Jan. 20, 1942. C. H. GAY 2,270,819

FORGING MACHINE

Filed Oct. 26, 1940 2 Sheets-Sheet 1

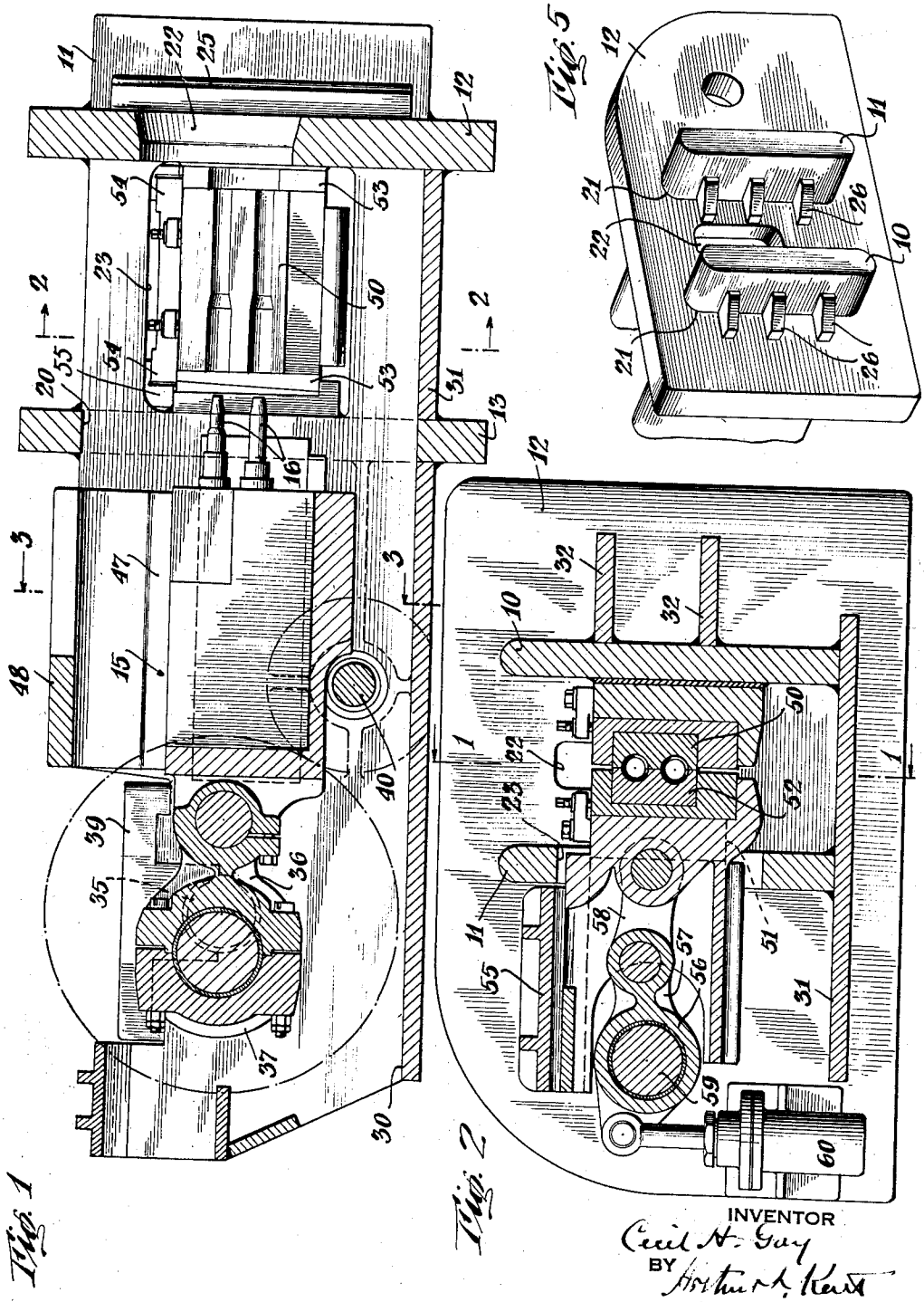

Fig. 1

Fig. 2

Fig. 5

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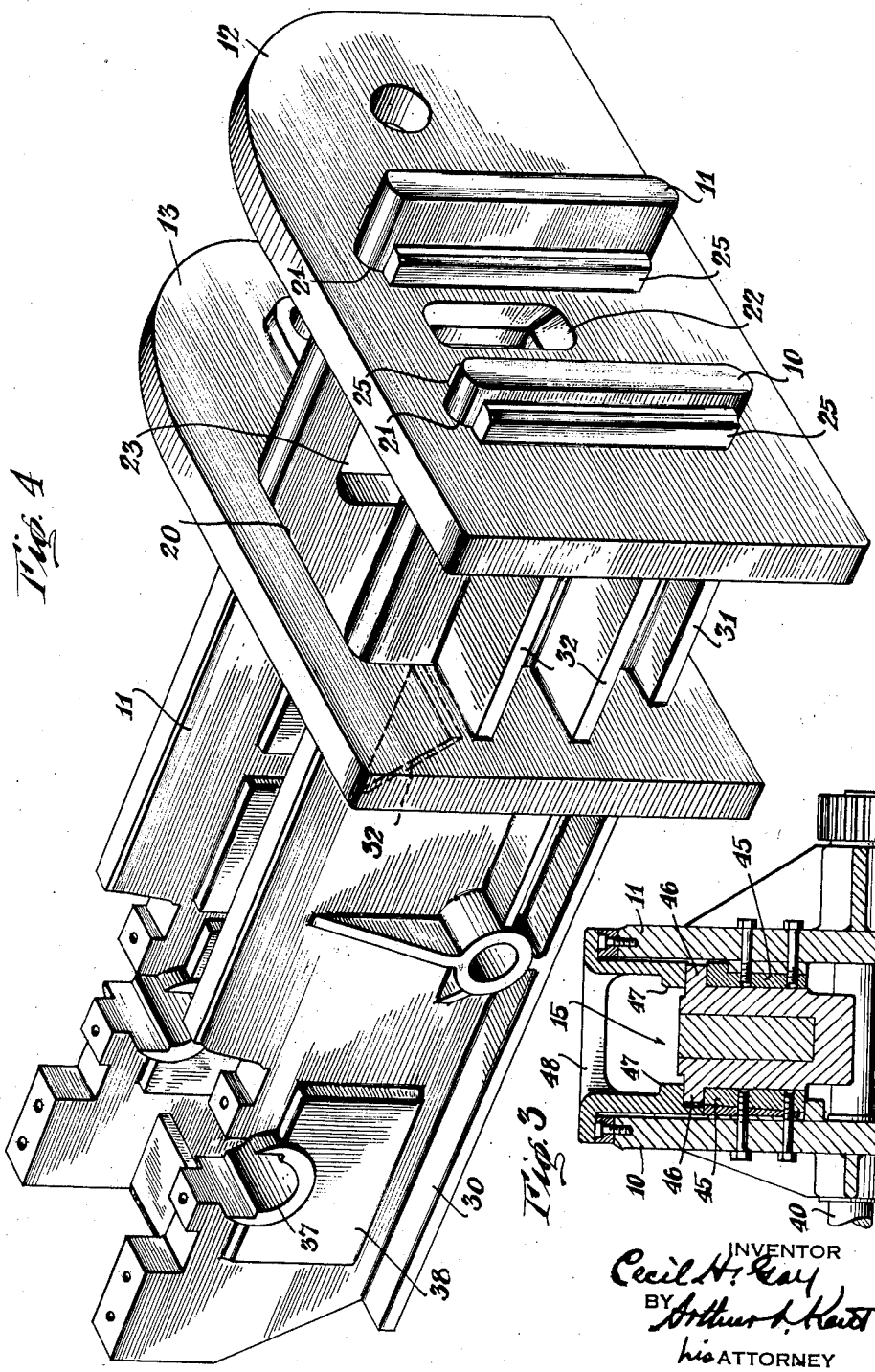

Fig. 4

Fig. 3

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2,270,819

FORGING MACHINE

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7 Claims. (Cl. 78—17)

This invention relates to forging machines. The main object of the invention is to provide an improved frame for carrying the working parts of the machine which shall have great strength and endurance, shall be of less weight than has been found necessary heretofore with the frames as heretofore made, and shall have other advantages hereinafter referred to.

The invention relates more particularly to forging, or upsetting, machines having a pair of gripping dies for holding the workpiece, one of which is reciprocated transversely of the machine, and having a slide which carries the upsetting tool and is reciprocated longitudinally of the machine. The forces required to move the movable gripping die against the workpiece and to hold the workpiece gripped securely during the upsetting operation, and to operate the upsetting-tool slide and effect the upsetting operation on the workpiece, impart extremely heavy stresses to the frame, and because of these extremely heavy stresses it is necessary that the frames of these machines be of great strength and rigidity.

It has been a difficult problem heretofore to make the frames of such machines for upsetting the ends of bars and tubes of wire and steel and certain alloys having high resistance to forging sufficiently strong and rigid to withstand the stresses to which they are subjected. The frames have customarily been made heretofore of a single integral casting having openings in certain of their walls for the reciprocating upsetting slide and tool and the reciprocating die slide and for entry of the workpiece, which openings extend through the top edge of the walls. Because of their large size and the required design and the thickness of various portions of these cast frames, they are not only difficult to cast but it is practically impossible to avoid weakening defects at various points in the casting, including inside defects which do not extend to the surface of the casting and are, therefore, not apparent and which cannot be cured. Such cast frames, therefore, although of great weight even for the smaller upsetting machines and of proportionately greater weight for the larger machines, are liable to develop weakening cracks and fissures in use, this liability being increased by the openings extending through the top of the walls. Efforts have been made to overcome such weakness of these cast frames by the addition of strengthening tie rods, but such tie rods as they have been applied to the cast frames, aside from being otherwise undesirable, have not been found completely to remove the danger of failure of the frames.

Forging machines according to the present invention have frames having as their principal stress-resisting members four separately made rolled or otherwise forged metal plates, two of these plates extending longitudinally of the machine, standing on edge and spaced apart parallel to each other to provide a slideway between them for the reciprocating slide carrying the upsetting tool, and two of the plates extending transversely of the machine and usually at right angles to the longitudinal plates, standing on edge and spaced apart parallel to each other to provide a slideway for the reciprocating clamping-die slide. The transverse plates are most desirably of greater vertical width than the longitudinal plates, the inner transverse plate having a window therein near one end thereof through which the two longitudinal plates extend and through which the upsetting tool reciprocates, and the outer transverse plate having two closed slots through which the ends of the longitudinal plates extend and a window for entry of the workpiece which is to be gripped by the clamping dies, and one of the longitudinal plates having a window through which the clamping-die slide reciprocates. The ends of the longitudinal plates beyond the outer transverse plate have thrust-resisting members for bearing against the outer face of the outer transverse plate. Meeting portions of the longitudinal and transverse plates are most desirably welded together, and the two pairs of plates are also suitably braced, especially by means of a horizontal base plate bridging the longitudinal plates beyond the inner transverse plate and welded to both the longitudinal plates and the inner transverse plate, and a horizontal base plate bridging the transverse plates and welded thereto and to the longitudinal plates.

By having the longitudinal plates extend through, and the upsetting tool reciprocate through, a window in the inner transverse plate, instead of the transverse plate being of the usual C-form, that is, with an opening extending down from the upper edge thereof, and by having a window in one of the longitudinal plates for the reciprocating die slide instead of an opening extending down from the upper edge of the plate, and by having the workpiece opening in the outer transverse plate in the form of a window instead of an opening extending down from the upper edge of the plate, the strength of the frame is not impaired as it would be if the customary openings were used instead of windows; the term "win-

dow" being understood, and being used herein, as meaning an opening through the plate which does not extend on any side through an edge of the plate but is completely surrounded by integral portions of the plate.

In the new frame, the longitudinal stresses are taken by the heavy longitudinal plates unweakened by the heretofore customary edge opening for the clamping slide, and the transverse stresses are taken by the heavy transverse plates unweakened by any edge opening either for the longitudinal plates or for the reciprocating upsetting tool or for the entry of the workpiece; and, being made of forged, and most desirably of rolled, metal, the plates are of maximum strength and free from hidden weakening defects. The result is that the new frame for a machine for operating on bars or tubes of a given size and material may be made of much less total weight than a cast frame such as heretofore used, and still have greater strength and rigidity and be free from liability of failure because of hidden defects. And the cost of the new frame is also much less than of the old cast frame for the same capacity machine. The invention provides a frame built up of separately formed pieces of rolled or otherwise forged plate in which the customary "C frames" are entirely done away with, and in which all main stresses are handled without relying on welds to resist stresses in tension.

A full understanding of the invention can best be given by a detailed description of an upsetting machine having a frame made in accordance with the invention, and such a description will now be given in connection with the accompanying drawings illustrating such a machine. In said drawings—

Fig. 1 is a longitudinal sectional view of such a machine, the view being taken on line 1—1 of Fig. 2;

Fig. 2 is a transverse sectional view of the machine taken on line 2—2 of Fig. 1;

Fig. 3 is a transverse section taken on line 3—3 of Fig. 1 but on a smaller scale and with more distant parts not shown;

Fig. 4 is an isometric perspective view showing the principal stress-resisting members of the machine frame; and

Fig. 5 is a fragmentary perspective view of one end of the frame showing an alternative form of the thrust-resisting members for locking the ends of the longitudinal frame plates to the outer transverse frame plate.

Referring to the drawings, the operating parts of the machine are mounted within a frame made up principally of four rolled, or otherwise forged, plates 10, 11, 12 and 13 of steel or other suitable metal. Two of these plates, 10 and 11, are longitudinal plates standing on edge parallel to each other and spaced apart to provide a slideway between them for the main slide 15 which carries one or more upsetting tools 16 as customary in forging machines of this general kind. The other two plates, 12 and 13, also stand on edge parallel to each other and spaced apart and extend transversely of the longitudinal plates near one end thereof and, most desirably, at right angles thereto as shown. The plates of one pair are of less vertical width than those of the other pair and extend through openings in the plates of the vertically wider pair. Most desirably, and as shown, the transverse plates are of the greater vertical width, and the inner transverse plate has a window 20 therein near one end thereof through which the two longitudinal plates extend and through which the upsetting tool reciprocates, and the outer transverse plate has two closed slots 21 through which the ends of the longitudinal plates extend and a window 22 through which the end of the workpiece is entered to be gripped by the clamping dies, and one of the longitudinal plates has a window 23 through which the clamping-die slide reciprocates. As indicated on Figs. 1 and 2 of the drawings, the meeting portions of the longitudinal and transverse frame plates are welded together. The ends of the longitudinal plates projecting beyond the outer transverse plate are locked against movement inward through the transverse plate by thrust-resisting members which bear against the outer face of the transverse plate. As shown in Figs. 1 and 2, these thrust-resisting members are formed by bars 25 welded one on either side of the projecting end of each of the longitudinal plates. In place of these welded-on thrust-resisting members, thrust keys 26 extending through slots in the ends of the longitudinal plates may be provided as shown in Fig. 5 for bearing against the outer transverse frame plate to take the upsetting thrust of the machine.

Horizontal base plates 30 and 31 are desirably provided, one, 30, bridging the longitudinal frame plates beyond the inner transverse plate, and, as shown and most desirably, extending beneath the longitudinal plates and butting the inner transverse plate, and being welded to the longitudinal plates and to the inner transverse plate, and the other, 31, bridging the transverse plates and, most desirably, and as shown, being on the same level with the plate 30, extending between the two transverse plates and beneath the bottom edges of the longitudinal plates and being welded to both pairs of plates. In addition, the plates may be further braced, as by means of welded brace plates 32.

The upsetting-tool slide 15 is reciprocated by a crank shaft 35 journalled in the longitudinal frame plates, the crank of said shaft being connected to the slide by pitman 36. The lower half of the journal bearings for the crank shaft are in the frame plates and are extended to provide bearings of suitable length by boss pieces 37 welded on to the plates and supported by welded-on plates 38. The upper halves of the journal bearings are provided by cap pieces 39 bolted on to the frame, one of which appears in Fig. 1.

The crank shaft may be driven in any customary or suitable manner. As shown, a driving shaft 40 is journalled in the longitudinal frame plates, extending between the plates beneath the main slide 15, and the bearings for this shaft also being extended by means of bosses welded to the frame plate and braced as shown for one of them in Fig. 3.

The upsetting-tool slide 15 reciprocates between face plates 45 secured to the frame plates 10 and 11 and is supported by these plates 45, the slide having lateral horizontally extending heavy machined flanges 46 which extend over the plates 45 to slide in a guideway between the plates 45 and hold-down plates 47 extending downward from a bridge 48 resting on and bolted to the frame plates.

The holder for the stationary gripping die 50 is mounted between the transverse frame plates backed against the longitudinal frame plate 10. The slide 51 which carries the holder for the movable gripping die 52 is mounted between the

transverse frame plates to reciprocate horizontally between face plates **53**, the slide having lateral horizontally extending heavy machined flanges **54** which extend over the plates **53** to slide in a guideway between the plates **53** and a cap piece or bridge **55**. The slide **51** is toggle-operated by a rocker **56** having a toggle arm **57** connected to the slide by toggle link **58**, the rocker being mounted on a shaft **59** extending between the transverse frame plates and being operated by the piston of an oscillating hydraulic cylinder **60** mounted between the frame plates. When the piston of the hydraulic cylinder moves downward the toggle is broken to retract the movable die, and when the piston is forced upward the toggle is straightened to force the movable die forward to grip the workpiece.

As will be seen, all parts for operating the movable gripping die are mounted between and carried by the two transverse frame plates, and all the forces for operating the die back to its separate source of power are symmetrical with respect to a single plane midway, or substantially so, between the transverse plates, racking forces on the transverse plates being thus avoided.

The machine is used, and the operating parts of the machine operate, in the usual way. Obviously, other suitable mechanism may be used for operating the upsetting-tool slide and the gripping-die slide, it being highly desirable, however, that the operating mechanism be such as to avoid racking forces on either pair of the main frame plates. It will also be understood that the upsetting tool or tools and the work-gripping dies will be shaped according to the workpiece to be operated on, whether solid or tubular, and the operation to be performed and shape to be produced.

Because of the main frame members being heavy forged plates and of the manner in which they are assembled, and because of the openings in the heavy plates forming the main frame members for extension of the plates of one pair through the plates of the other pair, and for the movement therethrough of the operating slides or parts carried thereby, and for the introduction of the workpiece, being in the form of windows or other closed openings, a machine frame of the required great strength may, as stated, be of much less weight than the cast metal frames heretofore used for upsetting machines of equal capacity, and may be produced at substantially less cost; and furthermore, the frames according to the invention may be made free from the internal defects which are characteristic of the heretofore used cast frames of such machines and which lead to the development of weakening cracks and fissures after more or less use.

What is claimed is:

1. A forging machine frame, comprising as its principal stress-taking parts two heavy longitudinal plates of forged metal standing on edge and spaced apart to provide a slideway for a reciprocating upsetting-tool slide, and two heavy transverse plates of forged metal standing on edge and spaced apart to provide a slideway for a movable gripping-die slide and extending transversely of the longitudinal plates near one end thereof, the inner transverse plate having a window through which the longitudinal plates extend and through which the upsetting tool is reciprocated, the outer transverse plate having two closed slots through which the ends of the longitudinal plates extend and a window for the workpiece, and one of the longitudinal plates having a window for movement therethrough of the gripping-die slide.

2. A forging machine frame, comprising as its principal stress-taking parts two heavy longitudinal plates of forged metal standing on edge and spaced apart to provide a slideway for a reciprocating upsetting-tool slide, and two heavy transverse plates of forged metal standing on edge and spaced apart to provide a slideway for a movable gripping-die slide and extending transversely of the longitudinal plates near one end thereof, the inner transverse plate having a window through which the longitudinal plates extend and through which the upsetting tool is reciprocated, the outer transverse plate having two closed slots through which the ends of the longitudinal plates extend and a window for the workpiece, and one of the longitudinal plates having a window for movement therethrough of the gripping-die slide, meeting portions of said longitudinal and transverse plates being welded together, and the ends of the longitudinal plates beyond the outer transverse plate being locked by thrust-resisting members bearing against the outer face of the outer transverse plate, the frame comprising also a horizontal base plate bridging said longitudinal plates beyond the inner transverse plate and welded thereto and to the inner transverse plate, and a horizontal base plate bridging the transverse plates and welded thereto and to the longitudinal plates.

3. A forging machine frame, comprising as its principal stress-taking parts two heavy longitudinal plates of forged metal standing on edge and spaced apart to provide a slideway for a reciprocating upsetting-tool slide, and two heavy transverse plates of forged metal standing on edge and spaced apart to provide a slideway for a movable gripping-die slide and extending transversely of said longitudinal plates near one end thereof, the vertical dimension of the plates of one pair being substantially greater than the vertical dimension of the plates of the other pair, and the plates of lesser vertical dimension extending through openings in the plates of the greater vertical dimension, which openings end a substantial distance from the upper and lower edges of their plates, the outer transverse plate having a window for the workpiece, the inner transverse plate having a window for reciprocation therethrough of the upsetting-tool, and one of the longitudinal plates having a window for movement therethrough of the gripping-die slide.

4. A forging machine, comprising two heavy longitudinal frame plates of forged metal standing on edge and spaced apart, an upsetting-tool slide mounted between said plates, a crank shaft journalled in said plates near one end thereof for reciprocating said slide, two heavy transverse frame plates of forged metal standing on edge and spaced apart and extending transversely of said longitudinal plates near one end thereof, the inner transverse plate having a window through which the longitudinal plates extend and through which the upsetting tool is reciprocated and the outer transverse plate having closed slots through which the ends of the longitudinal plates extend and a window for the workpiece, a stationary gripping-die holder mounted between said transverse plates and backed against one of said longitudinal plates, a movable gripping-die slide mounted between the transverse plates, and means for operating the movable gripping-die slide, the other longitudinal plate having a win-

dow through which the movable gripping-die slide is moved.

5. A forging machine, comprising two heavy longitudinal frame plates of forged metal standing on edge and spaced apart, an upsetting-tool slide mounted between said plates, a crank shaft journalled in said plates near one end thereof for reciprocating said slide, two heavy transverse frame plates of forged metal standing on edge and spaced apart and extending transversely of said longitudinal plates near one end thereof, the inner transverse plate having a window through which the longitudinal plates extend and through which the upsetting tool is reciprocated and the outer transverse plate having closed slots through which the ends of the longitudinal plates extend and a window for the workpiece, a stationary gripping-die holder mounted between said transverse plates and backed against one of said longitudinal plates, a movable gripping-die slide mounted between the transverse plates, a shaft extending between said transverse plates, a toggle arm on said shaft connected by a toggle link to the gripping-die slide, and a hydraulic power cylinder mounted between said transverse plates for operating said toggle arm.

6. A forging machine, comprising two heavy longitudinal frame plates of forged metal standing on edge and spaced apart, an upsetting-tool slide mounted between said plates, a crank shaft journalled in said plates near one end thereof for reciprocating said slide, two heavy transverse frame plates of forged metal standing on edge and spaced apart and extending transversely of said longitudinal plates near one end thereof, the vertical dimension of the plates of one pair being substantially greater than the vertical dimension of the plates of the other pair and the plates of the lesser vertical dimension extending through openings in the plates of the greater vertical dimension, which openings end a substantial distance from the upper and lower edges of their plates, the outer transverse plate having a window for the workpiece and the inner transverse plate having a window for reciprocation therethrough of the upsetting tool, a stationary gripping-die holder mounted between said transverse plates and backed against one of said longitudinal plates, a movable gripping-die slide mounted between the transverse plates, and means for operating the movable gripping-die slide, the other longitudinal plate having a window through which the movable gripping-die slide is reciprocated.

7. A forging machine frame as claimed in claim 3, in which the inner transverse plate has a single window for the plates of lesser vertical dimension and for the upsetting tool and the outer transverse plate has two closed slots for the ends of the plates of lesser vertical dimension and a separate window for the workpiece.

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