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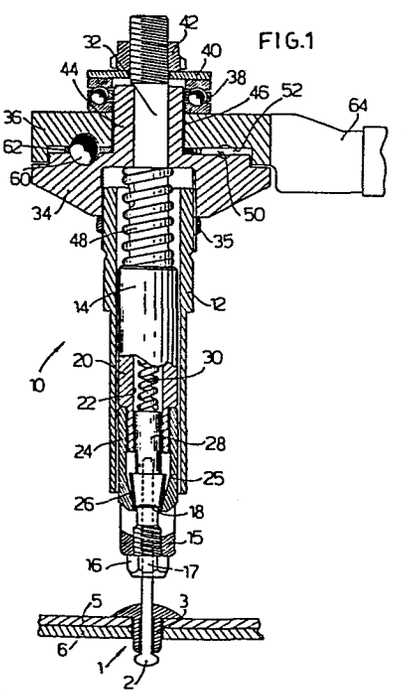
(54) **A riveting machine operating through inclined planes for applying a tractive force to a rivet pin.**

(57) A novel riveting machine (10) comprises a conventional pin gripping unit or assembly for gripping a pin (2) of a rivet (1); two elements (34,36) which may be rotated relative to each other; said elements having opposite faces (50, 52) with inclined surfaces; and balls (60) between said inclined surfaces. The mutual rotation of the elements allows for the opening and closing of the gripping jaws on the pin of a rivet and the application of a tractive force to said pin by a limited effort.

FIG.1



EP 0 062 869 A2

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"A RIVETING MACHINE OPERATING THROUGH INCLINED PLANES FOR APPLYING A TRACTIVE FORCE TO A RIVET PIN".

This application relates to the art of riveting. It is a known technique, particularly but not exclusively in aeronautical field, to fasten sheets or plates together, particularly when one face of the sheets or plates is not accessible, by means of rivets. The rivets are applied with the pin thereof inserted and projecting from an accessible face of the sheets or plates, and then a sufficient tractive force is applied to the pin for causing the rivet to be buckled on the opposite face or side of the sheets or plates, and preferably such a tractive force should be sufficient to cause the pin to break at a properly weakened section thereof. This tractive force is applied to the pin by riveting machines or devices, which may be

manually, oleopneumatically or pneumatically operated. These machines generally include a gripping unit or assembly comprising an outer sleeve and an inner body axially movable relatively to each other. Said sleeve is provided at one end with a piece forming an aperture for accommodating the pin, and internally of the sleeve said piece forms a spreading element generally comprising a bevelled circular surface. The body comprises a vice with spreadable jaws, said jaws having an inclined outer surface for fitting an inclined inner surface of a closing element or cap forming part of the body. The jaws are spring pressed to an extended condition relative to the body and, when encountering the spreading element and not bearing against the closing cap, such jaws can open for pin gripping, while when engaged by the closing cap and moved away from the spreading element they will grip and tighten the pin. When the jaws are at closed or tightening position, a tractive force can be applied to the body and accordingly to the pin until breaking the latter.

For the relative movement between said body and sleeve and application of the tractive force, all the types of riveting machines hitherto known variously operate by the known lever principle to allow for providing sufficient forces on the vice in order to break the pin, though applying a limited effect on the riveting machine arms. For example, among the manually operated riveting machines, known are a simple lever machine, a pantograph machine and the like. Such implements, while enabling a considerable reduction of the force to be applied, however require, particularly in the manual type, a considerable effort by the operator.

Thus, the object is to provide a riveting machine not requiring high operating efforts.

A further object is to provide such a riveting machine, which is sturdy, economical and reliable.

This object has been achieved by the riveting machine of the present invention, which riveting machine comprises a conventional bripping unit or assembly and is characterized in that a sleeve of the gripping unit or assembly is integral with a first element; a body of the gripping unit when subjected to tractive force is integral with a second element coaxial with the first element, the two elements being rotatable relatively to each other through inclined or sloping surfaces, and an axial relative movement between said sleeve and said body, from an open condition to a tightened condition, being caused by relative rotation between said elements.

The sloping surfaces on the two elements may directly cooperate with one another. However, rolling means, generally balls, are interposed therebetween. In one embodiment, said elements comprise opposite disc elements, and said sloping surfaces are provided in at least one of said disc elements, on the face or side thereof facing the other disc element, and are formed of rolling seats of decreasing depth, said seats having a center line which is a circular portion around the axis of the element.

In another embodiment, said elements are made with threads in opposite sides or faces therof and, although such threads may

be standard threads, the device is preferably designed with ball circulation threads.

The novel riveting machine in one embodiment may be manualy operated; in other embodiments it may be provided with pneumatic, or electric or fluid control; the machine is effective for applying a tractive force to a pin with considerably lower efforts than a standard or normal riveting machine. In addition, it is sturdy, reliable and economical.

Particular exemplary and unrestrictive embodiments of the riveting machine according to the invention will be hereinafter described in detail with reference to the accompanying drawings, in which:

Fig. 1 is an axial sectional view, with some parts in front view and other parts broken away, through a riveting machine according to the invention, shown under a rest condition with open jaws for pin insertion;

Fig. 2 is a plan view showing one of the two disc elements (the lower disc element of Fig. 1) and one of the balls at the condition of the riveting machine shown in Fig. 1; the position of the opposite grooves of the other disc element is drawn in dash lines;

Fig. 3 is an axial sectional view similar to that of Fig. 1, but showing the riveting machine at closed jaw gripping and traction condition on the pin;

Fig. 4 is a view corresponding to that of Fig. 2, but for the condition of the riveting machine shown in Fig. 3;

Fig. 5 is a development for the surface of a disc element

according to a circumference passing through the center lines of the ball grooves;

Fig. 6 is a view, partly in axial section, of a second embodiment of the riveting machine, in which the gripping unit or assembly has been drawn only as a whole without showing the details thereof, the riveting machine being shown at rest condition; and

Fig. 7 is a fragmentary view, partly in axial section, as seen from the left with respect to Fig. 6.

In the figures of the accompanying drawings, reference numeral 1 designates an exemplary rivet of ordinary use, which comprises a pin 2 and a cap 3 having an enlarged head and a deformable shank. In order to fasten two sheets or plates together, respectively designated at 5 and 6, after insertion of the rivet therein, a tractive force is applied to the pin, thereby to deform or buckle the rivet shank, generally until the pin breaks at a weakened preset zone therein.

In a first embodiment (Figs. 1-5), the novel riveting machine has been designated as a whole by numeral 10 and comprises a sleeve 12 and a body 14.

The sleeve 12 is substantially tubular, open at the bottom, while the end 15, the lower end in the figure, has a screwed piece 16, the latter being provided with a through longitudinal aperture 17 of sufficient diameter to accommodate the pin 2, and projecting internally of the sleeve to make up a spreading or widening element provided with a bevelled circular surface 18.

The body 14 comprises an internally hollow substantially cylindrical portion 20, the hollow or slot of which is shown at 22; a closing portion or cap 24 is screwed to portion 20, the cap internally having sloping or conical walls 25. Said body 14 is also comprises a vice 26 generally including three jaws of conical outer surface, having a taper substantially corresponding to that of wall 25. This vice 26 and closing cap 24 may be provided with a relative sliding motion and, depending on the relative arrangement, the vice jaws may widen out or spread apart to one another (to accommodate the pin 2), or may draw close to one another (to tighten the pin 2). The vice jaws are pressed to extended position from the body by a presser element 28 and a spring 30 received in the body slot 22. For the operation of said body, a tang 32 is integral with the body cylinder or barrel 20.

The body 14 is axially slidable relatively to the sleeve, so that both can appear at the conditions shown in Figs. 1 and 3. In Fig. 1, said body is downward displaced within the sleeve (obviously, such terms as "upward" or "downward" and the like shall be intended only with reference to the figure and not in a restrictive sense), until releasing the vice jaws 26 from the surface 25. The vice jaws 26, urged by spring 30, have encountered the bevel 18 of the spreading element and have been widened out; the pin 2 may loosely penetrate among the jaws. In Fig. 3, the body 14 has moved downward within the sleeve 12. The closing cap 24 has lifted the jaws 26 and firmly closed the same on pin 2. Thus, a tractive force applied to said tang 32 is also applied to said pin 2.

The gripping unit or assembly hitherto described is also provided on the prior art riveting machines.

According to the present invention, and as shown in the embodiment of figs. 1-5, the sleeve 12 is made integral with a first disc element 34, generally by screwing, and is secured by a nut 35. The body 14 is made integral, when subjected to a tractive force, with a second disc element 36. Preferably, the coupling between said body 14 and disc element 36 is carried out by a rolling bearing 38 between said disc element 36 and a plate 40, the latter being made integral with the tang 32 by a fastening or set nut 42. Preferably, a tooth 43 provides a coupling between said disc element 34 and tang 32, which coupling is effective when disc 34 is rotated.

The disc element 34 has at the top a tubular extension 44, which is rotatably received within an aperture 46 of the second disc element 36. Within the passage in the tubular extension 44, said tang 32 can be only vertically moved, so that traction only is transmitted to the pin 2. A spring 48 is interposed between the cylinder or barrel 20 of body 14 and the disc element 34, this spring 48 substantially pressing the two disc elements 34 and 36 against each other and by reaction urging said body 14 away from the disc elements, with the function of both overcoming the force of spring 30 at rest step (Fig. 1) and opening the vice, and bringing the disc 36 from traction condition (Fig. 3) back to rest condition (Fig. 1).

The opposite surfaces 50 and 52 respectively of the disc element 34 and disc element 36 have grooves of decreasing depth and

circle arranged around the disc axis. Such grooves have been shown in Figs. 2 and 4 by full line for the element 34 and are designated by numeral 54, while have been drawn in Fig. 2 by dash- line, only indicative for the position thereof, for the element 36 and are designated by numeral 56. In the embodiment shown, there are three grooves 54 (and respectively three grooves 56) consecutively arranged along a circumference, while a ball 60 is received within each pair of grooves 54, 56. The contour of the bottom wall of grooves 54 is shown in Fig.5, which is drawn assuming the elemenj 34 cut or se ctioned according to a circumference through the ball centers and developing or spreading out on a plane the surface thus obtained. It will be appreciated that such bottoms comprise sloping surfaces. In cross-section, the grooves 54 and 56 may be rounded out with substantially the same radius as that of balls 60, or may have contours designed for friction minimization.

Reference numeral 62 indicates a cage for said balls 60.

The riveting machine 10 operates as described in the following.

When rotating the disc elements 34 and 36 relatively to each other in a direction in which said balls 60 are positioned in deeper portions of grooves 54 and 56, the disc elements are drawn closer to each other allowing opening of the jaws 26, as shown in Fig; 1. On the other hand, when rotating the disc elements relatively to each other in a direction in which said balls 60 are positioned in less deep portions of grooves 54 and 56, the disc elements 34 and 36 are moved away from each other, and the body 14 takes a tightening and traction position

within the sleeve 12 as shown in Fig. 3. It should be appreciated that as the traction occurs through sloping planes, this would involve a considerable reduction in the relevant effort.

In the riveting machine embodiment shown at 70 (Figs. 6 and 7) the same reference numerals have been maintained for the identical parts of the preceding embodiment, and such parts will not be further described.

In said riveting machine 70 the sleeve 12 is rotatable secured with a first element 74 and the tang 32 is axially movable with a second element 76 through the bearing 38. The first and second elements are so formed as to have opposite cylindrical faces 78 for element 74 and 80 for element 76, respectively. Threads 78' and 80' are provided in the opposite faces 78 and 80 for receiving a series of balls 82. The assembly of threads 78' and 80' and balls 82 makes up a so-called ball circuit screw. Fig. 7 also showns a ball return channel 83.

The operation of the embodiment 70 is similar to that of embodiment 10. By rotating the elements 74 and 76 relatively to each other, so that such elements are axially drawn closer to each other (condition of fig. 6), the jaws are spread apart or open, while by rotating the same elements relatively to each other so that the same are axially moved away from each other, the jaws are closed and a tractive force is applied.

Elements 34 and 36, or 74 and 76, may be rotated relatively to each other by any means as desired. Particularly, where the riveting machine is intended for manual operation, either

disc will have integral long arms, of which only one has been partly shown in Figs. 1 and 6, and designated at 64. However, the novel riveting machine may be preset for pneumatic, or fluid, or mechanical or electrical operation by means of well known expedients.

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C L A I M S

1. A riveting machine comprising a sleeve (12) having an aperture for receiving a rivet pin and a spreading element (16) internally of the sleeve about said aperture, a body (14) slidable within the sleeve between an opening condition and a tightening and traction condition, said body including vice jaws (26) which are spring biassed and are open when engaged with said spreading element, and a closing cap (24) for said jaws, characterized in that said sleeve is integral with a first element (34; 74), said body is integral for an axial movement with a second element (36; 76) which is coaxial with said first element, the two elements being relatively rotatable through sloping surfaces (54, 56; 78', 80'), and that the relative movement between said sleeve and said body is provided by relative rotation between said elements.

2. A riveting machine according to Claim 1, characterized in that rolling means (60, 82) are interposed between said elements for cooperation with said sloping surfaces (54, 56; 78', 80').

3. A riveting machine according to Claim 1, characterized in

that said elements are disc elements (34, 36), balls (60) are interposed between said disc elements, and said sloping surfaces (54, 56) are provided in at least one of said discs on the face thereof opposite to the other disc, in form of rolling seats for said balls, said seats having a circular center line and decreasing depth.

4. A riveting machine according to Claim 1, comprising a spring (48) for pressing said elements against each other, that is to a rest condition.

5. A riveting machine according to Claim 1, characterized in that each said element has for manual operation an extended arm (64) integral therewith.

6. A riveting machine according to Claim 1, characterized in that the mutual rotation of said elements is provided by pneumatic, or fluid or electrical means.

7. A riveting machine according to Claim 2, characterized in that said elements (34, 36) are disc elements; said first disc element (34) has an axial tubular extension (44) on the opposite face to the sleeve for being rotatably received in an aperture (46) of the second disc (36); that said body (14) has a tang (32) extended within said axial extension of said second disc element by means of a bearing (38), and that a spring (48) to urge said two disc elements to move near each other is located between said body and first disc element.

8. A riveting machine according to Claim 1, characterized in that said sloping surfaces are part of a male and female thread on said two elements.

9. A riveting machine according to Claim 1, characterized in that said sloping surfaces are part of a ball circuit screw coupling (78', 80', 82') provided between said two elements.

10. A riveting machine according to Claim 1, characterized in that said elements have opposite cylindrical faces (78, 80) in which threads (78', 80') are provided for a ball circuit (82); said body has a tang (32) extended within said elements (74, 76) and secured to said second element through a bearing (38), and that a pressing spring (48) is interposed between said body and first element.

FIG.1

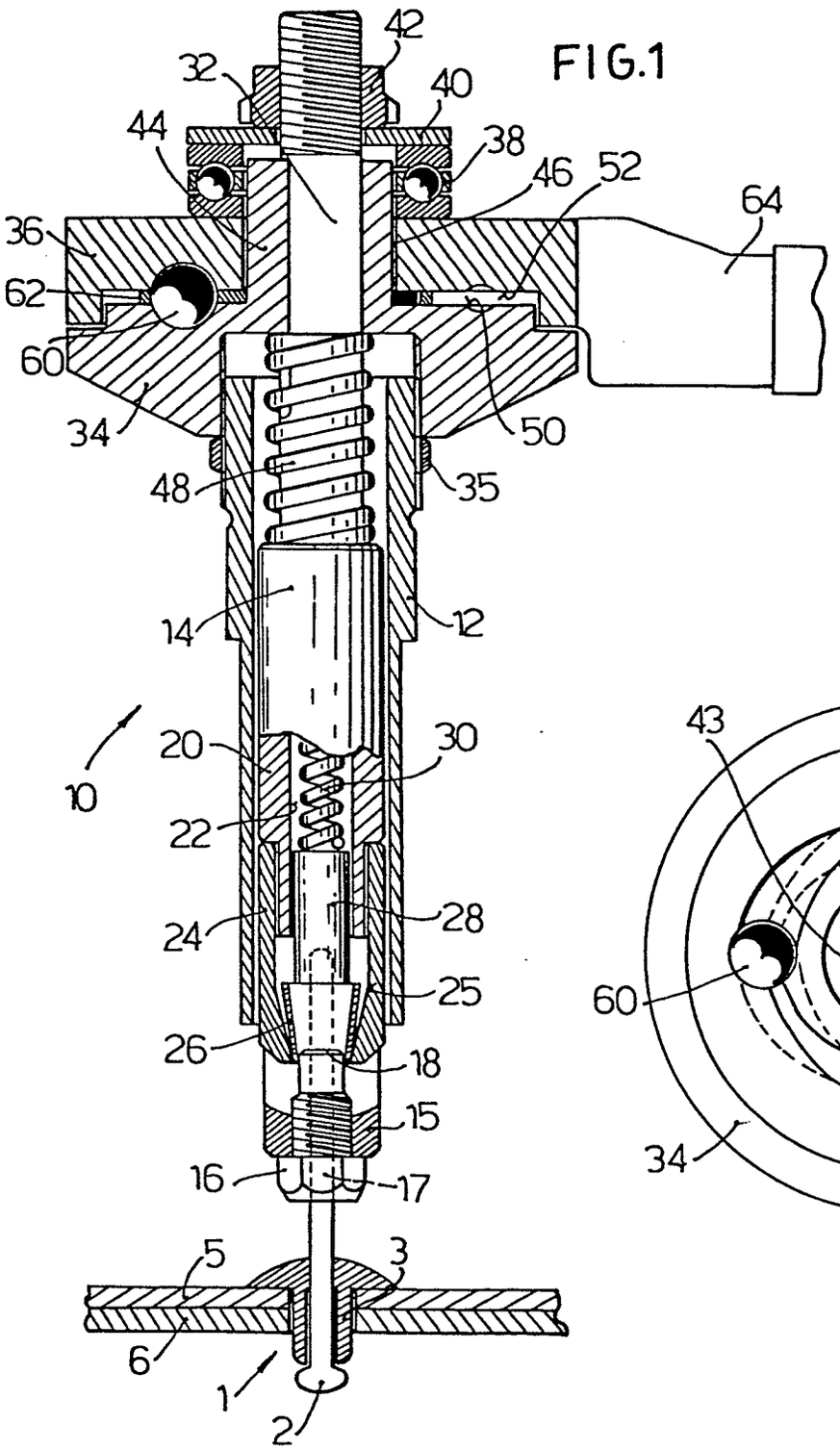
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FIG.2

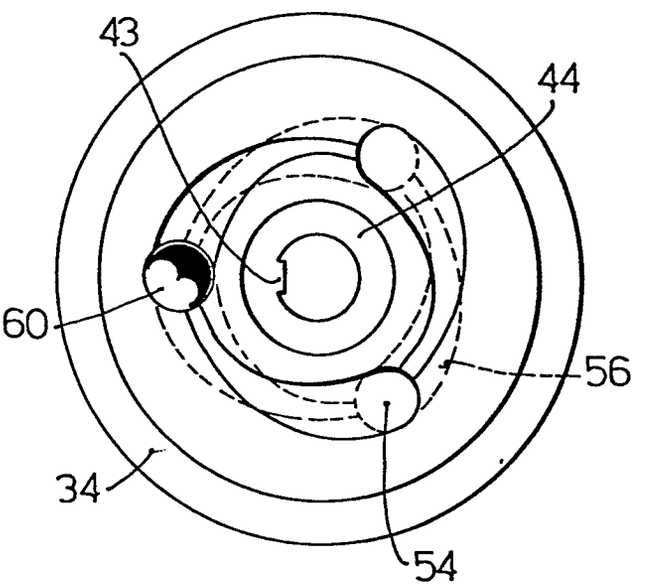
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FIG.3

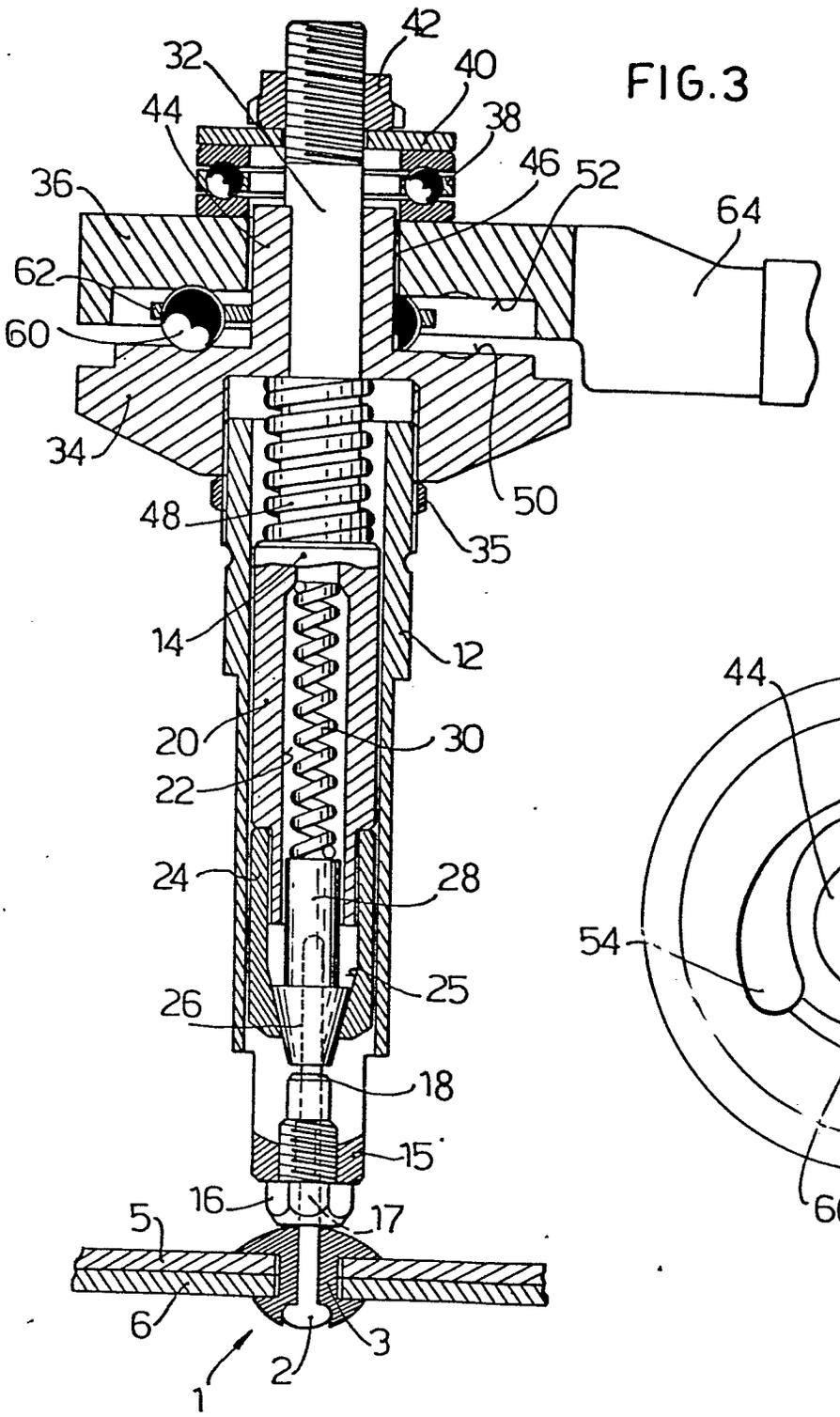
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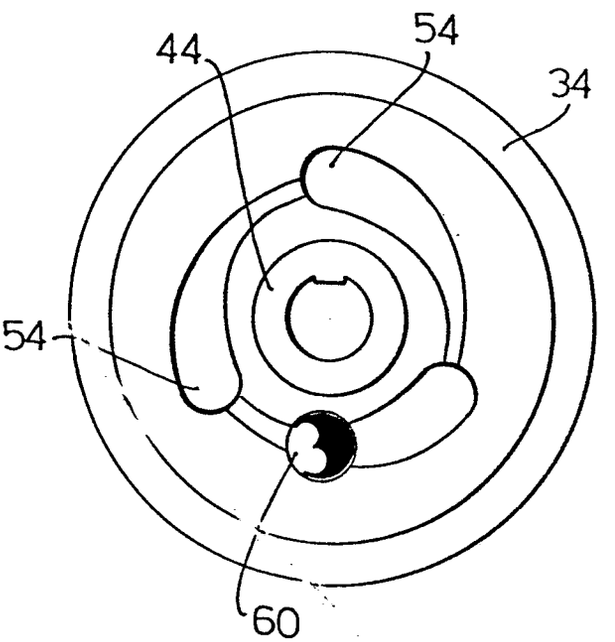
FIG.4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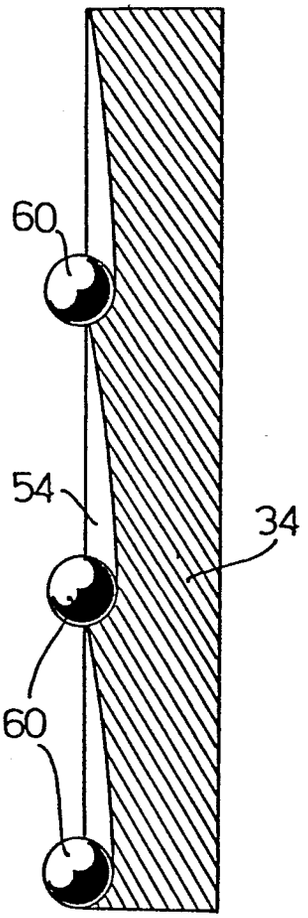

FIG.5

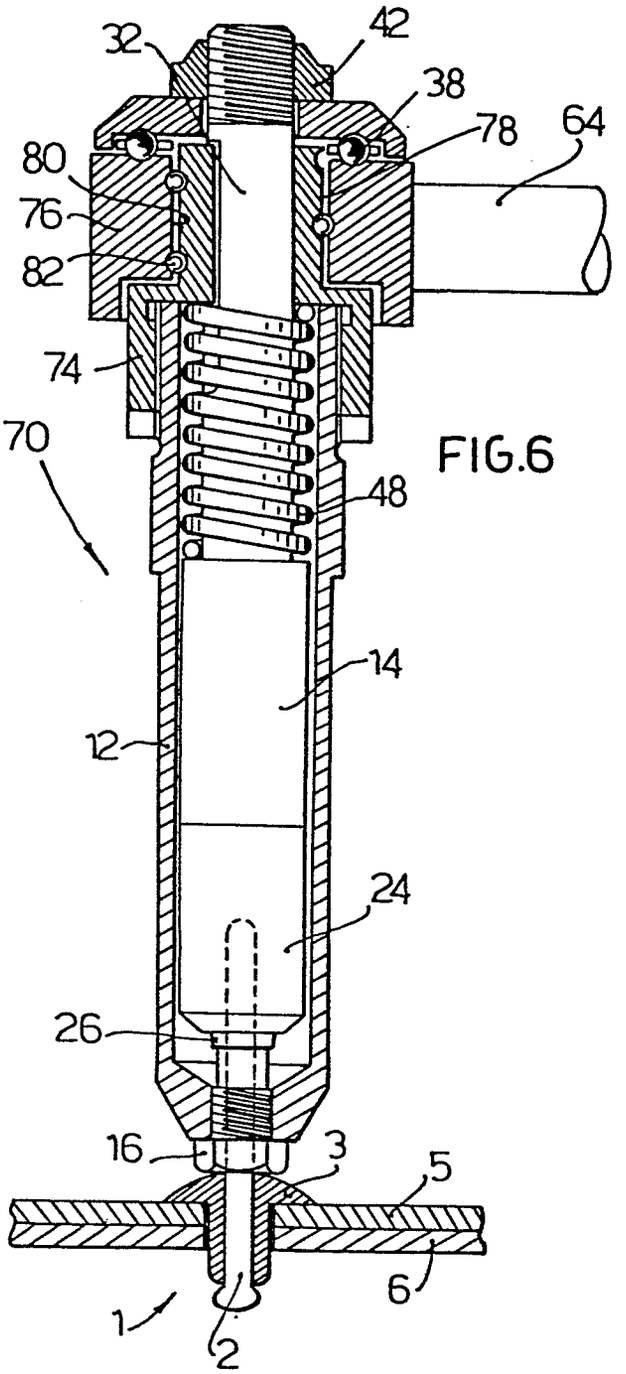

FIG.6

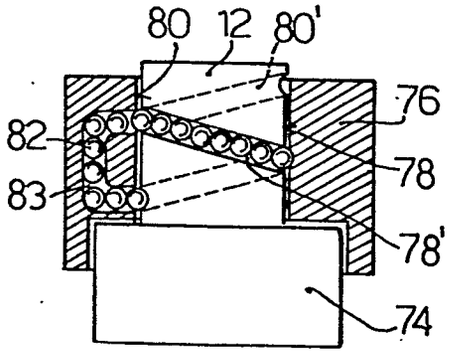

FIG.7