COMMONWEALTH of AUSTRALIA

PATENTS ACT 1952

598202

APPLICATION FOR A STANDARD PATENT

XX
We TRUMPF GMBH & CO.,
of Pos fach 1320,
7257 Ditzingen,
FEDERAL REPUBLIC OF GERMANY

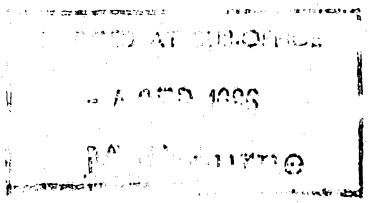
hereby apply for the grant of a Standard Patent for an invention entitled:

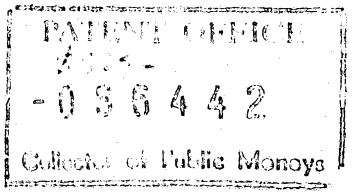
"BENDING PRESS"

which is described in the accompanying ~~provisional~~ complete specification.

Details of basic application(s):—

Number	Convention Country	Date
P 35 33 235.2	FEDERAL REPUBLIC OF GERMANY	18th September 1985





The address for service is care of DAVIES & COLLISON, Patent Attorneys, of 1 Little Collins Street, Melbourne, in the State of Victoria, Commonwealth of Australia.

Dated this 4th day of September 19 86

H. M. Rimington

To: THE COMMISSIONER OF PATENTS

.....
(a member of the firm of DAVIES & COLLISON for and on behalf of the Applicant).

Davies & Collison, Melbourne and Canberra.

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

DECLARATION IN SUPPORT OF CONVENTION OR NON-CONVENTION APPLICATION FOR A PATENT

In support of the Application made for a patent for an invention entitled: "BENDING PRESS"

Insert title of invention.

I
~~We~~ Hubert Bihel
of, TRUMPF GMBH & CO.
of, Postfach 1320
7257 Ditzingen
Federal Republic of Germany

Insert full name(s) and address(es) of declarant(s) being the applicant(s) or person(s) authorized to sign on behalf of an applicant company.

APPLICATION ACCEPTED AND AMENDMENTS ALLOWED 6-4-90

do solemnly and sincerely declare as follows :-

1. (a) ~~I am~~ / ~~We are~~ ~~the applicant ..... for the patent~~ ;

Cross out whichever of paragraphs 1(a) or 1(b) does not apply

1(a) relates to application made by individual(s)
1(b) relates to application made by company; insert name of applicant company.

or (b) I am authorized by

TRUMPF GMBH & CO.

the applicant..... for the patent to make this declaration on ~~its~~ / ~~their~~ behalf.

2. (a) ~~I am~~ / ~~We are~~ ~~the actual inventor ..... of the invention~~ -

Cross out whichever of paragraphs 2(a) or 2(b) does not apply

2(a) relates to application made by inventor(s)
2(b) relates to application made by company(s) or person(s) who are not inventor(s); insert full name/s) and address(es) of inventors.

or (b) Hans KLINGEL
of, 7141 Moglingen
Teckstr. 91
Federal Republic of Germany

~~is~~ / ~~are~~ the actual inventor..... of the invention and the facts upon which the applicant..... ~~is~~ / ~~are~~ entitled to make the application are as follows :-

State manner in which applicant(s) ive title from inventor(s)

The applicant would, if a patent were granted upon an application made by the said inventor, be entitled to have the patent assigned to it.

Cross out paragraphs 3 and 4 for non-convention applications. For convention applications, insert basic country(s) followed by date(s) and basic applicant(s).

3. The basic application..... as defined by Section 141 of the Act ~~was~~ / ~~were~~ made
in Federal Republic of Germany on the 18th September, 1985
by TRUMPF GMBH & CO.
in ..... on the .....
by .....
in ..... on the .....
by .....

4. The basic application..... referred to in paragraph 3 of this Declaration ~~was~~ / ~~were~~ the first application..... made in a Convention country in respect of the invention the subject of the application.

Insert place and date of signature.

Declared at ~~Sept. 23~~ Ditzingen this 23. day of September 1986

Signature of declarant(s) (no attestation required)

TRUMPF GmbH + Co.
i.V. Hubert Bihel

Note: Initial all alterations.

DAVIES & COLLISON, MELBOURNE and CANBERRA.

(12) PATENT ABRIDGMENT (11) Document No. AU-B-62445/86
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BENDING PRESS

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DE 3407445
US 4510789

(57) Claim

1. A bending press comprising a top tool and a bottom tool adapted to interact with the top tool, an adjustable first stop and an adjustable second stop positioned opposite to and in the same co-ordinate direction as the first stop, the first and second stops being adapted for adjustment in a direction substantially perpendicular to the direction of feed of the top tool by means of a drive motor, a program control means operable to actuate the drive motor, and a supporting device for supporting the workpiece comprising two partial support devices positioned on either side of the bending press, each partial support device being adapted to be lifted or lowered individually across the direction of movement of the adjustable first and second stops by means of controllable motors, the controllable motors being actuable by means of the program control means, the top and bottom tool being further adapted to be detachably held in respective tool holders allowing the top and

.../2

bottom tools to be changed using a motor-driven tool exchanger device, each drive motor of the tool exchanging device being actuable by the program control means such that the bending press remains inoperative during a tool change.

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COMPLETE SPECIFICATION

(Original)

FOR OFFICE USE

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Lodged:

Complete Specification Lodged:
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Published:

Priority:

Related Art:

This document contains the amendments made under Section ... printing.

Name of Applicant: TRUMPF GMBH & CO

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1 Little Collins Street, Melbourne, 3000.

Complete Specification for the invention entitled:

"BENDING PRESS"

The following statement is a full description of this invention, including the best method of performing it known to us :-

Trumpf GmbH & Co.

Machinery Manufacturer

Johann-Maus-Str. 2

7257 Ditzingen

Bending Press

This invention concerns a bending press with a top die and a bottom die acting with it, as well as a stop, especially a movable stop, and a support mechanism for the workpiece. Such bending presses are generally used in the forming of sheet metal. In a preferred manner, the invention concerns a forge bending press in which the top die is designed as a bending punch and the bottom die as the corresponding forming die. When the forming die has the shape of a V-shaped trough in cross section, for example with a flank angle of 90°, and a flat sheet is pushed into this trough using a bending punch, this leads to an angular sheet like that produced on an edging machine, for example. The length of the bending punch in this case is generally larger than the maximum extent of the sheet viewed in the longitudinal direction of the bending punch. The same applies to the forming die.

For the sheet to be bent at the proper place, before advancing the movable die, especially the top die toward the bottom die, the sheet is shifted. When it is positioned correctly with

respect to the bending die, the bending of the sheet takes place at the predetermined point.

The problem of this invention, then, consists of simplifying and speeding up the alignment of the workpiece relative to the bending die. It is also a purpose of the invention to design the bending press so that certain operating steps can be accomplished mechanically before the pressing.

According to the present invention there is provided a bending press comprising a top tool and a bottom tool adapted to interact with the top tool, an adjustable first stop and an adjustable second stop positioned opposite to and in the same co-ordinate direction as the first stop, the first and second stops being adapted for adjustment in a direction substantially perpendicular to the direction of feed of the top tool by means of a drive motor, a program control means operable to actuate the drive motor, and a supporting device for supporting the workpiece comprising two partial support devices positioned on either side of the bending press, each partial support device being adapted to be lifted or lowered individually across the direction of movement of the adjustable first and second stops by means of controllable motors, the controllable motors being actuable by means of the program control means, the top and bottom tool being further adapted to be detachably held in respective tool holders allowing the top and bottom tools to be changed using a motor-driven tool exchanger device, each drive motor of the tool exchanging device being actuable by the program control means such that the bending press remains inoperative during a tool change.

The workpiece, preferably sheet metal, is placed manually on the support mechanism, or optionally with the help of

a manipulator. If the first stop is already aligned relative to the workpiece, then the workpiece is pushed toward the first stop with the help of the second stop. This second stop then carries out the function of a shifting device. If the first stop is not permanently installed, but is also adjustable in a preferred manner, either it or the second stop can first be brought into the correct position relative to the die, and the workpiece can then be shifted with the other stop in each case toward the stop that is first positioned.

For simplicity, only a "sheet" will be referred to below, and it is also assumed that the top die is a wedge-shaped bending punch and the bottom die is a forming die with corresponding

cross section, without this being regarded as limiting.

It is clear that the sheet does not have to be inserted very precisely into this bending press, which permits the use of a loading device of a simple type or facilitates the insertion by hand. On the other hand, however, the stop fixed in the first place must be positioned very precisely relative to the bending die. This can naturally be brought about most simply and very precisely by automation. It is also obvious that the two stops must be so positioned and flexible in motion that the sheet can be associated with the bending die in any desired manner.

A refinement of the invention is characterized by a third stop, especially a movable stop, that is placed between the first and second stops but displaced from them laterally. These three stops can be placed against three edges of a rectangular sheet. The sheet must first lie against the third stop. It is then shifted along the third stop toward the first stop with the help, for example, of the second stop. In this example, therefore, the first and third stops must be aligned correctly relative to the bending die before the advance of the second stop.

Placement against the third stop can be carried out relatively simply in a preferred manner when in another refinement of the

invention there is a fourth stop that can be moved toward the third opposite stop, with the fourth and optionally the third stop being movable in a coordinate direction perpendicular to the direction of motion of the first and second stops. It is then possible to correlate each of the four edges of a quadrilateral sheet, especially a rectangular sheet, to a stop. Two of these four stops are aligned or will first be aligned relative to the bending die, and with the help of the two others, the sheet is shifted toward the positioned stops. At the end of this operation, it occupies a correct position relative to the bending die. With four movable stops, for example, the direction of advance of the first and second stops runs in the direction of a Y coordinate, while the direction of advance of the third and fourth stops is in the direction of an X coordinate. Each of these four stops can optionally be a stop or a shifting device, with one stop of each coordinate first being aligned and with the sheet then being shifted with the other stop of each coordinate to rest against the two fixed or fastened stops. Of course, the four stops must be designed and positioned so that none of them comes into the range of motion of the movable die, especially of the top die. This involves primarily the two stops that are correlated with the edges of the sheet running perpendicular to the longitudinal direction of the wedge-shaped bending punch.

In all of the embodiments of the bending press described above,

the sheet lies on a support mechanism during the alignment. This is a support table, a grate, rods, a lattice, or a similar device with a flat support face for the sheet. The bottom die, for which an appropriate slot, opening, separation between elements, or the like must be present in the support mechanism, is located particularly in the central region of this support mechanism. The forming part of the bottom die, or the groove of the forming die, is correlated with the support face of the support mechanism in the manner necessary for the particular bending process. The top end of the two groove flanks, for example, can lie in the plane defined by the support face of the support mechanism.

It follows from what is stated above that it is very beneficial if the direction of motion of the movable stops is approximately perpendicular to the direction of advance of the movable die. This means that with the X-Y coordinate system mentioned, the movable die is moved in the direction of a Z axis.

Another variation of the invention is characterized by the fact that each movable stop can be moved by means of a drive motor. This can be either an electric motor or a hydraulic or pneumatic motor. In the first case, the rotary motion of the motor must be converted into a suitable motion of translation, which can easily be brought about, for example, by using a pinion gear and a rack or spindle. In the second case,

the motor already executes a linear motion. The movable stop can be coupled directly to the piston of a hydraulic or pneumatic working cylinder, or indirectly by using an intermediate member. Electrical or electromagnetic drives with linear motion are also known and can be used.

The use of a drive motor for each movable stop opens up the possibility in a particularly beneficial manner of turning each drive motor for the motion of the stops on and off by means of a control, particularly a program control. In machining a sheet of known size, two of the four movable stops can thus be brought into the position necessary for the bending of the sheet at the desired place by the use of the program control.

After the alignment, for example of the first and third stops, the program-controlled advance of the second and fourth stops occurs. Of course, the four stops are also brought to an adequately large mutual separation before the insertion of the sheet, if they are not already in such positions, so that the sheet can be inserted into the "field" defined by the four stops without hindrance by the stops. The movable die is located above this field, and the die that is fixed at least during the pressing process is below it.

It is clear that sheets of any size can be bent completely automatically, precisely, and rapidly by using a program control

if their dimensions are within the maximum separations of the stops of this bending press. The loading of the press and the delivery of the bent sheet can also be provided for rapidly, reliably, and in a precisely reproducible manner by this program. For example, the delivery can be provided for by using at least one movable stop or at least with the help of this. For this purpose, under some circumstances it may be necessary for this stop to be able to be shifted beyond the vertical plane defined by the bending punch, or from a space on one side of this plane to a space on the other. To avoid the necessity of any limitations in this regard, it is advisable for all four stops to be able to be shifted in this way, possibly over the entire range of support.

Shifting beyond the support face of the support mechanism is possible if the stops are not mounted on the support mechanism, but in a preferred manner in guides separate from it, which extend far enough beyond the support face of the support mechanism or at least permit the motion of the stops beyond the limits of the support face.

The program control for the motion of the stops in a refinement of the invention is part of a program control for the die motion. This makes possible a completely automatic programmed process with correctly timed control, with the sheet first being aligned with the help of the stops and then being bent. The finished bent sheet is then withdrawn after this operating step.

An especially preferred embodiment of the invention is characterized by the fact that each of the four movable stops consists of two stop halves, with each stop half being movable back and forth separately. With regard to the motion, a motorized motion and particularly a program-controlled motorized motion is intended above all. Assuming the same initial positions of all of the stop halves, then the two stop halves stand in extension of one another, or on a common straight line in each case, but they have a lateral separation from one another. If the first and second stops are called "transverse stops" and the third and fourth stops are called "longitudinal stops", then the arrangement can be made in a preferred manner so that each half of a transverse stop is associated with one half of a longitudinal stop. If these are strip-shaped stops, then one half of a transverse stop and one half of a longitudinal stop in each case form a "stop corner". However, the two elements of each stop corner must be movable past one another without hindrance. It is also very beneficial for each stop or each half of a stop to be mounted removably in a stop retainer. It or they can be removed if needed and optionally replaced by a stop or a half stop of another type. The latter involves both the shape and the size.

Another refinement of the invention is characterized by the fact that the support mechanism for the workpiece consists of

two partial support mechanisms, each of which is movable individually perpendicular to the direction of motion of the movable stops, and in particular can be raised and lowered. The space between the two partial support mechanisms is intended for the bending die and optionally for the passage of the movable part of the bending die.

In a further refinement of the invention it is proposed that each partial support mechanism can be raised and lowered by a controllable motor, with the height-adjusting motors at least being able to be turned on and off, especially by means of the program control. Optionally, the speed of the motors can also be controlled through the program control. If there is no program control, or if the partial support mechanisms are not coupled to the program control, the motion of the partial support devices can also be brought about by turning the motors on and off manually with appropriate inspection of the final positions.

Expanded automatic, especially program-controlled, bending of sheets is opened up by another preferred embodiment of the invention that is characterized by the fact that the partial support mechanisms are movable up and down, parallel to one another, but at an angle to their support face or the like for the workpiece. We can speak here of a diagonal lowering of each partial support device. However, this is done in such

a way that this partial support mechanism when lowered is removed at the same time from the plane defined by the bending punch. In particular, a lowering of only one partial support mechanism is intended in each case. This assumes that the workpiece is prevented from possible tipping in a suitable way, which would occur if the center of gravity of the sheet is correlated with the partial support device to be lowered. For example, the sheet might then be held with the help of the bending die, or more precisely, might be clamped between the top die and the bottom die, without a bending process taking place initially.

If a flat sheet is bent at an angle by using a wedge-shaped bending punch and a forming die, and the flanks of the forming die extend at an angle to the support face for the sheet, especially at an angle of 45° in each case, then the two angular legs of the sheet bent at an angle extend in the direction of the flanks of the forming die, i.e., they also form an angle of 45°, for example, in each case with the support face of the support mechanism or its partial support mechanisms. In other words, the two parts of the sheet lift up from the support faces on one side and the other of the point of the bend. After withdrawing the top die, the bent sheet may remain in this position. This can be undesirable both for the further machining and for the removal, especially the automatic removal using one of the stops For this reason,

a very beneficial variation of the invention provides for a movable partial holddown device at a distance above each partial support mechanism, with each partial holddown device being able to advance toward or move away from the correlated partial support mechanism in a controlled manner, preferably with program control. By using one of these two partial holddown devices, the sheet can be tipped toward the desired side. Program-controlled motion is practical when a mechanical tipping back is always or at least generally necessary because of the special shape of the bent sheet or the special position of the center of gravity. In a further refinement of the invention, it is proposed for each partial holddown device to consist of at least one, but preferably several pins, rods, or similar elements positioned with lateral separation. If a partial holddown device consists of a group of rods or the like, individual pins or groups of pins can optionally also be advanced or retracted, especially with program control and for the production by bending of complicated sheet metal structures. Of course, it is assumed that each pin has its own drive and that each of these drives can be controlled separately.

The top and bottom dies are each preferably mounted removably in a top and a bottom die holder. However, a particularly beneficial design of the machine results if the top and bottom die retainers are of essentially the same shape and dimensions.

In this case specifically the top die can be exchanged with the bottom die, or more precisely, the top die can be inserted into the die retainer of the bottom die, and the bottom die in the die retainer of the top die. This permits bending the sheet in the other direction of bending. For example, one edge of a sheet can be bent up and another can be bent down in the opposite direction. A Z-shaped structure is then formed, for example. The latter may be part of a case or the like. Although it is bent away in the opposite direction, the sheet does not have to be turned over or turned around. It is only necessary after the first bending process to interchange the top and bottom dies and to shift the sheet into the correct position for the second bending process. It can easily be seen that this design, especially in combination with the lowerable partial support mechanisms, makes possible automatic production of complicated sheet metal parts. The space necessary for bending with interchanged top and bottom dies is provided by lowering one or optionally both of the partial support mechanisms. By raising them, the workpiece can again be brought into a desired position.

The replacement of the top tool by the bottom tool and vice versa by hand is undoubtedly time-consuming. For this reason, pursuant to another refinement of the invention the bending press is equipped with a die-changing device for the top die and another for the bottom die. By using these die-changing devices, which can be of a known design, the top tool is

withdrawn from the top die retainer and the bottom tool from the bottom die retainer, at the same time or separately. To leave the plane of the sheet basically free for the shifting of the sheet, as stated above, two separate die-changing devices are provided, with that for the top die being located above the plane of the sheet and that for the bottom die below the plane of the sheet. These are essentially and preferably hydraulic or pneumatic working cylinders with appropriate grippers for the dies involved, for example gripper pliers for each with gripper fingers that can pivot toward one another. A prerequisite for the automatic changing of the device is also an automatic locking and unlocking device, customary with other machine tools with back and forth motions, with the locking and unlocking being carried out, for example, by controllable keys that convert a horizontal motion into a locking motion or unlocking motion perpendicular to this. After the withdrawal of the top and bottom dies from the die retainers, these two dies are taken out of their changing devices and are exchanged for one another, or exchanged for other devices correlated with one another in the same way or in a transposed way.

Each drive motor of each die-changing device in a further refinement of the invention can be turned on and off by means of the control, particularly the program control of the bending press. In the case of a hydraulic or pneumatic working cylinder, the control turns the pump motor on and off, for

example, or opens and closes a shutoff device for the pressure medium.

Inasmuch as the bending die is not rotationally symmetrical, but as a rule is elongated, i.e., it consists of a strutlike bending punch and a correspondingly long and shaped forming die, not every association of the die-changing device to this bending die is suitable. For this reason, a preferred variation of the invention provides that the direction of insertion or removal of the die-changing devices is perpendicular to the direction of advance of the movable die along the bending line of the bent, or folded or angular workpiece.

Another beneficial embodiment of the invention is characterized by a device for rotating the workpiece, especially in the plane of the workpiece. In this way, workpieces can be produced with the shape of the bottom of a box, i.e., all four edges of a rectangular sheet can then be bent around with a single straight-line bending die. First, the two longitudinal edges opposite one another are bent up in succession, and after a 90° rotation, the rest of the sheet edges perpendicular to these are bent up in two further bending processes. This provides a further important step toward fully automatic production of such structures, which are needed, for example, for switchboxes and the like. At this point, however, it is pointed out explicitly that not only rectangular sheets and

not only sheets with straight edges can be machined with such a press, but also sheets with truly special outlines. This is particularly possible when using stop halves, with the word "halves" not being meant in the strict sense, but the two independent parts of each stop can also have different lengths, and can even have different shapes. If they can be advanced separately, a sheet can be shifted neatly parallel to itself with the two stop halves of a stop when the longitudinal edges correlated with these "stop halves" proceed in the manner of stairs. One of the stop halves precedes the other in the shifting motion in accordance with the projection of the step. The same also applies to the placement of permanently positioned stop halves.

A particularly beneficial refinement of the invention is obtained when the top and bottom tools form part of the workpiece-rotating device, with these dies being mounted to rotate in their die retainers, or with the die retainers being mounted to rotate in a holder for the die retainer, and with at least one die or each die retainer being equipped with a rotary drive. In this case, the axis of the rotation for the workpiece is parallel to the direction of advance of the movable die. The rotary drive can be designed in a known way, for example by attaching a pinion or a similar machinery element concentrically to a die shaft or to a die holder shaft, which drives by means of a matching different machinery element, for example

a rack or a gear, which is connected to an appropriate controllable motor through a rotary drive connection. It is clear that the rotation of the die is also accomplished preferably through a correspondingly expanded program control. Of course, the workpiece must be secured against shifting perpendicular to the axis of rotation during the rotary motion. Of course, this is generally not possible by using only linearly movable stops. One solution of this problem consists of clamping the workpiece between the top die and the bottom die during the rotation, without causing any deformation. The die then also constitutes a holding device for the workpiece during the rotation.

Another refinement of the invention is characterized by a die magazine to hold several top and bottom dies, with the die-changing device optionally also being correlated with the die magazine or the die retainer. Using the die-changing device, a top die and a bottom die are withdrawn from the preferably two-part die magazine. The top die is then transferred into the top die retainer and locked in, and the bottom die into the lower die retainer. After use, both are taken out of their die retainers and are placed back in the die magazine. The die needed next is then taken out of this. This die can optionally have the same design as that used before, but with the difference that the die-changing device now inserts a die into the top die retainer that corresponds to the one that was in the bottom die retainer before, and vice versa. Such a die interchange, in the manner described above, makes it possible

to bend up one edge of the sheet and then to bend down a second edge of the sheet, for example in parallel to this. The die-changing device can coordinate its gripper or the like optionally with the die magazine or with the die retainer of the press. Consequently, when changing from one die to another, the die magazine has to be moved. There is the possibility of designing this die magazine to rotate like a carousel, or to use a magazine that can move linearly back and forth.

All of the described motions of the machine and its auxiliary devices are preferably controllable by means of an overall program.

In a further refinement of the invention it is proposed for the die magazine to be movable, particularly perpendicular to the bending line.

The invention will be described in detail below using the drawing. The drawing shows an example of embodiment of the invention. The drawing shows:

Fig. 1 A side view of a bending press in schematic illustration,

Fig. 2 a cross section according to Fig. 1,

Fig. 3 a side view of another form of embodiment partially cut away,

Fig. 4 the partially cut away front view of another form of embodiment,

Fig. 5 a top view according to Fig. 4 in partial section,

Fig. 6 a side view of another form of embodiment,

Fig. 7
A to H a schematic side view in various operation positions.

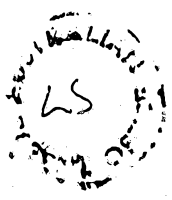
The frame 1 of the bending press consists as usual of a column and a bracket, at the free end of which there is a pressing cylinder 28. The support face 18 for the workpiece 6 is supported on the support mechanism 5 that is divided into two partial support mechanisms 16 to permit the passage of the top die 2 fastened in the die holder 21. Each of the partial mechanisms 16 is provided with a height-adjusting motor 17 so that different heights can be set, depending on the requirements. The bottom die 3 is likewise placed in a die holder 21 between the two partial support mechanisms 16.

For the workpiece 6, a rear stop 4 is first provided that is movable to obtain a basic setting. Opposite this there is a second movable stop 7 that at the same time performs the function of a shifting device. There is also a third stop 8 and a fourth stop 9 at the sides that are movable perpendicular to the direction of motion 11 of the two other stops 4, 7.

Drive motors 13 that are connected to a control device 14 are used to shift the stops 4, 7-9. As seen from Fig. 2, each of the four movable stops consists of two half-stops, with these in turn being combined into corner stops, by which a very precise alignment of the workpiece 6 can be achieved. If a workpiece 6 is not precisely of rectangular design, appropriately shaped inserts 27 are used to compensate for this. The stops are fastened in stop retainers 15, which in turn can be moved on guide rods 29.

It is then simply necessary to place the workpiece 6 on the support 18. The rear stop 4 is then brought into the desired basic position in the one coordinate direction 11 and the stops 8 and 9 are aligned in the coordinate direction 10, so that the workpiece 6 is advanced by the second stop 7 toward the rear stop 4 with lateral guidance into the machining position. The bending process can then take place by advancing the top die 2 in the direction of the arrow 12.

Fig. 3 also shows a holddown mechanism, with a holddown mechanism 19 with retaining pins 20 being coordinated with each partial support mechanism 16. This division is necessary to permit matching the partial support mechanisms 16 to various height settings, as well as to permit pushing back the bent workpiece and preventing a tilting of the workpiece with support faces at various heights.



In the machining of a Z-shaped workpiece 6, this would have to be turned over in the opposite direction for the downward bend. As shown by Figures 4 and 5, another way is chosen according to this invention in which the workpiece 6 remains in its position but the top and bottom dies 2, 3, as shown by Figures 4 and 5, are interchanged. A die-changing device 22 is provided for this purpose, which consists of two insertion and removal devices 23 for the top die 2 and the bottom die 3. Each of the dies is grasped by the grippers 31 and inserted into empty chambers of the die magazine 25. A separate magazine 25 is provided here for the top and bottom die, with the magazines being placed on guide rails 30 to move in the direction of the arrow 26. The new die is then taken out of a full chamber and inserted into the holder.

For many methods of machining, it is necessary to rotate the workpiece in its plane. For this purpose, a rotating rest 32 is provided in Fig. 6 against which the workpiece 6 is firmly pressed. A pressure pin 34 with a rotating plate at its free end is provided for this purpose. The rotary drive is accomplished by a separate motor 33. Naturally, it is also possible to arrange the two dies 2 and 3 to rotate and to clamp the workpiece between them for the rotation.

The many machining possibilities result from the sequence of illustrations according to Fig. 7. The production of a Z-shaped sheet is shown here. In Figure 7A all of the parts are in a

starting position and the workpiece 6 has been clamped to the support face 18. The rear stop 4 is then moved into the desired position. Figure B shows that the second stop 7 has pushed the workpiece 6 against the rear stop 4. In the following bending process according to Figure C, the workpiece 6 bends up on both sides. After the release of the workpiece by the top die 2, it automatically tips back, and this motion can be assisted by the pin 20 of the holddown device 19 shown in broken lines. Then, as Figure E shows, the dies are interchanged so that a bend in the opposite direction is possible. Then, if necessary, the workpiece 6 is shifted by the stops into the position of Figure F. The partial support mechanism 16 on the right must be lowered here in the plane of the drawing so that the free end of the workpiece 6 can escape downward after the bending, as shown in Figure G. The two partial support faces 16 are then moved in height opposite to one another so that the workpiece 6, as in Figure H, is aligned and the stops can push the workpiece out. While multiple placement and removal, as well as rotation and turning of the workpiece have been necessary in the past, a Z-shaped workpiece can now be manufactured without any manual intervention.

The reference numerals in the following claims do not in any way limit the scope of the respective claims.

THE NEW CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A bending press comprising a top tool and a bottom tool adapted to interact with the top tool, an adjustable first stop and an adjustable second stop positioned opposite to and in the same co-ordinate direction as the first stop, the first and second stops being adapted for adjustment in a direction substantially perpendicular to the direction of feed of the top tool by means of a drive motor, a program control means operable to actuate the drive motor, and a supporting device for supporting the workpiece comprising two partial support devices positioned on either side of the bending press, each partial support device being adapted to be lifted or lowered individually across the direction of movement of the adjustable first and second stops by means of controllable motors, the controllable motors being actuable by means of the program control means, the top and bottom tool being further adapted to be detachably held in respective tool holders allowing the top and bottom tools to be changed using a motor-driven tool exchanger device, each drive motor of the tool exchanging device being actuable by the program control means such that the bending press remains inoperative during a tool change.

2. A bending press according to claim 1 wherein above each partial support device there is an adjustable holding device, each holding device being controlled to move towards and away from its respective partial support device.

3. A bending press according to claim 1 or claim 2, wherein the top and bottom tool holders are substantially identically shaped.

4. A bending press according to any one of the

preceding claims, wherein the partial support devices are inclined with respect to the supporting device and are adapted for up and down movement.

5. A bending press according to any one of the preceding claims, wherein each holding down device consists of at least one pin, bolt or similar element arranged laterally.

6. A bending press according to any one of the preceding claims, wherein the direction of insertion and exchange of the tool-exchange device is perpendicular to the direction of feed of the advancing tool and parallel with the bending line of the bent workpiece.

7. A bending press according to any one of the preceding claims, further comprising a device to rotate the workpiece.

8. A bending press according to claim 7 wherein the device to rotate the workpiece is within the plane of the workpiece.

9. A bending press according to any one of the previous claims, wherein the top and the bottom tools form a part of a workpiece rotating device, the tools being either rotatably mounted in their tool holders or the latter is rotatably mounted in a holder for each tool holder and each tool or each tool holder is equipped with a rotary drive.

10. A bending press according to any one of the previous claims, comprising a tool storage device adapted to accommodate spare top and bottom tools, wherein the tool-exchanger device can be assigned selectively to the tool storage device or to the tool holder.

11. A bending press according to claim 10, wherein the tool storage device can be moved at right angles to the bending line laterally next to the tool holder.

12. A bending press according to any one of the preceding claims comprising a third and fourth adjustable stop wherein the third stop is positioned between the first and the second stop, and laterally offset relative to the first and second stops, the fourth stop being opposite to the third stop and adapted for movement in a co-ordinate direction perpendicular to the direction of movement of the first and second stops and each stop consisting of two separate advancable and resettable parts.

13. A bending press according to claim 11, wherein each stop or each stop-half is held removably in a stop holder.

14. A bending press substantially as hereinbefore described with reference to the accompanying drawings.

DATED this 6th day of March 1990
TRUMPF GMBH & CO.
By Its Patent Attorneys
DAVIES & COLLISON

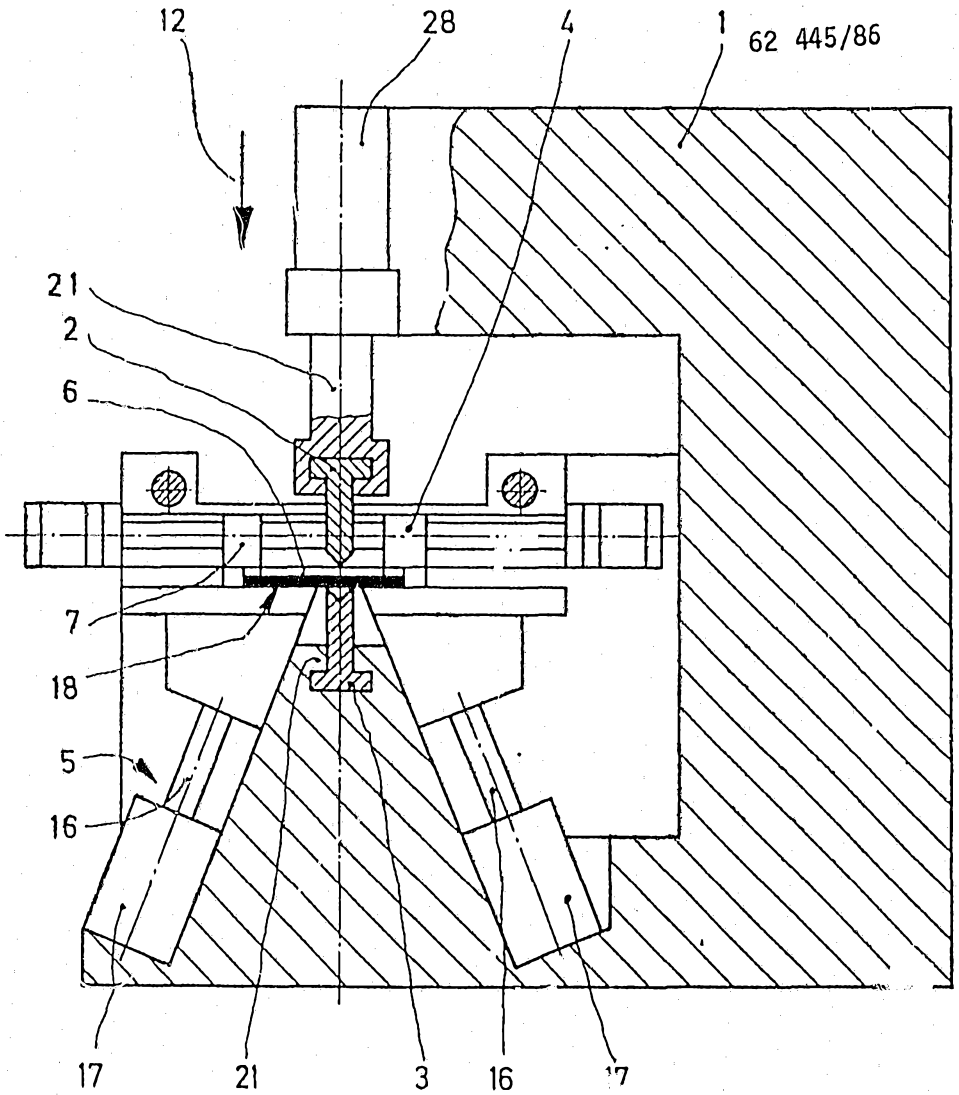


Fig. 1

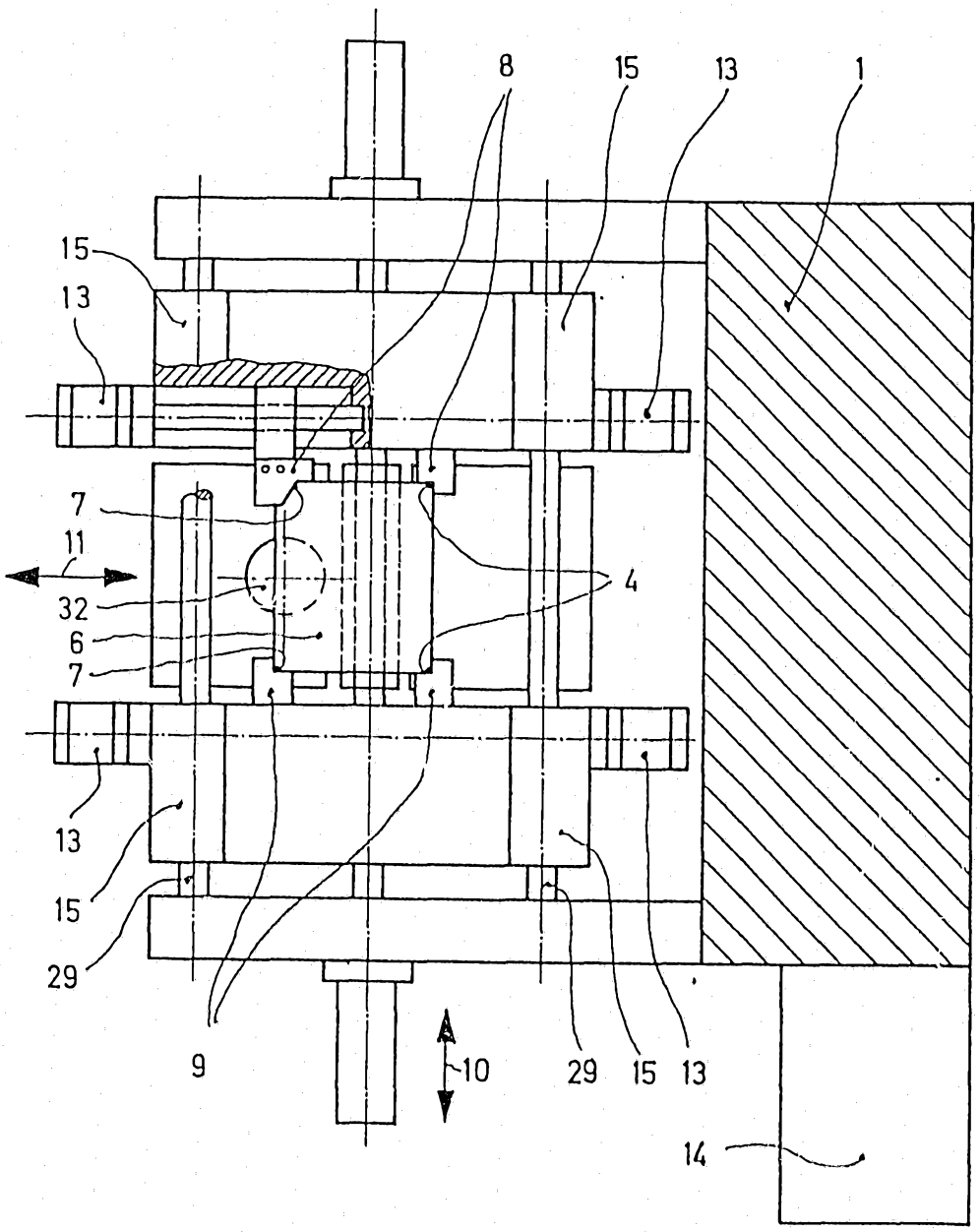


Fig. 2

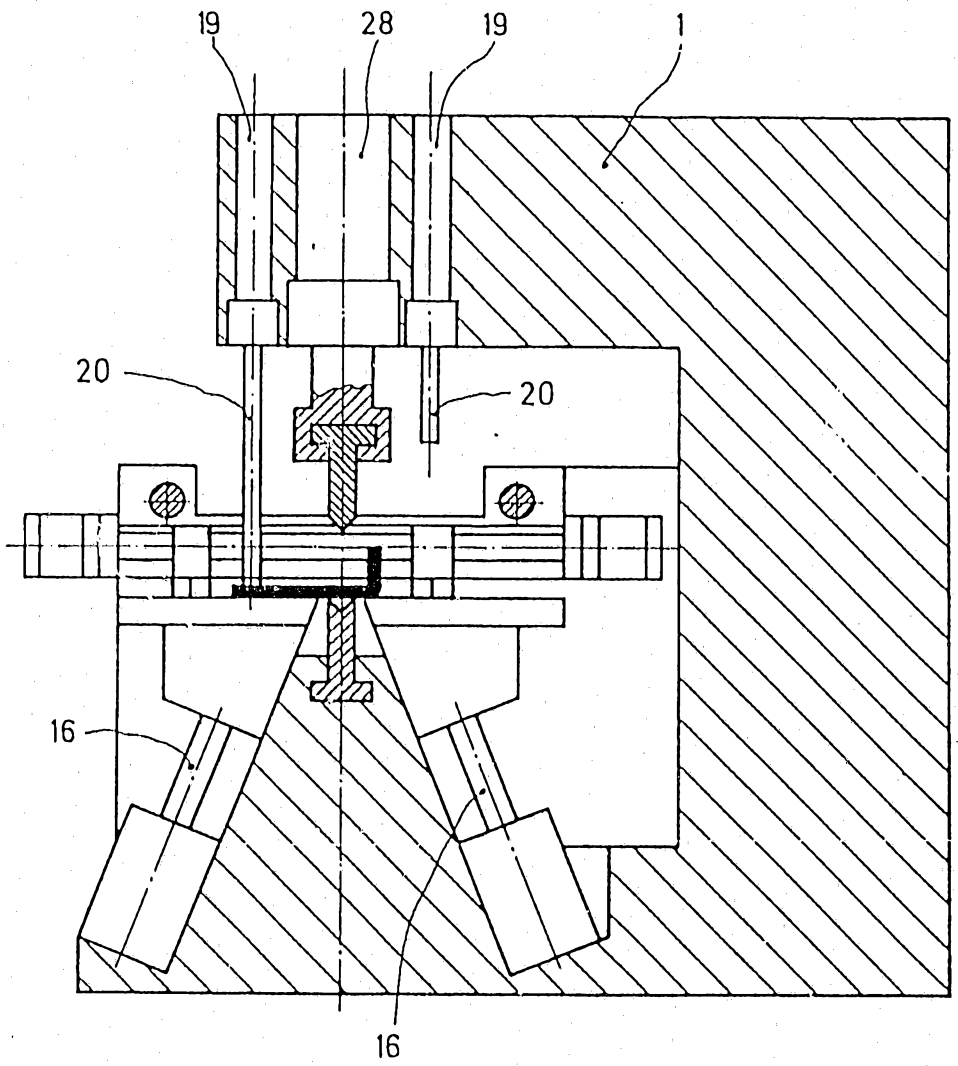


Fig. 3

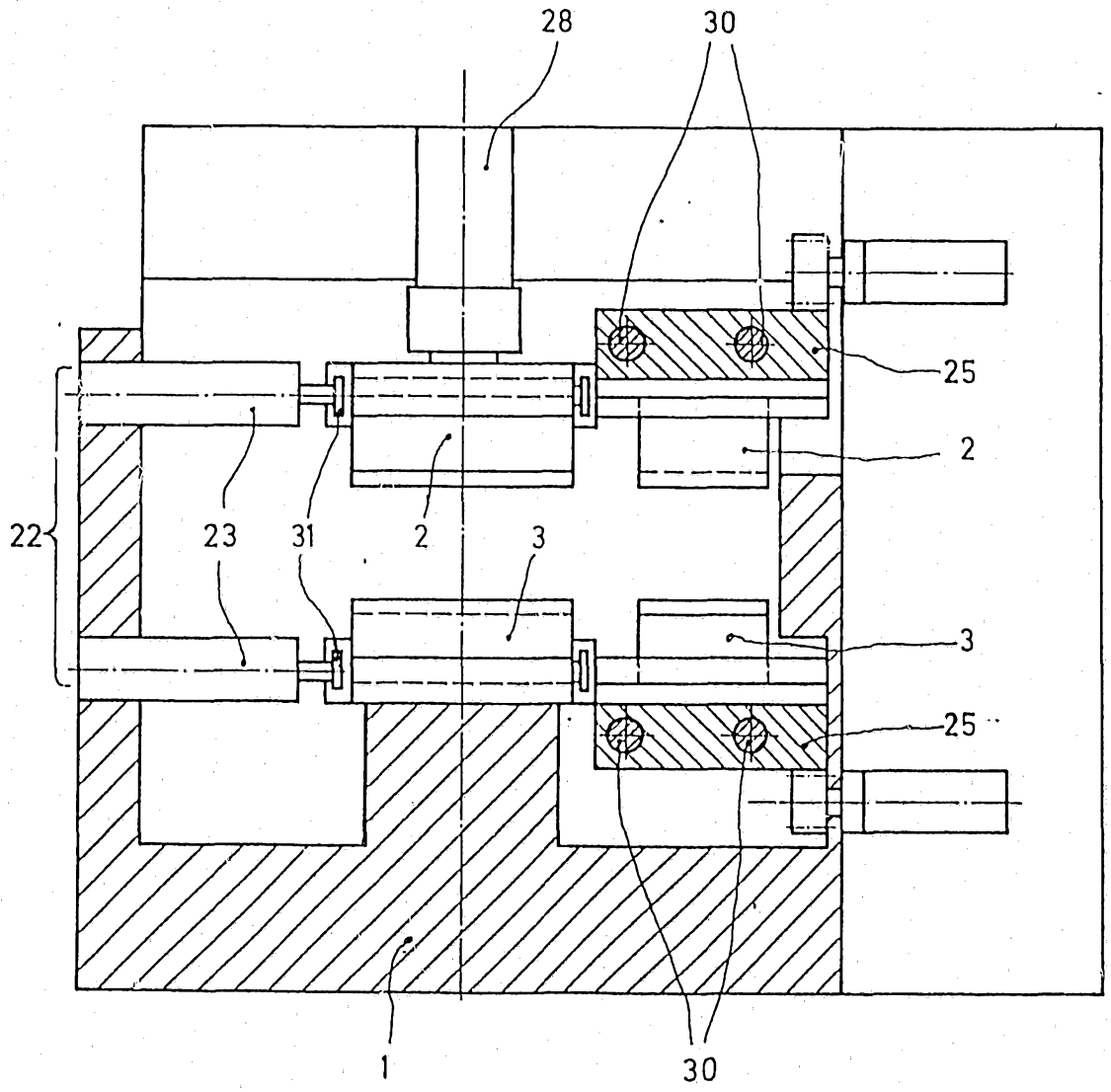


Fig. 4

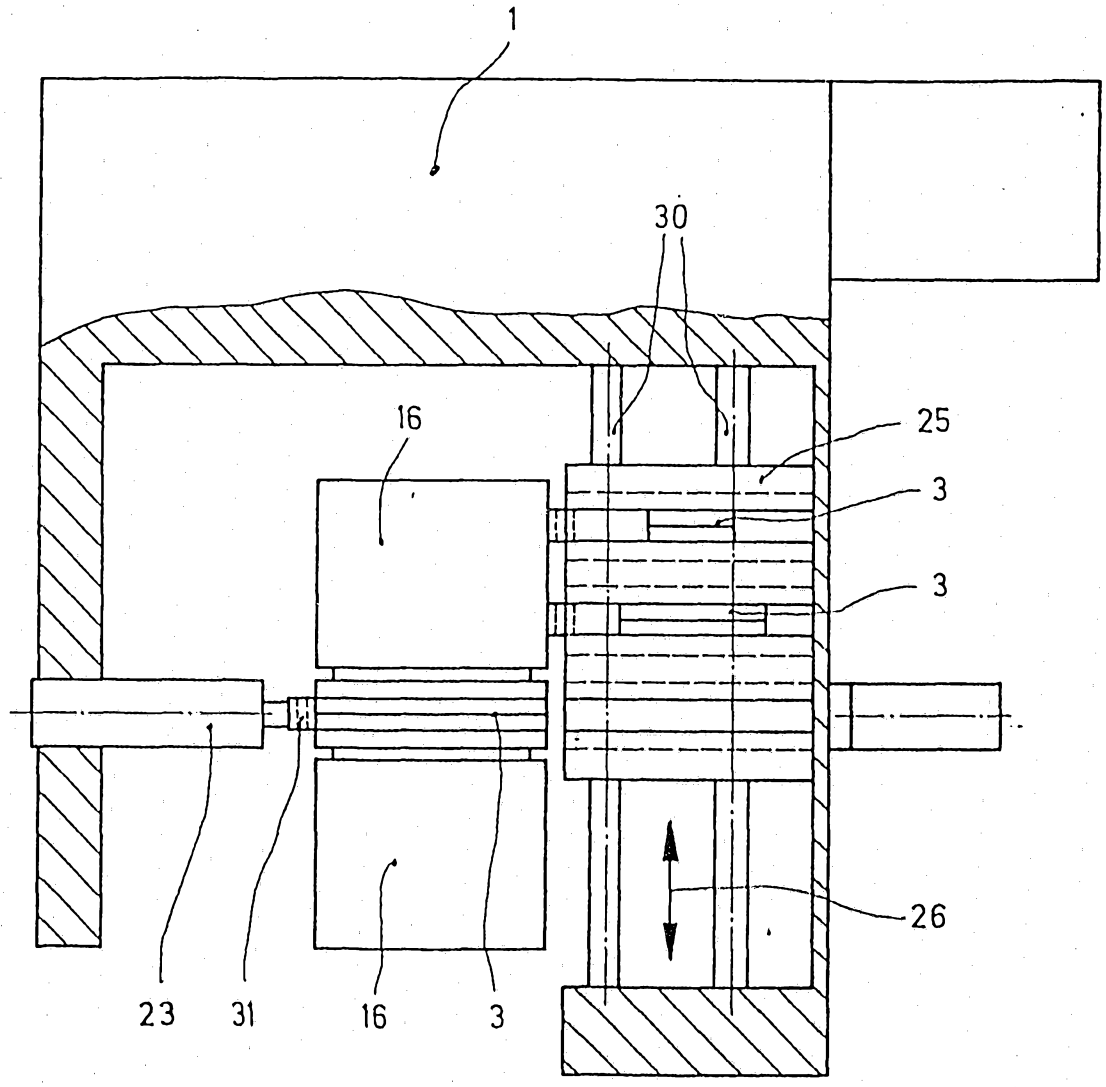


Fig.5

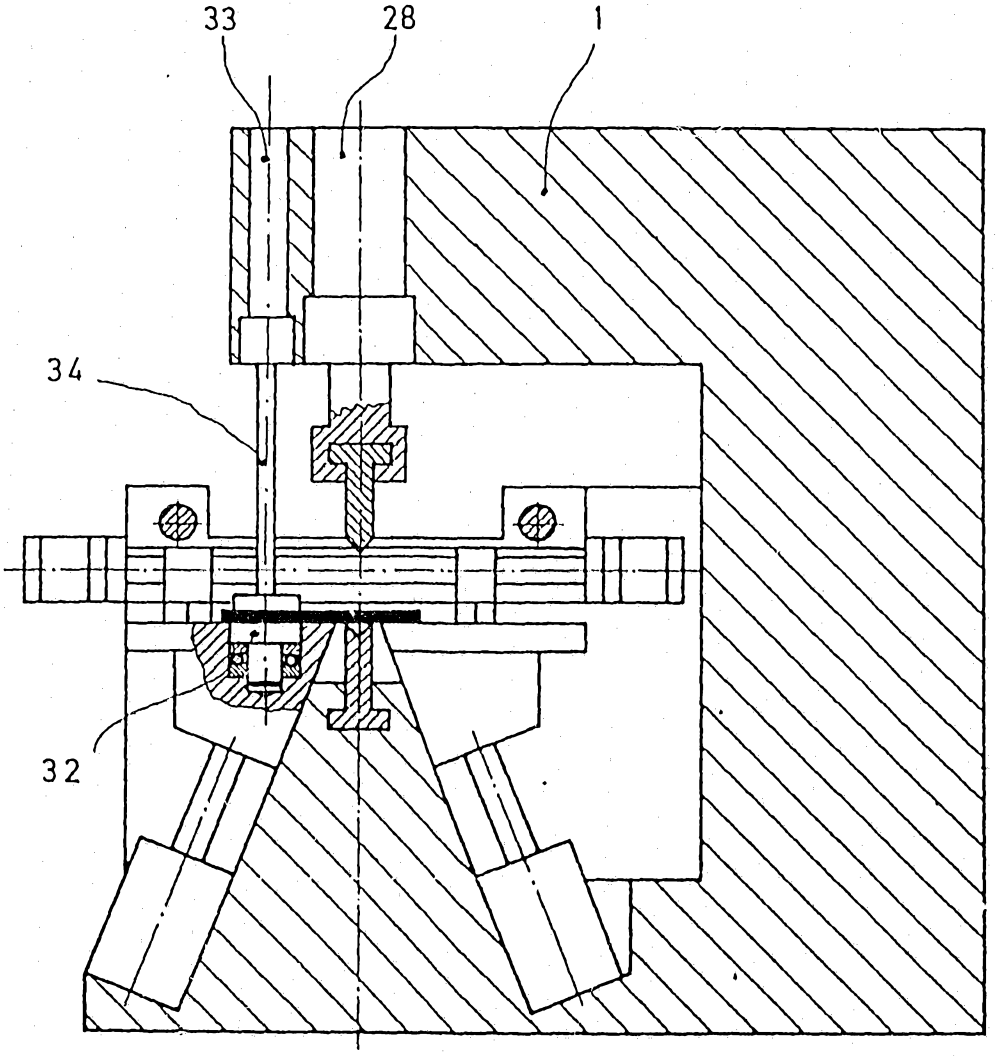


Fig. 6

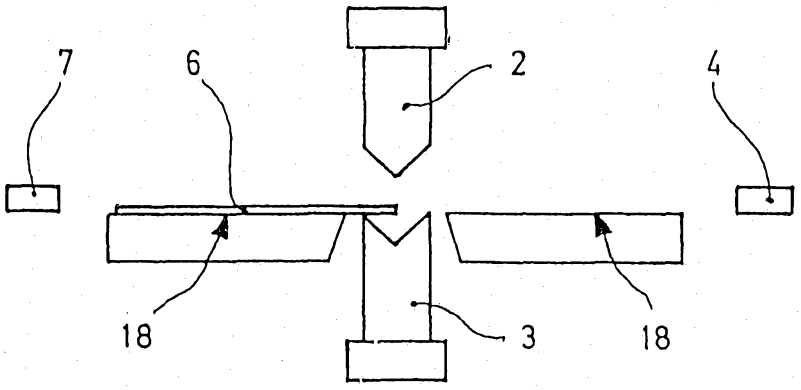


Fig. 7a

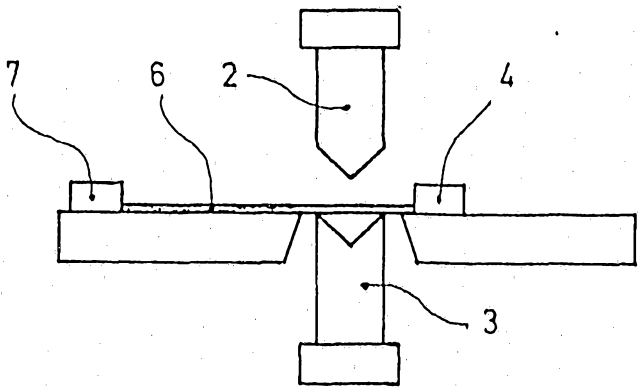


Fig. 7b

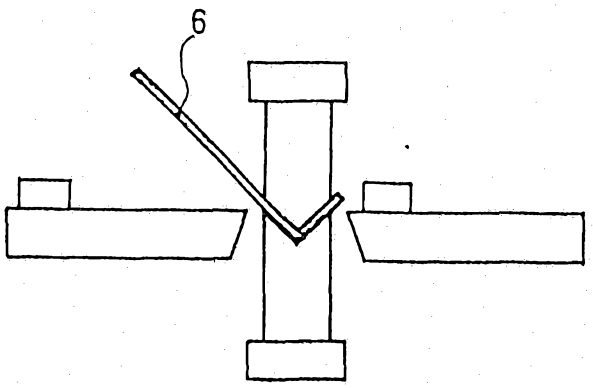


Fig. 7c

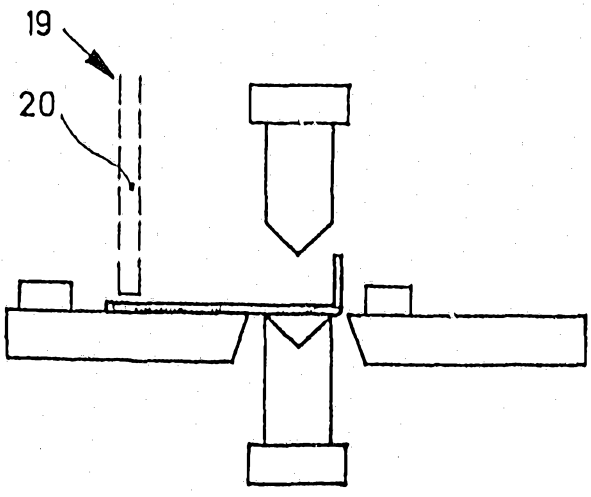


Fig. 7d

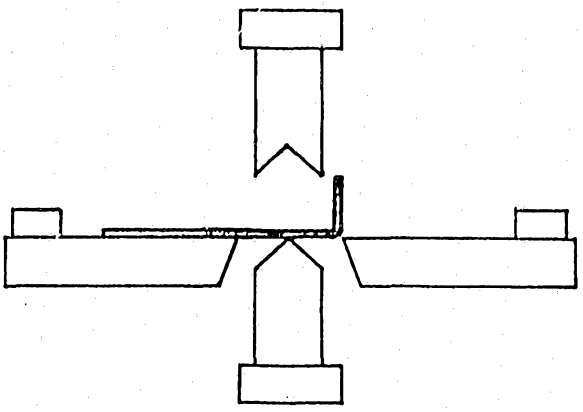


Fig.7e

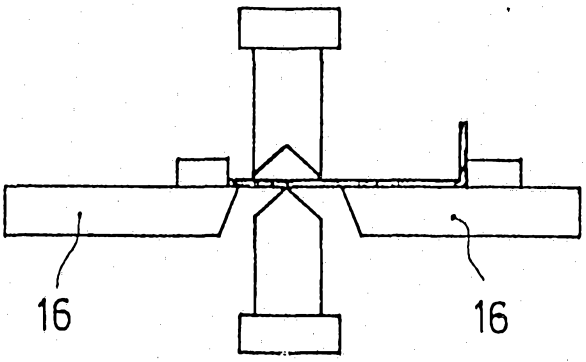


Fig.7f

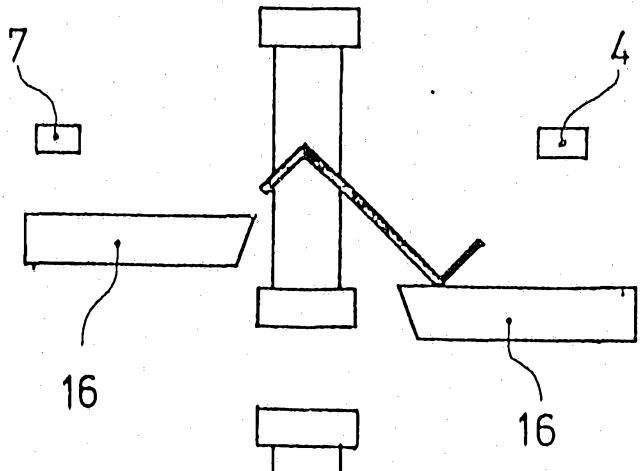


Fig.7g

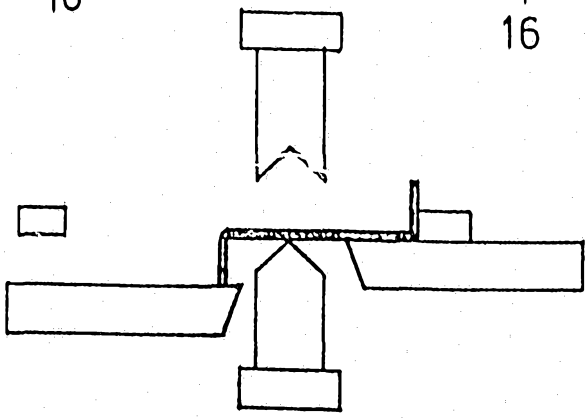


Fig.7h