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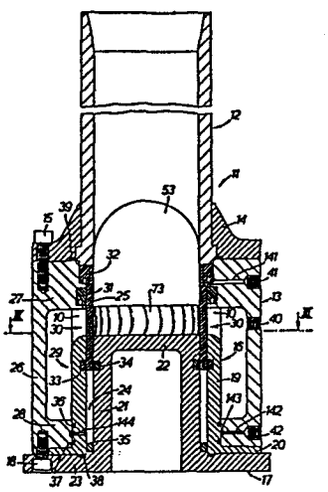
(54) Projectile propulsive device.

(57) A projectile propulsive device for propelling a projectile under the action of fluid under pressure comprises a barrel (11) having an axial bore in which a projectile (53) to be propelled is in use located, and a pressurised fluid supply for supplying fluid under pressure to the bore of the barrel (11) through a supply aperture (30) in the barrel (11) whereby in operation fluid under pressure from the supply flows through the supply aperture (30) to act on the base of the projectile to bring the projectile in the barrel to a predetermined axial velocity. To impart spin to the projectile (53), fluid under pressure from the supply is directed into the bore of the barrel (11) through the supply aperture (30) tangentially or partially tangentially with respect to the bore of the barrel (11).



PROJECTILE PROPULSIVE DEVICE.

The present invention relates to projectile propulsive devices which utilise fluid under pressure for propulsion of a projectile along a barrel of the device.

In a projectile launching device hitherto proposed a chamber for containing gas under pressure communicates with the bore of the barrel through one or more lateral apertures in the barrel which are sealed by the projectile itself when it is in a firing position in the barrel ready for launching. The projectile is launched by initially advancing it to a position in which the lateral aperture or apertures become uncovered, whereupon the pressurised gas flows from the chamber and acts on the base of the projectile to accelerate it along the barrel and to discharge it from the forward end of the barrel.

In another projectile launching device hitherto proposed the one or more lateral apertures in the barrel are sealed by a sleeve coaxially mounted with respect to the bore of the barrel and axially displaceable along the barrel between a closed position in which it seals the aperture or apertures and an open position in which it is clear of the aperture or apertures and allows gas under pressure to flow from the chamber into the barrel and act on the base of the projectile.

The projectile launching devices above referred to have been used successfully for example for deploying lines

between remote points such as between a ship and a mooring point on shore and also for deploying equipment at a remote point for which purpose the equipment is loaded within the projectile which is then launched and the equipment removed from the projectile or automatically released from it on arrival of the projectile at the remote point. When used for these purposes directional stability of the projectile in flight has been found to be adequate and ways of achieving improved stability by spinning the projectile have not been considered or have been considered and regarded as unnecessary.

It has however been found that improved directional stability of the projectile is particularly desirable for some applications. The conventional ways of inducing spinning by rifling the bore of the barrel or by providing inclined fins on the projectile are regarded as unsatisfactory as they increase the complexity of construction of the launcher barrel or the projectile and increase the cost of manufacture significantly.

It is an object of the present invention to provide a projectile launching device which induces spin in the projectile and which is of simple construction.

According to the present invention, there is provided a projectile propulsive device for propelling a projectile under the action of fluid under pressure comprising a barrel having an axial bore in which a projectile to be propelled is in use located, and pressurised fluid supply means for supplying fluid

under pressure to the bore of the barrel through a supply aperture or apertures in the barrel whereby in operation fluid under pressure from the supply means flows through the supply aperture or apertures to act on the base of the projectile to bring the projectile in the barrel to a predetermined axial velocity, characterised in that fluid under pressure from the supply means is directed into the bore of the barrel through the supply aperture or apertures or through a further supply aperture or apertures tangentially or partially tangentially with respect to the bore of the barrel to bring the projectile to a predetermined spin velocity.

Preferably, the fluid under pressure which is supplied to the bore of the barrel through the supply aperture or apertures to bring the projectile to the predetermined axial velocity is directed into the bore of the barrel tangentially or partially tangentially with respect to the bore of the barrel also to bring the projectile to the predetermined spin velocity.

In one embodiment of the invention hereinafter to be described deflector elements are provided in the supply aperture or apertures for directing the flow of fluid under pressure therethrough tangentially or partially tangentially with respect to the bore of the barrel. The supply aperture or at least one of the supply apertures may then extend throughout the circumference of the barrel with the deflector elements arranged in the aperture at equi-angularly spaced positions around the barrel.

In the embodiment of the invention hereinafter to be described, each deflector element is a deflector plate lying in a plane inclined to the radius of the bore of the barrel at the intersection of the plane with the bore of the barrel and each deflector plate lies in a plane parallel to the axis of the bore of the barrel. Furthermore, if desired, each deflector plate may also be arranged to lie in a plane inclined to the axis of the bore of the barrel thereby to create a helical flow of fluid under pressure along the bore of the barrel.

In the embodiment of the invention hereinafter to be described, each deflector plate is provided at a fixed position in the aperture. Alternatively, each deflector plate may be so mounted as to be angularly adjustable in the aperture. Furthermore, each deflector plate may be angularly adjustable about a pivotal axis extending parallel to the axis of the barrel so that the amount of spin imparted to the projectile can be varied.

In the embodiment of the invention hereinafter to be described, the pressurised fluid supply means comprises a chamber for containing fluid under pressure and communicating with the bore of the barrel through the supply aperture or apertures. The chamber is preferably formed as an annular space extending round the barrel and communicating with the bore of the barrel through the supply aperture or apertures which provide a direct communication between the annular space and the bore of the barrel. Valve means are provided for controlling the supply of fluid under pressure from the chamber to the bore of the barrel

through the supply aperture or apertures and preferably take the form of a sleeve coaxially mounted with respect to the bore of the barrel and axially displaceable between a closed position in which it closes the supply aperture or apertures and an open position in which it no longer closes the aperture or apertures. Alternatively, the supply of fluid under pressure from the chamber to the bore of the barrel through the supply aperture or apertures is controlled by the projectile propelled by the device, the projectile being movable upon firing of the device from a firing position in the bore of the barrel in which it closes the supply aperture or apertures to an advanced position in which it no longer closes the aperture or apertures.

The projectile in the embodiment of the invention hereinafter to be described is formed with an outer surface having spin-inducing grooves and is brought to the predetermined spin velocity by the action of fluid under pressure directed on to the grooved surface.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:-

Figure 1 is a schematic cross sectional view of a projectile launching device according to a first embodiment of the invention ready for firing,

Figure 2 is a schematic cross sectional view corresponding to that shown in Figure 1 in a disposition following firing,

Figure 3 is a schematic cross-section of the device shown in Fig. 1, taken on the line III-III in Figure 1, and

Figure 4 is a schematic diagram of a control circuit for controlling the operation of the device shown in Figures 1, 2 and 3.

Referring first to Figure 1 the projectile launching device shown comprises a barrel 11 having a forward barrel portion 12 to the rear end of which is secured an intermediate barrel portion 13 by a collar 14 held against the forward end face of the portion 13 by a plurality of screws 15, only one of which is shown in Figure 1, and two end portions 16 and 17 held against the rear end face of the intermediate portion 13 by a plurality of screws 18, only one of which is shown in Figure 1.

The end portion 16 consists of a hollow cylindrical section 19 terminating in a flange 20 by which it is secured to the end face of the intermediate portion 13. The end portion 17 is likewise formed with a hollow cylindrical section 21 closed at its forward end by an end section 22 and provided at its rear end with a

flange 23 by which it is secured to the end face of the intermediate portion 13.

The cylindrical sections 19 and 21 of the end portions 16 and 17 are radially spaced from each other to form an axially extending circumferential guide slot 24 which receives a sleeve 25 slidable within the slot 24.

The intermediate portion 13 is formed with a cylindrical wall section 26 and end sections 27 and 28 which together with the cylindrical section 19 of the end portion 16 form an annular space 29 which is closed off from the bore of the barrel by the sleeve 25 as shown in Figure 1, but which is in direct communication with the bore of the barrel via an aperture 30 when the sleeve 25 is moved to the position shown in Figure 2. The aperture 30 is defined by the rear end wall of the forward section 27 of the intermediate portion 13, the forward end of the section 19 and deflector plates 10 are arranged, as best seen in Figure 3, in the aperture at equi-angularly spaced positions around the bore of the barrel and inclined partially tangentially to the base of the barrel.

The sleeve 25 in the position shown in Figure 1 engages with seals 31 and 32 and abuts against the rear end face of the forward portion 12 of the barrel. Ring seals 33 and 34 are provided in the cylindrical sections 19 and 21 of the end portions 16 and 17 and a further ring seal 35 is provided at the rear end of the guide slot 24. Further seals 36 to 39 are also provided.

A projectile 53 for use in the launcher is front loaded into the barrel 11 and in the firing position rests on

the end section 22 of the portion 17 of the barrel. The projectile 53 is formed with a casing having a cylindrical outer surface provided with spin inducing grooves 73 and the spin of the projectile 53 is achieved by the action of the gas directed on to the grooves 73 from the aperture 30.

Inlets 40,41 and 42 are internally threaded to receive high pressure hose couplings for supplying pressurised gas for the operation of the launching device. The inlet 40 is in direct communication with the annular space 29 to which gas under pressure is to be supplied for providing the launching thrust for the projectile 53. The inlet 42 communicates through ducts 142, 143 and 144 with the guide slot 24 for supplying gas under pressure to the slot 24. The inlet 41 communicates through a duct 141 with an intermediate end face of the sleeve 25 for the supply of gas under pressure to the sleeve to displace it from the closed position in the direction of the open position shown in Figure 2.

A control system for controlling the application of gas under pressure to the inlets 40 to 42 is illustrated in Figure 4 and comprises two-position spring biased control valves 43 and 44 each provided with a relief port to atmosphere, a two-position on-off valve 45 provided with a relief port to atmosphere, a metering valve 46 with an associated non-return valve, a pressure regulator 47 with a relief port to atmosphere, and a pressure gauge 48.

Gas under high pressure from a supply cylinder (not shown) is applied to an input 49 of the control system and fed through line 50 to the two-position valve 45 which in the position shown provides a communication between the line 50 and an output line 51. Gas under

pressure in line 51 is applied to the two-position valve 43 which is spring biased to the cut-off position shown in Figure 3, preventing gas under pressure from being supplied to output line 52. Similarly gas under pressure is fed on line 54 to valve 44 likewise spring biased to its cut-off position as shown in Figure 3 and preventing gas under pressure from being supplied to output line 55. Finally gas under pressure on the line 51 is applied through line 56 and the manually operable metering valve 46 to output line 57.

With the valves 43,44 and 45 in the positions shown in Figure 4 and with the metering valve 46 open gas under pressure is fed to inlet 40 of the device shown in Figures 1 to 3 to charge the annular space 29 with highly pressurised gas. The metering valve 46 is then closed. To fire the launching device, the valve 44 is next operated to move it from the position shown in Figure 3 to its other position in which pressurised gas on line 54 is fed through it to inlet 41 and through duct 141 to an intermediate front end face of the sleeve 25. As the inlet 42 is connected by the valve 43 to atmosphere in the position of the valve 43 shown in Figure 4 the sleeve 25 is moved under the high pressure gas rearwardly in the launching device. As soon as the sleeve 25 moves clear of the seals 31 and 32 and into the region of the annular space 29 the high pressure gas in the space 29 rapidly accelerates the sleeve 25 into the retracted position shown in Figure 2. With the rapid retraction of the sleeve 25, the pressurised gas

is directed at the rear end of the projectile 53 partially tangentially by the deflector plates 10 and acts on the spin-inducing grooves 74, causing the projectile to spin. At the same time, it acts on the base of the projectile 53 causing the projectile 53 to be propelled with high axial velocity along the forward portion 12 of the barrel and to be launched from the end of the barrel with a predetermined axial velocity and a predetermined spin velocity. After firing of the projectile 53 the pressurised gas charge in the annular space 29 is expended and the device then needs to be re-set for the firing of a further projectile.

Re-setting of the launching device shown in Figures 1 and 2 is effected by first momentarily operating the control valve 43 so that it transmits gas under pressure from the line 51 to the line 52 and inlet 42. Pressurised gas at the inlet 42 is transmitted via ducts 142, 143 and 144 to the rear end of the guide slot, causing the slide 25 to advance from the position shown in Figure 2 back to the position shown in Figure 1. The metering valve 46 is then opened to supply pressurised gas through line 57 to inlet 40 for re-charging the annular space 29 and is then closed, leaving the launching device ready for firing a further projectile front loaded into the forward barrel portion 12. The two-position on-off valve 45, which is normally in the position shown in Figure 3, can be operated in an emergency to switch it into its other position in which it vents the line 51 to atmosphere and clears the launching device of pressurised gas.

In an alternative embodiment of the invention not illustrated the projectile 53 itself serves to seal the aperture 30 and the sleeve 25 is omitted. In this embodiment the projectile 53 is mounted in a firing position in which it completely seals off the aperture 30 and is advanced along the barrel 11 upon firing so that the aperture 30 is uncovered, allowing the pressurised gas in the chamber 29 to flow through the aperture 30 and act on the rear end of the projectile to bring it to the required spin and axial velocities for launching from the forward end of the barrel.

It will be appreciated that the pressurised gas from the chamber 29 in flowing through the aperture 30 serves the dual purpose of bringing the projectile 53 up to the spin and axial velocities required at launch. For some applications it may however be found more advantageous or convenient to arrange for the pressurised gas from the chamber 29 to follow a first path into the bore of the barrel through one or more apertures to bring about a spin of the projectile and a separate path through one or more other apertures for acting on the base of the projectile to accelerate it along the bore of the barrel.

In the embodiment of the invention described with reference to the drawings the deflector plates 10 are fixed plates. It may however be found desirable in some uses of the device to arrange for them to be angularly adjustable about pivotal axes extending parallel to the axis of the barrel so that the amount of spin imparted to the projectile can be varied.

Furthermore, for some uses of the device it may be found advantageous to arrange for the deflector plates 10 to lie in planes inclined to the axis of the barrel to create a helical flow of gas along the bore of the barrel in the direction of the open end.

In the embodiment of the invention hereinbefore described with reference to the drawings, the device is preferably charged and fired by air under pressure. It will however be appreciated that other gases such as nitrogen could equally well be used.

In the embodiment of the invention hereinbefore described with reference to the drawings the annular space 29 forms a chamber for containing gas under pressure. In an alternative embodiment of the invention a chamber is provided for housing an explosive charge which generates gas under high pressure and which is ignited when the device is to be fired. The sleeve 25 is then omitted.

In the embodiment of the invention hereinbefore described with reference to the drawings, the projectile 53 takes up a firing disposition in the barrel 12 in which the rear end of the projectile extends rearwardly completely across the aperture 30. In some applications of the launching device it may, however, be found desirable to arrange for the rear end of the projectile in its firing position to extend rearwardly only partially across the aperture 30.

CLAIMS

1. A projectile propulsive device for propelling a projectile under the action of fluid under pressure comprising a barrel having an axial bore in which a projectile to be propelled is in use located, and pressurised fluid supply means for supplying fluid under pressure to the bore of the barrel through a supply aperture or apertures in the barrel whereby in operation fluid under pressure from the supply means flows through the supply aperture or apertures to act on the base of the projectile to bring the projectile in the barrel to a predetermined axial velocity, characterised in that fluid under pressure from the supply means is directed into the bore of the barrel through the supply aperture or apertures or through a further supply aperture or apertures tangentially or partially tangentially with respect to the bore of the barrel to bring the projectile to a predetermined spin velocity.

2. A device according to claim 1 characterised in that the fluid under pressure which is supplied to the bore of the barrel through the supply aperture or apertures to bring the projectile to the predetermined axial velocity is directed into the bore of the barrel tangentially or partially tangentially with respect to the bore of the barrel also to bring the projectile to the predetermined spin velocity.

3. A device according to claim 2, characterised in that deflector elements are provided in the supply aperture or apertures for directing the fluid under

pressure therethrough tangentially or partially tangentially with respect to the bore of the barrel.

4. A device according to claim 3, characterised in that the supply aperture or at least one of the supply apertures extends throughout the circumference of the barrel and that the deflector elements are arranged in the aperture at equi-angularly spaced positions around the barrel.

5. A device according to claim 3 or 4, characterised in that each deflector element is a deflector plate lying in a plane inclined to the radius of the bore of the barrel at the intersection of the plane with the bore of the barrel.

6. A device according to claim 5, characterised in that each deflector plate lies in a plane parallel to the axis of the bore of the barrel.

7. A device according to claim 5, characterised in that each deflector plate lies in a plane inclined to the axis of the bore of the barrel thereby to create a helical flow of fluid under pressure along the bore of the barrel.

8. A device according to claim 5,6 or 7, characterised in that each deflector plate is provided at a fixed position in the aperture.

9. A device according to claim 5,6 or 7, characterised in that each deflector plate is so mounted as to be angularly adjustable in the aperture.

10. A device according to claim 9, characterised in that each deflector plate is angularly adjustable about a pivotal axis extending parallel to the axis of the barrel so that the amount of spin imparted to the projectile can be varied.

11. A device according to any of claims 1 to 10, characterised in that the pressurised fluid supply means comprises a chamber for containing fluid under pressure and communicating with the bore of the barrel through the supply aperture or apertures.

12. A device according to claim 11, characterised in that the chamber is formed as an annular space extending round the barrel and communicating with the bore of the barrel through the supply aperture or apertures which provide a direct communication between the annular space and the bore of the barrel.

13. A device according to claim 11 or 12, characterised by the provision of valve means for controlling the supply of fluid under pressure from the chamber to the bore of the barrel through the supply aperture or apertures.

14. A device according to claim 13, characterised in that the valve means comprises a closure element movable between a closed position in which it closes the supply aperture or apertures and an open position in which it no longer closes the aperture or apertures.

15. A device according to claim 14, characterised in that the closure element comprises a sleeve

coaxially mounted with respect to the bore of the barrel and axially displaceable along the barrel between the closed and open positions.

16. A device according to claim 11 or 12, characterised in that the supply of fluid under pressure from the chamber to the bore of the barrel through the supply aperture or apertures is controlled by the projectile propelled by the device, the projectile being movable upon firing of the device from a firing position in the bore of the barrel in which it closes the supply aperture or apertures to an advanced position in which it no longer closes the aperture or apertures.

17. A device according to any of claims 1 to 10, characterised in that the pressurised fluid supply means comprises an explosive charge which generates gas under high pressure and which is ignited when the device is to be fired.

18. In combination, a projectile propulsive device according to any of claims 1 to 17 and a projectile for propulsion thereby, characterised in that the projectile is formed with an outer surface having spin-inducing grooves and is brought to the predetermined spin velocity by the action of fluid under pressure directed on to the grooved surface.

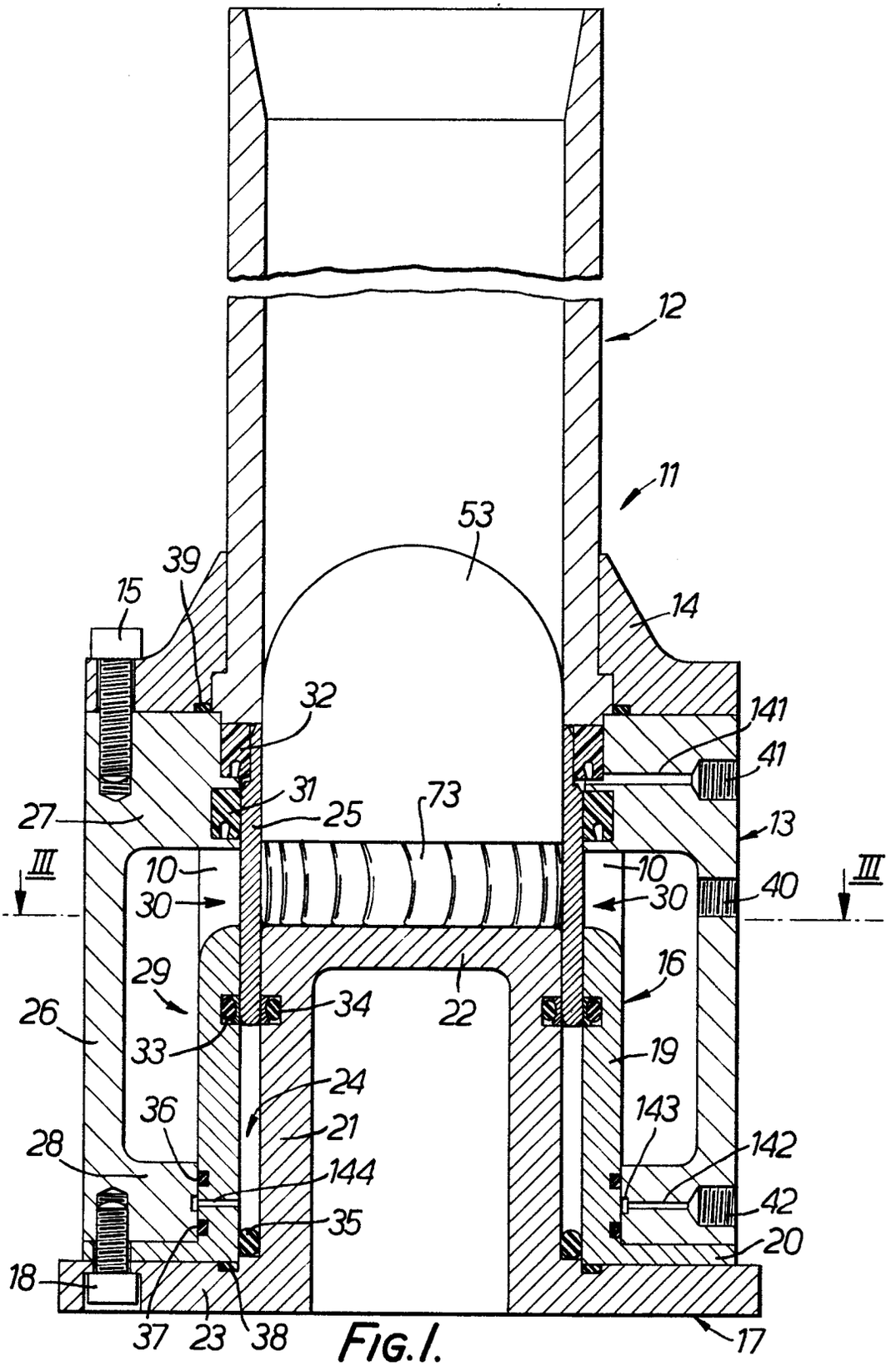

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FIG. 1.

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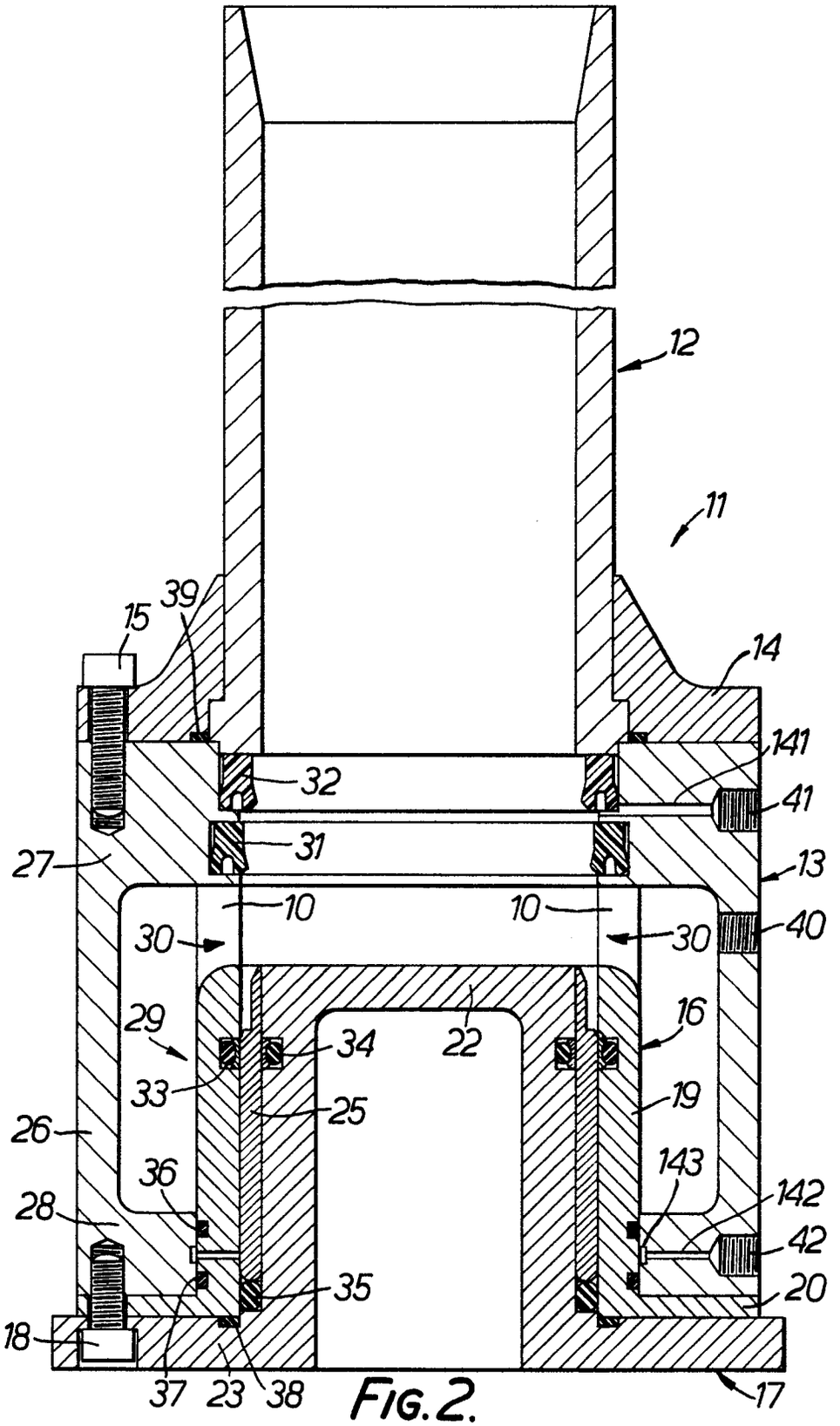

FIG. 2.

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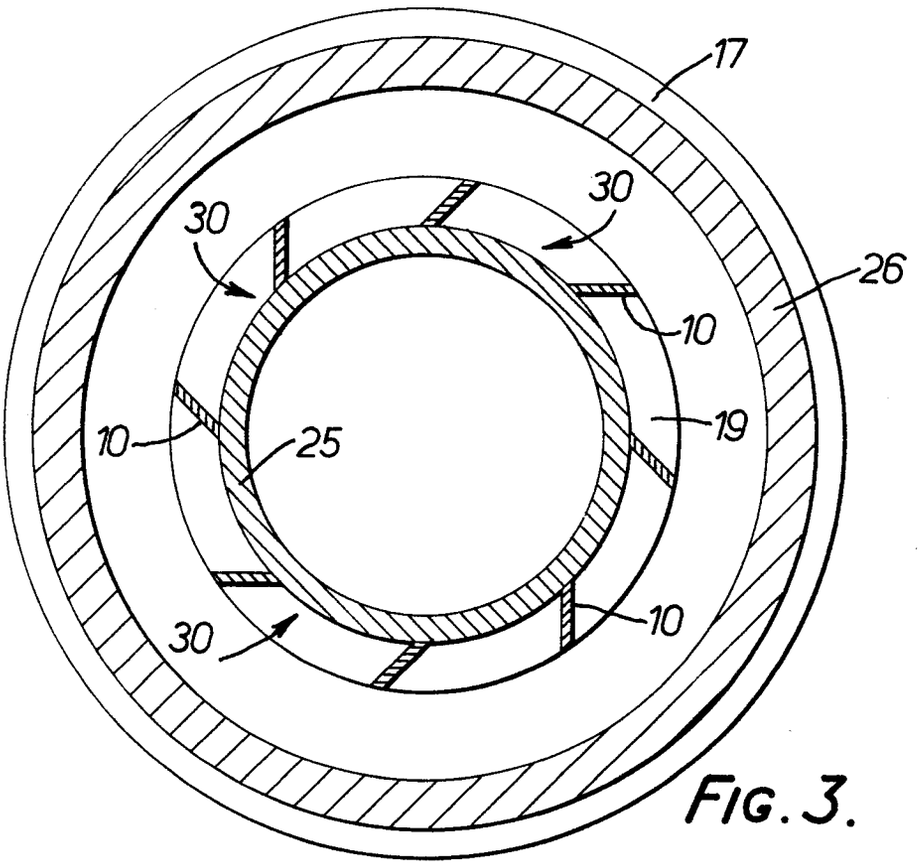

FIG. 3.

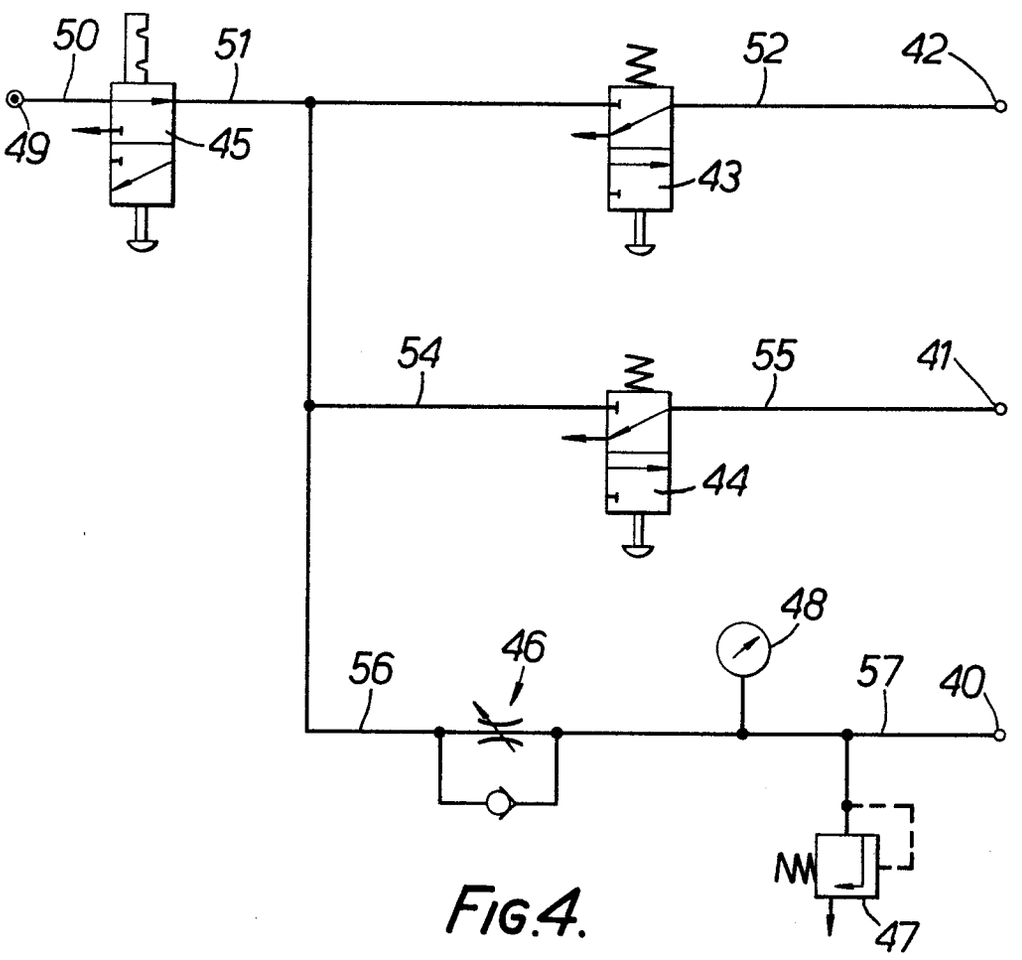

FIG. 4.

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EUROPEAN SEARCH REPORT

0140657
Application number

EP 84 30 7195

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)
Y	DE-C- 303 807 (SANDOR) * Whole document *	1-12, 16-18	F 41 F 1/04
Y	EP-A-0 037 870 (PLUMETTAZ S.A.) * Abstract; claims; figures *	1-12, 16-18	
A	GB-A-2 105 826 (CAMPBELL & ALLEN) * Page 2, column 1, lines 29-41; figure 4 *	13	
A	DE-C- 72 846 (RAPIEFF) * Page 1, column 1, lines 30-37; column 2, lines 1-8; page 2, column 2, lines 22-31; figures 6-8 *	14,15	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	US-A- 542 174 (SEWALL) * Abstract *	14,15	F 41 F
A	US-A-1 272 421 (GLISSENTI) * Abstract *	14,15	
P,A	EP-A-0 095 381 (ALLEN AND CAMPBELL) * Claims; figures *	14,15	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	04-02-1985	RODOLAUSSE P.E.C.C.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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