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(54) **Peristaltic hose pump.**

(57) Hoses (52) are tensioned between an input manifold (38) and an output manifold (28), passing round a rotor (34) comprising four sleeved rods (60, 64) which provide the peristaltic pumping action. The input manifold (38) is movably supported by pivotally mounted arms (40) for adjusting the hose tension. The input manifold (38) is pivotally mounted in the arms (40) and the output manifold (28) is pivotally mounted in the front frame so that the manifolds can rock about the axis parallel to the rotor axis and thereby accommodate tilting of the ends of the hoses (52) as the rotor rotates. This reduces hose fatigue. Hose tension is established by a compression spring tightened between a knob (156) screwed onto the end of a fixed rod (142) and a sliding bar (130) acting on the support arms (40) by way of links (116 and 120). A given tightening of the knob (156) towards the bars (130) corresponds to a given hose tension. A stop structure prevents the knob (156) being tightened beyond a setting corresponding to a predetermined maximum hose tension.

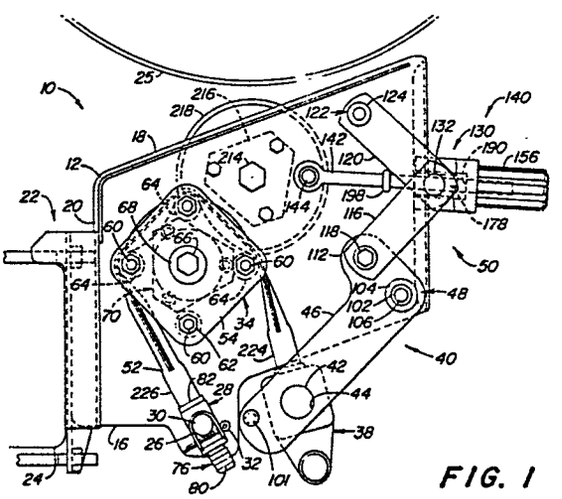


FIG. 1

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PERISTALTIC HOSE PUMP

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The present invention relates to a peristaltic hose pump comprising a plurality of hoses tensioned between an input manifold and an output manifold in an arc about a rotor which carries a plurality of circumferentially spaced pumping protuberances which induce peristaltic action in the hoses as the rotor rotates.

Such pumps are known from US 3 079 868, US 3 403 631 and US 3 781 142. The term manifold is used for convenience even although there may not be common flow at one or the other or both of the manifolds.

One problem with the known pumps is that, as the rotor rotates, the hoses kink if the manifolds are not properly aligned. Even when the hoses are aligned as recommended, hose ends will work against the respective connections (nipples) with the manifolds, as the rotor rotates. This flexing on the nipples reduces hose life and, when the hoses kink, the pump rate is reduced.

The first object of the present invention is to overcome the problem just outlined. To this end the pump is characterised in that the manifolds are pivotally mounted so that they can rock about axes parallel to the rotor axis and thereby accommodate tilting movements of the ends of the hoses as the rotor rotates. With previously available hose pumps, maintaining the desired hose tension for a uniform pumping rate has been a continuing problem.

If the hoses are too loosely tensioned around the rotor, the pumping rate from one hose to the next will be inconsistent and gravity feed will often cause an increased pumping rate. If, on the other hand, the hoses are tensioned too tightly around the rollers, the hoses will collapse and the rate will be reduced. In addition, the increased tension will decrease hose life. Periodic tensioning of the hoses is necessary during use to maintain the proper relationship between the hoses and the rollers. As the hoses stretch and take set, the tension must be readjusted. Many of the prior art devices are relatively difficult to adjust. With some, the operator must observe the hoses and adjust the tension so that the hose shape appears to be satisfactory. In others, it is

necessary to let liquid gravity feed through the hoses while they are relaxed and to continue to tension the hoses until the gravity feed is terminated. To adjust the tension of the hoses, it is common for one manifold to be moved relative to the roller assembly and this is either done by repositioning a manifold bracket which involves loosening and retightening of bracket bolts, or by adjusting a plate which supports the hose barbs (US 3 079 868 and US 3 403 631). Often these procedures are awkward and result in a less than precise adjustment of the hose tension. Therefore, pumping rates from hose to hose commonly have varied from the desired levels and hose life has not been as long as desired. With some pumps, rollers on the rotor are moved radially which involves loosening and retightening numerous bolts. Commonly with some of the available hose pumps, hoses are changed to change the pump rate, and the nipples which support the ends of the hoses must also be changed since the hoses are extruded and the ends of the hoses are the same diameter or shape as the remaining portion of the hoses. This can also be a time-consuming job since it is not uncommon for hose pumps to have eight or more nipples. In US 3 781 142 a screw adjustment is provided for positioning one manifold but no indication of the resulting hose tension is given. There is no correspondence between manifold position and hose tension as the tension depends also on hose length.

Although adjustment of a manifold is convenient, hose tension could also be adjusted by adjusting the rotor position.

A second object of the invention is to facilitate the setting of the correct hose tension. There is therefore provided a pump as first set forth above characterised by a resilient device providing tension in the hoses and including an adjusting device for adjusting the tension, whereby there is direct correspondence between the tension adjustment and the tension in the hoses.

Hose pumps are often used in a hostile environment, such as on agricultural implements to meter out fertilizer and other chemicals, and rollers and roller bearings of the rotor assembly are subject to corrosion and premature failure and therefore must be changed relatively often during the life of the pump. Failure of the rollers

to rotate properly results in excessive wear and tear on the rotor and the hoses and can adversely affect the application rate. The manifolds, too, are subject to corrosion and need for replacement since they are typically fabricated from steel.

The preferred embodiment of the invention includes an input and an output manifold pivotally connected for rocking with respect to the pump housing. A plurality of hoses are connected between the manifolds and are tensioned around a rotor which includes a plurality of steel shafts each rotatably supporting a high pressure laminated sleeve for rolling contact with the hoses. The sleeves are non-corroding and long-wearing and rotate easily even if the metal shaft begins to corrode. An interchangeable pair of gears drives the roller assembly to pump fluid from the input manifold to the output manifold. Kinking and flexing of the hoses adjacent their connections with the manifolds is prevented by permitting the manifolds to rock into alignment with the hoses. As a result, pump rates will be more consistent and hose life will be increased.

One of the manifolds is supported by a movable manifold bracket assembly connected to a resilient tensioning assembly which permits easy and accurate tension adjustments without tools. A screw-thread tensioning device including a protective plastic, internally threaded knob is utilized which incorporates a compression spring collapsed a preselected distance, thereby to obtain a preselected tension in the hoses. A ratcheting device prevents over-tensioning of the hoses so that pump rates will be consistent and closer to the desired level, and hose life will be increased.

Both manifolds are moulded one-piece plastic and include integral hose nipples all of the same size. The different hose sizes, which achieve different pump rates, are moulded with ends of the same diameter, permitting them to be interchanged on the manifolds without changing nipples. The plastic construction reduces problems of corrosion as well as reduces weight and the number of parts in the pump assembly.

All rate changes can be made easily without tools, except for changes effected by replacing hoses, and hose changes are greatly

simplified by the moulded hoses with uniform end configuration. The hoses are more easily attached in fluid-tight relationship on the nipples than, for example, extruded hoses with a non-circular cross section. As the hoses stretch and take set, the tension can be readjusted simply by rotating the plastic knob until the ratcheting structure stops the handle to indicate that the spring is collapsed the preselected distance. The ratcheting structure also permits the tension to be relieved easily.

The invention will be described in more detail, by way of example, with reference to the accompanying drawings, in which:

Fig 1 is a side view of a peristaltic pump embodying the invention with some parts removed to more clearly show the roller and tensioning assemblies.

Fig 2 is a rear view of the hose pump shown in Fig 1 but with the hoses removed.

Fig 3 is an exploded view of the pump shown in Fig 1.

Fig 4 is a rear view of the tension adjusting bar utilized with the pump of Fig 1.

Fig 5 is a bottom view of the bar of Fig 4.

Fig 6 is an enlarged side view of the tension adjusting handle utilized with the pump of Fig 1.

Fig 7 is an end view of the handle of Fig 6.

Fig 8 is a view of a high capacity hose with an enlarged center section which may be utilized to replace the lower capacity hoses shown on the hose pump of Fig 3.

Fig 9 is a view taken along line 9--9 of Fig 8.

Referring now to the drawings, therein is shown a hose pump assembly 10 including a pump housing 12 having upright and spaced-apart sidewalls 14 and 16 joined by upper and forward wall sections 18 and 20, respectively. A bracket arrangement 22 is connected to the forward wall 20 for supporting the hose pump assembly 10 on the square tubular beam 24 of an implement toolbar or frame. The frame 24 also supports a tank 25 filled with fluid to be dispensed, for example, to individual planter row units (not shown) connected to the frame. As described herein, the forward direction is to the left as viewed in Fig 1 but it is to be understood that the pump assembly

10 may be mounted in any direction on the beam 24 as available space permits. In the environment of a planter with rearwardly extending row units, the assembly 10 is preferably mounted on the forward face of the beam.

Downwardly opening, U-shaped brackets 26 extend inwardly from the lower portions of the sidewalls 14 and 16. A transversely extending output manifold 28 is rockably supported within the brackets 26. The manifold 28 includes end pivots 30 which are held captive in the brackets 26 by pins 32 (Fig 1). The manifold 28 is freely rockable about the axis of the pivots 30 between the sidewalls 14 and 16.

A roller assembly 34 is supported for rotation about an axis generally parallel to the pivotal axis of the manifold 28 between the sidewalls 14 and 16 above the manifold 28. A transversely extending input manifold 38 is rockably supported between the sidewalls 14 and 16 on the opposite side of the roller assembly 34 by a movable manifold bracket assembly 40. The manifold 38 includes end pivots 42 which are received in apertures 44 located in side arms 46 of the manifold bracket 40 for permitting the manifold to rock about a transverse axis generally parallel to that of the output manifold 28 and roller assembly 34. The side arms 46 are located inwardly adjacent the respective sidewalls 14 and 16 of the pump housing 12 and are connected thereto by a pivot assembly 48. An adjustable tensioning assembly 50, which will be discussed in detail later, is operably connected to the manifold bracket 40 to rock the input manifold 38 with respect to the roller assembly 34. A plurality of elastomer hoses 52 are connected between the input manifold 38 and the output manifold 28 and are tensioned around the roller assembly 34 so that as the assembly is rotated in the counterclockwise direction (Figs 1 and 3) in contact with the hoses 52, fluid will be pumped from the input manifold 38 through the hoses. Because the manifolds 28 and 38 are pivotally connected to their respective supportive members, the manifolds will automatically remain aligned with the hoses during rotation of the roller assembly 34 and as the manifold bracket 40 is adjusted by the tensioning assembly 50.

The roller assembly 34 includes a pair of transversely spaced, generally square plates 54 with apertures 56 located near the corners thereof. Four identical steel pump roller shafts 58 having reduced, threaded ends 60 are inserted through the holes 56 of the plates 54 and are non-rotatably held in position therein by nuts 62. Cylindrically shaped phenolic plastic bearings or sleeves 64 having an inner diameter approximately equal to but slightly larger than the diameter of the pump roller shafts 58 are mounted for rotation on the shafts and extend susbtantially the entire transverse distance between the plates 54. The plates 54 are non-rotatably supported on a hexagonal pump shaft 66 which extends through complementary shaped apertures in bushings 68 supported centrally on the plates 54. In turn, the shaft 66 is supported for rotation in the sidewalls 14 and 16 by bearing assemblies 70. The axes of the shafts 58 are parallel to, and spaced radially outwardly an equal distance from, the shaft 66.

The output manifold 28 includes an elongated plastic body 74 supporting a plurality of transversely spaced upright "barbs" or nipples 76 which are moulded integrally therewith and extend from an upper hose-receiving end 78 through the body 74 to a lower output terminal end 80. A fluid path is thus provided between the ends 78 and 80 of each of the barbs 76, but the individual barbs 76 are isolated from each other. The output ends of the hoses 52 are inserted over the upper ends 78 of the barbs 76 and are held in position thereon by hose clamps 82. The lower ends 80 are in turn connected to individual output feed lines (not shown) which direct the metered liquid to the desired locations, such as to individual row units on a planter.

In the preferred embodiment, the input manifold 38 is fabricated from plastic and includes upwardly projecting barbs 86 moulded integrally with the remainder of the manifold. The manifold 38 includes a transversely elongated, hollow body 88 which communicates with the barbs 86. Two input terminals 90 project transversely from a central section 92 of the input manifold and communicate with the hollow interior of the body 88. A supply line (not shown) is connected to one of the terminals 90 and to the source 25 of fluid

to be pumped, which is preferably located above the level of the pump 10. The remaining terminal may be capped, such as with the closure assembly 94 shown in Fig 3, or a hose may be attached to the terminal to direct fluid to another location, such as a second hose pump assembly. The input ends of the hoses 52 are positioned over the barbs 86 and held in position thereon by hose clips 98.

The input manifold 38 is rockably connected to and extends transversely between the side arms 46 of the manifold bracket assembly 40. the side arms 46 extend generally in the fore-and-aft direction inwardly of and closely adjacent to the sides 14 and 16 of the pump housing 12. A threaded spacer rod 101 extends between and is connected to the forward ends of the side arms 46 to maintain the proper spacing therebetween. The aft ends of the arms 46 are pivotally connected to a pivot tube 102 which extends through a cylindrical shaped spacing member 104 fixed to the arms. A threaded rod 106 extends through the pivot tube 102 and through apertures in the sidewalls 14 and 16. The rod 106 is secured between the sidewalls by lock nuts 108. As viewed in Figs 1 and 3, the side arms 46 include apertured projections 112 located above the pivotal connection of the manifold bracket 40 with the sidewalls 14 and 16. The tension-adjusting assembly 50 is connected to the apertured projections 112 for rocking the manifold bracket 40 about its pivotal connection with the sidewalls to move the input manifold 38 relative to the roller assembly 34 and the output manifold 28, and thereby adjust the tension of the hoses 52 around the sleeves 64 which are located on the pump roller shafts 58.

Connected to each aperatured projection 112 of the manifold bracket 40 is a first tension adjusting strut or link 116. The lower end of the link 116 is pivotally connected by a cap screw 118 to the projection 112. The upper end of the link 116 is pivotally conencted to the lower end of a second tension djusting strut or link 120. The upper ends of the second links 120 are each pivotally connected to the sidewalls 14 and 16 of the pump housing 12 by a pivot assembly 122 which includes a shouldered bushing 124 located between the link 120 and the respective sidewall and a cap screw 126

extending through an aperture 128 in the sidewall.

A tension adjusting bar 130 extends between the link pairs 116, 120 and includes end projections 132 which define the respective pivotal connections between the upper ends of the links 116 and the lower ends of the links 120. The projections 132 terminate closely adjacent the inside of the sidewals 14 and 16 and are grooved at 133 to receive snap rings 134 which maintain the links 116 and 120 pivotally connected to the projections. As best seen in Figs 1 and 3, the links 116 and 120 are approximately equal in length and extend at an angle rearwardly from a transverse vertical plane so that as the tension adjusting bar 130 is urged forwardly (that is, to the left as viewed in Figs 1 and 3) the lower ends of the links 116 will be urged downwardly. The lower ends of the links 116 are pivotally connected by the cap screws 118 to the upward ends of the projections 112 at a location generally forward of the pivotal connection 48 of the manifold bracket 40 with the housing 12 so that as the tension adjusting bar 130 is moved forwardly, the side arms 46 will be pivoted downwardly to increase the tension on the hoses 52.

As adjustable knob assembly 140 is provided to urge the tension adjusting bar 130 to the left to provide a predetermined tension on the hoses 52. The assembly 140 includes an eyebolt 142 having its eye end pivotally connected to a threaded rod 144 which extends transversely through the pump housing 12. The threaded ends of the rod 144 extend through the sidewalls 14 and 16 and are secured thereto by a pair of nuts 146. The eyebolt 142 is generally centered with respect to the sidewalls by a pair of equal length spacers 148 supported on the rod 144 on either side of the eyebolt. The tension adjusting bar 130 includes an enlarged and apertured central portion 150 which receives the eyebolt 142 therethrough and permits the adjusting bar 130 to slide freely thereon in generally a fore-and-aft direction. A coil spring 152 (Fig 3) is inserted over the eyebolt 142 and has a forward end which abuts against the tension adjusting bar 130 and a rearward end located inwardly of the end of the eyebolt. The end of the eyebolt 142 is threaded and receives an internally threaded plastic knob 156 thereon. As the

knob 156 is screwed on to the eyebolt, the knob abuts the aft end of the spring 152 and compresses the spring against the tension adjusting bar 130. The tension adjusting bar 130, in turn, acts against the links 116 and 120 to bias the manifold bracket 40 downwardly to tension the hoses 52 about the roller assembly 34. Therefore, the tension on the hoses 52 is directly related to the compression of the coil spring 152. The amount of compression of the spring 152 provides an indication of the tension in the hoses 52. As the knob 156 is turned to compress the spring 152, the tension adjusting bar 130 will slide over the shank of the eyebolt 142. As the tension in the hoses 52 increases, the coil spring 152 will compress to cause the forward end of the handle 156 to move closer to the enlarged center section 150 of the bar 130. Therefore, for a given tension of the hoses 52, the forward end of the knob 56 will be a preselected distance from the enlarged center section 150 of the bar 130. A cammed stop structure 160 (Figs 4 and 5) is provided on the rearwardly facing surface of the enlarged center section 150 to engage a forward end face surface 162 (Figs 6 and 7) of the knob 156. The knob face 162 includes a pair of opposed segments 164 and 166, each with a cam surface which rises in the counterclockwise direction (Fig 7) from a lowermost portion 168 to an abutment surface 170. The mating cammed stop structure 160 on the tension adjusting bar 130 (Figs 4 and 5) includes two camming surfaces 174 and 176 which rise in the counterclockwise direction (as viewed in Fig 4) to abutment surfaces 178 which face and are adapted to engage the abutment surfaces 170 of the knob 156 when a preselected spring compression is reached. The surfaces act as stops to prevent the knob from being rotated onto the eyebolt 142 beyond the position wherein the spring 152 is compressed to provide the preselected hose tension. Therefore, over-tightening of the hoses 52 is prevented. The camming surfaces 164, 166 and 174, 176 permit the knob to be rotated in the opposite direction from the stopped position to reduce the compression of the coil spring 152 and correspondingly
decrease the tension of the hoses 52.

A circular spring-receiving cavity 182 is provided in the enlarged center section 150 of the tension adjusting bar 130. The

cavity 182 is located radially inwardly of the surfaces 174 nd 176, which as best seen in Fig 4 are generally arc-shaped. The cavity 182 has a diameter slightly larger than the diameter of the coil spring 152 and receives the forward end of the coil spring therein. The forward end of the spring 152 abuts against forward end 184 of the cavity 182. An aperture 186 is provided coincentric with the circular cavity 182, but of smaller diameter, to receive the eyebolt 142 therethrough and permit the bar 130 to move fore-and-aft with respect to the eyebolt and the sidewalls 14 and 16 as the knob 156 is rotated.

The knob 156 includes an enlarged circular end portion 186 (Fig 6) of diameter equal to the diameter of the center section 150 and a forwardly opening circular cavity 188 of diameter slightly larger than that of the coil spring 152. The cavity 188 includes a forwardly directed spring-abutting surface 190. An internally threaded cavity 194 extends rearwardly from the abutment surface 190 through the grip portion of the knob 156. As the knob 156 is screwed on to the threaded end of the eyebolt 142, the aft end of the coil spring 152 is received in the cavity 188, and the spring is urged against the tension adjusting bar 130. The threaded end of the eyebolt 142 remains protected by the plastic knob 156 to prevent corrosion.

An enlargement or collar 198 is provided on the eyebolt between the eye end and the tension adjusting bar 130 to limit the forward movement of the bar 130 so that the straps 116, 120 will not be urged to an over-center position. A spacer 202 (Fig 3) may be placed over the eyebolt 142 in one of the cavities 182 or 188 against one end of the spring 152 to provide increased spring compression for a given knob position. Therefore, the preselected tension can be changed as necessary for example, when the number of hoses 52 is changed. As shown in Fig 3, six hoses 52 are provided, and the spacer 202 is inserted in the circular cavity 182 to increase the preselected tension. If only four hoses 52 are necessary, for example, when the pump 10 is utilized to supply four individual row units instead of six, two of the input barbs 86 are capped with closures such as indicated generally at 204. Since the number of hoses 52 has decreased, it is necessary to decrease the

overall force exerted on the input manifold 38 by the manifold bracket 40, and therefore the spacer 202 is removed to decrease the spring compression when the abutment surface 170 of the knob contacts the corresponding abutment surface 178 of the tension adjusting bar 130.

A spur gear 210 is releasably connected to one end of the pump shaft 66 by a quick connect pin 212. A drive shaft 214 is supported for rotation within the housing 12 by a pair of bearing assemblies 216 (Fig 1), connected to the sidewalls 14 and 16, for rotation about an axis parallel to the axis of the shaft 66. A drive gear 218 is supported on the end of the drive shaft 214 and meshes with the gear 210. The gear 218 is releaseably supported on the shaft by a second quick connect pin 220. As the gear 210 is driven by the gear 218, the roller assembly 34 rotates and the pump roller sleeves 64 rotate on the respective pump roller shafts 58 in contact with the underside of the hoses 52 to move fluid from the input manifold 38 to the output manifold 28. In the preferred embodiment, the sleeves 64 fabricated from high pressure laminated tube NEMA grade LE, which provides an extremely long-lasting bearing surface which is highly resistant to heat and which will seldom if ever need replacing during the life of the pump 10. The sleeves 64 also reduce the area of metal that is exposed for contamination by corrosive fluids and are not affected by any corrosion that might occur on the fixed steel shafts 58.

The input and output manifolds 38 and 28 and the tension adjusting bar 130 are fabricated from plastic material to also reduce problems of corrosion and to reduce cost and weight. In the preferred embodiment, the input manifold 92 is moulded from high density polyethylene, and the output manifold 28 and the tension adjusting bar 130 are moulded from glass fiber reinforced thermal plastic polyester. The barbs 76 and 86 are moulded integrally with the remainder of the output and input manifolds 28 and 38, respectively, which reduces the total number of parts and decreases assembly time.

To eliminate the need to change the size of the barbs 76 and 86 when one size of hose 52 is replaced with another size to change the

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capacity of the pump 10, the hoses 52 are moulded with common sized input and output end sections 224 and 226, respectively. Each end section 224 and 226 (Fig 8) is circular in cross section for better clamping action than, for example, an extruded hose having a constant oval or flattened cross section throughout its length. The hoses 52 include central portions 228 moulded in an oval or flattened configuration (Fig 9) for better sealing and pumping action. The oval cross section includes a major axis 229 substantially parallel to the axis of rotation of each of the sleeves 64 so that the hose 52 seals more effectively against the sleeves as the latter are rolled along or held stationary against the tensioned hose. As best seen in Fig 1, the circumferential spacing of the sleeves 64 results in fore-and-aft movement of hoses 52 near the extremities of the central portion 228 as the roller assembly 34 rotates. The axes of the barbs 76 and 86 automatically remain aligned with the corresponding hoses due to the pivoting action of the manifolds 28 and 38 to reduce hose fatigue adjacent the barb connection and prevent any kinking which could affect pump rate.

The drive shaft 214 is connected to a variable ratio drive transmission (not shown). To change the range of speeds available for the roller assembly 34, the gears 210 and 218, which have differing numbers to teeth, may be exchanged on the shafts 66 and 214 to change the sprocket ratio. In addition, pumping rate changes may be effected by replacing the hoses 52 with similar hoses which have a central portion with larger (Fig 8) or smaller center section 228 cross section depending on whether the pumping rate is to be increased or decreased, respectively. Since the ends 224 and 226 of the hoses 52 are of the same size regardless of the size of the center section 228, the input and output manifolds 38 and 28 do not have to be replaced when a hose change is made. All rate changes, except those accomplished by changing hose size, can be made without tools by adjusting the drive transmission and/or changing the gears 210 and 218.

CLAIMS

1. A peristaltic hose pump comprising a plurality of hoses (52) tensioned between an input manifold (38) and an output manifold (28) in an arc about a rotor (34) which carries a plurality of circumferentially spaced pumping protuberances (58, 64) which induce peristaltic action in the hoses as the rotor rotates, characterised in that the manifolds (28, 38) are pivotally mounted so that they can rock about axes parallel to the rotor axis and thereby accommodate tilting movements of the ends of the hoses (52) as the rotor (34) rotates.

2. A pump according to claim 1, characterised by a resilient device (40, 130, 140) providing tension in the hoses (52) and including an adjusting device (140) for adjusting the tension, whereby there is direct correspondence between the tension adjustment and the tension in the hoses.

3. A peristaltic hose pump comprising a plurality of hoses (52) tensioned between an input manifold (38) and an output manifold (28) in an arc about a rotor (34) which carries a plurality of circumferentially spaced pumping protuberances (58, 64) which induce peristaltic action in the hoses as the rotor rotates, characterised by a resilient device (40, 130, 140) providing tension in the hoses (52) and including an adjusting device (140) for adjusting the tension, whereby there is direct correspondence between the tension adjustment and the tension in the hoses.

4. A pump according to claim 2 or 3, characterised in that the adjusting device (140) comprises means (170) which indicate when a predetermiend hose tension has been reached.

5. A pump according to claim 4, characterised in that the indicating means (170) prevent adjustment to a tension higher than the predetermined tension.

6. A pump according to claim 2, 3, 4 or 5, characterised in that the resilient device (40, 130, 140) comprises a movable support (40) for one of the manifolds (38), an adjustment member (130) for the movable support, and a spring (152) compressed between the adjustment member (130) and a manually adjustable element (140).

7. A pump according to claim 6, characterised by an abutment (170) engageable with the adjustable element (140) when the spring (152) is compressed to a preselected length.

8. A pump according to claim 7, characterised by means (202) for adjusting the said preselected length of the compressed spring (152) to achieve a preselected operating tension as the number of hoses (52) is varied.

9. A pump according to claim 8, characterised in that the length adjusting means comprises a spacer (202) selectively positionable against one end of the spring (152).

10. A pump according to claim 6, 7, 8 or 9, characterised by a threaded rod (142) fixed mounted at one end and freely slidably received through an aperture in the adjustment member (130), in that the spring (152) is a coil spring freely encircling the rod, and in that the adjustable element (140) is a knob screwed on to the other end of the threaded rod so as to compress the spring between the knob and the adjustment member.

11. A pump according to claims 7 and 10, characterised in that the abutment (170) include a camming means for permitting the knob to be unscrewed to reduce the compression of the spring (152) upon engagement of the abutment surfaces.

12. A pump according to any of claims 6 to 11, characterised in that the adjustment member (130) acts on the movable support (40) by way of a pair of links (116, 120) having first ends pivoted together and to the adjustment member and second ends pivoted respectively to

a fixed pivot (122) and to the movable support (40).

13. A pump according to any of claims 1 to 12, characterised in that each manifold (28, 38) has circular hose nipples (76, 86) and the hoses (52) have correspondingly circular ends (224, 226) connected by hose sections (228) of non-circular cross-section.

14. A pump according to claim 13, characterised in that the manifolds (28, 38) are fabricated from plastics material and include integral projecting hose nipples (78, 86).

15. A pump according to any of claims 1 to 14, characterised in that the rotor (34) comprises a plurality of roller shafts (58) parallel to the rotor axis, and a plurality of sleeves (64) mounted for rotation on the roller shafts in rolling contact with the hoses (52).

16. A pump according to claim 15, characterised in that the sleeves (64) are fabricated from a phenolic material.

17. A pump according to any of claims 1 to 16, characterised in that the rotor (34) roller assembly has a pump shaft (66) carrying an interchangeable driven gear (210) meshing with an interchangeable drive gear (218).

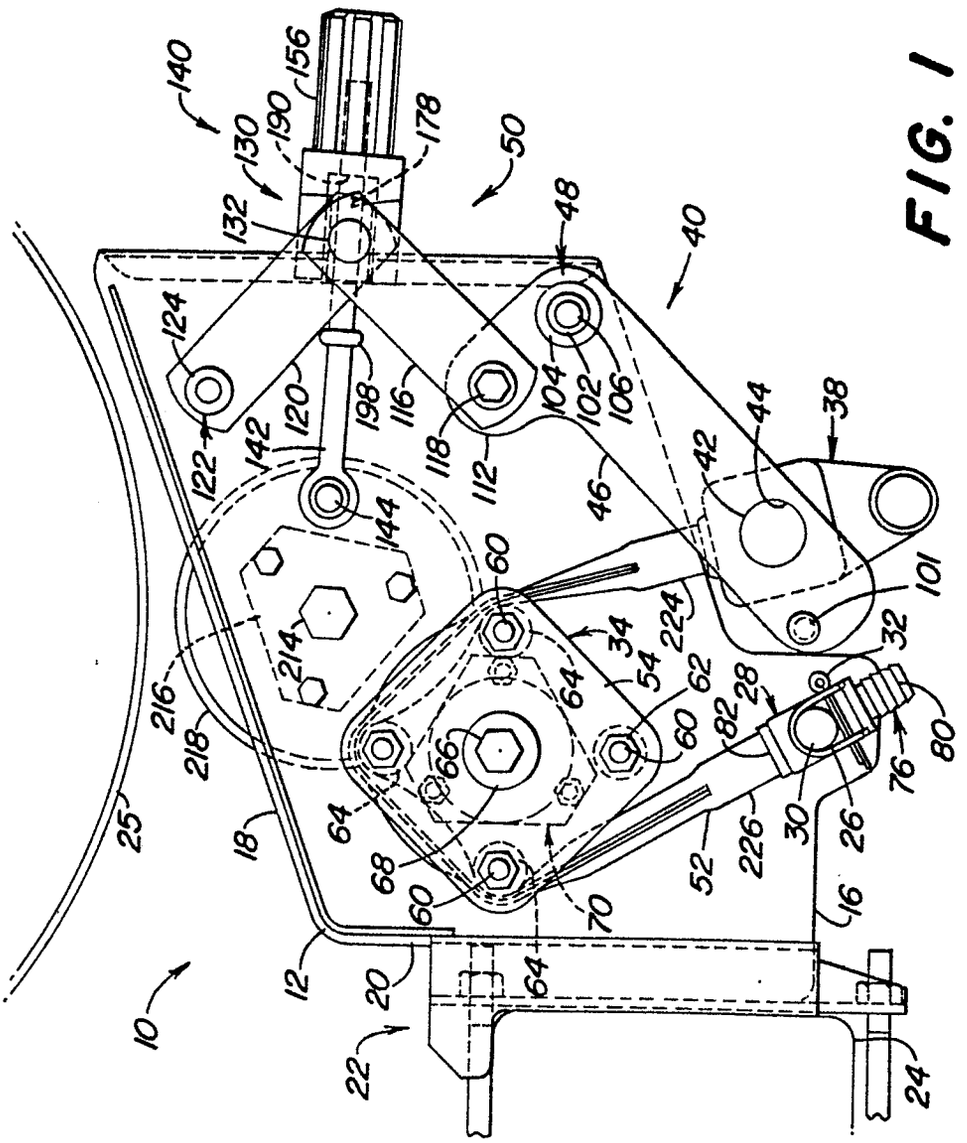

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FIG. 1

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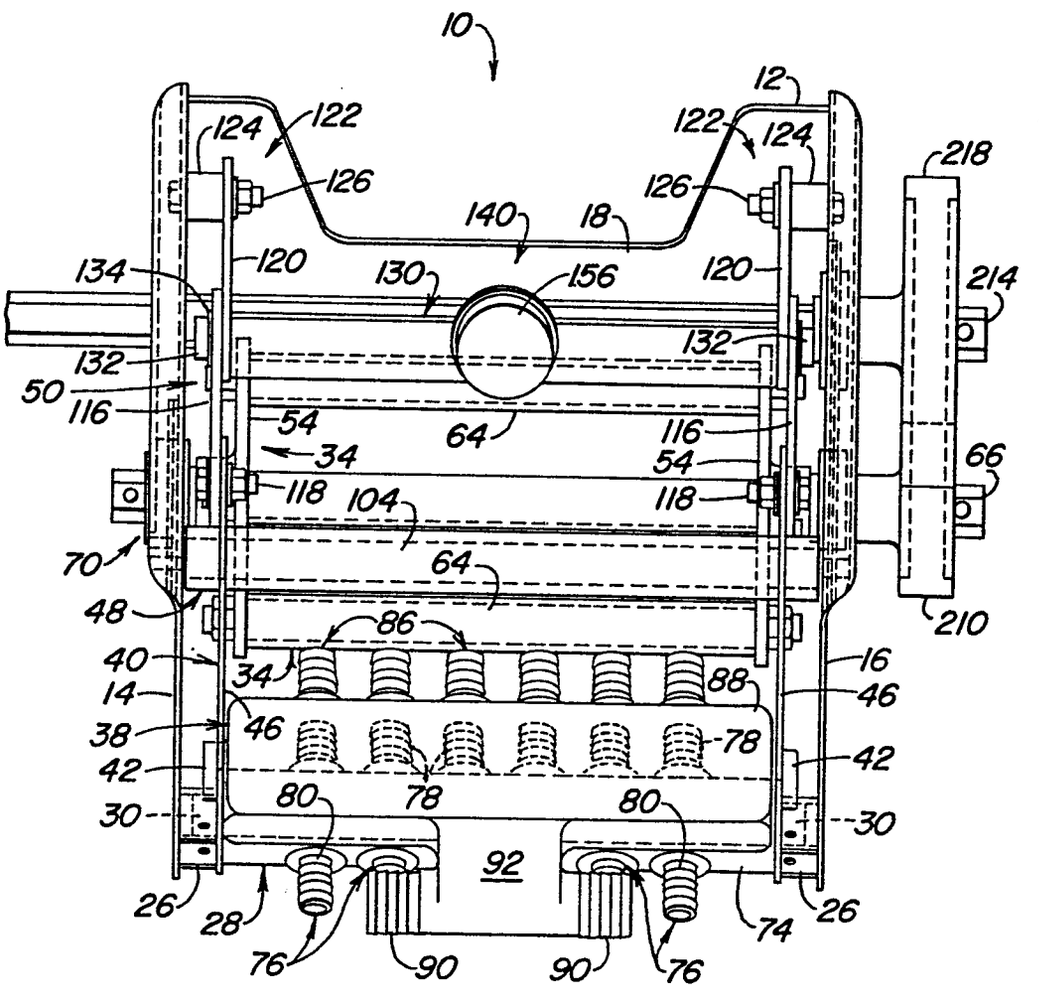

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FIG. 2

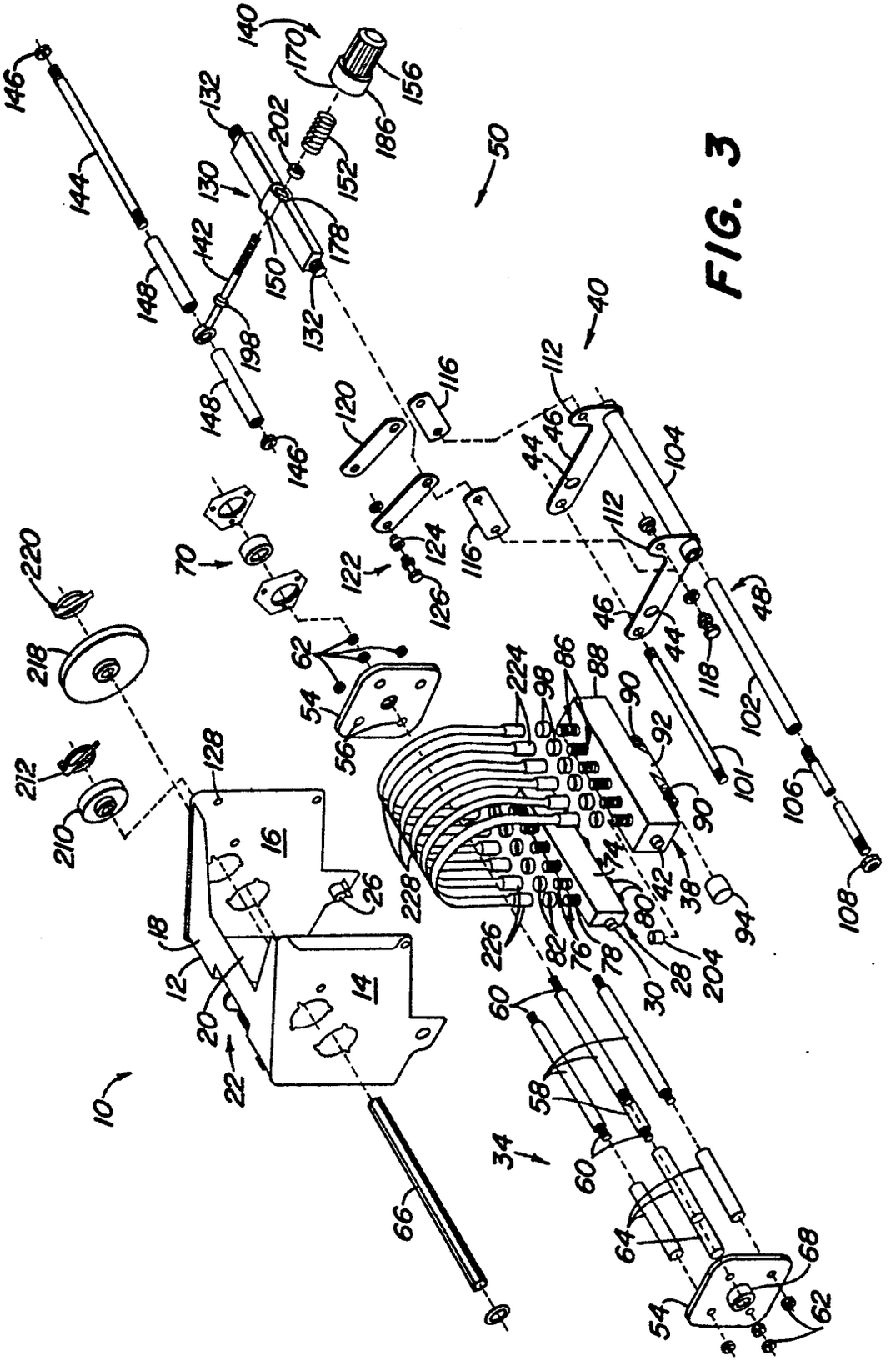


FIG. 3

FIG. 4

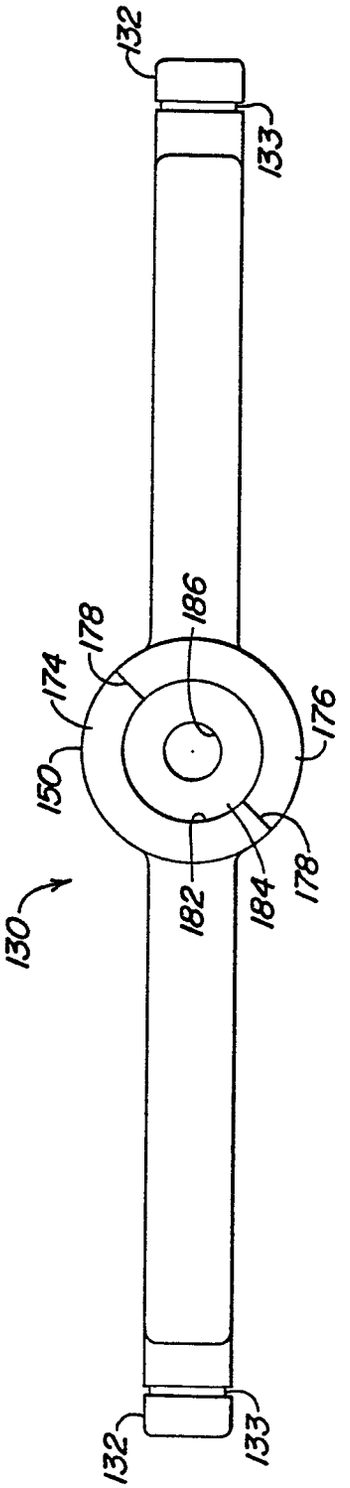
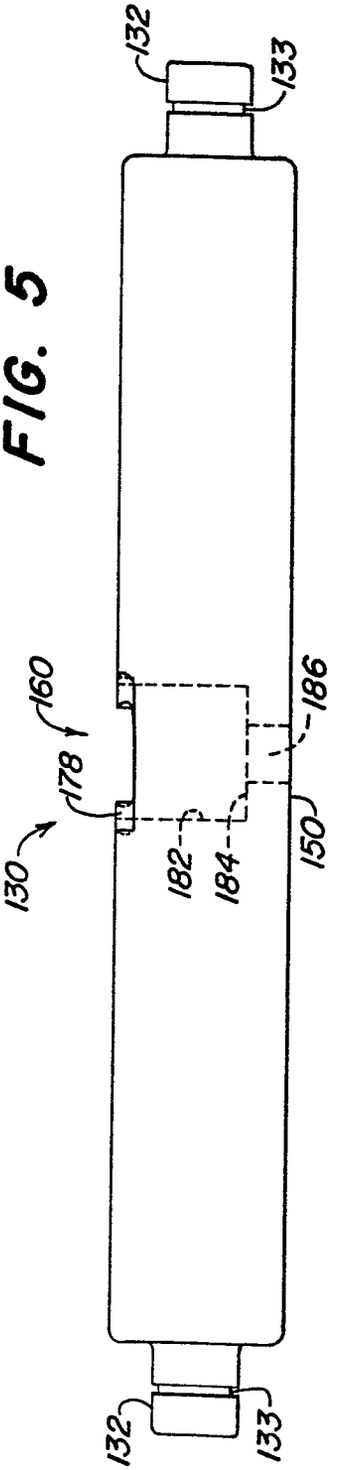

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FIG. 5


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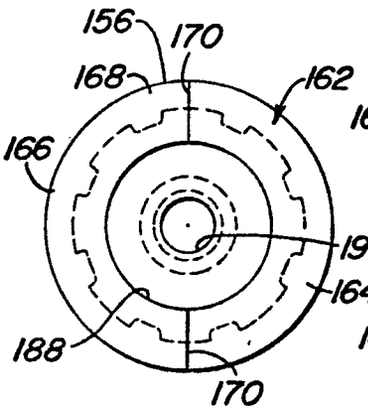


FIG. 7

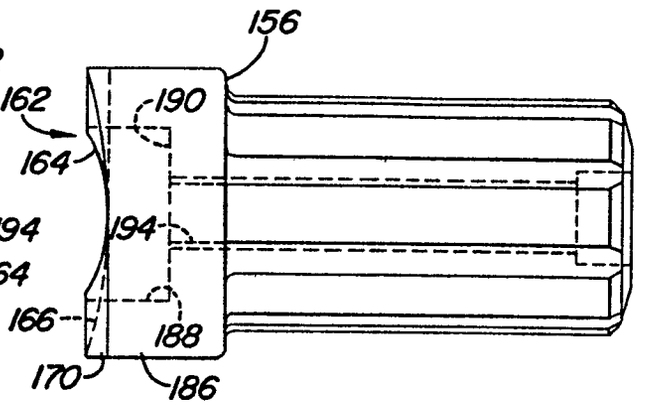


FIG. 6

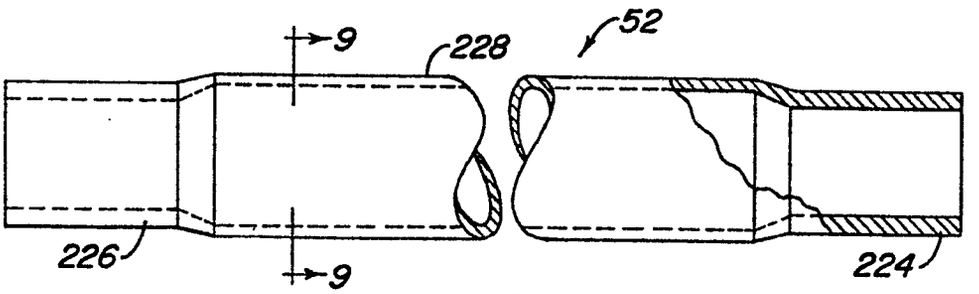


FIG. 8

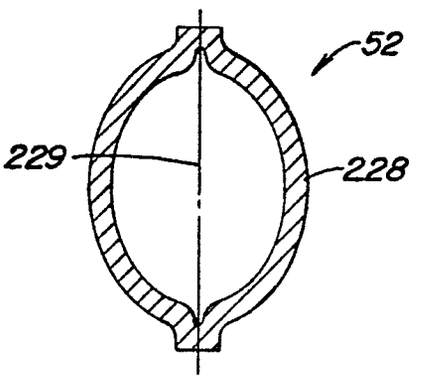


FIG. 9

European Patent Office

EUROPEAN SEARCH REPORT

0160388
Application number

EP 85 30 2079

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	DE-A-2 201 316 (HOFFMANN-LA ROCHE) * Figures 2-4; page 3, paragraphs 2-4 *	1-3	F 04 B 43/12
A,D	US-A-3 403 631 (TAAGEMAN) * Figures 1-5; column 3, line 23 - column 4, line 53; column 5, lines 8-30 *	1-3,13	
A	FR-A-2 168 090 (FLOW TECHNOLOGY CORP.) * Figures 1-3; page 4, line 31 - page 5, line 10; page 6, lines 5-25 * & US - A - 3 781 142 (Cat. D)	1-3,13 ,15	
A	US-A-2 483 924 (MOULINIER) * Figures 6,7; column 4, line 64; column 5, line 19 *	1,16	TECHNICAL FIELDS SEARCHED (Int. Cl.4) F 04 B A 61 M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02-07-1985	VON ARX H.P.

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