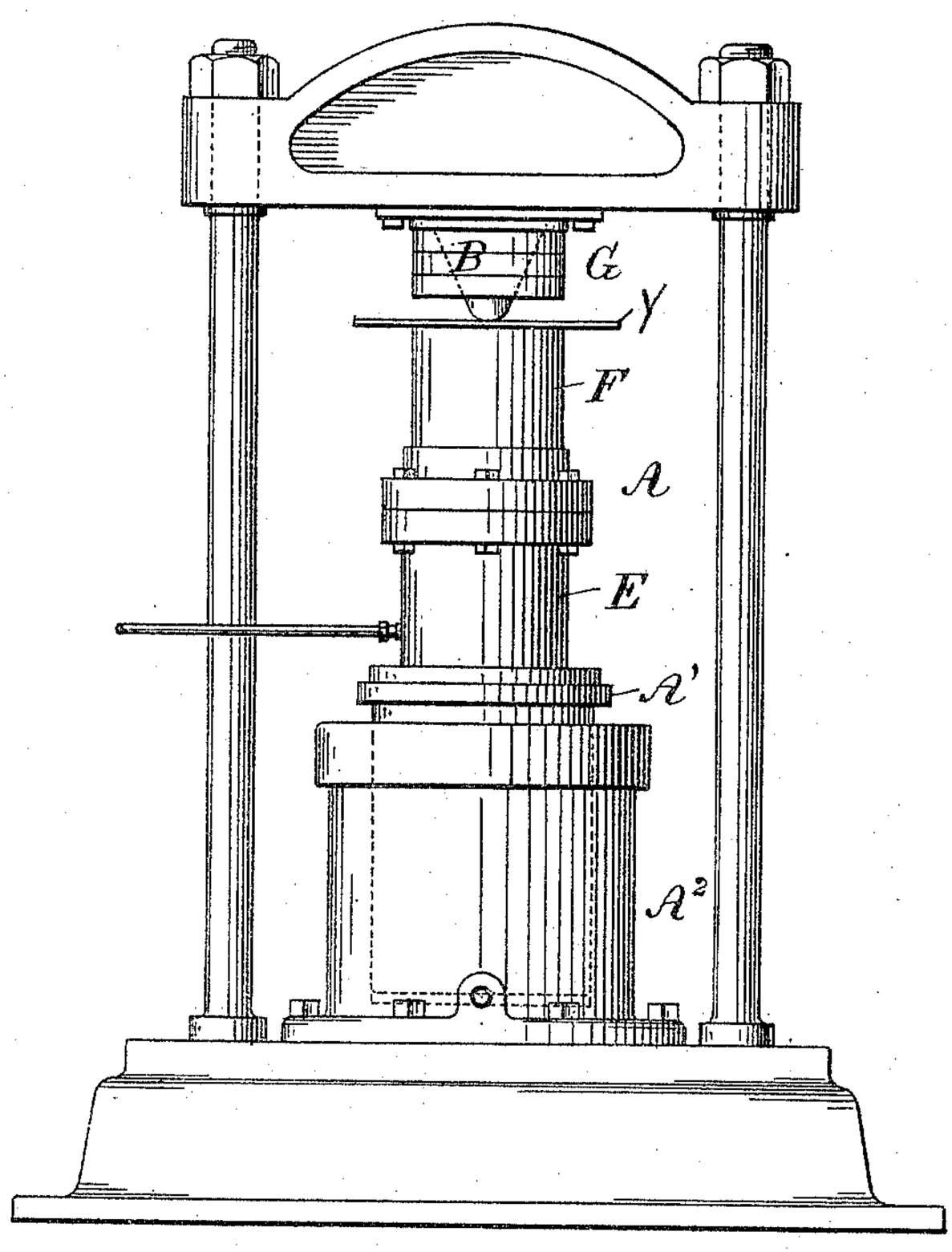
(No Model.) 2 Sheets—Sheet 1.

# C. A. KNIGHT & C. P. HIGGINS.

## HYDRAULIC STAMPING PRESS.

No. 495,591. Patented Apr. 18, 1893.

*Fig. 1*

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(No Model.) 2 Sheets—Sheet 2.

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## HYDRAULIC STAMPING PRESS.

No. 495,591. Patented Apr. 18, 1893.

*Fig. 2*

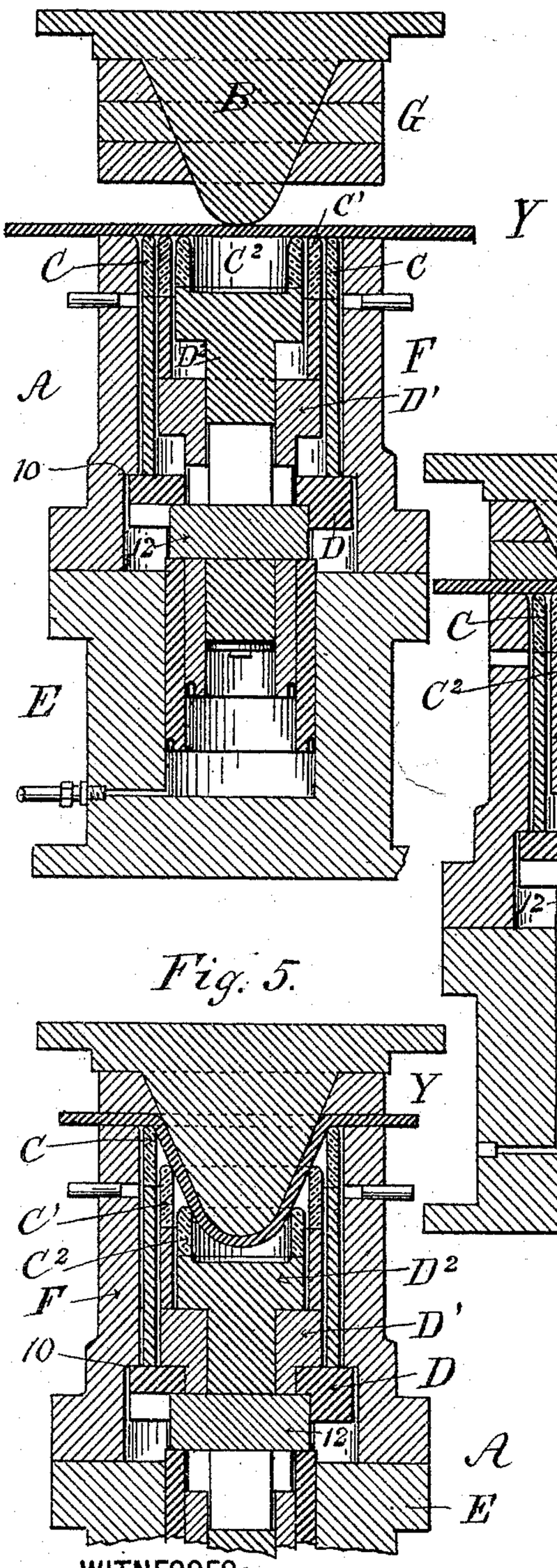


*Fig. 3.*

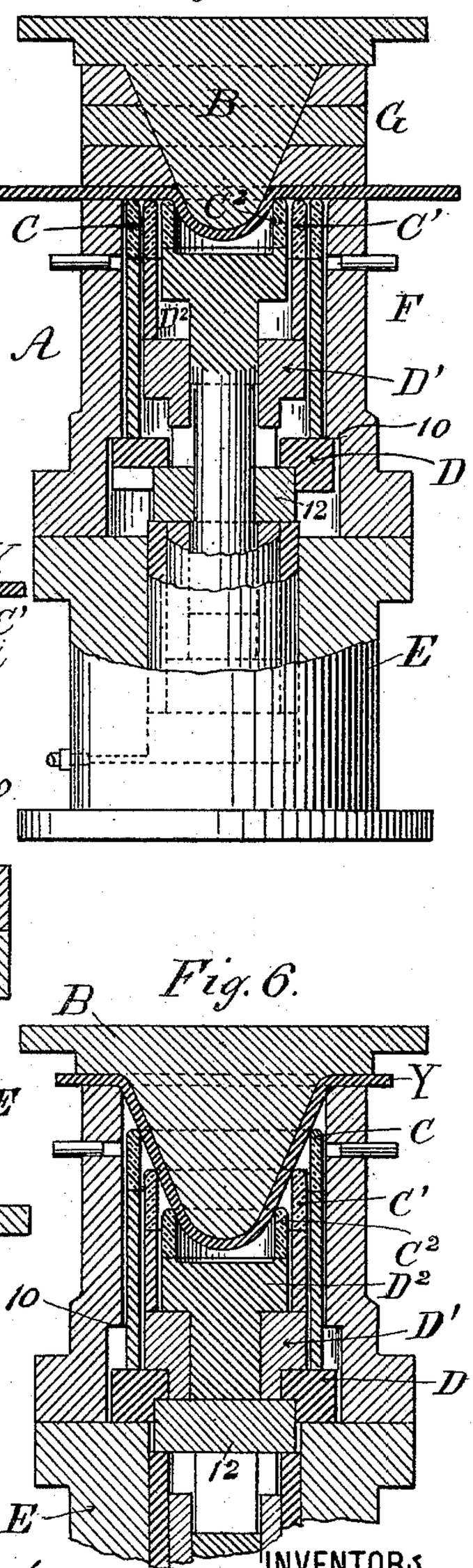


*Fig. 4.*

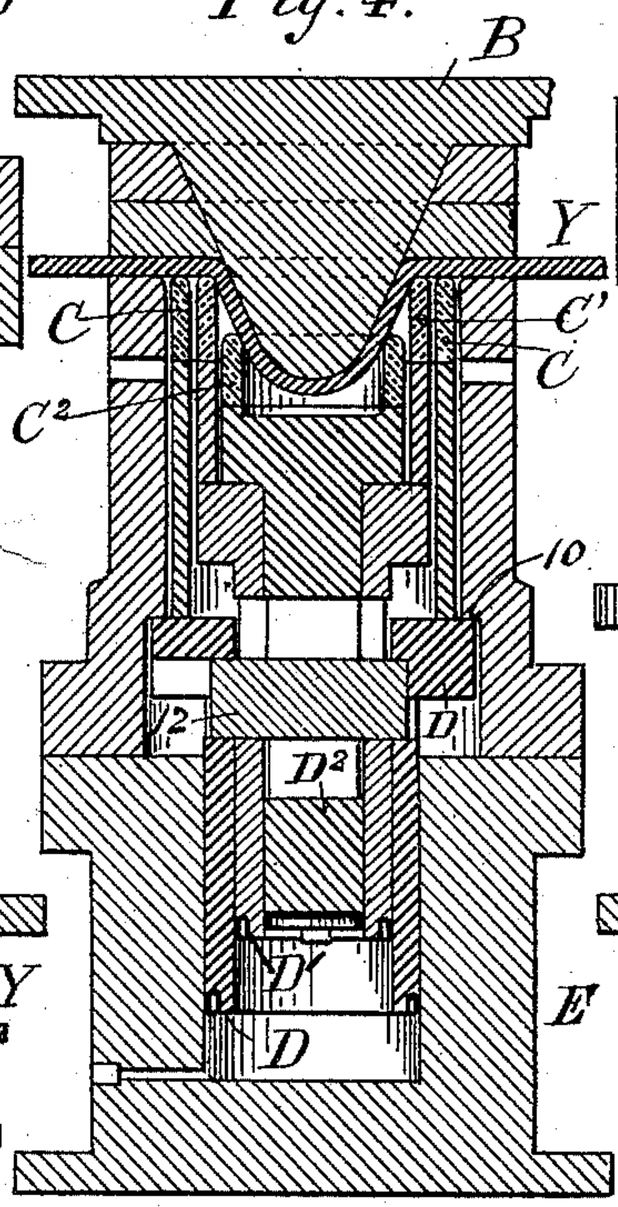


*Fig. 5.*




*Fig. 6.*




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# UNITED STATES PATENT OFFICE.

CHARLES A. KNIGHT, OF GLASGOW, AND CAMPBELL P. HIGGINS, OF KILBOWIE, SCOTLAND.

## HYDRAULIC STAMPING-PRESS.

SPECIFICATION forming part of Letters Patent No. 495,591, dated April 18, 1893.

Application filed March 26, 1891. Serial No. 386,578. (No model.) Patented in England April 3, 1890, No. 5,165; in France May 8, 1890, No. 205,555; in Belgium May 8, 1890, No. 90,489, and in Germany May 8, 1890, Nos. 56,681 and 57,534.

*To all whom it may concern:*

Be it known that we, CHARLES A. KNIGHT, residing at Glasgow, in the county of Lanark, and CAMPBELL P. HIGGINS, residing at Kilbowie, in the county of Dumbarton, Scotland, citizens of the United States, have invented certain new and useful Improvements in Hydraulic Stamping-Presses, (for which we have obtained patents in Great Britain April 3, 1890, No. 5,165; in France, No. 205,555, dated May 8, 1890; in Belgium, No. 90,489, dated May 8, 1890, and in Germany, Nos. 56,681 and 57,534, dated May 8, 1890,) of which the following is a specification.

This invention consists in a novel apparatus for dishing or bulging metal plates whereby the original thickness of the plate is substantially preserved throughout the dished or bulged portion.

It may be stated that the invention is particularly applicable for the forming of bulges in wrought metal plates used in the process of manufacturing cross boxes or saddles for attachment to the steam and water drum or reservoir of a sectional steam generator of the well known Babcock & Wilcox type, although it is equally applicable to the manufacture of plates having a dished or bulged surface adapted for other uses.

As a more complete understanding of the invention will be had from a detailed description of the improved apparatus employed in carrying it out, such description will now be given, reference being had to the accompanying drawings, in which:—

Figure 1 is a side elevation of an ordinary hydraulic press provided with the improved apparatus. Fig. 2 is an enlarged sectional elevation of a portion of the apparatus shown in Fig. 1, the hydraulic press proper not being shown. Fig. 3 is a similar view partly in elevation showing the first step of the method of operation. Figs. 4, 5 and 6 are similar views showing successive steps of the method of operation and the completion of the dishing or bulging of the plate.

The apparatus consists essentially of a hydraulic press adapted to be used as a tool or as a supplemental press A in a hydraulic press of the usual form. Thus, as shown in Fig. 1, it is mounted upon the end of a movable ram or plunger A′ of the usual hydraulic press $A^2$, and may when occasion requires be entirely removed therefrom so that the press may be employed for other purposes.

The supplemental press consists of a cylinder E forming a base for that press and provided with an upper casing F. Within the cylinder and the casing there is mounted a plurality of plungers or rams D, D′, $D^2$, arranged telescopically, one within the other, as shown, and each provided at its upper end with a ring or annular die C, C′, $C^2$, respectively, which are also arranged telescopically one within the other. These ring dies are formed independent of the plungers and rest upon their respective heads as shown. The upward movement of the plungers is limited first by the head of the outer plunger striking a shoulder 10 of the casing F, while the other two plungers are limited by a key 12 that is supported by the outer plunger and passes diametrically through slotted openings in the other plungers as shown. The downward movements of the plungers are also limited by the meeting of the head of the innermost plunger with the head of the surrounding plunger and likewise by the meeting of the head of the latter plunger with the head of the outer plunger, and the outer one is limited by its head meeting the cylinder E. By reason of the limitation of the movement of the plungers in their upward position, the ring dies are held, for a purpose that will afterward appear, substantially level with the upper surface of the casing F as in Fig. 2. The ring dies may be of circular shape and arranged concentrically one within the other, or they may be of any other shape such as oblong or rectangular suited to the form of dish or bulge that is to be imparted to the plate, and by making the said ring dies independent of the plungers they may be removed and others substituted for them.

Co-operating with the supplemental press described there is a die block B secured to the top sill of the press and having a number of removable stop disks G thereon for determining the extent to which the plate will be bulged

at each operation, and forming stops limiting the upward movement of the supplemental press in the successive steps of the process.

In the operation of the apparatus, the motor fluid under say eight hundred pounds pressure, will be allowed to pass to the supplemental press A thereby forcing each of its plungers to the limit of their upward movement to bring the upper surface of each of the ring dies in substantially the same plane and preferably in the same plane with the top surface of the casing F. Upon the top of this casing is placed the metal plate Y to be bulged, having been previously heated, see Fig. 2. The motor fluid is then allowed to pass to the main hydraulic press $A^2$ under the same pressure as that in the supplemental press A, thereby causing the ram or plunger to move the supplemental press bodily upward toward the die-block B causing the heated plate to be partially bulged or dished around the end of the die-block as shown in Fig. 3; all further movement of the press being stopped by the meeting of the lower stop disk with the plate and confining the latter between the said disk and the ring dies and top of the casing F. The pressure in the main press is then temporarily cut off to lower the supplemental press from the die block and allow the removal of one or more of the stop disks G. The pressure is then allowed to pass to the main press under an increased pressure over that in the supplemental press and thus raise the supplemental press and with it the partially bulged plate again against the die block. This increased pressure which may be two thousand pounds is sufficient to overcome the lesser pressure upon the plungers of the supplemental press so that the inner plunger $D^2$ and its ring die will yield with respect to the upward movement of the supplemental press as a whole; in other words said plunger and its ring remain in position in contact with the previously bulged portion of the plate while the remaining plungers and their ring dies with the supplemental press as a whole move bodily upward. The rising movement of said remaining plungers and the supplemental press as a whole, independent of the inner plunger and its ring die, thereby gradually increases the effective diameter of the lower die face. In the change from the ring die $C^2$ to the next adjacent ring die C′, which is now in position to bear against the metal plate, its edge acts as a drawing face over which the metal is drawn uniformly inwardly from all sides while it is constantly holding the inwardly drawn metal against the die block until the further movement of the supplemental press and its dies is stopped by the stop disk meeting the plate as in Fig. 4, the plate having been further dished or bulged. If a yet larger dish or bulge is desired in the plate, the pressure is relieved from the main press and the supplemental press allowed to drop from the die block so that one or more of its stop disks may be removed, when the increased pressure will again pass to the main press sufficient to more than overcome that in the supplemental press acting upon the inner and intermediate plungers $D^2$, D′, and their ring dies $C^2$, C′, which in this case will both yield as did the inner plunger and its ring die in the previous step; or in other words the inner and intermediate plungers $D^2$, and D′ with their ring dies will remain still in forcible contact with the bulged portion of the plate upon the die block while the remaining plunger D, its ring die C and the supplemental press move still farther bodily upward until the press assumes the position shown in Fig. 5, and the stop disk meets the metal plate whereby that plate is still further dished around the die block and is bent or turned over the edge of the ring die C of the outer plunger. If a still more enlarged dish or bulge is necessary to the plate, a similar operation will be followed first removing the remaining stop disk from the die block and applying the increased pressure to the main press so that all three plungers with their ring dies yield while the supplemental press moves still farther upward leaving the said three ring dies in forcible contact with the bulged plate against the die block, the plate being then bent or turned over the edge of the casing F, as shown in Fig. 6. In the first step in the dishing of the plate, the ring die of the inner plunger supports the metal around its edge in contact with the outer surface of the die block so that it partakes of its shape as in Fig. 3. In the second step, as shown in Fig. 4, the inner ring die still supports the plate against the die block, but the adjacent ring die is aiding the support and has also forced the plate to conform still more with the shape of the die block; and in Fig. 5, all three of the ring dies are supporting the dished portion of the plate against the die block, while in Fig. 6, their support is supplemented by the edge of the casing F, and as each ring die has acted in succession against different portions of the metal plate in the upward movement of the press, each has aided in the drawing of the metal inwardly in a uniform manner to provide sufficient metal to form the bulge without drawing upon that portion already bulged. The drawing action of each ring die is made uniform by providing a stop limiting its upward movement at the end of each step in the process and insuring the simultaneous yielding movement of one, two and then of all three ring dies and their plungers. At the same time the upward movement of the intermediate plunger D′ will be limited by the head of the inner plunger, while the upward movement of the outer plunger D will be limited by the head of the intermediate plunger, and the upward movement of all three plungers will be limited by the head of the outer plunger meeting the top of the cylinder E, as shown in

Fig. 6. Of course between each successive action of the dies and die block B, the plate may be reheated if desired. The stop disks placed around the die block are merely to limit the maximum movement of the supplemental press at each step of the process and by being pressed against that portion of the plate surrounding the depression insures the definite position of the depressed metal to the flat portion and to form the proper radius or curve of the corners of the depression where they join said flat portion. Thus a greater pressure is turned onto the main cylinder of the press after the first depression has been formed and the plate is tightly squeezed between the stop disk and the head of the auxiliary press to straighten out the metal. The area of the main cylinder being more than sufficient to overcome the combined areas of the plungers of the supplemental press and the resistance of the metal as the plate of the main cylinder rises carrying the supplemental press with it, each of the plungers thereof with its ring die in turn acts upon the metal until it is backed off or yields by the superior pressure of the main cylinder, and thereafter during the continuance of the operation merely acting as a clamp to hold the metal already formed in shape against the die block.

In the use of the apparatus following the method of operation described, it has been found that instead of straining the metal around the apex or end of the die block B at each successive operation, thereby reducing the thickness of the metal, the metal is drawn uniformly from the outside of the die inwardly so that the dished or bulged portion of the plate is kept of substantially the same thickness as that portion of the plate that has not been disturbed.

What is claimed is—

1. A press for dishing or bulging a metal plate having a rigid die, a plurality of yielding dies, and corresponding stop disks, as set forth.

2. The herein described supplemental press consisting of a plurality of telescopically arranged plungers each carrying a die in combination with stop disks, and a die block coacting therewith, substantially as described.

3. The combination of a plurality of telescopically arranged plungers each having a die, a stop limiting the movement of each plunger, and a die block coacting therewith substantially as described.

4. The combination of a plurality of telescopically arranged plungers, each carrying a die, a stop limiting the movement of each plunger, and another stop limiting the combined movement of the plungers, substantially as described.

5. The combination of a cylinder and its casing, a plurality of telescopically arranged plungers in said cylinder and within the casing, a plurality of dies one for each plunger, the head of the outer plunger or plungers forming a stop for the adjacent inner plunger, and the cylinder forming a stop for all of the plungers.

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