

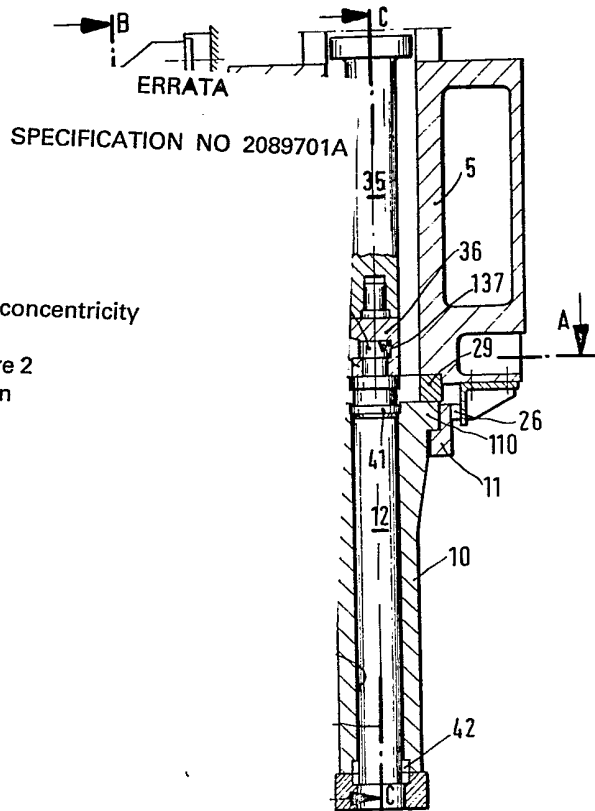
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Fielding Plant Design  
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(54) Billet piercing or expanding  
presses

(57) A press for operating on metal  
billets has a pair of movable crossheads  
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comprising an upsetting stem 10 and a  
mandrel 12 disposed concentrically in a

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provided with a tool carrier 11, guiding  
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with respect to its crosshead, and a  
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upsetting stem during movement of the  
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THE PATENT OFFICE  
27 September 1982

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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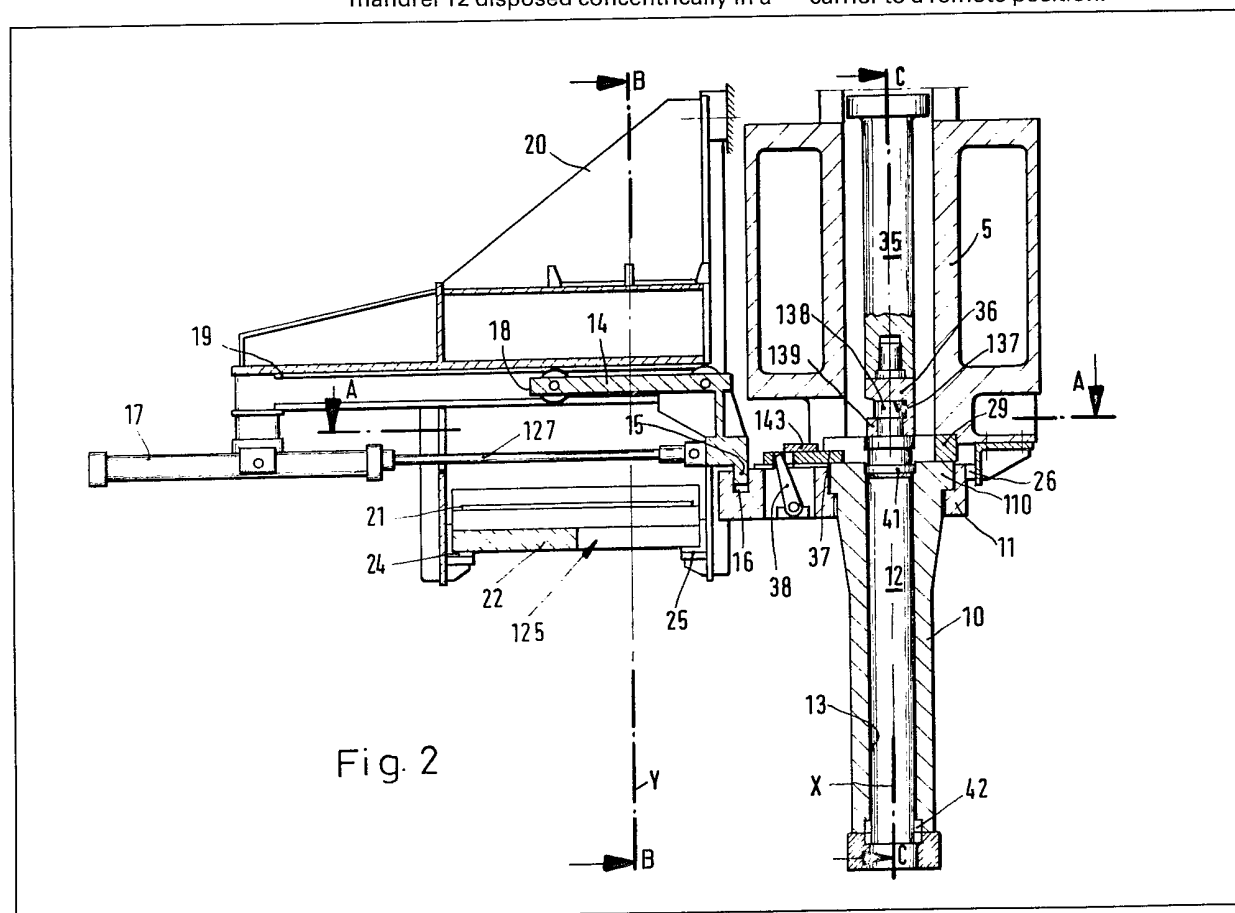
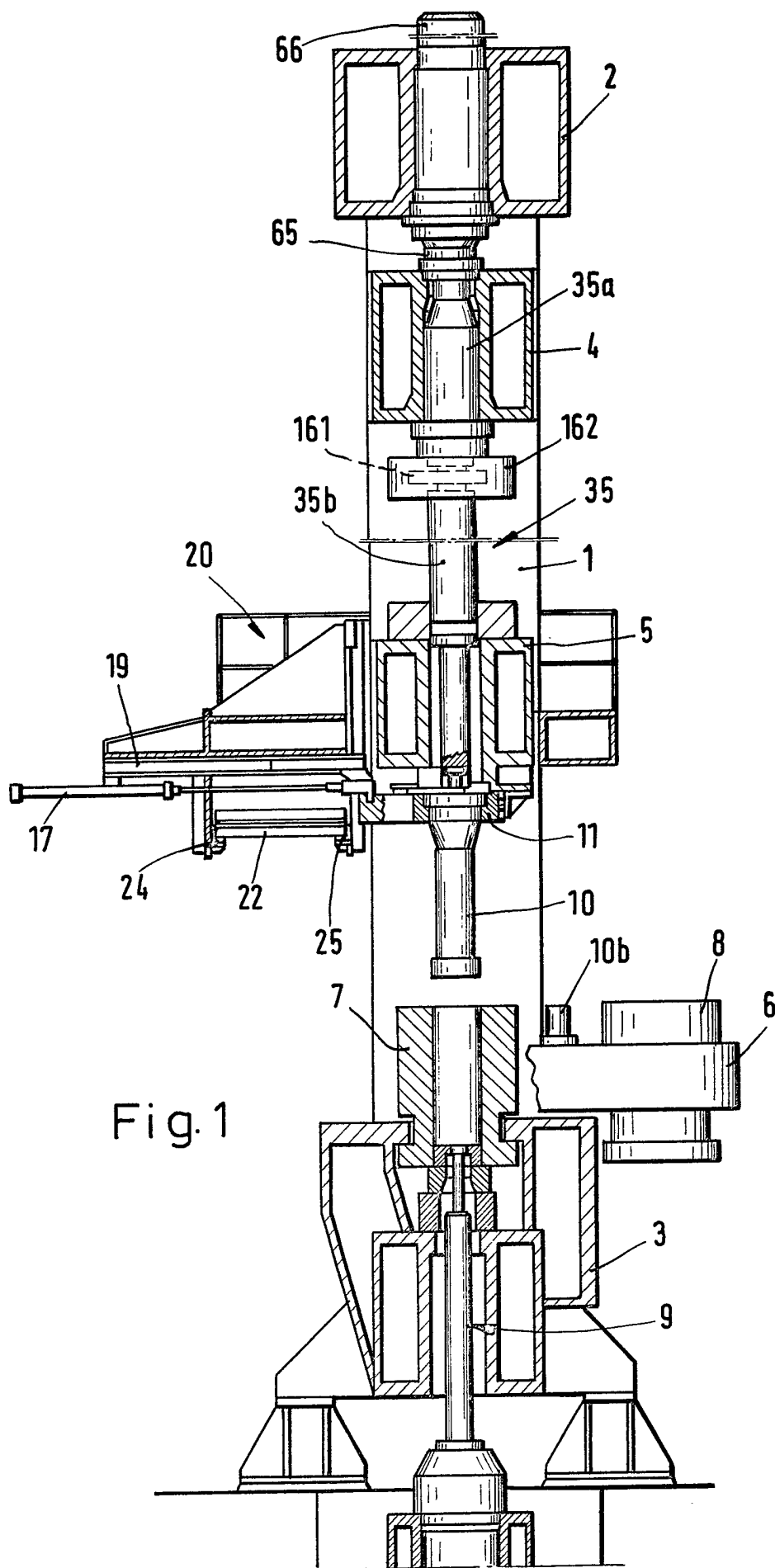


Fig. 2

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.



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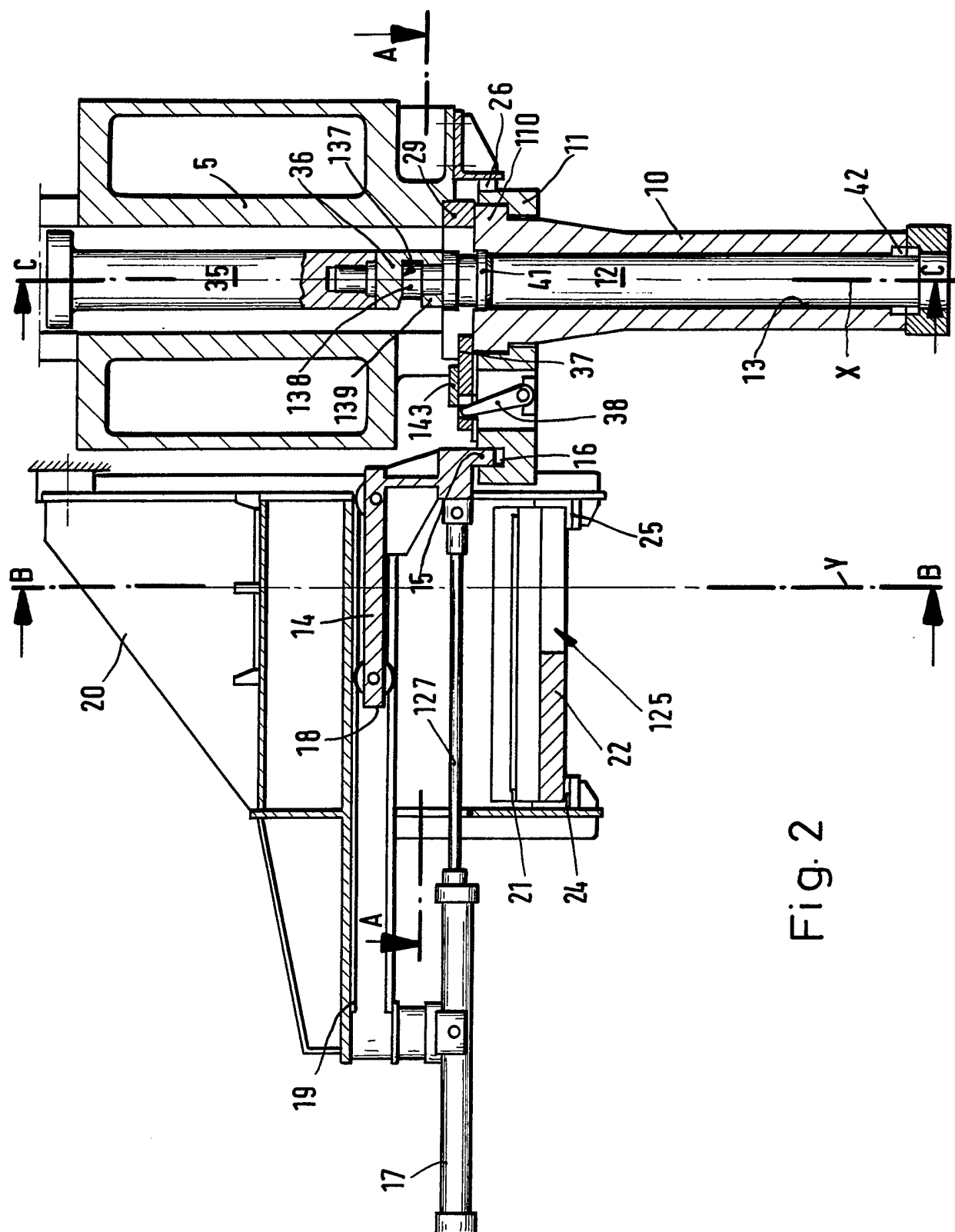


Fig. 2

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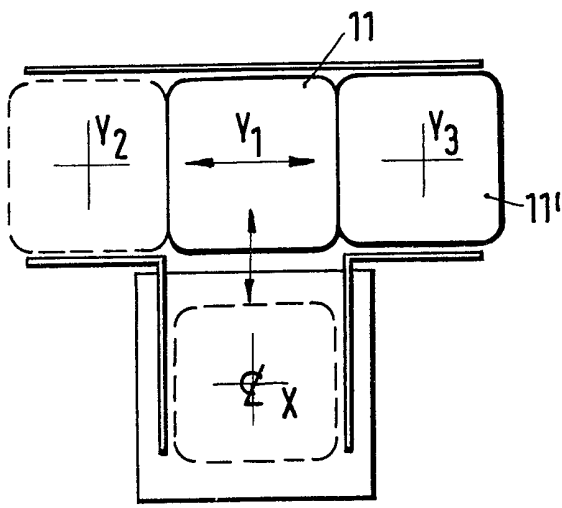


Fig. 3

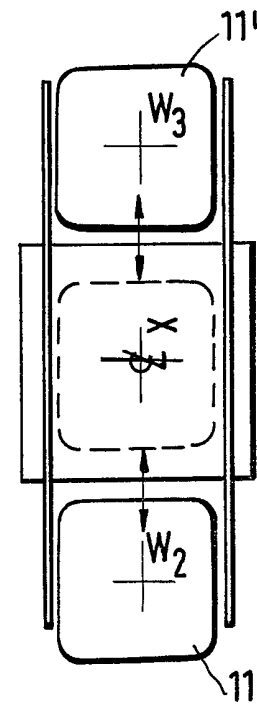


Fig. 9

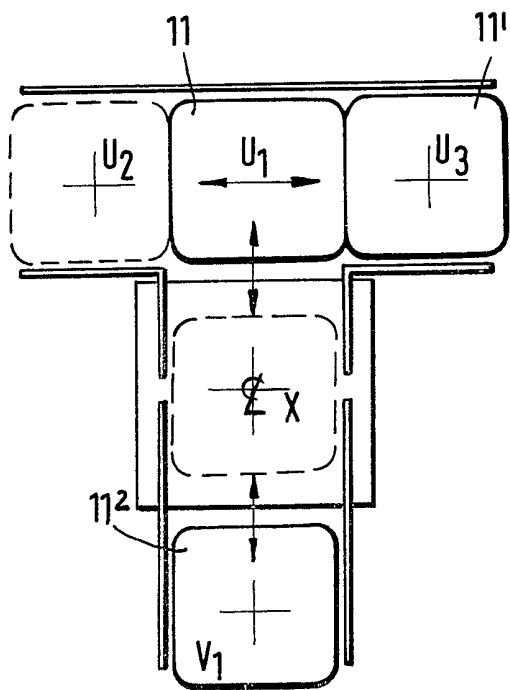


Fig. 10

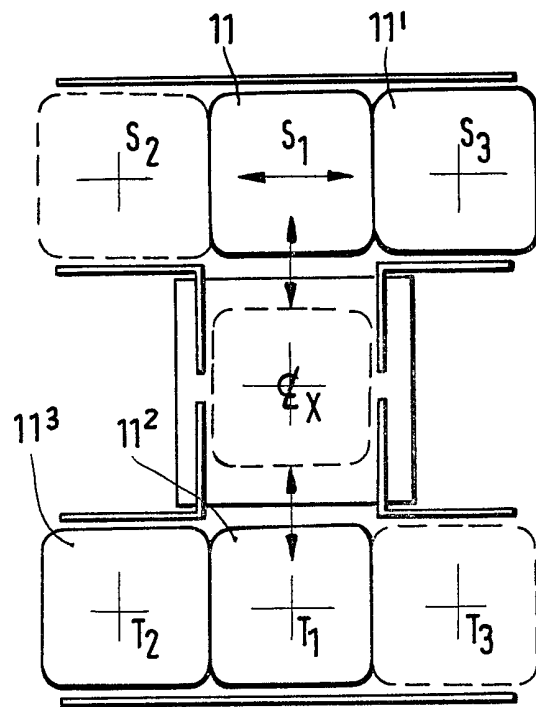
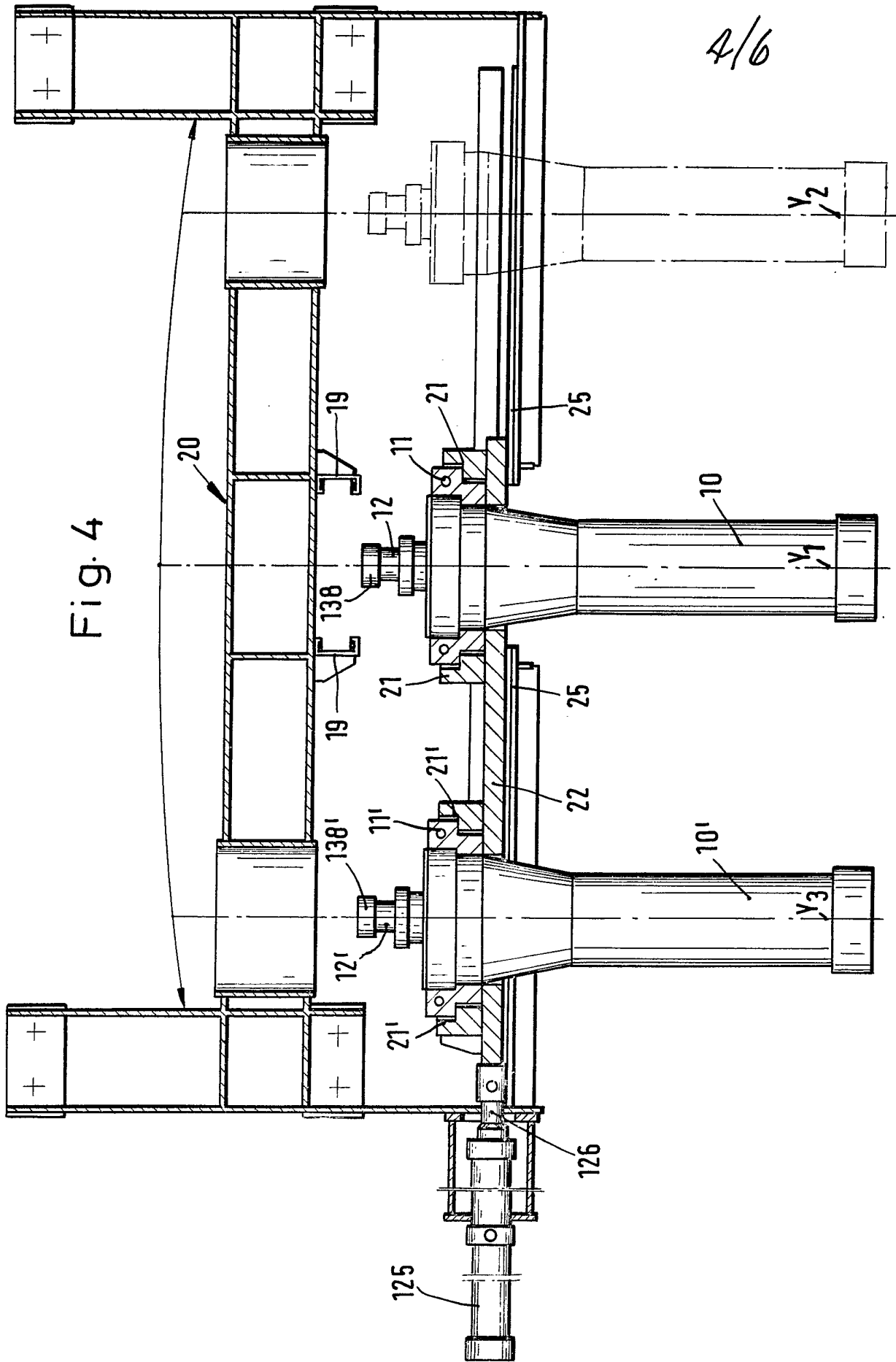


Fig. 11



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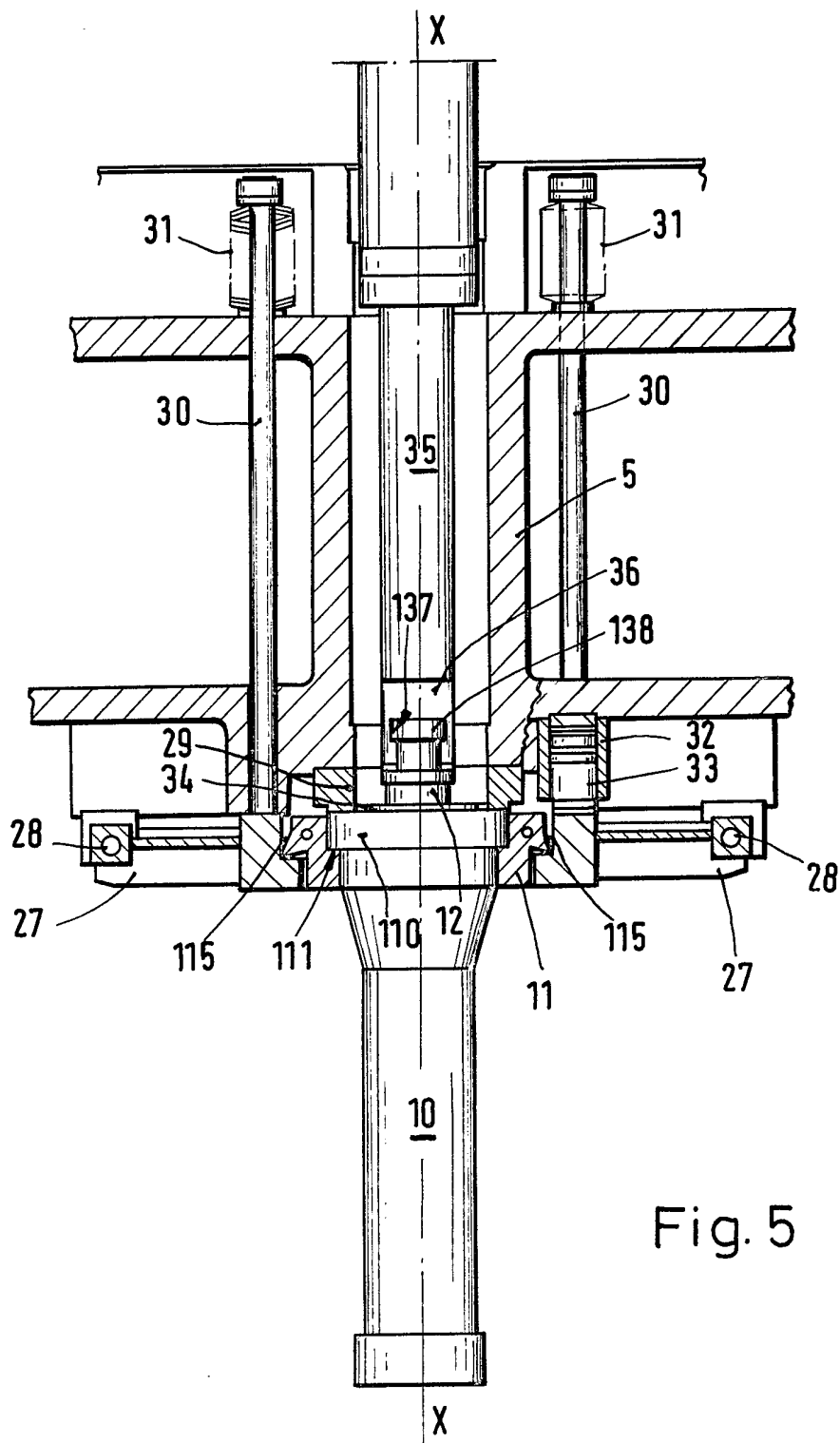


Fig. 5

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Fig. 8

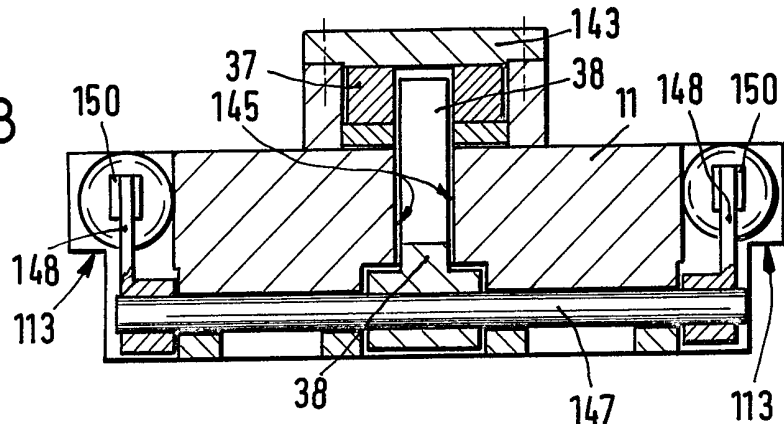


Fig. 7

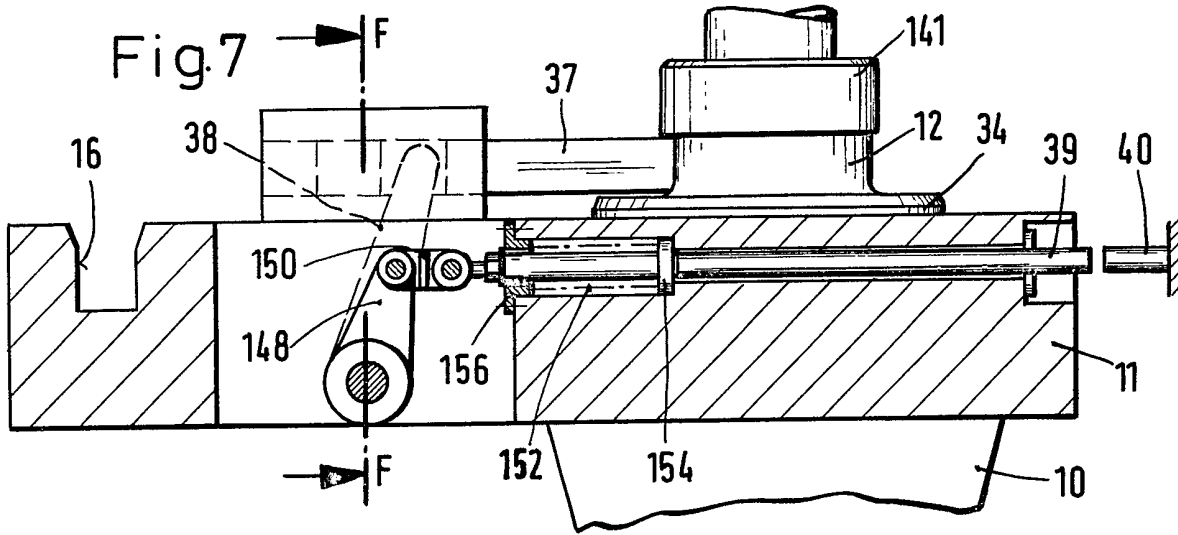
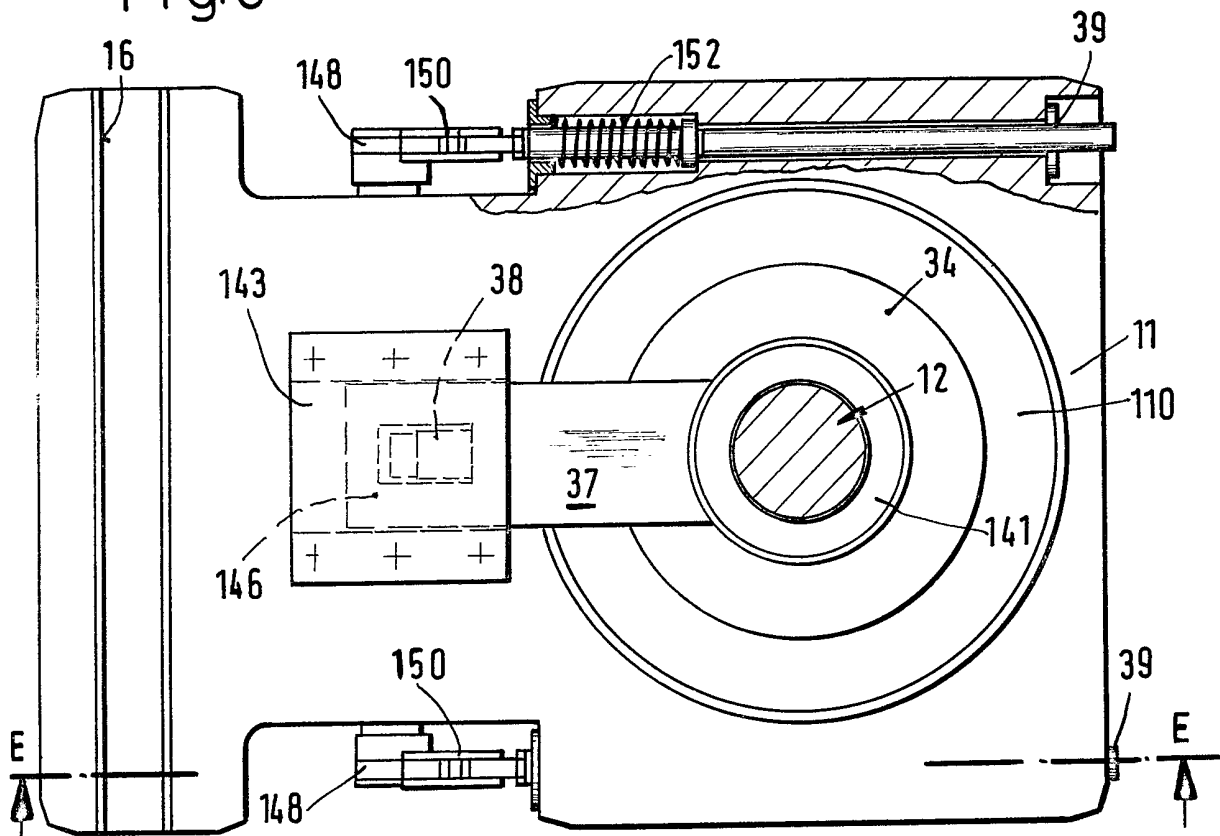


Fig. 6



## SPECIFICATION

**Presses, such as piercing presses or expanding presses, for operating on metal billets**

5 This invention relates to presses, such as piercing presses or expanding presses for operating on metal billets, comprising first and second concentrically disposed metal-working tools provided by an upsetting stem having an axially disposed internal bore and a mandrel movable within the bore in the upsetting stem, the upsetting stem and the mandrel being movable either together or separately along a common axis (conveniently the centre line of the press) to operate upon a metal billet supported, during operation of the press, in a billet container mounted in the press. In a press of the types under consideration, the upsetting stem and the mandrel are connected respectively to movable crossheads of the press, the crossheads being (in well known manner) guided for movement, either separately or together, to effect the desired axial movements of the upsetting stem and the mandrel during various stages of a cycle of operations of the press, the movements of the crossheads being effected by hydraulic piston and cylinder arrangements.

In a piercing press the mandrel is of the piercing type and, during a cycle of operations of the press, the upsetting stem and piercing mandrel are first moved together to apply pressure to one end of a solid metal billet supported in the billet container (the billet, when placed therein, being of slightly smaller diameter than the container) thereby to "upset" the billet and cause it to expand to the full diameter of the container. The piercing mandrel is then advanced relatively to the upsetting stem to cause the mandrel to pierce the billet. During the piercing operation billet material displaced by the advancing mandrel flows reversely around the mandrel as permitted by a retraction of the upsetting stem.

In an expanding press the upsetting stem is provided with a loose nose (which is retained in the upsetting stem in well known manner) and the mandrel is a so-called expanding mandrel, these tools being arranged to operate, during a cycle of operations of the press, to expand a billet (which has previously been machined to provide an axial bore therein for reception of the mandrel) in preparation for subsequent operation in an extrusion press to produce tubes or hollow members. It is to be understood that the invention is applicable to presses of either the piercing or expanding types but, for convenience, only a press of the piercing type will be described herein as illustrative of the invention.

In presses of the types under consideration it is known to connect a mandrel to its crosshead by means of a mandrel holder including a threaded connection between the mandrel and the holder. With such an arrangement it is necessary, in order to exchange mandrels, to effect disconnection of the old mandrel from the mandrel holder and the connection of a new mandrel thereto, at the centre line of the press, which is frequently a difficult and time-consuming operation due to the weight of the

mandrels and the possibility of misthreading or damaging the screw threaded connection. With a view to overcoming such difficulties it has been proposed to provide, in such presses, carriers for a plurality of mandrels and means for displacing the carriers with respect to the centre line of the press so that a selected one of the mandrels may be moved to operative position and connected to its holder in the press for use while another mandrel is being serviced or replaced.

With a view to further facilitating the exchanging of metal-working tools in a press of the types under consideration the present invention provides a press for operating on metal billets by means comprising first and second concentrically disposed metal-working tools provided by an upsetting stem having an axially disposed internal bore and a mandrel movable within the bore in the upsetting stem, the upsetting stem and the mandrel being connected, when in operative position in the press, respectively to movable crossheads of the press, the crossheads being guided in a main frame of the press for movement, either separately or together, to effect the desired movements of the upsetting stem and the mandrel along a common axis (e.g. the centre line of the press) during various stages of a cycle of operations of the press on a billet supported in a billet container mounted in the press, the movements of the crossheads being effected by hydraulic piston and cylinder arrangements, wherein the press is provided with a tool carrier for supporting the upsetting stem in operative position coaxial with said axis, said tool carrier being mounted for movement, on guide means disposed transversely with respect to said axis, to carry an upsetting stem and mandrel housed therein simultaneously to a position remote from said axis upon disconnection of the upsetting stem and mandrel from their respective crossheads.

Preferably, in a press as set out in the last preceding paragraph, the guide means comprises a pair of clamping and guiding members which, when a tool carrier is in operative position, are arranged to clamp the tool carrier in such position with an upsetting stem mounted thereon in operative engagement with its crosshead, the press also having means for moving the clamping and guiding members in a direction to unclamp the tool carrier and free it for movement along the clamping and guiding members towards its remote position. Conveniently the press is provided with spring means for urging the clamping and guiding members towards clamping position and with fluid pressure operated means for urging them, against the action of the spring means, in a direction to free the tool carrier.

Furthermore the last-mentioned crosshead is preferably provided with a pressure ring for engagement with an upsetting stem supported on the tool carrier, an aperture in the ring being arranged to receive an upstanding spigot formed on the upsetting stem to locate the stem on the press axis, the construction and arrangement being such that, when the clamping and guiding members are moved to free the tool carrier for movement, the upsetting stem is thereby lowered to withdraw the spigot from the aperture in

the pressure ring.

Preferably, in a press as set out in the last preceding paragraph but one, the movable cross-head for the mandrel is provided with a mandrel holder having a slotted connecting member for reception of a head portion of the mandrel, the construction and arrangement being such that, on movement of the tool carrier towards its remote position, the head portion of the mandrel slides out of the slotted connecting member. Furthermore the tool carrier is provided with means for supporting the mandrel within the upsetting stem during movement of the tool carrier between operative and remote positions. Conveniently the mandrel supporting means comprises a latch member movable, under the action of spring means, towards a position in which it engages beneath a collar portion of the mandrel and means is provided for automatically withdrawing the latch member from mandrel engaging position as the tool carrier completes its movement to operative position and the head portion of the mandrel moves into engagement with the slotted connecting member of the mandrel holder.

Preferably a press as set out in the last preceding paragraph but two comprises support means, carried by a main frame of the press and extending transversely of the press clear of said movable crossheads, for guideways on to which the tool carrier may be moved from the clamping and supporting members when the tool carrier is moved to its remote position. Conveniently the guideways just referred to are mounted on a transfer table movable along said support means between a position in which the guideways are in alignment with the clamping and guiding members on which the tool carrier is supported when in operative position in the press, and a remote position in which an upsetting stem and mandrel carried by a tool carrier supported on the guideways may be removed for servicing and replacement. Furthermore the transfer table preferably comprises additional guideways for supporting a second tool carrier with an upsetting stem and mandrel ready for transfer to operative position in the press. With such an arrangement it is possible rapidly to exchange one set of tools for another without the need for shutting down the press for any considerable period of time. Furthermore, the use of quick release connections between the tools and their respective crossheads further facilitates the tool-changing operation without the risk of damage to screw threaded connections as used in some conventional press arrangements. A press in accordance with the invention may include a pair of transfer tables and associated tool carriers arranged at front and rear sides of the press. Alternatively, no transfer tables may be used but a pair of tool carriers may be mounted on suitable guide means and movable transversely of the press axis towards remote positions one to the rear of the press and the other to the front thereof. It will be appreciated that the use of a press arrangement in which a tool carrier for an upsetting stem and mandrel is moved to a remote position in which the tool carrier is then supported on a portion of the press frame and not upon a support projecting from

a moving crosshead avoids the imposition on that crosshead of out-of-balance forces which would result from having a tool carrier and tools supported thereon mounted on such a projecting support.

Preferably, in a press as set out in the last preceding paragraph but three, a holder for connecting a mandrel with its crosshead includes means for adjusting the effective overall length of the mandrel holder and thereby adjusting the axial position of the mandrel with respect to its associated upsetting stem, thus facilitating the accurate setting up of the press tools for operation on a billet.

In order to maintain accurate control over the metal-working tools in a billet piercing operation so as to ensure a satisfactory piercing of the billet, a tool assembly comprising an upsetting stem having an axially disposed internal bore and a mandrel within the bore in the upsetting stem for use in a press as set out in the last preceding paragraph but four preferably includes guide means for maintaining concentricity between the mandrel and the upsetting stem during a billet piercing operation. Conveniently the diameter of the mandrel is somewhat less than that of the internal bore of the upsetting stem and said guide means comprises (a) a collar portion of the mandrel arranged near its head portion, the collar portion being of such a diameter as slidably to engage within said bore, and (b) a guide bush provided adjacent an end portion of the bore of the upsetting stem to provide for guidance of the mandrel as it emerges from said bore in a billet piercing operation.

With a view to facilitating the movement of a tool carrier between operative and remote positions without imposing any restriction on operative movements of the crossheads of the press, a press as set out in the last preceding paragraph but four and having clamping and guiding members as set out in the last preceding paragraph but three and support means carried by the main frame of the press for guideways on to which a tool carrier can be removed, preferably includes power-operated means, mounted on said support means, for withdrawing a tool carrier from operative position along said guideways, said power operated means being automatically connected with the tool carrier as the crosshead supporting the tool carrier moves to a position at which the clamping and guiding members are in alignment with said guideways, and disconnected therefrom when the crosshead moves in a cycle of operations of the press.

There will now be given, with reference to the accompanying drawings, a more detailed description of a press provided by and illustrative of the invention, the press being a piercing press of the kind above referred to. It is, however, to be clearly understood that the illustrative press is selected for description merely by way of exemplification, and not by way of limitation, of the invention.

In the accompanying drawings:-

*Figure 1* shows the general arrangement of a first form of the illustrative piercing press, in vertical section through the centre line of the press;

*Figure 2* is a sectional view taken on the same plane as *Figure 1* but to a larger scale, showing a

piercing mandrel, upsetting stem and associated parts, together with means, including a tool carrier, for removing the mandrel and upsetting stem from operative position on the centre line of the press to a remote position for servicing or replacement;

*Figure 3* is a diagrammatic representation, as viewed in plan on section A - A in *Figure 2*, showing positions taken up by the tool carrier during the withdrawal and exchanging of a mandrel and upsetting stem;

*Figure 4* is chiefly a sectional view taken on the plane B - B indicated in *Figure 2* showing a mandrel and upsetting stem on their associated carrier withdrawn from the press axis and a second tool carrier and associated mandrel and upsetting stem in a displaced position ready to be moved into operative position;

*Figure 5* is a view, chiefly in section on the plane C - C indicated in *Figure 2*, showing means for supporting and clamping a tool carrier in operative position in the press;

*Figure 6* is a plan view (partly in section) of a tool carrier and associated parts for supporting a mandrel and upsetting stem during movement between operative and remote positions;

*Figure 7* is a view, in vertical section on the plane E - E indicated in *Figure 6*, of the tool carrier and associated parts;

*Figure 8* is a sectional view of the tool carrier and associated parts on the plane F - F indicated in *Figure 7*; and

*Figures 9, 10 and 11* are diagrammatic representations (generally similar to *Figure 3*) but showing positions which may be taken up by tool carriers in modified forms of the illustrative press.

Referring to *Figure 1*, the illustrative press, in its first form to the described, comprises a main frame comprising a pair of upright side members 1 (one only shown in *Figure 1*) connected together, in well known manner, by upper and lower fixed cross-heads 2 and 3 respectively. Slidably associated in the machine frame (in well known manner) are a pair of movable crossheads 4, 5, an upper one (4) of which supports (as hereinafter described) a piercing mandrel 12 (see *Figure 2*) and a lower one (5) of which supports (also as hereinafter described) an upsetting stem 10. As is shown in *Figure 2*, the upsetting stem 10 has an axially disposed internal bore 13 in which the mandrel 12 is movable as hereinafter described, the upsetting stem and mandrel providing first and second metal working tools which, during a cycle of operations of the press, are movable either together or separately along a common axis arranged to be on the centre line X - X of the press (*Figure 1*) to operate upon a metal billet supported, during operation of the press, in a billet container 7 mounted in the press in well known manner. As shown in *Figure 1*, the billet container 7 is one of two billet containers 7, 8 received in a billet container holder assembly 6 which is rotatably mounted, about a vertical shaft 106 upstanding from the lower fixed crosshead 3, to bring the billet containers 7, 8 alternatively into operative position in well known manner. The invention is not, however, limited to presses having the particular billet container holder arrangement

described. The billet container 7 in operative position is arranged to support a billet of heated metal above a so-called back-up assembly of well known construction. The back-up assembly is indicated generally by the reference 9 in *Figure 1* and will not be described in detail herein.

The upper movable crosshead 4 is connected to a ram 65 of a hydraulic cylinder arrangement 66 supported by the upper fixed crosshead 2 and the mandrel 10 is (during operation of the press) carried by a mandrel holder 35 depending from the crosshead 4. Releasable connections (not shown, but of known construction) are provided between the upper and lower movable crossheads 4, 5, so that they can be moved together or separately as required during a cycle of operations of the press. The ram 65 may therefore be effective to move the two crossheads 4, 5 downwardly together during part of the cycle after which the crosshead 4 may move downwardly relatively to the crosshead 5 during a billet piercing operation. Other hydraulic piston and cylinder arrangements (not shown) are provided for effecting return movements of the crossheads 4, 5 as required.

In order to ensure satisfactory guidance of the mandrel 12 relatively to the upsetting stem 10 during a billet-piercing operation, the mandrel (which is, throughout the major portion of its length, of somewhat smaller diameter than the bore 13 in the upsetting stem) is provided with an upper collar portion 41 of such a diameter as to provide a sliding fit in the bore 13, while the lower end portion of the upsetting stem 10 is provided with a guide bush 42 housed within the bore 13 to maintain the piercing mandrel accurately in concentric alignment with the bore 10 of the upsetting stem during the piercing operation.

The manner in which the upsetting stem 10 and piercing mandrel 12 are supported in the press for movement between operative and remote positions when it is desired to exchange the mandrel and upsetting stem will now be described.

An upper portion of the upsetting stem 10 is provided with a flange portion 110 (see *Figures 2 and 3*) by which it is supported on a shoulder 111 in a tool carrier 11, the shoulder surrounding an aperture in the tool carrier through which the stem 10 extends downwardly.

The tool carrier 11 is constructed as shown in greater detail in *Figures 6, 7 and 8*. Shoulders 113 (*Figure 8*) extend along opposite side portions of the carrier 11 and these shoulders are slidably mounted in guideways 115 (*Figure 5*) of a pair of guiding and clamping members 117 formed on arms 27 which are pivotally mounted on shafts 28 supported by the crosshead 5 at opposite sides of the tool carrier 11. Inner end portions of the arms 27 providing the guiding and clamping members 117 are urged upwardly relatively to the crosshead 5 by means of a plurality of tie rods 30 extending heightwise through oversized bores in the crosshead 5, lower end portions of the tie rods being pivotally connected to the members 117 and upper end portions being headed and supported by a series of disc springs 31. The springs normally urge the guiding and clamping

members upwardly to clamp the tool carrier 11 with the flange portion 110 of the upsetting stem 10 clamped against a pressure ring 29 carried by an underside of the crosshead 5. As is shown in Figures 5, 6 and 7, the upsetting stem 10 is provided with a slightly projecting spigot 34 for locating the upsetting stem accurately (co-axially with the centre line of the press) within the pressure ring 29.

When it is desired to free the upsetting stem 10 and tool carrier 11 for movement away from operative position at the centre line of the press, the guiding and clamping members 117 are moved downwardly (by slight pivotal movement of the arms 27 about their shafts 28) by the action of hydraulic fluid on pistons 33 housed in cylinders 32 depending from the crosshead 5, the pistons 33 acting on upper surfaces of the members 117 against the action of the spring discs 31. The movement of the arms 27 under the action of the pistons 33 is limited, by any suitable means, to an amount sufficient to unclamp the stem 10 from engagement with the pressure ring 29, the stem 10 being lowered sufficiently to allow the spigot 34 to clear the ring 29. The tool carrier 11 can then be displaced along the guideways 115 as hereinafter described.

The piercing mandrel 10 is detachably held in a slotted connecting member 36 screwed to a lower end portion of the mandrel holder 35. The member 36 is provided with a slot 137 extending from one side of the member and adapted to receive a head portion 138 of a mandrel 12. Just below the slot 137 the connecting member 36 has a portion 139 (C-shaped as seen from the lower end of the connecting member) which embraces a neck portion of the mandrel just below the head portion 138. The dimensions and arrangement of the co-acting parts of the mandrel and the connecting member are such as to provide a fairly close and secure fit of the parts while allowing the mandrel to be displaced laterally from the centre line of the press to detach the mandrel from the mandrel holder when the tool carrier 11 is moved along the guideways 115, so that the mandrel 12 and the stem 10 can be removed together from operative position while the mandrel remains housed in the bore 13 in the stem 10.

With a view to preventing the mandrel 10 from dropping through the bore 13 as it becomes detached from the connecting member 36 as a consequence of lateral movement of the tool carrier 11, the latter is provided with a mandrel-latching device which is shown in Figures 2, 6, 7 and 8. The latching device comprises a latch plate 37 which is guided for movements towards and away from the mandrel 12 in a guide arrangement 143 secured to an upper surface of the tool carrier in such manner as to bridge an aperture 145 extending heightwise there-through (see Figures 7 and 8). During movement of the tool carrier the latch member is arranged to engage the mandrel 12 below a collar portion 141 thereof (the free end portion of the latch plate being appropriately curved to correspond to the circumferential surface of the portion of the mandrel just below the collar portion 141) and thus to support the mandrel within the upsetting stem 10. For moving the latch plate to mandrel supporting position, there

is provided a lever 38 housed in the aperture 145 and having an upper end portion engaging within a slot 146 in the latch plate. The lever is secured to a cross shaft 147 housed within the tool carrier 11 by suitable bearing arrangements. Secured to opposite end portions of the shaft 147 are a pair of parallel arms 148 connected by links 150 with push rods 39 slidably mounted in suitable bores in the tool carrier 11, these bores extending in the direction of movement of the tool carrier. Springs 152 housed around the push rods 39 between flanges 154 on the push rods and end caps 156 screwed into said bores, urge the push rods to the right (as seen in Figures 6 and 7) and thus (through the arms 148, cross shaft 147 and lever 38) act to urge the latch plate 37 into mandrel-supporting position. When the tool carrier 11 is moved towards the right as seen in Figures 2, 6 and 7 to locate an upsetting stem 10 and mandrel 12 in operative position in the press with the head 138 of the mandrel located in the connecting member 36, end portions of the push rods 39 engage fixed stop members 40 (fixedly mounted on the crosshead 5 in any suitable manner) just before the completion of such movement of the tool carrier so that the final portion of such movement causes the push rods 39 to be moved to the left (as seen in Figures 6 and 7) to withdraw the latch member 37 from supporting engagement with the mandrel 12.

A frame assembly 20 is fixedly secured to the side members 1 of the press frame (see Figures 1, 2 and 4) and extends transversely between the side members 1 at a locality to the rear of the movable crosshead 5. Supported by the frame assembly 20 are a pair of guideways 24, 25 (see Figure 2) upon which is slidably supported a transfer table 22 movable in a direction extending widthwise of the press in a horizontal plane extending between the side members of the main frame, such movements of the transfer table being effected by a hydraulic piston and cylinder arrangement, the cylinder 125 of which is supported on the frame assembly 20 and the piston 126 of which is connected to the transfer table (see Figure 4). Mounted on the transfer table are two pairs of guideways 21, 21 and 21', 21'. When the transfer table 22 occupies the position in which it is shown in Figure 4, the guideways 21 are so positioned that they effectively form extensions of the guideways 115 of the guiding and clamping members 117 (Figure 5), it being understood that the frame assembly 20 is located on the press frame at the desired heightwise position with respect to the crosshead 5 when the latter is held at a certain heightwise position (i.e. the position it is shown occupying in Figure 1) and the guiding and clamping members 117 being in their unclamped positions so that the tool carrier 11 is freed to be moved, together with the upsetting stem 10 and mandrel 12 supported thereon, along the guideways 115 and on to the guideways 21, 21 on the transfer table, the table being provided with a recess 127 into which the stem 10 is received (see Figures 2 and 4).

The frame assembly 20 supports a pair of rails 19, 19 spaced apart widthwise of the press as shown in Figure 4, along which rails is movable a trolley 14 (see Figure 2) having wheels 18 running on the rails.

Movement of the trolley 14 along the rails 19 is effected by means of a hydraulic piston/cylinder arrangement, the cylinder 17 of which is supported on a frame member extending between the rails 19 and the piston rod 127 of which is connected to a depending portion of the trolley on which is formed a downwardly extending tongue 15 which (when the piston rod 127 is in an out-stroked position as shown in Figure 2) is arranged to enter an upwardly facing groove 16 formed in the tool carrier 11 when the tool carrier is in operative position and the crosshead 5 occupies its raised position as shown in Figure 2.

The guideways 21', 21' (Figure 4) on the transfer table 22 are arranged to support a second tool carrier 11' carrying a replacement upsetting stem 10' and associated mandrel 12' and the distance between the two sets of guideways 21, 21 and 21', 21' is such that, after a tool carrier 11 has been withdrawn from its operative position (represented by X in Figure 3) to its withdrawn position (indicated by Y<sub>1</sub> in Figures 3 and 4) and the piston rod 126 has been outstroked to move the transfer table 22 along the guideways 24, 25 until the tool carrier 11 and the stem and mandrel supported thereby arrive at displaced position indicated by Y<sub>2</sub> in Figures 3 and 4, the tool carrier 11' with replacement stem 10' and mandrel 12' supported thereby are transferred from position Y<sub>3</sub> to Y<sub>1</sub> ready for the tool carrier 11' to be moved from position Y<sub>1</sub> into operative position on the press centre line X (Figure 3) by the outstroking of piston 127 (Figure 2), to a limit determined by engagement of the tool carrier with a step member 26 (Figure 2) supported by the crosshead 5, the spigot 34 on the upsetting stem then being located beneath the opening in the pressure ring 29. It will be understood that movement of the transfer table as just described will have disengaged the groove 16 of the tool carrier 11 from the tongue 15 of the trolley 14 and will have caused the tongue to enter the corresponding groove 16' of the tool carrier 11'. After the tool carrier 11' has been moved to operative position with the mandrel 12' and stem 10' located on the centre line of the press, hydraulic pressure is released from the cylinders 32 to allow the disc springs 31 once again to cause the tie rods 30 to swing the arms 27 upwardly to cause the guiding and clamping members 117 to clamp the carrier 11' and stem 10' in operative position on the centre line of the press with the upsetting stem seated against the pressure ring 29. Movement of the tool carrier to operative position will have caused the head 138' of the mandrel 12' to enter the slot 136 of the connecting member 35 to establish connection between the mandrel 12' and the mandrel holder 35, and hence between the mandrel and the piercing crosshead 4.

It is important to maintain the correct heightwise relationship between the lower end portions of the mandrel 12 and the upsetting stem 10 and for this purpose the illustrative press includes means 160 (Figure 1) for adjusting the overall length of the mandrel 35. While this adjusting means may be of any suitable form, it is convenient to make the mandrel holder 35 in two parts, an upper one 35a of which is fixedly connected to the crosshead 4 and a lower one 35b of which is connected to the connect-

ing member 36 which supports the mandrel. The two portions 35a and 35b of the mandrel holder are conveniently connected together by means of a connecting member 161 which is threaded into the portions 35a and 35b with screw threads of opposite hand so that rotation of the connecting member will effect adjustment of the overall length of the mandrel holder 35. Preferably rotation of the connecting member 161 is effected by a motor drive housed within a housing 162 surrounding the mandrel holder 35.

The illustrative machine may be provided with mandrel and upsetting stem carrying arrangements of somewhat modified forms as compared with that hereinbefore described, the modified forms providing for different combinations of tool carriers and associated parts arranged so that the tool carriers may be moved to carry mandrels and upsetting stems to and from the centre line of the press in paths indicated generally in Figures 9, 10 and 11.

The modified arrangement depicted in Figure 9 comprises a pair of tool carriers 11 and 11', the carrier 11 having been moved forwardly away from a position in which it locates a mandrel and upsetting stem on the centre line X of the press to a displaced position W<sub>2</sub>. The second carrier 11' is shown as occupying a rearwardly displaced position W<sub>3</sub> ready to be transferred to operative position to locate another mandrel and upsetting stem in operative position on the centre line X. A press incorporating the arrangement depicted in Figure 9, while being generally similar to the form of the illustrative press hereinbefore described with reference to Figures 1 - 8, is modified to the extent that it requires no transfer table like the transfer table 22 or parts associated therewith. It will be apparent that the press will incorporate a suitably modified guide arrangement for the tool carriers 11 and 11' and duplicated piston and cylinder devices (generally similar to that including the cylinder 17 shown in Figures 1 and 2) there being one each at the front and rear of the press. Furthermore the mandrel holder 35 will need to have a modified slotted connecting member (cf the connecting member 36 hereinbefore described) to permit movement of mandrels forwardly and rearwardly from the press centre line, and modified stop means (cf the stop member 26) will need to be provided for locating either one of the tool carriers 11 and 11' in operative position.

The modified arrangement depicted in Figure 10 comprises three tool carriers 11, 11' and 11<sup>2</sup>, of which the carriers 11 and 11' are arranged for movement between positions U<sub>1</sub>, U<sub>2</sub> and U<sub>3</sub> by a transfer table and from position U<sub>1</sub> and operative position on the press centre line X as hereinbefore described with reference to Figures 1 - 8, while the tool carrier 11<sup>2</sup> is directly transferable between operative position on the press centre line X and a forwardly displaced position V<sub>1</sub> in a generally similar manner to the tool carrier 11 in the arrangement depicted in Figure 9.

The modified arrangement depicted in Figure 11 comprises four tool carriers 11, 11', 11<sup>2</sup> and 11<sup>3</sup> of which 11 and 11' are supportable upon a first

transfer table for movement between positions  $S_1$  and  $S_2$  and between positions  $S_3$  and  $S_1$ , the carrier at position  $S_1$  being movable to operative position on the press centre line X all as hereinbefore

5 described in connection to the first form of the illustrative press shown in Figures 1 - 8. The tool carriers  $11^2$  and  $11^3$  are similarly supportable upon a second transfer table mounted for movement across the front of the press between positions  $T_1$  and  $T_3$  and between positions  $T_2$  and  $T_1$  respectively, the carrier at position  $T_1$  being movable to operative position on the press centre line X assuming that both carriers 11 and  $11'$  are in displaced positions at the rear of the press. All of the arrangements depicted in Figures 9, 10 and 11 are considered to be within the scope of the present invention.

It will be appreciated that, in order to permit transverse movement of a mandrel with an upsetting stem on a tool carrier as hereinbefore described, the pressure ring 29 (carried by the crosshead 5), against which the upper end portion of the upsetting stem is clamped when in operative position, is provided with a gap (through which also slides the latch plate 37, see Figure 20) or, in the case of the modified arrangements depicted in Figures 9, 10 and 11, a pair of such gaps diametrically opposed. The crosshead 5 is also provided with a recess or recesses as necessary for the passage of the mandrel head.

At each of the displaced positions to which the several tool carriers are adapted to transfer mandrels and associated upsetting stems for replacement or servicing, there will be provided a suitable hoist arrangement (either manually or power-operated) for lifting the mandrel and upsetting stem from a tool carrier, and also means for moving the push rods 39 of the tool carrier against the action of the springs 152 to cause the latch plate 37 to be withdrawn from engagement with the mandrel collar portion 141 to free the mandrel and upsetting stem for removal from the tool carrier by the hoist arrangement. After the tool carrier has been reloaded with a mandrel and upsetting stem the push rods 39 will be released to the action of the springs to cause the latch plate 37 to latch the mandrel and upsetting stem in position on the tool carrier ready for transfer back to operative position in the press.

Whilst reference has been made in the foregoing description to a pair of guiding and clamping members 117, it is to be understood that an alternative arrangement may be provided wherein the clamping members are separate from the guiding members, and are independently actuated.

## 55 CLAIMS

1. A press for operating on metal billets by means comprising first and second concentrically disposed metalworking tools provided by an upsetting stem having an axially disposed internal bore and a mandrel movable within the bore in the upsetting stem, the upsetting stem and the mandrel being connected, when in operative position in the press, respectively to movable crossheads of the press, the crossheads being guided in a main frame

of the press for movement, either separately or together, to effect the desired movements of the upsetting stem and the mandrel along a common axis (e.g. the centre line of the press) during various stages of a cycle of operations of the press on a billet supported in a billet container mounted in the press, the movements of the crossheads being effected by hydraulic piston and cylinder arrangements, wherein the press is provided with a tool carrier for supporting the upsetting stem in operative position coaxial with said axis, said tool carrier being mounted for movement, on guide means disposed transversely with respect to said axis, to carry an upsetting stem and mandrel housed therein simultaneously to a position remote from said axis upon disconnection of the upsetting stem and mandrel from their respective crossheads.

2. A press in accordance with claim 1 wherein the guide means comprises a pair of clamping and guiding members which, when a tool carrier is in operative position, are arranged to clamp the tool carrier in such position with an upsetting stem mounted thereon in operative engagement with its crosshead, and there being means for moving the clamping and guiding members in a direction to unclamp the tool carrier and free it for movement along the clamping and guiding members towards its remote position.

3. A press in accordance with claim 2 wherein the press is provided with spring means for urging the clamping and guiding members towards clamping position and fluid pressure operated means for urging them, against the action of said spring means, in said direction to free the tool carrier.

4. A press in accordance with claim 3 wherein the crosshead to which the tool carrier is clamped by said clamping and guiding members is provided with a pressure ring for engagement with an upsetting stem supported on the tool carrier, an aperture in the ring being arranged to receive an upstanding spigot formed on the upsetting stem to locate the stem on said axis, the construction and arrangement being such that, when the clamping and guiding members are moved to free the tool carrier for movement, the upsetting stem is thereby lowered to withdraw the spigot from the aperture in the pressure ring.

5. A press in accordance with any one of claims 2, 3 and 4 wherein the movable crosshead for the mandrel is provided with a mandrel holder having a slotted connecting member for reception of a head portion of the mandrel, the construction and arrangement being such that, on movement of the tool carrier towards its remote position, the head portion of the mandrel slides out of the slotted connecting member.

6. A press in accordance with claim 5 wherein the tool carrier is provided with means for supporting the mandrel within the upsetting stem during movement of the tool carrier between operative and remote positions.

7. A press in accordance with claim 6 wherein the mandrel supporting means comprises a latch member movable, under the action of spring means, towards a position in which it engages beneath a

collar position of the mandrel and there being means for automatically withdrawing the latch member from mandrel engaging position as the tool carrier completes its movement to operative position and the head portion of the mandrel moves into engagement with the slotted connecting member of the mandrel holder.

8. A press in accordance with any one of claims 2 - 7 inclusive wherein the press comprises support means, carried by a main frame of the press and extending transversely of the press clear of said movable crossheads, for guideways on to which the tool carrier may be moved from the clamping and supporting members when the tool carrier is moved to its remote position.

9. A press in accordance with claim 8 wherein said guideways are mounted on a transfer table movable along said support means between a position in which the guideways are in alignment with the clamping and guiding members on which the tool carrier is supported when in operative position in the press, and a remote position in which an upsetting stem and mandrel carried by a tool carrier supported on the guideways may be removed for serving and replacement.

10. A press in accordance with claim 9 wherein the transfer table comprises additional guideways for supporting a second tool carrier with an upsetting stem and mandrel ready for transfer to operative position in the press.

11. A press in accordance with any one of claims 8, 9 and 10 wherein the press is provided with a plurality of tool carriers with any required transfer means constructed and arranged to provide for movements of the tool carriers between operative and remote positions in any one of the ways depicted in Figures 3, 9, 10 and 11 of the accompanying drawings.

12. A press in accordance with any one of the preceding claims wherein a holder for connecting a mandrel with its crosshead includes means for adjusting the effective overall length of the mandrel holder and thereby adjusting the axial position of the mandrel with respect to its associated upsetting stem.

13. A tool assembly, comprising an upsetting stem having an axially disposed internal bore and a mandrel movable within the bore in the upsetting stem, suitable for use in a press in accordance with any one of the preceding claims, wherein guide means is provided for maintaining concentricity between the mandrel and the upsetting stem during a billet piercing operation of the mandrel.

14. A tool assembly in accordance with claim 13 wherein the diameter of the mandrel is somewhat less than that of the internal bore of the upsetting stem and said guide means comprises (a) a collar portion of the mandrel arranged near its head portion, the collar portion being of such a diameter as slidably to engage within said bore, and (b) a guide bush provided adjacent an end portion of the bore of the upsetting stem to provide for guidance of the mandrel as it emerges from said bore in a billet piercing operation.

15. A press in accordance with any one of claims

8 - 11 inclusive wherein said support means has mounted thereon power operated means for withdrawing a tool carrier from operative position along said guideways, said power operated means being automatically connected with the tool carrier as the crosshead supporting the tool carrier moves to a position at which the clamping and guiding members are in alignment with said guideways, and disconnected therefrom when the crosshead moves in a cycle of operations of the press.

16. A press in accordance with claim 1 wherein the press is provided with guiding members and at least one clamping member which, when a tool carrier is in operative position, is arranged to clamp the tool carrier in such a position with an upsetting stem mounted thereon in operative engagement with its crosshead, and there being means for moving the clamping member in a direction to unclamp the tool carrier and free it for movement along the guiding members towards its remote position.

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