slight rigidity, is connected to the leading end of microfilm **4** and wound on reel **13** along with the microfilm in cartridge **12.** When cartridge **12** is attached, tape leader **4***a* is completely wound on reel **13** together with microfilm **4.** If reel **13** is rotated by drive roller **15** in the direction of arrow *b* shown in FIG. **2**, the roll of microfilm **4** on reel **13** is gradually loosened and outer convolutions thereof are caused to move radially outwardly by centrifugal force as reel **13** rotates. Tape leader **4***a* is gradually shifted radially outwardly toward the periphery of the flanges of reel **13** and, finally, the forward end of tape leader **4***a* is brought into engagement with draw-out roller **16** and presses against the same with a pressure of considerable magnitude.

Since roller **16** has a diameter greater than that of roller **15**, it has a peripheral velocity higher than that of roller **15.** Consequently, the forward end of tape leader **4***a*, pressing against roller **16**, is subjected to the drawing out action of roller **16** and which is performed at a rate bigher than the rate of rotation of reel **13.** At the same time, the forward end portion of tape leader **4***a*, maintained in engagement with roller **16**, is curved along the periphery of roller **16**, so that this forward end portion is disengaged from the periphery of the roller microfilm **4** and is brought to an upright position. Thus, the forward end is directed toward aperture **12***f*, so that microfilm **4** can be drawn automatically out of cartridge **12** by simple means. Tape leader **4***a*, drawn out through aperture **12***f* of cartridge **12**, is moved between capstan roller **5** and pinch roller **6** through the medium of a guide **36** disposed between aperture **12***f* in capstan roller **5**, as shown and FIG. **2.**

Capstan roller **5** is mounted on a shaft **5***a* which is driven by the drive means described hereinafter to rotate in either the normal or the reverse direction, or to remain stationary. This shaft is adapted to rotate in the normal direction, or in the direction of the arrow *c* in FIG. **1**, when the equipment is loaded with microfilm **4.** A peripheral groove **5***b*, having a width slightly less than the width of the microfilm **4** and tape leader **4***a*, is formed in the periphery of capstan roller **5**, and flanges **5***c* are provided on axially opposite end surfaces of this roller.

Pinch roller **6** has a width such that its periphery is received in peripheral groove **5***b* of capstan roller **5.** Roller **6** is rotatably supported by a shaft **6***a* secured to an arm **37** which has its base secured to a rotatable support shaft **38.** An arm **39** is secured to shaft **38** and has secured thereto one end of a tension spring **40** which biases arms **38** and **39** to pivot counter-clockwise about support shaft **38**, as viewed in FIG. **1.** A switch actuator **39***a* is mounted at the free end of arm **39** to face toward a normally open switch **S1.** When there is no microfilm **4** or tape leader **4***a* between capstan roller **5** and pinch or counter roller **6**, roller **6** is received in the peripheral groove **5***b* of roller **5**, and arm **39** maintains switch **S1** closed through switch actuator **39***a*.

If tape leader **4***a* is introduced between the rotating capstan roller **5** and its associated pinch or counter roller **6**, as mentioned above and as shown in FIG. **2**, roller **6** is scooped out of peripheral groove **5***b* of roller **5** by the tape leader, and brought into a position in which it presses against tape leader **4***a*. The distance covered by this movement of roller **6** corresponds to the depth of peripheral groove **5***b*. As roller **6** is thus shifted, arms **37** and **39** pivot clockwise about shaft **38**, as viewed in FIG. **1**, through an angle corresponding to the distance covered by the movement of pinch roller **6.** Clockwise pivoting of arm **39** releases switch actuator **39***a* from engagement with switch **S1**, as shown in broken lines in FIG. **2**, so that switch **S1** is opened.

Switch **S1** serves to connect the electromagnetic clutch of drive shaft **25** to a source of potential so that, when switch **S1** is opened, the electromagnetic clutch is disengaged to disconnect shaft **25** from the motor. Consequently, drive shaft **25** is free to rotate and, accordingly, the torque tending to swing pivotal arm **18** and that rotating pulley **22** are discontinued. As a result, rollers **15** and **16** cease to rotate and, at the same time, pivotal arm **18** is restored by spring **35** to its original position **18A**, shown in dash and dot lines in FIG. **2**, in which arm **18** and pulley **22** maintain rollers **15** and **16** away from reel **13.** With rollers **15** and **16** disengaged from reel **13**, tape leader **4***a* and microfilm **4** are advanced in the normal direction by capstan roller **5** and pinch roller **6** operating along on the tape leader and the microfilm. The forward end of tape leader **4***a* passes between gate plates **7** and **8** and is introduced into winding section **3** over idler roller **10.**

As shown in FIG. **1**, in microfilm winding section **3** there is disposed a casing **42** formed with an annular recess for housing a take-up reel **41** which is rotatable in casing **42** and has a central or axial opening receiving therein a film take-up reel shaft **43.** Reel **41** has a hub **41***a* with a peripheral surface formed of rubber, synthetic resin, or other material having a high friction coefficient. The frictional dragging of the peripheral sur-

face of hub 41*a* can be increased, as by mounting on hub 41a an O-band of rubber. A pinch or counter roller 44 is disposed against the peripheral surface of hub 41*a* between two flanges of reel 41, and is rotatably mounted on the free end of a tape guide arm 45 whose base is secured to a rotatable shaft 46 disposed outwardly of the periphery of reel 41. An arm 47 is secured to shaft 46 and has a pin 48 to which is secured one end of a tension coil spring 49, connected to a fixed pin 50, biasing arms 45 and 47 to pivot clockwise about shaft 46, as viewed in FIG. 1, so that arm 45 urges pinch roller 44 to press against the periphery of hub 41*a* of reel 41.

Walls 42*a* of casing 42, which define an annular recess in the casing as shown in FIG. 1, are formed, at the side thereof toward idler roller 10, with the microfilm inlet aperture 42*b*, and the walls serve as a guide for introducing tape leader 4*a* into aperture 42*b* and winding of the film or tape on reel 41. Peripheral grooves 42*c* formed in walls 42*a* reduce frictional dragging of the walls on tape leader 4*a* or microfilm 4, to protect the surface thereof. The open end of casing 42 is covered with a plate 51 secured to the casing by four pins 50.

Reel 41 is connected, by suitable means, to take-up reel shaft 43 so as to rotate as a unit therewith, and shaft 43 is connected to the drive means described hereinafter through a one-way clutch or clutches, also described hereinafter, so that it may be driven in a direction in which it winds microfilm 4 on reel 41, or in the direction of arrow *d* in FIG. 1, only when the microfilm is moved in the normal direction. Thus, reel 41 rotates, together with shaft 43, in the same direction.

Tape guide arm 45 is shaped like the letter γ, and its free end is formed with an intercepting portion 45*a* effective to prevent tape leader 4*a* from entering into reel 41 in the direction opposite to the direction in which the microfilm is to be wound on reel 41. Arm 45 also is formed with a curved guide portion 45*b* extending from its base to pinch roller 44 and serving to guide tape leader 4*a* to move between the periphery of hub 41*a*of reel 41 and pinch roller 44, after the tape leader has been introduced along the peripheries of the flanges of reel 41. Thus, tape leader 4*a*, entering into aperture 42*b* over idler roller 10, moves between the flanges of reel 41 as this reel rotates in the direction of arrow *d*, to be held readily by the peripheries of hub 41*a* and pinch roller 44. Since reel 41 rotates at a rate higher than the movement of tape leader 4*a*, tape leader 4*a* and microfilm 4 are wound rapidly on the outer peripheral surface of hub 41*a*.

As microfilm 4 is wound progressively on reel 41, the diameter of the roll of microfilm on this reel increases gradually, as shown in FIG. 4, and moves pinch roller 44 toward the peripheries of the flanges of reel 41. This movement of roller 44 causes arm 45 to be swung angularly about the axis of shaft 46, which has secured thereto an indicator 52 cooperating with a graduated scale 53, as shown in FIG. 4, provided on plate 51 to indicate the amount of microfilm wound on reel 41 as shaft 46 is gradually displaced angularly.

A slot large enough to permit pinch roller 6 to pass therethrough is formed in the trailing end portion of microfilm 4 and, when this trailing end portion is indexed with capstan roller 5, pinch roller 6 is received in the slot so that capstan roller 5 and pinch roller 6 cease to advance microfilm 4. This is effective to prevent microfilm 4 from being subjected to extensive tension and damage in reel 13, or between rollers 5 and 6, when microfilm 4 is moved in the normal direction.

When roller 6 passes through the slot to press against roller 5, arms 37 and 39 pivot and switch S1, shown in FIG. 1, is closed. A switch actuator 47*a* at the free end of arm 47 of winding section 3 maintains a normally open switch S2 in closed position when the roll of microfilm wound on reel 41 is small in diameter. However, with an increase in the diameter of the roll of microfilm on reel 41, actuator 47*a* is moved away from switch S2 as guide arm 45 pivots, thereby permitting switch S2 to open.

Switches S1 and S2 are connected in series with each other between the main switch and the electromagnetic clutch for drive shaft 25 so that, even if pinch roller 6 is received in through the slot of microfilm 4 and switch S1 is closed, as mentioned, the electromagnetic clutch is not engaged again because switch S2 is open. This prevents rollers 15 and 16, or pivotal arm 18, from being rendered operative inadvertently when it is not required to feed the microfilm. Switches S1 and S2, however, are both closed in the initial stages of feeding microfilm 4, so that the electromagnetic clutch is engaged immediately once the main switch is closed.

Referring to FIG. 5, which illustrates a driving mechanism for the microfilm projector thus far described, a pulley 54 is secured to shaft 5a of capstan roller 5, and a pulley 55 is secured to a shaft 10a loosely mounting idler roller 10. Pulleys 54 and 55 are connected, through an endless belt 56, to a main drive pulley 57 secured to a shaft 57a which is connected to a suitable drive means (not shown) such as a reversible motor, for example, which can be operated from a point externally of the microfilm reader, so that the direction of its rotation can be switched between normal and reverse so that pulley 57 can be rotated in the normal direction as indicated by the arrow *e*, or in the reverse direction. Other pulleys 58 and 59 are also secured to shaft 5*a*. A crossed endless belt 61 is trained about pulley 58 and a drive pulley 60 secured to film supply reel shaft 11 to rotate shaft 11 in the direction indicated by the arrow *f*, in FIG. 5, and pulley 59 is connected, through an endless belt 63, to a pulley 62 secured to drive shaft 25 for pivotal arm 18. The electromagnetic clutch mentioned before is interposed between drive shaft 25 and pulley 62.

Furthermore, a pulley 64 is secured to shaft 10*a* of idler roller 10, and a crossed endless belt 66 is trained about this pulley and about a drive pulley 65 secured to film take-up reel shaft 43. Rotation of main drive pulley 57 in either the normal or the reverse direction thus is transmitted to shaft 5*a* of capstan roller 5, drive shaft 25 and pulleys 60 and 65, so that pulleys 60 and 65 rotate simultaneously in the same direction.

Referring now to FIG. 6, film supply reel shaft 11 is journaled, at one end portion thereof, by a bearing 70 fitted in a sleeve 69 secured to a fixed member 67 by a screw 68 and, at the other end portion thereof, by a bearing 73 mounted on a support plate 72 secured to a fixed member 71. Shaft 11 has fitted thereover, through a one-way clutch 74, a brake ring 75 against which a rod-shaped brake shoe 77, of nylon or other similar material, and biased by a spring 76, presses at its outer end, so that brake shoe 77 exerts a weak braking force on brake ring 75. One-way clutch 74 transmits the braking force of brake ring 75 to shaft 11 only when this shaft rotates in a direction in which it pays

out microfilm 4 from a reel thereon, or in the direction of an arrow *f* as shown in FIG. 5. The rear or outer end of spring 76 abuts against a setscrew 76*a*.

Another sleeve 79 is fitted over film supply reel shaft 11 through another one-way clutch 78, and drive pulley 60 is loosely fitted over sleeve 79 which is formed with a flange 79*a*. A friction disk 80 is interposed between flange 79*a* and one end surface of drive pulley 60, whose other end surface is engaged by a spring 71, mounted on sleeve 79, and biasing pulley 60 to press toward flange 79*a*. As a result, drive pulley 60 is maintained in frictional engagement with sleeve 79 through friction disk 80. The rear end of spring 81 abuts against a ring 82 threadedly fitted on sleeve 79.

One-way clutch 78 for sleeve 79 is prevented from being disengaged from film supply reel shaft 11 by a locking sleeve 83 secured to shaft 11, and is adapted to transmit the driving torque of pulley 60 to shaft 11 only when pulley 60 is driven to rotate in a direction opposite to the direction of arrow *f* in FIG. 5. At this time, microfilm 4 is rewound on the film supply reel on shaft 11, or is fed in the reverse or opposite direction.

Referring to FIG. 7, film take-up reel shaft 43 is shown as rotatably journaled by bearings 87 and 88 fitted in a sleeve 86 connected to a fixed member 84 by a screw 85. A brake ring 90 is fitted over shaft 43 through a one-way clutch 89, and a rod-shaped brake shoe 92, biased by a spring 91, presses at its front end against brake shoe 92 so that the brake shoe exerts a weak braking force on brake ring 90. The rear end of spring 91 abuts against a setscrew 91*a*. One-way clutch 89 is adapted to transmit the braking force of brake ring 90 to shaft 43 only when shaft 43 rotates in the direction in which microfilm 4 is paid out therefrom, or in a direction opposite to the direction of arrow *d* in FIG. 5.

Another sleeve 94 is fitted over shaft 43 through another one-way clutch 93, and drive pulley 65 is loosely fitted over sleeve 94, which is formed with a flange 94*a*. A friction disk 95 is interposed between flange 94*a* and one end surface of drive pulley 65 whose other end surface is biased by a spring 96, mounted on sleeve 94, to press pulley 65 against flange 94*a*. As a result, pulley 65 is maintained in frictional engagement with sleeve 94 through friction disk 95. The rear end of sleeve 96 abuts against a stop ring 97 threaded onto sleeve 94.

One-way clutch 93 for sleeve 94 is prevented from being dislodged from film take-up reel shaft 43 by a locking sleeve 98 secured to shaft 43, and this clutch is adapted to transmit the driving torque of pulley 65 to shaft 43 only when pulley 65 rotates in the direction of arrow *d* of FIG. 5. At this time, microfilm 4 is moved in a direction in which it is wound on film take-up reel 41, or is fed in the normal direction.

From the foregoing description, it will be seen that film supply reel shaft 11 and film take-up reel shaft 43 are provided with similar devices which constitute the mechanism according to the invention, and are simultaneously driven to perform similar operations. The operation of the mechanism embodying the invention will now be described with reference to feeding of microfilm 4 in the normal direction.

When the microfilm is fed in the normal direction, main drive pulley 57, shown in FIG. 5, is rotated in the direction of arrow *e* so as to drive shaft 5*a* of capstan roller 5 to rotate in the direction of arrow *c*, and to rotate drive pulleys 60 and 65 to rotate in the directions of arrows *f* and *d*, respectively, as shown in FIG. 5. If shaft 5*a* rotates in the direction of arrow *c*, microfilm 4 will be fed in the normal direction by capstan roller 5 and pinch roller 6. The rate of rotation of film supply reel 13, rotating during this film feed operation, is set such that it is either equal to or smaller than the rate of rotation of drive pulley 60. Thus, at this time, one-way clutch 78 for drive pulley 60 is disengaged to declutch shaft 11 from pulley 60, so that film supply reel 13 is free to rotate without interference. However, the weak braking force of brake ring 75 is transmitted to shaft 11 by one-way clutch 74, so that excessive acceleration of the rotation of reel 13 is thereby inhibited. This prevents slackening of the microfilm between reels 13 and 41.

If drive pulley 65 rotates in the direction of arrow *d*, its rotation will be transmitted to shaft 43 by one-way clutch 93, so that film take-up reel 41 is driven to rotate in the same direction as drive pulley 65. At this time, the one-way clutch 89 for brake ring 90 is disengaged to leave shaft 43 free, so that no excessive braking force is exerted on the shaft. Film take-up reel 41 is driven by drive pulley 65 at a rate which is equal to or higher than the rate at which microfilm is fed by capstan roller 5 and pinch roller 6. The difference between this microfilm feed rate and the film winding rate is absorbed by the frictional engagement of drive pulley 65 with sleeve 94, thus avoiding the imposition of an excessive tensile force on microfilm 4. This frictional engagement means may be disposed in any position as desired between drive pulley 65 and film take-up reel 41, which is also the case with the friction engagement means disposed between drive pulley 60 and film supply reel 13.

When microfilm 4 is fed in the normal direction and a desired frame of the microfilm is indexed at a predetermined position for projecting the image thereof on the screen, rotation of main drive pulley 57 is interrupted. This results in interruption of the rotation of shaft 5*a* of capstan roller 5 and of drive pulleys 60 and 65. At this time, further rotation of film supply reel 13, which might otherwise be caused by inertia, is prevented through the frictional engagement of drive pulley 60 with sleeve 79, the rotation of drive pulley 60 having been interrupted, so that excessive unwinding of microfilm from reel 13 is avoided.

Although the braking force of braking ring 75 is transmitted through one-way clutch 74 to shaft 11 at this time, this braking force is not sufficiently high to prevent rotation of film supply reel 13 due to inertia. On the other hand, interruption of the rotation of drive pulley 65 results in the rotation of film take-up reel 41 in a direction opposite to the direction of arrow *d* being precluded by drive pulley 65, thereby avoiding loosening of the roll of microfilm wound on reel 41. Also, the braking force of braking ring 90 contributes, through one-way clutch 89, to preventing rotation of reel 41 in a direction opposite to the direction of arrow *d*.

From the foregoing description, it will be appreciated that the film feed mechanism embodying the invention provides for ready and positive feeding of microfilm 4 in the normal direction, and indexing of a desired frame thereof at a predetermined position, by the functional cooperation of various components of the mechanism. Microfilm 4 can be fed in the reverse direction by rotating main drive pulley 57 in a direction opposite to the direction of arrow *e*. In such case, capstan roller 5 ro-

tates in a direction opposite to the direction of arrow *c*, and drive pulleys **60** and **65** also rotate in directions opposite to the respective arrows *f* and *d*, with the various components of the mechanism functioning as if film supply reel shaft **11** and film take-up reel shaft **45** were merely interchanged with respect to the feeding of the microfilm in the normal or forward direction. Consequently, description of the operation of feeding the microfilm in the reverse direction, utilizing the mechanism of the invention, will be omitted. The mechanism functions rationally and accurately and its performance is reliable because various components of the mechanism functionally cooperate with one another in the reverse feed operation also.

While the mechanism has been described as using drive pulleys **60** and **65** in the illustrated embodiment, for exemplary illustration of the principles of the invention, it is to be understood that a power transmitting means including gears and chains, for example, may be utilized by substituting suitable gears for drive pulleys **60** and **65.** The order of mounting various elements of the mechanism on shafts **11** and **43** may be varied as desired as long as such variation does not interfere with proper functioning of the mechanism.

In order to rotate main drive pulley **57,** or a corresponding gear, in both the normal and reverse directions, means may be provided to change the polarities of a DC motor from a point outside the microfilm projector, by actuating a switch for rotating the same in either the normal or reverse direction. Alternatively, means may be provided to bring an intermediate pulley or intermediate gear into and out of contact with a drive system by operating a shifter, so that an AC motor, which rotates only in one direction, may be caused to rotate the film reels in both the normal and reverse directions.

While a specific embodiment of the invention has been shown and described in detail to illustrate the applification of the principles of the invention, the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A feed mechanism for moving a strip, having information recorded thereon, in normal and reverse directions between a supply reel and a take-up reel comprising, in combination, a supply reel shaft for mounting and rotating a supply reel; a take-up reel shaft for mounting and rotating a take-up reel; a respective drive wheel mounted on each shaft; a respective one-way clutch interposed between each drive wheel and its associated shaft; reversible driving means operatively connected to both drive wheels to rotate the same simultaneously in the same selected direction; each one-way clutch coupling its associated drive wheel to its associated shaft only when its associated drive wheel is driven in a direction to wind strip on a reel mounted on its associated shaft, and disconnecting its associated drive wheel from the associated shaft when its associated drive wheel is driven in a direction to unwind strip from a reel mounted on its associated shaft; a respective braking wheel mounted on each shaft; a respective brake shoe engaged with each braking wheel; and a respective further one-way clutch interposed between each braking wheel and its associated shaft; each further one-way clutch coupling its associated braking wheel to its associated shaft only when its associated shaft is driven in a direction to unwind strip from a reel mounted thereon, and disconnecting its associated braking wheel from its associated shaft when its associated shaft is driven in a direction to wind strip on a reel mounted thereon.

2. A feed mechanism for moving a strip, having information recorded thereon, in normal and reverse directions between a supply reel and a take-up reel comprising, in combination, a supply reel shaft for mounting and rotating a supply reel; a take-up reel shaft for mounting and rotating a take-up reel; a respective drive wheel mounted on each shaft; a respective one-way clutch interposed between each drive wheel and its associated shaft; reversible driving means operatively connected to both drive wheels to rotate the same simultaneously in the same selected direction; each one-way clutch coupling its associated drive wheel to its associated shaft only when its associated drive wheel is driven in a direction to wind strip on a reel mounted on its associated shaft, and disconnecting its associated drive wheel from the associated shaft when its associated drive wheel is driven in a direction to unwind strip from a reel mounted on its associated shaft; said driving means including a main driving pulley; driven pulleys and endless belts interconnecting said driving pulley to said drive wheels; a capstan roller engaged with the strip between said supply reel shaft and said take-up reel shaft; a driven pulley rotatable with said capstan roller; said endless belts including an endless belt interconnecting said main driving pulley and said last-named driven pulley; a third shaft between said capstan roller and said take-up reel shaft; an idler pulley rotatable on said third shaft and having the strip trained thereover; a driven pulley rotatable on said third shaft; said endless belt interconnecting said driving pulley and the driven pulley rotatable with said capstan roller being trained over said last-named driven pulley; an additional driven pulley rotatable with said last-named driven pulley; a first endless belt interconnecting said additional pulley and the drive wheel mounted on said take-up reel shaft; another additional driven pulley rotatable with the driven pulley which is rotatable with said capstan roller; and an endless belt interconnecting said other additional driven pulley with the drive wheel mounted on said supply reel shaft.

3. A strip feed mechanism, as claimed in claim **1,** in which said reversible driving means includes capstan roller means operatively engaged with the strip between said supply reel shaft and said take-up reel shaft; said capstan roller means being rotated simultaneously with said drive wheel to move the strip in the selected direction.

4. A strip feed mechanism, as claimed in claim **3,** in which each drive wheel, when rotated in a direction to wind strip on the reel connected to its associated shaft is rotated by said driving means at an angular velocity greater than the angular velocity of its associated shaft as controlled by the strip being wound thereon as driven by said capstan roller means.

5. A strip feed mechanism, as claimed in claim **1,** including means frictionally coupling each drive wheel to its associated one-way clutch.

6. A strip feed mechanism, as claimed in claim **1,** in which said drive means includes an external-switch-controlled reversible electric motor.

7. A strip feed mechanism, as claimed in claim **1,** in which said driving means includes a main driving pul-

ley; and driven pulleys and endless belts interconnecting said driving pulley to aid drive wheels.

8. A strip feed mechanism, as claimed in claim **7**, including a capstan roller engaged with the strip between said supply reel shaft and said take-up reel shaft; a driven pulley rotatable with said capstan roller; said endless belts including an endless belt interconnecting said main driving pulley and said last-named driven pulley.

9. A strip feed mechanism, as claimed in claim **2**, in which the endless belts interconnecting each drive wheel to its associated driven pulley are crossed belts.

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