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(54) Pump.

(57) The invention relates to a pump of a peristaltic type, in which a medium is fed in a conduit of an elastic material in such a way that the conduit is compressed in a given sequence at a plurality of places and the pressure is then subsequently relased. According to the invention, the means effecting the compression comprise projections (5,6,7,8), which protrude from a disc (4) or from a base (2) against which the disc presses the conduit (1), which is arranged along at least the part of the disc (4) or the base (2) from which the projections (5,6,7,8) extend. The disc (4) is arranged to carry out a rocking movement such that the projections (5,6,7,8) in turns press against the conduit (1) and compress it and in the same order release the pressure on the conduit (1) so that it admits the medium to be pumped.

The pump is preferably also provided with means (18) for adjusting the distance between the disc (4) and the base (2), between which is arranged the conduit (1), and in this way the amount fed can be adjusted.

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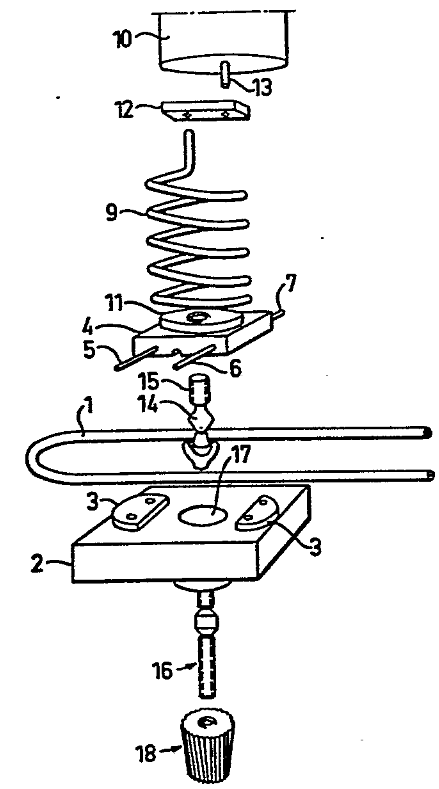
FIG.1



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Pump

This invention relates to a pump of a peristaltic type, at which a medium to be pumped is fed in a conduit of an elastic material in such a way that suitably designed pressure means compress the conduit in a definite sequence and again release the pressure against it. More exactly, the invention relates to a new and improved device for achieving the sequential compression and release of the conduit.

Peristaltic pumps are well-known and have been widely used in many fields, as they have a number of advantages. Thus, they can be used for pumping very different media from liquids of a low viscosity to more or less paste-like materials. Moreover, they can be made from materials which are insensitive to corrosive or abrasive constituents in the pumped medium. Another advantage is that the amount dosed can be adjusted very precisely and be varied continuously from zero to full capacity. Because of this, peristaltic pumps have been widely used in medicine, for instance at infusion of various preparations to a patient. A further advantage is here that it is easy to clean and sterilize those parts of the pump with which the pumped medium gets into contact. As the very pump means actually only consists of a piece of an elastic piping or hose this can be of a disposable type and be discarded after use. In this way a maximal freedom of bacterial and other contamination is secured.

Several various constructions of peristaltic pumps are previously known. Here it can e.g. be referred to US patents 2,105,200; 2,393,838 and 3,630,647 as well as French patent 1,401,317. Common to most of the previously known embodiments is that the piping or hose goes straight through the apparatus, where a number of pressure means compress the hose in a given order and then release it again. The device is operated by a motor, which transforms the rotating movement via a plurality of link and cam systems to a reciprocating movement. This often means a considerably complicated construction, which is expensive to manufacture and requires observation of strict tolerances to operate well. Moreover, it may be difficult in the previously known devices to achieve in a simple way the continuous adjustment of the pumped amount of material. It is also difficult to change the hose as it must be pulled through the apparatus, which may then be contaminated, as liquid remaining in the hose leaks out.

These disadvantages are eliminated by the pump according to this invention, and a peristaltic pump with only a few movable parts is provided, which makes possible a simple and accurate adjustment of the pumped amount and a simple exchange of the piping for the pumped medium.

This invention relates to a peristaltic pump comprising a conduit of an elastic material for feeding the mediuum to be pumped, and a number of means for compressing the piping and releasing the pressure in a given sequence to press the medium forward. According to the invention, the means for compression and release comprise projections extending from a disc or a base against which the conduit is pressed by the disc, and the conduit is arranged along at least that part of the periphery of the disc or of the base, from which the projections protrude. The disc is arranged to perform such a rocking movement that the projections in a given order press against the conduit and compress it, and to release the pressure against the conduit in the same order so that it lets the medium pass. The projections preferably consist of pins having a substantially round cross section, which are arranged substantially radially extending from the edge of the disc along at least a part of its periphery. The number of the projections is at least three and in a suitable embodiment four pins are arranged in a substantially square disc with each two mutually parallel pins extending from two opposite edges of the disc. Also other embodiments of the projections are possible as shown in the following. The expression "periphery" with regard to the disc is to be taken in a wide sense and is not merely restricted to a circular disc but relates to the circumference of discs of any suitable form.

The invention is illustrated more in detail by the accompanying drawing which shows suitable embodiments. In this, Fig. 1 is an exploded view of an embodiment of a pump according to the invention. Fig. 2 is a view of the rocking disc and Fig. 3 is a sectional view of a device for adjustment of the amount fed by the pump. Figs. 4 and 5 show additional embodiments of the invention. In the drawing figures, like details have been given the same reference numerals.

In Fig. 1, a flexible piping or hose 1 for feeding the medium to be pumped is shown. The hose 1 rests against a solid base 2 and is held in its correct position thereon by shoulders 3. The pumping is effected by the rocking disc 4 which is provided with four pins 5,6,7,8 extending from two opposite edges of the substantially square disc 4. This is shown more in detail in Fig. 2.

The rocking movement of the disc is brought about by a helical spring arranged between the disc 4 and a drive motor 10. The spring rests with one of its ends against the upper side of the rocking disc 4 and is held in its position there by means of the guide means 11 or in any other suitable way. The spring is mounted with its other end in one end of an eccentric member 12, whose other end is joined to the shaft 13 of the drive motor 10.

The rocking disc 4 is attached to an articulated joint member 13 at its lower side, such as by the threaded member 15 being screwed into the disc. The joint member 14 is made such that the rocking disc 4 can rock in all directions without being able to rotate and can for instance be a universal joint as schematially indicated in the drawing figure. The joint member can however also be a ball and socket joint which allows rotation per se but where turning of the rocking disc 4 in the horizontal plane is prevented by the shape of the shoulders 3. The lower end of the articulated joint member 14 is attached to a shaft 16, which passes through a hole 17 in the base 2. The shaft 16 is attached to a device for setting and adjusting the position of the rocking disc, which device is generally designated by 18 and is described in closer detail in Fig. 3.

Fig. 2 is a top view of the rocking disc. It is apparent that the disc is substantially square and that the four pins 5,6,7,8 project from two opposite edges of the square and are substantially parallel to the two other opposite sides. Small deviations in this respect, however, are without importance for the function of the pump. The guide means 11 on the upper side of the rocking disc is also shown. The thickness of the rocking disc 4 and the exact position of the pins 5,6,7,8 are substantially defined by the dimensions of the elastic conduit 1, which is to feed the pumped medium and by the compression and release of which the pumping effect arises, and can be easily established by one skilled in the art.

Fig. 3 shows in detail a schematical sectional view of the device 18 for setting and adjusting the position of the rocking disc. Here the shaft 16 is shown, the upper end of which is attached to the joint member, such as by means of a thread 19. The shaft 16 is provided with a guide 20, which guides the shaft in the hole 17 and prevents the shaft from being turned in this hole. This can also be achieved in different manners as is clearly evident to one skilled in the art. The hole 17 can e.g. have a cross section like a polygon, and the guide 20 can be shaped in a way suitable for this.

The lower portion of the adjusting means 18 is designed as a knob 21 which has a central recess 22, from the bottom of which the central inner sleeve 23 protrudes. The inner sleeve 23 is provided with an internal thread, which receives an outer thread on the lower portion 24 of the shaft 16. Thus, the shaft 16 can be screwed into the inner sleeve 23 to a varying depth.

In the recess 22 a guide bushing 25 is arranged around the inner sleeve 23 and is concentrical therewith, and between the guide bushing 25 and the inner sleeve 23 a spring 26 is arranged. The lower end of the spring rests against the bottom of the recess 22, and its upper end rests against an internal shoulder 27 in the guide bushing 25. The spring tends to urge the guide bushing 25 out of the recess 22. This is prevented by the support ring 28, which is preferably screwed onto the outer end of the inner sleeve 23. The upper end of the guide bushing 25 rests against the underside of the base 2.

The function of the pump according to the invention is as follows:

When the drive motor 10 is in operation, the upper end of the spring 8 will be forced by the eccentric member 12 to follow a circular orbit in substantially the same plane as the rocking disc. This movement will be transmitted as a rocking movement to the lower end of the spring, which rests against the rocking disc 4 so that a circular rocking movement is imparted also to the disc. By the rocking movement, the four pins 5,6,7,8 in the rocking disc will by turns press more strongly against the hose and compress it while the pin substantially diametrically opposed will release its pressure against the hose 1. The pins should be arranged in the rocking disc in such a way that in the rocking movement, the hose will always be compressed on at least one point. In this way a pumping effect will arise on the medium, such as a liquid, which is present in the hose. Through the joint member 14, a rocking movement is made possible in all directions at the same time as the rocking disc is prevented from rotating either by the construction of the joint member 14, or by the shape of the shoulders 3. It should be noted that the spring itself does not perform any rotating movement, but that its upper end, which is freely mounted in the eccentric member 12, is only moved around in a circular orbit.

The conduit or the hose 1 for feeding the pumped medium is arranged so that the pins of the rocking disc can compress it in a given order. In the embodiment shown, the hose is introduced from one side and placed around one of the shoulders 3 so that it is bent roundly. In this way the pins of the rocking disc can compress the hose in turn before and after its bending around the shoulder 3. The hose rests against the solid base 2 so that a good support for the compression is obtained. The capacity of the pump is adjusted by the adjusting means 18 as described in the following.

By turning the knob 21, it will be possible to screw the threaded shaft 16 into the inner sleeve 23 to a varying depth. The shaft 16 is prevented by the guide 21 to follow the turning. In turning, the distance between the rocking disc 4 and the base 2 will be changed via the joint member 14, and consequently also the capacity of the pump, as the distance between the rocking disc and the base decides how great a movement (obliquity) can be effected by the rocking disc 4. When the movement of the rocking disc is such that the hose is completely compressed under two pins and fully open under the opposite pins, the distance is at maximum, and accordingly also the pump capacity. When the distance is reduced, the slanting of the rocking disc is also reduced and consequently also the flow in the hose. At the limit position, the hose is completely compressed by all four pins and no rocking movement can be performed by the rocking disc, and therefore the flow will be zero.

The spring 26 placed in the recess 22 of the knob 21 between the inner sleeve 23 and the guide bushing 25 has several functions. As the knob 21 is urged upwards against the spring force, the shaft 16 and its associated rocking disc 4 will also be urged upwards. Thus, the hose 1 will be released from the pins of the rocking disc and can then easily be removed and exchanged. There is no risk of spillage from the hose when it is removed.

Furthermore, the spring 26 can act as a safety means and prevent damage to the apparatus or hose breakage due to excess pressure if for instance a hose should be clogged or the pump operate against a closed valve. At a suitably selected spring force the effect may be obtained that the pump does not give a higher pressure than that permitted by the spring force. If this pressure is exceeded in the hose, the rocking disc 4 will be lifted against the spring force due to the pressure and, as a result, the pumping effect will cease. Accordingly damage to the device due to a uncontrollably high pressure is prevented. The spring force of the spring 26 can be adjusted by screwing the support ring 28 to a suitable position along the inner sleeve 23.

The embodiment shown here is only an example and several modifications are possible within the scope of the inventive idea. Thus, it is not necessary that the movement of the rocking disc is brought about by having exactly a spring perform a circular movement, but other methods are also possible. The eccentric member 12 attached to the motor shaft 13 can for instance be provided with a spring-loaded wheel, which rolls against a circular roller path arranged on the upper side of the rocking disc 4. The rocking disc will in this way be given the rocking movement, which is the essential feature of the invention.

In Fig. 4, a partly sectional view of a simpler embodiment of a pump according to the invention is shown. Here the hose 1 is arranged between the base 2 and the rocking disc 4, which is continuously urged against the hose and the base by means of a compression spring 29. Of course the pressure force must be so great that the hose is completely compressed in at least one point. The rocking disc 4 is extended upwards by a member

30, which is provided with a cylindrical recess 31. In this recess, an eccentric member 32 is mounted, which is driven eccentrically by the drive motor 10 via the motor shaft 13. The mounting of the eccentric member 32 in the recess 31 is carried out by means of spherical bearing surfaces or arranged in some other way so that an angle is made possible between the motor shaft 13 and the extension member 30 of the rocking disc. In this figure, the rocking disc is shown as simply mounted in a recess 33 in the base 2 by means of a pin 34, but it can of course also be connected with a joint member in a way similar to that shown in Fig. 1.

It is possible to adjust he amount pumped by variation of the speed of the motor. This of course applies to all the embodiments shown.

The rocking disc can be provided with projections in the form of pins in the same way as in Figs. 1 and 2, but the projections can also be formed as ridges on the underside of the rocking disc, which create the sequential compression of the hose at the movement of the rocking disc. It is also possible to arrange the projections in the form of ridges on the base for the hose and to have the underside of the rocking disc smooth, and in certain cases it is even possible to have the base for the hose as well as the underside of the rocking disc smooth. If the rocking disc has a square or rectangular form as seen in a vertical direction and is given the rocking movement, the corners of the disc will act as projections and provide the sequential compression of the hose so that a pump effect is obtained.

When the motor in the embodiment shown in Fig. 4 is driven, the shaft 13 will give the eccentric member 32 an eccentrically rotating movement. As the eccentric member 32 is mounted in the recess 31 in the extension member 30 of the rocking disc this extension member will be moved around in a circular orbit, the movement being transferred to the rocking disc 4 as a rocking movement. Due to the compression spring 29, the rocking disc will be continuously urged against the hose, and the hose will be compressed sequentially by suitably embodied projections (not shown in detail), as described in the foregoing, resulting in a pump effect.

Another embodiment of the invention is shown in Fig. 5, which is an exploded view of a pump according to the invention. This embodiment is somewhat similar to that shown in Fig. 1, but the drive of the rocking disc and its construction are different, as well as the guide for the rocking disc.

The hose 1 is arranged on a base 2 and is guided by shoulders 3 in the same way as in the previously shown embodiments. The rocking disc 4 is provided with two edge areas 35 and 36 bent down perpendicularly, the downwardly directed edge portions 37, 38, 39 and 40 of which act as projections to compress the hose sequentially. The rocking disc is attached to a threaded shaft 16 by means of a bushing 41 via a thin music wire 42, which acts as a joint member in this case. The shaft 16 is provided with a stationary guide 20, which fits into a guide hole 43 in a guide plate 53 and in this way prevents the shaft 16 from being turned, and its thread fits into a bushing 44, to which an adjusting knob 21 is attached. This knob is also provided with a helical spring 45 which is mounted between the knob 21 and the underside of the base plate 2. By turning the knob, the shaft 16 can thus be screwed into the bushing to a varying length, and in this way the distance between the rocking disc and the base plate can be changed. At the same time the knob 21 with the bushing 44 and the shaft 16 can be pressed upwards against the spring 45 so that the hose 1 is completely released and can be removed, and at an excessively high pressure in the hose, the rocking disc will also be lifted against the spring pressure and the pumping effect will cease in the same way as described for the embodiment shown in Fig. 3.

The rocking disc is driven by the drive motor 10, the shaft 13 of which is rigidly connected to a disc 46, which is provided with a downwardly directed, eccentrically arranged pin 47. The pin 47 is connected with a bearing 49 for the shaft pin 50 of the rocking disc via a draw spring 48, said shaft pin being secured in the bushing 41. The downwardly bent edge portions 35 and 36 of the rocking disc are guided in the recesses 51 and 52 of the guide plate 53, these recesses being so large that the rocking movement of the rocking disc becomes possibe. The guide plate 53 is retained at a suitable distance, which is not critical, over the base 2 by suitable holding means not shown in the drawing.

When the motor shaft 13 rotates, the disc 46 will bring the pin 47 in a circular orbit. The draw spring 48, which is shorter in unloaded state than the distance between the pin 47 and the shaft pin 50, will then pull the shaft pin 50 via the bearing 49 so that it is forced to follow a circular orbit and consequently will give the rocking disc 4 the rocking movement in this way. It should be observed that the shaft pin 50 does not itself rotate but is merely urged around in a circular orbit. By the rocking movement of the rocking disc 4, the edge portions 37, 38, 39 and 40 of the downwardly bent edge regions 35 and 36 will successively press against the hose 1 so that in this way a pumping effect is obtained.

The embodiment shown in Fig. 5 has the advantage as compared with that shown in Fig. 1 that the energy consumption in operation is less, as hysteresis losses in the spring 9 (Fig. 1) are avoided. Moreover, the design of the adjusting means of the pump shown in Fig. 5 is simpler than that shown in Fig. 3, as the concentric guide sleeves and the enclosed spring are eliminated.

The rocking disc need not be designed exactly as shown in the drawing figures. The number of projections or pins in the rocking disc or the base should be at least three for a pump effect to be obtained and in one such a case these pins can be arranged with a division of, for instance, 90° along the periphery of a circular rocking disc and act on the hose along its bent portion. In this case, the one of the two shoulders 3 around which the hose is placed is excluded and the other shoulder is designed for a suitable guidance of the hose. It is also possible to use rocking discs with more than four pins and the modifications of the device which will then be necessary can be easily determined by one skilled in the art with a knowledge of the basic idea behind the invention.

In one embodiment, even the disc as such in the rocking disc may be excluded and be replaced by a suitable framework construction through which the projections can act in a desired manner. Such an embodiment can for instance be designed as a vertical shaft, to which are directly attached pins, which extend perpendicularly from the vertical shaft and with a radial division of the horizontal plane. If an upper end of the shaft is made to follow a circular orbit in the horizontal plane, the imagined horizontal plane in which the pins are situated will perform a rocking movement in the same way as a disc of the previously described type and the pins can act on an elastic conduit in the same way as indicated above.

Moreover, the articulated joint member 14 can be made in any way that in combination with a guide for the rocking disc makes possible an unhindered rocking movement in all directions and prevents turning around a vertical axis. As mentioned above, various types of universal and ball joints can be used, but also other devices are possible, such as a flexible rubber coupling with a low stretchability.

Other features of the invention can also be modified without going beyond the scope of the invention. The fundamental principle thereof is that a sequential compression and pressure release on a flexible conduit are obtained in such a way that projections, preferably arranged as protruding from a disc, which is given a rocking movement, are made to effect the compression and pressure release of the conduit. Additional modifications will easily be apparent to one skilled in the art.

By the present invention, a pump of a peristaltic type is provided, the design of which is simple and which can be easily adjusted in respect of its capacity, allows an easy replacement of the flexible conduit and which is safe against detrimentally high pressures in the pump line. This involves great advantages as far as costs and safety in use are concerned, especially in the medical field. However, it is realized that the use of the pump of the present invention is not merely restricted to this field but the pump can be used in any application where a pump of peristaltic type has been found to be suitable.

CLAIMS

1. A peristaltic pump comprising a conduit (1) of an elastic material for feeding the medium to be pumped and a number of means for compression of the conduit and releasing the pressure in a given sequence to urge the medium forwards and characterized in that the means consist of projections (5,6,7,8), which extend from a disc (4) or from a base (2), against which the conduit (1) is pressed by the disc (4), and the conduit is partly arranged along at least that part of the disc (4) or the base (2), from which the projections (5,6,7,8) protrude, and that the disc (4) is arranged to carry out a rocking movement such that the projections (5,6,7,8) are pressed sequentially against the conduit (1) and compress it and in the same sequence release the pressure against the conduit (1) so that it admits the pumped medium.

2. The pump of claim 1, characterized in that the number of projections (5,6,7,8) is at least three.

3. The pump of claim 1 or 2, characterized in that the projections are designed as pins (5,6,7,8) having a substantially round cross section and extending from the edge of the disc (4).

4. The pump of claim 1 or 2, characterized in that the projections (5,6,7,8) are made in the form of ridges on the underside of the disc (4).

5. The pump of claim 1 or 2, characterized in that the projections (5,6,7,8) are made in the form of ridges on the base (2) for the conduit, while the disc (4) has a smooth underside.

6. The pump of any one of claims 1-5, characterized in that the rocking movement is achieved by a helical spring (9), one end of which rests against the upper side of the disc (4), while its other end is made to follow a circular orbit in substantially the same plane as that of the disc.

7. The pump of any one of claims 1-5, characterized in that the rocking movement is achieved by pressure means pressing against the disc (4) and being made to follow a substantially circular path over the disc.

8. The pump of any one of claims 1-5, characterized in that the disc (4) on its upper side is provided with an upwardly ex-

tending shaft or axis (30,50), the upper end of which is made to follow a circular orbit in substantially the same plane as that of the disc.

9. The pump of any one of claims 1-8, characterized in that the disc via an articulated joint member (14,42) is retained at its underside by means of holding means (18) such as a screw device (23,24,16,44) by means of which the distance can be varied between the disc (4) and the stationary base (2) against which the conduit (1) rests.

10. The pump of claim 9, characterized in that the holding means (18) comprises a spring means (25,26,45) such that the disc (4) is lifted by compression of the spring means (26,45) so that the pumping effect ceases.

FIG.1

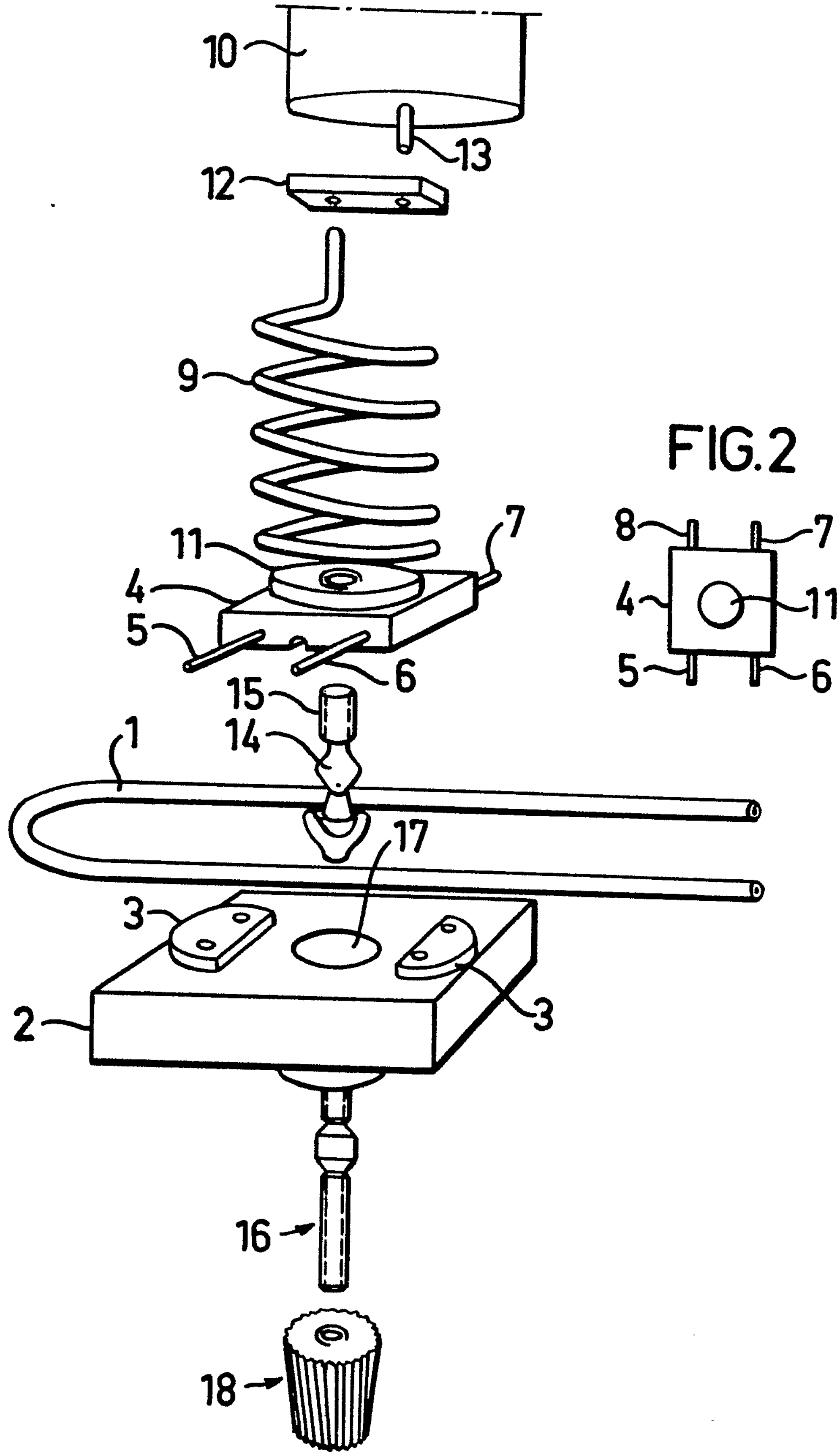


FIG.3

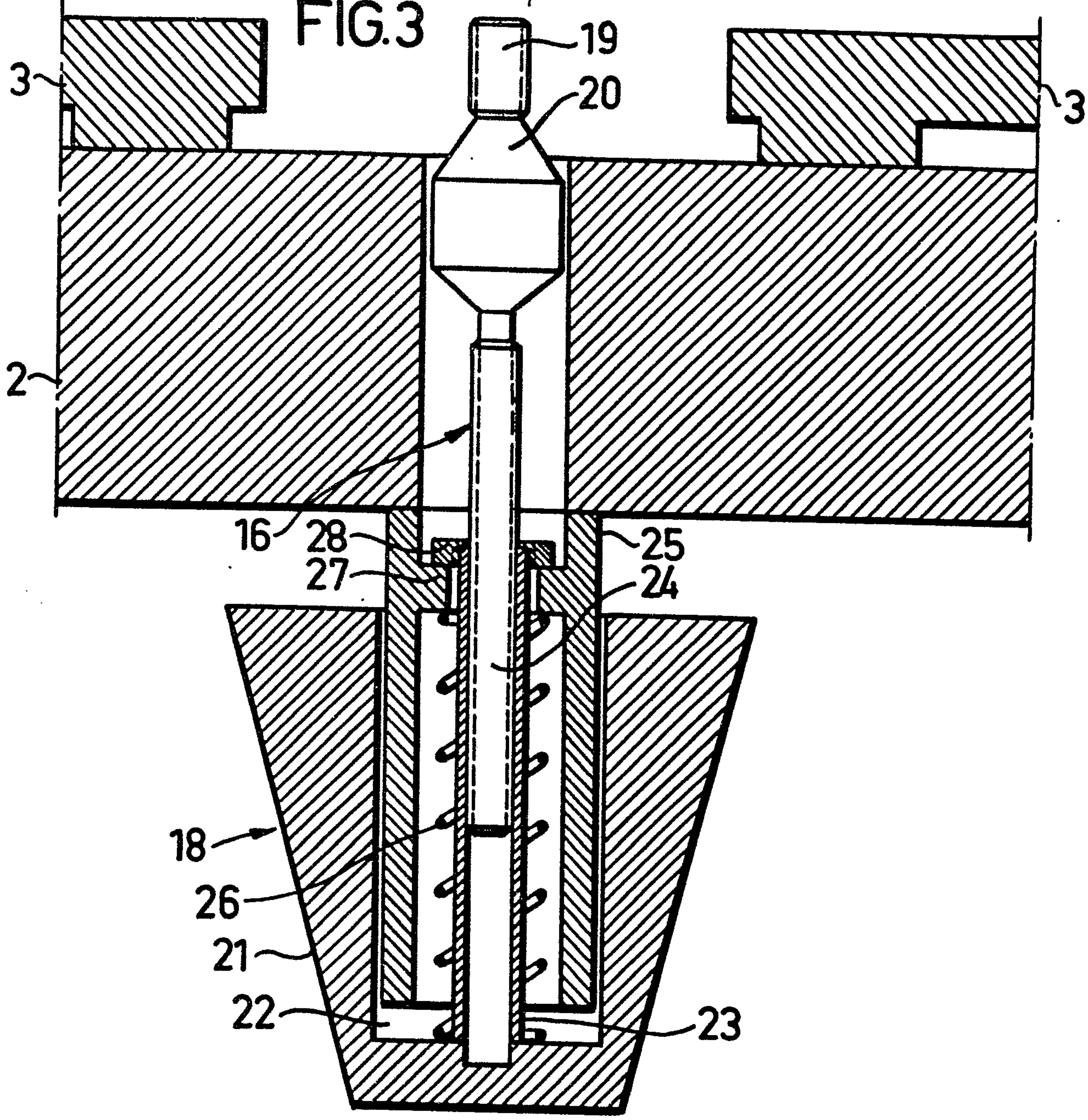


FIG.4

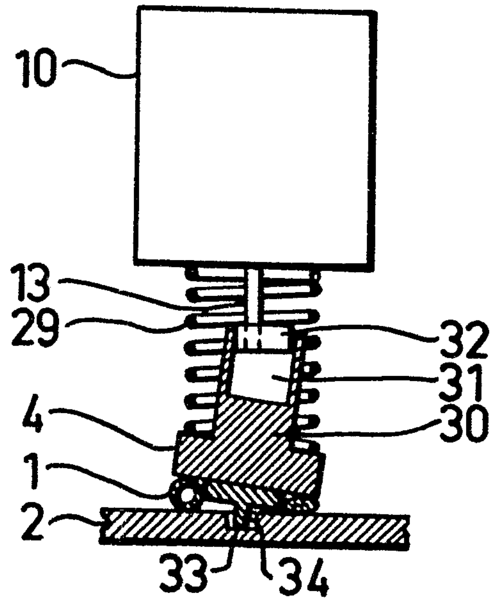
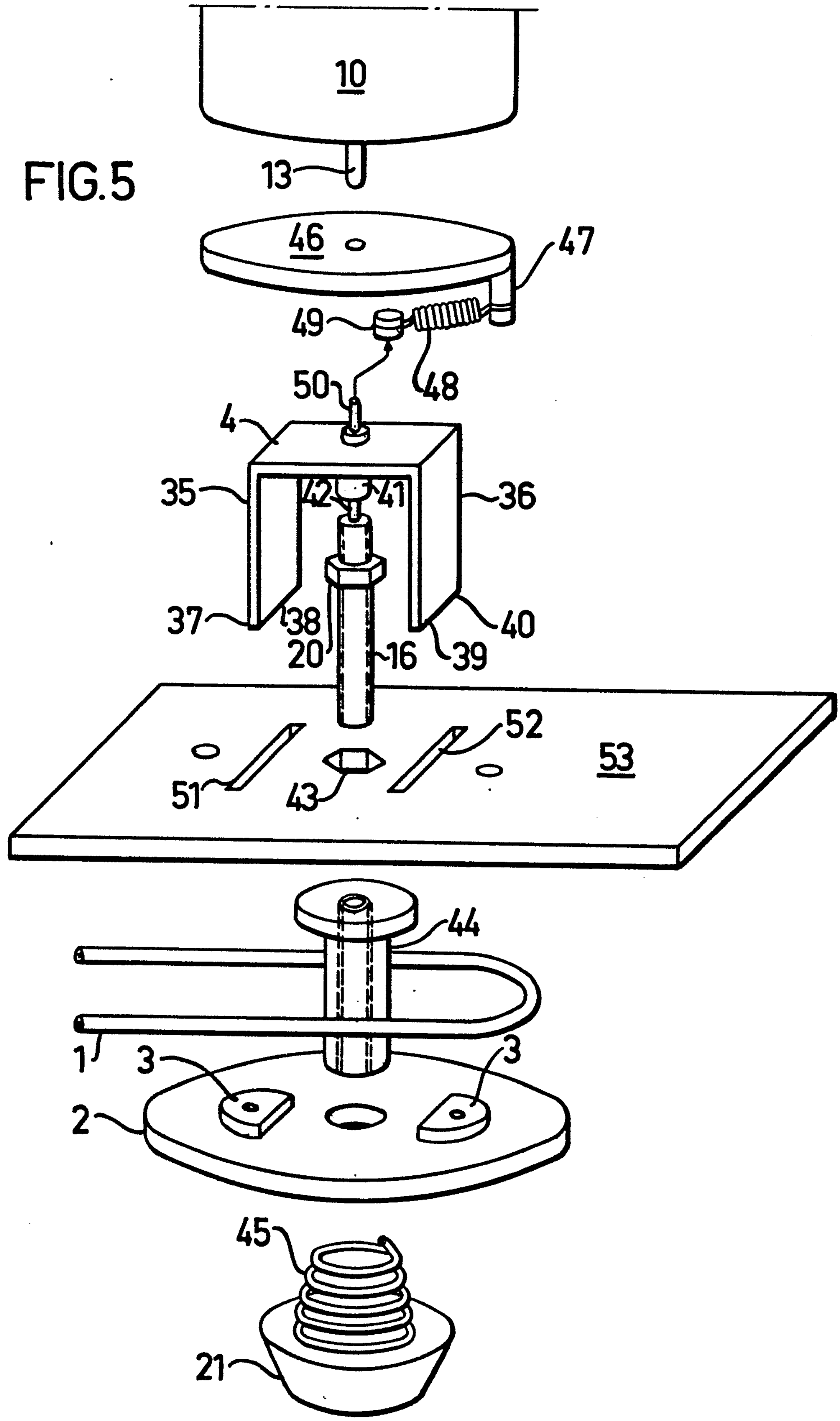


FIG.5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EUROPEAN SEARCH REPORT

0056019
Application number
EP 82 85 0001

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
X	MACHINE DESIGN, vol. 32, no. 15, July 21, 1960 CLEVELAND (US) "Scanning the field for ideas: Nutating spokes" page 134 * the whole article *	1,2,3	F 04 B 43/12
A	GB - A - 815 687 (CORNEIL) * page 2, lines 59-62 *	4,5	
A	US - A - 3 720 489 (RAPER) * column 2, lines 64-66 *	6-10	TECHNICAL FIELDS SEARCHED (Int.Cl. 3) F 04 B
A	FR - A - 1 238 312 (BEAUDOUIN) * page 2, column 1, line 22 to the end of page 2 *	7-10	
A	US - A - 2 915 983 (BERRIAN) * column 3, lines 63-64 *	9	
A	US - A - 3 584 983 (HINDMAN)		

CATEGORY OF CITED DOCUMENTS

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X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26-03-1982	BAATH