(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 173 075**
B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **10.10.90**

(51) Int. Cl.[5]: **F 04 B 43/12**

(21) Application number: **85109278.3**

(22) Date of filing: **25.07.85**

(54) **Peristaltic pump.**

(30) Priority: **07.08.84 US 638597**

(43) Date of publication of application:
05.03.86 Bulletin 86/10

(45) Publication of the grant of the patent:
10.10.90 Bulletin 90/41

(84) Designated Contracting States:
BE CH DE FR GB IT LI NL SE

(56) References cited:
FR-A-1 562 024
GB-A-1 344 825
US-A-4 165 954

(73) Proprietor: **ABBOTT LABORATORIES**
14th Street and Sheridan Road North St
North Chicago Illinois 60064 (US)

(72) Inventor: **Kidera, Edward H.**
20405 45th Street
Bristol Wisconsin 53104 (US)

(74) Representative: **Modiano, Guido et al**
MODIANO, JOSIF, PISANTY & STAUB Modiano
& Associati Via Meravigli, 16
I-20123 Milano (IT)

Courier Press, Leamington Spa, England.

EP 0 173 075 B1

Description

Background of the Invention

This invention relates to peristaltic pumps which utilize flexible tubing. More particularly this invention relates to an improved mounting system for the surface against which flexible tubing is compressed in a peristaltic pump.

The operability of peristaltic pumps depends on the successive and repetitive compression of a length of flexible tubing which causes the fluid within the length of flexible tubing to flow. Accuracy of fluid flow from a peristaltic pump can only be maintained if the amount of compression of the flexible tubing can be duplicated each time a new piece of flexible tubing is operatively engaged with a peristaltic pump head.

Problems have arisen in maintaining accurate fluid flow rates in peristaltic pumps because of the varying sizes and durometers of flexible tubing employed. The problem of maintaining accurate fluid flow rates is compounded with increasing viscosities of the fluid to be pumped. In addition if the flexible tubing is not properly positioned with respect to the pump rotor and the surface against which it is compressed or if the pump head has a slight eccentricity, the rotating pump head may bind against the flexible tubing thus causing the rotation of the pump head to cease. Various attempts to overcome these problems have been made by adjustably mounting those portions of a peristaltic pump which repetitively and successively compress the flexible tubing. This adjustable mounting is designed to provide self correction for eccentricities in the pump head itself or irregularities in the flexible tubing. While improving performance these adjustable mounting systems have made peristaltic pump heads difficult to clean and difficult to manipulate when placing the flexible tubing in contact with the pump rotor.

Known from GB-A-1,344,825 is a vending machine for dispensing measured quantities of liquids wherein the liquid to be dispensed is stored in a container having a flexible tube outlet through which the liquid is delivered. The flexible tube is engaged by a peristaltic pump comprising a pump head rotatable about an axis and having a plurality of pressure wheels, a plate member having an arcuate surface against which flexible tubing may be compressed by said pressure wheels, and means for causing relative positioning of said pump head and said plate member such that said pressure wheels cooperate with said arcuate surface for causing fluid flow by the successive and repetitive compression of a length of flexible tubing inserted therebetween, said axis of said pump head being located at a stationary position, and said means for causing relative positioning of said pump head and said plate member comprising a pivot member operatively associated with said plate member, and means for resiliently biasing said arcuate surface towards said stationary position of said axis through rotation of said plate member about said pivot member, to selectively position said plate member with respect to said pump head and said axis for causing operative engagement of said arcuate surface with a length of flexible tubing.

However, while this known type of pump is capable of correcting eccentricities in the pump head itself or irregularities in the flexible tubing, such peristaltic pump head, as mentioned heretofore, is difficult to clean and difficult to manipulate when placing the flexible tube in contact with the pump rotor.

These problems of the prior art have been overcome by a peristaltic pump as defined in claim 1.

The present invention encompasses a floating compression surface for use witn a peristaltic pump. The floating compression surface is biased into position with respect to the pump rotor and against the flexible tubing so that it applies a constant force on the flexible tubing as the pump rotor turns. As those portions of the pump rotor which repetitively and successively compress the flexible tubing the surface against which the flexible tubing is compressed will rotate on a pivot mount. This rotation will allow the compression surface to respond to any irregularities in the pump rotor or in the flexible tubing. In this manner flexible tubing of varying sizes and durometers may be used with a single pump head without affecting pump accuracy.

Summary of the Invention

The device of the present invention is a compression surface for use with a peristaltic pump. Peristaltic pumps typically include rollers which successively and repetitively compress flexible tubing in order to maintain flow of fluid through flexible tubing. In order for the flexible tubing to be compressed a surface must be provided against which the rollers may compress the flexible tubing. The pressure surface of the present invention includes a plate member which has an arcuate surface against which the flexible tubing is compressed. The plate member is mounted on a pivot so that it may rotate with respect to the peristaltic pump head. Biasing means hold the plate member in operative engagement with the flexible tubing when the tubing is placed in operative engagement with the peristaltic pump head. In this manner the arcuate pressure surface floats on the flexible tubing while at the same time exerting a constant force against the flexible tubing for maintaining accuracy of fluid flow.

Brief Description of the Drawings

The device of the present invention may be better understood by reference to the drawings wherein:

FIGURE 1 is a front elevational view of a peristaltic pump, incorporating the pressure surface of this invention.

FIGURE 2 is a side elevational view partially in section of the peristaltic pump of FIGURE 1.

FIGURE 3 is a rear elevational view of the peristaltic pump of FIGURE 1.

FIGURE 4 is a view similar to FIGURE 3; however, the pressure surface has been moved away from the pump rotor.

FIGURE 5 is a partial side elevational view taken at line 5-5 of FIGURE 4.

Detailed Description of the Embodiments

Utilization of the device of the present invention may be best understood by reference to peristaltic pump, generally 20 as shown in FIGURE 1. Pump 20 consists of four main parts; specifically tubing guide piece 12, flexible tubing 22, rotatable pump head 24 and pressure plate 10. As pump head 24 rotates, pressure wheels 26 contact flexible tubing 22 to repetitively and successively compress flexible tubing 22. Arcuate surface 11 of pressure plate 10 operatively engages flexible tubing 22 to provide a surface against which pressure wheels 26 may compress flexible tubing 22. If desired arcuate surface may be bordered by a fence 13 which acts to retain flexible tubing 22 in operative engagement with a pump head 24.

FIGURE 2 illustrates the mounting of pressure plate 10 with respect to pump head 24. A rotatable pivot bar 14 extends through pressure plate 10. Pressure plate 10 is held in place on rotatable pivot bar 14 by set screw 36. As shown in FIGURES 3 and 5 arm 44 is attached to the opposite end of pivot bar 14 is arm 44. An electrical switch 30 may be placed on arm 44 to indicate the position of arm 44.

Pressure plate 10 is held in position by spring 28. Spring 28 consists of a spring retainer 64, a coil portion 62, a straight portion 58 and a bent-over portion 56. The action of straight portion 58 against cam finger 42 causes arm 44 to be biased in a downward manner. This downward biasing of arm 44 causes pump pressure plate 10 to remain in contact with and provide a surface for the compression of flexible tubing 22.

Operation

When it is desired to operatively engage flexible tubing 22 with pump head 24 to operate peristaltic pump 20 pressure plate 10 is moved out of the way as shown in FIGURE 4. As shown in FIGURE 1 flexible tubing 22 may now be threaded through tubing guide 12 and over pressure wheels 26. When flexible tubing 22 is properly in place pressure plate 10 may be moved back into position over flexible tubing 22 by manually grasping knob 16 and moving it into contact with flexible tubing 22. If desired an automatic spring return may be used. As can be best seen by comparing FIGURES 3 and 4 the moving of pressure plate 10 causes cam finger 42 to slide down straight portion 58 of spring 28. Electrical switch 30 will signal the position of the pressure head 10.

When electrical power is applied through lead 50 to motor 32 a rotating motion is imparted through speed reducer 34 to drive axle 18. Drive axle 18 causes rotatable pump head 24 to rotate. As rotatable pump head 24 rotates the incompressibility of fluid and the size and durometer of flexible tubing 22 will cause pressure plate 10 to move or float with respect to pivot bar 14 as the pump operates. Spring 28 provides a biasing force for pressure plate 10 against flexible tubing 22.

When the requisite amount of fluid has been pumped to the patient the rotation of rotatable pump head 24 may be stopped and flexible tubing 22 may be removed from the peristaltic pump 20. This removal of flexible tubing 22 is accomplished by grasping knob 16 and moving pressure plate 10 up and away from flexible tubing 22 to the position shown in FIGURE 4. As pressure plate 10 is moved away from rotatable pump head 24 cam finger 42 slides up along the straight portion of spring 28. When cam finger 42 reaches bent-over portion 56 of spring 28 the downward force felt at bent-over portion 56 caused by the action of coil portion 62, held in place by spring retainer 64, will allow pressure plate 10 to remain in the open position. If the automatic return is used plate 10 will return to the closed position when released. Closing of pressure plate 10 again is easily effected by grasping knob 16 and moving pressure plate 10 back into contact with flexible tubing 22.

In this manner pressure surface 10 around rotatable peristaltic pump head 24 is allowed to rotate on the pivot bar 14 in response to any eccentricities in the rotating pump head or irregularities in the flexible tubing.

Claims

1. A peristaltic pump comprising a pump head (24) rotatable about an axis (18) and having a plurality of pressure wheels (26), a plate member (10) having an arcuate surface (11) against which flexible tubing (22) may be compressed by said pressure wheels (26), and means for causing relative positioning of said pump head (24) and said plate member (10) such that said pressure wheels (26) cooperate with said arcuate surface (11) for causing fluid flow by the successive and repetitive compression of a length of flexible tubing (22) inserted therebetween, said axis (18) of said pump head being located at a stationary position, and said means for causing relative positioning of said pump head and said plate member comprising a pivot member (14) operatively associated with said plate member (10), and means (28) for resiliently biasing said arcuate surface (11) towards said stationary position of said axis (18) through rotation of said plate member (10) about said pivot member (14), to selectively position said plate member (10) with respect to said pump head (24) and said axis (18) for causing operative engagement of said arcuate surface (11) with a length of flexible tubing (22), characterized in that said peristaltic pump further comprises retaining means (28, 42, 62, 64), operatively associated with said plate member (10) for selectively retaining said plate member (10) in an open position, said retaining means comprising an arm (44) with at least one cam finger (42)

rigidly rotatively associated with said plate member (10) and adapted for cooperation with at least one spring (28), said cam finger (42) being adapted for sliding along said spring (28) upon pivoting movement of said plate member (10) and said arm (44).

2. A peristaltic pump according to claim 1, characterized in that said retaining means comprise at least one cam finger (42) rigidly rotatively associated with said plate member (10) and adapted for cooperation with at least one spring (28).

3. A peristaltic pump according to claim 1 or 2, characterized in that said plate member (10) is rigidly associated with a pivot bar (14), in turn rigidly associated with an arm (44), such that radial movement of said plate member (10) causes radial movement of said arm (44).

4. A peristaltic pump according to claim 3 characterized in that said arm (44) is adapted for cooperation with electrical position indicator means (30).

5. A peristaltic pump according to claim 1, characterized in that it further comprises means (16) for moving said plate member (10) from said open position to a position whereat said arcuate surface (11) cooperates with said pressure wheels (26).

6. A peristaltic pump according to claim 1, characterized in that said spring (28) comprises at least one coil portion (62), a retainer portion (64) at least one straight portion (58) and at least one bent-over portion (58), said coil portion (62) and said retainer portion (64) being adapted for biasing said straight portion (58) of said spring (28) towards said axis (18).

7. A peristaltic pump according to claim 1, characterized in that said bent-over portion (58) of said spring (28) is adapted for cooperation with said cam finger (42) for retaining said arm (44) and said plate member (10) in said open position.

8. A peristaltic pump according to claim 1 or 5 characterized in that said arcuate surface (11) of said plate member (10) is bordered by at least one fence (13), adapted for retaining flexible tubing (22) in operative engagement with said pressure wheels.

Patentansprüche

1. Schlauchpumpe, die einen Pumpenkopf (24), der um eine Achse (18) drehbar ist und eine Mehrzahl von Druckrädern (26) hat, ein Plattenteil (10), das eine gewölbte Fläche (11) hat, gegen die die flexible Schlauchleitung (22) mittels der Druckräder (26) zusammengedrückt werden kann, und eine Einrichtung aufweist, welche eine relative Positionierung des Pumpenkopfs (24) und des Plattenteils (10) derart bewirkt, daß die Druckräder (26) mit der gewölbten Fläche (11) zusammenarbeiten, um zu bewirken, daß ein Fluid durch das aufeinanderfolgende und wiederholte Zusammendrücken eines Längsstücks der flexiblen Schlauchleitung (22) die dazwischen eingeführt ist, strömt, wobei die Achse (18) des Pumpenkopfs sich an einer festen Stelle befindet, und die Einrichtung, welche eine relative Positionierung des Pumpenkopfs und des Plattenteils bewirkt, ein Schwenkteil (14) aufweist, das betriebsmäßig mit dem Plattenteil (10) verbunden ist, und eine Einrichtung (28) aufweist, die die gewölbte Fläche (11) federnd nachgiebig in Richtung auf die feste Stellung der Achse (18) durch das Drehen des Plattenteils (10) um das Schwenkteil (14) vorbelastet, um selektiv die Position des Plattenteils (10) bezüglich des Pumpenkopfs (24) und der Achse (18) zum Bewirken eines Betriebseingriffes der gewölbten Fläche (11) im Zusammenwirken mit einem Längsstück der flexiblen Schlauchleitung (22) zu positionieren, dadurch gekennzeichnet, daß die Schlauchpumpe ferner eine Halteeinrichtung (28, 42, 62, 64) aufweist, die betriebsmäßig mit dem Plattenteil (10) zum selektiven Festlegen des Plattenteils (10) in einer Offenstellung zugeordnet ist, daß die Halteeinrichtung einen Arm (44) mit wenigstens einem Nockenfinger (42) aufweist, der drehfest mit dem Plattenteil (10) verbunden ist und derart beschaffen und ausgelegt ist, daß er mit wenigstens einer Feder (28) zusammenarbeitet, und daß der Nockenfinger (42) derart beschaffen ist, daß er längs der Feder (28) bei der Schwenkbewegung des Plattenteils (10) und des Arms (24) gleitbeweglich ist.

2. Schlauchpumpe nach Anspruch 1, dadurch gekennzeichnet, daß die Halteeinrichtung wenigstens einen Nockenfinger (42) aufweist, der drehfest mit dem Plattenteil (10) verbunden ist und derart ausgelegt ist, daß er mit wenigstens einer Feder (28) zusammenarbeiten kann.

3. Schlauchpumpe nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das Plattenteil (10) starr mit einem Schwenkglied (14) verbunden ist, das seinerseits starr mit einem Arm (44) verbunden ist so daß die Radialbewegung des Plattenteils (10) eine Radialbewegung des Arms (44) bewirkt.

4. Schlauchpumpe nach Anspruch 3, dadurch gekennzeichnet, daß der Arm (44) so beschaffen ist, daß er mit einer elektrischen Positionsanzeigeeinrichtung (30) zusammenarbeitet.

5. Schlauchpumpe nach Anspruch 1, dadurch gekennzeichnet, daß sie ferner eine Einrichtung (16) zum Bewegen des Plattenteils (10) von seiner Offenstellung zu einer Stellung aufweist, an der die gewölbte Fläche (11) mit den Druckrädern (26) zusammenarbeitet.

6. Schlauchpumpe nach Anspruch 1, dadurch gekennzeichnet, daß die Feder (28) wenigstens einen Windungsabschnitt (62), einen Halteabschnitt (64) an wenigstens einem geraden Abschnitt (58) und wenigstens einen umgebogenen Abschnitt (58) aufweist, wobei der Windungsabschnitt (62) und der Halteabschnitt (64) derart beschaffen und ausgelegt sind, daß sie den geraden Abschnitt (58) der Feder (28) in Richtung auf die Achse (18) vorbelasten.

7. Schlauchpumpe nach Anspruch 1, dadurch gekennzeichnet, daß der umgebogene Abschnitt (58) der Feder (28) derart ausgelegt ist, daß er mit dem Nockenfinger (42) zum Festhalten des Arms

(44) und des Plattenteils (10) in der Offenstellung zusammenarbeiten kann.

8. Schlauchpumpe nach Anspruch 1 oder 5, dadurch gekennzeichnet, daß die gewölbte Fläche (11) des Plattenteils (10) durch wenigstens einen Begrenzungsrand (13) begrenzt wird, welcher derart ausgelegt ist, daß die flexible Schlauchleitung (22) in Betriebseingriff mit den Druckrädern festgehalten ist.

Revendications

1. Une pompe péristaltique comprenant une tête de pompe (24) pivotante autour d'un arbre (18) et munie d'un ensemble de roues de pression (26), d'une plaque-support (10) comportant une surface incurvée (11) contre laquelle un tube flexible (22) peut être comprimé par les dites roues de pression (26) et de moyens destinés à provoquer le positionnement relatif de la dite tête et de la dite surface, de telle sorte que les dites roues de pression agissent en coopération avec la dite surface pour entraîner l'écoulement du fluide, grâce à la compression succesive et répétitive d'une certaine longueur de tube flexible insèré entre elles; le dit axe de la dite tête ayant été mis dans une position stationnaire, les dits moyens destinés à provoquer le positionnement relatif de la dite tête de pompe et de la dite plaque-support comportant un pivot-support associé de manière opérationnelle à la dite plaque-support,

- des moyens de maintien de la dite surface incurvée vers la dite position stationnaire du dit axe grâce à la rotation de la dite plaque-support autour du pivot-support pour positionner de façon sélective la plaque-support par rapport à la dite tête de pompe et provoquer la mise en contact de la dite surface incurvée avec une longueur donnée du tube flexible.

Cette pompe péristaltique est caractérisée en ce qu'elle est munie de moyens supplémentaire de retenue (28, 42, 62, 64) associés à la dite plaque-support (10) pour maintenir de façon sélective la dite plaque-support (10) en position ouverte; ces dits moyens de retenue comprennent un bras (44) associé à au moins un poussoir de came (42), associé rigidement pendant la rotation à la dite plaque-support (10) et adapté à une action commune avec au moins un ressort (28), le poussoir de la came (42) étant adapté à un glissement le long du dit ressort (28) pendant le mouvement de pivotement de la dite plaque-support (10) et du dit bras (44).

2. Une pompe péristaltique selon la revendication 1, caractérisée en ce que les moyens de retenue comportent au moins un poussoir de came (42) associé rigidement au pivotement de la dite plaque (10) et adapté à une action commune avec au moins un ressort (28).

3. Une pompe péristaltique selon les revendications 1 ou 2, caractérisée en ce que la dite plaque (10) est associée rigidement à une barre pivotante (14) qui est, à son tour, fixée à un bras (44), de telle sorte qu'un mouvement radial de la dite plaque (10) entraîne un mouvement radial du dit bras (44).

4. Une pompe péristaltique selon la revendication 3, caractérisée en ce que le dit bras (44) est adapté à une action coordonnée avec des moyens électriques d'indication de position (30).

5. Une pompe péristaltique selon la revendication 1, caractérisée en ce qu'elle comporte des moyens supplémentaires (16) destinés à déplacer la dite plaque (10) depuis une dite position ouverte vers une position dans laquelle la dite surface incurvée (11) a une action coordonnée avec les dites roues de pression (26).

6. Une pompe péristaltique selon la revendication 1, caractérisée en ce que le dit ressort (28) comporte au moins une partie enroulée (62), une partie de retenue (64), au moins une partie rectiligne (58) et au moins une section recourbée vers le haut (58); la dite partie enroulée (62) et la dite partie de retenue sont destinés au maintien de la dite partie rectiligne (58) du dit ressort (28) dans la direction du dit axe (18).

7. Une pompe péristaltique selon la revendication 1, caractérisée en ce que la dite partie recourbée vers le haut (56) du dit ressort (28) est adaptée à une action commune avec le dit poussoir de la came (42) pour retenir le dit arbre (44) et la plaque-support (10) dans la dite position ouverte.

8. Une pompe péristaltique selon les revendications 1 ou 5, caractérisée en ce que la dite surface incurvée (11) de la dite plaque-support est entourée par au moins une bordure (13) disposée de façon à maintenir le tube flexible (22) en contact effectif avec les dites roues de pression.

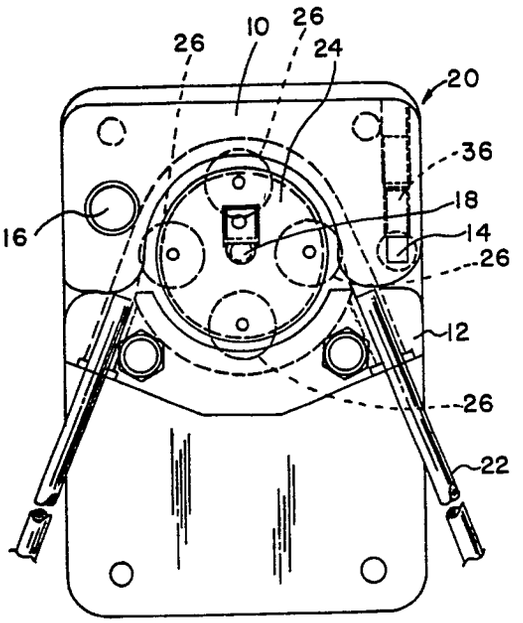

FIG. 1

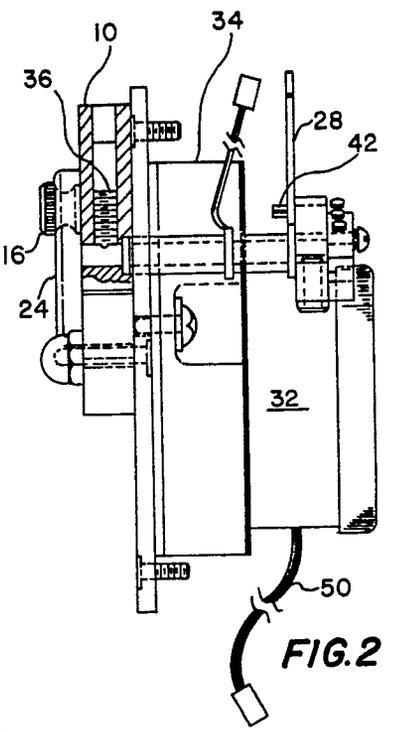

FIG. 2

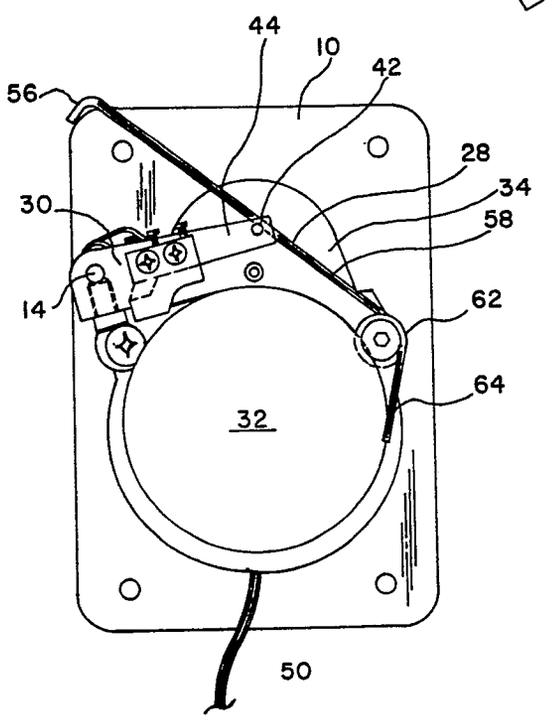

FIG. 3

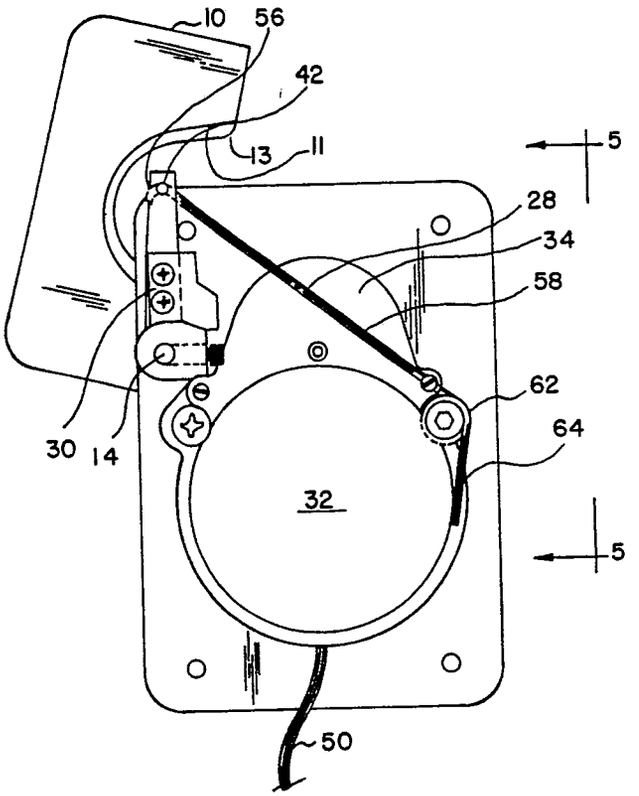

FIG. 4

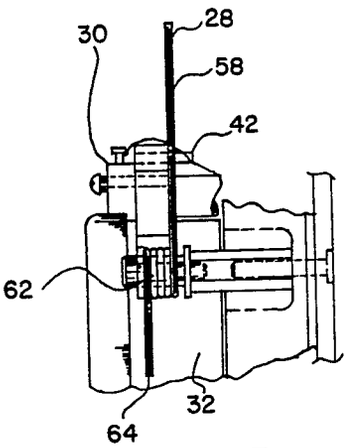

FIG. 5