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

(11) Publication number: **0 046 142**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **81830119.4**

(51) Int. Cl.³: **F 04 B 39/12**

(22) Date of filing: **15.07.81**

(30) Priority: **31.07.80 IT 6822980**

(43) Date of publication of application:
17.02.82 Bulletin 82/7

(84) Designated Contracting States:
CH DE FR GB LI NL SE

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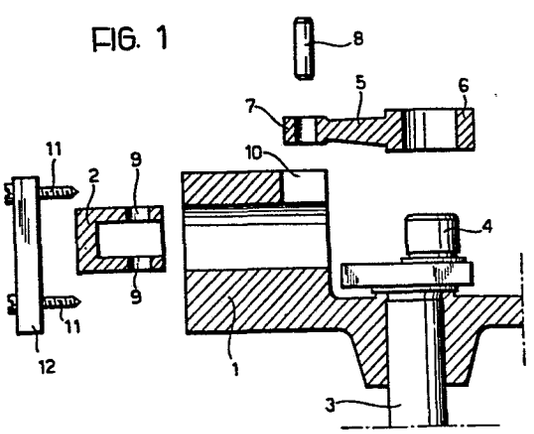
(54) Motor-driven compressor unit particularly for airtight compressors on fluid compressing or refrigerating machines.

(57) The present invention relates to a motor-driven compressor unit, particularly for airtight compressors on refrigerating machines, comprising a main part (1), a crankshaft (3) which rotates in a first seat in the main part (1) and the crank pin (4) of which constitutes one end of the shaft, a piston (2) which slides in a second seat in the main part (1), and a single-piece connecting rod (5) coupled directly to the crank pin (4) with no parts inbetween and to the piston (2) by means of a pin (8). In one arrangement of the present invention, an opening (10) is made in the piston slide seat nearest the crank pin (4) so that parts may be assembled in the following order: crankshaft (3) in the main part (1) with the crank pin (4) in the bottom dead centre position; connecting rod (5) straight inside the crank pin (4) through the said opening (10); piston (2) in the cylindrical seat; pin (8) in the piston (2) and connecting rod (5). Besides making assembly easier, this arrangement reduces the number of component parts required as well as friction and total weight.

FIG. 1



EP 0 046 142 A2

Motor-driven compressor unit particularly for airtight compressors on fluid compressing or refrigerating machines".

The present invention relates to a motor-driven compressor unit, particularly for airtight compressors on fluid compressing or refrigerating machines, comprising: a main part with at least a first and second cylindrical seat at right-angles to each other; a piston with at least one hole in its side walls and which slides inside the said first cylindrical seat; a crankshaft with a crank pin which rotates in the said second cylindrical seat; a connecting rod for converting the circular movement created by the crank pin into a back-and-forth movement of the said piston, the said connecting rod having at least a first and second eye, the first for connecting the said connecting rod to the said piston by means of at least one pin inserted inside the said hole of the said piston and in the said first eye, and the second inserting the said connecting rod inside the said crank pin.

One of the major problems involved in designing and manufacturing motor-driven compressor units is to overcome the difficulty of assembling the various parts on the refrigerating fluid compression system, in particular the crankshaft, connecting rod and piston assembly. A number of solutions to this problem are already known.

In one of these, the connecting rod has a side slot and eye for the crank with a larger diameter than on the crank pin. For assembling the parts, the crankshaft is first inserted into the main part on the compressor, followed by the connecting rod-pin-piston group already assembled together.
The connecting rod is then turned round the pin and inserted, through the said slot, into the crank pin. The difference between the diameters is then adjusted by means of a bushing.
This solution, however, entails machining difficulties for making the slot and also increases the number of component and moving parts involved.

In another solution, connection is made by assembling a ball joint between the connecting rod and piston so that the crankshaft can be assembled first in the main part of the compressor followed by the connecting rod-piston assembly. The connecting rod is then lowered and inserted into the crank pin which has a smaller diameter than the eye on the connecting rod. In this case too, a clearance bushing is assembled between the connecting rod and crank pin. The difficulties involved in this solution are machining the ball joint and accurate assembly of the bushing which again increases the number of component and moving parts involved.

In yet another solution, the eye of the connecting rod on the crank side is made very flat with a short

crank pin smaller in diameter than the eye. This is done so that it cannot be inserted straight into the eye to which it must be connected using a bushing. In this case the crankshaft is inserted first, followed by the piston-pin-connecting rod assembly, the connecting rod being passed over the crank pin which is short enough not to interfere with it. The drawbacks of this solution, however, are the critical nature of the system which provides for only an indirect connection of the crank pin to the eye of the connecting rod and the higher number of component parts involved.

Other solutions provide for assembling the crankshaft after the connecting rod-piston assembly. The shaft is generally longer with a smaller diameter than the part inserted into the main part on the compressor or the eccentric part of the crank so it can be inserted into the main part through the eye on the connecting rod. In this case, the flywheel is on the opposite side of the crankshaft as compared with the previous solutions which means a second support is needed for the crankshaft. This is assembled after the shaft thus resulting in greater friction, more machining and increased weight of the overall mechanism.

Other solutions provide for a connecting rod in two parts so that it can be assembled after inserting the piston into the cylinder and the two parts screwed

together. Besides the obvious difficulty of machining the connecting rod in two parts, this solution also involves the problem of increased weight of the moving parts.

The aim of the present invention is therefore to overcome the above drawbacks by providing a means of constructing a motor-driven compressor unit which enables the component parts of the refrigerating fluid compression system to be assembled quickly and easily.

A further aim of the present invention is to overcome the difficulties involved in machining the said component parts. A further aim is to reduce the weight and number of the said component parts so as to reduce the friction and bending moments exerted on the crankshaft.

With these aims in view, the present invention relates to a motor-driven compressor unit, particularly for airtight compressors on fluid compressing or refrigerating machines, comprising: a main part with at least a first and second cylindrical seat at right-angles to each other; a piston with at least one hole in its side walls and which slides inside the said first cylindrical seat; a crankshaft with a crank pin which rotates in the said second cylindrical seat; a connecting rod for converting the circular movement created by the crank pin into

a back-and-forth movement of the said piston, the said connecting rod having at least a first and second eye, the first for connecting the said connecting rod to the said piston by means of at least one pin inserted inside the said hole on the said piston and in the said first eye, and the second for inserting the said connecting rod inside the said crank pin, characterised by the fact that the said crank pin constitutes one of two ends of the said crankshaft, that the said connecting rod is a single piece, that the said crank pin and the said second eye are connected directly with no component parts inbetween, and that construction means are provided for assembling the said connecting rod after inserting the said crankshaft in the said second cylindrical seat without altering the axial position of the said crankshaft after it has been inserted, and for connecting the said piston to the said connecting rod by means of the said pin after assembling the connecting rod in the crank pin.

The invention will now be described with reference to the attached diagrams in which:

- Fig. 1 shows an exploded cross section of a number of parts on a motor-driven compressor unit showing one possible arrangement of the present invention;

- Fig. 2 shows the same section as in Fig. 1 after the parts are assembled;

- Fig. 3 shows a top view of how the present invention is arranged;

- Fig. 4 shows a cross section of the motor-driven compressor unit showing another possible arrangement of the present invention;

- Figs 5-10 show a number of possible arrangements of particular parts of the present invention.

Number 1 in Fig. 1 indicates the main part on the motor-driven compressor unit. This comprises a cylindrical seat for piston 2 and a seat for crankshaft 3 which, in turn, comprises crank pin 4. Connecting rod 5 between piston 2 and crankshaft 3 has one eye (6) for accomodating crank pin 4 and another eye (7) for accomodating pin 8. The latter also passes through holes 9 in piston 2 for connecting rod 5 and piston 2.

On the main part of motor-driven compressor 1 with the cylindrical seat for piston 2, there is an opening (10). When assembling the component parts, crankshaft 3 is turned until crank pin 4 reaches the bottom dead centre as shown in the diagram. Connecting rod 5 is then inserted horizontally, as shown in the diagram, through opening 10.

Piston 2 is then inserted into the cylindrical seat of main part 1, starting from the position shown in the diagram, until holes 9 coincide with eye 7 of connecting rod 5. At this point, pin 8 is assembled and secured using one of the techniques described later on. Finally, cover 12, including valves not shown in the diagram, is fitted to main part 1 using screws 11.

Fig. 2 shows the Fig. 1 parts after assembly using the same numbering system.

Fig. 3 shows a top view of the arrangement already described with the component parts numbered in the same way as for Figs 1 and 2. Notice in particular the shape and position of opening 10 for assembling connecting rod 5. Piston 2 inside main part 1 of the motor-driven compressor is drawn with a dotted line.

The diagrams clearly show to what extent opening 10 simplifies assembly of the various component parts involved.

There is no need to divide the connecting rod in two or assemble a bushing between crank pin 4 and eye 6 on the connecting rod. What is more, the crankshaft may be as short as possible with no need for a second support for the shaft on the crank pin side. The number of component parts used and, consequently, also the weight of moving

parts is reduced to a minimum in that both the crankshaft and connecting rod may have minimum diameters resulting in a big reduction in friction, machining and the bending moments exerted on the crankshaft.

Fig. 4 shows another possible arrangement of the present invention. The component parts and numbers are the same as in the previous diagrams so only the changes will be described. In the Fig. 4 arrangement, piston 2 has been made longer to bring the pin 8 seat area sufficiently clear of main part 1 (opening 10 is no longer needed) so as to enable the parts to be assembled in the same way as previously, i.e.: first crankshaft 3, then connecting rod 5, piston 2 from the main part (1) side, including the valves not shown and, finally, pin 8.

Figs 5 and 6 show a type of pin 8 that may be used with the present invention and how it is fitted inside piston 2. Two slots (15) are milled on the ends of pin 8 and two holes drilled in the piston so that pin 8 may be secured using one or two pins (13). One of these may even be inserted in piston 2 before it is assembled in its cylindrical seat.

Groove 16 and hole 17 are for lubricant.

Figs 7 and 8 show another possible type of pin 8 and how it is fitted inside piston 2. There is

a blind hole (18) at each end so that pins 13 cannot go right through.

Fig. 9 shows another type of pin 8 with a groove (19) at each end for accomodating spring plates 14 securing the pin 8 to piston 2. The two grooves (19) are positioned so that, when the pin is inserted into the piston, they correspond with the gaps between the connecting rod and inside walls of the piston so that the spring plates can be inserted straight into the grooves on the pin with no need for slots in the walls of the piston.

Figs 10, 11 and 12 show other possible types of pins combining the features of the previous ones with; groove 19 for spring plate 14 and blind hole 18 for pin 13 (Fig. 10); groove 19 and milled slot 15 for pin 13 (Fig. 11); blind hole 18 and milled slot 15 (Fig. 12).

The advantages of the present invention will be clear from the description given.

Firstly, the possibility of constructing a motor-driven compressor unit in such a way that the parts comprising the refrigerating fluid compression system may be assembled quickly and easily.

Secondly, the advantage of reducing the number of component parts and, consequently, also the amount of

machining involved.

Thirdly, the advantage of reducing the weight of moving parts and, consequently, also friction, machining and the bending moments exerted on the crankshaft.

To those skilled in the art it will be clear that a number of changes can be made to the device described without, however, departing from the scope of the present invention.

CLAIMS

1) Motor-driven compressor unit, particularly for air-tight compressors on fluid compressing or refrigerating machines, comprising: a main part (1) with at least a first and second cylindrical seat at right-angles to each other; a piston (2) with at least one hole (9) in its side walls and which slides inside the said first cylindrical seat; a crankshaft (3) with a crank pin (4) which rotates in the said second cylindrical seat; a connecting rod (5) for converting the circular movement created by the crank pin (4) into a back-and-forth movement of the said piston (2), the said connecting rod (5) having at least a first and second eye, (7, 6) the first for connecting the said connecting rod (5) to the said piston (2) by means of at least one pin (8) inserted inside the said hole (9) on the said piston (2) and in the said first eye (7), and the second (6) for inserting the said connecting rod (5) inside the said crank pin (4), characterised by the fact that the said crank pin (4) constitutes one of two ends of the said crankshaft (3), that the said connecting rod (5) is a single piece, that the said crank pin (4) and the said second eye (6) are connected directly with no component parts inbetween, and that construction means are provided for assembling the said connecting rod (5) after inserting the said crankshaft in the said second cylindrical seat without altering the axial position of the said crankshaft (3) after it has been inserted, and for connecting the said piston (2) to the said connecting rod (5) by means of the said

pin (8) after assembling the connecting rod (5) in the crank pin (4).

2) Motor-driven compressor unit according to Claim 1, characterised by the fact that the said construction means comprise an opening (10) in the said main part (1) allowing access to the said first cylindrical seat, the said opening (10) being made on the said main part (1) opposite the said second cylindrical seat, nearer the said crank pin (4) and of such a size that the eye (7) of the said connecting rod (5) can pass through it.

3) Motor-driven compressor unit according to Claim 2, characterised by the fact that the said opening (10) is semicircular in shape.

4) Motor-driven compressor unit according to Claim 1, characterised by the fact that the said construction means provide for such a distance between the said first and second cylindrical seats and such a length of the said piston (2) that, when the said piston (2) reaches bottom dead centre, the said hole (9) in the side walls of the piston (2) remains sufficiently clear of the said first cylindrical seat to allow assembly of the said connecting rod (5) and piston (2) without altering the position of the said crankshaft (3).

5) Motor-driven compressor unit according to Claim 1, characterised by the fact that the said pin (8) has a slot (15) milled at each end and the said piston (2) two holes

drilled on the side facing the connecting rod (5) and that the said pin (8) is secured to the said piston (2) by means of two pins (13) passed through the said holes and slots (15).

6) Motor-driven compressor unit according to Claim 1, characterised by the fact that the said pin (8) has a blind hole (18) at each end and the said piston (2) two holes on the side facing the connecting rod (5) and that the said pin (8) is secured to the said piston (2) by means of two pins (13) inserted into the said blind holes (18).

7) Motor-driven compressor unit according to Claim 1, characterised by the fact that the said pin (8) has two grooves (19) positioned so that, when the said pin (8) is inserted into the said piston (2), they correspond with the gaps between the said connecting rod (5) and inside walls of the said piston (2) and that the said pin (8) is secured to the said piston (2) by means of two spring plates (14) inserted straight into the said grooves (19).

8) Motor-driven compressor unit according to Claim 1, characterised by the fact that the said pin (8) has a blind hole (18) at one end and a milled slot (15) at the other, that the piston (2) has two holes drilled on the side facing the connecting rod (5) and that the said pin (8) is secured to the said piston (2) by means of two pins (13) inserted through the said holes, one terminating inside the said blind hole (18) and the other passing

through the said slot (15) as well.

9) Motor-driven compressor unit according to Claim 1, characterised by the fact that the said pin (8) has a blind hole (18) at one end and a groove (19) at the other positioned so that, when the said pin (8) is inserted into the said piston (2), the said groove (19) corresponds with the gaps between the said connecting rod (5) and inside walls of the said piston (2) and that the said pin (8) is secured to the said piston (2) by means of a pin (13) inserted into a hole in the piston and terminating in the said blind hole (18) and a spring plate (14) inserted straight into the said groove (19).

10) Motor-driven compressor unit according to Claim 1, characterised by the fact that the said pin (8) has a milled slot (15) at one end and a groove (19) at the other positioned so that, when the pin (8) is inserted into the said piston (2), the said groove (19) corresponds with the gaps between the said connecting rod (5) and inside walls of the said piston (2) and that the said pin (8) is secured to the said piston (2) by means of a pin (13) inserted through a hole in the piston (2) and the said slot (15) and by means of a spring plate (14) inserted straight into the said groove (19).

11) System for assembling a motor-driven compressor, particularly for airtight compressors on fluid compressing or refrigerating machines comprising: a main part (1) with at least a first and second cylindrical seat

at right-angles to each other; a piston (2) with at least one hole (9) in its side walls and which slides inside the said first cylindrical seat; a crankshaft (3) with a crank pin (4) which rotates in the said second cylindrical seat; a connecting rod (5) for converting the circular movement created by the crank pin (4) into a back-and-forth movement of the said piston (2), the said connecting rod (5) having at least a first and second eye (7, 6), the first for connecting the said connecting rod (5) to the said piston (2) by means of at least one pin (8) inserted inside the said hole (9) on the said piston (2) and in the said first eye (7), and the second for inserting the said connecting rod (5) inside the said crank pin (4), the said crank pin (4) constituting one of two ends of the said crankshaft (3), the said connecting rod (5) being a single piece and the said crank pin (4) and second eye (6) being connected directly with no component parts inbetween, characterised by the following stages: insertion of the said crankshaft (3) into the said main part (1) turning it to bring the said crank pin (4) to bottom dead centre and without altering the axial position of the said crankshaft (3) further during assembly; insertion of the said second eye (6) of the said connecting rod (5) straight into the said crank pin (4); insertion of the said piston (2) into the said first cylindrical seat until the said hole (9) on the said piston (2) mates with the said first eye (7); insertion of the said pin (8) into the said hole (9) on the said piston (2) and into the said first eye (7) to connect the said connecting rod (5)

to the said piston (2).

12) Assembly system as per Claim 11, characterised by the fact that, when the said connecting rod (5) is inserted, the part comprising the said first eye (7) is passed through an opening (10) in the said first cylindrical seat.

13) Motor-driven compressor unit as described and shown in the attached diagrams.

FIG. 1

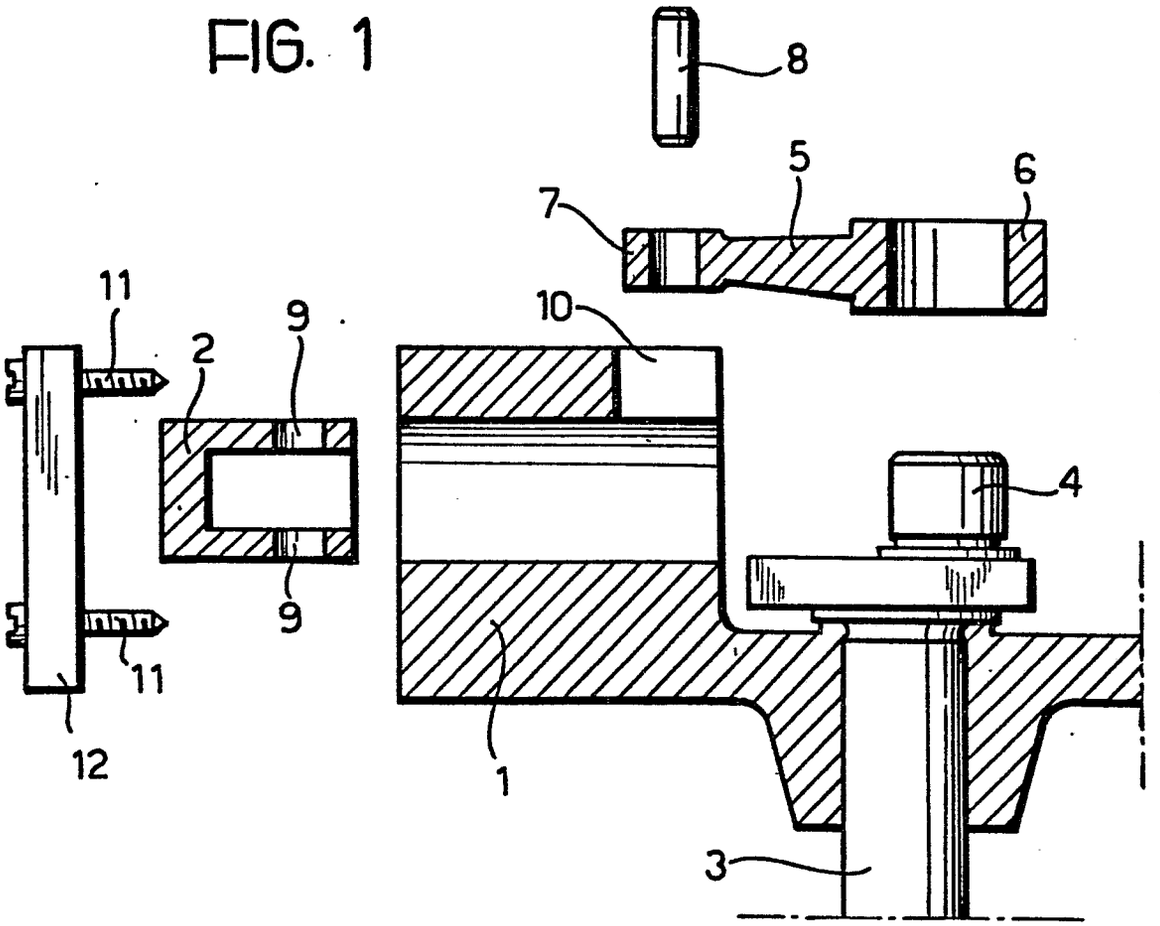


FIG. 2

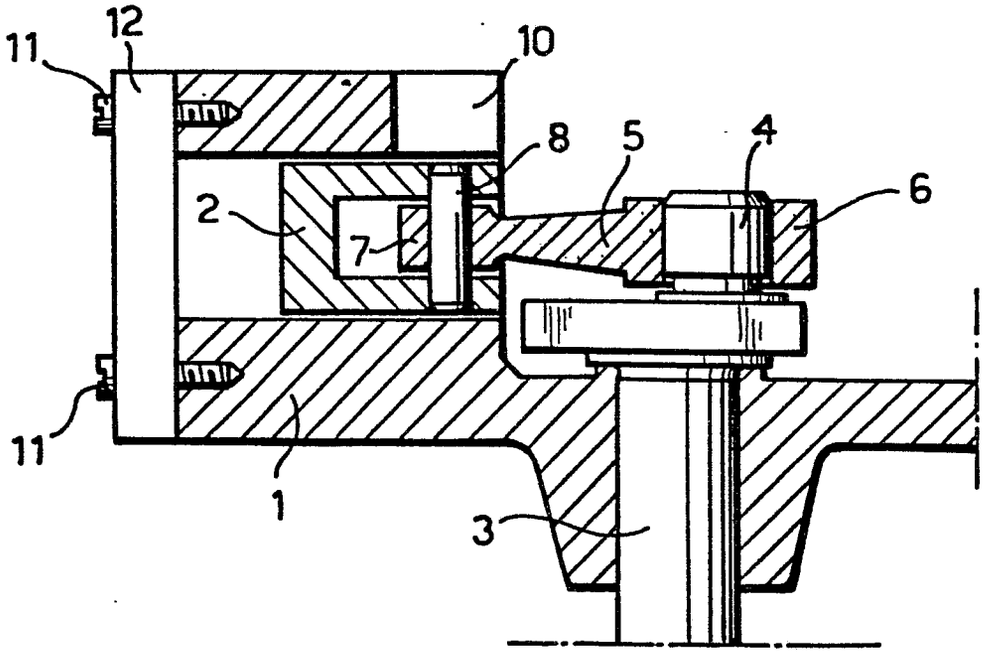


FIG. 3

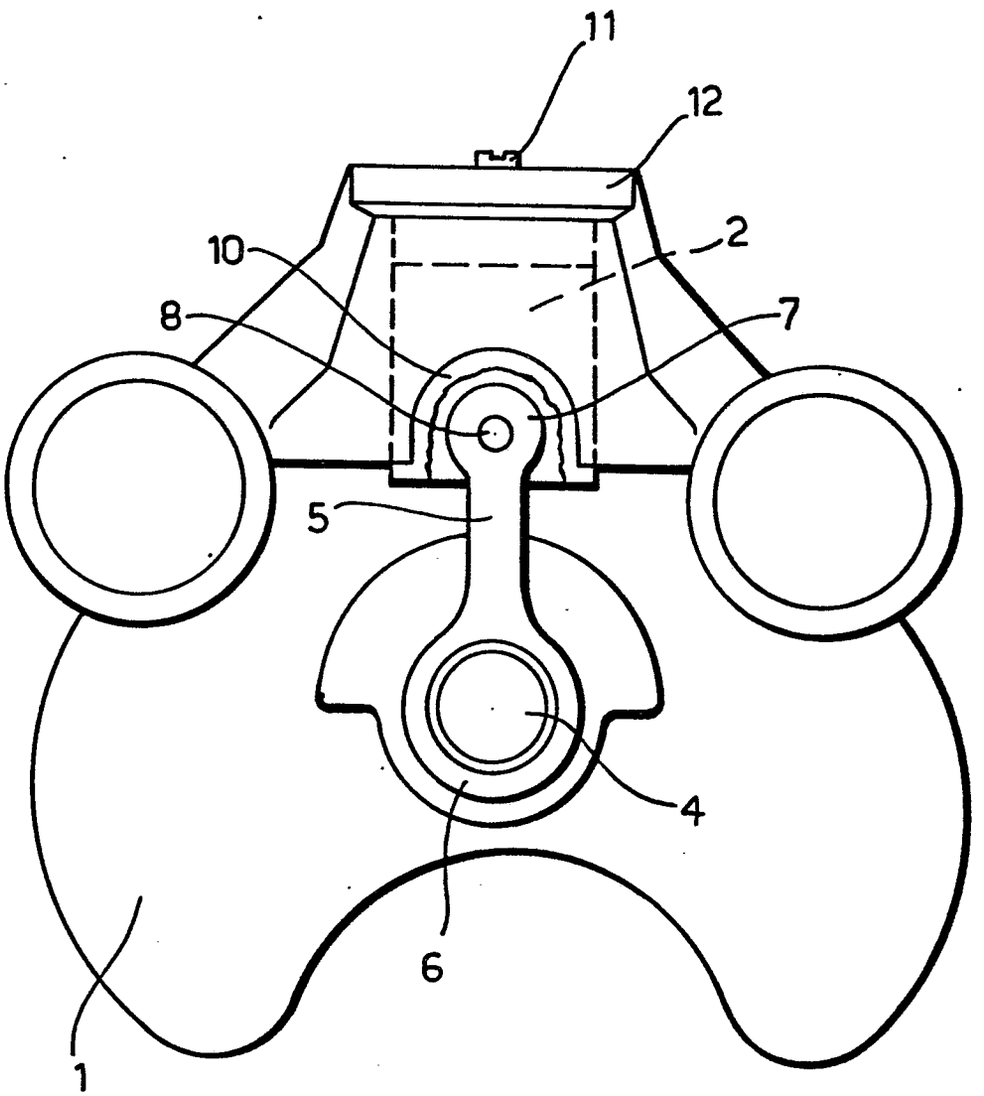


FIG. 4

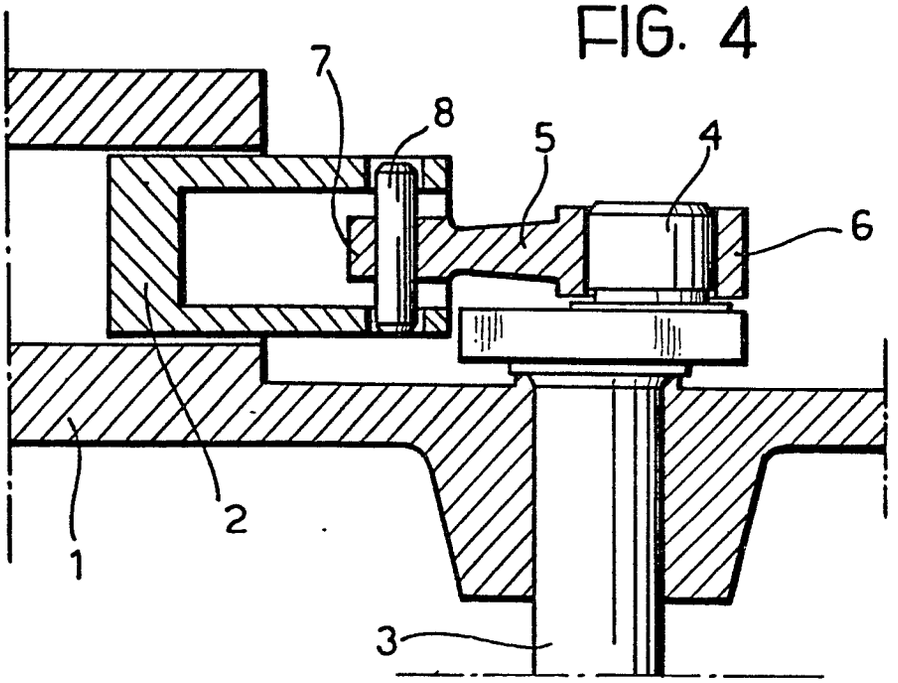


FIG. 5

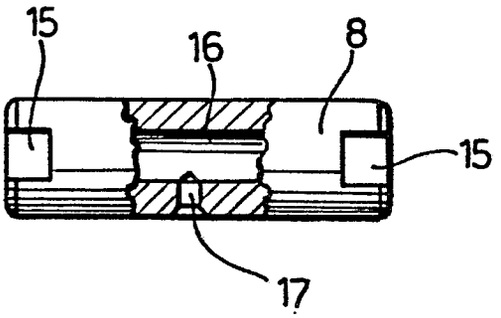


FIG. 6

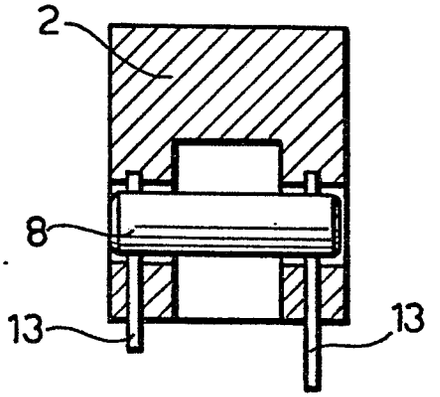


FIG. 7

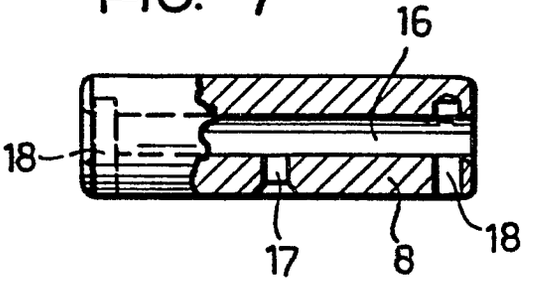


FIG. 8

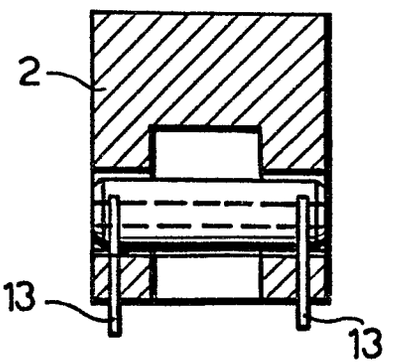
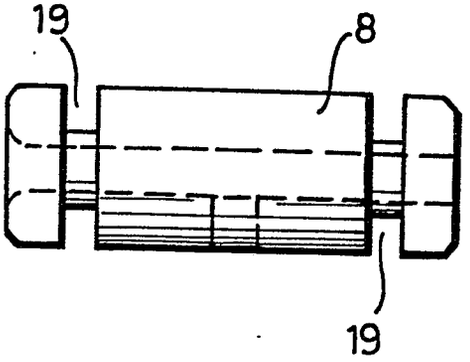


FIG. 9



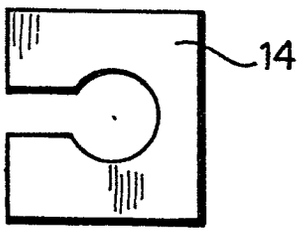


FIG. 10

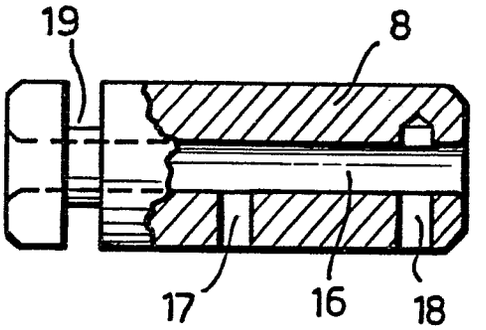


FIG. 11

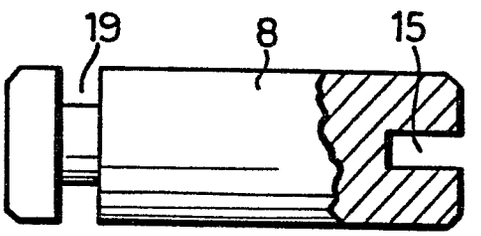


FIG. 12