July 4, 1950 C. A. BRAUCHLER 2,513,710

PRESS FORGING APPARATUS

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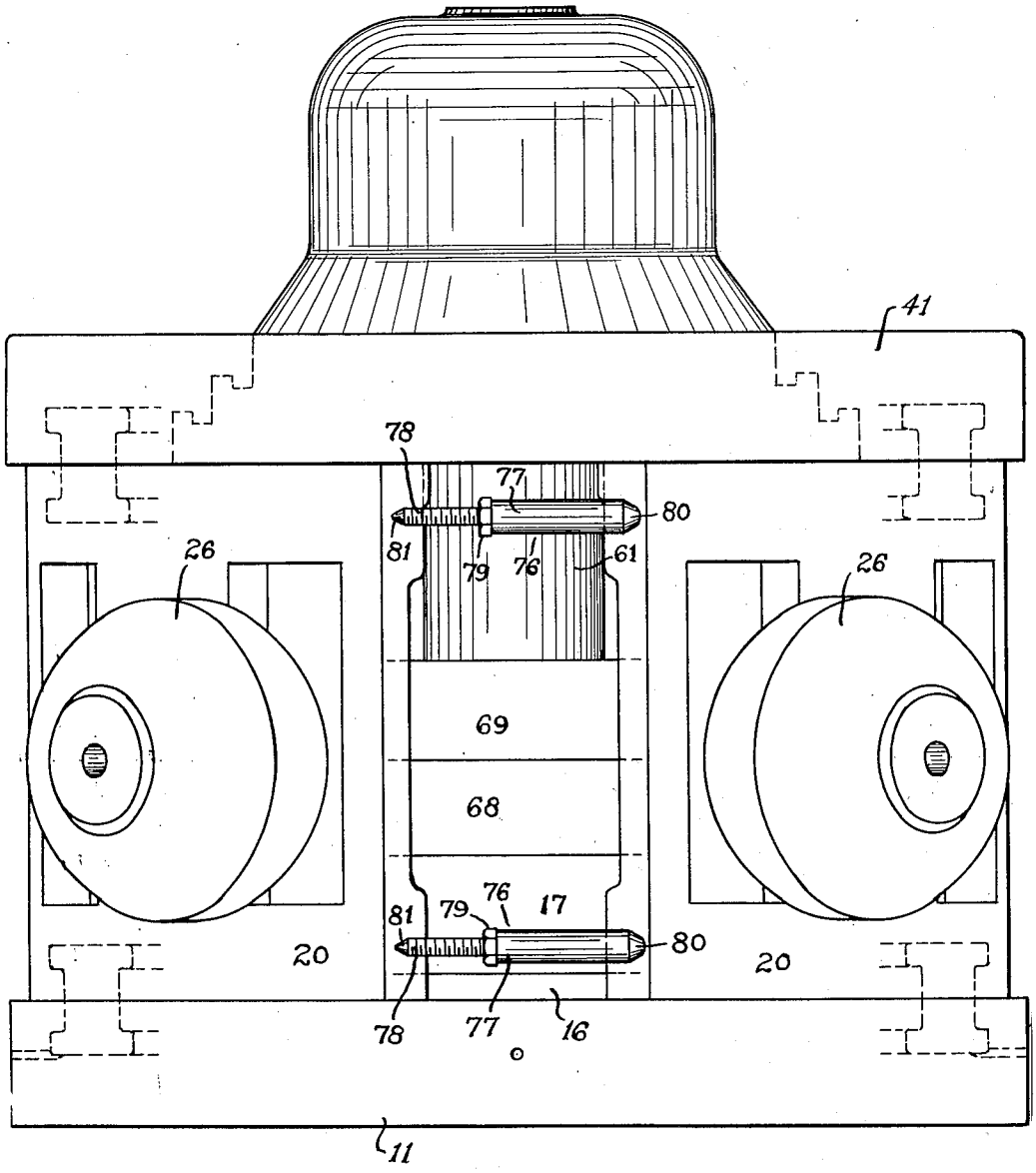


Fig. 1

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By Charles A. Brauchler

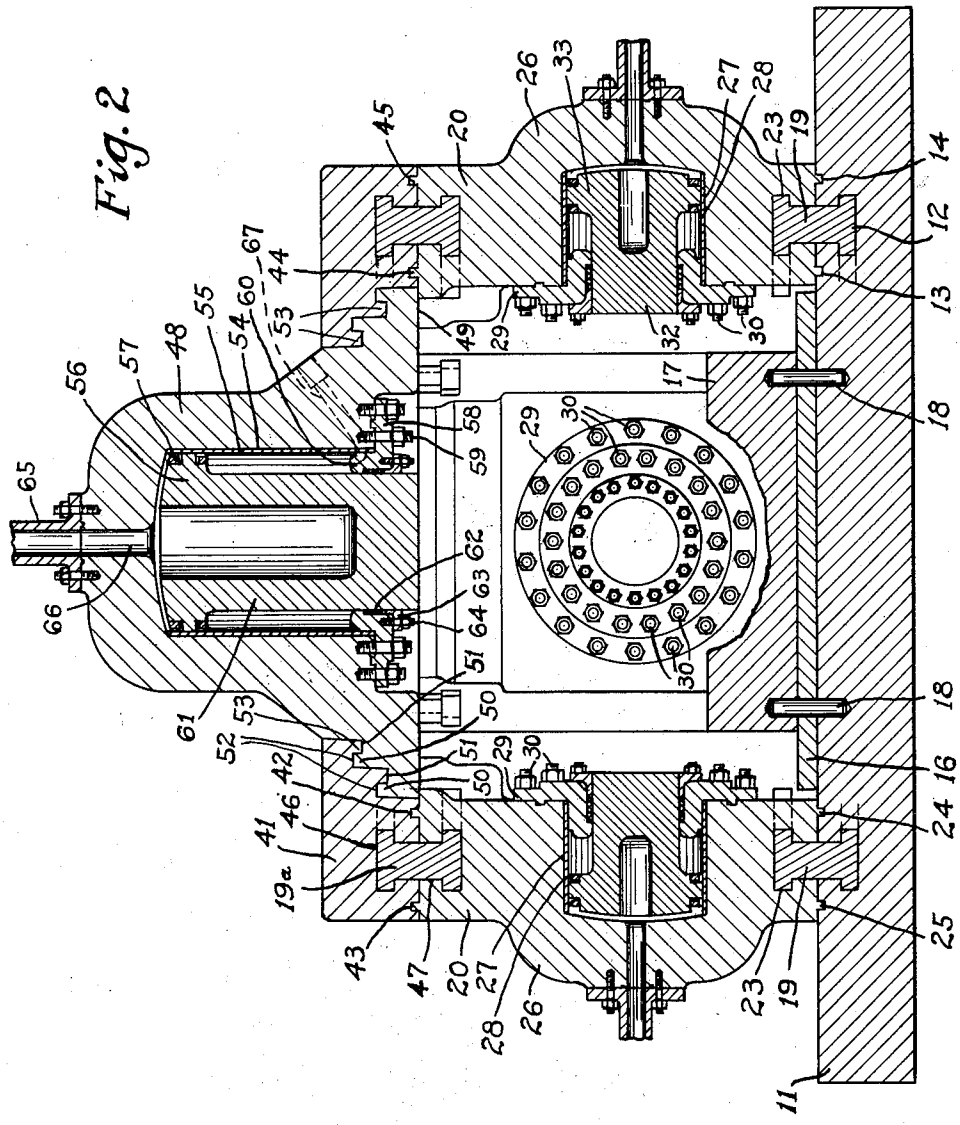
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Fig. 2



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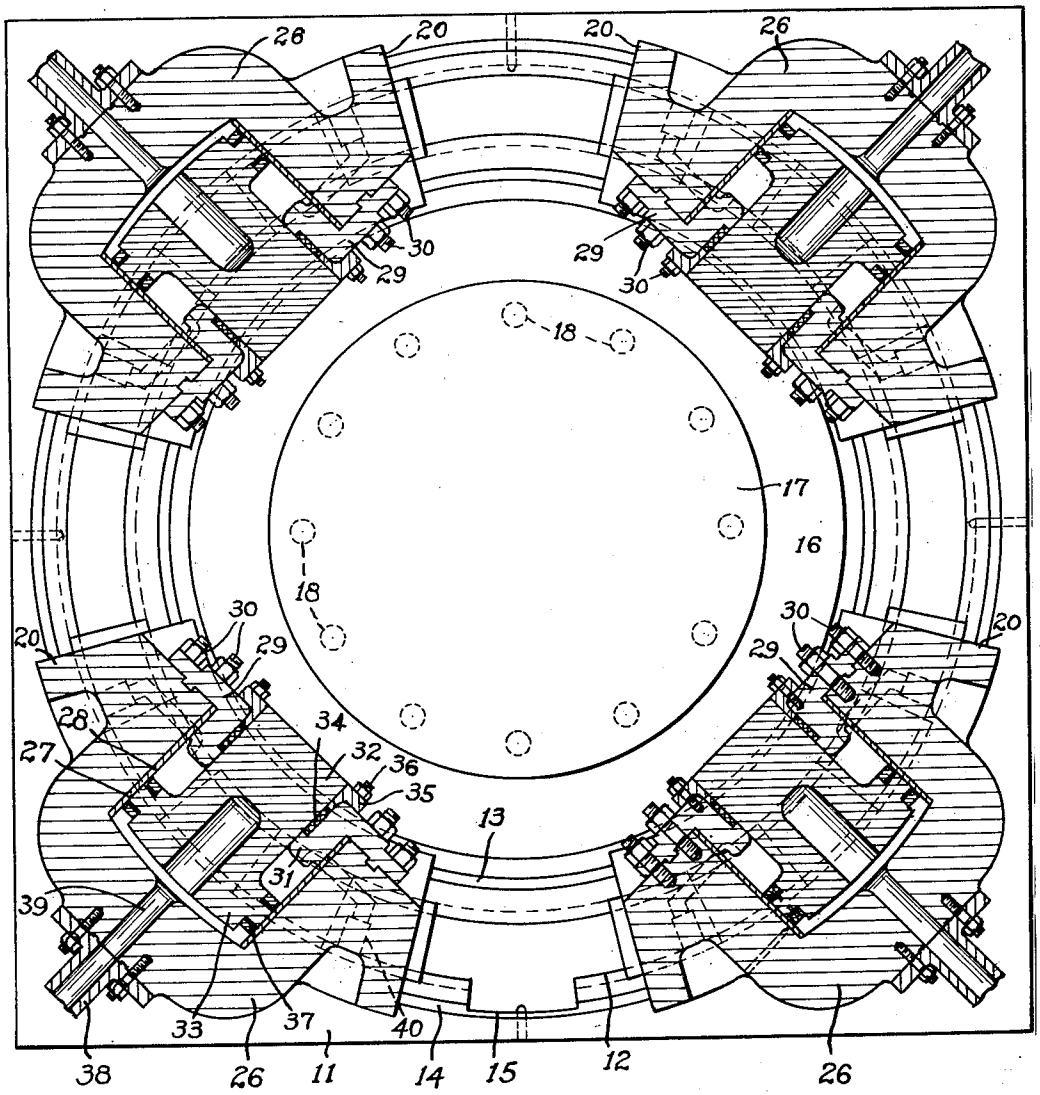


Fig. 3

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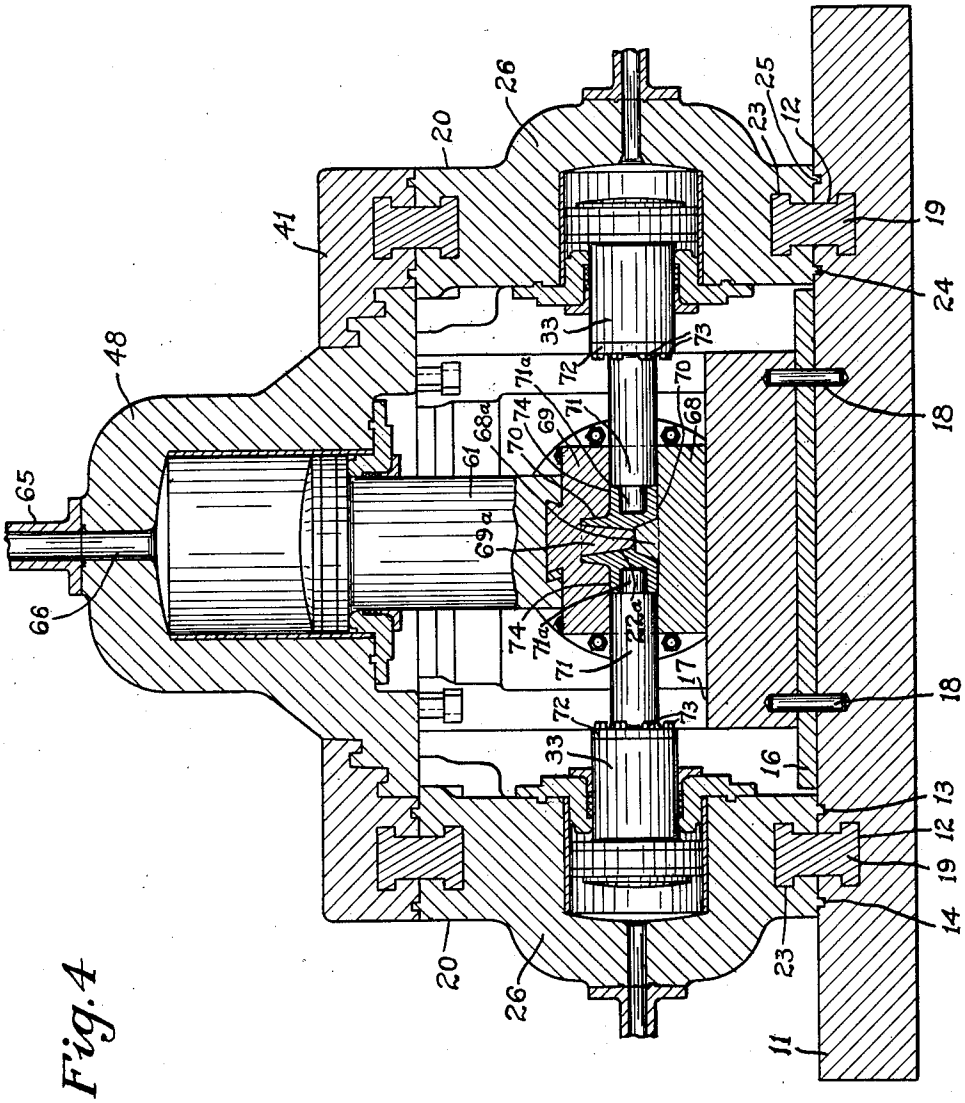


Fig. 4

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PRESS FORGING APPARATUS

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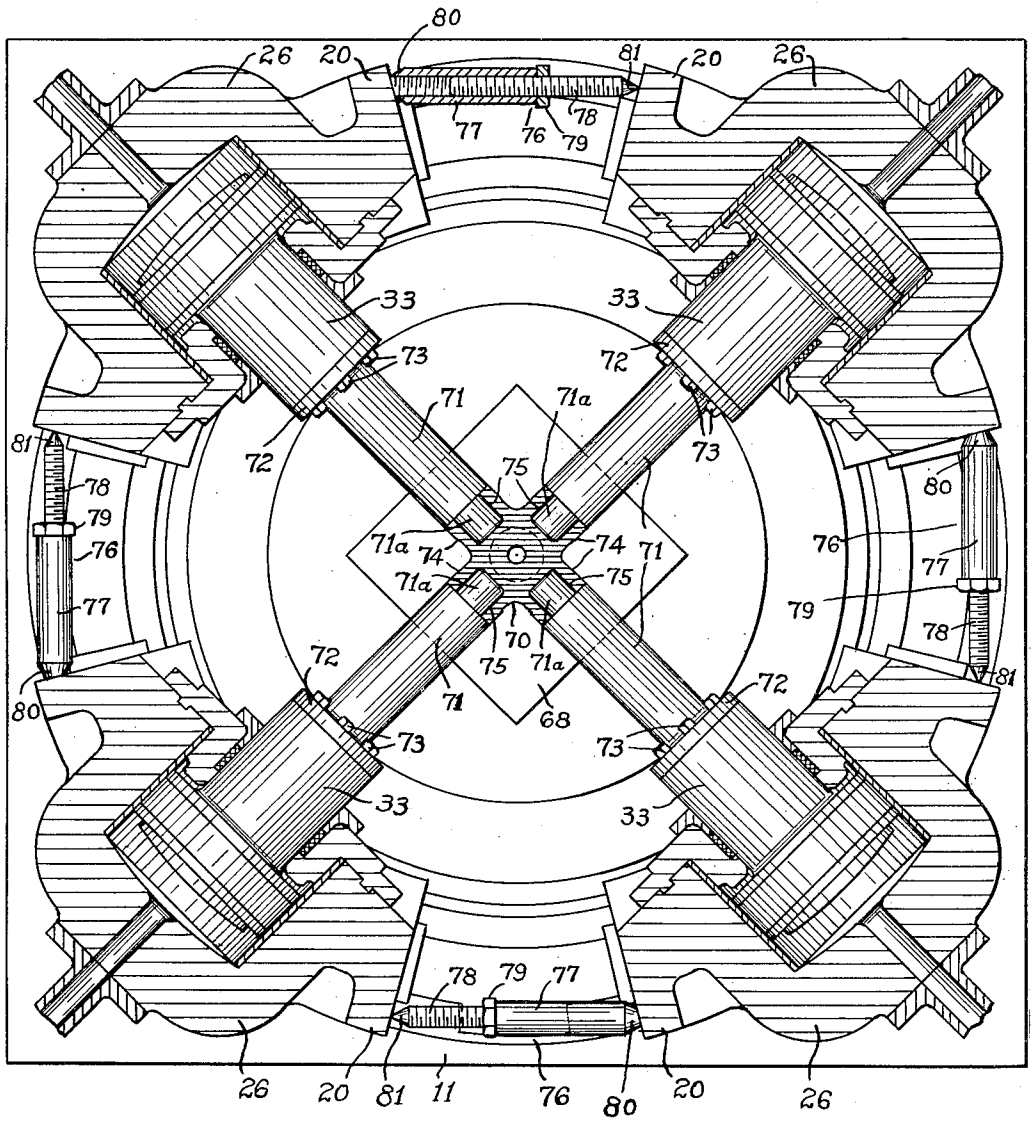


Fig. 5

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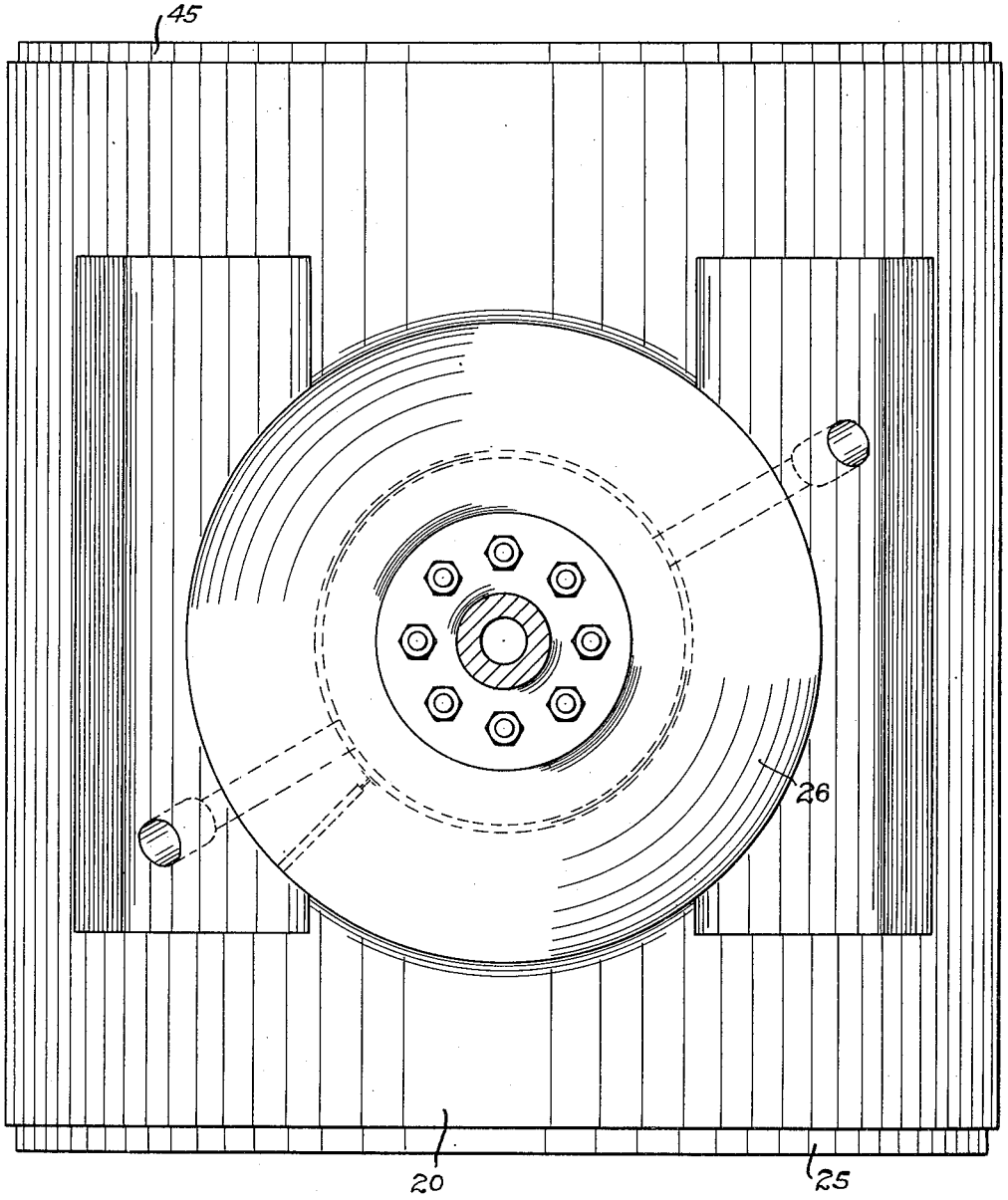


Fig. 6

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PRESS FORGING APPARATUS

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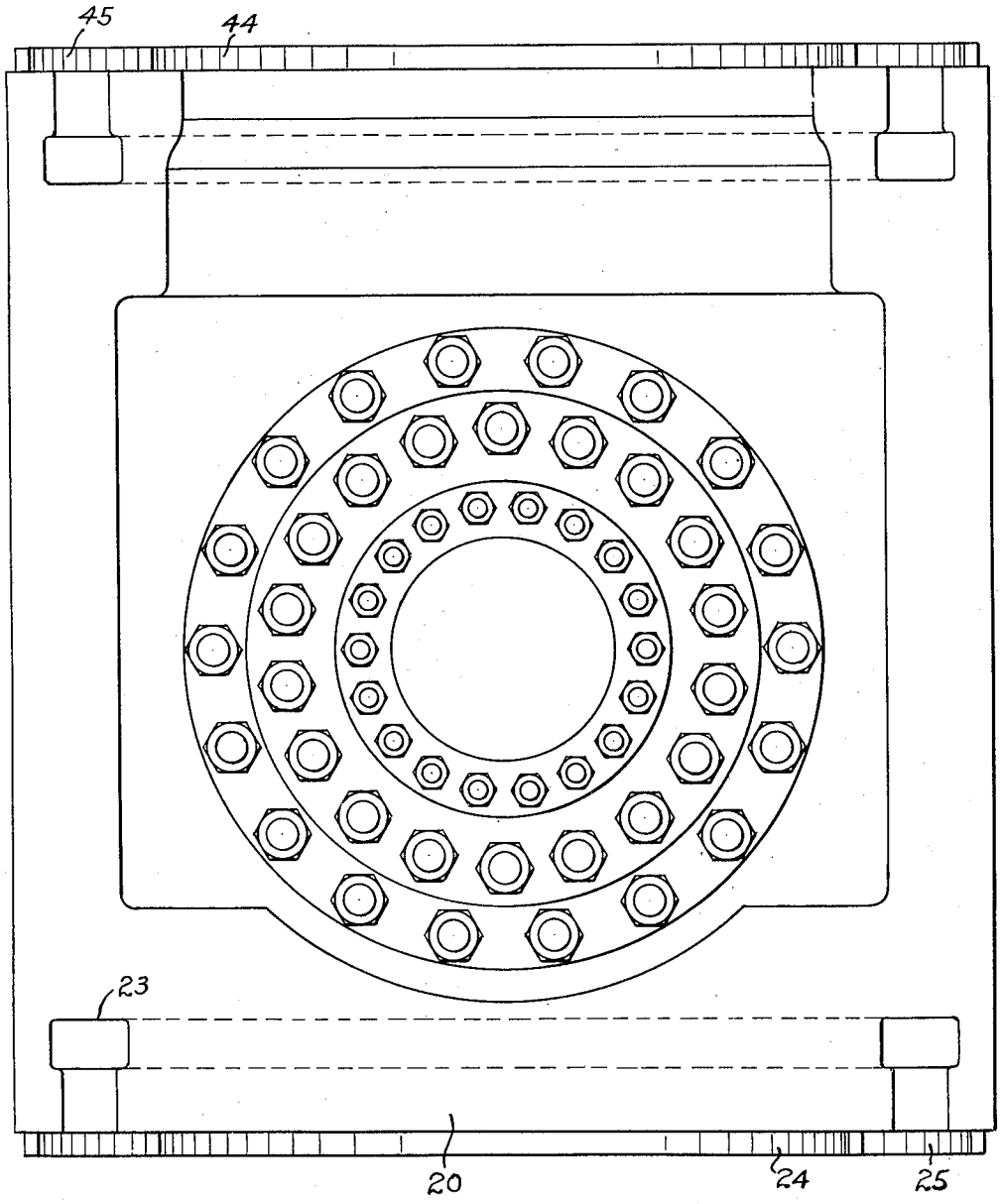


Fig. 7

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PRESS FORGING APPARATUS

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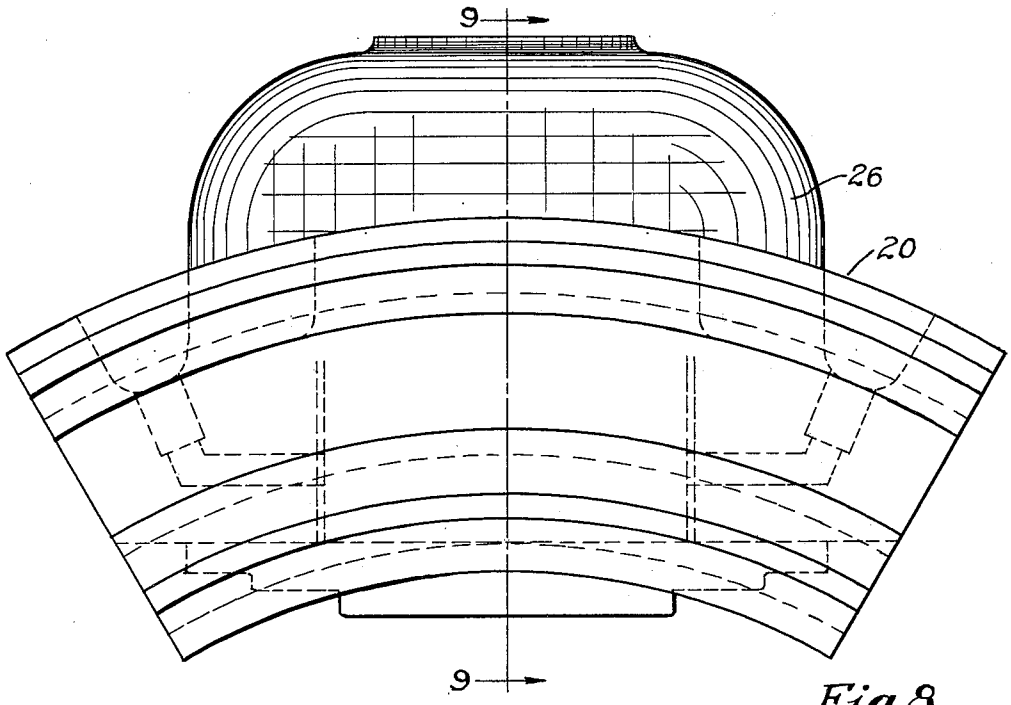


Fig. 8

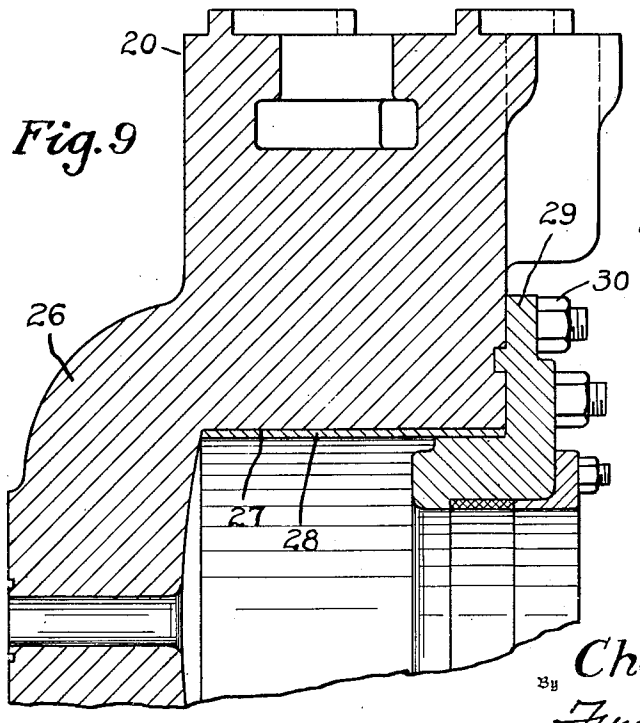


Fig. 9

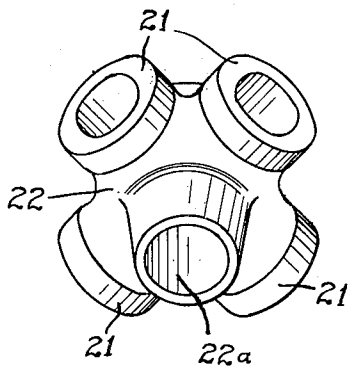


Fig. 10

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Patented July 4, 1950 2,513,710

UNITED STATES PATENT OFFICE

2,513,710

PRESS-FORGING APPARATUS

Charles A. Brauchler, Canton, Ohio

Application January 20, 1945, Serial No. 573,717

7 Claims. (Cl. 78—18)

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The invention relates to apparatus for press forging substantially large, heavy forgings, such as airplane propeller hubs, airplane engine cylinder heads and other articles having a plurality of angular protuberances or angular recessed portions, and the present invention contemplates certain improvements upon the apparatus disclosed in my prior Patents No. 2,378,060 dated June 12, 1945, and No. 2,424,075 dated July 15, 1947.

My prior applications above referred to relate to the press forging of articles having a plurality of angular recesses or protuberances which are pierced during the forging operation, but such machines were so constructed that they could only form and pierce the particular article for which they were made and if any change was desired in the angularity of the recessed portions this would require a machine built especially to form and pierce at such angles.

Such machines were provided with a plurality of angularly disposed rams or plungers, operated as by hydraulic cylinders, for forming a forging with angular protuberances thereon and piercing or recessing the same in a series of continuous steps in a die, but the hydraulic cylinders were permanently located at the desired angles for forming and piercing one design of article and could not be relatively moved for producing a similar article with recessed portions or protuberances at other angles.

It is therefore an object of the present invention to produce a universal forging apparatus having a plurality of power operated rams or plungers arranged to be adjustably mounted at various angles so as to produce forgings having recesses or pierced protuberances located at any desired angles.

Another object is to provide apparatus of this character including a vertically operating, overhead plunger and a plurality of horizontally operating, radially disposed plungers and means for adjusting the horizontally operating plungers at any desired angles relative to each other.

A further object is to provide apparatus of this character in which the radially disposed, horizontally operating plungers are mounted in circular guideways in the base plate and cap plate of the machine.

Still another object is the provision of apparatus of this character in which the horizontally operating plungers are carried upon independent, arcuate side members having keyways to receive keys by means of which they are independently, adjustably mounted in the circular grooves of the bed plate and cap plate of the machine.

A still further object of the invention is to provide apparatus of this character in which means is provided for holding the horizontally

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operating cylinders in radially adjusted positions.

A further object is the provision of apparatus of the character referred to in which the various parts are keyed together so as to withstand the extreme pressure to which the parts are subjected when the hydraulic cylinders are operated.

Another object is to provide a press forging apparatus of this character in which spacer means is provided for holding the several horizontal cylinders in adjusted position.

Still another object of the invention is the provision of such forging apparatus in which the spacer means for holding the cylinders in adjusted position is in the form of screw jacks arranged to be located between adjacent cylinders.

The above objects together with others which will be apparent from the drawings and following description, or which may be later referred to, may be attained by constructing the improved press forging apparatus in the manner illustrated in the accompanying drawings, in which;

Figure 1 is a side elevation of a universal press forging apparatus constructed in accordance with the invention;

Fig. 2 is a vertical sectional view through the machine with the pistons of the hydraulic cylinders withdrawn and the plungers and die blocks removed for the purpose of illustration;

Fig. 3 a plan sectional view through the machine in the same condition as in Fig. 2;

Fig. 4 a vertical sectional view similar to Fig. 2 with the die blocks mounted in the machine in closed position and the plungers in operated position for forming and piercing a four blade propeller hub;

Fig. 5 a plan sectional view similar to Fig. 3 showing the parts in the position shown in Fig. 4;

Fig. 6 an enlarged elevation of the outer side of one of the adjustable side members carrying one of the horizontally operating cylinders;

Fig. 7 a similar view of the inner side of the side member shown in Fig. 6;

Fig. 8 a top plan view of one of the side members shown in Figs. 6 and 7;

Fig. 9 a fragmentary vertical sectional view through the upper portion of one of the side members and cylinders, and

Fig. 10 a perspective view on a smaller scale of a four blade propeller hub forging such as may be formed in the apparatus.

The improved press forging apparatus is mounted upon the bed plate 11, which may be square as shown in the drawings and which is of sufficient thickness to support the massive structure comprising the forging apparatus.

A circular groove 12 of inverted, T-shape cross section is concentrically formed in the top surface

of the lower bed plate 11 near its outer edge and the concentric inner and outer grooves 13 and 14 respectively are formed in said top surface of the bed plate on the inner and outer sides of the T-shape groove 12.

A cutout 15 is formed at one point in the T-shape groove 12 for inserting the keys by means of which the structure is locked together as will be later explained.

A riser plate 16 is concentrically mounted upon the bed plate 11 and a pillow block 17 is centrally mounted on the riser plate, the pillow block and riser plate being fastened upon the bed plate by means of pins 18.

Mounted upon the bed plate 11, by means of the I-shape keys 19, as will be later explained, is a plurality of vertical side members 20, any desired number of these members being provided, depending upon the shape of the forging to be produced. In the present case, four of these side members are provided for piercing the four bosses 21 upon a four blade propeller hub forging indicated generally at 22.

Each of the side members 20 is of arcuate shape, as best shown in Fig. 8 and is provided in its lower edge with an arcuate, T-shape groove 23, registering with the inverted T-shape circular groove 12 on the base plate 11, and arranged to be attached thereto by means of the I-shape keys 19 which have a snug sliding fit within both grooves as best shown in Figs. 2 and 4.

Depending arcuate ribs 24 and 25 are formed upon the under side of each member 20 and fit within the circular grooves 13 and 14 respectively in the base plate. Each of the members 20 is domed upon its outer side, as indicated at 26, to form a hydraulic cylinder.

A horizontal bore 27 is provided through the inner side of each member 20 to form the hydraulic cylinder and a brass liner 28 may be located therein.

Each of the cylinders has a ring 29 mounted in its open end, the ring being shouldered and connected to the end of the cylinder as by the screws or bolts 30. The elongated, cylindrical portion 31 of the ring 29 surrounds the reduced portion 32 of the piston 33 and may be recessed to receive packing material 34, the gland 35 being located within the stuffing box thus formed and held in place as by screws 36, connected to the ring 29.

The enlarged portion 33 of the piston is slidably mounted within the liner 28, and the usual piston rings 37 may be provided thereon. Fluid under pressure is admitted to the outer end of each cylinder, as by the pipe 38 which communicates with the central bore 39 in the dome 26, and for the purpose of reversing the movement of the piston, fluid pipes may be connected to the passages 40 which communicate with the inner end of each cylinder as indicated in Fig. 3.

A circular cap plate 41 rests upon the upper ends of the side members 20 and has the concentric inner and outer circular grooves 42 and 43 respectively formed in its under surface, which receive the arcuate inner and outer ribs 44 and 45 respectively, formed upon the upper ends of the side members 20.

The cap plate 41 has a circular groove 46, of T-shape cross section formed in its under side, between the circular grooves 42 and 43, and each of the side members 20 has an inverted T-shape groove 47 formed in its upper edge to register with the circular groove 46. I-shape keys 19a, similar to the keys 19, are located in the grooves

46 and 47 to lock the side members and cap plate together.

The upper cylinder 48 has a peripheral flange 49 at its lower end, which rests upon the upper edges of the side members 20, and is provided on its upper surface with the tapered ribs 50 and grooves 51 which interlock with the correspondingly shaped grooves 52 and ribs 53 upon the under side of the cap plate 41.

The cylinder 48 has a central bore 54, within which may be mounted a brass liner 55, within which is mounted the piston 56 having rings 57 in its enlarged portion slidably fitting within the liner 55.

A ring 58 is mounted in the open lower end of the cylinder and connected thereto as by the bolts 59. The elongated cylindrical portion 60 of the ring 58 surrounds the reduced portion 61 of the piston 56 and may be recessed to receive packing material 62, the gland 63 being located within the stuffing box thus formed and held in place as by the screws 64.

Fluid under pressure is admitted to the upper end of the cylinder 48 as by the flanged pipe 65 which communicates with the central bore 66 in the cylinder, and for the purpose of reversing the movement of the piston, a fluid pipe may be connected to the passage 67 which communicates with the inner end of the cylinder as indicated in Fig. 2.

A stationary die block 68 may be fixed upon the pillow block 17 and cooperates with the movable die block 69 carried by the piston 61 of the upper cylinder 48, said die blocks having complementary die cavities 70 to form a propeller hub, or any other desired forging having a plurality of angular, pierced protuberances or recesses.

A plunger 71, of any desired and suitable shape, is attached to the reduced end 32 of each piston 33 as by the flange 72 and bolts or screws 73, these plungers being shaped to enter the angular passages 74 of the die cavity which form the protuberances 21 upon the forging 22 and to pierce the same as indicated at 75.

It will of course be understood that the die blocks 68 and 69 and the plunger 71 are removable so that the proper die and plungers may be attached to the apparatus for forming any desired forging.

Since each of the side members 20, carrying the horizontally operating cylinders 26, is independently circumferentially adjustable to any desired or necessary position within a complete circle, it will be obvious that any adjustment of the apparatus may be obtained for producing any shape of forging having two, three, or four angular pierced protuberances or recesses so that various styles and shapes of propeller hubs having two, three, or four blade propellers and various styles of cylinder heads with rocker boxes located at any desired angle may be formed and pierced in a single complete operation of the machine.

In operating the apparatus to produce a forging of this character, assuming that it is desired to forge a propeller hub for a four blade propeller, of the general type indicated in Fig. 10, the four side members 20 are circumferentially adjusted between the base plate 11 and cap plate 41 to exactly 90° apart, as best shown in Figs. 3 and 5.

Although it may not be necessary in all cases, as a precaution against any circumferential displacement of the side members 20 when the apparatus is in operation, spacer means may be

provided for rigidly holding the side members accurately in adjusted position.

This spacer means may comprise any suitable spacer blocks or the like of exactly the proper length to accurately fit between adjacent side members 20, and these spacers are preferably in the form of screw jacks as indicated generally at 76 in Figs. 1 and 5 of the drawings.

Each jack may comprise an internally threaded tube 77 and a screw 78 threaded therein and provided with a locking nut 79 adapted to be tightened against the adjacent end of the tube 77 to lock the jack in adjusted position.

The tube member 77 of the jack may if desired be fixed to one side of the side members 20 by any usual and ordinary means, or as shown in the drawing the outer end of the tube may be shaped as at 80 so as to fit against the angular side edge of the side member.

The screw 78 of the jack may be provided with a sharpened end as indicated at 81 to engage the opposed side edge of the next adjacent side member 20, as shown in Figs. 1 and 5, in order to assist in holding the jack against movement between the two spaced side members and to positively hold the side members in accurately adjusted position during the operation of the press.

The desired stationary die block 68 is then attached to the pillow block 17 as shown in Figs. 1, 4 and 5, with the angular passages 74 of the die cavity 70 thereof aligned with the pistons 33 of the cylinders 26, as best shown in Fig. 5.

The corresponding movable die block 69 is then attached to the piston 56 of the upper cylinder 48, in such position that the die cavity 70 thereof mates with the die cavity of the stationary die block and the angular passages 74 therein register with the angular passages 74 in the die cavity of the lower die block, as best shown in Fig. 4.

A blank of aluminum alloy, or other metal, of approximately the exact weight of the forging to be produced, is heated to forging temperature and placed in the cavity 70 of the lower die block 68. This blank may be a cast blank, or roll bar stock somewhat approximating the desired finished shape of the forging to be produced.

The upper piston 56 is then operated to lower the upper or movable die 69 into contact with the lower or stationary die 68, squeezing the hot metal blank under extreme continuous pressure in one operation, causing the metal to fill the die cavities producing the general contour of the propeller hub 21 with the partially formed extruded bosses 22 located within the angular passages 74 of the die cavities.

The central posts 68*a* and 69*a* in the cavities of the dies 68 and 69 respectively, pierce the hub longitudinally as indicated at 22*a*, during the closing movement of the dies, with the dies held under pressure in closed position and the posts 68*a* and 69*a* holding the blank against lateral movement, the pistons 33 of the cylinders 26 may then be operated in unison, or in succession, or in any desired combination, forcing the plungers 71 thereon through the angular passages 74 of the die cavities, the reduced piercing portions 71*a* upon said plungers piercing the protruding bosses 21 of the propeller hub as indicated at 74 in Figs. 4 and 5 causing the extruded metal to completely fill the angular passages 74 of the die cavities and producing the finished, pierced propeller hub forging shown in Fig. 10 with substantially no flash thereon and of such shape that a minimum

of machining is required to complete the propeller hub.

It will be obvious that with the apparatus operated in the manner described and illustrated a complete pressed forging may be produced therein with a single heating of the metal in a single operation of the apparatus, thus greatly reducing the time and labor required for producing such forgings.

By making the blank of approximately the exact weight of the finished forging to be produced, the heated metal when deformed between the dies and plungers will flow into every portion of the die cavities completely filling the same and thus practically eliminating the formation of flash at any point on the forging.

By providing a 360° circumferential adjustment of each of the horizontal cylinders any desired contour of forging with pierced angular protuberances or recesses at various angles may be produced.

It will be apparent that with any adjustment of the horizontal cylinders around the apparatus there will always be a sufficient opening at at least one point around the apparatus between two of the side members 20 through which the heated blank may be passed to place the same within dies and through which the finished forging may be removed after the press forging operation has been completed.

Since the apparatus is designed to form the finished forging and pierce the same all in a single operation of the dies and plungers, enormous power is required and the hydraulic cylinders which operate the dies and plungers may have a capacity of as great as 2500 tons.

Although the invention is illustrated and described as operated by hydraulic cylinders, it should be understood that it is not the desire or intention to limit the power means to hydraulic cylinders but any mechanical press means which will develop the necessary power may be substituted for the hydraulic cylinders without in any manner changing the construction and arrangement of the apparatus and without departing from the scope of the invention as set forth in the appended claims.

I claim:

1. Apparatus for press forging a forging having angular recesses therein, said apparatus including a bed plate, a stationary die mounted on the bed plate, a vertical cylinder spaced above the bed plate, a ram in said cylinder, a movable die block carried by the ram and cooperating with the stationary die block, there being complementary die cavities in the die blocks, a circular guideway including an inverted T-shape groove in the upper surface of the bed plate, a plurality of arcuate side members mounted upon the bed plate around said die blocks, each side member having an arcuate T-shape groove in its lower end registering with the inverted T-shape groove in the bed plate, I-shape keys in said grooves, a horizontal cylinder in each side member, and a radially disposed plunger carried by each cylinder and cooperating with the die blocks.

2. Apparatus for press forging a forging having angular recesses therein, said apparatus including a base plate, a stationary die block mounted upon the base plate, a circular guideway on the upper surface of the base plate and including an inverted T-shape groove, a plurality of arcuate side members mounted on said circular guideway and having arcuate T-shape grooves in their lower ends, I-shape keys located

in the grooves of the side members and base plate, a cap plate upon said side members, a circular guideway on the under side of the cap plate and including a T-shape groove, there being arcuate, inverted T-shape grooves in the upper ends of the side members, I-shape keys located in the upper grooves of the side members and the cap plate, horizontal, radially disposed plungers carried by the side members, means for reciprocating the plungers, a vertical ram mounted upon the cap plate, and a movable die block carried by said ram.

3. Apparatus for press forging a forging having angular recesses therein, said apparatus including a base plate, a stationary die block mounted upon the base plate, a circular guideway on the upper surface of the base plate and including an inverted T-shape groove, a plurality of arcuate side members mounted on said circular guideway and having arcuate T-shape grooves in their lower ends, I-shape keys located in the grooves of the side members and base plate, a cap plate upon said side members, a circular guideway on the under side of the cap plate and including a T-shape groove, there being arcuate, inverted T-shape grooves in the upper ends of the side members, I-shape keys located in the upper grooves of the side members and the cap plate, horizontal cylinders carried by the side members, radially disposed plungers operated by the cylinders, a vertical cylinder mounted upon the cap plate, a ram in said vertical cylinder, and a movable die block carried by the ram.

4. Apparatus for press forging a forging having angular recesses therein, said apparatus including a base plate, a stationary die block mounted upon the base plate, a circular guideway on the upper surface of the base plate and including an inverted T-shape groove, a plurality of arcuate side members mounted on said circular guideway and having arcuate T-shape grooves in their lower ends, I-shape keys located in the grooves of the side members and base plate, a cap plate upon said side members, a circular guideway on the under side of the cap plate and including a T-shape groove, there being arcuate, inverted T-shape grooves in the upper ends of the side members, I-shape keys located in the upper grooves of the side members and the cap plate, horizontal cylinders carried by the side members, radially disposed plungers operated by the cylinders, the cap plate having a central opening, circular, concentric ribs and grooves surrounding said opening on the under side of the cap plate, a vertical cylinder located through the central opening of the cap plate, an annular flange at the bottom of the vertical cylinder having concentric, circular ribs and grooves interlocked with the ribs and grooves of the cap plate, a ram in said vertical cylinder and a movable die block carried by the ram.

5. Apparatus for press forging a forging having angular recesses therein, said apparatus including a base plate, a stationary die block mounted upon the base plate, a circular guideway on the upper surface of the base plate and including an inverted T-shape groove, a plurality of arcuate side members mounted on said circular guideway and having arcuate T-shape grooves in their lower ends, I-shape keys located in the grooves of the side members and base plate, a cap plate upon said side members, a circular guideway on the under side of the cap plate and including a T-shape groove, there being arcuate, inverted T-shape grooves in the upper ends of the side members, I-shape keys located in the upper grooves of the side members and the cap plate, horizontal cylinders carried by the side members, pistons in said cylinders, plungers removably mounted on the pistons, a vertical cylinder mounted upon the cap plate, a ram in the vertical cylinder, and a movable die block carried by the ram.

6. Apparatus for press forging a forging having angular recesses therein, said apparatus including a bed plate, a stationary die block mounted upon the bed plate, a vertical cylinder spaced above the bed plate, a ram in said cylinder, a movable die block carried by the ram and cooperating with the stationary die block, there being complementary die cavities in said die blocks, a circular, inverted, T-shape guideway in the bed plate surrounding the stationary die block, a plurality of horizontal cylinders adjustably mounted upon the bed plate, inverted, T-shape members carried by the horizontal cylinders and slidably mounted in said guideway, radially disposed plungers carried by said horizontal cylinders and cooperating with the die blocks, and means for adjusting the horizontal cylinders at any point around the circular guideway.

7. Apparatus for press forging a forging having angular recesses therein, said apparatus including a bed plate, a stationary die block mounted upon the bed plate, a circular, inverted T-shape guideway in the bed plate surrounding the stationary die block, a plurality of arcuate side members adjustably mounted upon the bed plate, inverted T-shape members carried by said side members and slidably mounted in said guideway, a cap plate upon said arcuate side members, a circular T-shape guideway in the under side of said cap, T-shape members carried at the upper ends of said arcuate side members and slidably mounted in said T-shape guideway, horizontal radially disposed plungers carried by said arcuate side members, means for reciprocating the plungers, a vertical ram mounted upon the cap plate, a movable die block carried by said ram, and means for adjusting the positions of the arcuate side members around said circular guideways.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
426,653	Aiken	Apr. 29, 1890
691,869	Petch	Jan. 28, 1902
720,052	McKibben	Feb. 10, 1903
804,542	Loss	Nov. 14, 1905
1,835,539	Thomas	Dec. 9, 1931
1,946,117	Sparks	Feb. 6, 1934
2,021,703	Sparks	Nov. 19, 1935
2,246,494	Amiot	June 24, 1941
2,256,740	Gup	Sept. 23, 1941
2,289,855	Ralston	July 14, 1942
2,302,115	Gazey	Nov. 17, 1942
2,303,059	Misfeldt	Nov. 24, 1942
2,342,021	Swanson	Feb. 15, 1944
2,435,849	Schlitters	Feb. 10, 1948

OTHER REFERENCES

Holtzer-Cabot Motors, Advertisement, dated Jan. 30, 1934.