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(54) **Servo positioning valve.**

(57) A servo-valve (12) for operating a fluid-operable actuator (5), the servo-valve (12) having a valve member (13) which is movable from an initial position in response to a change of position from a datum position (X) of a part (2) to be moved by said actuator (5) and means for creating a time delay (33,35-34,36) from the commencement of said movement of the valve member (12) from said initial position and to apply a correcting movement to said actuator (5) at the end of said time delay, thereby to return said part to said datum position and the valve member (12) to said initial position.

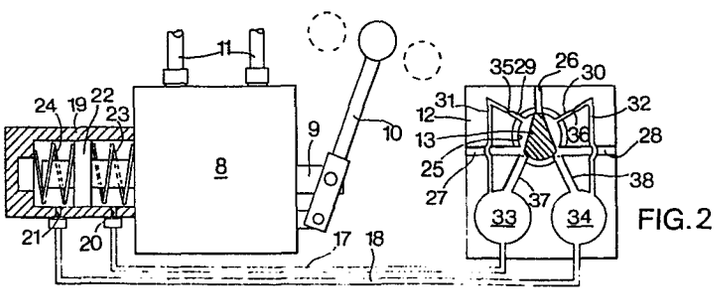

FIG. 2

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SERVO-VALVE

The invention relates to a servo-valve and is particularly concerned with a servo-valve for operating a fluid-operable actuator, the servo-valve having a valve member which is movable from an initial position in response to a change of position from a datum position of a part to be moved by the actuator.

In known servo-valves of this kind the response of the servo-valve to change in position from the datum position of the part being controlled is usually effected without substantial delay. However there are applications where it is desirable that the servo-valve should not detect instantaneous changes in position of the part being controlled and should only react to sustained change of position. Such an application is the control of the height of the body of a vehicle above the ground, that is its clearance with the ground, where it is undesirable that a servo-valve should control a body levelling actuator in response to momentary change in the level of a body and should only respond to change in level which occurs for an appreciable period. It is envisaged however that that period may be short, for example, only five seconds.

According to the invention, a servo-valve for operating a fluid-operable actuator has a valve member which is movable from an initial position in response to a change of position from a datum position of a part to be moved by said actuator and means for creating a time delay from the commencement of said movement of the valve member from said initial position and to apply a correcting movement to said actuator at the end of said time delay, thereby to return said part to said datum position and the valve member to said initial position.

Preferably the valve member is movable in either of two opposite senses from said initial position in response to a corresponding change of position in one or other of a pair of opposite senses from said datum position of the part to be moved by said actuator.

The valve member may, for example, be rotatable within a cylinder having a pressurised fluid inlet port, a pair of supply ports each leading through a supply line via a flow restrictor to one or other side of pressure-responsive means controlling the actuator and spaced apart circumferentially of the cylinder at respective sides of the inlet port and a pair of exhaust ports spaced apart circumferentially of the cylinder at respective sides of the inlet port, whereby the valve member has three positions, namely a neutral position in which the inlet port is closed by the valve member and both supply ports or lines are connected to the corresponding exhaust port, a first operative position in which the inlet port is connected to one of the supply ports, the corresponding exhaust port is closed and the other supply port is connected with the other exhaust port and a second operative position in which the inlet port is connected to said other supply port, said other exhaust port is closed and said one supply port and said one exhaust port are connected together.

Each restrictor may be connected to a respective reservoir, said respective restrictor and reservoir being connected by a respective supply line to one or other end of said pressure-responsive means controlling the actuator.

The invention also includes the combination of a servo-valve as set out in either of the two immediately preceding paragraphs and the actuator, the actuator being a power fluid control valve having a valve member movable between two operative positions by said pressure-responsive means, the latter comprising a piston

movable in a cylinder to which said supply lines are connected one at or adjacent each end of the cylinder to move the piston in one or other direction or to hold it in a neutral position according to the position of the valve member of the servo-valve, the piston being acted upon by return springs acting in both directions in opposition to the fluid pressure delivered to the cylinder through the respective supply lines.

The actuator is preferably additionally controllable by a personally-operable control member. For example by a manually-operable control member.

By way of example, a servo-valve and actuator for controlling the level of the skip of a dumper truck to maintain the clearance with the ground substantially constant is now described with reference to the accompanying drawings, in which:-

Figure 1 is a diagram showing a side elevation of the dumper truck and position of the skip, the actuator for controlling a hydraulic suspension and levelling system and the servo-valve;

Figure 2 is a side view, partly in section, to a larger scale of the actuator and the servo-valve, the valve member of the latter being shown in its neutral position, and

Figures 3 and 4 respectively show the servo-valve with its valve member in each of its two operative positions.

Referring to Figure 1, the dumper truck 1 has a skip 2 which is supported by the chassis of the truck at 3 by a link 4 and by a suspension and levelling cylinder 5 at 6. The desired normal position of the skip 2 is indicated by full lines. High and low positions of the skip 2 are indicated in broken lines at 2A and 2B respectively. The purpose of the servo-valve and actuator

provided by this invention is to maintain the skip in its normal position in order to maintain substantially constant the clearance X with the ground under all load conditions. However momentary fluctuations in the height of the skip relative to the wheels 7 as a result of the dumper truck travelling over uneven ground do not matter and so, as will be explained, a dwell of approximately five seconds is provided before the servo-valve will commence to control the actuator.

The actuator is shown at 8 and is a fluid operable control valve having a spool valve member 9 operable by a manual control lever 10. The actuator is connected by fluid control lines 11 to the suspension and levelling cylinder 5. This part of the actuator 8, the lines 11 and the cylinder 5 comprise a hydraulic suspension and levelling circuit of known type. Thus the operator can move the spool valve 9 by means of the lever 10 to raise and lower the skip 2.

In accordance with the invention, servo-valve 12 is mounted on the chassis of the dumper truck 1. The servo-valve 12 has a rotary valve member 13 (shown in Figures 2-4) having an operating arm 14 which is connected by a link 15 to the skip 2 at 16. Thus as the skip 2 rises and falls the arm 14 and hence the valve member 13 will be rotated anticlockwise and clockwise respectively from the neutral position, shown in Figure 2, which the valve member 13 occupies when the skip 2 is in its normal position.

The servo-valve 12 is connected by lines 17, 18 to a pair of ports 20, 21 in a control cylinder 19 in the actuator 8 containing a piston 22 mounted between the ports 20, 21 in the cylinder 19. The piston 22 is mounted on the spool valve 9 of the actuator 8 or an extension of the spool valve so that as the piston 22 is moved in either direction by the servo-valve 12, the spool valve 9 of the actuator 8 will be moved to effect a levelling correction

by the cylinder 5 on the skip 2. The piston 22 is returned to the neutral position shown in Figure 2 after each correction movement, or manual adjustment by the lever 10, by a spring 23, 24 positioned inside the cylinder 19 and acting against the piston 22 in the return direction. The pressurised fluid used in the servo-valve circuit and in the cylinder 19 is compressed air but could be oil.

The servo-valve 12 comprises a block having five ports circumferentially-spaced around a cylindrical chamber 25 containing the rotary valve member 13. The five ports are an inlet port 26 connected to a source of compressed air (see Figures 2-4), a pair of exhaust ports 27, 28 positioned one each side of the port 26 circumferentially of the chamber 25, and a pair of supply ports 29, 30 positioned respectively between the inlet port 26 and the exhaust ports 27, 28. The exhaust ports 27, 28 communicate with atmosphere. The supply ports 29, 30 are connected by ducts 31, 32 respectively to reservoirs 33, 34 formed in the block of the servo-valve 12 and then to the respective lines 17, 18. The reservoirs 33 and 34 are respectively connected by ducts 37, 38 to the chamber 25. Each duct 31, 32 contains a fixed restrictor or orifice 35, 36 respectively. The purpose of the restrictors 35, 36 is to provide the aforesaid delay in response of the servo-valve 12 to change of level of the skip 2. The delay effected by the restrictors 35, 36 is substantially 5 seconds.

The operation of the servo-valve 12 is now described with particular reference to Figures 2-4. When the skip 2 is in its normal position as shown in full lines in Figure 1, the arm 14 of the servo-valve 12 holds the valve member 13 in the neutral position as shown in Figure 2. In this position, the valve member 13 closes the inlet port 26 and each exhaust port 27 and 28 communicates through the respective duct 37, 38 with the

reservoir 33, 34. Thus both the reservoirs 33, 34 are at exhaust (i.e. atmospheric) pressure and so the springs 23, 24 together return the piston 22 and thus the spool valve 9 to their neutral positions.

When the skip 2 moves to a low position 2B, the arm 14 turns the valve member 13 in the clockwise direction, as shown in Figure 3. In this position the inlet port 26 is opened and admits compressed air into the part of the chamber 25 adjacent the supply port 29. Air flows through the restrictor 35 to the reservoir 33 which is closed to exhaust. The reservoir 34 is open through the adjacent portion of the chamber 25 to the exhaust port 28. After a delay of substantially 5 seconds produced by the restrictor 35, the reservoir 33 provides sufficient pressure to be transmitted through the line 17 to push the piston 22 to the left, as viewed in Figure 2, and so the actuator 8 will transmit pressure to the cylinder 5 to raise the skip 2. Simultaneously on movement of the piston 22 to the left, air will be exhausted from the left-hand end of the cylinder 19, through the line 18, the reservoir 34 and the exhaust port 28 to atmosphere. When the skip 2 has been returned to its normal position, the valve member 13 will have been turned anticlockwise to the neutral position shown in Figure 2, the reservoir 33 will be rapidly exhausted and the piston 22 and the spool valve 9 will return to and be held in their neutral positions as already described.

When the skip 2 moves to a high position 2A, the arm 14 turns the valve member 13 in the anticlockwise direction, as shown in Figure 4. In this position, the inlet port 26 is opened and admits compressed air into the part of the chamber 25 adjacent the supply port 30. Air flows through the restrictor 36 to the reservoir 34 which is closed to exhaust. The reservoir 33 is open through the adjacent portion of the chamber 25 to the exhaust

port 27. After a delay of substantially 5 seconds produced by the restrictor 36, the reservoir 34 provides sufficient pressure to be transmitted through the line 18 to push the piston 22 to the right, as viewed in Figure 2, and so the actuator 8 will transmit pressure to the cylinder 5 to lower the skip 2. Simultaneously on movement of the piston 22 to the right, air will be exhausted from the right-hand end of the cylinder 19, through the line 17, the reservoir 33 and the exhaust port 27 to atmosphere. When the skip 2 has been returned to its normal position, the valve member 13 will have turned clockwise to the neutral position shown in Figure 2, the reservoir 34 will be rapidly exhausted, and the piston 22 and the spool valve 9 will be held in their neutral positions as already described.

One advantage of the servo-valve 12 is that the valve member can be sealed within the block, that is except for the provision of the ports. One way in which the sealing of the valve member can be effected is to use a floating sleeve between the valve member and the block, the sleeve being sealed within the block by elastically deformable seals, such as O-rings, but there being no seals between the valve member and the floating sleeve.

Another advantage is that the ducts 37, 38 provide a free-flow by-pass of the respective restrictors 35, 36 from the reservoirs 33, 34 on exhaust, without the need for a ball or other non-return valve in parallel with the respective restrictor.

Although the illustrated and described example of servo-valve is applied to the controlling of the level of a dumper truck skip, it may be used in may other applications both as a means of restoring a part to a datum position from one direction only or from two opposite directions, one on each side of the datum position.

The servo-valve may be used to control an actuator automatically with or without the provision of manual control of the actuator.

CLAIMS

1. A servo-valve for operating a fluid-operable actuator, the servo-valve having a valve member movable from an initial position in response to a change of position from a datum position of a part to be moved by the actuator, characterised in that the servo-valve also includes means for creating a time delay from the commencement of said movement of the valve member from said initial position and to apply a correcting movement to said actuator at the end of said time delay, thereby to return said part to said datum position and the valve member to said initial position.

2. A servo-valve as claimed in Claim 1 in which the valve member (13) is movable in either of two opposite senses from said initial position in response to a corresponding change of position in one or other of a pair of opposite senses from said datum position of the part to be moved by said actuator.

3. A servo-valve as claimed in Claim 2 in which the valve member (13) is rotatable within a cylinder (25) having a pressurised fluid inlet port (26), a pair of supply ports (29, 30) each leading through a supply line (31, 32) via a flow restrictor (35, 36) to one or other side of pressure-responsive means (22) controlling the actuator (8) and spaced apart circumferentially of the cylinder (25) at respective sides of the inlet port (26) and a pair of exhaust ports (27, 28) spaced apart circumferentially of the cylinder (25) at respective sides of the inlet port (26), whereby the valve member (13) has three positions, namely a neutral position in which the inlet port (26) is closed by the valve member (13) and both supply ports (29, 30) or lines are connected to the corresponding

exhaust port (27, 28), a first operative position in which the inlet port (26) is connected to one of the supply ports (29, 30), the corresponding exhaust port (27, 28) is closed and the other supply port (30, 29) is connected with the other exhaust port (28, 27) and a second operative position in which the inlet port (26) is connected to said other supply port (30, 29), said other exhaust port (28, 27) is closed and said one supply port (29, 30) and said one exhaust port (27, 28) are connected together.

4. A servo-valve as claimed in Claim 3 in which each restrictor (35, 36) is connected to a respective reservoir (33, 34), said respective restrictor (35, 36) and reservoir (33, 34) being connected by a respective supply line (17, 18) to one or other end of said pressure-responsive means (22) controlling the actuator (8).

5. The combination of a servo-valve (12) as claimed in Claim 3 or 4 and said actuator (8), said actuator (8) being a power fluid control valve having a valve member movable between two operative positions by said pressure-responsive means, the latter comprising a piston (22) movable in a cylinder (19) to which said supply lines (17, 18) are connected one at or adjacent each end of the cylinder (19) to move the piston (22) in one or other direction or to hold it in a neutral position according to the position of the valve member (13) of the servo-valve (12), the piston (22) being acted upon by return springs (23, 24) acting in both directions in opposition to the fluid pressure delivered to the cylinder (19) through the respective supply lines (17, 18).

6. The combination as claimed in Claim 5 in which the actuator (8) is additionally controllable by a personally-operable control member (10).

7. The combination as claimed in Claim 5 or 6 in which the actuator (8) is connected to supply power fluid to one or other end of a fluid-operable device (5) which is to be maintained in said datum position by applying correctional movement to said actuator (8) under the control of said servo-valve (12).

8. The combination as claimed in Claim 7 in which the fluid-operable device (5) acts on the body (2) of a vehicle of which the level is to be maintained to maintain its clearance with the ground substantially constant.

9. The combination as claimed in Claim 8 in which the vehicle is a dumper truck and said body (2) is the skip of the dumper truck.

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FIG.1

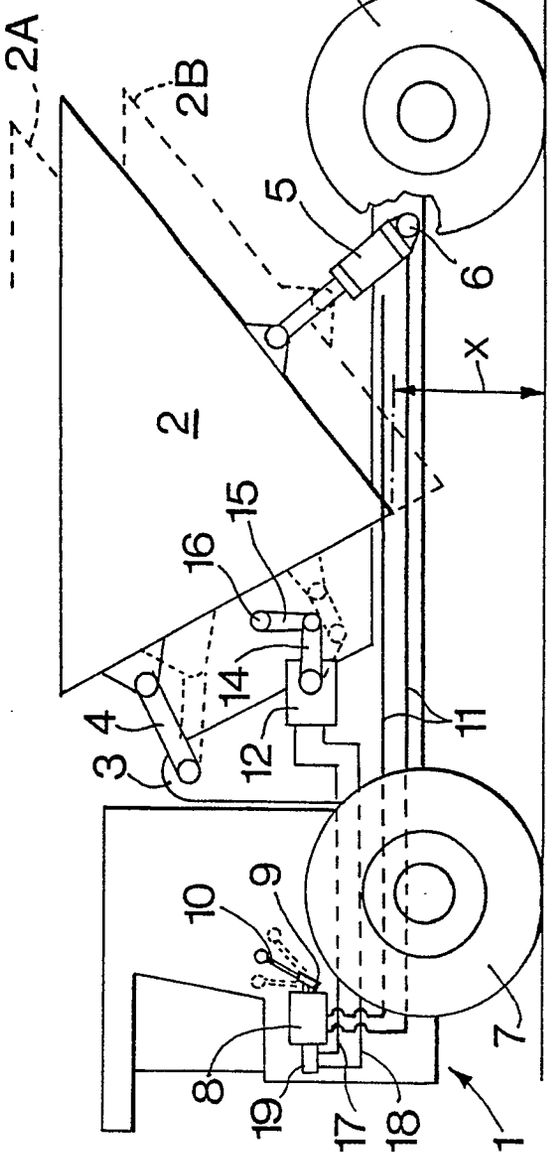
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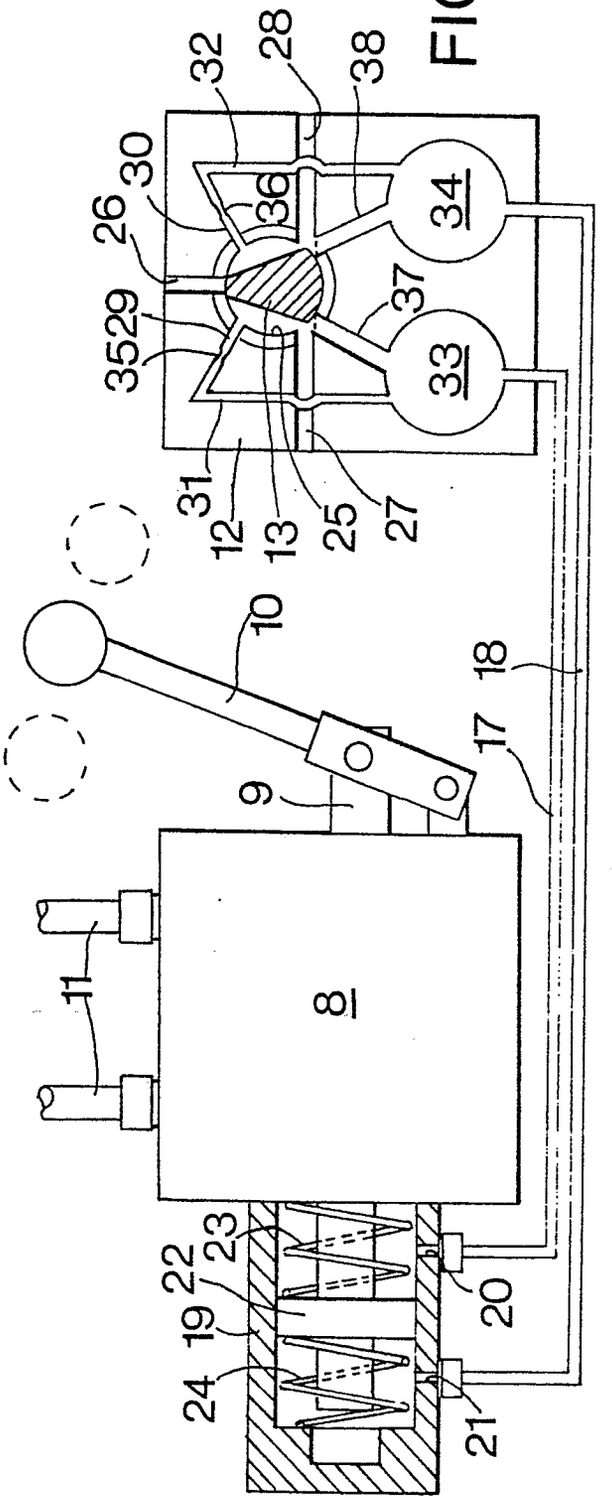
FIG.2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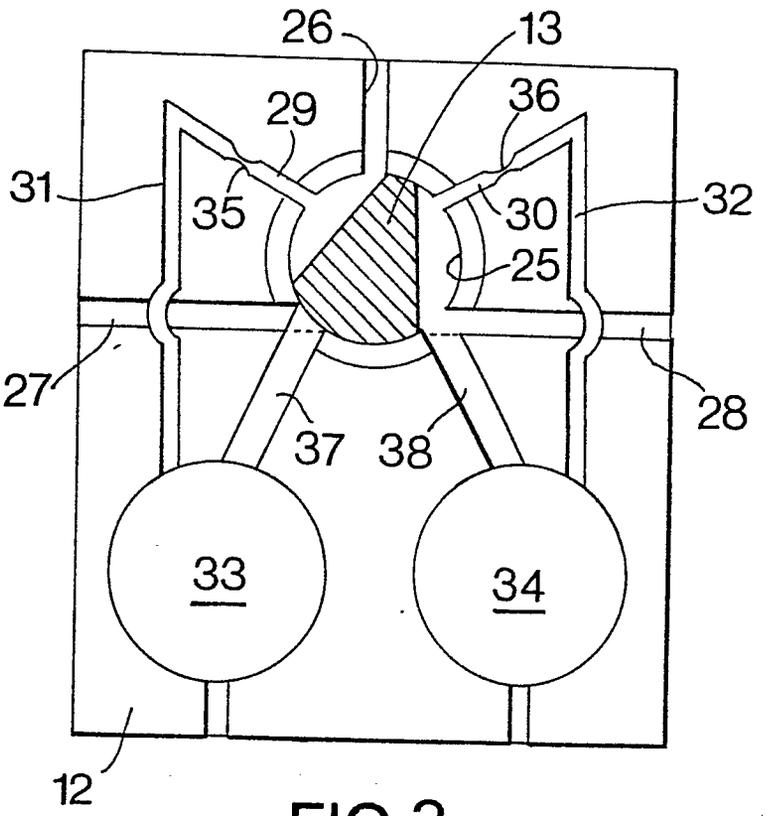
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FIG.3

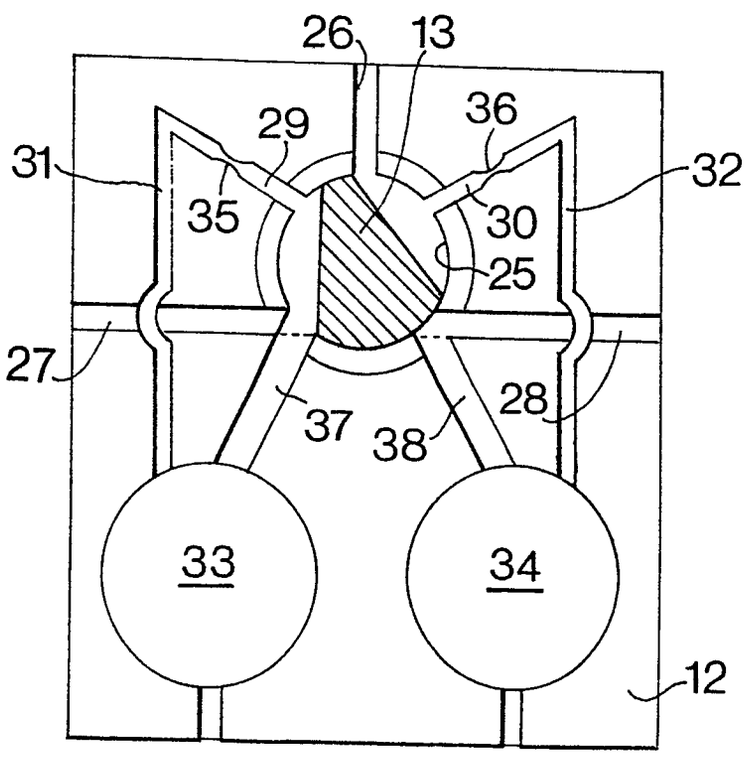
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FIG.4

European Patent Office

EUROPEAN SEARCH REPORT

0098083
Application number

EP 83 30 3522

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. ³)
A	DE-C- 819 942 (RIXMANN) * Whole document *	1-3,5, 6	F 15 B 9/08 B 62 D 33/06
A	OELHYDRAULIK UND PNEUMATIK, vol. 8, no. 1, January 1964, pages 8,12-14, Mainz, DE. K. ZIESLING: "Pneumatische Zeitglieder"	1,3,4	
A	DE-A-1 430 542 (TUCZEK) * Whole document *	1,5,8	
A	FR-A-1 470 073 (AIROYAL) * Page 1, right-hand column, line 32 - page 2, left-hand column, line 13; figure 1 *	1,7-9	
A	DE-A-2 710 440 (FISCHER)		TECHNICAL FIELDS SEARCHED (Int. Cl. ³) F 15 B F 16 K B 60 G B 62 D
A	US-A-4 014 533 (KREIJIR)		
A	US-A-4 164 956 (TAKAHASHI)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02-09-1983	BENZE W.E.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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