

Description

[0001] The present invention relates to a device for extracting fixings, such as bolts and the like, from a workpiece.

[0002] In fitting bolts to aircraft wing skins and stiffening members such as stringers and ribs, obtaining the correct fit of the bolt to the hole in which it is located is important. Very often an interference fit is required and this will necessitate a precise force to be applied to the bolt to fit it into the hole. It is not unknown for this fitting operation to go awry with the bolt being inserted crooked, or a countersunk head of the bolt not seating flush with a corresponding countersunk hole. Also, it is often necessary to withdraw bolts from in-service aircraft and restricted access to the threaded side of a bolt prevents it from being driven out cleanly through the hole.

[0003] A present technique for removing bolts is illustrated diagrammatically in figure 1. An extractor device, generally designated 2, comprises a cylindrical housing 4 containing an extractor rod 6. The extractor rod 6 has a threaded stem 8 which projects through a hole in the top of the housing 4. A nut 10 is carried by the stem 8 and abuts the exterior of the housing 4. The extractor rod 6 has a head 12 in which there is provided a slot 14 adapted to receive the head of a bolt 16. In use, the bolt 16 is tapped out a short way so that its head stands proud of the wing skin 18. The extractor device 2 is positioned over the bolt 16 such that the head is received in the slot 14. The stem 8 is then drawn out through the housing 4 by turning the nut 10 on the thread.

[0004] Drawbacks with this present system include the fact that a differently sized and configured rod head is required for differently sized bolts and hence a stock of different extractors therefore needs to be kept to enable the withdrawal of any size of bolt. It has been found that the high tensile forces often experienced in withdrawing bolts from their holes has led to damage to the extractor rod thread, with the result that the whole extractor rod has to be scrapped often after only a very short life. Additionally, the use of the extractor device described above is awkward and slow, in particular when work is being done to an in-service aircraft and the bolt being extracted from a wing is located above the operator's head. A combination of the high torque required to be applied to the nut 10 when removing a stubborn bolt, and the often awkward location of the bolt can often lead to movement of the housing, during an extraction operation, which in turn can lead to damage to the wing skin surface.

[0005] According to a first aspect of the present invention there is provided an extractor device for extracting a fixing from a work piece, the extractor device including an extractor tool adapted to receive the fixing, and a driver connected to the extractor tool, the driver being adapted to exert an extraction force on the fixing via the extractor tool. The extraction force is preferably a vibratory extraction force.

[0006] The driver may include a driver housing and a mandrel moveable relative to the housing. Movement of the mandrel relative to the housing so as to provide, in use, the extraction force may be effected for example electrically, mechanically, hydraulically and/or pneumatically.

[0007] In a preferred embodiment the extractor device includes an abutment member adapted to abut the workpiece. The extractor tool may be provided in the housing. In such an embodiment the abutment member engages the driver housing, preferably in abutting relationships thereto, and the mandrel is connectable to the extractor tool.

[0008] According to a second aspect of the present invention there is provided a tool for extracting a fixing from a workpiece, the tool comprising a carrier member and an engagement member adapted to receive the fixing, the carrier member and engagement member being retainable in association with one another such that, in use, an extraction force applied to the carrier member is transmitted through the engagement member to the fixing.

[0009] In a preferred embodiment the carrier member and engagement member are retainable in association with one another by a form locking arrangement. In such an embodiment the engagement member may be carried in a recess of the carrier member, and the engagement member may correspond to the shape of the recess.

[0010] Preferably the engagement member is adapted to receive a head of the fixing at an engagement location. The engagement location may be at least partially shaped so as to correspond to the head of the fixing.

[0011] According to a third aspect of the present invention there is provided an extractor device for extracting a fixing from a workpiece, the extractor device including an extractor tool adapted to receive a fixing, and a driver connected to the extractor tool, the driver being adapted to exert a preferably vibratory extraction force on the fixing via the extractor tool, and the tool comprising a carrier member and an engagement member adapted to receive the fixing, the carrier member and engagement member being retainable in association with one another such that, in use, the extraction force applied to the carrier member is transmitted through the engagement member to the fixing.

[0012] According to a fourth aspect of the present invention there is provided a method of extracting a fixing from a workpiece such as an aircraft component, the method comprising the steps of:

- providing a device comprising an extractor tool adapted to receive the fixing and a driver connected to the extractor;
- placing the device in contact with the component and engaging the fixing with the tool, and
- operating the driver so as to exert an extraction

force on the fixing via the extractor tool to withdraw the fixing from the component.

[0013] Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows a partially cross-sectional side view of a known extractor device;

Figures 2a and 2b show plan and side views of an extractor rod and insert according to an aspect of the present invention;

Figures 3a to 3e show perspective, plan and side views of an extractor insert for use with the extractor rod of figures 2a and 2b;

Figure 4 shows a cross-sectional side view of an extractor device according to another aspect of the present invention;

Figures 5a and 5b show plan and side views of a housing of the device shown in figure 4;

Figures 6a and 6b show plan and side views of an extractor rod of the device shown in figure 4; and

Figure 7 shows a side view of a pneumatic hand unit adapted for use with the device of figure 4.

[0014] Referring firstly to figures 2a to 3e there is shown an extractor rod 20 and an extractor rod insert 22 according to an aspect of the present invention. The rod 20 comprises a stem 24 having a head 26 at one end and a threaded portion 28 at the other. The threaded portion 28 is adapted to fit a fluid operated hand-tool, the use of which is described in greater detail below. In the embodiment shown, the head 26 has a substantially cubic form with the stem 24 extending from an upper face 30 thereof. A rounded blind aperture 32 is provided in the head 26. The aperture 32 extends in a direction perpendicular to the longitudinal axis of the rod 20 between opposing side faces 34,36 of the head 26. A slot 38 communicating with the aperture 32 is provided in the lower face 40 of the head 26. As can be seen from figure 2a the slot 38 extends from an edge of the head 26 to the middle of the lower face 40.

[0015] Figures 3a to 3b show an insert 22 adapted to fit into the aperture 32 of an extractor rod 20. The insert 22 is a corresponding cross-sectional shape to that of the aperture 32 and is sized so as to be a sliding fit within the aperture 32. A blind hole 42 is provided in one end face 44 of the insert 22. A slot 46, narrower than the slot 38 in the head 40, is provided in the insert 22. The interior surface of the hole 42 on either side of the slot 46 is chamfered so as to provide an engagement surface.

[0016] In use an insert 22, having a slot 46 which is sized and a chamfer which is angled to cooperate with a particular size of fixing 82 to be removed, is placed in the aperture 32 of the head 40 and the respective slots 36,46 of the two components align with one another. The rod and insert 20,22 can then be positioned relative to a screw, bolt or like fastener such that the head of the

fastener is received within the insert 22. When the appropriately sized and chamfered insert is chosen the chamfered portions of the insert 22 correspond to the shape of a countersunk screw head, and thus ensure that there exists line, as opposed to point, contact between the screw head and the insert 22.

[0017] The above described insert 22 and rod 20 arrangement has the advantage that a single rod 20 can be supplied with a plurality of interchangeable inserts 22 configured so as to accommodate the head size and countersink angle of a range of fasteners. The time taken in removing and replacing an insert 22 is less than that taken changing a conventional single piece extractor rod. Additionally if an insert 22 is worn or damaged then only it, and not the entire rod 20, usually needs to be replaced.

[0018] Referring now to figures 4 to 7 there is shown an extractor device, generally designated 50, according to a further aspect of the present invention. The device 50 comprises an extractor rod 52, a cylindrical body 54 and a driver 56. In the embodiment shown, the extractor rod 52 is of a conventional single piece construction having a head 58 and a stem 60 extending therefrom. The head 58 of the rod 52 is provided with an aperture 78 and slot 80 adapted to receive the head and shank of a fixing 82 as described above.

[0019] The driver 56 is in the form of a fluid operable hand tool or gun. The gun has a barrel 62 within which is housed an elongate adapter rod 64. The free end 66 of the adapter rod 64 is threaded. When connected to a supply of pressurised fluid, the gun can be operated to draw the adapter rod 64 through the barrel 62 with a vibratory motion.

[0020] The cylindrical body 54 is substantially hollow and is adapted to, in use, accommodate the head 58 of the extractor rod 52. A hole 68 through which the stem 60 of the extractor rod 52 can project is provided in the top 70 of the body 54. A peripheral flange 72 provided around the bottom 74 of the body 54 defines a seat which rests against a work piece 76, in use. A cutaway portion 84 of the cylindrical body 54 allows fixings 82 to be fitted to and removed from the head 58 of the extractor rod 52. A runner 86 made from, for example, brass is provided within the cylindrical body 54 opposite the cutaway portion 84 to maintain orientation of the extractor rod 52 with respect to the body 54.

[0021] In use, the cylindrical body 54 is connected to the barrel 62 by an adjustable adapter 88, and the extractor rod 52 is threaded to the adapter rod 62 such that the aperture 78 of the head 58 is aligned with cutaway portion 84 of the cylindrical body 54. The extractor device 50 is then positioned such that a fixing 82 is received in the aperture 78 as shown in figure 4. Once in position, the adaptor 88 can be adjusted to take up any slack between the head 58 of the extractor rod and a head 90 of the fixing 82, the driver 56 is then operated so as to draw the adapter rod 64 and extractor rod 52 through the barrel 62 with a vibratory motion and thereby

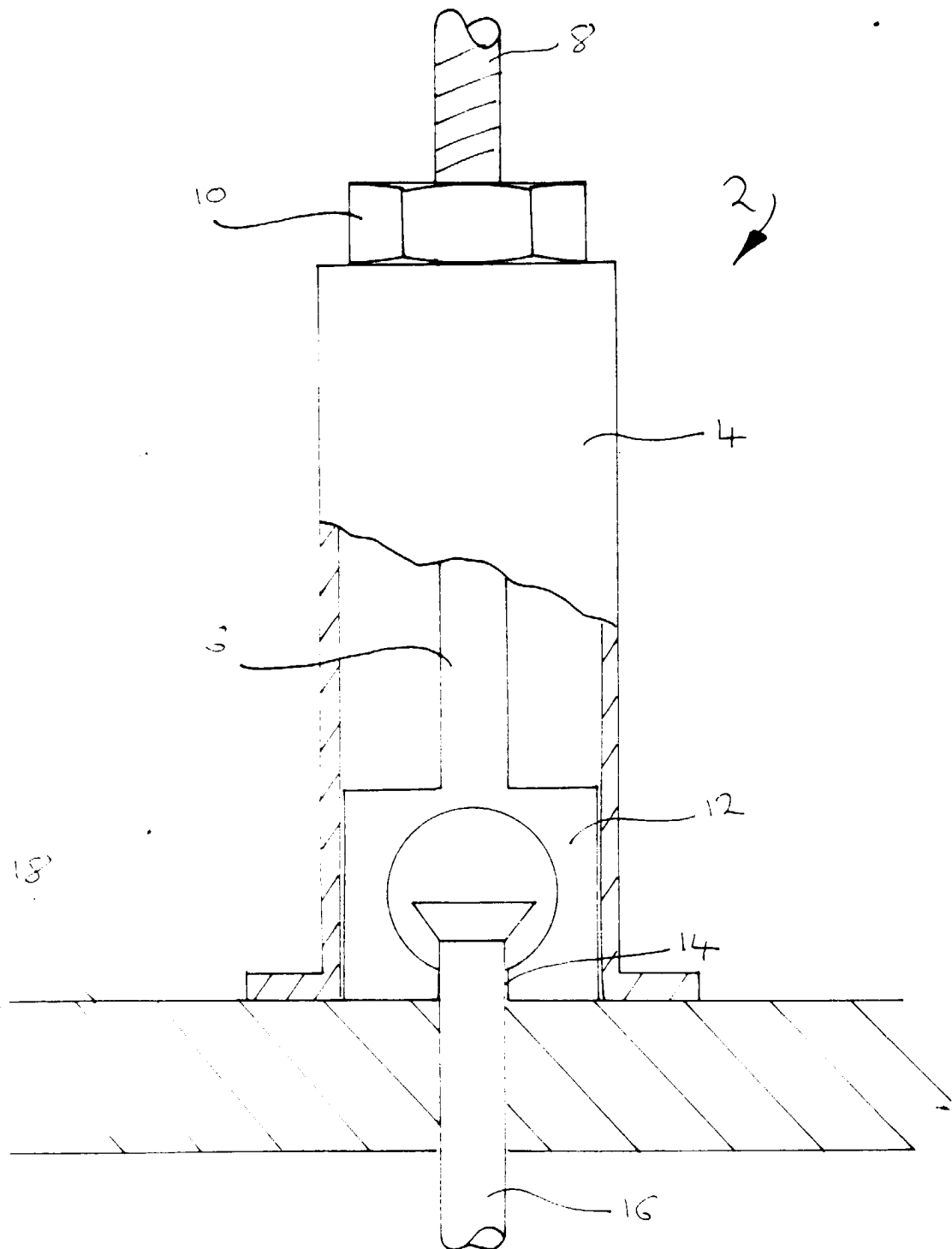
extract the fixing 82. The flange 72 of the cylindrical body bears against the workpiece 76 during extraction of the fixing 82 and spreads the reactive load experienced during extraction so as not to distort or damage the surface of the workpiece 76. It will be appreciated that the act of extracting the fixing imparts no relative torque between the flange 72 and workpiece and so greatly cuts down the risk of damage to either the tool or the workpiece. In addition, the likelihood of any fretting between the tool and workpiece is also reduced by the speed and precision with which a fixing can be removed, according to the invention.

[0022] It has been found, in addition, that even the most reluctant fixings, for example those which are over-size or inserted askew, are easily removed with the device of the invention and that problems of the previous method using the threaded nut 10 on the stem 8, in which flat-by-flat turning of the nut could often achieve no more than stretching of the stem 8 whilst leaving the fixing still firmly stuck, no longer apply. It is believed that the higher extraction force capable of being applied by the device of the invention, which may be assisted by the vibratory action when used, somehow releases the jam between fixing and workpiece and discourages its re-occurrence once released.

[0023] It will be understood that the extractor rod and insert described with reference to figures 2 to 3e is readily adaptable for use with the extractor device described with reference to figures 4 to 7.

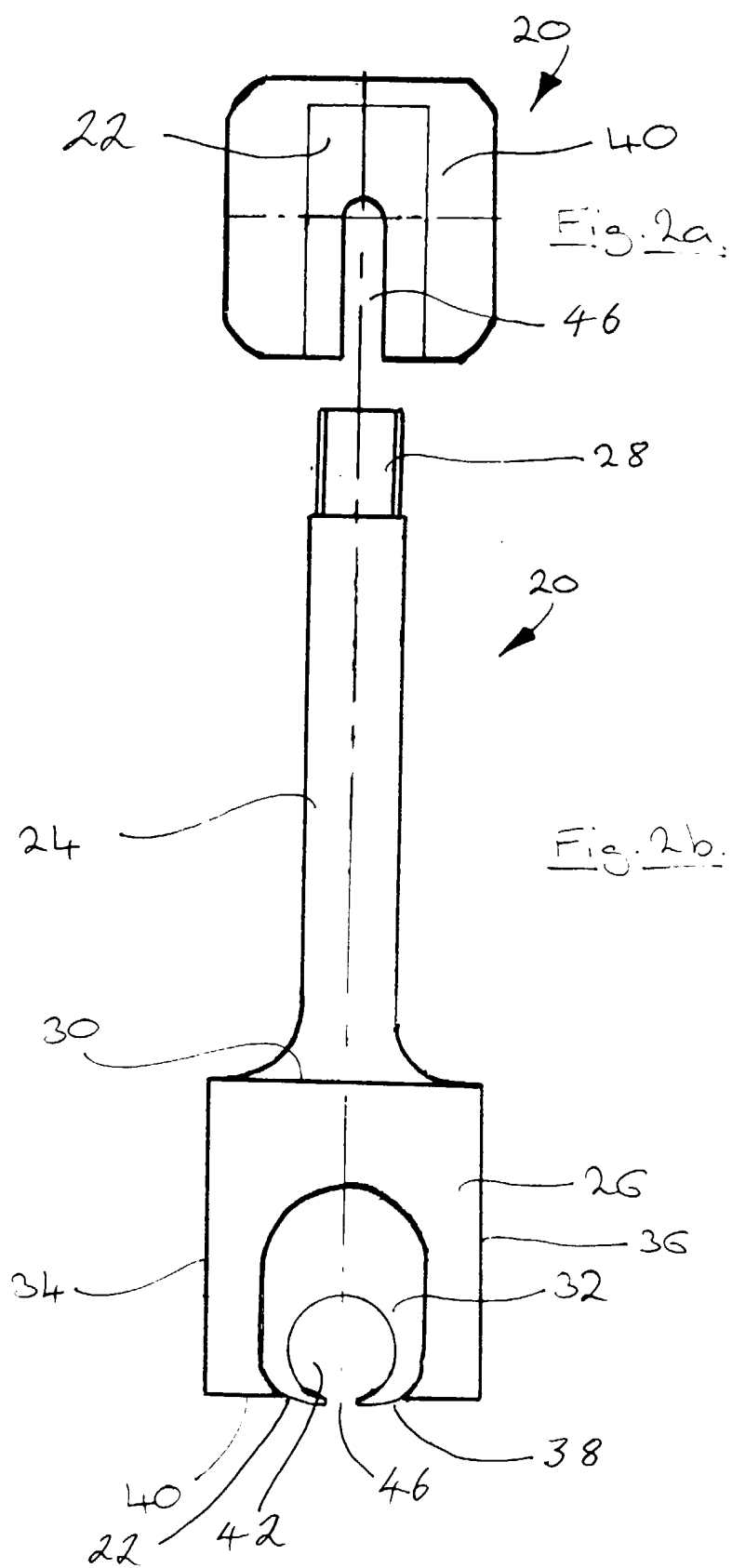
Claims

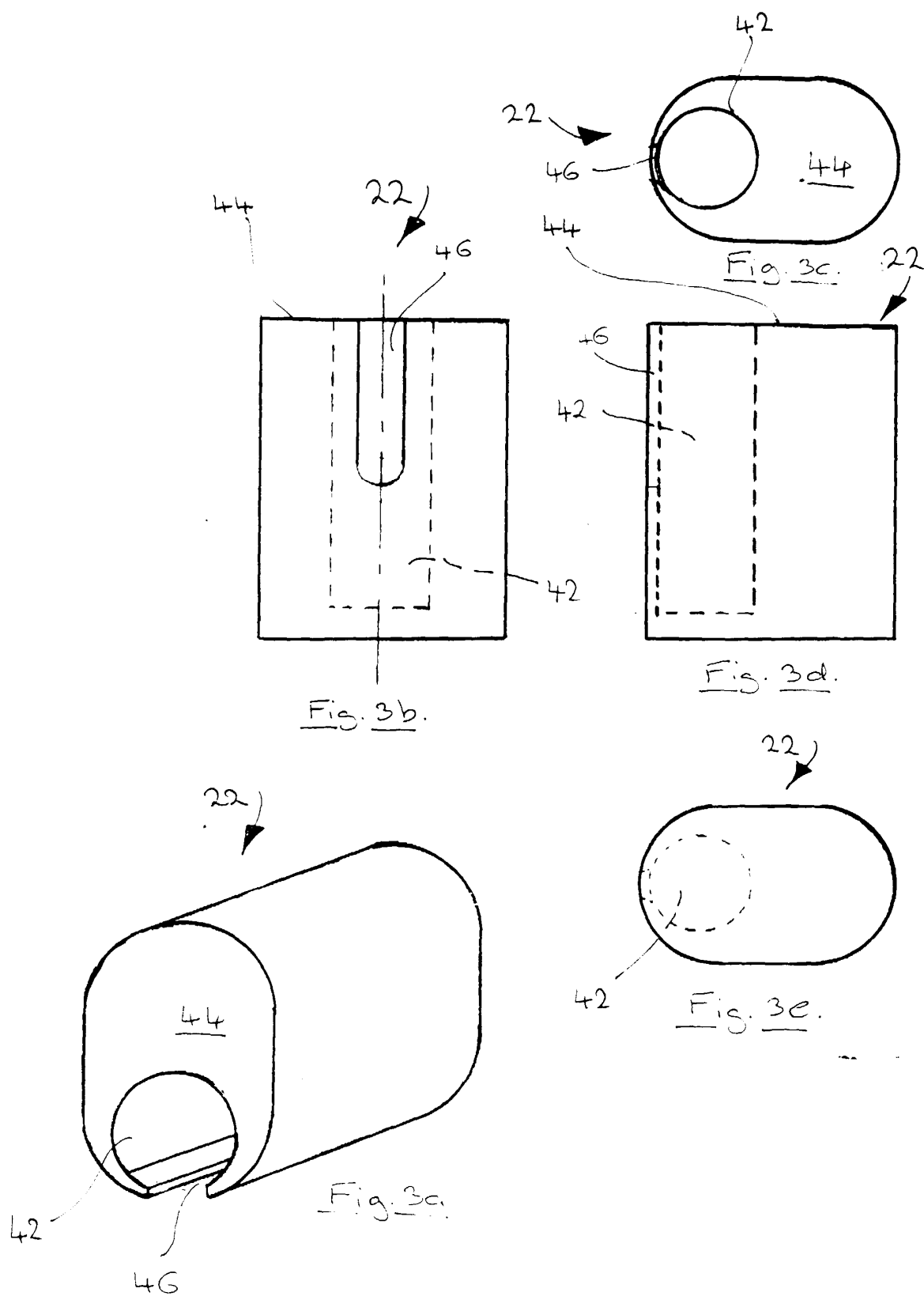
1. An extractor device for extracting a fixing from a work piece, the extractor device including an extractor tool adapted to receive the fixing, and a driver connected to the extractor tool, the driver being adapted to exert an extraction force on the fixing via the extractor tool.
2. An extractor device as claimed in claim 1 wherein the driver includes a driver housing and a mandrel connectable to the extractor tool, the mandrel being movable relative to the driver housing, in use.
3. An extractor device as claimed in claim 1 or claim 2 wherein the extractor device includes an abutment member adapted to abut the workpiece during extraction of a fixing therefrom.
4. An extractor device as claimed in claim 3 wherein the extractor tool is provided within a cavity of the abutment member.
5. An extractor device as claimed in any preceding claim wherein the driver is adapted to be hand held by a user.
6. An extractor device as claimed in any preceding claim wherein the driver is fluid operated.
7. An extractor device as claimed in any preceding claim in which the driver is adapted to exert a vibratory extraction force.
8. An extractor device as claimed in any preceding claim wherein the extractor tool comprises a carrier member and an engagement member adapted to receive the fixing, the carrier member and engagement member being retainable in association with one another such that, in use, an extraction force applied to the carrier member is transmitted through the engagement member to the fixing.
9. An extractor device as claimed in claim 8 wherein the carrier member and engagement member are retainable in association with one another by a form locking arrangement.
10. An extractor device as claimed in claim 9 wherein the engagement member is retainable in a recess of the carrier member.
11. An extractor device as claimed in claim 8, 9 or 10 wherein the engagement member includes an engagement location adapted to receive the fixing, the engagement location being at least partially shaped so as to correspond to the head of the fixing.
12. An extractor device as claimed in claim 11 wherein the engagement location is chamfered.
13. A method of extracting a fixing from an aircraft component, the method comprising the steps of:
 - providing a device comprising an extractor tool adapted to receive the fixing and a driver connected to the extractor;
 - placing the device in contact with the component and engaging the fixing with the tool, and
 - operating the driver so as to exert an extraction force on the fixing via the extractor tool to withdraw the fixing from the component.
14. An extractor device for extracting a fixing from a work piece substantially as hereinbefore described with reference to or as shown in figures 2a to 7 of the accompanying drawings.

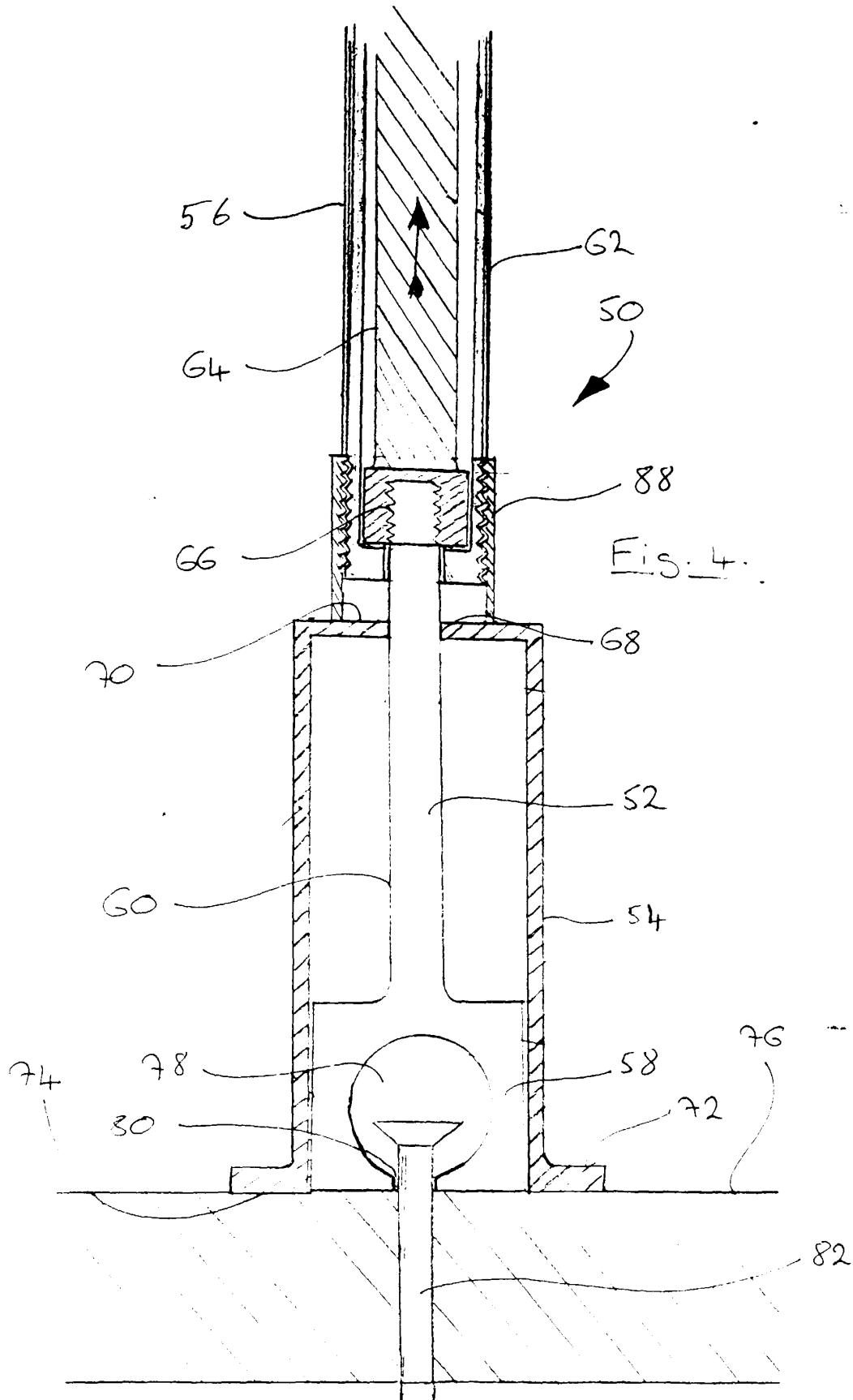


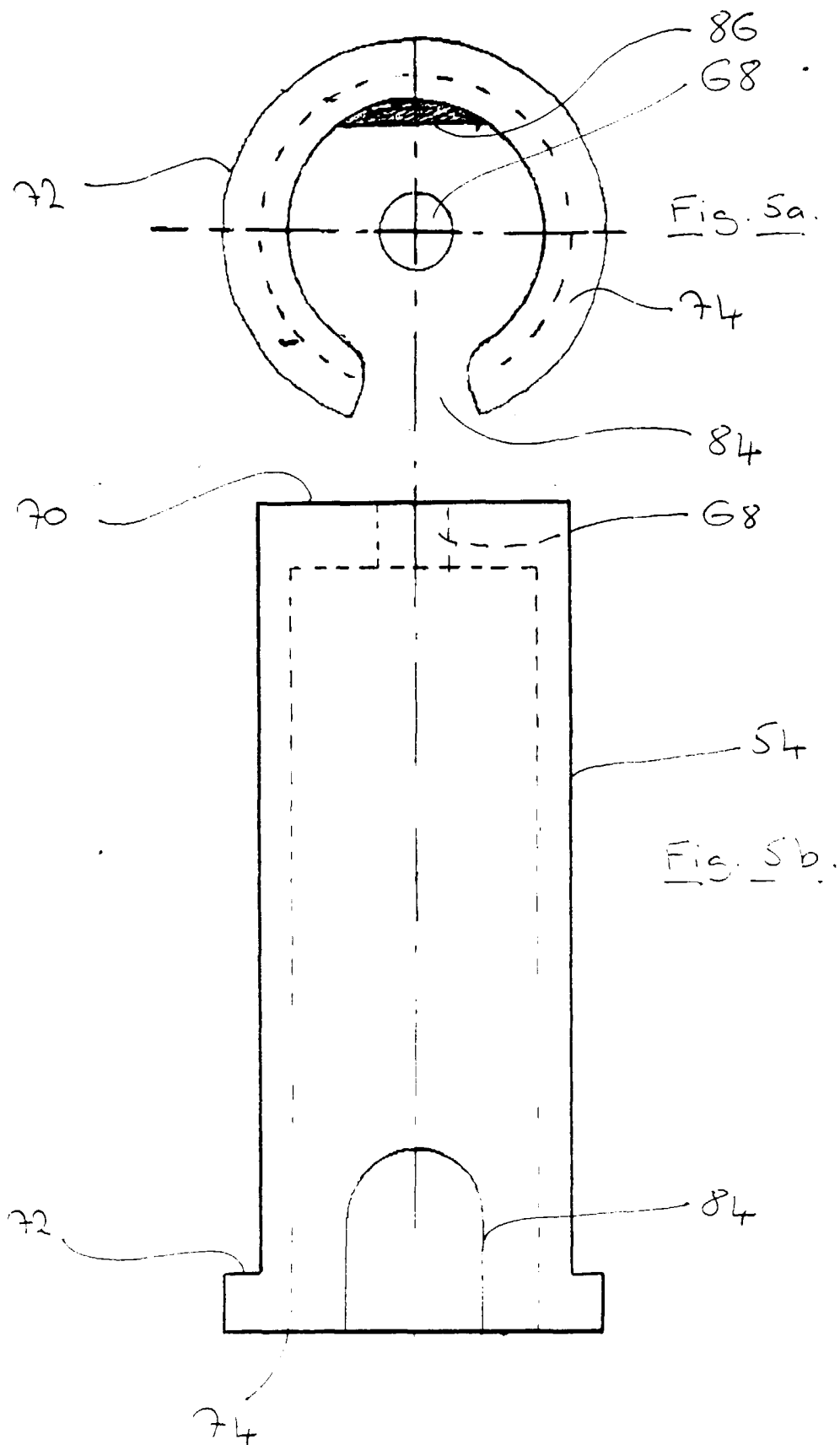
PRIOR ART

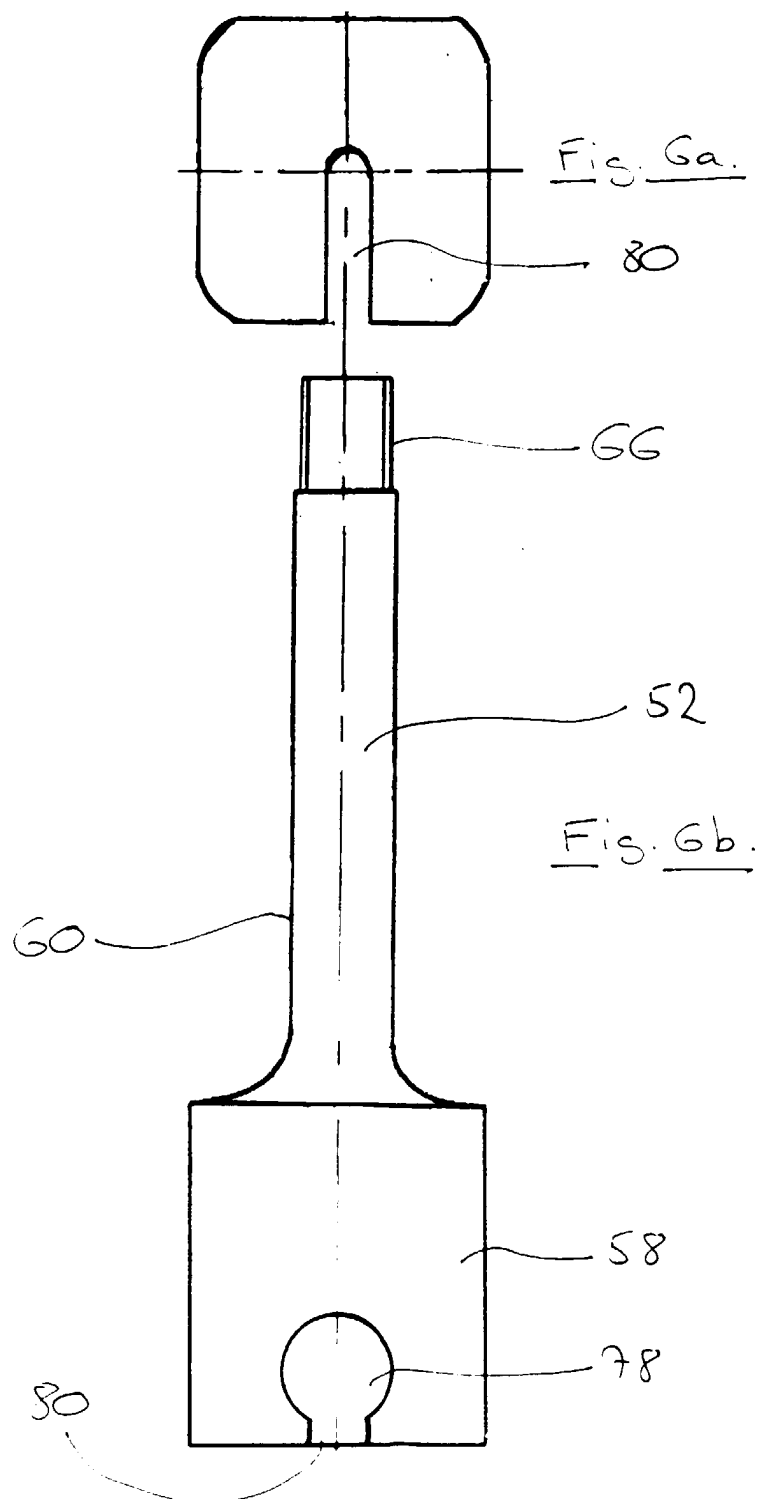
Fig. 1.











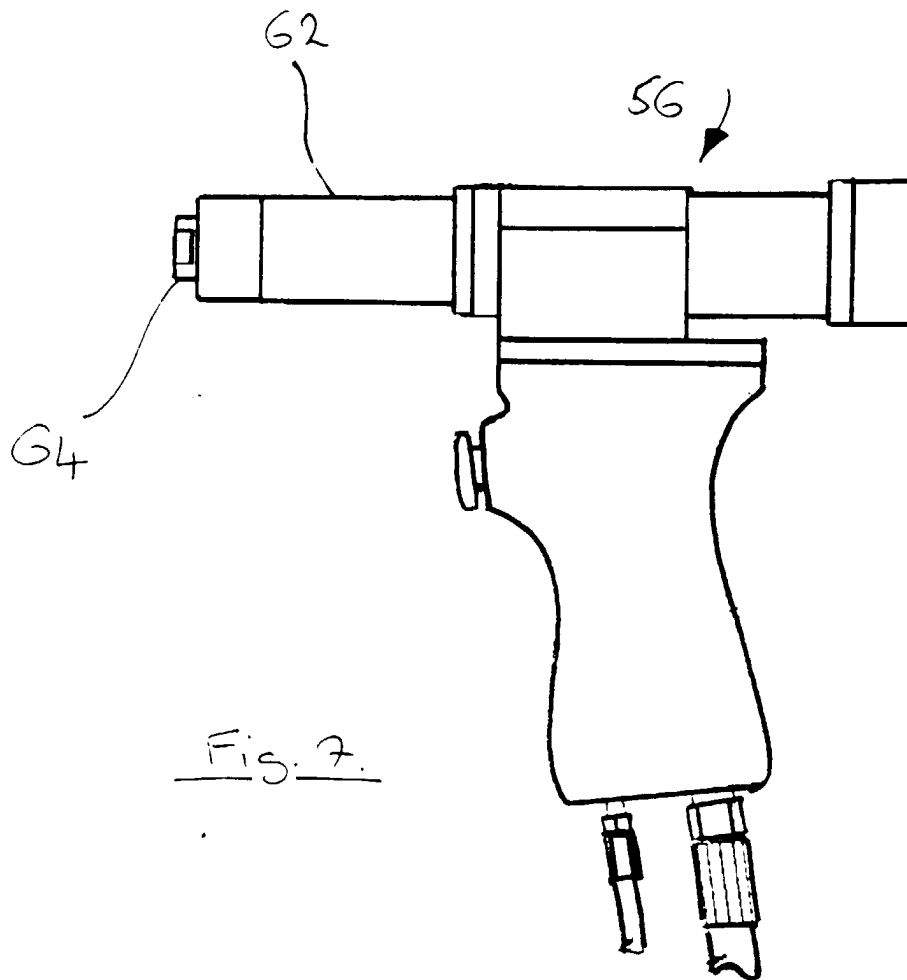


Fig. 7.



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 99 30 6067

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.7)
X	US 2 452 457 A (G.W.GRAY ET AL.) 26 October 1948 (1948-10-26) * the whole document *	1-5, 8-11,13	B25C11/00 B25B27/02
X	GB 127 673 A (THE SOPWITH AVIATION COMPANY, LIMITED) * page 3, line 19 - line 23; figure 1 *	1,2,8,9, 11,12	
X	DE 88 03 981 U (SANKYO OILLESS INDUSTRY GMBH) 1 June 1988 (1988-06-01) * claims; figures 1,5,7-10 *	1,5,6,8, 9,11,12	
A	WO 88 02246 A (C.DICECCA ET AL.) 7 April 1988 (1988-04-07) * claim 1 *	7	
A	WO 97 16281 A (N.PERIN) 9 May 1997 (1997-05-09) * abstract; figures *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B25C B25B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 13 January 2000	Examiner Majerus, H
CATEGORY OF CITED DOCUMENTS 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		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	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 99 30 6067

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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13-01-2000

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