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(54) Ribbon supply tensioning means and printing machine therewith.

(57) A ribbon supply means, preferably a ribbon cartridge (28), is provided with tensioning means such as a resilient pad (95) mounted between anchoring means, for example the wall of the ribbon cartridge (28), and an incrementally driven ribbon capstan (70) for urging the ribbon (20) into good frictional contact with a frictional surface on the capstan (70) for wiping the ribbon (20) clean and damping the motion of the ribbon (20) as it is driven forward. The ribbon supply means is suitable for use with printing machines, for example electronic typewriters.

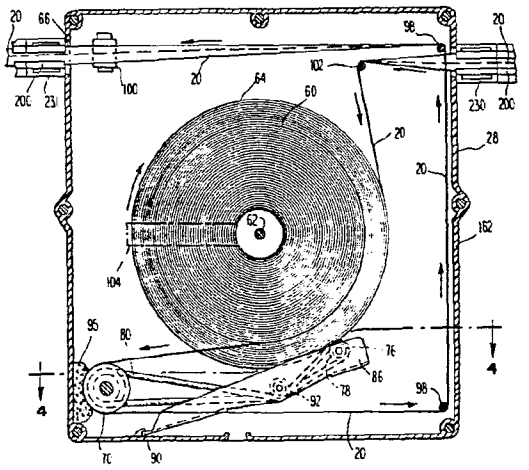

Fig. 3

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This invention relates to an improvement in typing ribbon cartridges of the type wherein a capstan is used to drive an inked typing ribbon from a supply reel into a position juxtaposed with a character element so that the ink may be deposited on a paper. More specifically, the invention relates to a means for supplying tension to the tape whereby it is held against the drive capstan so that excess ink and contaminants are removed from the ribbon and whereby the ribbon is not wasted due to over supply of ribbon requirements.

In a particular machine which is sold by the assignee of the present invention, an inked ribbon is pulled off a spool in a disposable cartridge mounted on the frame of a typewriter, passed through a flexible leader, past the print point by means of a ribbon locating structure, and passed through a second flexible leader back to a take-up spool, mounted concentrically with the supply spool, within the body of the cartridge. The drive of the ribbon to and from the cartridge is controlled by means of a stepper motor which increments the position of the ribbon one step with each key stroke. The stepper motor on the typewriter drives the ribbon ahead through a capstan in frictional engagement with the substrate of the ribbon. If ribbon is not to be wasted, it is necessary that the incremental advance of the ribbon provided by the stepper be implemented by good frictional contact between the capstan and the ribbon so that no ribbon need be wasted. Since the cost of ribbon is a primary element of cost-per-character calculations, it is incumbent upon the manufacturer of replacement cartridges to ensure that as little ribbon is advanced with each incremental motion of the capstan as will permit proper printing of characters.

Therefore, it has been found desirable to provide means for damping the motion of the supply spool so that when the capstan is energized by the stepper motor the spool rotates only so far as necessary to supply the amount of

ribbon called for and no further. This has worked well for damping the incremental advance but has caused other problems. Specifically, with heavily inked multi-strike ribbons, ink from the inked side of the ribbon has a tendency to be deposited on the non-inked side of the substrate as it is in contact therewith while the ribbon is wound upon the supply spool. This ink then tends to be deposited on the friction surface of the capstan which in some cases can lead to slippage between capstan and ribbon. As the capstan must provide sufficient force to overcome the damping force provided by the damping means, any decrease in the friction between the substrate and the capstan will be made more critical by the additional force necessary to overcome the damping force. It would therefore be desirable to limit the amount of force required to provide damping, thus simplifying and making less critical the interaction of capstan and ribbon.

It is an object of the invention to provide a ribbon movement damping means which performs its function adequately but which does not introduce a great deal of frictional damping force into the mechanism.

It is a further object of the invention to provide a cartridge in which the motion of ribbon is damped while requiring minimal force to supply the ribbon.

Finally, it is an object of the invention to provide an improved printing mechanism of the type comprising an inked ribbon cartridge.

According to the present invention, a cartridge is provided with damping for the ribbon by interposing a comparatively small portion of a resilient foam material between the cartridge and the capstan itself. This foam provides the triple function of removing excess ink and any contamination from the ribbon, of urging the substrate of the ribbon into engagement with a friction surface on the capstan, and of providing damping for the ribbon so that it is not overly moved by the incremental motion of the capstan.

The invention will be better understood if reference is made to the accompanying drawing, in which:

Fig. 1 represents an overview of the cartridge of the invention in its intended environment, i.e. a typewriter;

Fig. 2 represents an enlarged perspective view of the cartridge including its leader means and ribbon locator means;

Fig. 3 represents a plan view of the interior of the cartridge including the foam pad according to the invention;

Fig. 4 is a cross-sectional view of the cartridge taken along the line 4-4 in Fig. 3;

Fig. 5 represents a schematic view of the supply reel of ribbon, capstan, the foam pad and the wall of the tape; and

Figs. 6 and 7 represent cross-sectional views taken along the line 6-6 in Fig. 5 of several types of foam pads and capstans according to the invention.

Referring now to Fig. 1 a typewriter comprises a keyboard 10 which controls the motion of a print wheel 12 which comprises a plurality of spokes having character elements formed at their ends and adapted to be impacted by a hammer 14 in order to drive a selected character element against a platen 16 over which a sheet of paper 18 may be interposed. A print ribbon 20 is interposed between the character element 12 and the paper 18 so as to leave an inked impression corresponding to the character elements selected. In operation, the ribbon 20 is raised by lifter means (not shown) when the hammer 14 is about to impact the character element 12. The ribbon 20 is carried by locator means 180 which is provided with an uplifted portion 181 under which the hammer and character element may pass on their way to the paper 18. The locator means 180 is mounted by means of posts 44 on a moving carriage 22 desirably driven by a linear stepper motor 26. The

ribbon 20 is then passed through flexible leaders 34 and 36 which are connected in turn to a ribbon cartridge 28 which is mounted within a receptacle 30. In this way, when the carriage 22 moves back and forth with respect to the frame of the typewriter and the paper 18, the flexible leaders 34 and 36 permit the locating means 180 to move with the carriage 22 while the cartridge 28 remains fixed, the flexible leaders 34 and 36 providing the interconnection therebetween.

There may also be mounted on carriage 22 an erase ribbon 42 which may be supplied from a reel 38 and taken up by a second reel 40 and used to either overprint a letter struck in error or to remove it, depending on the type of ink supplied by the ribbon.

Referring now to Fig. 2, the cartridge 28 is connected to the flexible leader 200 by means of mounting structure 231 and 230. Ribbon 20 is fed through first flexible leader 200 to locator 180 and returns by means of second flexible leader 200 back to cartridge 28.

Locator 180 comprises a central section spacing ends 188 and 187 apart. These ends are adapted to mate with corresponding pieces of leader 20. The ends 187 and 188 are provided with shaped notches 183 which engage posts 184 which are mounted on the carriage 22 of the typewriter and are, as discussed above, lifted when typing is performed so as to interpose the ribbon 20 between a selected character element and paper 18. A raised central portion 181 of the locator 180 is provided so that the hammer 14 and character element 12 may pass therethrough on their way to impact the paper. Desirably, the ends 187, 188 of the locator 180 are provided with fingers 182 which may be operated by the operator when changing ribbons in order to open notches 183 so as to disengage from posts 184, as discussed in further detail in copending U.S. patent application Serial No. 61,454.

Referring now to Figs. 3 and 4, internal details

of the cartridge 28 are shown. The ribbon 20 is unwound from a supply reel 60 by means of a capstan 70 which is desirably driven by a stepper motor mounted on the typewriter (not shown). Ribbon 20 then passes around two guide posts 98, over a roller 100, and exits the cartridge 28 by means of leader mounting structure 231 and leader 200, thence to pass to the print point. After being typed upon, the ribbon 20 is returned again via leader 200 and leader mounting structure 230 over a post 102 and onto a take-up reel 64. Said supply and take-up reels 60 and 64, respectively, (which in a preferred embodiment are flangeless coils of ribbon) are mounted concentrically on a hub 62 and are both driven by means of the stepper motor, not shown, acting on capstan 70. However, while the capstan 70 directly pulls on the ribbon 20 to supply it, the take-up 64 is driven by means of an intermediaty O-ring 80 and a star wheel 76 which is provided with teeth 78 which engage the typed-upon ribbon as it is wound onto the take-up reel 64. Said O-ring may desirably be passed over an intermediate pully 92 which may be arranged so as to exert an inward tension (i.e. a tension acting toward the hub 62) on the arm 86 pivoted at 90 on which the star wheel 76 is mounted so as to keep the star wheel in engagement with take-up reel 64. It is desirable to make the star wheel 76 by an integral molding process, whereby a plastic wheel is formed around a stamped metal star; in this way, an effective and unitary construction may be formed simply and inexpensively.. It will be observed from Fig. 4 that the capstan 70 is shown as comprising a recilient band around its lower circumference which drives the inked ribbon. In some circumstances, it is desirable to form this tire integrally with the capstan 70 by means of an integral molding process. In other cases, a resilient band of the proper size may be slipped over the capstan 70.

The articulated leader 34 and 56 of the structure

is more fully discussed and claimed in co-pending U.S. patent application Serial No. 61880 assigned to the assignee of the present invention. It has furthermore been found that the ribbon 20 prior to being rewound on the take-up spool 64, may desirably be deformed by a stress exceeding its elasticity limit, which may be provided by passing the used ribbon 20 over a profile designed to impart such stresses. This is discussed in more detail in co-pending U.S. patent application Serial No. 61875.

Referring now to Fig. 5, a schematic view is shown of the ribbon 20 being passed off the hub 62 of the supply reel. The ribbon 20 is then passed over capstan 70 which, as discussed above, is driven by a stepper motor. A friction surface 202 engaged the non-inked surface of the ribbon 201 and pulls it off supply reel 62; the ribbon 20 is then fed to the remainder of the mechanism as shown and discussed above in connection with Fig. 3. A foam pad 95 is interposed between the wall of the cartridge 28 and the inked side 203 of the ribbon 20.

This interposition of a pad between a wall of the cartridge 28 and the inked side 203 of the ribbon 20 forces certain limitations in the design of such a ribbon. For example, certain ribbons are now in common use which are of the "lift-off" type. These are designed to be used in conjunction with an erase tape of the type which removes the ink from the paper rather than overprinting it with a second ink of a color designed to match that of the paper (an "overprint" ribbon). With such a lift-off ribbon, the ink is so loosely attached to the substrate that the wiping action provided by a foam pad 95 would be far too rigorous for the ink to survive such a passage. Hence, the present invention is not designed for use with a so-called lift-off type tape since the tape is simply too fragile to allow damping of the reel to be accomplished in this fashion. Instead, foam pads are installed in the cartridges containing such ribbon between the sides of the spool of tape 20 and

the front or back wall of the cartridge 28. U.S. Patent No. 4,079,827 to Work shows a similar arrangement. Therefore, the present invention is suitable only with tapes of the overprint type whether they be of the single-strike or multiple-strike class.

As discussed above, the interposition of a foam pad 95 between the wall of the cartridge 28 and the ribbon 20 performs three distinct functions. First, any additional ink which has accumulated on the ribbon 20 as well as any contamination is wiped off thereby. Second, the foam pad 95 presses the ribbon 20 into firm engagement with the resilient friction surface 202 of the capstan 70 so that it can be driven thereby. Finally, the foam pad 95 provides a damping mechanism for the ribbon 20 so that when the capstan 70 is incrementally moved under the action of the stepper motor (not shown) the ribbon 20 does not tend to move any further than necessary and hence is not wasted; thus ribbon 20 is used efficiently, and the cost per character of the printing operation is reduced.

It will be apparent from a perusal of Fig. 5 that if the ribbon were wound tightly as indicated in Fig. 3 rather than loosely as shown schematically in Fig. 5, ink from the inked side 203 of the ribbon 20 would tend to be deposited on the uninked side 201 of the ribbon 20. This ink, being largely carbonaceous or graphitic, tends to provide a slippery surface to all with which it comes into contact. Specifically, friction surface 202 of the capstan 70 can eventually become coated with this ink and if the demands placed on it are too great or if it is not properly designed, can slip, thus not advancing the ribbon 20 properly. For example, in a previous arrangement it has been the practice to provide a damping pad on the side of the supply reel 60 of ribbon 20, as discussed above in connection with a lift-off type of tape. Since in that case the foam was required to provide sufficient damping force to damp the motion of the entire spool 60 of tape, considerable force had to be

exerted thereon. According to the present invention, however, only the motion of the small length of ribbon 20 being unwound from the spool 60 need be damped, as the spool 60 itself is permitted to free wheel. Therefore, a great deal less force is required to be imparted to the ribbon 20 by the capstan 70 so that the effects of inking thereon become much less critical. Further, the provision of the foam pad between the capstan and the wall of the cartridge 28 forces the ribbon into firmer engagement with the friction surface 202 of the capstan 70 than might otherwise be the case while also providing adequate damping.

Referring now to Figs. 6 and 7, two distinct embodiments are shown in which a foam pad 95 is provided for the several functions listed above. In each case a capstan 70 being pivoted about an axis 69 under the influence of a stepper motor (not shown) is provided with an inserted friction surface 202 which in Fig. 6 is shown as an inserted band of square cross-section which may desirably be made of a resilient material such as rubber and in Fig.7 is a resilient band of round cross-section of a similar material. Alternatives include forming a "tire" about that portion of the capstan 70 designed to contact the ribbon 20; the tire may be integrally molded according to well-known techniques. Still a further possibility involves a flat cross-section band such as a common rubber band; or alternatively, the entire capstan 70 could be made out of a resilient friction material such as rubber. Furthermore, the foam pad 95, can, as shown in Fig. 6, only contact the ribbon 20, in which case it would press the ribbon 20 into engagement with the capstan 70 most effectively while providing damping force only to the ribbon 20; whereas in Fig. 7 the foam pad is shown contacting a portion of the capstan 70 as well. In this case, while the foam would perform a friction engaging function (that is, pressing the ribbon firmly against the friction surface 202) it would perform the additonal function in

the embodiment of Fig. 7 of also damping the motion of the capstan 70 itself, which might in some circumstances prove to be useful.

It has thus been shown how the placement of a foam pad 95 juxtaposed to the capstan of an inked ribbon cartridge system can solve several problems at once. Placement of the foam pad 95 between the wall of the cartridge or another similar anchorage and the drive capstan 70 permis the damping function of the foam pag 95 to be carried out with suitable efficiency while not providing such a great force that the friction required between driving capstan 70 and the inked ribbon 20 itself is excessive and difficult to provide. Further, the foam pad 95, placed as shown, increases the probability that the frictional co-efficient between the capstan 70 and the inked ribbon 20 will be sufficient by firmly engaging the two together rather than depending on the physical arrangement of the parts within the cartridge 28 for this function. While one skilled in the art will appreciate that the preferred embodiment cartridge described above with reference to Figs. 3 and 4 pulls the ribbon ahead to some degree by its provision of a star wheel 76 driving the rewind reel 64, nevertheless the provision of the stepper motor driven capstan 70 is essential to proper feeding of the ribbon 20, as otherwise the tension of the ribbon 20 may vary. Control of ribbon tension is important; if tension is excessive, the ribbon 20 may break, or be overprinted. If insufficient tension is provided, i.e., if the ribbon 20 slips with respect to the capstan 70 the ribbon may tangle and not wind up properly.

It will be appreciated by those skilled in the art that numerous modifications and improvements can be made to the invention as described without departing from its essential scope. Specifically, the foam material chosen can be any one of a wide variety of possible materials although in a presently preferred embodiment a common plastic foam is preferred. Further, different methods of assembling the car-

tridge 28 according to the invention are possible. For example, the foam 95 can be adhesively attached to an anchoring point, whether the side of the cartridge 28 or some other point, in order to hold it in its proper position with respect to the ribbon 20 and capstan 70. Further, the capstan 70 itself could be driven by means other than by a stepper motor mounted on the typewriter and indeed need not even be a part of the cartridge 28 but could be mounted externally thereto. Even so, if a capstan 70 having a frictional surface 202 is to be used to engage the ribbon 20 and impart to it a driving force, it is anticipated that the foam pad 95 of the invention will find utility therein.

European patent application No. , filed on 25 July 1980 and entitled "Ribbon Locating Bridge and Supply Assembly" corresponds to the U.S. patent application Serial No. 61,454 filed 27 July 1979 referred to herein.

European patent application No. , filed on 25 July 1980 and entitled "Ribbon System and Printing Apparatus and Method of Operation Thereof' corresponds to the U.S. patent application Serial No. 61,875 filed 30 July 1979 referred to herein.

European patent application No. , filed on 25 July 1980 and entitled "Ribbon Supply and Printing Apparatus with Flexible Ribbon Leader" corresponds to the U.S. patent application Serial No. 61,880 filed 30 July 1979 referred to herein.

WHAT WE CLAIM IS:

1. Ribbon supply means in which, in operation, ribbon (20) is impelled to a point of use by means of a capstan (70) in frictional engagement with said ribbon, characterized in that a resilient foam pad (95) is provided for urging said ribbon (20) into engagement with a frictional surface on said capstan (70), so that, in operation, the motion of said ribbon (20) is damped by the force exerted thereon by said foam pad (95).

2. Ribbon supply means as claimed in claim 1, characterized in that said ribbon (20) is stored in a cartridge (28).

3. Ribbon supply means as claimed in claim 2, characterized in that said capstan (70) is mounted with said cartridge (28).

4. Ribbon supply means comprising a supply of ribbon (20) and a capstan (70) for driving said ribbon in response to force applied to said capstan, characterized in that a foam pad (95) is provided for urging said ribbon into engagement with said capstan (70); whereby, in operation, relative motion of said ribbon (20) with respect to said capstan (70) is limited, said ribbon (20) is wiped by said foam pad (95) and the frictional force available between said capstan (70) and said ribbon (20) is increased by the force exerted on said ribbon by said foam pad (95).

5. Ribbon supply means as claimed in claim 4, characterized in that said ribbon (20) is disposed with its inked surface in contact with said pad (95).

6. Ribbon supply means as claimed in claim 5, characterized in that said foam pad (95) contacts said capstan (70) and said ribbon (20).

7. A printing machine having character element means (12) for being impacted into a ribbon (20) at a print location for producing a mark on a medium corresponding to a particular one of said character elements, the ribbon (20) being driven, in operation, to and from said print location by means of frictional engagement between a driving capstan (70) and said ribbon (20); characterized in that a pad (95) of a resilient foam material is located between anchoring means and said ribbon at said capstan (70) such that, in operation of the machine, said foam pad (95) wipes a surface of said ribbon (20), urges said ribbon (20) into engagement with a frictional surface on said capstan (70) and provides a damping action to limit the motion of said ribbon (20).

8. A printing machine as claimed in claim 7, characterized in that said ribbon (20) is stored in a cartridge (28).

9. A printing machine as claimed in claim 7 or claim 8, characterized in that said capstan (70) is mounted within said cartridge (28).

10. A printing machine as claimed in claim 8 or claim 9, characterized in that said anchoring means comprises a wall of said cartridge (28).

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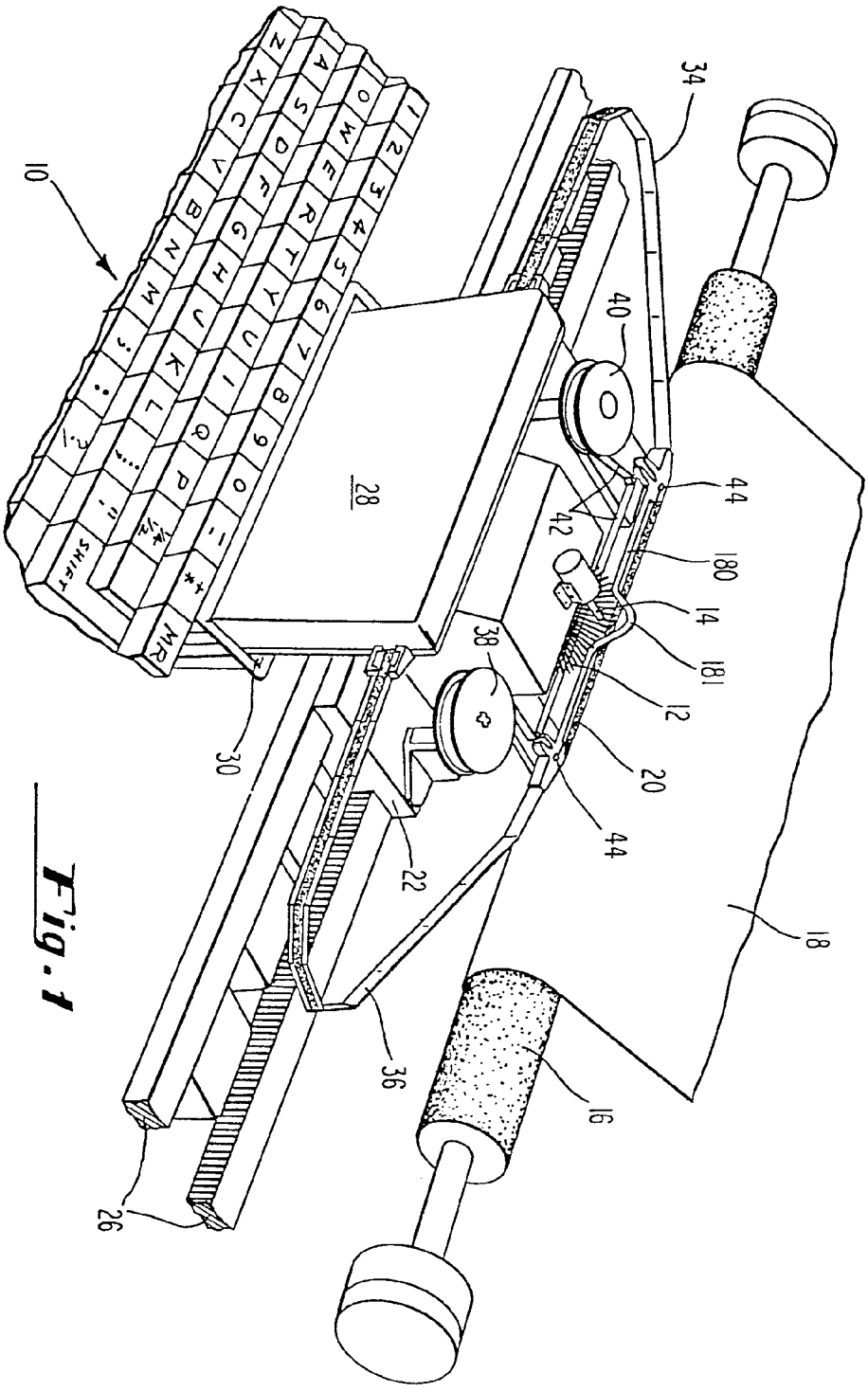

Fig. 1

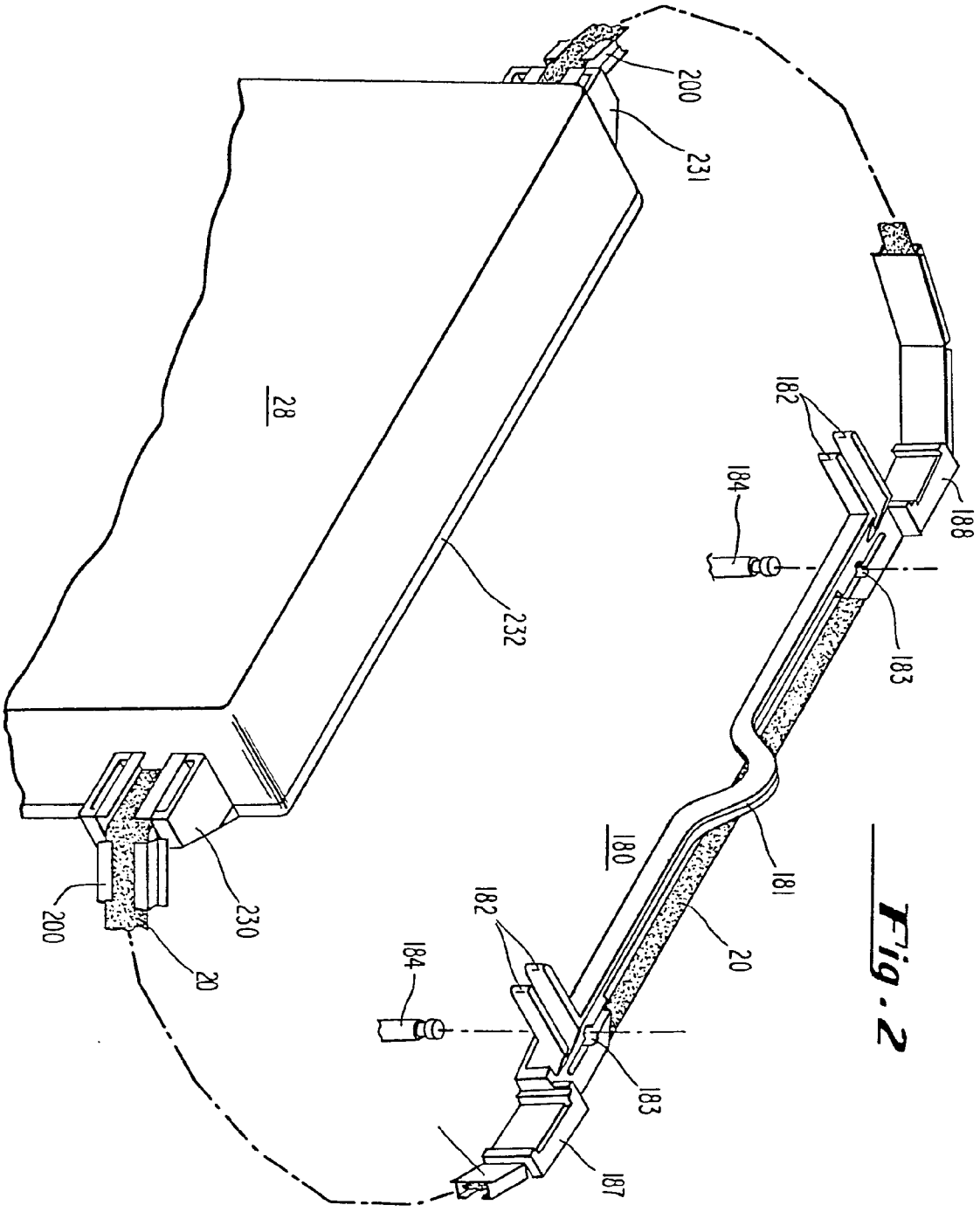
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Fig. 2

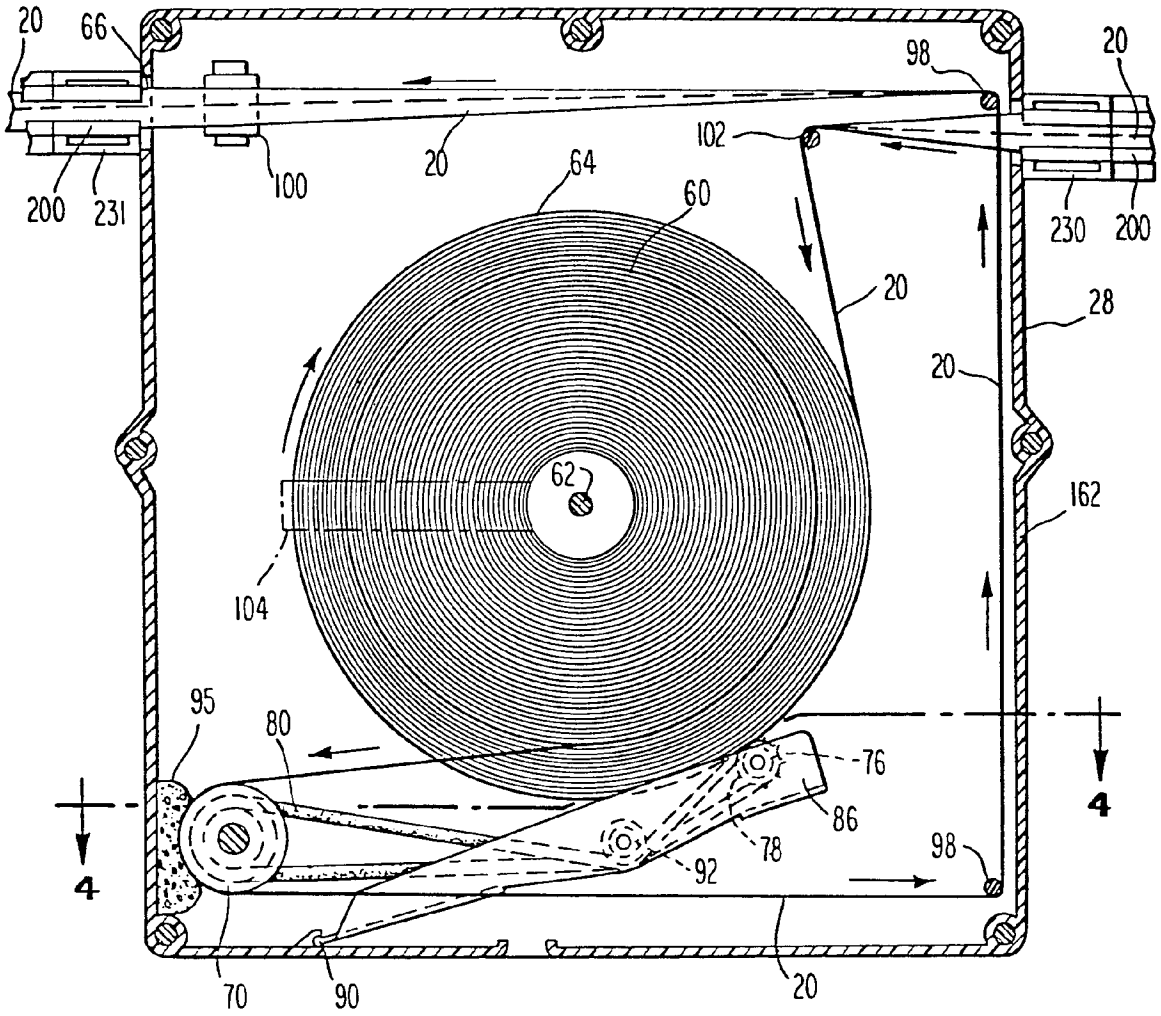
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Fig. 3

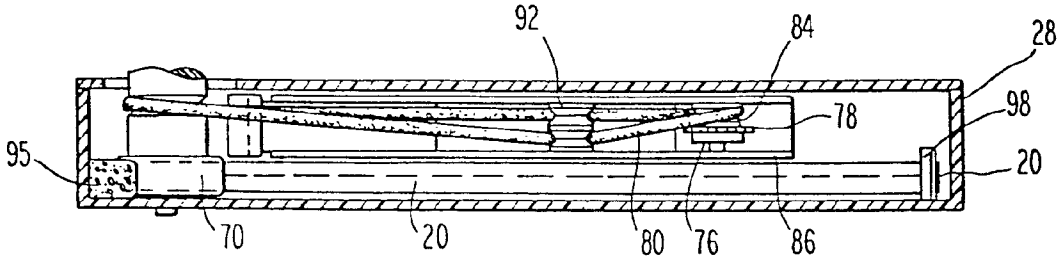
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Fig. 4

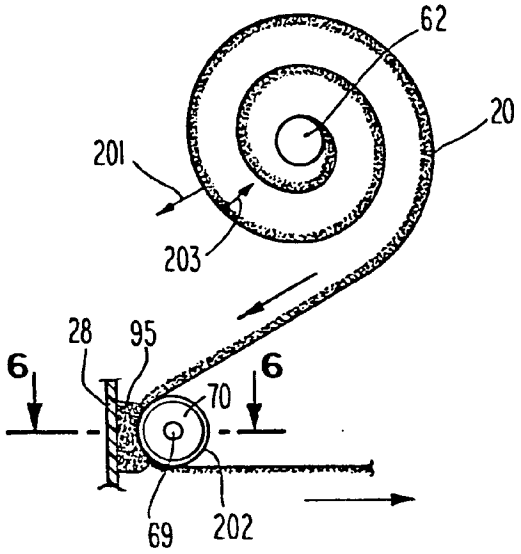

Fig. 5

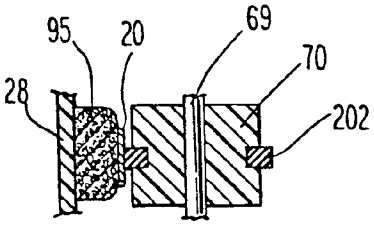

Fig. 6

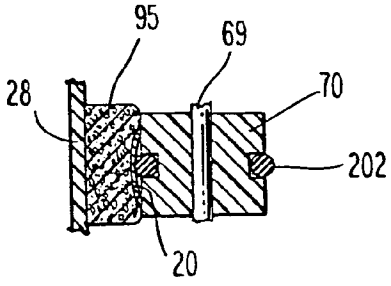

Fig. 7