March 18, 1947. I. PATRICK 2,417,781

OPERATING MECHANISM FOR PRESSES

Filed Jan. 14, 1944 6 Sheets-Sheet 1

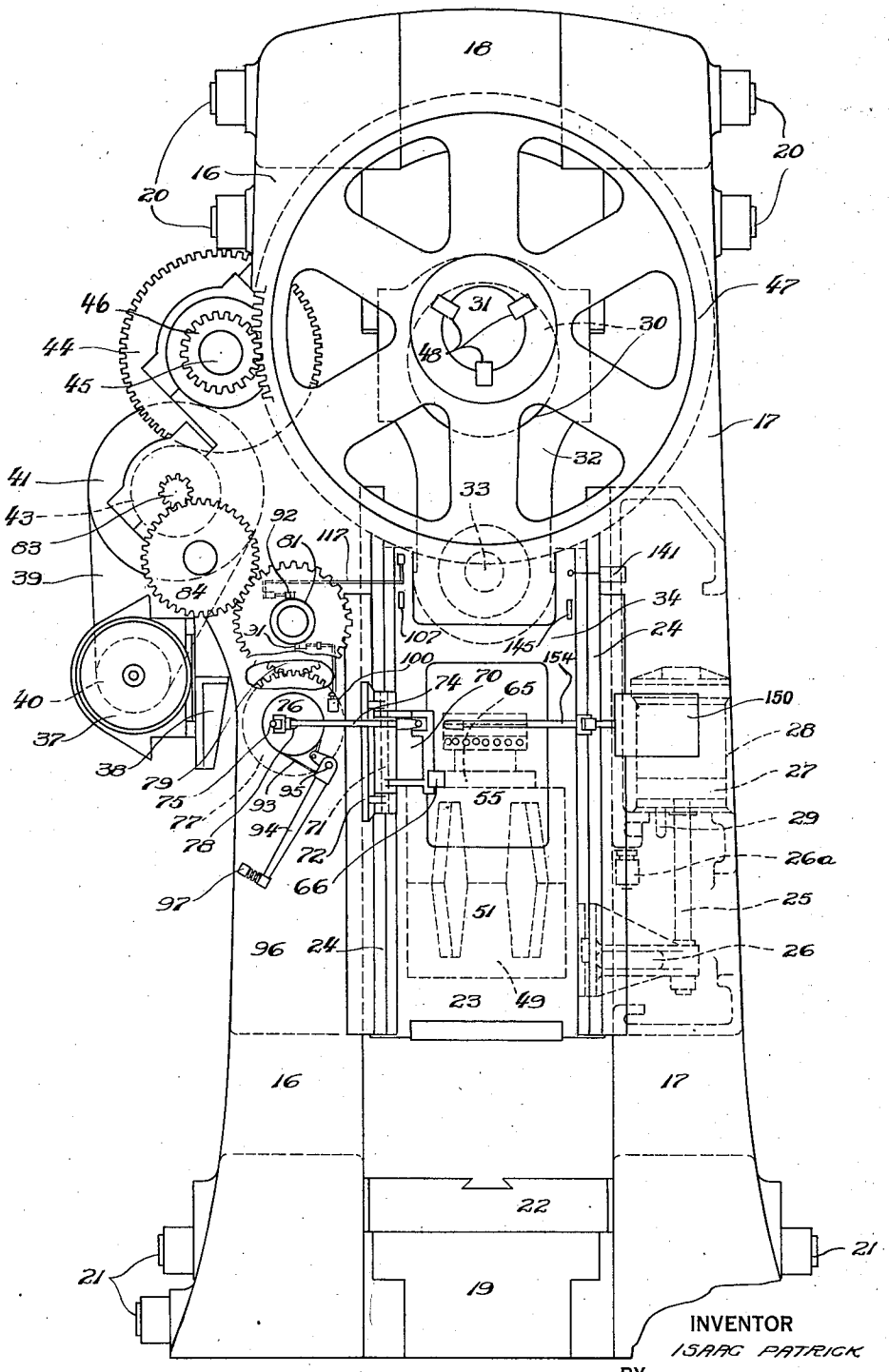


Fig 1

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OPERATING MECHANISM FOR PRESSES

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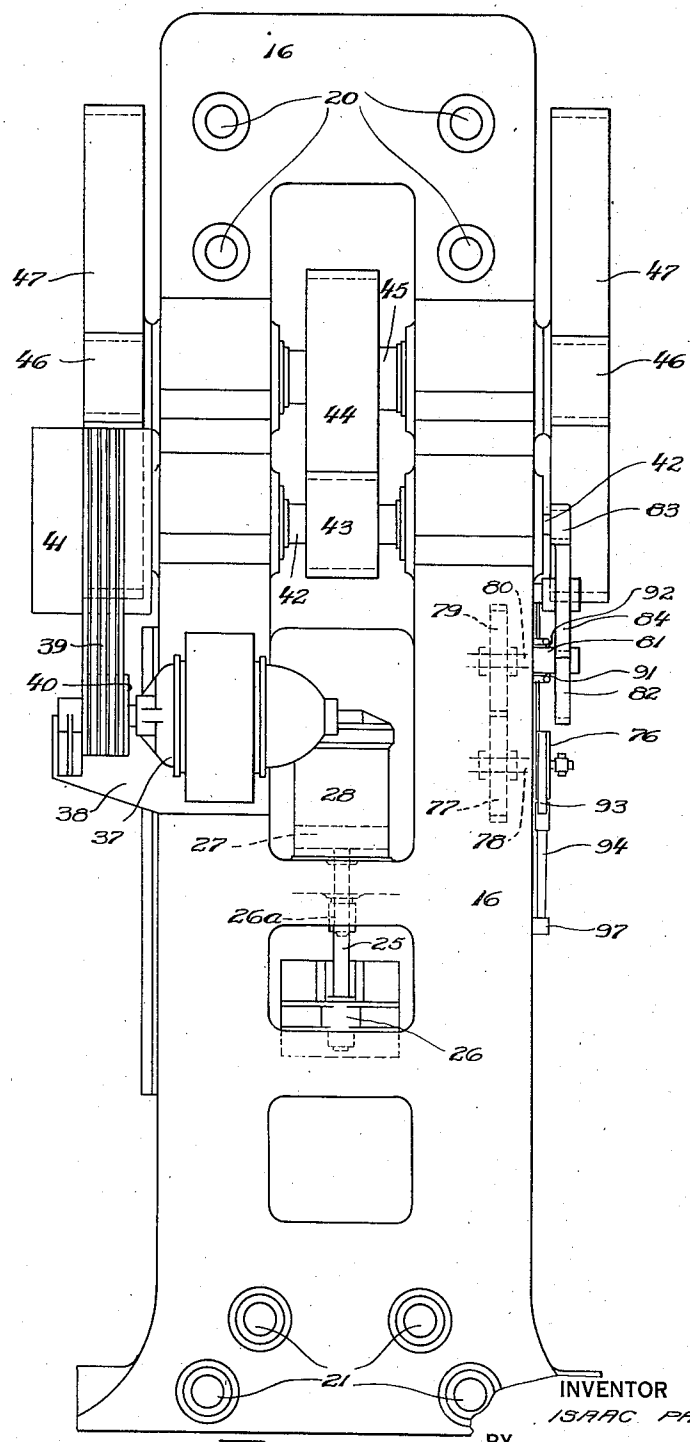


Fig 2

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OPERATING MECHANISM FOR PRESSES

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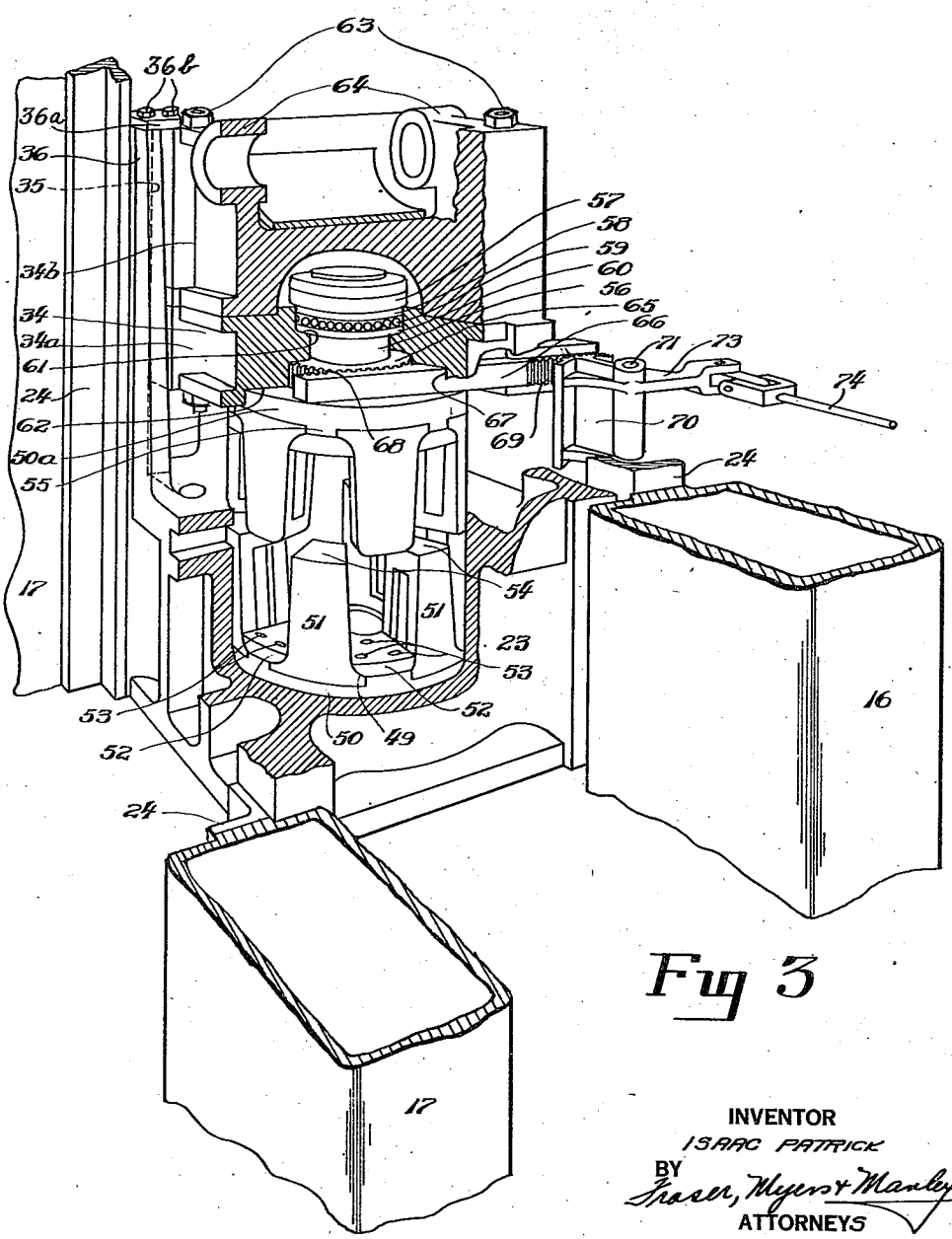


Fig 3

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OPERATING MECHANISM FOR PRESSES

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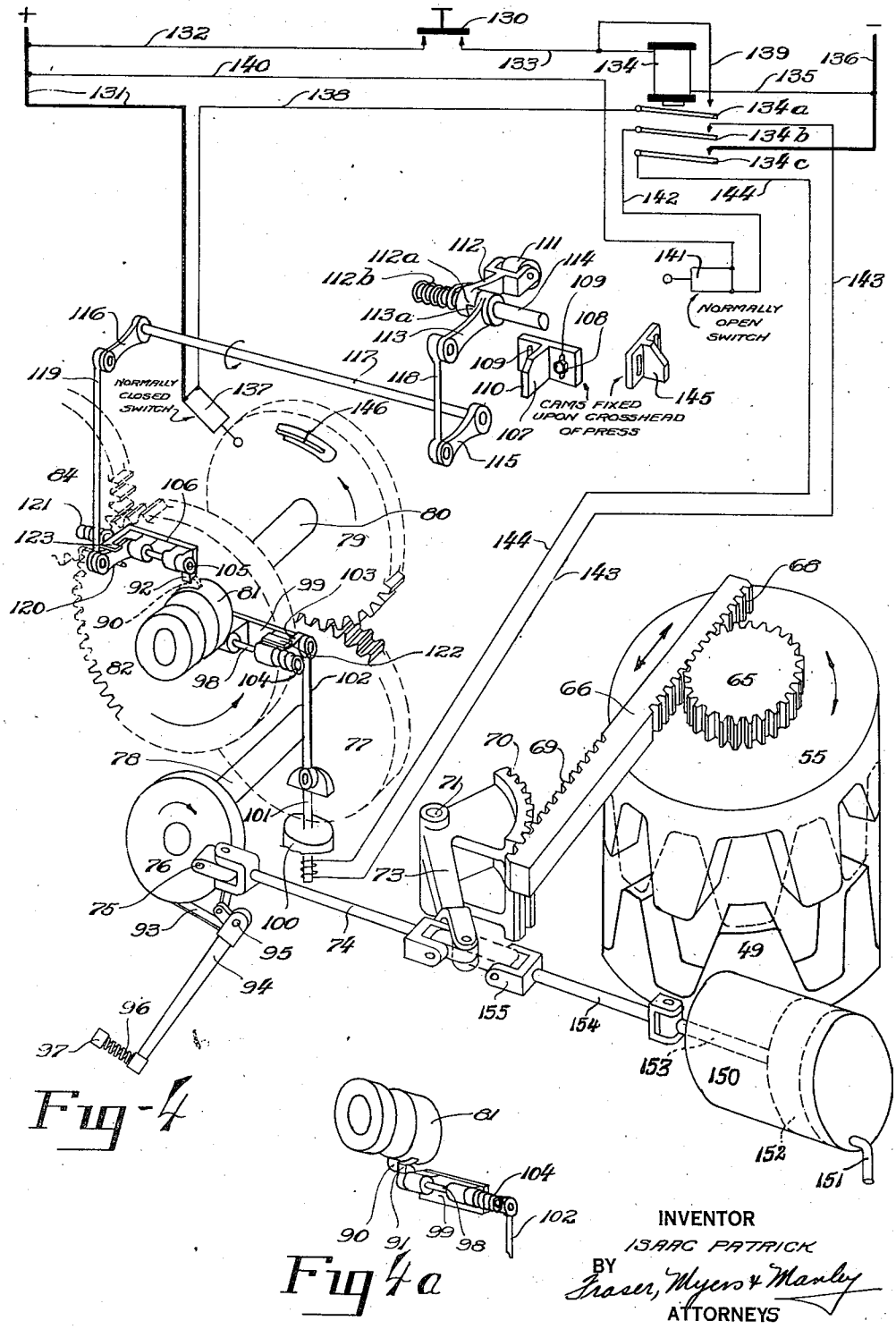


Fig-4

Fig 4a

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OPERATING MECHANISM FOR PRESSES

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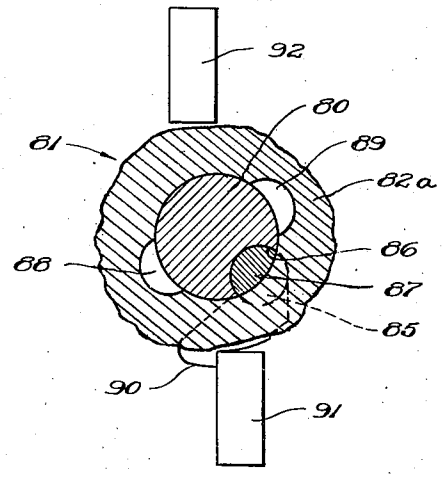


Fig 5

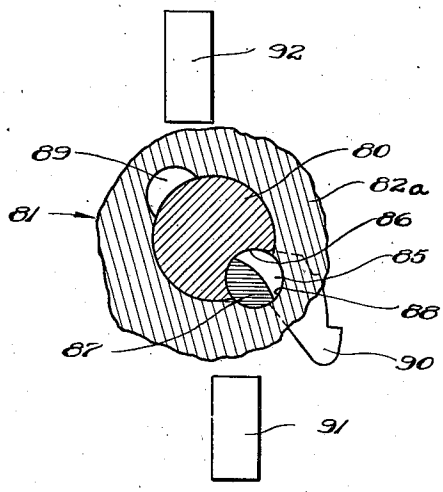


Fig 6

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OPERATING MECHANISM FOR PRESSES

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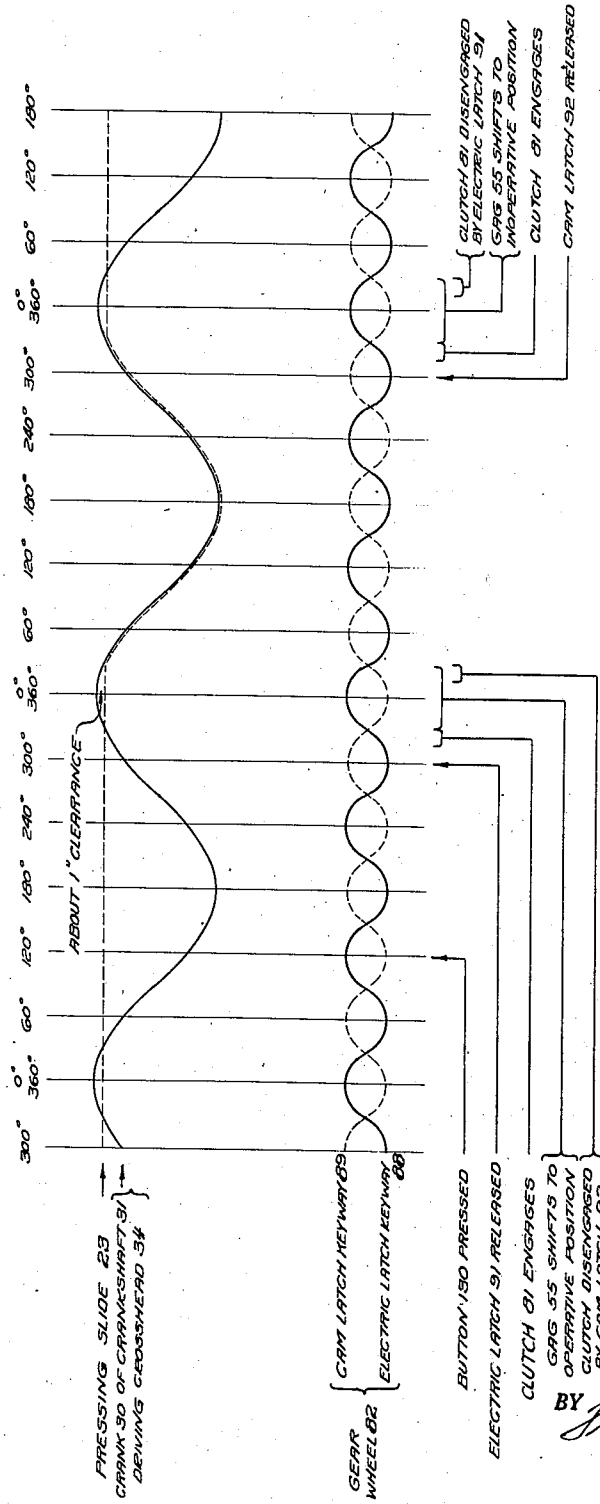


Fig 7

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2,417,781

UNITED STATES PATENT OFFICE

2,417,781

OPERATING MECHANISM FOR PRESSES

Isaac Patrick, Brooklyn, N. Y., assignor to E. W. Bliss Company, Brooklyn, N. Y., a corporation of Delaware

Application January 14, 1944, Serial No. 518,489

12 Claims. (Cl. 78—39)

1

This invention relates to an improved operating mechanism for presses, such as forging or forming presses, and more particularly to mechanical presses having a so-called gag mechanism connecting continuously running parts of such a press with a pressing slide. The mentioned gag mechanism is of a character adapted to permit the said continuously running parts to be either operatively connected with the said slide to perform a pressing operation or to be disconnected from the said slide so that the latter will remain inactive while the motion of the mentioned running parts, nevertheless, continues. The present invention is directed to means for operating the mentioned gag mechanism so that the pressing operations of the press may be controlled effectually.

It is well understood by those versed in the art that certain moving parts of such presses are very large and of substantial weight, and that various means have been employed, with different degrees of success, for effecting interengagement and disengagement of the mentioned continuously running parts with the pressing slide, the chief difficulty residing in the provision of clutching or other engaging means capable of withstanding the severe stresses arising from the inertia of such large and heavy parts. A satisfactory mechanism for operating such a press must be capable of surmounting the mentioned difficulty and must, in addition, be of a character to safeguard an operator of the press.

The mentioned gag mechanism has been used quite successfully for controlling the operating connection between the slide and the continuously running parts of the press. As employed in the embodiment of the present invention illustrated in the accompanying drawings, it comprises a castellated annular member, having upwardly-extending, circumferentially arranged fingers, fixed against rotation within the press slide, and a somewhat similar castellated member, with similar depending fingers, fixed against vertical displacement within a continuously running upper slide member, but being capable of rotation within said slide member between an operative position, in which the ends of the fingers of the two castellated members may coact to cause the pressing slide to be forced downwardly in response to a crank action of the press, and an inoperative position, in which the fingers of the upper and lower castellated members may interengage so that reciprocation of the upper castellated member will not yield a corresponding reciprocation of the pressing slide.

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An important object of the present invention is to provide improved means, within the control of a press operator, for effecting rotation of the mentioned upper castellated member between its operative and inoperative positions to control the operation of the pressing slide of a press.

Another important object is the provision of clutch means between the running gear of the press and parts for causing the rotation of the said upper castellated member, which parts, however, may be of relatively light weight, with consequent low inertia, and in which arrangement several of the mentioned parts are so connected with the upper castellated member and with other parts for operating the latter, that the inertia in some operating parts tends to counteract the inertia in other operating parts.

Another object of the invention is the provision of improved means for controlling the operation of the mentioned clutch mechanism so that the press may be easily and safely operated.

The foregoing and other objects of the invention may be gathered from the following specification and the accompanying drawings, in which—

Figure 1 is an elevational view of what, for present purposes, may be considered the front of an illustrative form of mechanical press;

Fig. 2 is an elevational view of the press as seen from the left side of Fig. 1;

Fig. 3 is an interior view of the press, broken away in many respects to show the arrangement of the two mentioned castellated members, one within a lower or pressing slide and the other within an upper or continuously running slide or cross-head; this figure showing also a rack and segment assembly for rotating the upper castellated member;

Fig. 4 is a diagrammatic view of the rotatable upper castellated member and mechanical means for rotating the said member; said figure including also certain electrical apparatus and connections employed in controlling the operation of the said castellated member; the latter member and the mechanical parts directly coacting with it being shown in perspective and the press parts on or within which said mechanisms are mounted being omitted for the sake of clearness;

Fig. 4a is a detailed view in perspective showing portions of a clutch control mechanism which are obscured from view in Fig. 4;

Fig. 5 is a somewhat diagrammatic central cross-sectional view of a clutch mechanism which is suitable for use in practising the present invention, the various parts of said mechanism being in their free or non-clutching positions;

Fig. 6 is a view similar to Fig. 5, the mentioned parts, however, being in their engaged or clutching positions; and

Fig. 7 is a graph showing the chief features in relation to the operation of a preferred operating mechanism according to the invention.

In the present specification and drawings, only one embodiment of the invention is described and illustrated, as applied to a particular press structure, and it should be understood that as the mentioned single embodiment and press structure are used only for illustrative purposes, the invention is not to be considered as limited to such particular structures.

General structure of the press

The press, as illustrated, comprises preferably opposed upright frame members 16, 17, spaced apart at the top and bottom thereof, respectively, by distance pieces 18, 19, all tied together at the upper end by suitable horizontal tie-rods 20 and at the lower end by similar tie-rods 21.

Within the lower part of the press is fixed a bed 22 adapted to support a lower die member; and a pressing slide 23, which may carry an upper die member on its under side, is suitably guided for vertical reciprocation within the frame members 16, 17, as, for example, by gibs 24.

The pressing slide 23, by coaction with a crank mechanism of the press, hereinafter described, may be forced downwardly from its uppermost or open position, wherein a clear space is present between the dies to receive a blank to be pressed, to a closed position in which the blank is forcibly pressed between said dies. Except as pressed downwardly by the mentioned crank mechanism, the slide 23 is held yieldably in its uppermost position by similar, fluid actuated piston assemblies (only one being shown in the drawing) disposed at opposite sides of the slide, each of said assemblies comprising a piston rod 25, fixed at its lower end to a bracket 26 which is rigidly secured to the slide 23, and having a piston 27 at its upper end accurately fitted to work within a cylinder 28 which is suitably mounted, rigidly, within one of the frame members 16 or 17, the assembly which is illustrated being shown in frame member 17.

The upper end of cylinder 28 may be vented in any suitable manner and the lower end thereof may be connected by a conduit 29 to a fluid pressure tank (not shown), or other suitable fluid pressure source, wherein may be maintained pressure which, reacting upon the under sides of the pistons 27 of the two opposite piston assemblies, is sufficient to cause the latter to forcibly urge the slide 23 to its uppermost position. The movement of the slide 23 to its uppermost position may be limited by stops 26*a*, fixed in suitable positions on the frame, at opposite sides of the said slide, and adapted to arrest the upward movement of the slide by engagement with portions of the latter or with portions of the brackets 26 fixed thereon. Suitable cushioning means may be employed with or instead of the stops 26*a* to cushion the termination of the up stroke of the pressing slide 23. It will be understood that, although the fluid pressure in the cylinders 28 serves to urge the slide 23 upwardly, the latter, nevertheless, may be forced downwardly to perform a pressing operation by a preponderant counteracting force exerted downwardly upon said slide.

A counteracting force may be exerted downwardly upon the slide 23 by a conventional crank

mechanism comprising a crank or eccentric 30 (Fig. 1), carried upon and constrained to rotate with a crank-shaft 31, and a pitman or connecting rod 32, the upper end of which is suitably strapped to the crank 30 and the lower end of which is secured by a wrist pin 33 in a cross-head 34 which, as best seen in Fig. 3, is adapted to slide vertically within the slide 23, the cross-head being guided within said slide by vertically-extending guiding recesses 35 in upright extensions 36 located at the four corners of the slide 23 (only one recess 35 and extension 36 being shown in the drawing).

As the cross-head 34 is drawn upwardly by the upstroke of the crank 30, the pressing slide 23, after a pressing stroke, would follow the cross-head upwardly in response to the fluid pressure acting upon the pistons 27, but to assure positively such following upward movement of the slide 23, suitable interengaging means may be provided between the cross-head 34 and the slide 23, as, for example, drag plates 36*a* (only one being shown, Fig. 3) secured by bolts or screws 36*b*, to the upper ends of the corner extensions 36 of the slide 23, in positions to overlie and be engaged by top corner surfaces of the cross-head 34. Other interengaging means yielding similar results may, of course, be employed.

The crank-shaft 31, in normal operation of the press, is continuously driven, preferably, by an electric motor 37, carried upon a bracket 38 suitably mounted upon frame member 16, the drive from said motor to the crank-shaft 31 being effected through the medium of a belt 39, which is driven by pulley 40, keyed to the shaft of the said electric motor and drives pulley 41 which is mounted upon and turns shaft 42. Mounted upon, and constrained to turn with the latter, is a gear wheel 43 which meshes with and drives gear wheel 44 which is keyed upon and turns shaft 45, having similar pinions 46, keyed upon opposite ends thereof, which mesh with and drive similar large gear wheels 47. The latter are keyed upon opposite ends of the crank-shaft 31 as by keys 48.

The several mentioned shafts, of course, are journaled in suitable bearings provided in the press frame in a well understood manner, and it may be seen that, while the motor 37 is operating, the crank-shaft 31 is continuously driven through the medium of the mentioned belt and gear train, and the cross-head 34 reciprocates continuously in response to the action of the crank 30 and the connecting rod 32.

The gag mechanism

The gag mechanism, hereinbefore referred to, serves to establish either an inoperative relationship between the cross-head 34 and the pressing slide 23, in which the former may reciprocate freely within the said slide without actuating the latter; or an operative relationship, wherein the said cross-head is caused to coact with and reciprocate the pressing slide.

The gag mechanism, as illustrated, comprises a lower castellated member 49, fixed against rotation within a hollowed-out central portion of the slide 23 (Fig. 3). The castellated member 49 comprises, preferably, a circular base plate 50 upon which are rigidly mounted a plurality of similar, upwardly-extending fingers 51, which are firmly fixed circumferentially and in spaced relationship upon the plate 50 by cleat plates 52, the radial sides of which engage the broadened bases of the fingers 51, when cleat bolts 53 are

tightened, thereby holding said fingers firmly in upright position. The fingers 51 taper somewhat from their bases to their upper ends 54 which are horizontal plane surfaces of fairly substantial area. The spaces between the fingers 51, preferably, are substantially complemental to the said fingers.

The gag mechanism, further, comprises an upper castellated member 55, having parts substantially identical with the parts, already described, of the lower castellated member 49. The member 55, however, is disposed with its fingers in depending position, and is mounted for rotation, about a vertical axis, within a lower element 34a of the cross-head 34, in axial alignment with the lower castellated member 49.

The base plate 50a of the upper castellated member 55, which, in the latter's inverted position, constitutes the top of the member 55, has a spindle 56 secured thereto and extending upwardly through a central opening in the cross-head element 34a. On the upper end of the spindle 56 is fixed a suitable circular supporting plate 57, which rests upon an upper race 58 of a ball or roller bearing 59, and a lower race 60 of said bearing is supported within a shouldered annular recess 61 in the cross-head element 34a. By this anti-friction bearing arrangement, the upper castellated member is afforded adequate support within the cross-head 34 and is rendered freely rotatable therein.

It may be observed that the flat top surface of the plate 50a works within a relatively slight or negligible clearance with respect to the adjacent lower flat surface of the cross-head element 34a as indicated at 62, so that any upward thrust upon the upper castellated member 55 is received by a substantial area of the underside of the cross-head. For convenience in assembly, the cross-head 34 comprises the mentioned element 34a and an upper element 34b, which are suitably tied together by vertically-extending tie-bolts 63 at each corner of the cross-head, only two of said bolts, however, being shown in Fig. 3. The upper end of the element 34b is provided with a bifurcated journal 64 to receive the wrist pin 33, by which means, with the connecting rod 32, the continuous oscillation of the crank 30 is communicated, as continuous vertical reciprocation, to the cross-head 34 and the upper castellated member 55 carried thereby.

When the cross-head 34 and the upper castellated member 55, carried thereby, and the pressing slide 23 and the lower castellated member 49, mounted therein, are in their uppermost positions, in which they are shown in Fig. 3, and when the member 55 is rotated to the position thereof shown in Fig. 3, relatively to the member 49, the uninterrupted reciprocation of the cross-head and the member 55 may take place and continue without causing any reciprocation of the pressing slide 23 which may perform any pressing operation, for, in the relationship shown, the fingers of the upper castellated member 55 will work freely within the spaces between the fingers of the member 49. In such a condition it may be said that the two castellated members are in "inoperative" positions and that the press is "running inoperatively"; and these terms are used hereinafter in the sense indicated.

It may readily be seen, however, that, when the press is running inoperatively, the upper castellated member, when at the top of its stroke, is so disposed that its lowermost portions, the ends of the depending fingers, are above the plane of the upper ends of the upright fingers 51 of the lower castellated member 49, preferably to the extent of about a 1" clearance. When so disposed, the member 55 may be rotated to the position thereof, relatively to the member 49, shown in Fig. 1, in which the fingers of the two castellated members are in vertical alignment.

Upon the fingers of the two castellated members being brought into vertical alignment, the lower ends of the fingers of the upper member 55, when the latter descends, engage the upper ends of the fingers of the lower member 49, thus forcing the latter and the pressing slide 23 downwardly to pursue a pressing stroke against the fluid pressure present in the cylinders 28. When the fingers of the members 49 and 55 are in vertical alignment, it may be said that the two castellated members are in "operative" positions and the latter term is used hereinafter in the sense indicated.

The downward or pressing stroke of the pressing slide 23 is caused, as just explained, by the downward force transmitted thereto by the cross-head 34, through the several castellated members, and the upward or retractive stroke of said slide is derived by the fluid pressure in the cylinders 28 which causes the slide 23 to follow the cross-head in its upward movement. In order to discontinue reciprocation of the pressing slide 23, the upper castellated member 55 may be rotated to inoperative position, after which the inoperative running of the press continues.

Although the operating mechanism of the press may be arranged, if desired, to yield fully automatic operation, in which the reciprocation of the pressing slide continues uninterruptedly, nevertheless, in many press installations, it is desirable to arrange that the press may be caused by the operator to yield a single operating cycle in which the pressing slide pursues a single pressing stroke, then a return stroke, whereupon the pressing slide comes to rest in its uppermost position and, although the press continues running inoperatively, another operating cycle may not be started except at the will of the operator.

The gag operating mechanism

According to the present invention, as illustrated in the accompanying drawings, the gag operating mechanism, which enables a press operator to control the rotation of the upper castellated member 55 and, thus, to control the operation of the press, comprises a toothed gear 65 fixed upon the spindle 56, and a rack 66, mounted for horizontal reciprocation within a suitable guideway or opening 67 in the cross-head element 34a, and having a toothed face 68 at its inner end adapted to mesh with the gear 65 and turn it and the upper castellated member 55 when the said rack is moved horizontally.

The rack 66 is provided with another toothed face 69, at its outer end, adapted to mesh in vertically slidable relation with and be driven by elongated teeth upon an axially elongated segment 70 which is mounted for controlled oscillation on and about a vertical pin 71 in a bracket 72 which is fixedly secured upon the frame member 16 in a suitable position with relation to the rack 66.

The segment 70 has a horizontally-extending arm 73, preferably formed integrally therewith, to the outer bifurcated end of which arm may be connected, universally, one end of a pitman 74, the other end of which may be connected, universally, to a crank pin 75 in a rotatable drum

76, all as best seen in Fig. 4. The drum 76 and a gear wheel 77 are keyed, respectively, to the outer and inner ends of a shaft 78 which is driven by meshing of the wheel 77 with a gear wheel 79, mounted upon one end of a shaft 80 and constrained to turn therewith. The shaft 80 carries a clutch 81 upon its opposite end, which, when in clutching engagement, transmits rotation to said shaft from a continuously running gear wheel 82, which is driven by a pinion 83, keyed upon the near end of the shaft 42; the rotation of the said pinion being transmitted to the gear wheel 82 through an intermediate idler gear 84.

As may be seen from Fig. 2, the pinion 83, the gear wheels 84 and 82, and the drum 76, are located outside the frame member 16, and the gear wheels 79 and 77 are located inside the said frame member. In order to afford a clear understanding of the operating relationship of the parts just mentioned, the frame member and other parts of the press structure have been omitted from Fig. 4, and, in that figure, gear wheel 82 has been broken away almost in its entirety to reveal clutch-operating mechanism disposed in back of said gear wheel.

It may be understood, from the foregoing, that as the gear wheel 82 is rotated continuously through the described gear connections to the electric motor 37, movement of the rack 66 and consequent rotation of the upper castellated member 55 may be started and stopped, respectively, by engagement and disengagement of the gear wheel 82 and the shaft 80 through engagement and disengagement of the clutch 81. It should be apparent, however, that rotation of the said castellated member should only be effected when the cross-head 34 and the pressing slide 23 are substantially in their respective uppermost positions, as shown in Fig. 3, and that, to assure this condition, the clutch 81 must be so controlled that it becomes engaged and remains engaged only during a period or periods when the cross-head is substantially at the top of its stroke. Mechanism assuring the fulfillment of these conditions will be described hereinafter.

The clutch mechanism

The clutch 81 preferably, may be a rolling key clutch, substantially as described and illustrated in United States Patent No. 1,481,444, dated January 22, 1924. With an understanding of the mentioned patent disclosure, Figs. 5 and 6 of the accompanying drawings should serve to illustrate the manner in which the clutch 81 functions in the present invention.

In Figs. 5 and 6, 82*a* indicates a hub portion which may be a bushing of the gear wheel 82 which is driven continuously by the running gear of the press, in the direction indicated by arrows, and 85 is a cylindrical rolling key carried in a semi-cylindrical shaft keyway 86 in the shaft 80 and constrained to remain in said keyway and rotate with said shaft, about the latter's axis. A central longitudinal portion of the key 85 has been cut away, partly, leaving a portion 87 of elliptic cross-section.

The key 85 is continuously subject to the force of a torque spring (not shown) tending to urge it toward one extreme rotative position as shown in Fig. 6, wherein the elliptic portion 87 extends partly into a semi-cylindrical keyway 88 in the gear wheel 82, thus constraining the shaft 80 to turn with the said gear wheel. In the condition just described it may be said that the clutch 81 is engaged and that the key 85 is in an engaged

position. For reasons hereinafter made apparent a second keyway, 89, preferably similar to and located diametrically opposite to keyway 88, is provided in the gear wheel 82.

The key 85 has a clutch hook 90, fixed upon one end thereof and extending clear of the wheel 82 and the mechanism of the clutch 81, and adapted when depressed—i. e., turned clockwisely as viewed in Figs. 5 and 6—to roll the key 85 to the position thereof shown in Fig. 5 in which the elliptic portion 87 is entirely within the keyway 86 and within the circumference of the shaft 80, thus permitting the wheel 82 to turn freely about said shaft. In the condition just described, it may be said that the clutch 81 is disengaged and that the key 85 is in disengaged position.

Inasmuch as the hook 90 protrudes substantially from the clutch 81 and is carried around the axis of the shaft 80 when the clutch is engaged, it may readily be understood that the clutch may be disengaged by interposing a suitable releasable latch in the path of said hook, two such latches, 91 and 92, being shown diagrammatically in Figs. 5 and 6. In Fig. 5, latch 91 is shown in latching position, holding the hook 90 depressed and the clutch 81 disengaged to permit the wheel 82 to rotate freely about the shaft 80. In Fig. 6, latch 91 is shown after being moved to its non-latching position, thereby releasing the hook 90 and permitting it to swing counter-clockwisely, in response to the mentioned torque spring of the rolling key 85 as the keyway 88 approaches and registers with the keyway 86, to cause the clutch 81 to become engaged. Fig. 6 illustrates the positions of the various mentioned parts at the instant that the engaging of the clutch has been completed, at which the shaft 80 then becomes constrained, by the elliptic portion 87, to rotate with the wheel 82 until, upon substantial completion of a half-turn of said wheel, the clutch hook 90 is engaged and depressed and the clutch 81 disengaged to again permit the wheel 82 to turn freely about the shaft 80.

The latches 91 and 92 function similarly in the control of the operation of the clutch 81, and, by control means hereinafter described, the two said latches become instrumental in causing successive half-turns of the shaft 80 and consequent successive half-turns of the drum 76, whereby to derive reciprocation of the pitman 74 and the rack 66 to shift the upper castellated member 55 between its engaged or operative position relatively to the lower castellated member and its disengaged or inoperative position relative thereto. In order to prevent coasting or over-riding of the drum 76 and thus to assure that the castellated member 55 may come to rest immediately upon each release of the clutch 81, the drum 76 is provided with a continuously-acting brake mechanism comprising a brake band 93, held taut upon said drum by two arms of a bell-crank 94 which is pivoted to the frame member 16, as at 95. The necessary braking force is yieldingly applied by means of a compression spring 96 interposed between a lug 97, on the frame member 16, and the free end of a long arm of the bell-crank 94.

The clutch controlling mechanism

The latches 91 and 92 may be of any suitable type and may be mounted in various ways, but, as illustrated in the drawings—particularly Figs. 4 and 4a—they and their mounting and operation are substantially as illustrated and described in

the mentioned patent, to which reference may be made for details.

The latch 91, hereinafter referred to, for convenience, as the "electric latch," may be located beneath the clutch 81 (Fig. 4a), and may be keyed upon one end of a shaft 98, journaled in a bracket 99, fixed upon the frame member 16, in such position that clockwise rotation of the shaft 98 will shift the latch 91 from its latching position, indicated in the drawing, to its non-latching position. Such clockwise rotation of the shaft 98 may be derived from an electric solenoid 100, suitably mounted on the frame member 16, the core 101 of said solenoid being pivotally connected by a link 102 to the free end of an arm 103 which is keyed, at its other end, upon the shaft 98. A torque spring 104, co-acting with the arm 103 and the bracket 99, serves to hold the latch 91 in its latching position except when the said solenoid is energized.

The latch 92, hereinafter referred to, for convenience, as the "cam latch," may be located above the clutch 81, diametrically opposite the electric latch 91, and may be keyed upon one end of a shaft 105, journaled in a bracket 106, fixed upon the frame member 16, in such position that counter-clockwise rotation of the shaft 105 will shift the latch 92 from its latching position to its non-latching position. Such counter-clockwise rotation of the shaft 105 may be derived from a cam-piece 107 as the latter moves upwardly with the cross-head 34, upon one side of which said cam-piece is adjustably mounted, as by machine screws 108 (only one being shown in the drawing, Fig. 4) which extend through vertical slots 109 in the cam-piece and are threaded into the cross-head.

The upward movement of the cam-piece 107 causes its cam face 110 to engage a roller 111 on the free end of an arm 112 which may be freely mounted, in uni-directional driving relation to an opposed freely-mounted arm 113, on a short shaft 114, supported by the press frame at a point near the path of movement of the said cam-piece. The uni-directional driving co-action between the arms 112 and 113 is derived from opposed adjacent shoulders 112a and 113a, formed, respectively, on the hub ends of said arms, and their arrangement is such that as the free end of the arm 112 is pushed upwardly by the cam-piece 107, the shoulders 112a and 113a co-act to turn the arm 113 to move the latter's free end downwardly. However, when the said cam-piece, on its downward movement with the cross-head 34, pushes the arm 112 down, there is no resultant movement of the arm 113. A torque spring 112b, co-acting with the shaft 114, or other fixed member, and the arm 112, urges the free end of the latter upwardly to hold the shoulders 112a and 113a normally in engagement.

The downward movement of the free end of the arm 113 is transmitted to the shaft 105, to operate the latch 92, through arms 115 and 116 which are keyed upon opposite ends of a shaft 117 suitably supported upon the press frame, the free end of the arm 115 being pivotally connected by link 118 to the free end of the arm 113, and the free end of the arm 116 being pivotally connected by link 119 to the free end of an arm 120, the opposite end of which is keyed to the shaft 105. A torque spring 121, co-acting with the arm 120 and the bracket 106, serves to hold the latch 92 normally in its latching position.

The latches 91 and 92 may be limited, by suitable stop means, against rotation beyond that which carries them to their latching positions—as, for example, by stop lugs or stop pins, indicated diagrammatically, at 122 and 123, which may be formed upon or fixed into the brackets 99 and 106, or the press frame or other fixed member, and arranged, respectively, to engage the upper sides of the arms 103 and 120. Rotation of the latches, to their opposite or unlatched positions, may be limited by suitable positioning and adjustment of the solenoid 100 and the cam-piece 107.

The remainder of the clutch controlling apparatus comprises chiefly certain electric circuits and apparatus which, for convenience, are described in the following explanation of the operation of the press.

Operation of the press

The operation of the press may best be understood by reference to Figs. 4 and 7, the latter figure being a graph showing the relationship between the movements of the crank-shaft 31 and the cross-head 34, the pressing slide 23, and the gear wheel 82, and also showing the timing of the operation of the upper castellated member 55 (hereinafter sometimes referred to as the "gag," and so characterized in Fig. 7), the clutch 81, and the latches 91 and 92, with reference to the said movements.

It should be helpful to observe from Fig. 7 that the gearing between the crank-shaft 31, which actuates the cross-head 34, and the gear wheel 82, preferably is such as to yield a three-to-one ratio—i. e., 360° rotation of wheel 82 equals 120° rotation of the crank-shaft 31—and that the said wheel and crank-shaft are so timed that keyway 88 in said wheel (hereinafter sometimes referred to as the "electric latch keyway," and so characterized in Fig. 7) is at its lowermost position, on each third turn of the wheel 82, when the cross-head 34 is at its lowermost position corresponding to bottom dead-center position of the crank 30 of the crank-shaft. The keyway 89 in the wheel 82 (hereinafter sometimes referred to as the "cam latch keyway," and so characterized in Fig. 7) is, of course, directly opposite to the keyway 88, as already explained.

Let it be assumed that the electric motor 37 (as to which the wiring is conventional and, hence, not shown) is running, and that the press is running inoperatively. Under such conditions the press remains open, the continuously-running gear-wheel 82 is turning counter-clockwisely—as indicated by the arrow thereon—the clutch hook 93 is held depressed by latch 91—as shown in Fig. 4a—to hold the clutch 81 disengaged, the wheels 79 and 77 and the drum 76 are motionless, and the said drum and the gag 55, and the connections between the two, are substantially in the positions shown in full lines in Fig. 4.

After a blank has been placed properly in the press the operator desires to cause the press to commence a pressing cycle—and, obviously, he may wish to take proper action to initiate such a pressing cycle at any point in the rotation of the crank-shaft 31. For present purposes it may be assumed that at the moment the crank 30 of the crank-shaft 31 has pursued 120° of downward rotation, the operator presses and momentarily closes a push-button starting switch 130, thereby closing an electric starting circuit from a main electric lead 131—which may be considered as a positive lead, and is so indicated in

the drawing—through wire 132, said push-button switch 130, wire 133, relay magnet 134, and wire 135, to a main electric lead 136—which may be considered as a negative lead, and is so indicated in the drawing.

The mentioned starting circuit energizes the relay magnet 134 and, as a result, the latter draws three related relay contactors 134a, 134b, and 134c from their normally open or non-contacting positions to closed or contacting positions. Although the operator may, and ordinarily would, shortly release the push-button switch 130, the starting circuit through the magnet 134 is, nevertheless, maintained and the said magnet kept energized by a holding circuit which bridges the push-button switch 130 and includes a normally-closed limit switch 137, wire 138, contactor 134a, and wire 139.

The closing of the contactors 134b and 134c establishes an incomplete gag-shifting circuit from positive lead 131, through wire 140, normally-open limit switch 141, wire 142, contactor 134b, wire 143, solenoid 100, wire 144, and contactor 134c, to negative lead 136, the incompleteness of said circuit residing in the fact that the switch 141 is open.

As the crank 30, moving upwardly, approaches its uppermost position after having pursued about 300° of a complete cycle, the limit switch 141—which is suitably positioned on the press frame adjacent the side of the cross-head 34—is engaged and closed by a cam-piece 145, or its equivalent, suitably mounted in such position on the cross-head 34 as to effect the mentioned closing of the said limit switch, the mounting preferably being similar to the mounting of cam-piece 107, to permit vertical adjustment. It is important to observe that limit switch 141 is one which may be operated to close a circuit therethrough only through movement of its operating arm in one direction. The said switch, or its operational equivalent, furthermore, is so mounted in relation to the cross-head 34 that, although the cam-piece 145 may engage and move the operating arm of said switch on both the up and down strokes of the cross-head, the said switch nevertheless is operated and closed only on the upstroke of the cross-head.

The closing of the switch 141 by the upwardly-moving cam-piece 145, completes the mentioned gag-shifting circuit through the solenoid 100, thereby energizing the latter—which, through link 102 and arm 103, rotates the shaft 98 clockwisely, moving electric latch 91 to its non-latching position and thus releasing the clutch hook 90. As indicated in Fig. 7, this preferably occurs approximately at the 300° point in the cycle of crank 30, at which moment electric latch keyway 88 is at its lowermost point of rotation—and, by reference to Fig. 5, it may be seen that the keyway 88, when in its said lowermost position, is just about to move into registry with shaft keyway 86 and the rolling key 85 therein.

As the keyway 88 moves into registry with the keyway 86, the rolling key 85 is free to turn, in response to its torque spring, to the position thereof shown in Fig. 6, in which the clutch 81 is fully engaged. Following engagement of the clutch, the shaft 80 is constrained to turn with the wheel 82, thereby turning gear wheels 79 and 77 and drum 76, and causing the toothed segment 70 to rotate and draw the rack 66 forwardly, as viewed in Fig. 4, to turn the gag 55, from its inoperative position, toward its operative position relatively to the non-rotatable, lower castellated member 49.

The mentioned turning of the drum 76 continues until the protruding clutch hook 90 engages the cam latch 92 and is depressed by the latter to disengage the clutch 81 and limit the mentioned rotation of the shaft 80 and the drum 76 to 180°. As a result of this half-turn of the drum 76, the rack 66 is shifted from its extreme rearmost position, as shown in Fig. 4, to its opposite extreme or most forward position, thereby effecting a rotational shift of the gag 55 from its inoperative position to its operative position, as shown in broken lines in Fig. 4.

As indicated in Fig. 7, the shifting of the gag 55 to its operative position takes place during the movement of the crank 30 through about 60°, at the top of its stroke—which may correspond to about the hereinbefore-mentioned 1'' of vertical movement of the gag 55 above and clear of the lower castellated member 49. Fig. 7, in addition, indicates the fact that the period of the mentioned disengagement of the clutch 81, effected by latch 90, occurs in a rotational period of the wheel 82 which follows, by 180° rotation of said wheel, the period of engagement of the clutch caused by the release of latch 91, and that the said disengagement of the clutch is completed substantially upon completion of the shifting of the gag 55 to its operative position.

As also shown in Fig. 7, the shifting of the gag to its operative position is completed by the time the cross-head 34 has moved downwardly to take up the mentioned 1'' clearance, so that the lower surfaces of the fingers of the gag 55 engage the upper surfaces of the fingers of the lower castellated member 49, and thus, as the gag moves downwardly with the cross-head 34, it forces the member 49 downwardly with the pressing slide 23, within which it is mounted, to effect the pressing stroke, for yielding the desired operation upon the blank in the press, and a return stroke for opening the press.

As the cross-head 34 approaches the end of its return or up-stroke—or, more particularly, after the crank 30 has pursued about 300° of its rotation—the cam-piece 107, being properly positioned for the purpose upon the cross-head, actuates the arm 112 and shifts the cam latch 92 to its non-latching position, thereby again releasing the clutch hook 90 and permitting the elliptic portion 37 of the rolling key 85 to engage within the cam latch keyway 89 which, at the time, is substantially at the top of its rotative movement, as may be understood by reference to Fig. 7. The engagement of the rolling key in the keyway 89, effecting engagement of the clutch 81, causes a further rotation of the drum 76, to move the rack 66 rearwardly.

The further rotation of the drum 76, following release of the cam latch 92, is limited to a second 180°, in much the same manner as the first described 180° of rotation thereof was limited—that is, by the engagement and depressing of the clutch hook 90 by the electric latch 91, which, after its mentioned movement to non-latching position by the solenoid 100, was restored to its latching position by the momentary opening of limit switch 137, through the engagement of the operating arm of said switch by a cam 146 mounted, adjustably, upon gear wheel 79. The cam 146 is so positioned on the wheel 79 as to open the switch 137 to reset the latch 91, preferably at an intermediate time during the shifting of the gag to its operative position.

By reference to the wiring diagram included in Fig. 4, it may be seen that the described momentary opening of the switch 137 breaks the holding circuit through the magnet 134, thus causing the latter to release the contactors 134b and 134c, thereby de-energizing the solenoid 100 and enabling the torque spring 104 to reset the latch 91 in its latching position.

The mentioned second 180° rotation of the drum restores the gag 55 to its inoperative position, as shown in full lines in Fig. 4, in which position it remains, leaving the press running inoperatively until the operator again presses and closes the push-button starting switch 130 to effect another pressing stroke of the pressing slide 23.

It may be readily understood, from the foregoing description, that the push-button starting switch 130 may be operated at any point in the rotation of the crank 30. If it is pressed at the moment during which the switch 141 is held closed, the solenoid will function instantly to release the electric latch 91 to shift the gag and start the pressing stroke of the slide 23. Closing of the switch 130 at any other point in the rotation of the crank 30 will result in operation as hereinbefore described in detail.

The press operating mechanism comprising the present invention, may advantageously include fluid actuated means for urging the gag to its operative position and holding it in that position while the motor 37 is being operated under manual control as, for example, for inching the press slide when dies are being set in the press. Such means may comprise an air cylinder 150 suitably mounted on the press frame, an air line 151 leading from a suitable air pressure source into one end of said cylinder, a piston 152 having a piston rod 153 extending from the other end of the cylinder, a link 154 pivotally connected to said rod, and a yoke 155 on the free end of said link, adapted to be pivotally pinned to the outer or free end of the arm 73 of the toothed segment 70, in place of the pitman 74. Obviously when the link 154 is connected in this manner, the establishment and maintenance of suitable air pressure in the cylinder 150 through the line 151, serves to shift the gag 55 to its operative position and hold it there so that the operation of the press may be manually controlled in a convenient manner at any point in its operating cycle, the gag 55, meanwhile, being effectually restrained against unintended shifting to its inoperative position.

The present invention, as may be gathered from the foregoing description, provides effective means for shifting from inoperative to operative running of a press, which means impose only relatively light engaging stresses upon the clutch, inasmuch as the parts directly controlled by the clutch are relatively light in weight in comparison to the ponderous, continually moving parts of the press and to the press slide to which movement is ultimately communicated.

In addition, the design and coaction of the parts of the gag operating mechanism are such as to yield little or no tendency to coast after the clutch is released; the gag 55 (the heaviest part of the structure directly controlled by the clutch), the rack 66, the segment 70, and the pitman 74, all being reciprocating members which reach their limits of movement at the moment of the release of the clutch so that their momentum is spent upon reaching their respective limits of movement, thus leaving no material inertia force to commence an uncontrolled reverse movement of said reciprocating members. Although the drum 76 develops momentum which tends to cause it to coast after release of the clutch, the inertia present in the mentioned reciprocating parts, upon reaching their limits of movement, strongly opposes the coasting tendency of the drum 76 and this condition, together with the action of the described brake device, assures stopping of the drum 76 immediately upon release of the clutch.

The invention reduces the manual operation of the press to the mere pressing of the starting switch 130, all shifting of parts to yield the described operation being accomplished automatically. This, by eliminating the human factor in the operation of the press parts during a pressing cycle, yields a substantial measure of safety both to the operator and to the press. Improved safety conditions are also derived from the fact that when the press is running inoperatively and an operator or operators are positioning a blank in the press, the press slide can not be caused to descend except by pressing of the starting switch 130, which, of course, may be so placed as to render it practically impossible to be operated unintentionally.

Other advantages of the present invention will be readily perceived. It will also be realized that the structures illustrated and described herein constitute only one embodiment to which reference has been made mainly for illustrative purposes, and that the inventive concept may be effectuated in various structures other than those illustrated and described herein without departing from the invention as defined in the following claims.

What I claim is:

1. In a press having a reciprocable pressing slide, a continuously reciprocable cross-head, and a castellated member adapted, by rotation thereof, to operatively connect and disconnect said slide with respect to the cross-head; an operating mechanism comprising actuating means for rotating said castellated member, manually operable first control means, second control means operable, after momentary operation of said first control means, to cause operation of said actuating means at a predetermined point of movement of said cross-head, to rotate said castellated member to an operative position and thereby constrain the slide to move through a pressing cycle with said cross-head, and third control means operable to control said actuating means at a later predetermined point of movement of said cross-head, to cause said actuating means to rotate said castellated member from said operative position to an inoperative position to remove the mentioned constraint and permit the said slide to remain at rest while reciprocation of the cross-head continues.

2. In a press having a reciprocable pressing slide, a reciprocable cross-head for actuating said slide, running gear for continuously reciprocating said cross-head, and a movable gag member for establishing and dis-establishing coaction between the cross-head and the slide, to control actuation of the latter; operating means for operating the pressing slide comprising a second running gear mechanism for moving said gag member between operative and inoperative positions, a clutch mechanism for establishing and dis-establishing such coaction between the said second running gear mechanism and the gag member to control the movement of the latter, means for operating the clutch mechanism to establish the latter coaction, and means operable independently of the

latter means for operating the clutch mechanism to dis-establish said latter coaction.

3. In a press having a reciprocable pressing slide, a continuously reciprocable cross-head for actuating said slide, and a gag which is rotatable to obtain coaction between the cross-head and the slide, effecting actuation of the latter; operating means comprising a reciprocating gag-actuating member for rotating said gag back and forth between operative and inoperative positions, a crank mechanism for reciprocating said gag-actuating member to rotate said gag, a clutch mechanism for controlling the operation of said crank mechanism in timed relation to the movement of the cross-head to cause timed rotation of the gag between its mentioned positions, and means operative independently of each other, for operating the clutch mechanism to cause rotation of the gag to each of its mentioned positions.

4. In a press having a reciprocable pressing slide, a cross-head, a shiftable gag for operatively connecting and disconnecting said slide and cross-head, and driving means for continuously reciprocating said cross-head and for actuating said gag; operating means for operating the pressing slide comprising an eccentric device for moving said gag between an operative position corresponding to the extreme position of an eccentric portion of the eccentric device in one direction, and an inoperative position corresponding to the extreme position of the said eccentric portion in the opposite direction, a clutch for controlling the driving connection between said driving means and said eccentric device, and separate clutch operating means for operating said clutch to start and stop said eccentric device to move the latter from either of said extreme positions to the other, and thereby shift said gag alternately between operative and inoperative positions thereof to cause actuation of the slide through coaction thereof with the cross-head, followed by a termination of such slide actuation.

5. Press operating means according to claim 4, further characterized in that the clutch operating means comprise latches operable, substantially upon the eccentric portion reaching either of its mentioned opposite extreme positions, to disengage the clutch to terminate one movement of the gag, and being releasable to cause engagement of the clutch and a subsequent movement of the gag.

6. Press operating means according to claim 4, further characterized in that the clutch operating means comprise latches operable, substantially upon the eccentric portion reaching either of its mentioned opposite extreme positions, to disengage the clutch to terminate one movement of the gag, and being releasable to cause engagement of the clutch and a subsequent movement of the gag, and further comprising means operable in response to movement of the cross-head for releasing each of said latches.

7. Press operating means according to claim 4, further characterized in that the clutch operating means comprise latches operable, substantially upon the eccentric portion reaching either of its mentioned opposite extreme positions, to disengage the clutch to terminate one movement of the gag, and being releasable to cause engagement of the clutch and a subsequent movement of the gag, one of said latches being electrically operated to permit electric control of the starting of press slide reciprocation.

8. Press operating means according to claim 4, further characterized in that the clutch operating means comprise latches operable, substantially upon the eccentric portion reaching either of its mentioned opposite extreme positions, to disengage the clutch to terminate one movement of the gag, and being releasable to cause engagement of the clutch and a subsequent movement of the gag, one of said latches being electrically operated to permit electric control of the starting of press slide reciprocation and another of said latches being operable by the press slide during movement thereof to terminate such slide reciprocation.

9. In a press having a reciprocable pressing slide, a cross-head, a gag for operatively connecting said slide and cross-head, and driving means for reciprocating said cross-head continuously and for actuating said gag; operating means comprising a crank mechanism for oscillating said gag, a clutch for controlling the driving connection between said driving means and said crank mechanism, a clutch operating member which rotates with said clutch when the latter is engaged, an electric starting circuit subject to manual control at any point in the movement of the cross-head, an electrically releasable latch for engaging said clutch operating member to disengage the clutch, a second electric circuit, partially controlled by said starting circuit for controlling the operation of said latch, a switch in said second circuit, operable by the cross-head at a point of approach thereof to the top of its stroke following manual closing of the starting circuit, to close said second circuit and release said latch to cause the clutch to become engaged and, as a result, to cause the gag to move to operative position at the top of said stroke of the cross-head to start a pressing stroke of the press slide, a second releasable latch for engaging said clutch operating member to disengage the clutch after 180° rotation thereof, and means, operable in response to movement of the cross-head, for releasing said second latch at a substantially corresponding point in the next approach of the cross-head to the top of its stroke, to cause the clutch again to become engaged and to rotate a further 180° to move the gag back to inoperative position to terminate the movement of the slide, the said electrically controlled latch being arranged to engage said clutch operating member to again cause disengagement of the clutch to terminate the last mentioned gag rotation leaving the operating means in condition to function in a later similar cycle of operation.

10. In a press having a reciprocable pressing slide, a cross-head, a gag for operatively connecting said slide and cross-head, and driving means for reciprocating said cross-head continuously and for actuating said gag; operating means comprising a crank mechanism for oscillating said gag, a clutch for controlling the driving connection between said driving means and said crank mechanism, latches for controlling the clutch to yield intermittent oscillation of said gag, electric apparatus, for controlling a first one of said latches, comprising manually operable circuit control means and circuit control means operable in response to movement of the cross-head and arranged to coact with said manually operable means to operate said first latch to cause the gag to move to operative position to start reciprocation of the slide through coaction thereof with the cross-head, and means, responsive to movement of said cross-head, for operating a second one of said latches to cause the gag to move to inoperative position to terminate such slide reciprocation.

11. In a press having a reciprocable pressing

slide, a continuously reciprocable cross-head, a gag for operatively connecting said slide and cross-head, and driving means for reciprocating said cross-head; operating means for operating said pressing slide comprising a crank mechanism for oscillating said gag, a clutch connection between said driving means and said crank mechanism, an electrically operable latch, an electric circuit for controlling the shifting of said latch from latching to non-latching position to permit the clutch to become engaged to cause movement of the gag to operative position, and means actuated by said crank mechanism for breaking said circuit to restore the latch to latching position.

12. In a press having a reciprocable pressing slide, a continuously reciprocable cross-head, a gag for operatively connecting said slide and cross-head, and driving means for reciprocating said cross-head; operating means for operating said pressing slide comprising a crank mechanism for oscillating said gag, a clutch connection between said driving means and said crank mechanism, an electrically operable latch, an electric circuit for controllling the shifting of said latch from latching to non-latching position to permit

the clutch to become engaged to cause movement of the gag to operative position, and means, operative subsequently to the mentioned shifting of said latch, for breaking said circuit to restore the latch to latching position.

ISAAC PATRICK.

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