Dec. 29, 1953 O. H. MAY 2,664,191

DRAWING PRESS

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FIG. 1.

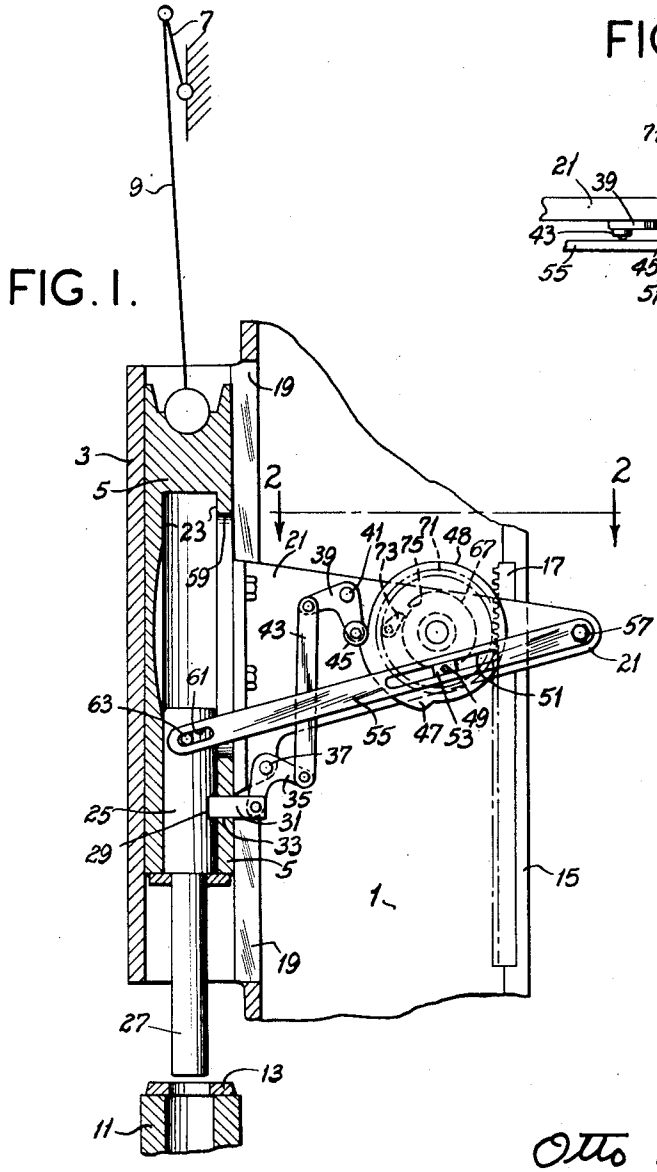

FIG. 2.

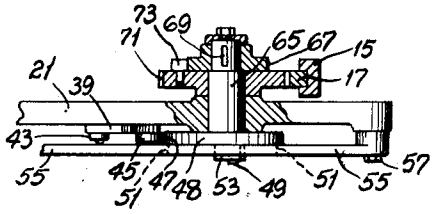

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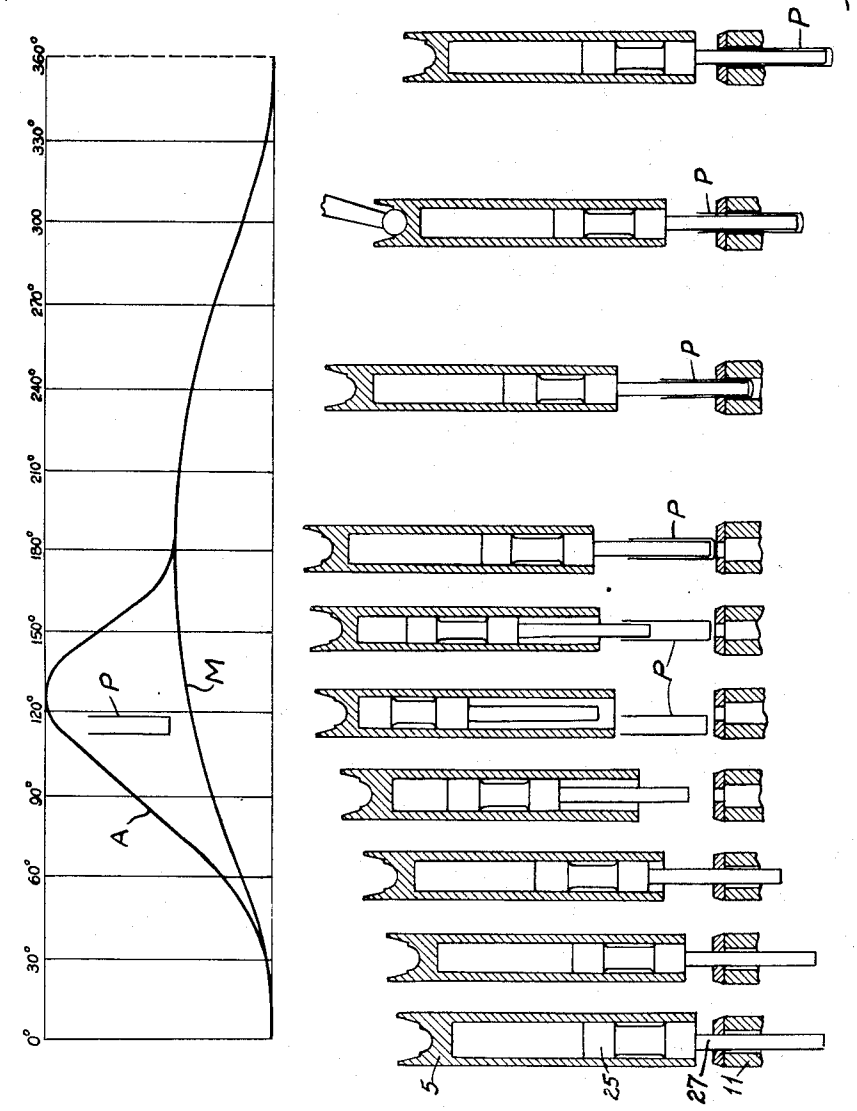
FIG.3.



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DRAWING PRESS

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7 Claims. (Cl. 113—38)

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This invention relates to drawing presses, and with regard to certain more specific features, to crank drawing presses such as are employed for forming long shells.

Present-day drawing presses have several disadvantages, the chief one of which is that drawing progresses at a decreasing drawing speed while the opposite is desirable in order to avoid a punching effect. A second disadvantage is that the pressure required at the beginning of the drawing operation is applied when the driving crank is in its most unfavorable position of greatest reactive lever arm, instead of at a minimum which may be gradually increased. A third disadvantage is that stroke of the press may be more than double the length of the shell, with the result that the ram first travels a substantial distance without doing any work. The end result of the stated disadvantages is a press that is unnecessarily large and expensive in construction, having an unnecessarily low production rate at a given forming speed. Moreover, the former presses, as a result of the stated disadvantages, have a shorter useful life.

The present invention avoids the stated disadvantages without losing any of the other known advantages of drawing presses, by providing an auxiliary ram on the main ram. This auxiliary ram carries the punch and moves it parallel to the axis of motion of the main ram in such a manner that the auxiliary ram performs an independent return and forward stroke superimposed upon the return and forward stroke of the main ram. The return and forward strokes of the auxiliary ram occur substantially during the retraction of the main ram.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

Fig. 1 is a vertical section of parts of a drawing press illustrating the significant parts of the invention;

Fig. 2 is a fragmentary horizontal section taken on line 2—2 of Fig. 1; and

Fig. 3 is a curve illustrating the coordinated operations of the two rams, the relative positions of the rams with respect to one another and with respect to the drawing ring being also shown in coordination.

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Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now more particularly to Figs. 1 and 2, there is shown at numeral 1, a press frame which forms a guide 3 for a reciprocating main ram 5. The ram is reciprocated by the action of the usual crank 7 coupled through connecting rod 9, both being shown diagrammatically. A support 11 is provided on the frame for a drawing ring 13. A support 15 is also provided for a vertical rack 17. Part of the frame 1 adjacent to the guide 3 is slotted at 19 to accommodate the motion of a bracket 21 which is bolted to the main ram 5. Thus as the crank 7 rotates anticlockwise, the main ram 5, together with the bracket 21, is reciprocated up and down.

Interiorly, the main ram 5 (which is hollow) is provided with a guide 23 for an auxiliary ram 25 which carries a punch 27. The auxiliary ram 25 is notched as shown at 29 to accommodate insertion of a latch 31 which passes through a suitable opening 33 in the side of the main ram 5. Elements 29, 31 and 33 constitute releasable coupling or holding means between the main ram 5 and the auxiliary ram 25. This latch is pinned to a bell-crank lever 35 which is pinned at 37 to the bracket 21. A second bell-crank lever 39 is pinned at 41 to the bracket 21. The bell-crank levers are coupled by means of a link 43. One arm of the bell-crank lever 39 carries a roller follower 45 engaging a cam 47 on a crank disc 48. Members 31, 35, 43, 39, 45, 47 may be referred to as coupling means for coupling and decoupling the auxiliary ram 25 relatively to the main ram 5. The crank disc carries a crankpin 49, which forms a coupling with a slot 51 by means of a sliding shoe 53. The slot 51 is located in an oscillating arm or link 55, which is pinned at 57 to the bracket 21 and reaches into the main ram 5 through a slot 59 therein. The end of the arm 55 is slotted, as shown at 61, to accommodate a pin 63 on the auxiliary ram, so that when the arm 55 is oscillated or cycled relatively to the bracket 21, the auxiliary ram 25 may be reciprocated relatively to the main ram 5. Parts 53 and 55 may be referred to as cycling means.

The crank disc 48 is attached to a journal 65 rotary in the bracket 21. This journal has keyed to it, as shown at 69, a ratchet 67. Rotary on the journal 65 is a control gear 71 which meshes with the stationary rack 17. Pinned to the gear 71 is a pawl 73, which is spring-biased in the usual manner against the ratchet 67. The ratchet carries a notch 75 with which the pawl 73 is en-

gageable. The mechanism 67 and 73 constitutes a one-way clutch between the gear 71 and the crank disc 48. Thus the releasing means for the lock 29, 31 and the operating means 48, 53 and 55 for reciprocating the auxiliary ram 25 are responsive to the upward or retractive movement of the main ram 5, but unresponsive to its downward or advancing movement. Parts 17, 71, 73, 75 and 67 may therefore be designated as timing means.

Operation is as follows, referring to Figs. 1 and 2:

Assume that the parts start from the position shown in Fig. 1, the crank 7 rotating anticlockwise. The main ram 5 will descend, the auxiliary ram 25 then being locked to it by means of the latch 31. The auxiliary ram 25 is now in the most advanced position which it will hold relatively to the main ram 5. The punch 27 is about to enter the draw ring 13. How the shell is inserted (upon the ram operates) will be described later in connection with Fig. 3. The following system of parts then moves downward as a unit, namely; main ram 5, auxiliary ram 25 with the punch 27, and bracket 21. The locking latch 31 has prior to this been biased by the effect of gravity on parts 39, 43 and 35 to lock together rams 5 and 25 so that they move as a unit. The control gear 71 at this time rolls down and the rack 17, being turned thereby anticlockwise relative to the bracket 21. However, this has no effect at this time upon the lever arm 55, because the gear 71 merely drags the pawl 73 anticlockwise around the ratchet 67 without driving the ratchet. Thus the drawing stroke is accomplished.

When the stated system reaches the bottom of its travel, the main ram 5 is thereafter raised or retracted. The control gear then begins to roll up the rack 17, its rotation being reversed to clockwise movement with respect to the bracket 21. This causes the pawl 73 to engage the notch 75 and turn the ratchet 67. Since the latter is keyed at 69 to the journal 65, the crank disc 48 is rotated clockwise. Then the first action is for the cam 47 to lift the follower 45. This, through the operative connecting linkage 39, 43, 35, 31, disengages the latch 31 to free the auxiliary ram 25 from the main ram 5. Then as further upward motion progresses, the pawl-driven ratchet 67 turns the crankpin 49 once, which, being operative in the slot 51, oscillates the lever 55. The diameter of the gear 71 and length of the rack 17 are designed so that for the full lift of the main ram 5, the rotary system attached to the gear rotates once, as stated. This oscillates the lever 55 up and down from the position shown in Fig. 1 (relatively to the bracket 21) and back to that position. It will be understood that when the lever 55 returns to its downward angular position after one revolution of the gear, the main ram 5 is approximately at the top or retractive end of its stroke.

The above points will be clear from a consideration of diagrammatic Fig. 3, wherein at the bottom is shown a sequence of positions of the main ram 5, auxiliary ram 25 and support 11. Above this sequence of positions are shown curves of displacement of the rams plotted against angular positions of the crank 7. In the chart, 0° represents the crank position for the bottommost location of both rams. Curve M is the graph of displacement of the main ram 5. Curve A is the curve of displacement of the auxiliary ram 25. The letter P diagrammatically illustrates a shell to be drawn. Referring to Fig. 3, in the 0° crank position (in this case the lower dead center), both the main ram 5 and the auxiliary ram 25 are in their lowermost positions at the end of the working stroke, being latched together at the moment. When the crank has rotated 30° anticlockwise, both rams 5 and 25 are slightly lifted without having, however, a relative motion, as indicated by the fact that the curves A and M still coincide with one another. In the 60° position, the main ram has moved up more. The auxiliary ram, which partakes of the motion of the main ram has, however, an additional retractive motion in the same direction, due to the swinging action of the lever 55. Therefore, at this time the auxiliary ram 25 has advanced up inside of the main ram 5. This movement can be traced on the curves A and M by noting that they separate. In the 90° position, the superimposed accelerating motion of the auxiliary ram 25 on the motion of the main ram 5 can be traced. In approximately the 120° position, the auxiliary ram 25 has been drawn or retracted completely into the main ram 5 (curve A approximately as far above curve M as it will become). During the subsequent travel of the crank between the 120° and the 180° positions (i. e., during the time that the up or retractive stroke of the main ram 5 is completed) the auxiliary ram 25 is again advanced downward until the two curves A and MH again meet at or about 180°. At this time the latch 29 again holds or couples and locks the auxiliary ram 25 to the main ram 5 and the two rams are ready to be pushed down by the remaining action of the crank from the 180° position to the 360° position. This effects the drawing or working stroke as is clear from Fig. 3, wherein the workpiece P is shown as inserted above the drawing ring 13 at about the 120° position of the crank. It is applied under the punch 27, which, as it descends, drives it through the drawing ring 13, as illustrated. In the 360° position, the shell has been driven entirely through the drawing ring and upon retraction of the punch 27, will be stripped therefrom in the usual manner and dropped.

In Fig. 3, the forward or downward operation between 180° and 360° is illustrated in four steps. These steps show that the drawing operation begins immediately after the crank has passed the upper dead center position, which means that the main ram and the auxiliary ram latched thereto advance slowly during this period under best conditions of reactive moment arm. Therefore, the highest working pressure which the press has to exert is available right at the beginning of the drawing operation, which means that the pressure is applied under the most favorable conditions for the work in hand. In other words, a violent punching action is avoided while a desirable accelerating action is obtained.

Moreover, it is clear that the stroke of the main ram 5 is much shorter for a given amount of clearance attained between the punch 27 and the drawing ring 13. In other words, the radius of the crank 7 may be about halved. Thus it will be observed that the highest pressure to be exerted upon the shell coincides with the beginning of the drawing operation and with the best position of the crank. Any acceleration thereafter occurs during, but not before, the drawing operation. An auxiliary result is that the press may be operated at higher speeds and with less wear. Moreover the mechanism is compact and reliable.

Also, the arrangement of the crank arm of the

crank disc 48 intermediate the link pivots 57 and 63 provides for relatively slow retraction of the auxiliary ram 25 and relatively fast advance of this ram, thereby causing maximum retraction of the auxiliary ram to occur near the end of the return stroke of the slide 5. Thus maximum space is obtained at the correct time for insertion of the work piece (note the fifth step from the left in Fig. 3 and compare the next two steps).

It will be understood that while I show as an example a particular arrangement of parts providing a main ram drive, coupling means for coupling and decoupling the rams, cycling means for reciprocating the auxiliary ram on the main ram and timing means for coordinating actions to produce the actions illustrated in Fig. 3, equivalent arrangements of parts may be used.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A drawing press comprising a frame, a main ram, a crank and a connecting rod for reciprocating the main ram between extended and retracted positions, an auxiliary ram reciprocating with respect to the main ram from extended to retracted positions with respect thereto, supporting means movable with the main ram, a latch mechanism for locking the auxiliary ram in extended position or unlocking it and carried upon said supporting means, an oscillating link pivoted to the support and having an operative connection with the auxiliary ram, a crank and cam on the support, the crank having a slotted connection with said oscillating link and the cam being operative upon said latch mechanism, a ratchet and pawl device operating said crank and cam, and a gear rotatable on the support for operating said ratchet and pawl and cooperating with a rack on the frame, the ratchet and pawl device being inoperative to drive the crank and cam mechanisms during advance of the main ram but being operative to drive them during retraction of the main ram.

2. A drawing press comprising a frame, a main ram, a crank and a connecting rod for reciprocating the main ram between extended and retracted positions while the crank moves between dead center positions, an auxiliary ram reciprocating with respect to the main ram from extended to retracted positions with respect thereto, supporting means movable with the main ram, a latch mechanism for locking the auxiliary ram in extended position or unlocking it and carried upon said supporting means, an oscillating link pivoted to the support and having an operative connection with the auxiliary ram, a crank and cam on the support, the crank having a slotted connection with said oscillating link and the cam being operative upon said latch mechanism, a ratchet and pawl device operating said crank and cam, and a gear rotatable on the support for operating said ratchet and pawl and cooperating with a rack on the frame, the ratchet and pawl device being inoperative to drive the crank and cam mechanisms during advance of the main ram but being operative to drive them during retraction of the main ram, said gear and rack being designed to effect single cyclic movements of the latch mechanism and the oscillating link during one retraction of the main ram.

3. A drawing press comprising a frame, a main ram guided on the frame for reciprocation, power means for reciprocating the main ram through working and return strokes, an auxiliary ram guided on the main ram for reciprocation thereon between extended and retracted positions, a latch for locking the auxiliary ram in its extended position, an actuating mechanism carried by the main ram and having a driving contact with the frame so as to be reversibly movable upon reciprocation of the main ram, a member having a one-way driving connection with said reversibly movable actuating mechanism and intermittently driven thereby, a latch release mechanism operatively connecting said driven member and the latch adapted to move the latch to unlock the auxiliary ram upon initial return movement of the main ram, and an additional mechanism connecting said driven member and the auxiliary ram adapted in response to one-way movement of said member to retract and advance the auxiliary ram relative to the main ram during a retractive stroke of the latter.

4. A drawing press comprising a frame, a drawing die supported by the frame, a main ram, a driving mechanism adapted to reciprocate the main ram through working strokes toward the die and retractive strokes from it, an auxiliary ram mounted for reciprocation between advanced and retracted positions on the main ram and carrying a working tool for working cooperation with said die when in said advanced position, releasable coupling means movable to lock the auxiliary ram in said advanced position relative to the main ram and to release it, an actuating mechanism operative by the movement of the main ram and adapted to lock said releasable coupling means during substantially the entire working stroke of the main ram and to release said coupling means during a retractive stroke, means controlled by said actuating mechanism adapted to retract and advance the auxiliary ram relative to the main ram during the retractive stroke of the latter, said actuating mechanism being constituted by a supporting bracket fixed to and movable with the main ram, a linkage on said bracket adapted to lock and release said coupling means, an additional linkage on said bracket adapted to effect said reciprocation of the auxiliary ram on the main ram, and a member carried on said bracket engageable with the frame for movement responsive to movement of the bracket, said member coordinately actuating both linkages.

5. A drawing press comprising a frame, a main ram guided on the frame for reciprocation, power means for reciprocating the main ram through working and return strokes, an auxiliary ram guided on the main ram for reciprocation thereon and with respect thereto between extended and retracted positions, locking means on the main ram and operative in connection with the auxiliary ram for locking the latter in its extended position, an actuating mechanism carried by the main ram and movably cooperating with the frame to lock the auxiliary ram to the main ram throughout said working stroke and to unlock the auxiliary ram during said return stroke, and also to retract the auxiliary ram during an initial part of said return stroke and to advance the auxiliary ram to its extended position during a final portion of said return stroke, said auxil-

iary ram reciprocating mechanism comprising gear means on the main ram cooperating with a rack on the frame to assume reversing rotary movements, an actuator which is ratchet driven from said gear means to rotate once upon each return movement of the main ram, a first oscillating linkage driven by said actuator and connected to reciprocate the auxiliary ram during one revolution of the actuator, a second lingage for releasing said locking means at the beginning of each retraction of the main ram, and a cam on said actuator and adapted to drive said second linkage during the same revolution of said actuator.

6. A drawing press made according to claim 5, wherein said oscillating linkage comprises an arm pivoted at one end relative to the main ram and connected at the other end to said auxiliary ram, the arm being driven by a crank on the rotary actuator, said crank having a sliding connection with the arm intermediate said pivot and connection, thereby providing for a relatively slow retraction of the auxiliary ram during a major part of the return stroke of the main ram and for relatively fast advance movement during a minor part of said return stroke.

7. A drawing press comprising a frame, a drawing die supported by the frame, a main ram, a driving mechanism adapted to reciprocate the main ram through working strokes advancing toward the die and retractive strokes from it, an auxiliary ram mounted for reciprocation between

advanced and retracted positions on the main ram and adapted to carry a working tool for cooperation with said die, coupling means adapted to couple and decouple the auxiliary ram relative to the main ram, cycling means adapted to reciprocate the auxiliary ram with respect to the main ram, and timing means coordinated with movements of the main ram relative to the frame adapted to position said coupling means first to permit coupling of the auxiliary ram to the main ram when the auxiliary ram is in its advanced position relative to the main ram and the main ram is in its retracted position, second to hold coupled the main and auxiliary rams during movement of the main ram toward the die, and third to decouple the auxiliary ram from the main ram only after the main ram starts a retractive movement from the die, said timing means being operative also upon said cycling means to effect reciprocation of the auxiliary ram back and forth relative to the main ram substantially during retractive movement of the main ram from the die.

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