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Applicant: **C.B.C. S.p.A.**
Via Einaudi, 3
I-42016 Guastalla (Reggio Emilia)(IT)

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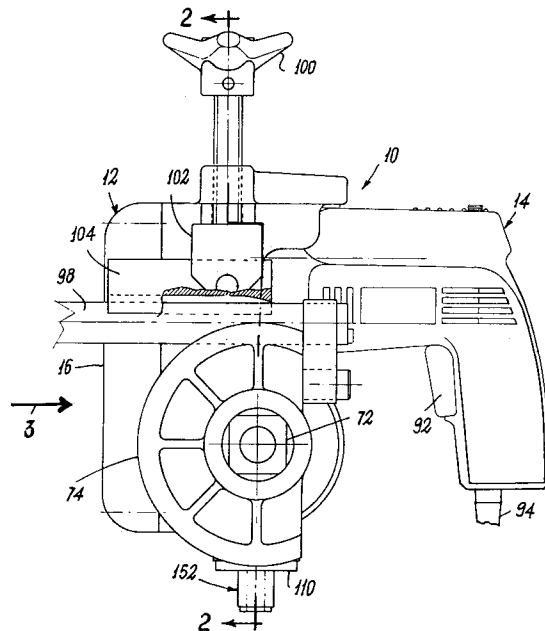
Inventor: **Vezzani, Giorgio**
Via Alberini, 12
I-42016 Guastalla, Reggio Emilia(IT)

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Representative: **Giambrocono, Alfonso, Dr.**
Ing. et al
Ing. A. Giambrocono & C. S.r.l. Via Rosolino
Pilo 19/B
I-20129 Milano (IT)

Pipe bending machine with an auxiliary mechanism for performing supplementary operations.

The bending machine (10; 10'), of the type provided with a motorized shaft (70), comprises an auxiliary mechanism (86, 88, 90; 86, 88', 90) for transforming the rotary movement of the shaft (70) into a reciprocating movement for operating additional devices (152, 152'; 154, 154') for performing supplementary operations such as widening or flanging the ends of pipes (98, 98''; 98', 98'') or punching pipes or metal sheets.



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The present invention relates to a bending machine for metal pipes and similar linear elements. In particular, the pipes can be of circular or polygonal cross-section. Other linear elements which can be bent by the machine include for example metal sections.

Such bending machines are used both at the craftsman and industrial level for the most varied uses, including the formation of heat transfer coils, the production of metal furniture or metal structures in general, and in industrial heating, sanitary and electrical systems.

Many bending machines are known in the art for bending pipes and metal sections.

A particularly versatile bending machine which enables a mechanical workshop to satisfy the most varied pipe and metal section bending requirements is that described in utility model patent No. 213 444. This bending machine, besides possessing the basic requirement of not deforming the pipe cross-section during bending and of being easily operated with one hand, is able to form bends of both of very small and very large radius of curvature, to form several successive bends with a very small space between them, to adapt to the various diameters and dimensions of commercially available pipes and sections, and form bends having an angle of curvature of 180° and more.

The aforesaid bending machine comprises a box casing in which a die shaft is rotated manually, or by an electric motor via a step-down gear. The bending machine is provided with a pipe presser shoe shaped to adapt to part of the outline of the cross-section of the element to be bent, this shoe being movable towards the element to be bent and away from it to lock it before operating the bending machine.

Although this bending machine can be made small and lightweight compared with other bending machines, so enabling it to be easily moved by an operator without particular strength, it still has to be fixed to a stand, workbench or the like for operation.

It should be noted that the stand or workbench cannot always be located in the optimum position for using the bending machine, either because of space considerations or because of the position or height at which the work has to be carried out, or for other reasons. This means that the operator has to carry the element to be bent from its location to the position in which the bending machine is located, with a considerable loss of time.

The simultaneous industrial invention patent application entitled "Grippable bending machine for pipes and the like", in the name of the present applicant, describes a bending machine which obviates the aforesaid drawbacks. This bending machine comprises an electric drive motor, a casing,

and a die shaft with die, supported rotatably by the casing and operable by a gear train for transmitting rotary motion from the motor to the die with speed step-down. Means are provided for gripping the bending machine with only one hand and means for controlling the operation of the motor using the actual hand gripping the bending machine. The bending machine is at least partly formed of aluminium and/or light alloy and/or plastics material.

The bending machine can be used by gripping it with only one hand, and therefore enables a pipe or similar linear element to be bent in any position, including for example on a ladder or where space problems do not allow a stand to be positioned.

The bending machine can however obviously be provided likewise with means for fixing it to a conventional support if this is required, for example for repetitive work or work to be done offsite or in the workshop.

According to a particularly preferred embodiment of said bending machine, the electric drive motor is a gun-type drill motor. The gear train is contained in a bending unit of which said casing forms part. Means are also provided for connecting said drill to the casing, and means for transmitting the movement of the drill chuck to said gear train.

In this manner a bending machine is obtained which is grippable by gripping the handle of the electric drill and controllable by the actual hand gripping the bending machine, the other hand being left free to manipulate the pipe to be bent. Preferably the casing and all other suitable parts of the bending machine are constructed of aluminium and/or light alloy and/or suitable plastics material. This reduces the weight of the bending machine to a truly minimum level, to achieve maximum manoeuvrability with minimum effort by the user.

In addition to the bending operation it is often necessary to perform supplementary operations on the pipe such as widening or flanging a pipe end. This is currently done either with specific devices or machines independent of the bending machine, or by using certain bending machines in which the die is removable from its shaft by which it is rotated and replaceable by flanging or widening devices operated by said shaft. These bending machines suffer from the serious drawback that the bending machine either operates as such or as a flanging or widening machine, but does not simultaneously offer the two functions, its conversion from bending machine to flanging or widening machine requiring the the removal of the die and its replacement with a suitable mechanism as stated, and its re-conversion to bending machine involving the reverse procedure.

The object of the present invention is to provide a bending machine of the type comprising a motorized shaft which is able to perform supple-

mentary operations of the aforesaid type without the need to remove the die from the bending machine.

Said object is attained by the bending machine according to the present invention, characterised by comprising an auxiliary mechanism for transforming the rotary movement of said motorized shaft into a reciprocating movement for operating additional devices which form part of the bending machine or can be fitted thereto for performing supplementary operations. In this manner its operation as a bending machine is made independent of the performing of supplementary operations, so that the machine of the present invention can be used in either mode without having to replace the die with the mechanism in order to perform said supplementary operations.

Conveniently said motorized shaft of the bending machine comprises parallel to the shaft axis an eccentric portion of circular cross-section, and is provided with a cam follower movable only in a direction perpendicular to the axis of the eccentric portion. In this manner the rotary movement of said motorized shaft is transformed into a reciprocating movement suitable for operating said additional devices.

According to a modified embodiment of the present invention, this transformation is achieved by the motorized shaft operating a connecting rod/crank mechanism.

Said additional devices, operated by the reciprocating movement obtained by said auxiliary mechanism, are preferably devices for widening or flanging pipe ends, or for punching pipes or metal sheets.

By way of example, if the auxiliary mechanism consists of the aforesaid eccentric portion of the motorized shaft of the bending machine plus the relative cam follower moving with reciprocating movement, said cam follower conveniently comprises a coaxial conical point to be inserted into a seat provided in a cylindrical unit coaxial to said point, said cylindrical unit being formed from several wedge elements which move radially following the insertion of the point into its seat.

If a pipe with an inner diameter just greater than the diameter of said cylindrical unit is mounted over the end of said unit, the insertion of said point results in widening of the pipe end.

According to a further modification of the present invention, there is fixed to the cam follower a punch of the type suitable for flanging or, respectively, widening a pipe end, this end being retained by a clamp coaxial to the punch, the clamp being connectable to the bending machine.

The clamp can comprise a plurality of seats for receiving pipes of various diameters.

The punch can also be of the type suitable for punching pipes or metal sheets, these latter being retained in position during punching by a suitable clamp connectable to the bending machine.

To an expert of the art the convenience and practicality of the bending machine according to the present invention are apparent, in that it also enables pipe ends to be widened or flanged, or tubes or sheet metal to be punched, these operations being often carried out together with pipe bending.

The present invention will be more apparent from the description of a bending machine provided with said auxiliary device according to the invention, given hereinafter with reference to the accompanying drawings, in which:

Figure 1 is a partly sectional side view of the bending machine, which is of the grippable type and is provided with an additional device for widening pipes;

Figure 2 is a vertical section therethrough on the line 2-2 of Figure 1;

Figure 3 is a front view thereof in the direction of the arrow 3 of Figure 1, in which the widening device has been replaced by a simple protection bush, and in which the die is not present;

Figure 4 is a vertical section therethrough on the line 4-4 of Figure 3, but showing the drill in full view;

Figure 5 is an enlarged cross-section on the line 5-5 of Figure 2.

Figure 6 is a partial section through a modification of the bending machine of Figure 4, which enables flared flanges to be obtained;

Figure 7 shows how the lower part of Figure 6 is modified in order to obtain a flat flange after forming a flared flange

Figure 8 is a section therethrough on the line 8-8 of Figure 6;

Figure 9 is a side view thereof in the direction of the arrow 9 of Figure 8;

Figure 10 shows a modification of the lower part of the bending machine of Figure 6, for widening a pipe end.

For a detailed description of the bending machine and its operation as such, reference should be made to the cited patent application entitled "Grippable bending machine for pipes and the like".

It will be merely stated herein that the bending machine 10 is composed basically of a conventional drill 14 of gun type, connectable to a bending unit 12.

This latter consists of a casing 16 comprising a recess (Figure 4) into which said drill 14 is inserted.

Means 23, 24 are provided for transmitting the rotary movement of the drill chuck 20 to a gear

train 30/34, 42/44, 52/54, 66/68 which transmits the rotary movement of the electric motor of the drill 14 with speed step-down to rotate a die 74, into the groove 96 of which the pipe 98 to be bent is inserted. A pipe pressing shoe 104, shaped to fit part of the contour of the cross-section through the pipe 98 and fixed to the clamp 102, can be moved by the handwheel 100 both away from and towards the pipe 98 to lock it before operating the bending machine.

The operation of the bending machine 10 is controlled by the trigger 92 on the handgrip 13 (Figure 3) of the drill 14.

Two embodiments of the auxiliary mechanism with which the mechanism of the present invention is provided are described hereinafter in greater detail. A first auxiliary mechanism is shown in Figures 1, 2 and 4 and consists essentially of an eccentric extension 86 of the shaft 70, said extension having a circular cross-section. The upper end of a pin 88, which acts as a guide for a return spring 90, always remains in contact with the surface of the eccentric extension 86. Consequently (Figure 4), when the drill 14 is operated by pressing the trigger 92, the rotary movement of the chuck 20 is transmitted via the gear train 30/34, 42/44, 52/54, 66/68 to the shaft 80, so that the pin 88 (Figure 2) moves with reciprocating movement in the direction of its axis.

The pin 88 is guided by a bush 120 (Figure 3) inserted into a hole 124 provided in the casing 16. Said bush 120 consists of two coaxial cylindrical parts, both threaded. A nut 120 is screwed onto the smaller-diameter part of the bush 120 (Figure 4) to lock it in position.

As can be seen in Figures 2 and 4, the pin 88 has a conically pointed lower end 106. This latter, assumed to be in the position shown in Figure 2, is pushed downwards on operating the drill 14, to operate a device which in this specific case enables pipe ends to be widened. This additional device consists of four wedges 108 (see also Figure 5) which are urged radially outwards when the point 106 on being lowered becomes inserted between the wedges 108. Each wedge 108 is provided with a fin 116 positioned between an outer circular wall 112 and an inner circular wall 114 of a retaining bush 110 screwed onto the larger-diameter outer part of the bush 120.

The fin 116 and the circular walls 112 and 114 enable the wedges 108 to be correctly guided in their radial movement. If on the outwardly projecting part of the wedge assembly 108, which forms an overall cylindrical projection, a pipe of diameter just greater than this cylindrical part is mounted, the lowering movement of the point 106 will cause the end of the pipe to undergo a radially outward force. If this force exceeds the elastic limit of the

constituent material of the pipe, said pipe end will be widened by the end of the operation, ie it will have a diameter greater than its original diameter. This enables a so-called socket joint to be formed between said widened end and the end of another pipe which has not undergone this operation.

Figures 3 and 4 do not comprise the described additional device, which is removable by simply unscrewing the bush 110. It is replaced by a rounded protection bush 118, fitted when the additional device is not to be used.

Figure 6 shows an auxiliary mechanism slightly different from that heretofore described.

In the following description, parts identical to those of the aforescribed bending machine are indicated by the same reference numeral, whereas similar parts are indicated by the same numeral plus an apex.

The upper end of the pin 88' is maintained constantly resting against the surface of the eccentric extension 86 by the return spring 90, so that it moves with reciprocating movement when the drill 14 is operated.

A punch 124 lowerly of frusto-conical shape is fixed to the lower end of the pin 88' by conventional means, clearly visible in Figure 6.

A holder 126 comprising a threaded circular hole 128 in its top is screwed tightly onto the bush 120 as shown in Figure 6.

The two lower arms 130 of the holder 126 are arranged to receive and support a bar-shaped clamp 132, better seen in Figures 8 and 9. The clamp 132 comprises a series of through holes of different diameter and can be moved longitudinally within the holder 126 to enable each hole 134, 136, 138 to be centered below the punch 124. The centering of these holes is facilitated by the presence of suitable locator steps 140, 142, 144 and 146 provided on the lower side of the clamp 132 (Figure 9).

The clamp 132 is divided longitudinally into two parts (Figure 8) hinged together by a hinge 148 so that the clamp 132 can be opened to insert the pipe to be widened or flanged into the relative hole. The holes 134, 136, 138 are of diameters to match pipes of commonly used standard diameters, so that the pipe becomes locked in position when the clamp 132 is closed.

The clamp can be locked in its closed position by a conventional snap handle 150 (Figure 8).

The additional device shown in Figure 6 enables a flared flange to be formed at the end of a pipe 98' locked in the clamp 132, as a result of the descent of the punch 124 (its lowest position is indicated by a dashed and dotted line in Figure 6).

When this has been achieved the pipe 98' is released by operating the snap handle 150 after removing the clamp from the holder 126.

Figure 7 shows a further additional device to be fitted to the bending machine 10' to obtain a flat flange at the end of a pipe 98" starting from a flared flange previously formed by the device of Figure 6. In this case the punch 124' has the shape shown in Figure 7. The operation of the device is obvious and does not require further comment.

Figure 10 shows a further additional device to be fitted to the bending machine 10' for widening the end of a pipe 98"". In this case the punch 124" has the shape shown in Figure 10. The operation of the device is again obvious from this figure, and does not require further comment.

It will be apparent to an expert of the art that the auxiliary mechanism, the purpose of which is to transform the rotary movement of the shaft 70 into reciprocating movement of a pin 88, 88', can also be formed in other ways, for example by a connecting rod/crank mechanism.

It will also be apparent to an expert of the art that although a grippable bending machine such as that of the cited simultaneous patent application has been illustrated and described, the bending machine can also be of completely different type, for example of the type which can operate only if fixed to a bench or stand. In particular, the type described in the cited utility model No. 213444 can be used.

Claims

1. A bending machine (10) of the type provided with a motorized shaft (70), characterised by comprising an auxiliary mechanism (86, 88, 90) for transforming the rotary movement of the shaft (70) into a reciprocating movement for operating additional devices (152, 152'; 154, 154') which form part of the bending machine or can be fitted thereto for performing supplementary operations.
2. A bending machine (10) as claimed in claim 1, characterised in that the shaft (70) comprises an eccentric portion (86) parallel to the shaft (70), there being provided a cam follower element (88) which is movable only in a direction perpendicular to the axis of the eccentric portion (86).
3. A bending machine (10) as claimed in claim 1, characterised in that the motorized shaft (70) operates a connecting rod/crank mechanism.
4. A bending machine (10, 10') as claimed in any one of the preceding claims, characterised in that the additional device, operated by the reciprocating movement obtained by the auxiliary mechanism, is a device (152; 152') for widening the end of a pipe (98, 98").
5. A bending machine (10') as claimed in any one of claims 1 to 3, characterised in that the additional device is a device (154; 154') for flanging the end of a pipe (98', 98").
6. A bending machine as claimed in any one of claims 1 to 3, characterised in that the additional device is a device for punching pipes or metal sheets.
7. A bending machine (10) as claimed in claim 4 and dependent on claim 2, characterised in that the cam follower (88) (conveniently) comprises a coaxial conical point (106) for insertion into a seat (156) provided in a cylindrical unit coaxial to said point and formed of several wedge elements (108) which move radially as a result of the insertion of the point (106) into its seat (156).
8. A bending machine (10') as claimed in claim 5 or 6, characterised in that to the cam follower element there is fixed a punch (124"; 124, 124') of the type suitable respectively for flanging and widening the end of a pipe (98"", 98', 98"), said end being retained coaxial to the punch by a clamp (132), the clamp (132) being connectable to the bending machine (10').
9. A bending machine (10') as claimed in claim 8, characterised in that the clamp (132) comprises a plurality of seats (134, 136, 138) for receiving pipes of various diameters.
10. A bending machine as claimed in claim 2, characterised in that to the cam follower element there is fixed a coaxial punch suitable for punching pipes or metal sheets, these latter being maintained in position during punching by a clamp connectable to the bending machine.

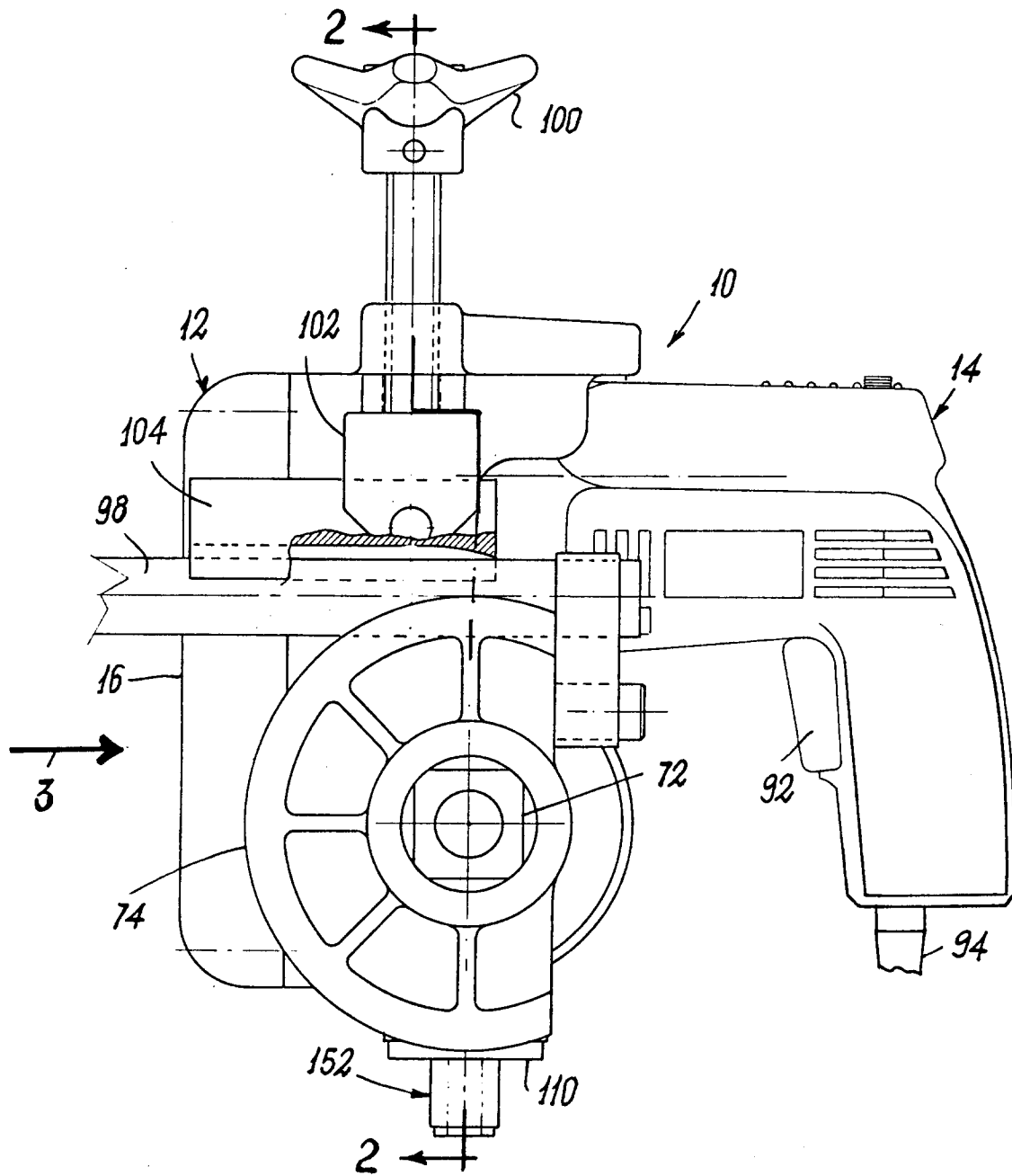
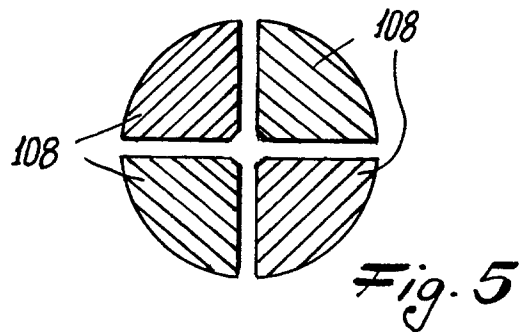
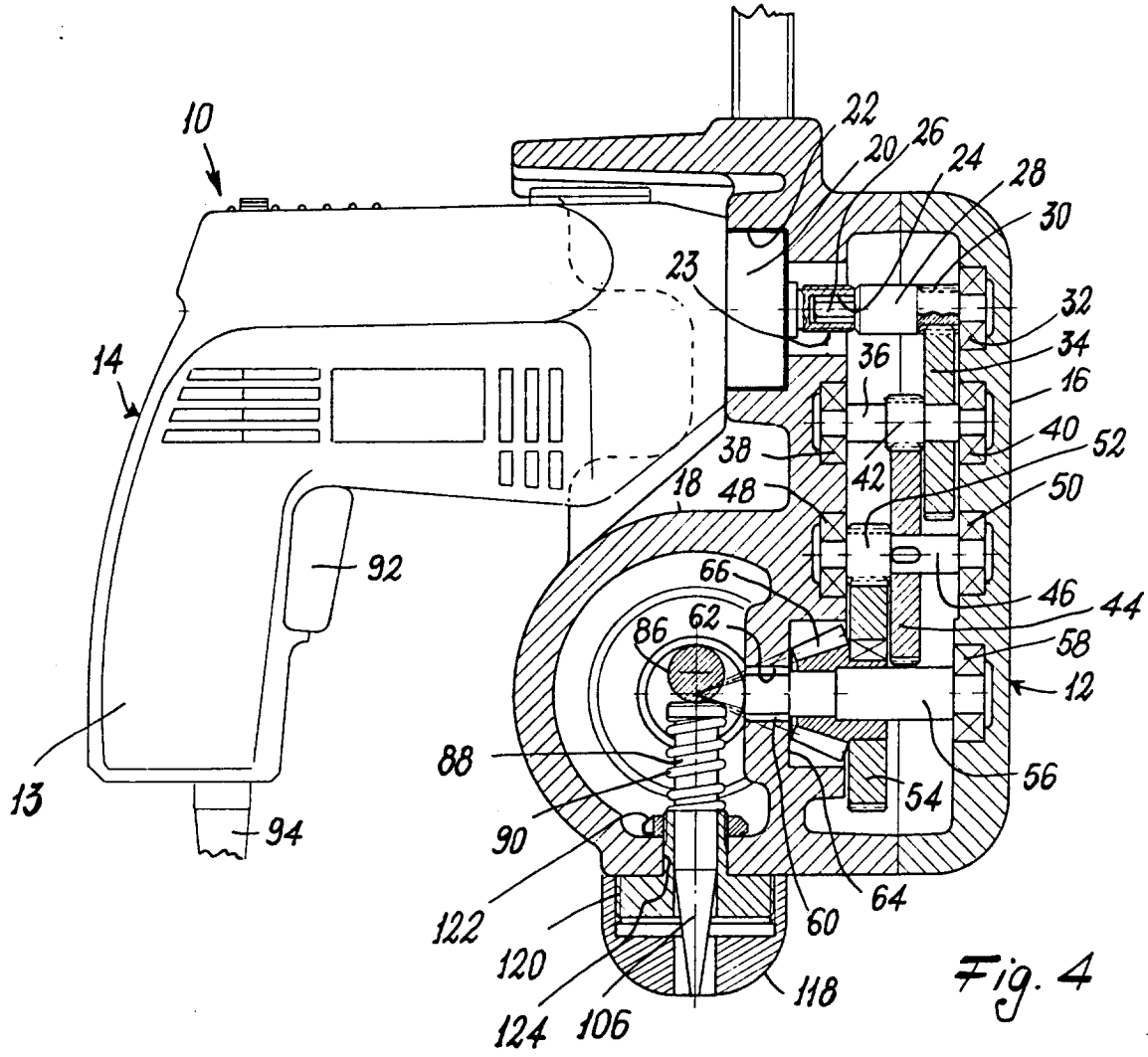


Fig. 1



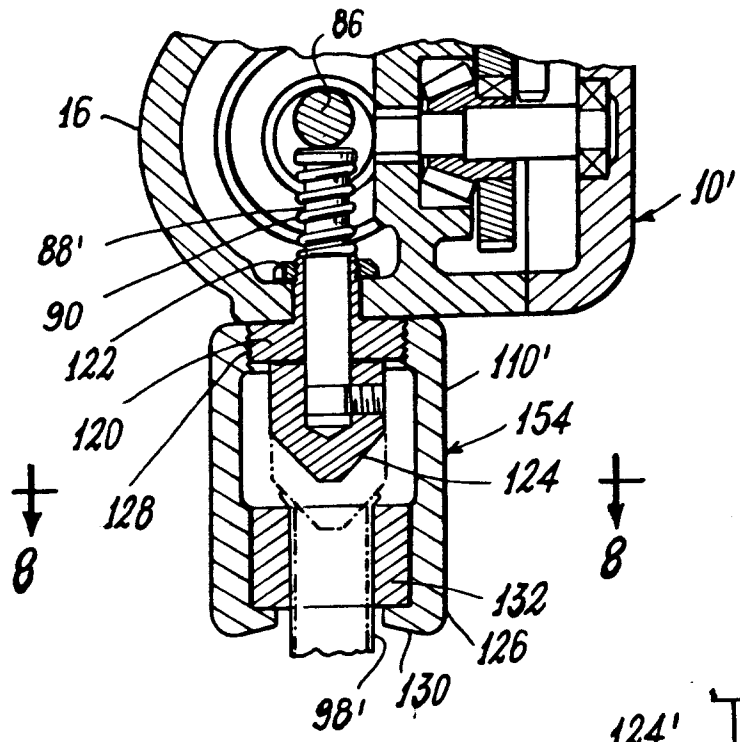


Fig. 6

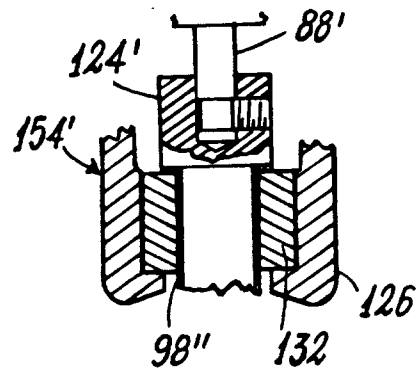


Fig. 7

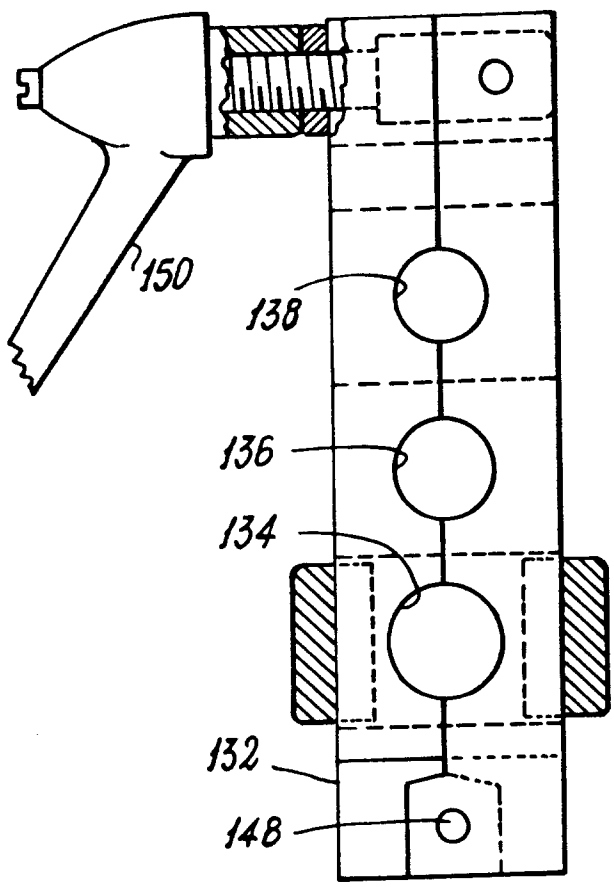


Fig. 8

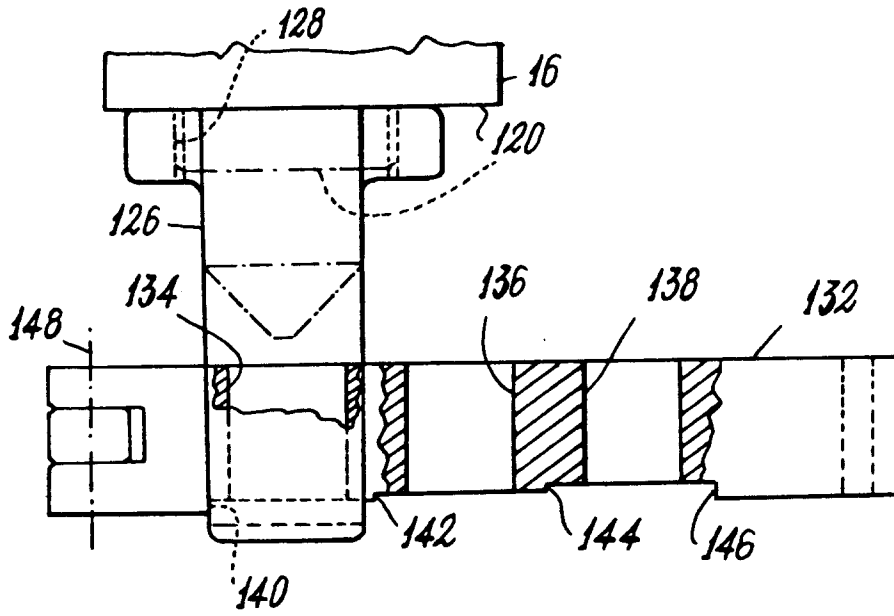


Fig. 9

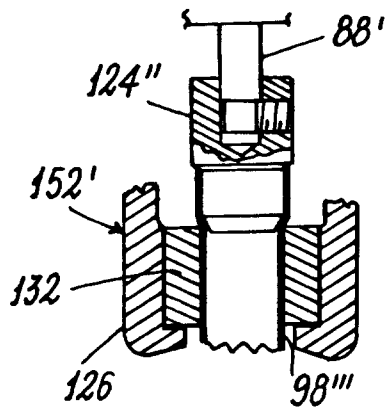


Fig. 10



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.5)
A	FR-A-2 483 271 (GATEAU INTERNATIONAL) * page 4, line 28 - page 5, line 27; figure *	1,4,5,8, 9	B21D7/06 B21D41/02
A	FR-A-2 478 498 (LE PIROL) * page 2, line 29 - page 5, line 34; figures *	1,4,5,7	
A	DE-A-3 925 950 (WORLEIN) * figure *	1	
A	EP-A-0 004 858 (BELOTTI) * page 5, line 3 - page 6, line 12; claim 1; figures *	1	
A	GB-A-121 705 (GREENWOOD AND BATLEY LTD) * page 1, line 18 - line 22; figure 1 *	2	
A	GB-A-509 188 (MANNESMANNRÖHREN-WERKE) * figure 1 *	3	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B21D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 16 DECEMBER 1992	Examiner BARROW J.
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	