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

(11) Publication number: **0 178 039**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **85304190.3**

(22) Date of filing: **12.06.85**

(51) Int. Cl.⁴: **F 42 B 33/06**, F 41 F 1/00

(30) Priority: **15.06.84 GB 8415276**

(43) Date of publication of application: **16.04.86 Bulletin 86/16**

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

(71) Applicant: **Technical Research Products Limited, 1 Maddox Street, London W1R 0LB (GB)**

(72) Inventor: **Thomas, Roger, 6 Shawford Road West Ewell, Epsom Surrey (GB)**

(74) Representative: **Higgins, Michael Roger, Marks & Clerk 57/60 Lincoln's Inn Fields, London WC2A 3LS (GB)**

(54) Disrupter for explosive devices.

(57) A disrupter (1, 2) for the disruption of explosive devices comprises an elongate tube (3) with a bore (4) of substantially constant cross-section closed at one end by a breech assembly (6). A nozzle (10) having a tapering bore (9) is detachably mounted on the other end of the tube (3). The arrangement provides for improved performance over prior art devices with bores of constant cross-section whilst avoiding the expense of machining a continuously tapering bore.

The breech assembly (6) comprises a pin (24) slidably housed in a plastic insert (23). The pin is biassed by means of a spring (28) and screw plug (54) to contact a centre terminal of an electrically activated cartridge (not shown). Voltage is supplied to the cartridge via plugs inserted in apertures in the breech assembly body (22) and the plug (54).

The disrupter (1, 2) is slidably mounted in a holder (13, 14) and positioned by means of springs (15) which absorb recoil when the device is activated.

Also disclosed in a mounting assembly (40, 41, 42, 13, 14) for mounting a plurality of disrupters in variety of different relative orientations.

EP 0 178 039 A2

TITLE MODIFIED
see front page

DISRUPTION OF EXPLOSIVE DEVICES

The present invention relates to disrupters for the disruption of explosive devices, particularly improvised explosive devices.

GB.2030684 describes a disrupter for projecting a water missile into an improvised explosive device. The water penetrates the wall of the device, often of cardboard or light wood, and disrupts the contents, in particular the bomb circuitry, in a time scale sufficient to prevent actuation of the device. The disrupter of GB 2030684, as put into practice, comprises an elongate, aluminium tube having a constant internal diameter and closed at one end by a screw cap. An explosive safety cartridge is located at the closed end and terminals are provided to fire the cartridge electrically. A plug of water fills the remainder of the tube, the open end of the tube being sealed by a plastic cap. When the cartridge is fired the water is shot from the tube at extremely high velocity and penetrates the explosive device, the hot gases following the water serve to further disrupt the device.

Another form of disrupter comprises an elongate tube operated in the same way as the device of GB 2030684, but in which the bore of the tube is tapered throughout its length, towards the open end of the tube. This device is made of stainless steel for strength and may achieve greater penetration than the previously described device. However, the device is extremely costly to produce in view of the long tapered, bore.

A first aspect of the present invention provides a disrupter comprising an elongate tube closed at one end, means for generating an expanding gas in the bore of the tube adjacent the closed end, a liquid missile housed in the bore of the tube adjacent the other end

thereof, wherein the bore is of substantially constant cross-section along a major portion of its length and is tapered at said other end towards an outlet thereof.

Very preferably the taper is formed in a nozzle which is releasably attached to a main tube of substantially constant cross-section, for example by means of a screw thread connection.

By providing a tube in which only the end region is tapered the manufacturing costs can be reduced significantly, whilst the penetrating power of the device is maintained or improved. The nozzle may comprise a single bore of tapering cross-section, tapering from a cross-section substantially equal to the bore of the main tube. A plurality of bores may be provided in the nozzle to direct the liquid out of the device in a number of jets, the bores being merged at an inner end of the nozzle. A number of nozzles may be provided with the device to give outlet openings of different diameters, which will enable the penetrating power of the missile to be varied.

The expanding gas generator may comprise an electrically actuated, safety cartridge. A seal, such as plastic cup, may be positioned between the cartridge and the missile to keep the cartridge dry. Also, in some circumstances it is desirable to space the missile from the cartridge.

The missile is held in the tube by means of a cap which may fit over the outer end of the tube or nozzle, however a cap or plug may be provided in the tube bore adjacent the tapered region, the force exerted on the missile by the cartridge when fired being sufficient to rupture or deform the cap(s) and carry it (them) through the tube bore.

Recoil is a significant problem with such devices, often resulting in the device being thrown or bowled a great distance from the firing point, which can be dangerous with a stainless steel tube weighing 3 kg. Also it may place considerable loads on an arm of a robot vehicle used to position the device.

Accordingly, in a preferred embodiment the tube is slidingly mounted in a holder and is resiliently biassed towards a rest position by resilient biassing means, said biassing means absorbing recoil of the device when fired. Preferably the resilient biassing means comprises a spring. The spring may be a helical spring surrounding the tube and positioned between the holder and a shoulder provided on the tube. Preferably two springs are provided around the tube, one either side of the holder which holds the tube at a central portion thereof.

In prior art devices using an electrically actuated cartridge for producing the expanding gas, one of the electrical connections to the cartridge is formed by a pin which is mounted in a screw cap closing the tube end, the pin being electrically insulated from the screw cap which, together with tube, forms the other connection to the cartridge. The environment at the closed tube end on actuation of the cartridge is very hostile, resulting in wear of the pin and reducing the efficiency of the electrical connection as the device is used repeatedly.

A further aspect of the present invention provides breech assembly for a disrupter of the type comprising an elongate tube housing a liquid missile and an electrically activated cartridge, wherein a pin forming an electrical connection to the cartridge is biassed against the cartridge. Preferably the pin is biassed by means of a spring, which may bear against the end or a shoulder of the pin. Preferably the pin and biassing means are housed in a plastics plug, which is screwed into a body of the breech assembly, and which serves to electrically insulate the pin from the metal body of the tube and also to provide a degree of shock resistance. The pin may comprise a stem, one end of which contacts a cartridge and the other end of which is flattened. A spring bears against the flat end and the spring and pin are slidably received in a bore of the plastics plug. A screw closes an outer end of the

bore and bears down on the spring to compress it and thus bias the pin towards the cartridge.

It is often desirable to position two or more disrupter devices in the vicinity of an explosive device. The second may be used as a backup, to avoid the need to rearm the first device in the event that the first "shot" was not a complete success, or to fire two disrupter simultaneously to achieve greater penetration or to increase the area of disruption, particularly where the location of the detonator of the explosive device is not readily apparent.

A further aspect of the invention provides apparatus for supporting a plurality of disrupters, wherein means are provided to enable the relative orientation of two or more of the disrupters to be adjusted. Preferably the means comprises first members each for holding a said disrupter, and a coupling means pivotally connecting the holding members. The coupling means may comprise a central, cuboid, block portion for attachment to a support, such as an arm of a robot. A wedge shaped member or members may be provided at one or both ends of the central block portion. The wedge shaped member(s) may be formed integral with the central block portion or a respective holding member. Other shaped spacing members may be used between the central member and the holding member(s).

When a wedge shaped member is interposed between the central block portion and a holding member, by pivoting the central block portion, wedge shaped member(s) and holding members relative to one another the orientations of the holding members, and hence the disrupters held thereby may be adjusted through a wide range, for example convergent, to divergent and out-of-plane orientations. Preferably the different members are form-locked together, preferably by means of a generally cylindrical protrusion on one member which engages in a cylindrical recess on the adjacent member, allowing the members to be rotated relative to one another whilst still being form-locked together. The

members may be fixed relative to one another by screws.

Wedge shaped members subtending different angles may be provided. Also other shaped spacing members, such as cuboid may be utilised to increase the spacing between disrupters etc.

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

Fig. 1 is a side view, partially cut away, showing an embodiment of the invention;

Fig. 2 is a sectional view of a breech assembly of the embodiment of Fig. 1;

Figs. 3a and 3b are sectional and end views of a nozzle;

Fig. 4 is a partially exploded view, from below, of the assembly of Fig. 1 with a disrupter removed, and with an additional wedge shaped member.

Figure 1 shows two disrupters 1,2 of identical construction. Each disrupter comprises an elongate main tube 3 which is preferably of stainless steel, but may be of any material to suit the desired application, e.g. aluminium. The tube 3 has a bore 4 of substantially constant cross-section along its length. One end, 5, of the tube is closed by a breech assembly 6 (Fig. 2) which is screwed onto the end of the tube. The breech body 22 is preferably of aluminium when the tube 3 is of stainless steel to enable the breech assembly to be readily unscrewed from the tube, particularly after the disrupter has just been fired, when the tube and breech assembly may be hot. The other end 8 of the tube 3 is open and is provided with a tapered bore or choke 9. Tapered bore 9 is formed in a nozzle 10 which is detachably mounted by means of a screw-thread connection 11. The tapered bore 9 may be formed as an integral part of the tube, but it is preferably separate to facilitate production and allow for the provision of a variety of nozzles 10, having different tapers so that

the size of the outlet 12 can be varied. The inner end of the taper is of the same size as the bore 4 to provide for reasonably smooth flow of liquid from the bore through the taper.

After firing of the disrupter difficulty may be experienced when trying to unscrew nozzle 10, particularly when the nozzle and tube are of stainless steel. The threads may be coated with a low friction material such as polytetrafluorethylene to reduce stiction. The use of polytetrafluorethylene tape will also serve to form a liquid tight seal on the connection.

The breech assembly 6 (Fig. 2) comprises a breech body 22, a plastics breech plug 23 which is screwed into the breech body and which houses a brass pin 24. Brass pin 24 projects through a bore 25 in the breech body 22 to project into the tube bore 4. Plug 23 has a stem 26 which projects partway into the bore 25 to ensure that the pin 24 is electrically insulated from the breech body 22. Pin 24 has a flat disc portion 27 at its outer end. A metal spring 28 bears on the disc and is held in the plug 23 by a brass plug insert 54 which is screwed into the plug 23. Insert 54 has a central bore for receiving a banana plug or the like (not shown) to form an electrical connection through to the pin 24 in the insert 54 and spring 28.

Breech body 22 has a pair of blind holes 29 for receiving banana plug connectors.

Each disrupter 1,2 is slidably mounted in a holding member 13,14. Helical springs 15 surround the tube 3 on either side of the holding member 13,14. Lower spring 15a bears on a washer 50 which rests on a shoulder 16 on the tube 3 and on a washer 17 adjacent holding member 13. Upper spring 15b is between a washer 18 adjacent the holding member 13 and a washer 19 adjacent the breech assembly 6. The tube is slidable in the washers.

To insert the disrupter 1 into the holding member 13, the tube 3, with spring 15a and washers 17,50 in position, is slid into the holding member 13 from below, as seen in Fig. 1. Washers 18,19 and spring 15b are then positioned on the tube and the breech assembly 6 screwed onto the tube end.

A screw 20 (Fig. 4) having a plastics, e.g. polytetrafluoroethylene, end plug 21 is screwed into a side of the holding member 13 so that the plug 21 bears against the side of the tube to prevent it sliding out of the member 13 under its own weight when the breech assembly 6 is unscrewed.

To operate the disrupter 1, the breech assembly 6 is removed and a plastics cup 31 is pushed into the bore. The liquid missile, e.g. 100 cm^3 of water, is poured into the bore through the nozzle and plastics cap 30 is fitted on the end of the nozzle 10. An electrically activated safety cartridge for producing expanding gas is fitted in the bore at the "closed" end 5. The bore may be widened at this end to form a shoulder 32 on which the cap may sit. Also, or alternatively, the cartridge may have a shoulder at its outer end to rest in a recess at the tube end. The breech assembly is then screwed onto the tube end. The arrangement is such that the pin 24 will bear against a central terminal provided on the cartridge, the pin retracting within the bore 25 as may be necessary, the spring 28 being compressed, to accommodate the cartridge.

The bore 4 may be charged so that there is an air chamber between the liquid missile and the cartridge. However the bore may be filled substantially completely with liquid. Water is generally used for the liquid missile, being cheap, easy to handle, and readily available. However, a preferred feature of the invention is to use a liquid which will mop up available oxygen or oxygen radicals, such as proprietary fire extinguishing liquids.

Electrical connections are made to the plug insert 23 and the breech body 22. A voltage is applied across the connections, thus applying a voltage across the cartridge via pin 24 and the cartridge outer casing which is in contact with the tube wall 4 and the breech body 22, thus firing the cartridge. The cartridge normally has a metal outer casing, forming one terminal, which is in electrical connection with the breech body. However if a cartridge having two discrete terminals is used, then two biassed pin connections may be provided, positioned appropriately. A second pin connection may be made to the cartridge casing in any event to ensure good electrical contact.

When fired the cartridge produces a rapidly expanding gas. This forces the liquid missile out of the open end of the tube, through tapered bore 9, carrying cap 30 with it, at great velocity. Cup 31 will also be forced out through the nozzle 10, to be followed by the expanding gases. The device operates in substantially the same way as the prior art devices described above. There will be a considerable amount of recoil on the firing of the cartridge. This is absorbed by the springs 15 which allow the tube 3 to reciprocate within the holder 13.

Figs. 3a and 3b show a second embodiment of the nozzle 10, having a plurality of outlet holes 33.

Apparatus for mounting two or more disrupters 1,2, comprises a central, cuboid block 40. Block 40 receives a sleeve 41 which may be held in the block by locking screws (not shown). Sleeve 41 may be part of a robot arm etc. Holding member 13 is attached to the central block 40 via a wedge shaped member 42. Holding member 14 is connected directly to block 40.

Block 40 has outwardly extending cylindrical protrusions 43 which are received in corresponding cylindrical recesses 44 in wedge shaped member 42 and holding member 14. Wedge shaped member 42 has a similar protrusion 45, received in a recess 44 of member 13.

Centrally positioned, lone screws 46,47 connect member 13 to member 42, and member 14 to member 40 respectively, the screws passing through holes 51 in the side of the members 13,14 and being countersunk in the wall of the bore 4. Accordingly the orientation of the members 13,14 relative to their adjoining members can be adjusted by loosening the respective screw 46 or 47 and relatively rotating the members. The screws may be tightened and loosened after the tubes 3 have been removed, access being gained through the bore of the member or a hole 52 provided opposite the screw. Hole 52 may be used to mount a second connecting member such as wedge shaped block 42, a square block or a member 40, to allow the connection of a third disrupter to the assembly.

A resilient member such as a flat spring 48 may be located between the members to maintain the orientation as the screw 46,47 is loosened.

The members can be swivelled through up to 360°.

Wedge shaped member 42 is fixed to the central block 40 by means of a number of screws 49 located in screw holes 53 evenly spaced around a circle. The screws are 6 in number, allowing the wedge shaped member to be located in any one of six orientations.

A screw hole may be provided in the side wall of bore 4 to cooperate with one of the screw holes 53 to allow the orientation of the holding member 13,14 to be fixed positively in one of six positions.

Fig. 4 shows wedge shaped members 42 positioned on each side of the centre block 40. It can be seen that the holding members 13,14 may be swivelled about their respective screws 46, so that the disrupters 1,2 may be held in a wide variety of relative orientations, including convergent, parallel and divergent when in the same plane.

The line of members may be extended, and the holding members may be fixed one against the other, allowing for the build up of an array of disrupters. Such an array when fired together will produce a considerable force able to achieve greater effect than that of prior art arrangements. It is envisaged that such an array with appropriately oriented disrupters may be sufficient to remove a car door, a common requirement when dealing with explosive devices.

The centre block 4 may be arranged to receive holding members etc. on each of four sides thereof.

CLAIMS:

1. A disrupter comprising an elongate tube (3) having a bore (4) of substantially constant cross-section closed at one end (5) for housing a liquid missile and means for generating an expanding gas, characterised in that the other end (8) of the tube has a tapered bore (9).

2. A disrupter as claimed in claim 1, characterised in that the tapered bore (9) is formed in a nozzle (10) which is detachably mounted on the end of the tube (3).

3. A disrupter as claimed in claim 2, characterised in that the nozzle (10) has a plurality of bores (33).

4. A disrupter as claimed in claim 1, 2 or 3, wherein the end (5) of the tube (3) is closed by a breech assembly (6), characterised in that the breech assembly (6) comprises a body (22) housing a non-conducting insert (23) in which a pin (24) of electrically conducting material is slidably mounted, said pin projecting through an aperture in the (25) breech assembly into the bore (4) and means (28) are provided for biassing said pin (24) towards the bore (4).

5. A disrupter as claimed in claim 4, characterised in that said biassing means comprises a spring (28) which bears at one end against head (27) of said pin (24), said head engaging an end wall of the insert (23) to limit the movement of the pin (24).

6. An assembly comprising a holding member (13, 14) and a disrupter as claimed in any one of the preceding claims, characterised in that said tube (3) is slidably mounted in the holding member (13,14) and is resiliently biassed towards a predetermined position relative to said holding member (13,14) whereby means (15) resiliently biassing the disrupter (1,2) will absorb recoil on actuation of the disrupter.

7. A breech assembly for a disrupter, comprising a breech body (22) which is detachably mountable on a tube member of the disrupter, characterised in that said breech assembly (6) further comprises an electrically conducting pin (24) which protrudes through a wall of said breech body, and biassing means for biassing said pin to project through said wall.

8. A breech assembly as claimed in claim 1, characterised in that said pin (24) is slidably mounted in a non-conducting insert (23) housed in said breech body (22).

9. Apparatus for supporting a plurality of disrupters, comprising a plurality of holding members (13,14) each for holding a respective disrupter (1,2), a support member (40) and a plurality of coupling members (41,42) for pivotably coupling together the first members (13,14) and the support member (40).

10. Apparatus as claimed in claim 9, wherein the members are form locked together.

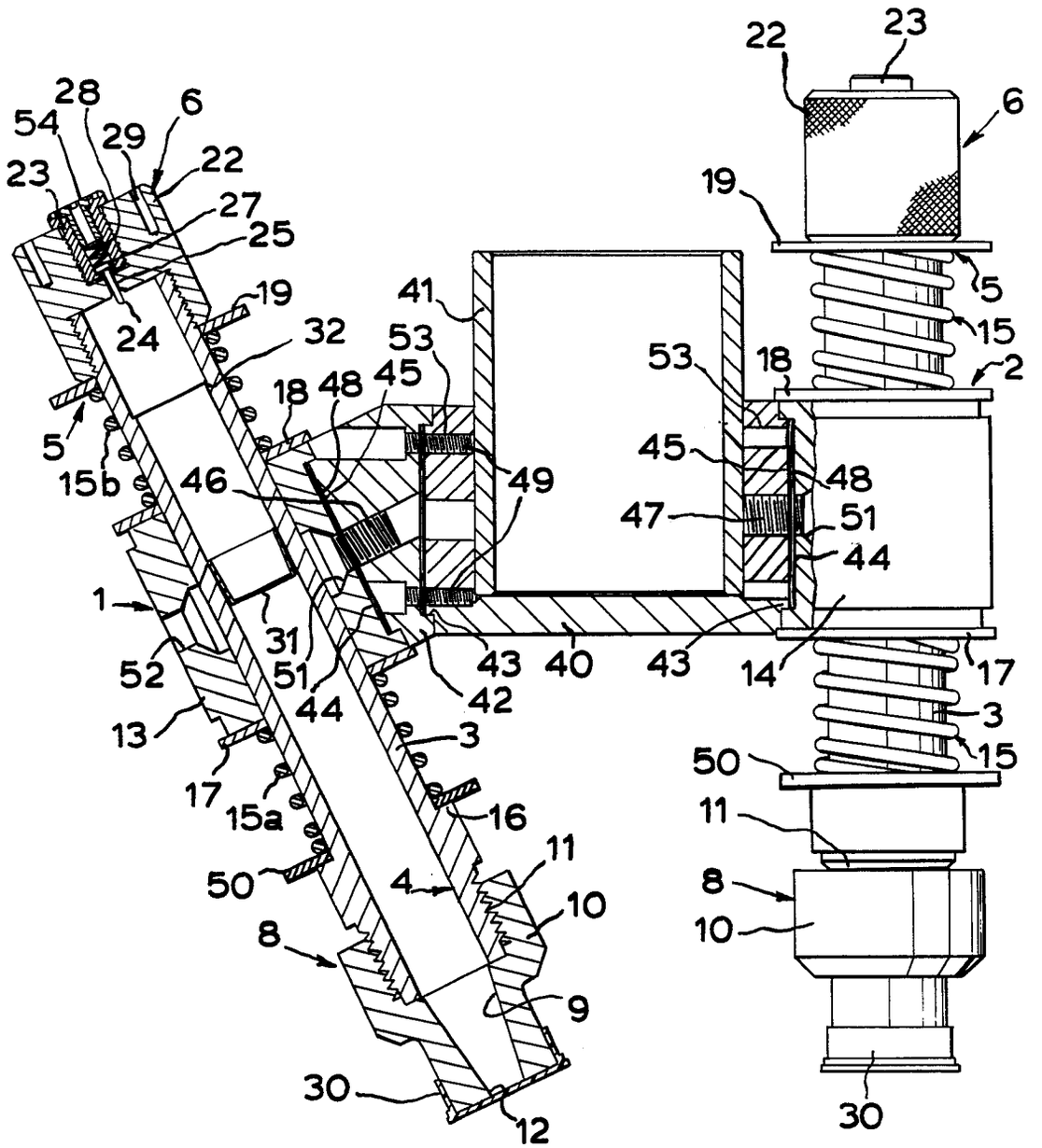

22
23
6
19
5
15
2
53
18
45
48
47
51
44
41
49
43
40
14
17
3
50
11
8
10
30
28
54
29
6
22
23
27
25
24
19
32
53
18
48
45
5
15b
46
1
31
51
44
52
13
17
15a
50
8
43
42
3
16
11
4
10
9
12

FIG.1.

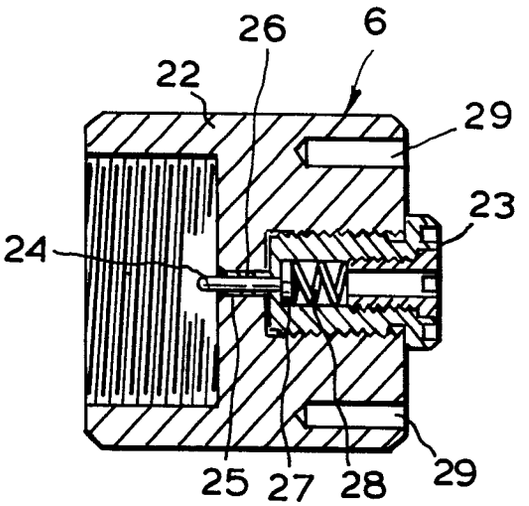


FIG. 2.

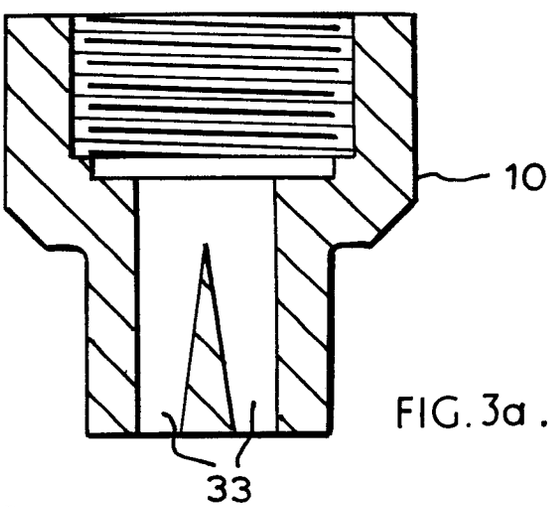
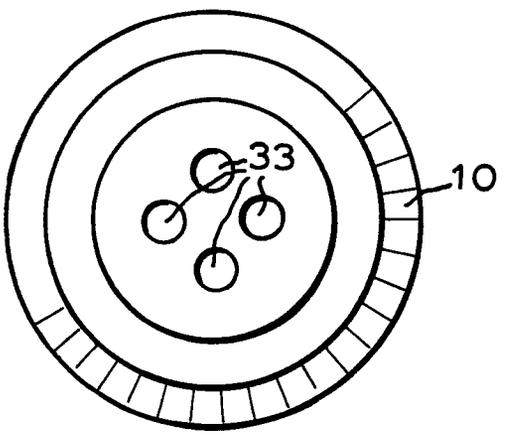


FIG. 3a.

FIG. 3b.



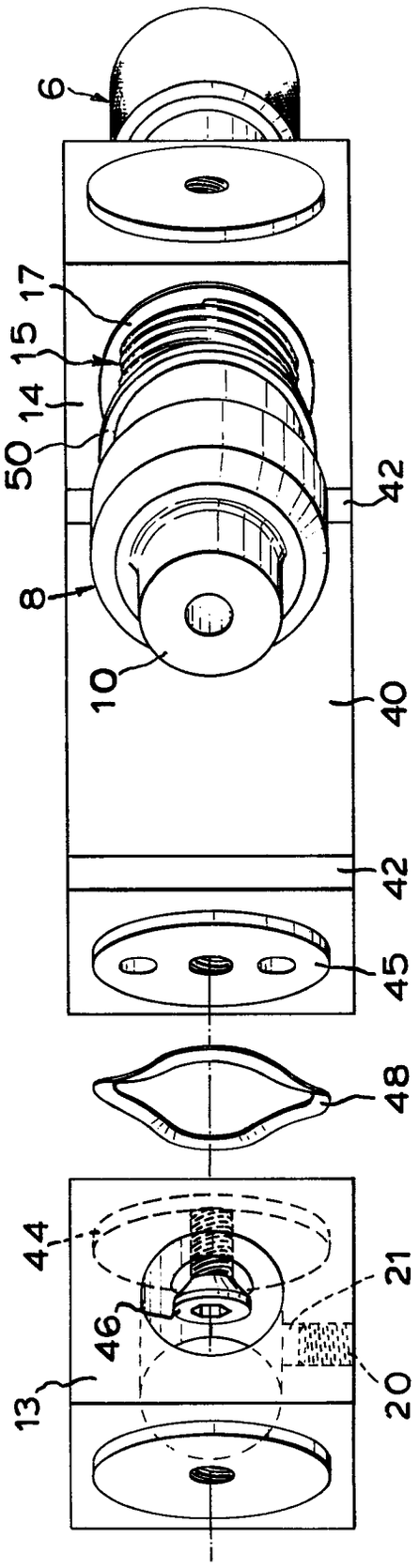


FIG. 4.