



Europäisches Patentamt

⑯

European Patent Office

Office européen des brevets

⑯ Publication number:

0 203 426
A1

⑯

EUROPEAN PATENT APPLICATION

⑯ Application number: **86106259.4**

⑯ Int. Cl.1: **F 15 B 15/08**

⑯ Date of filing: **07.05.86**

⑯ Priority: **07.05.85 NO 851802**

⑯ Applicant: **NORSK HYDRO A/S, Bygdøy Allé 2, N-0257 Oslo 2 (NO)**

⑯ Date of publication of application: **03.12.86**
Bulletin 86/49

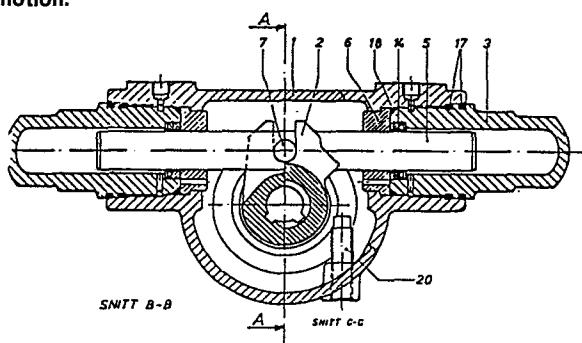
⑯ Inventor: **Heim, Edgar, Villav. 33, N-3660 Rjukan (NO)**
Borkenhagen, Alf, Ekornvn. 16, N-3660 Rjukan (NO)
Ohrn, Ragnar O., Orevegen 24, N-3658 Miland (NO)
Berge, Knut, N-3658 Miland (NO)

⑯ Designated Contracting States: **AT BE CH DE FR GB IT LI LU NL SE**

⑯ Representative: **Weickmann, Heinrich, Dipl.-Ing. et al.**
Patentanwälte Dipl.-Ing. H. Weickmann Dipl.-Phys. Dr. K. Fincke Dipl.-Ing. F. A. Weickmann Dipl.-Chem. B. Huber Dr.-Ing. H. Liska Dipl.-Phys. Dr. J. Prechtel
Möhlstrasse 22, D-8000 München 80 (DE)

⑯ **Actuator for transmission of a rectilinear motion to a rotating motion.**

⑯ The linear force from a working cylinder is transformed to a rotary movement through a stud and fork sliding mechanism which is characterized by the utilization of a driving pin (7) directly connected into a reciprocating plunger piston (5), a housing (1) for the piston (5) and an adapter member (2), with sideways directed channels of larger diameter than piston (5) with connected driving pin, that the channels are surrounding the corresponding driving cylinder (3), and that a sleeve (6) is provided at the inner end of the cylinder. The sleeve (6) is supported by the walls of the housing and is held in position of a corresponding cylinder, this sleeve providing gliding support of the piston (5).



A1

EP 0 203 426

The present invention relates to a mechanism for transmission of a rectilinear motion to a rotating motion, especially a hydraulic or pneumatic actuator to operate valves etc.

The actuator is of that type where the rectilinear power from a working cylinder is transmitted to a rotating motion by means of a pin- and fork in sliding engagement, the so-called "Scotch-Yoke" mechanism. Such a construction will provide an increasing torque near its end positions, and its curve of moments will be quite near a typical curve of moments for a flap- or butterfly valve or ball valve.

Previously is known an actuator of this type of very robust and rigid construction, so that sliding and/or backlash motions in connection with the transmission and power and motions can be avoided. The actuator is also very dependable and has been especially suited for operating big and heavy flap valves, where high operating forces and a liquid tight closure will be demanded. This valve actuator is described in more detail in US patent No. 3,507,192.

However, a considerable disadvantage with the above mentioned actuator has been its complexity, heaviness and material-consuming construction. This makes the construction more expensive and the assembly time-consuming.

Thus, the construction consists of a T-formed housing with two open ends, a plunger piston which is slidably arranged in the housing between two axially separated cylinders which are

securely bolted to the endpieces of the housing and form an integrated part of this.

A double-acting piston is slidably arranged in the housing and is supported by parallel bearings arranged in the open ends of the housing. For transmission of the cylinder's linear motion to a rotating motion is provided, a specially designed spacer member which has a through-going pin projecting from both sides. The spacer member is fastened to the intermediate free piece of the piston by means of two screws. The pin on the spacer member is slidably engaged within the longitudinal recesses of a double forked lever arm or adapter. Thus, this spacer member was considered necessary to position the adapter in the actuator. To obtain a steady mounting of the adapter, it is necessary to secure it to a co-operating valve spindle. The outer positions of the rotating movement must further be fixed or defined by means of special abutments arranged inside the valve housing.

It is the object of the present invention to provide a new and improved actuator, consisting of fewer construction parts and of a more simple construction without a reduction of the reliability and with improved steadiness and bending rigidity also when high operating forces are employed.

A further object of the invention is to provide a construction or design which to an essential degree simplifies the assembling and adjusting of the actuator, and where it is unnecessary to make use of the valve spindle to complete the mounting and adjustment of the actuator.

Finally, it is an object of the invention to provide a construction which - without changes in the essential features of the construction - easily can be transformed into a double-acting respectively single-acting actuator.

According to the invention this can be obtained by means of a construction characterized by the special features cited in the subsequent patent claims, including the main claim and the supporting sub claims.

The preferred embodiments of an actuator relating to the invention will be further described referring to the enclosed drawings, where;

Fig. 1 shows a longitudinal sectional view of a double-acting actuator. Sectional planes B-B and C-C are used so that the most important functional parts of the mechanism are shown.

Fig. 2 shows a sectional view along the plane A-A on Fig. 1.

Fig. 3 shows an actuator seen from the top, i.e. from that side which is turned away from the valve.

Fig. 4 shows a longitudinal sectional view of a single-acting actuator.

On the drawings indicates 1 the housing of the mechanism, on which housing is mounted two hydraulic cylinders 3, in which cylinders a piston in the form of a double-ended plunger piston 5 runs back and forth slideably mounted on two bearings 6. The bearings are placed against the inner ends of the cylinders 3 and between the bearings 6 and the inner room of the housing are provided gaskets 14. Between the plunger and the inner cylinder wall is a small clearance or gap.

In the middle, free part of the plunger piston is arranged a through-going pin 7.

The double-acting actuator is shown in detail on Fig. 1.

The housing 1 leads into two lateral directed, open channels. The main room has openings on the top and at the underside. The underside is intended to be directly connected to the top or head flange of the valve. For this purpose the valve spindle runs directly into the bore of the adapter member and the bore is provided with key seats.

The adapter member 2 is supplied with a protruding flange on the side facing the top of the actuator housing. The part which is facing against the underside of the housing is provided with stepped parts or shoulders which bear against corresponding protruding parts or edge flanges in the wall of the housing. In addition a groove is provided to accommodate an "O-ring" 19 which secures tightening against the underside of the housing.

On the top or overside of the housing is placed a lid 4 which is fastened by means of screws or bolts, and which keep the adapter member flange in position against a shoulder in the bottom of the housing. For tightening are used "O-rings" 15 and 16.

The adapter member is thus mounted and supported in both ends, without use of further supporting parts.

The adapter member 2 is further provided with a double forked lever arm, each arm having a longitudinal gap or opening which is in mesh with the through-going pin in the central part of the piston.

The two fork arms are supplied with special ears or lugs which co-operate with adjustable stop screws 20. Thereby is obtained an adjustable deflection of the rotating motion. The piston cylinders 3 are supplied with external threads for screwing into the lateral directed open channels of the housing. Further there are "O-rings" 17 and 18 to secure tightening between the housing and the cylinders.

As it will be seen from the drawings, the channels in the housing have a considerably larger diameter than the diameter of the reciprocating piston 5, as well as the inner diameter of the corresponding cylinder 3. The piston is slidably mounted in a special sleeve or supporting bearing 6 which has numerous functions. It is supported against a low inner shoulder formed internally in the lateral directed open channels of the housing.

And a gasket 14 co-operating with an "O-ring" 18, provides the tightening or sealing against the sleeve 6 as well as against the cylinder wall when the whole unit is squeezed together in position when the threaded cylinders 3 are fastened.

The side of the sleeve 6, which is facing the inner side of the housing, serves as a stop or abutment for the adapter member's largest allowed deflection. This will provide a rotating deflection of about 94°.

Further the sleeve is provided with a through-going channel with the following functions:

For a double-acting actuator; draining of the back of the gasket 14. For a single-acting actuator; draining of the ring chamber which is formed behind the piston 8 (Fig. 4) resulting from the fact that the single-acting actuator is provided with an enlarged piston.

While a double-acting actuator is shown on Fig. 1, 2, and 3, Fig. 4 shows an embodiment of a single-acting actuator.

On Fig. 4 is shown a spring housing 12 with an end flange 10 screwed tightly against the one open end channel of the housing. A helical spring 13 bears against a spring plate 11 with an open bore or channel which encloses the end of the piston 5. The sleeve 6 has a channel which provides open connection between the spring housing and the actuator housing. In order to compensate the increased counterpressure which is due to the spring load, the cylinder 3 is expanded internally and supplied with an enlarged piston 8 which co-operate with an internal cylinder sleeve 9, and is supplied with a gasket 14. For tightening are used "O-rings" 17, 18 and 19. However, the mode of operation should clearly be seen from the drawing. The expanded threaded end part of the housing is also here of special advantage allowing a very simple assembly of spring housing (just the same method of assembling as for an assembly of a cylinder to the actuator housing).

The essential advantage of the construction is its simpleness combined with dependability and stability. The number of construction parts are reduced at the same time as the total weight and material consumption is reduced.

The actuator alone represents here a complete and functional assembled unit. It does not base its function and steadiness on the mounting and support of a valve spindle. Hereby the actuator will transfer its torque alone to the valve spindle.

The assembling of the actuator mechanism is also considerably simplified by its special design and construction.

The adapter member is placed into the housing from the top side. The piston with the through-going bolt can be introduced side- ways. The piston sleeves are placed in position and their mutually position will be determined when the end pieces, i.e. the threaded cylinders, are fastened in end position. Finally, the lid 4 is fastened with screws on the top side of the housing. This design has reduced the assembly time with more than fifty per cent compared with the conventional assembling of the actuator design described above as prior art.

The actuators are constructed in accordance with ISO-standard, this with regard to the torque or momentum specified as well as the specifications concerning the valve connecting flange and spindle sizes. In addition, the design takes special care to obtain a simple assembling on the valve, and furthermore to obtain quick and simple service without use of special tools.

The construction is very robust and the actuators can be used immersed in tanks without modifications.

The new actuator is delivered with adjustable stroke ($90^\circ \pm 2^\circ$) in both end positions, or with mechanical locking of the rotating motion in the end positions.

The actuator has built in local continuous indication, and different types of electrical position indicator means can be included additionally.

Manual operation/emergency operation is performed by means of a hand pump. The actuators can be equipped with a specially adjusted block unit with pressure-controlled valves and speed couplings for connecting of a conventional permanently mounted hand pump. Smaller actuator sizes can alternatively be equipped with a square nut on the top for manual operation with a spanner.

Patent Claims

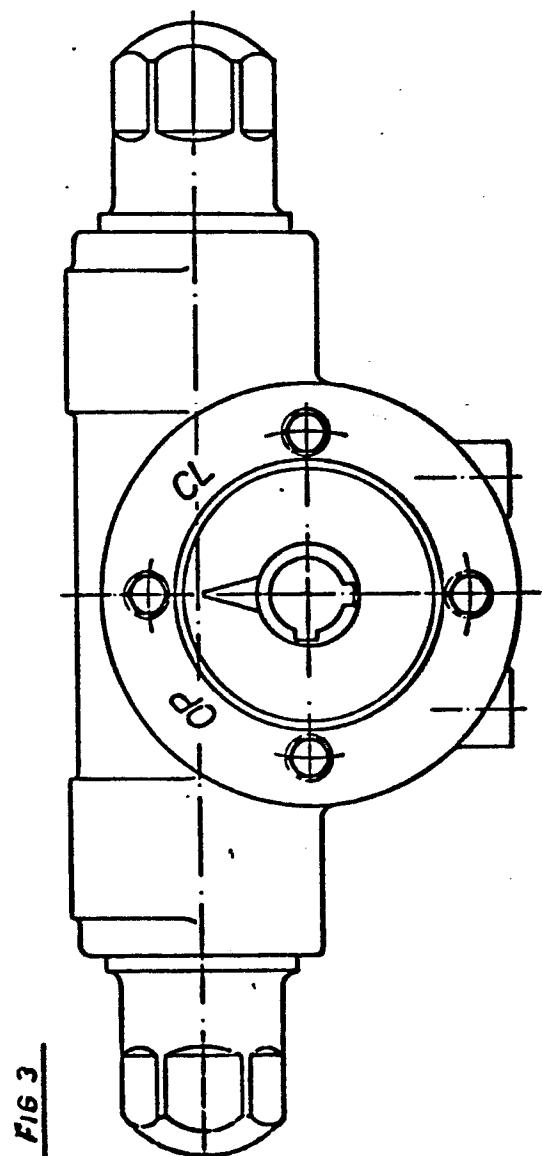
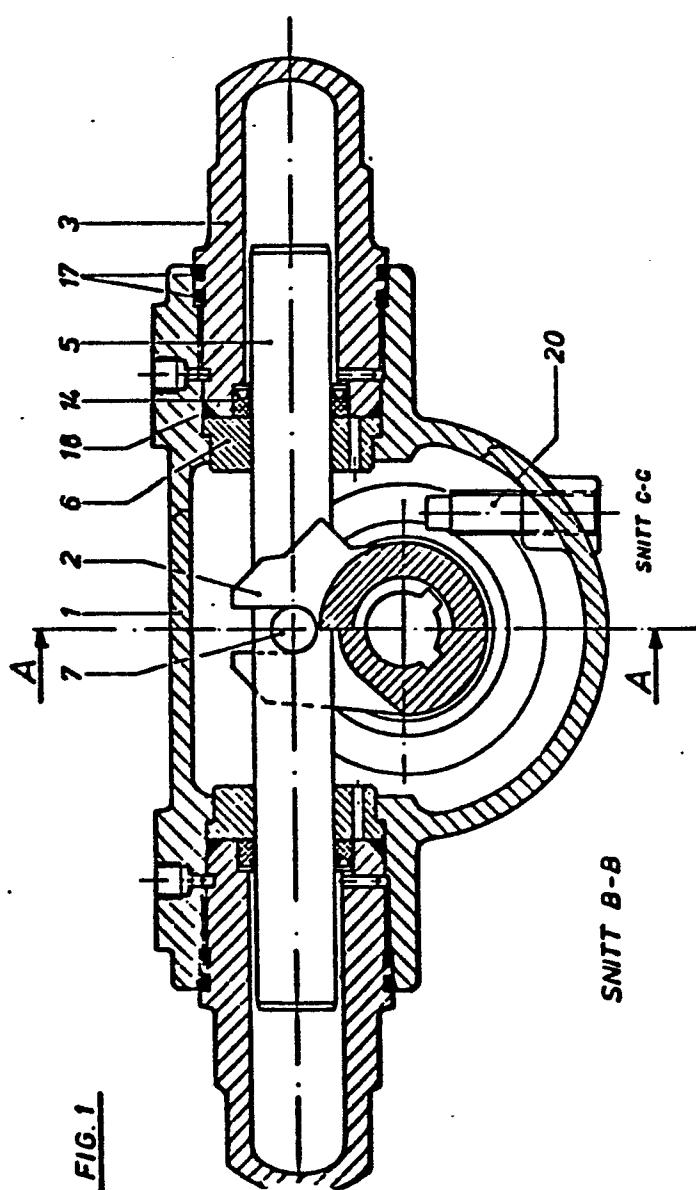
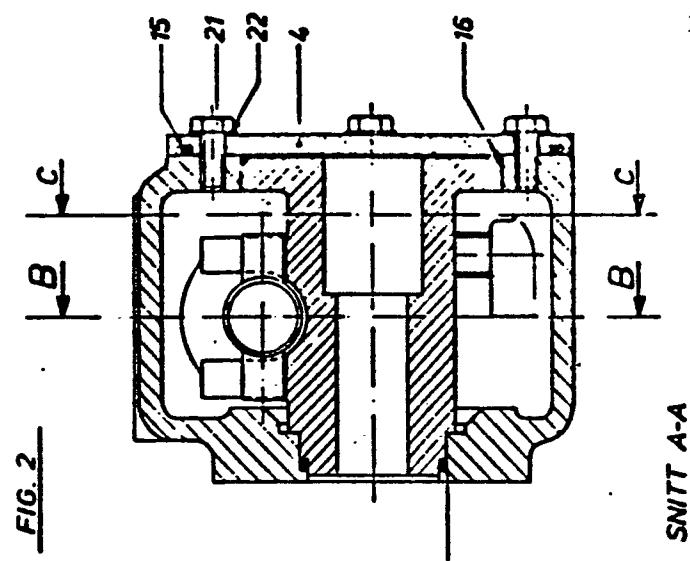
1. An actuator for transmission of a rectilinear motion to a rotating motion, comprising a housing (1) with an intermediate chamber and two lateral channelformed openings with connected driving cylinders (3), a rodlike piston (5) slidable mounted in the housing and cylinders with a lateral directed transmission unit comprising a driving pin (7) arranged to co-operate with an adapter member (2), which together with the driving pin fuctions as a "Scotch Yoke"-mechanism transferring a linear motion to a rotating motion to a connected, rotating spindle which can open and close a valve or the like, and comprising means to supply fluidum under pressure to each cylinder and piston, characterized in that the mechanism's driving pin(7) is directly connected to and protruding to both sides of the middle part of the piston (5), that the lateral directed channels of the housing have larger internal diameter than the piston with its connected driving pin, that the channels are circumscribing the co-operating driving cylinders (3), and that the inner end of the channels is provided a sleeve or bearing (6) which is supported against the wall of the housing and is held in position by the corresponding, neighbouring cylinder and which sleeve (6) provides the gliding support of the piston (5).

2. Actuator according to claim 1,
characterized in that
the adapter member (2) is mounted in the upper and
the lower side of the housing (1), the member being
provided with an upper, circular flange supported by
the upper side of the housing and having a stepped
shoulderlike part at the lower side, fitting into a
circular groove in the lower side of the housing, and
with the member (2) being kept in position by an upper,
removable lid (4).
3. Actuator for transferring a linear movement to a
rotary movement according to claim 1,
characterized in that
the open channels in the housing and the opposite
neighbouring cylinders are connected with the means of
screw threads or the like, formed in the cylinders and
channels, respectively.
4. Actuator for transferring a linear movement to a
rotary movement according to claim 3,
characterized in that
a cylinder sleeve (6) and the corresponding
cylinder (3) is provided with an internal gasket (14)
supporting the piston as well as the cylinder sleeve.
5. Actuator for transferring a linear movement to a
rotary movement according to claim 4,
characterized in that
the cylinder sleeve (6) is positioned so deep into the
housing's main chamber that it serves as a stopper and
support for the adapter member (2) when reaching its
maximum deflection.

6. Actuator for transferring a linear movement to a rotary movement according to claim 5, characterized in that the adapter member (2) is formed as one integral piece with a through-going bore ending flush with the upper side and the lower side of the housing, the adapter further is provided with a protruding knob or shoulder in each forked arm co-operating with two adjustable stoppers (20), whereby the deflection of the adapter member can be controlled.
7. Actuator according to any of the prior claims 1-6, characterized in that one of the threaded cylinders is replaced by a correspondingly threaded spring housing (12) with an internally mounted return spring (13).
8. Single-acting actuator according to claim 7,, characterized in that the cylinder (3) which is situated at the opposite end of the housing, is provided with an internal, enlarged recess, wherein is mounted an additional cylinder sleeve (9) accommodating a piston (8) of enlarged diameter.
9. Single-acting actuator according to claim 8,, characterized in that the spring (13) is supported by a support plate (11) forming an open stud at the end which stud encloses the free end of the rodlike double ended piston, and where the opposite end of the piston with the expanded additional piston head (8) is provided with a gasket 14 sealing the connection between the piston and the cylinder sleeve (9).

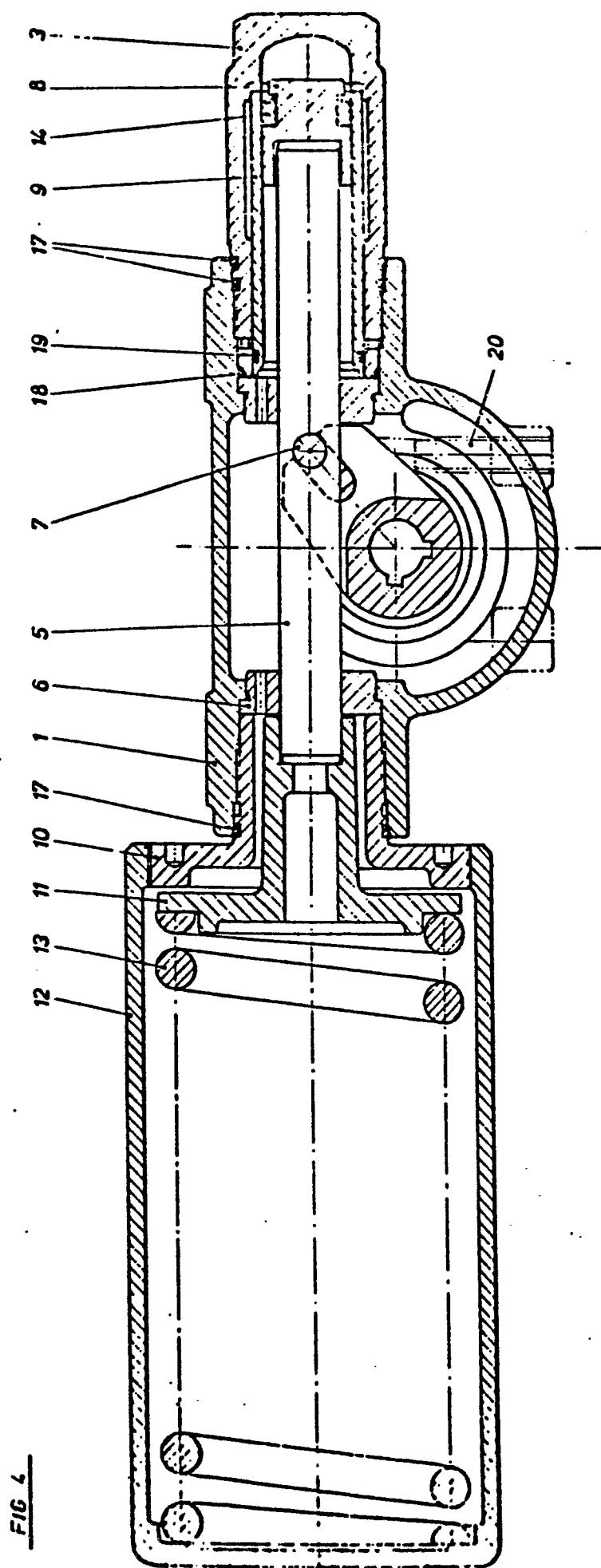
0203426

1/2



0203426

2/2





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	GB-A-2 056 565 (KITAZAWA VALVE) * page 3, line 31 - page 4, line 3; figures 4-7, 13-15 *	1,7	F 15 B 15/08
A	---	2-4,8	
Y	GB-A-1 174 121 (AUTOMOTIVE PRODUCTS) * complete document *	1,7	
Y	---	3,4,9	
A	DE-A-2 525 820 (FLO-TORK) * page 8, line 27 - page 9, line 2; figure 4 *	3	
A	---	6	TECHNICAL FIELDS SEARCHED (Int. Cl. 4):
A	GB-A-1 404 049 (GEC-ELLIOTT MECHANICAL HANDLING) * figures 1, 2 *		F 15 B 15/00
D,A	US-A-3 507 192 (E. STOKKE) -----		
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
BERLIN	01-08-1986	LEMBLE Y.A.F.M.	
CATEGORY OF CITED DOCUMENTS		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 & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			