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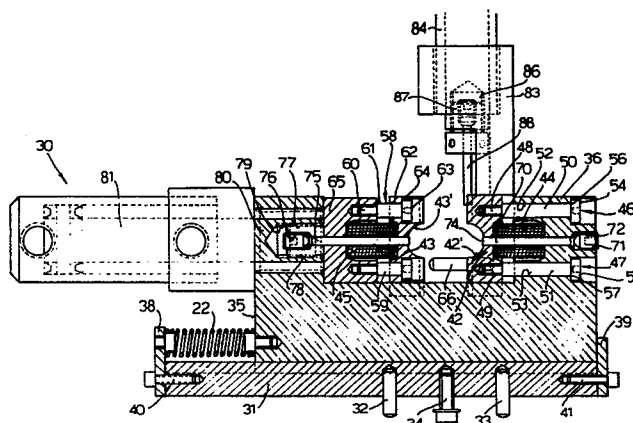
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⑤④ **A tube punching and/or bending assembly, particularly for punching holes having axes transversely to one another and/or for bending a tube with curves not coplanar to one another.**

⑤⑦ A tube punching assembly comprises a pair of jaws (42, 43) movable relatively to each other in a first direction to clamp an interposed tube; and a frame (83) integral with one of said jaws and carrying a rod or stem (84) movable in a second direction transverse to said first direction. Said rod carries a piercing punch (88) or a tube bending pad. One or both jaws are provided with openings for allowing the operation of said punch, and/or with a particular shape for cooperation in tube bending. Preferably, each jaw is provided with a punch (70, 75) which is movable in said first direction relative to the jaws. The jaws are carried onto a movable body (35) on a base (31).



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"A TUBE PUNCHING AND/OR BENDING ASSEMBLY, PARTICULARLY FOR
PUNCHING HOLES HAVING AXES TRANSVERSELY TO ONE ANOTHER AND/OR
FOR BENDING A TUBE WITH CURVES NOT COPLANAR TO ONE ANOTHER"

This invention relates to the punching of tubular elements
and/or bending or curving thereof.

For various requirements, particularly in furnishings art,
tubular bodies or pieces are required provided with one hole,

5. or with two diametrically opposite holes or with a plurality
of holes at one or more locations. It is well known (see
U.S. Patent Specifications Nos. 3,971,275 and 2,844,204)
to provide holes in a tubular body by a single punch, which

punches or pierces the tubular body wall at one location.

From said patents it is also well known to provide diametrically opposite holes in a tubular body by first piercing a first hole at one location in the body wall and then immediately

5. piercing a second hole at a diametrically opposite location in the wall, the tubular body being clamped between jaws, of which at least one jaw is movable in the same direction as the punch. This technique has a number of drawbacks. It has the trend to deform the tube, it generally leaves a burr
10. at the second hole, and it often occurs that the metal slug or small disk sheared in the first punching step remains stucked on the punch at the time of the second punching step, thus resulting in an inaccurate and irregular second hole.

The above mentioned U.S. Patent Specification No. 2,844,204

15. also discloses an operation as above cited, which is carried out simultaneously at a plurality of locations along the tubular body.

The U.S. Patent Specification No. 3,234,838 discloses a machine for simultaneously piercing a tube at diametrically

20. opposite locations by two aligned punches which move within two jaws; the jaws in turn are movable near and away to each other, and said punches move in the same direction as the jaws.

An earlier patent application of the same applicant describes

25. a machine comprising, in a single operative assembly, a plurality of pairs of jaws and relative punches acting on diametrically opposite locations of a tubular work-piece,

each pair of jaws being mounted on a body, which is movable on a base or mount.

- Hitherto the problem has not been yet dealt with of providing holes in a tubular piece in a single working or operating
5. assembly, which holes have their axes transversely to one another. Till now, tubular pieces in which holes had to be pierced with axes placed transversely to one another were placed on a machine, such as that of the above mentioned patents, in which a first series of holes was carried out;
 10. then such pieces were retaken and repositioned as rotated in the same machine, or in a similar machine, for carrying out a second series of holes. It clearly appears that such a technique has the disadvantage of a relatively long working time, which is required for repositioning.
 15. A similar problem arises in connection with those tubular pieces which require, in addition to holes, to be provided with small curves, in case in planes transverse to one another, such as end curves in a transverse plane relative to a plane containing intermediate curves. According to a technique at
 20. present in use, after piercing or punching operations such pieces are retaken and positioned on a bending machine, where they are curved or bent.

- Therefore, an object was to provide an apparatus enabling to pierce holes in a tubular piece with coincident axes and
25. holes with axes transversely to one another, said apparatus possibly being able also to carry out curves lying on planes not coincident with one another, in a single working

station, without any need of moving or displacing the tubular element.

The foregoing objects have been achieved by the present invention, which substantially provides a tube punching and/or

5. bending assembly, comprising a pair of tube gripping jaws relatively moving toward and away from each other in a first direction, said apparatus including a toolholder rod movable in a second direction transvers to said first direction, and comprising an opening or slot in said jaw or
10. jaws of such a size as to allow the passage of a tool carried by the said rod.

The invention also provides a tube punching assembly, comprising: a pair of tube gripping jaws, relatively movable toward and away from each other in a first path line or direction;

15. two punches disposed and movable in said first direction; and a frame integral with one of said jaws, which frame is for a toolholder rod movable in a second direction which is transverse to the first direction; an opening in said jaw or jaws allows the passage of a tool carried by said rod. The
20. toolholder rod may be provided with either a punch for tube punching, or a bending pad for tube bending. The jaws may be straight or curved for providing a curve in the tube, in a per se known manner.

The punching and bending assembly according to this invention

25. allows to obtain substantial savings in working times and required labour, thus affording a considerable reduction in

production costs and also an increased accuracy in the obtained product.

A detailed description of exemplary embodiments of the present invention will now be given with reference to the accompanying drawings, in which:

5. Fig. 1 is a perspective view of an exemplary tubular element or piece involving the execution of holes and curves which are not coplanar to each other;
10. Fig. 2 is a cross-sectional view through a tubular piece having a pair of coaxial holes and at least one hole at an axis transverse to the axis of said pair;
- Fig. 3 is a fragmentary perspective view showing two jaws and a supporting frame for a punch implement for providing holes with axis transverse to the jaw movement;
15. Fig. 4 is a front part sectional view of a punching assembly taken on a vertical plane containing the punch axis, said assembly punching a plurality of holes with axes transversely of one another;
- Fig. 5 is a plan view of the assembly shown in fig. 4;
20. Fig. 6 is a schematic view of a modified embodiment of the assembly shown in Fig; 4;
- Fig. 7 is a perspective view similar to that of Fig. 3 showing a transverse casing or frame unit and relative jaws, the whole modified to provide an end bending on the tubular element;
25. Fig. 8 is an enlarged perspective view of a bending pad;
- Fig. 9 is a perspective view similar to that of Fig. 3 of a curved jaw unit or assembly; and

Fig. 10 is a schematic plan view showing a plurality of punching and or bending assemblies mounted onto a machine for processing a tube, such as that shown in Fig. 1.

- Fig. 1 shows an exemplary tubular piece 1 which, for example,
5. could be a leg element of an openable clothes hanger. Metal tubular elements or pieces are variously used, for example in the furnishings art, as chair and table legs, structural elements for beds, etc. At lengthwise spaced apart position, said piece 1 has pairs of diametrically opposite holes 2, 2',
 10. more clearly shown in Fig. 2, and one or more holes 3, an axis of hole 3 is at right angles or generally transverse to the axis of holes 2, in a plane containing said axis of holes 2, or in an offset plane. Said element 1 also has curved end portions 4, whose centerlines lie on plans transverse to a
 15. plan defined by a centerline of the remainder of element 1.

For working the tubular element 1 on a single machine without any intermediate repositioning, a punching assembly has been conceived, a first embodiment of which is shown in schematic perspective view in Fig. 3.

20. The assembly 10 shown in Fig. 3 comprises a pair of jaws 11 and 12, both of which are provided with a longitudinal slot 13 and 14, respectively, for accommodating a tubular element or tube such as 1, not shown in this figure. Each of the jaws are resiliently restrained by spring elements 16 to a respective
25. plate 11', 12'. In any per se known manner, said jaws 11 and 12 can be moved near each other to clamp the tube, and away from each other to release the tube. Generally, only one jaw,

- such as 12, will be movable along with the relative plate to and fro in a direction indicated by arrow A in Fig. 3; while the other jaw 11 will only be shifted by slight resilient adjustments relative to its own plate. Guide elements for the jaws are denoted at 15. As to any further detail of construction, reference is made to the later description for the embodiment shown in figs. 4 and 5.
- 5.

- One of the jaws, generally jaw 11, has secured thereto a casing or frame 18 carrying a sliding rod 19 under the control of a jack or cylinder-piston assembly 20. Said rod 19 may terminate with a punch (not shown) and operates moving along according to an axis 22, which is transverse with respect to a first direction which is the jaw movement direction; in this particular case axis 22 is at right angles thereto. For the operation of the punch, each jaw has an opening or notch respectively 23 for jaw 11 and 24 for jaw 12, of a sufficient size for the punch to pass therethrough. Of course, when a hole has to be pierced in the tubular element 1, at an axis which is not perpendicular to the jaw movement direction, but inclined at any angle thereto, a suitable modified frame could be provided (as hereinafter explained), so that the punch can operate along the desired axis.
- 10.
- 15.
- 20.
- 25.
- Similarly, it should be noted that the opening comprising said notches 23 and 24 can be provided in a single jaw and be of any shape, provided that it would allow for the punch passage.

Figs. 4 and 5 particularly show a punching assembly 30 having a plurality of punches, at least one of which has its axis

transverse to the others. It comprises a mount 31, intended to be mounted onto a bench, not shown, by means of two pins 32 and 33 and a setting screw 34.

- A body 35 of the punching assembly is slidable on said mount
5. 31 through a relief guide (not shown) on mount 31 and a corresponding groove on body 35. Two shoulders 38 and 39, secured by screws 40 and 41, provide for limiting the sliding travel of body 35 on mount 31.

- Said body 35 carries a plier member having two jaws 42 and
10. 43. each jaw has a slot or recess 42' and 43', respectively, for receiving a tube to be pierced. Through a resilient elastomeric spring element 44 said jaw 42 bears against an extension 36 of body 35, while said jaw 43 bears against a plate of punch holder 65 through an elastomeric element 45.
15. The jaw 42 is mounted on the extension 36 by two screws 46 and 47, the threaded ends 48 and 49 of which are screwed in the jaw and the unthreaded portions 50 and 51 slidably engage in passages 52 and 53 in body 35. The enlarged heads 54 and 55 of screws 46 and 47 will rest against inner shoulders
20. 56 and 57 of said passages 52 and 53.

- The jaw 43 is mounted on the punch holder 65 by means of screws 58 and 59. Since this type of mounting is identical for each screw, hereinafter only screw 58 will be described. This screw 58 has a threaded end 60 screwed in the punch holder 65
25. and an unthreaded portion 61 engaged within a passage 62 of jaw 43. The enlarged head 63 of screw 58 bears against an inner

shoulder 64 of passage 62. The screws 46 and 47, 58 and 59 also provide for tensioning the springs 44 respectively 45, and further act as guides for the jaws in the movement thereof relative to said body 35 respectively punch holder

5. 65, limiting the travel of the jaws with respect to the body and punch holder by bearing of the enlarged heads on the corresponding shoulders.

- Two guide spokes 66 and 67 (Fig. 5) are mounted on jaw 42 and jaw 43 has two correspondig holes 68 and 69 to ensure a
10. guide for the movement of the jaws relative to each other. Such guide spokes also provide for preventing a tube to be punched from falling on the bottom of jaws 42 and 43.

- A first punch 70 is mounted on the extension 36 of body 35, and a punch head 71 is retained by a thread 72. Punch 70
15. passes through said body 35 and jaw 42, so that when the punching assembly is at rest, a shearing tip 74 of the punch is flush with an inner surface of the jaw.

A second punch 75 is mounted on said punch holder 65 and passes through jaw 43.

20. This punch 75 is made integral with the punch holder 65 by a locking thread 76 screwed in an internal thread of a threaded ring extension 77 of the punch holder. This threaded ring 77 also has an external thread 78, by which it is screwed in a threaded recess 79 of an end of a stem 80 of
25. a hydraulic jack or cylinder-piston control unit 81 integral with body 35.

A casing or frame 83 is mounted on an extension of jaw 42 and made integral with said extension. The frame 83 carries a jack or cylinder-piston control unit 84, a piston stem 85 of which has an end internally threaded at 86 for engagement

5. of a ring 87 retaining a punch 88. Of course, other connecting means between said punch 88 and relative control unit 84 could be provided. The jaws 42 and 43 at a position corresponding to punch 88 are made with opposite notches 91, 92 of such a size as to provide a sufficient opening for the passage of

10. said punch 88, when the jaws are at a position close to each other. In Figs. 4 and 5 the third punch 88 has been shown arranged at right angles to the operating or movement line of punches 70 and 75, and it operates moving in a vertical plane spaced apart with respect to a vertical plane containing the axes

15. of the first two punches. Of course, for particular purposes, frames could be provided in which the third punch would operate moving along any axis which is skew to the operating line of the first two punches. An assembly with a third punch at an axis which is not orthogonal to the first two punches is

20. schematically shown with closed jaws in Fig. 6, in which parts corresponding to those of Figs. 4 and 5 have been denoted with the same reference numerals followed by letter "a" and will not be described in detail. Thus, the assembly 30a comprises two opposite jaws 42a and 43a, of which jaw 42a bears against

25. a body 35a through resilient or spring element 44a, while jaw 43a bears against punch holder 65a through resilient or spring element 45a. Two coaxial punches are shown at 70a and 75a, and the third punch at 88a, the latter being inclined relative to an hypothetical line at right angles to the axis

30. of the other two punches. A casing or frame for the third punch

is denoted by reference numeral 83a; a control unit for the two aligned punches is denoted at 81, and a control unit for the transverse punch is denoted at 84a.

Hereinafter the operation of the apparatus will be described

5. with reference to Figs. 4 and 5, it being understood that upon change of the reference, the foregoing also applies to Fig. 6.

A tube T is placed between the spaced apart jaws 42, 43 (or 42a, 43a). The cylinder-piston assembly 81 (81a) is operated.

10. Under the action of stem 80 (80a) the jaw 43 (43a) is moved towards the jaw 42 (42a) until the jaws are brought in contact with each other and the punches 70 and 75 (70a and 75a) are in contact with an outer surface of the tube. Then, the piston of assembly 81 continues to move forward, squeezing or pressing
15. spring 45, (this being limited by the contact between the jaw 43 and punch holder 65) and sinking the punch 75 in tube T until the latter is punched. Should the tube be not fixed, i.e, should the tube be able to move along the axis of the aligned punches, when pushed by the jaws, the increased
20. pressure in the cylinder-piston assembly results in retraction (to the right as seen in Fig. 4) of the jaw 42, squeezing of spring 44 (limited by the contact between said jaw 42 and extension 36 of body 35), sinking of punch 70 in the tube and punching thereof.
25. Actually two holes are pierced in a tube at a same time, one hole by punch 70 and the other by punch 75.

- At this point the operation of the third punch 88 is controlled by delayed action cylinder-piston assembly 84, after the closing of jaws 42 and 43. Once the holes have been punched out, pressure automatically falls in the cylinder-piston
5. assemblies 81, 84 (or 84a), for example by means of a timer mechanism, and the springs 44 and 45 release, such a release being limited by the pairs of screws 46, 47 and 58, 59. If the tube T is fixed, as is the case when tube T is V-shaped and the holes have to be adjacent to the curves, from the
 10. time at which the two jaws contact under the action of the cylinder-piston assembly 81, the increase in the pressure exerted by the cylinder-piston assembly results on one hand in the displacement (to the right as seen in Fig. 2) of the punch holder 65, this resulting in tube piercing by the
 15. punch 75, with squeezing of spring 45 limited by the contact between said jaw 43 and punch holder, and on the other hand in the sliding (to the left as seen in Fig. 2) of body 35 and tube piercing by the punch 70, with squeezing of spring 44 limited by the contact between said jaw 42 and body 35.
 20. The sliding of body 35 on the guide member results in compression of a return spring 82 provided between said body 35 and shoulder 38 of mount 31.

- When the pressure falls in the jack or cylinder-piston assembly 81, the jaws open again and body 35 moves back to
25. the initial position under the action of return springs (not shown) or cylinder-piston assembly 81, when the latter is of double acting type.

The machine may be provided with curved jaws, as seen in

plan view for providing a slight curve, as described in the above mentioned earlier patent application of the same applicant.

Fig. 7 shows a modified embodiment of the assembly of

5. Fig. 3. In the assembly 120 of fig. 6, the jaws 121 and 122 have respective slots 123 and 124 configurated at one end with a downwardly curved lower portion 123' and 124', respectively. A frame 125 for a rod 126 is movable vertically or generally transversely of the jaw movement under the control
10. of the cylinder-piston assembly 127. A bending member 130 is made integral at the lower end of rod 126. This bending member, shown in Fig. 8, substantially comprises a block 131, having hingedly connected thereto at 132 a pad 133, the latter being generally curve shaped at the bottom at 134 for
15. matching with the surface of the tube to be bent. The jaws have notches or generally removed portions 135 and 136, respectively, for operation of said member 130. For any other constructive detail, reference is made to the preceding assemblies.
20. Fig. 9 shows a further modified embodiment of the assembly. In the assembly 160 of Fig. 9, jaws 161 and 162 have cavities 163 and 164 that in plan view are of curved shape, so as to provide in a tube a bending, simultaneously with the punching operation, in a plane according to approaching direction of
25. the jaws. In Fig. 9 reference numeral 165 designates mutual positioning spokes for the jaws; reference numeral 169 designates a vertical punch on the relative casing or frame 168, reference numerals 173 and 174 designate slots for operation

- of the vertical punch, and reference numerals 180 and 181 indicate the centerlines for two horizontal punches. For any other detail of assembling and operation of said jaws and punches reference is made to the embodiment of Figs. 4 and 5.

- Fig. 10 shows a bench 140 whereon eight punching/bending assemblies are mounted, some of them being for punching aligned holes, and some for punching holes having axis transverse to the aligned holes. The cylinder-piston control assemblies are parallel connected to a same hydraulic control, not shown. An U-shaped tube T is placed in these assemblies to be punched simultaneously at various locations therealong (so as to provide holes in it having centerlines transverse to each other), and to be bent in the plane where it lies and/or in a plane transverse to said plane.

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C L A I M S

1. A tube punching and/or bending assembly, comprising a pair of tube gripping jaw (11, 12; 42, 43; 42a, 43a; 121, 122; 161, 162) relatively movable towards each other according to a first direction, characterized by including a toolholder .
5. means (19, 84, 87; 126) movable according to an axis transverse to said movement direction of the jaws, and comprising an opening (23, 24; 91, 92; 135, 136; 173, 174) in said jaw or jaws of a size for the passage of a tool carried by the means.
10. 2. An assembly according to Claim 1, characterized in that said tool is a punch (19; 88; 88a).
3. An assembly according to Claim 1, characterized in that said tool is a bending pad (133) and said jaws are configured with tube gripping slots (123', 124') shaped
15. according to a curved shape to be given to the tube.

4. A tube punching assembly, comprising a pair of tube gripping jaws (42, 43; 42a, 43a) relatively movable towards each other according to a first direction, two punches (70, 75; 70a, 75a) arranged according to the axis of movement
5. for said jaws, characterized by further including a casing or frame (83; 83a) integral with one of said jaws, which casing or frame is for a toolholder rod (87; 87a; 126) movable according to an axis transverse to said movement direction for the jaws, and comprising an opening (91, 92)
10. in said jaw or jaws of a size for the passage of a tool (88; 88a; 133) carried by the rod.

5. An assembly according to Claim 4, characterized in that said tool is a punch (88, 88a).

6. An assembly according to Claim 4, characterized in
15. that said tool is a bending pad (133) and said jaws (121, 122) are configured with tube gripping slots (123, 124) shaped according to the curved shape to be given to the tube.

7. An assembly according to Claim 4, characterized in that said jaws are carried onto a body (35) and movable
20. relative thereto, said body being movable on a base mount (31).

8. An assembly according to Claim 1 or Claim 4, characterized in that said jaws (161, 162) have slots (163, 164) configured with a curved shape in a plane developed according to the approaching direction for the jaws.

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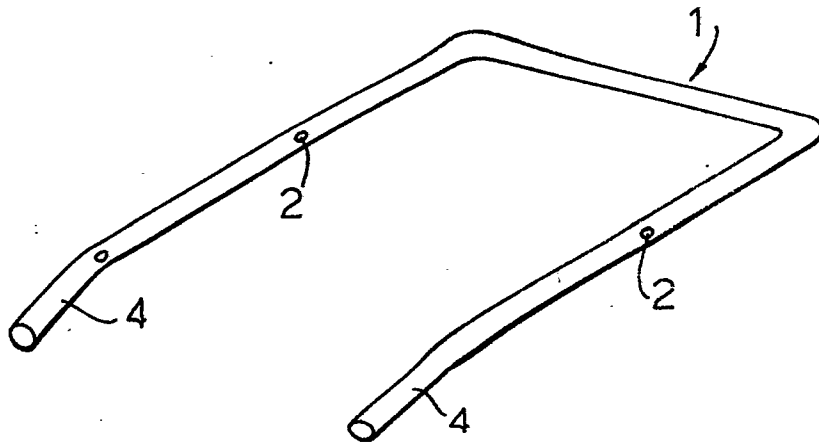


FIG. 1

FIG. 2

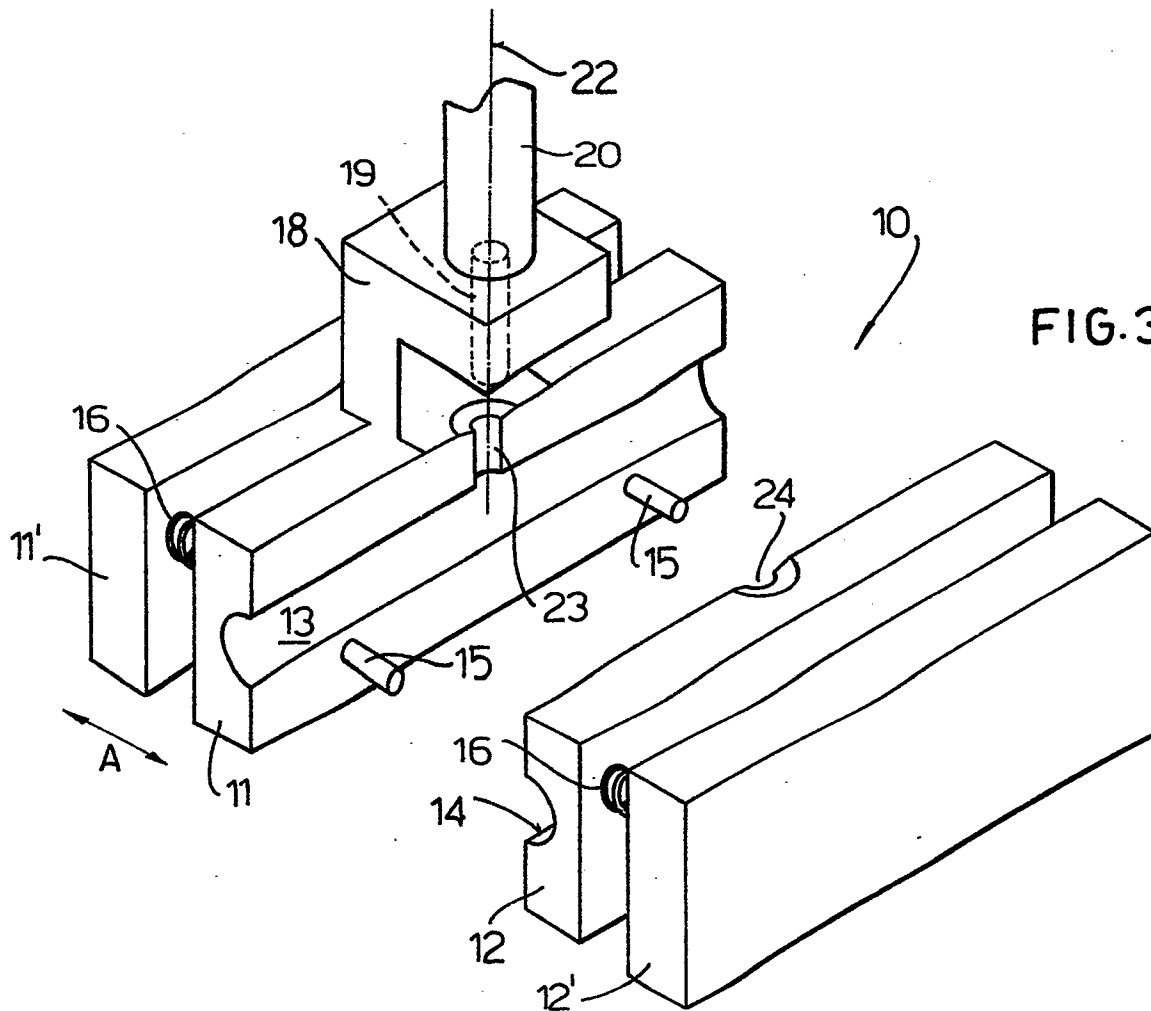
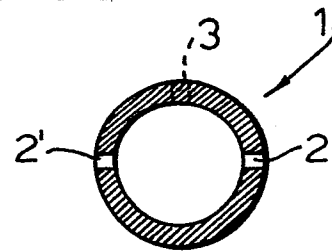


FIG. 3

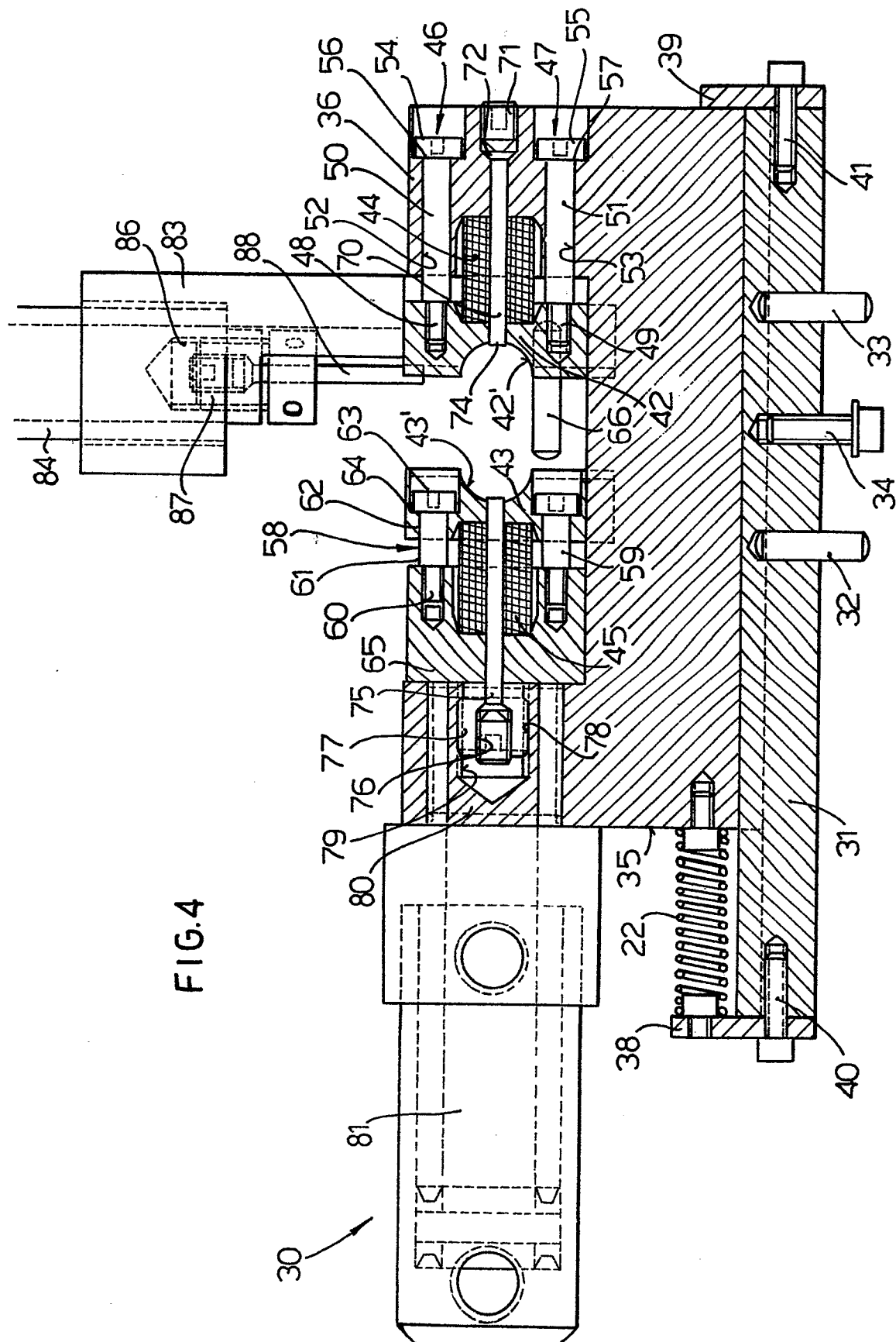
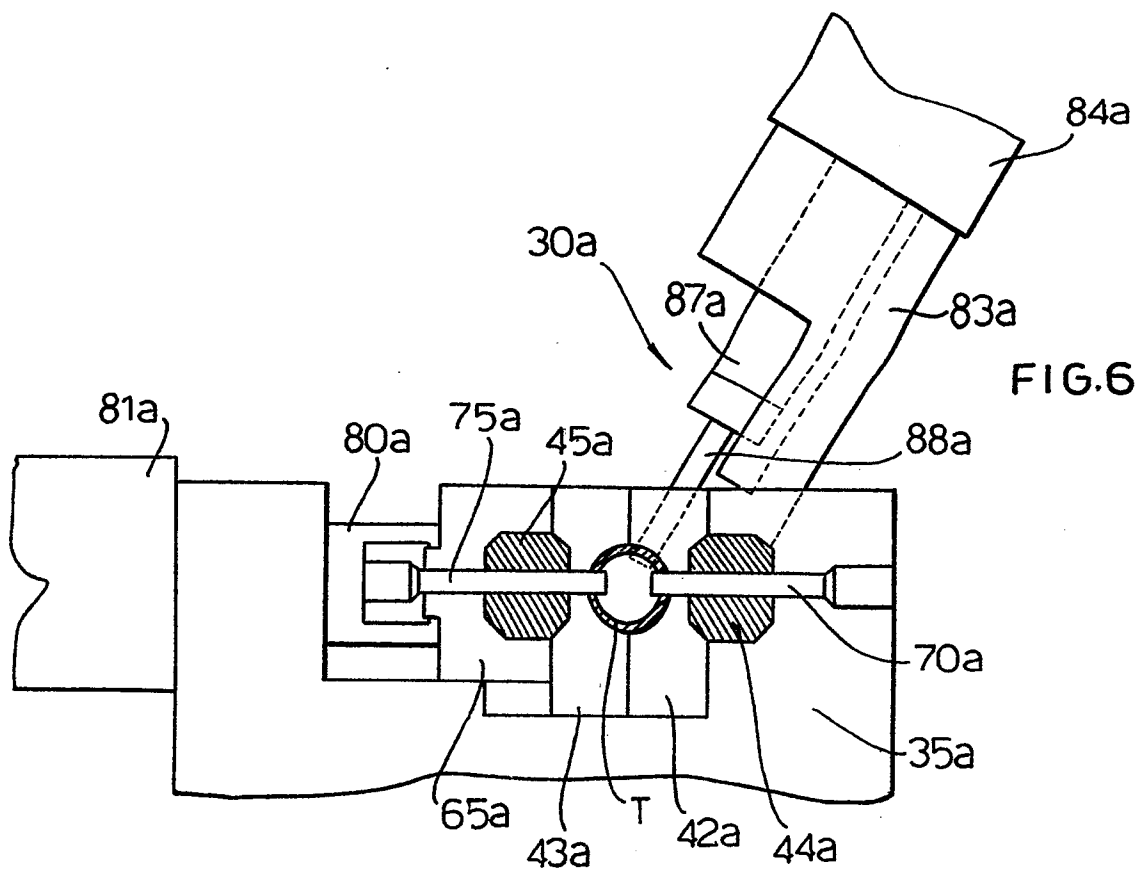
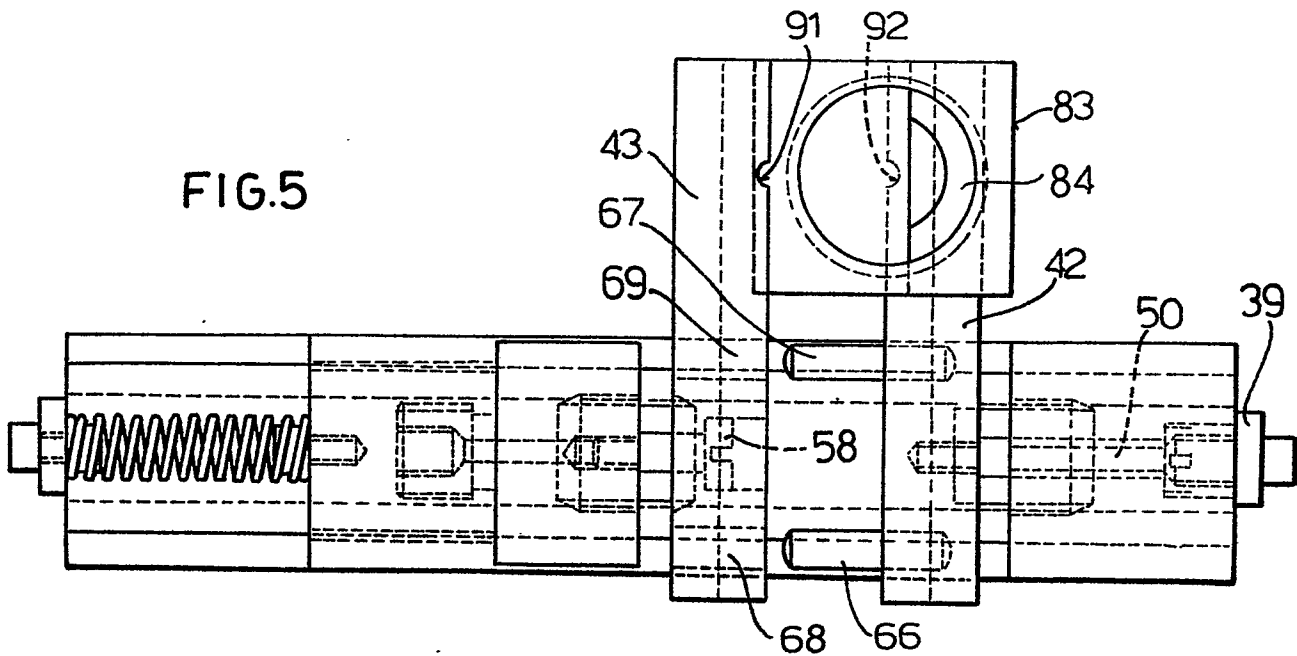
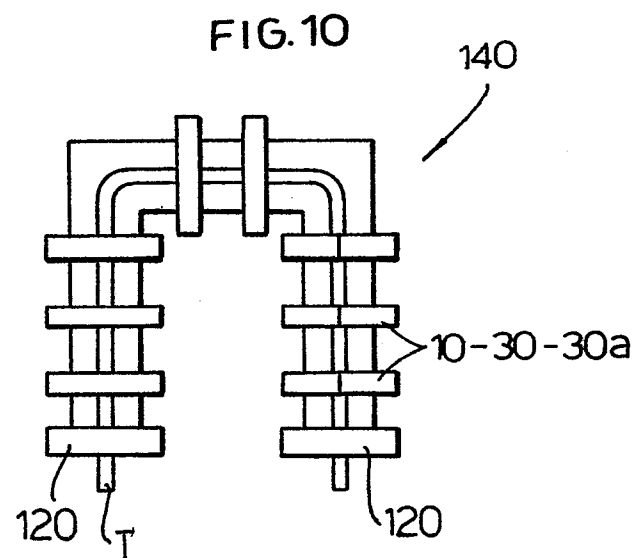
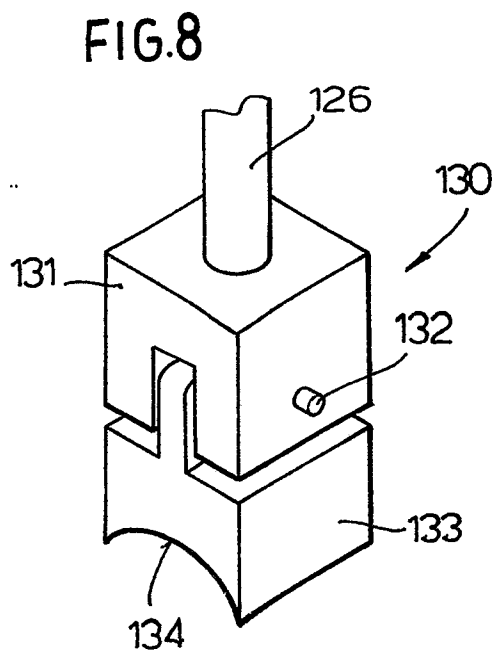
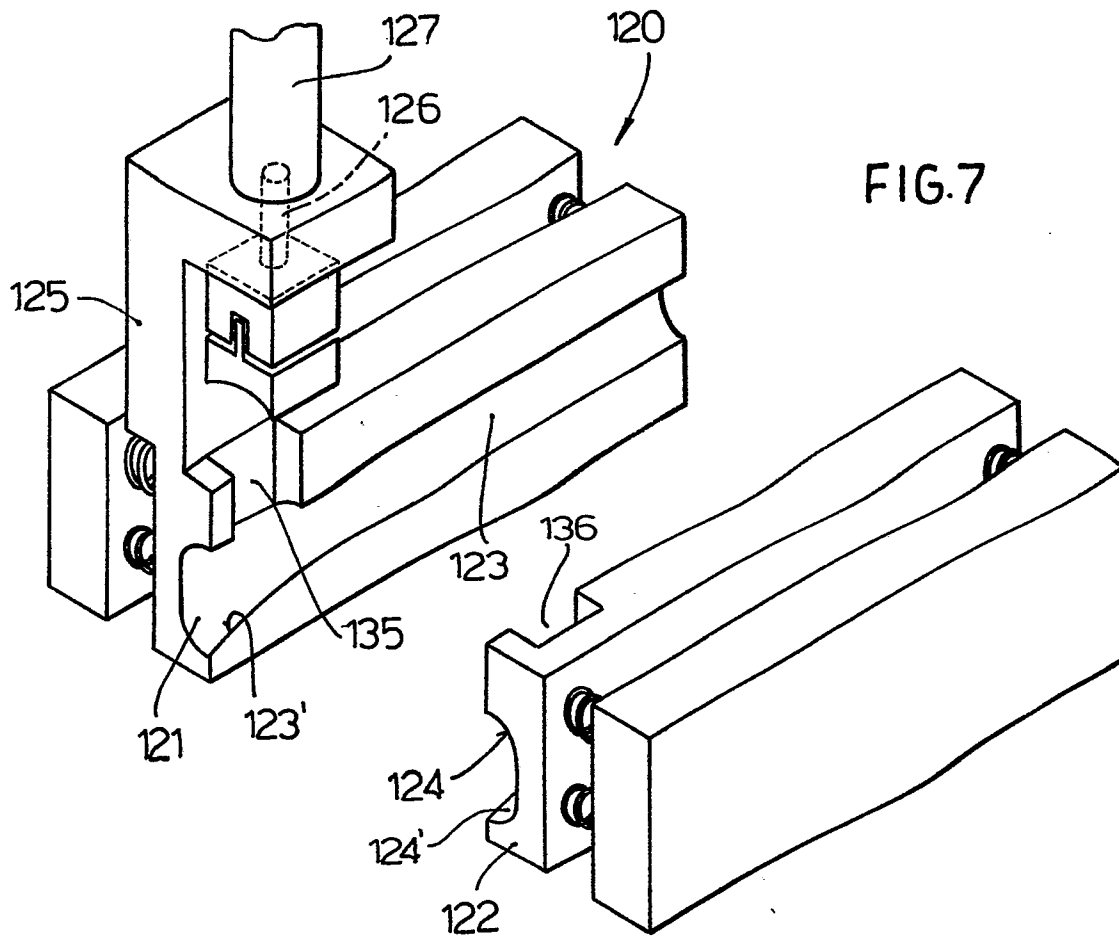


FIG.5







European Patent
Office

EUROPEAN SEARCH REPORT

0088152
Application number

EP 82 10 6553

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. ³)
D,A	US-A-3 234 838 (FAULL)		B 21 D 28/28
D,A	US-A-3 971 275 (MACH)		
D,A	US-A-2 844 204 (BEEBEE)		
Y	DE-B-2 330 224 (OLTMANN) * Claim 1; figure 2 *	1-3	
Y	US-A-1 812 046 (GROEHN) * Figures 1, 3, 11; claims 1, 2 *	1-3	
Y	DE-A-3 020 545 (BEBI) * Claim 1; figures 1, 9 *	1-3	
A	FR-A-2 416 063 (MATTHEY-DORET) * Figure 2; claim 1 *	1	
A	US-A-2 556 987 (STOUDT) * Figures 1, 5 *		
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 09-05-1983	Examiner SCHLAITZ 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			