

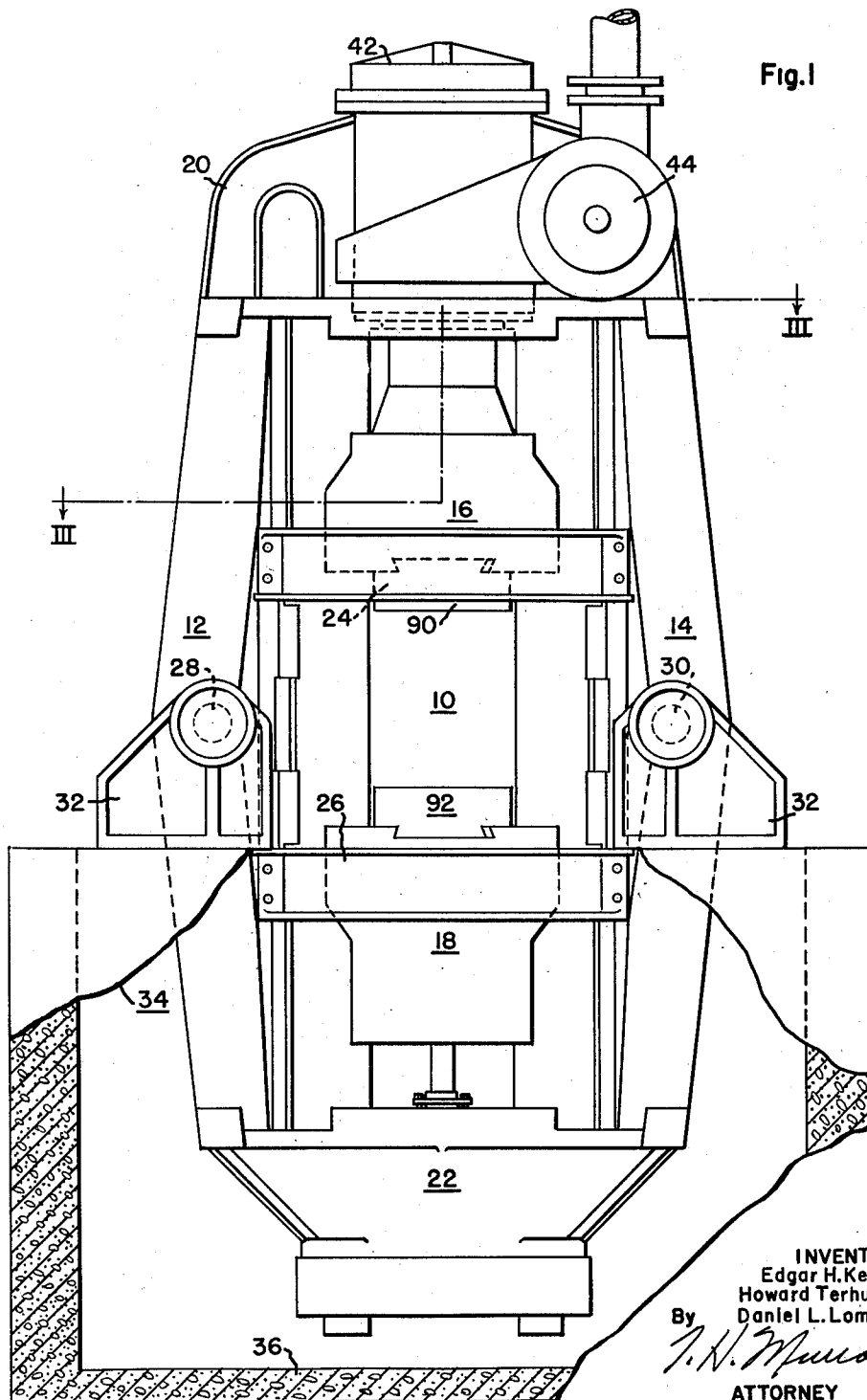
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E. H. KENDALL ET AL
COUNTER-BLOW FORGING HAMMER

2,914,971

Filed May 28, 1957

5 Sheets-Sheet 1



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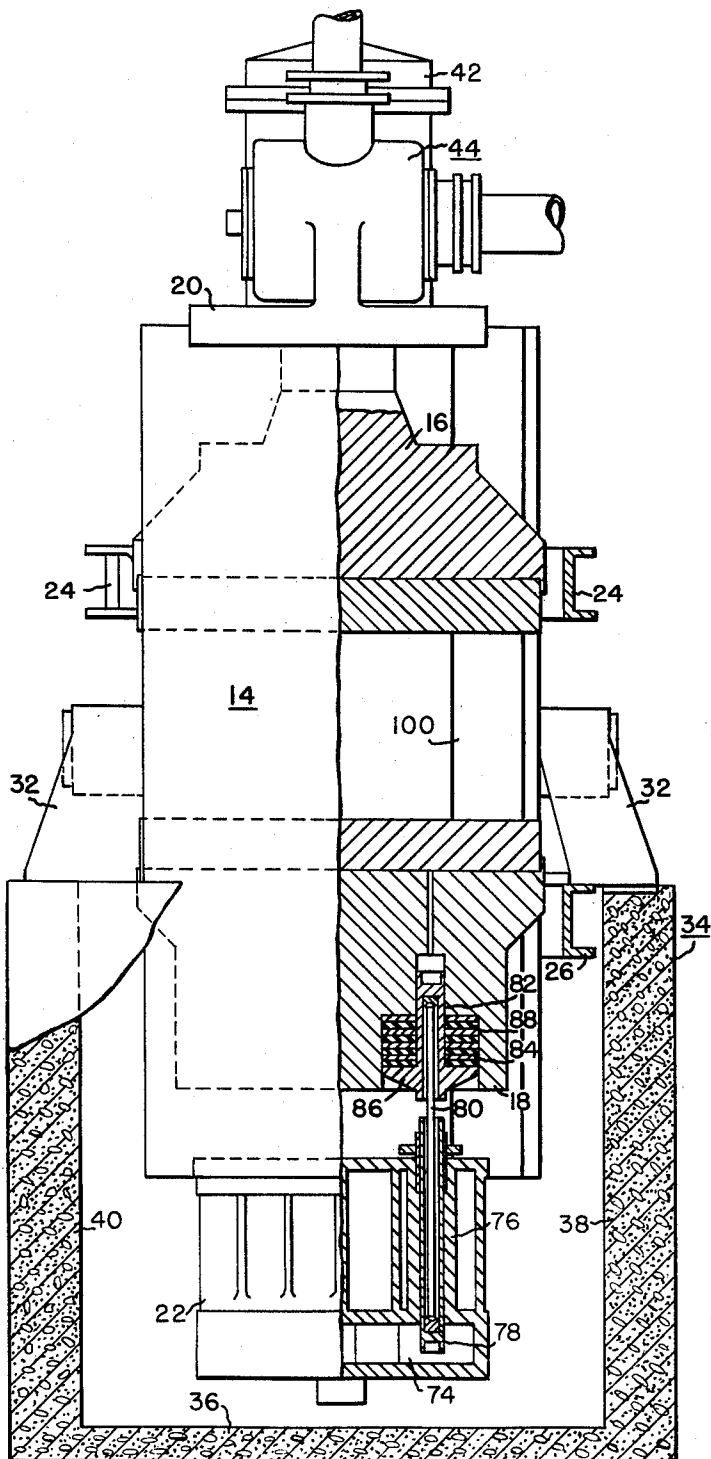
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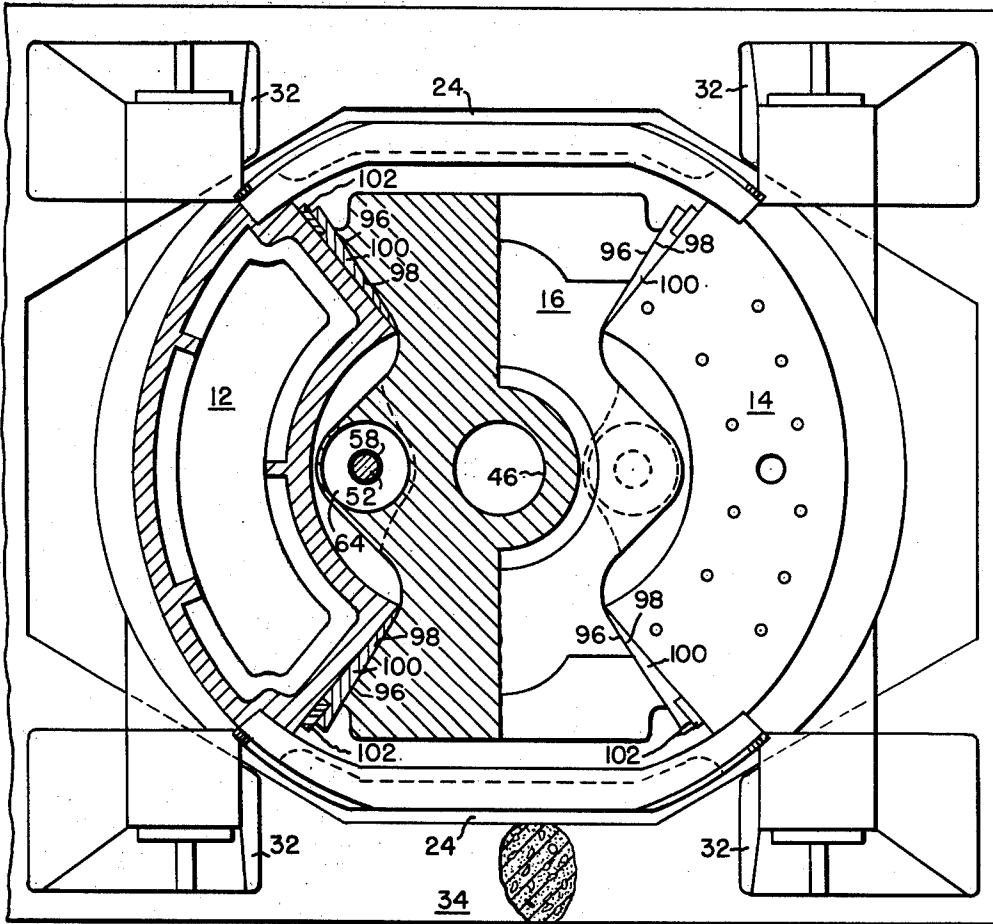


Fig. 3

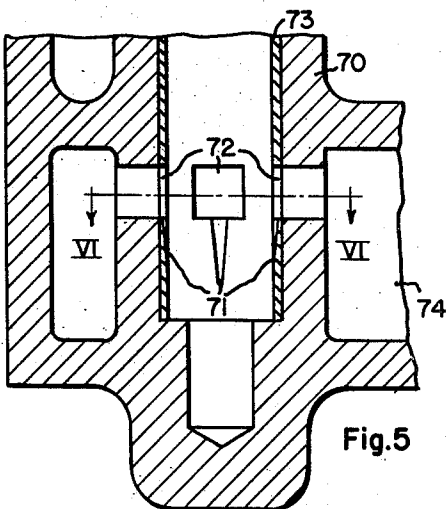


Fig. 5

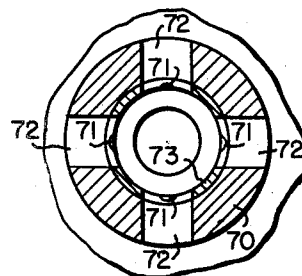


Fig. 6

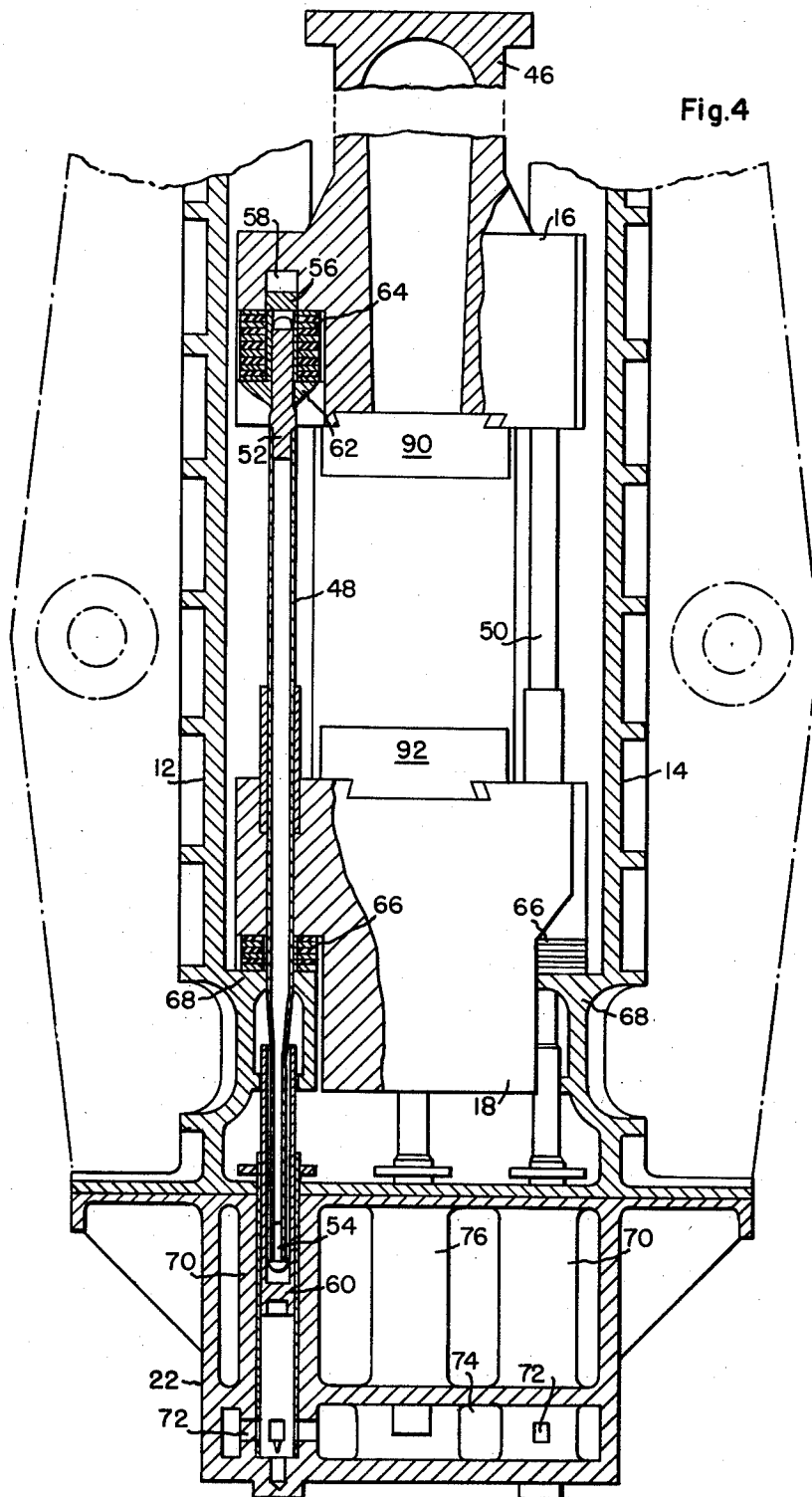
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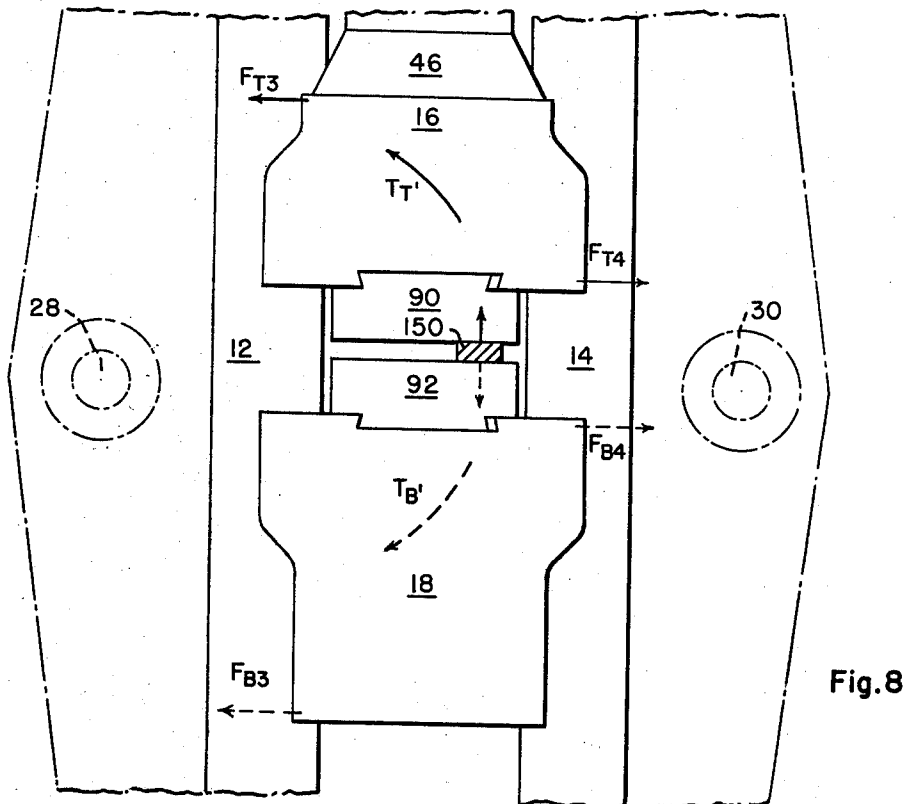
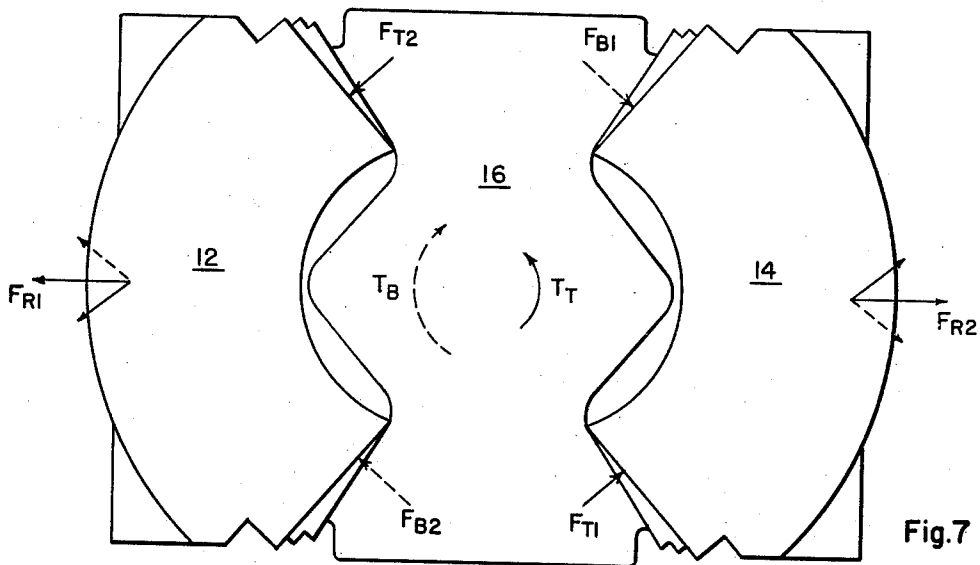
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COUNTER-BLOW FORGING HAMMER

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8 Claims. (Cl. 78—42)

This invention relates to counter-blow forging hammers of relatively large capacity and more particularly to support means for a counter-blow hammer which will minimize bending and twisting moments in the structural members of the hammer.

As the name implies, counter-blow forging hammers are those in which a forging is formed between a pair of relatively movable forging rams which are forced together into engagement along a vertical axis. The arrangement is such that as an upper ram moves downward, it transmits force through a fluid transmission system to a lower ram which moves upward to meet the downwardly moving ram.

It has been common practice in the construction of counter-blow hammers to provide a base or foundation which supports a plurality of upright columns for guiding the rams along their vertical path of travel. The upper extremities of the columns are interconnected by a large heavy crosshead which normally carries a steam cylinder or other similar device which provides motive power to force the rams into engagement. Although hammers of this type have proved to be successful in certain installations, they are generally considered to be impractical for forgings of great length or width where very high forging pressures are required. Usually the shape of the forging dies is such that an uneven loading will be produced on the rams when they are forced into engagement, thereby causing the rams to twist or skew with respect to their axial path of travel during the impact of forging. Since the rams are guided by the aforesaid vertical columns, this twisting causes bending moments or deflection in the columns, resulting in high internal stresses and mismatching of die impressions.

Heretofore, the problem of bending and deflection has been attacked by attempting to provide columns having the requisite strength characteristics to take such loadings. For example, one method has been to laminate the vertical columns and crosshead so that the laminae making up the structural members are free to move relative to each other and are thus stressed separately. The present invention, on the other hand, solves the problem of bending and deflection, not by attempting to design columns and other support members which will withstand severe internal stresses, but by providing an entirely new counter-blow hammer configuration which will minimize or eliminate bending moments in the structural members of the hammer.

Accordingly, it is a primary object of this invention to provide a new and improved counter-blow hammer arrangement.

More specifically, an object of the invention is to provide a counter-blow forging hammer in which bending and deflection of the structural members of the hammer are minimized.

Another object of the invention is to provide means for supporting a counter-blow hammer against gravity in a plane which is in close proximity to the plane of engagement of the two forging rams of the hammer.

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A still further object of the invention is to provide a new and improved hydraulic force transmission system for a counter-blow hammer.

In one embodiment of the invention, hereinafter described, there is provided an integral frame member including a pair of lateral guiding and supporting members located on either side of two forging rams. The frame is suspended on the upper edges of a generally cup-shaped foundation by projections which extend outwardly from the lateral guiding members, the arrangement being such that a portion of the frame extends into the cavity formed by the cup-shaped foundation. By locating these projections in close proximity to the plane of engagement of the forging rams, and by securing the projections to the upper edges of the cup-shaped foundation, an external lateral support is provided for the ram guides at a point where maximum deflection would occur, thereby minimizing or eliminating such bending.

The above and other objects and features of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings which form a part of this specification, and in which:

Figure 1 is a plan view of one embodiment of the invention;

Fig. 2 is a partially broken away side view of the embodiment shown in Fig. 1;

Fig. 3 is a sectional view taken along line III—III of Fig. 1;

Fig. 4 is a broken away cross sectional view of the invention showing its hydraulic transmission system;

Fig. 5 is a detailed showing of a portion of the hydraulic force transmitting system of the invention;

Fig. 6 is a cross sectional view taken along line VI—VI of Fig. 5;

Fig. 7 is a diagrammatic view of the horizontal twisting moments and forces produced by the rams of the invention during a forging impact; and

Fig. 8 is a diagrammatic view of the vertical twisting moments and forces produced by the aforementioned rams.

Referring to Figs. 1, 2 and 3, the embodiment of the invention shown comprises an integral frame member 10 having a pair of spaced, upright columns 12 and 14 which guide forging rams 16 and 18 along a vertical path of travel. The upper extremities of the columns 12 and 14 are interconnected by a crosshead 20 while the lower extremities are interconnected by a housing structure, generally indicated at 22. As will be understood, the ends of the columns 12 and 14 are securely fastened to the crosshead 20 and housing 22, respectively, by bolts or other suitable fastening means so that a composite structure is formed for guiding the rams 16 and 18 along their vertical paths of travel. The columns 12 and 14 are joined at opposite sides by cross bars 24 and 26, substantially as shown.

Extending through the columns 12 and 14 approximately midway between their opposite extremities are bars 28 and 30 which support the hammer against gravity. The opposite ends of the bars 28 and 30 are journaled in four bearing blocks 32 which rest on the upper edge of a generally cup-shaped foundation 34 of concrete or other suitable material. In cross section (Fig. 2) the foundation appears as a base 36 having a pair of spaced upwardly extending structures 38 and 40 which support the blocks 32 on their upper extremities. Besides being located approximately midway between the opposite extremities of columns 12 and 14, the bars 28 and 30 are also located in, or in close proximity to, the plane of engagement of rams 16 and 18 for a purpose which will hereinafter be explained.

Carried on crosshead 20 is a steam cylinder 42 which is controlled by a control valve 44. Reciprocable within cylinder 42 is a piston 46, shown in Fig. 4, which is an integral part of the upper forging ram 16, the arrangement being such that when steam under pressure is admitted to cylinder 42 above piston 46 the piston and ram 16 are forced downward. Movement of the lower ram 18 is effected by a hydraulic transmission system, hereinafter described, which forces the lower ram 18 upward as the upper ram 16 moves downward, and vice versa.

The hydraulic system for controlling ram 18 is best shown in Figs. 2 and 4 and comprises a pair of tubular rods 48 and 50 positioned on either side of the central axis of the hammer. The opposite ends of each of the rods 48 and 50 are provided with plugs 52 and 54. The upper plug 52 extends into an annular shoulder element 56 which has a necked-down portion extending into a vertical bore 58 provided in ram 16, while a reduced diameter portion of the rod and the lower plug 54 extend into the hollow interior of a tubular piston 60. Surrounding element 56 between flange 62 and a corresponding shoulder on the ram are laminated washers 64 which may, for example, comprise successive annuli of rubber and metal to provide a cushion between ram 16 and rod 48 or 50. Similar washers 66 surround each of the rods 48 and 50 between an inwardly-projecting flange 68 on the column 12 or 14 and a shoulder on the underside of ram 18 to cushion and limit the downward travel of the lower ram.

Each of the pistons 60 is reciprocable within an associated cylinder 70 carried within housing 22. The lower portions of the cylinders 70 communicate through passages 72 with a chamber 74 in the lower portion of housing 22. Chamber 74 also communicates with a second pair of spaced cylinders 76, one of which is shown in cross section in Fig. 2. Reciprocable within cylinders 76 are tubular pistons 78 which are similar to the pistons 60 already described. As shown, each of the pistons 78 is connected to the lower ram 18 by a tubular rod 80, the upper extremity of which extends into an annular shoulder element 82. A cushion 84, similar to those already described, is positioned between a flange 86 on the element 82 and the upper inside surface of a bore 88 in ram 18.

From the foregoing, it should be apparent that when steam is applied to the upper surface of piston 46 to force ram 16 and rods 48 and 50 downward, the resulting fluid pressure in chamber 74 forces pistons 78 and ram 18 upward to meet the downwardly-moving ram 16. The strokes of the rams are substantially the same so that the surfaces of dies 90 and 92 which are carried by the rams meet in a plane which lies in close proximity to the midpoint between the opposite extremities of columns 12 and 14.

If, for some reason, the hydraulic transmission system is not entirely filled with fluid, the upper ram 16 will move downward to take up the unfilled volume before the lower ram 18 starts moving upward. This, of course, increases the stroke of the upper ram. If the increase in stroke is great enough, damage may result from the pistons 60 bottoming against the ends of cylinders 70. To prevent such damage, the arrangement shown in Figs. 5 and 6 is provided wherein tapered grooves 71 are employed on the inner surface of the sleeve 73 in cylinder 70. It is apparent from the drawing that the cross-sectional areas of the orifices formed by grooves 71 as pistons 60 overshoot and travel downward beyond passages 72 gradually decrease. Consequently, the pressure beneath the pistons increases as their forward ends pass grooves 71, and this increase in pressure produces a relatively gradual deceleration of the ram 16 and pistons 60 to prevent any damage which otherwise might be caused by impact of the pistons against the bottoms of cylinders 70. It will be noted that since the entire lower

portion of the hydraulic system is contained within the integral housing structure 22, the possibility of leakage is minimized. Furthermore, since the housing 22 is connected to the lower extremities of columns 12 and 14 over a wide area, the downward force produced on housing 22 is distributed over a wide area also, and the strength requirements of the individual devices for fastening these parts together are not as severe as they would be if the lower portion of the hydraulic system were broken into several parts.

In Fig. 3 it can be seen that the columns 12 and 14 are arcuate in cross section and that, together with ram 16 or 18, they form a generally circular configuration. The columns are hollow and are reinforced with ribs extending along their inner surfaces. In order to produce matched forgings, it is necessary for the rams 16 and 18 to be securely guided throughout their vertical paths of travel. Since the rams will heat up and expand during operation of the hammer, some means must be provided to allow for expansion of the rams while maintaining secure lateral guiding support for the same.

The arrangement for supporting the rams while permitting expansion due to heating is shown in Fig. 3 and comprises four bearing surfaces 96 which are radial with respect to the central axis of the forging hammer. Each of the surfaces 96 slide on cooperating bearing surfaces 98 of wedge-shaped guide members 100 which extend along the full length of the column 12 or 14. The bearing surfaces 98 are on the same radii with respect to the central axis of the hammer as surfaces 96. Since the resultant of heat expansion and contraction forces in any part of the ram will be radially disposed, any expansion or contraction of the ram will merely result in relative sliding movement between each set of cooperating bearing surfaces 96 and 98.

As the bearing surfaces 96, 98 wear, the guide members 100 may be adjusted to move inwardly toward the axis of the hammer. It will be noted that the surfaces on the ends of columns 12 and 14 which lie adjacent the guide members 100 are not parallel to surfaces 96, 98, but converge toward the hammer axis. Consequently, as the surfaces 96, 98 wear, the members 100 may be moved inwardly without altering the radial positioning of the wear surfaces. For locking guide members 100 in a predetermined position, wedges 102 are provided at the rear of each of the guide members.

If the shape of dies 90 and 92 were such that only vertical forces were produced in the structural members of the hammer, the construction of the hammer would be relatively simple and no problems would arise by virtue of deflection of various members in the hammer. In actual practice, however, the shape of the dies is such that severe bending and/or twisting moments will be produced in the rams during a forging impact. Such moments are shown in Figs. 7 and 8 wherein the vector T_T represents a horizontal bending or twisting moment produced in the top ram 16. Remembering that for each action there must be an equal and opposite reaction, it is apparent that a twisting moment T_B is produced in the lower ram 18. If the moment T_T tends to rotate upper ram 16 in a counter-clockwise direction, it follows that the moment T_B tends to rotate the lower ram 18 in a clockwise direction. Moment T_T thus produces force F_{T1} on one side of column 14 and force F_{T2} on the other side of column 12. In a similar manner, moment T_B produces force F_{B1} on the upper side of column 14 (as viewed in Fig. 7) and force F_{B2} on the lower side of column 12. Forces F_{B1} and F_{T1} add up to produce a resultant force F_{R1} tending to bow column 14 outward; while forces F_{T2} and F_{B2} add up to produce a resultant force F_{R2} tending to bow column 12 outward.

The advantage of supporting columns 12 and 14 approximately midway between their extremities and in close proximity to the plane of engagement of rams 16 and 18 thus becomes apparent. If the columns were supported at

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one end as in conventional counter-blow hammers, the resultant forces F_{R1} and F_{R2} would tend to spread the columns 12 and 14 and produce severe deflections in the same. By virtue of the unique arrangement of the present invention for supporting the hammer approximately midway between the opposite extremities of its lateral guiding members, the resultant forces F_{R1} and F_{R2} are taken directly by the bearing blocks 32 and foundation 34; and bending or deflection in the columns is minimized or completely eliminated.

In Fig. 8 vertical bending moments T_T and T_B are illustrated which also tend to bow the columns 12 and 14 outward. For purposes of illustration, a workpiece 150 is shown between dies 90 and 92 which produces the two bending moments, one of which tends to rotate ram 18 clockwise and the other of which tends to rotate ram 16 counter-clockwise. The amount T_T produces force F_{T1} tending to force column 12 outward, and force F_{T4} tending to force column 14 outward. Likewise, the moment T_B produces forces F_{B3} and F_{B4} . Forces F_{T4} and F_{B4} produce a resultant force which acts against bearing blocks 32 on one side of the hammer; whereas, forces F_{T3} and F_{B3} produce a resultant acting against the bearing blocks on the other side of the hammer. As will be understood, the forces shown in Fig. 8, as well as those shown in Fig. 7, would deflect the columns 12 and 14 were it not for supporting means employed in the present invention.

Other force patterns will obviously be produced by the rams, depending upon the placing of the workpiece and the shape of the dies. In each case, however, the maximum stress in columns 12 and 14 is located approximately midway between their opposite extremities.

Although the invention has been shown in connection with a certain specific embodiment, it will be readily apparent to those skilled in the art that various changes in form and arrangement of parts may be made to suit requirements without departing from the spirit and scope of the invention.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A counter-blow forging hammer comprising two axially aligned and movable forging rams which are forced together into cooperative engagement to form a forging therebetween, an integral support frame for the forging rams comprising a pair of spaced lateral guiding members, cross members connecting the opposite ends of said guiding members, a base member, and connections for suspending said support frame on said base member at a point substantially midway between said cross members.

2. A counter-blow hammer comprising a pair of axially aligned forging rams which are forced together along a vertical axis into cooperative engagement, a pair of vertical frame members positioned on opposite sides of said forging rams for guiding the same along said vertical axis, means connecting the upper and lower extremities of said frame members together into an integral structure, and means connected to said integral structure at a point substantially midway between said upper and lower extremities of the frame members for supporting the integral structure against gravity.

3. A counter-blow hammer comprising a pair of axially aligned forging rams which are forced together into cooperative engagement, an integral frame member for guiding said forging rams along a straight line path, supporting means having a base and a pair of spaced structures extending upwardly from said base, and projections extending laterally outwardly from said frame member in close proximity to the plane of engagement of said forging rams for suspending the frame from the upper extremities of said spaced structures.

4. A counter-blow forging hammer comprising, in combination, a pair of axially aligned forging rams which

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are forced together into cooperative engagement along a vertical axis, an integral frame member for guiding said forging rams along a straight line path, a base member, and connections located in close proximity to the plane of engagement of said rams for suspending said frame member on the base member.

5. A counter-blow forging hammer comprising, in combination, a pair of axially aligned forging rams, means for forcing said rams into cooperative engagement, a pair of upright members located on either side of said forging rams for guiding the rams along a vertical straight line path, means connecting the respective upper and lower extremities of said upright members to form an integral support frame for the forging rams, guiding surfaces on the upright members arranged for cooperative engagement with said rams, the guiding surface on one upright member facing the guiding surface on the other upright member, supporting means having a base and a pair of spaced structures extending upwardly from the base, and means for suspending said integral support frame from the upper extremities of said spaced structures, said latter-mentioned means including a first pair of spaced projections extending outwardly from the side of one of said upright members opposite its guiding surface to engage the upper extremity of one of said spaced structures, and a second pair of spaced projections extending outwardly from the side of the other of said upright members opposite its guiding surface to engage the upper extremity of the other of said spaced structures.

6. A counter-blow forging hammer comprising, in combination, a pair of axially aligned forging rams, means for forcing said rams into cooperative engagement, an integral frame including a pair of spaced members located on either side of said forging rams for guiding the rams along a vertical path of travel, substantially U-shaped supporting means comprising a base having a pair of spaced structures extending upwardly from the base, and projections extending outwardly from said members for supporting said integral frame on the upper extremities of said spaced structures.

7. The combination claimed in claim 6 in which said projections are located on the spaced members to offer maximum resistance to bending forces in said members due to twisting of the rams along their path of travel.

8. A counter-blow hammer comprising, in combination, a pair of axially aligned forging rams, means for forcing said rams into cooperative engagement, an integral frame including a pair of spaced members located on either side of said rams for guiding the rams along a straight line vertical path, and a support structure connected to said spaced members in close proximity to the plane of engagement of said rams to thereby offer maximum resistance to bending forces produced in the spaced members due to twisting moments produced by said rams.

References Cited in the file of this patent

UNITED STATES PATENTS

545,758	Aiken	Sept. 3, 1895
615,214	Ferguson	Nov. 29, 1898
1,990,478	Fitzgerald	Feb. 12, 1935
2,117,575	Saives	May 17, 1938
2,220,037	Fitzgerald	Oct. 29, 1940
2,241,787	Murray	May 13, 1941
2,386,155	Weyer	Oct. 2, 1945
2,729,943	Clarke et al.	Jan. 10, 1956
2,807,177	Terhune	Sept. 24, 1957

FOREIGN PATENTS

128,489	Germany	May 13, 1902
467,193	Great Britain	June 14, 1937
630,111	Germany	May 20, 1936
845,003	Germany	Oct. 30, 1952
857,118	France	Apr. 8, 1940
946,404	Germany	Aug. 2, 1956