

Aug. 19, 1947.

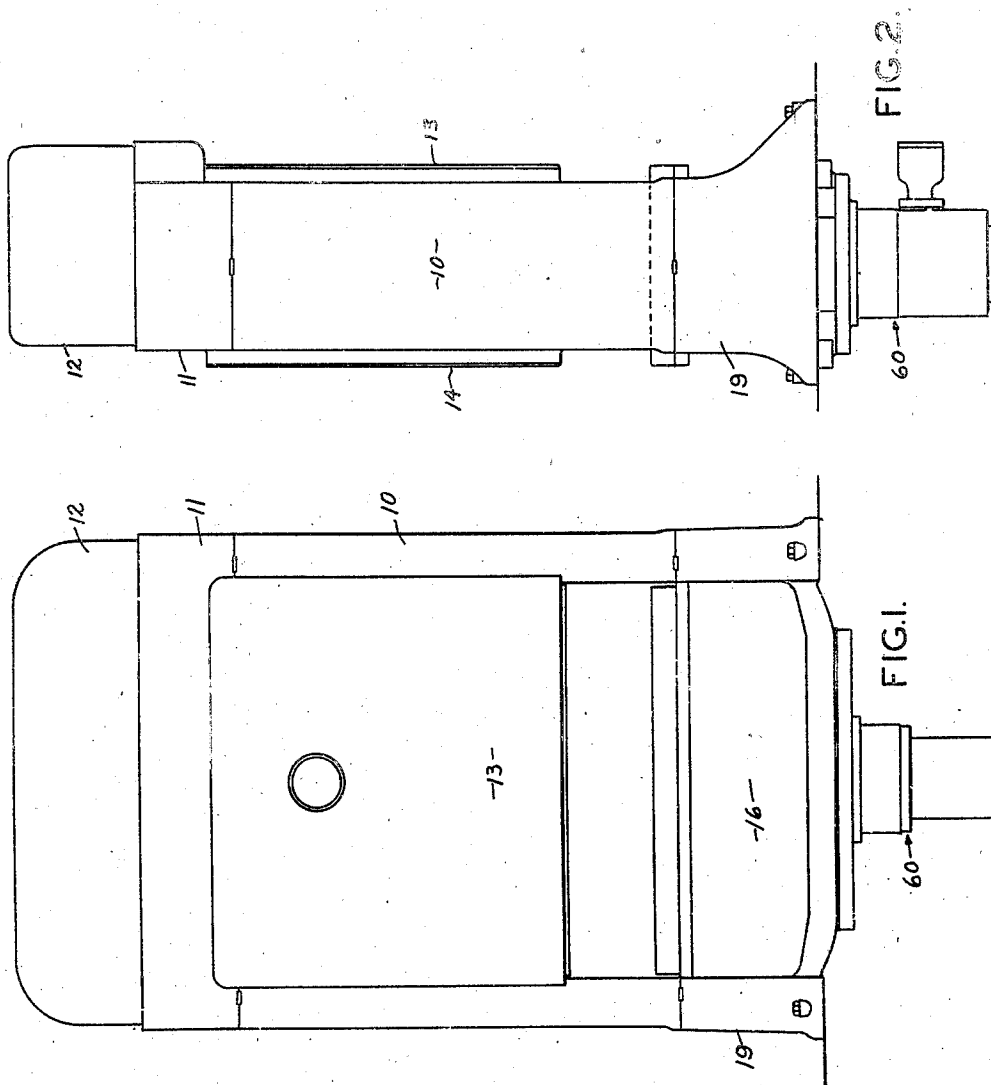
F. J. RODE

2,426,155

INCREMENT PRESS

Filed Aug. 4, 1942

5 Sheets-Sheet 1



INVENTOR
FREDRICH J. RODE
BY *Ray Macklin, Esq.*
Williams, L. Hilton and Esq.
ATTORNEYS

Aug. 19, 1947.

F. J. RODE

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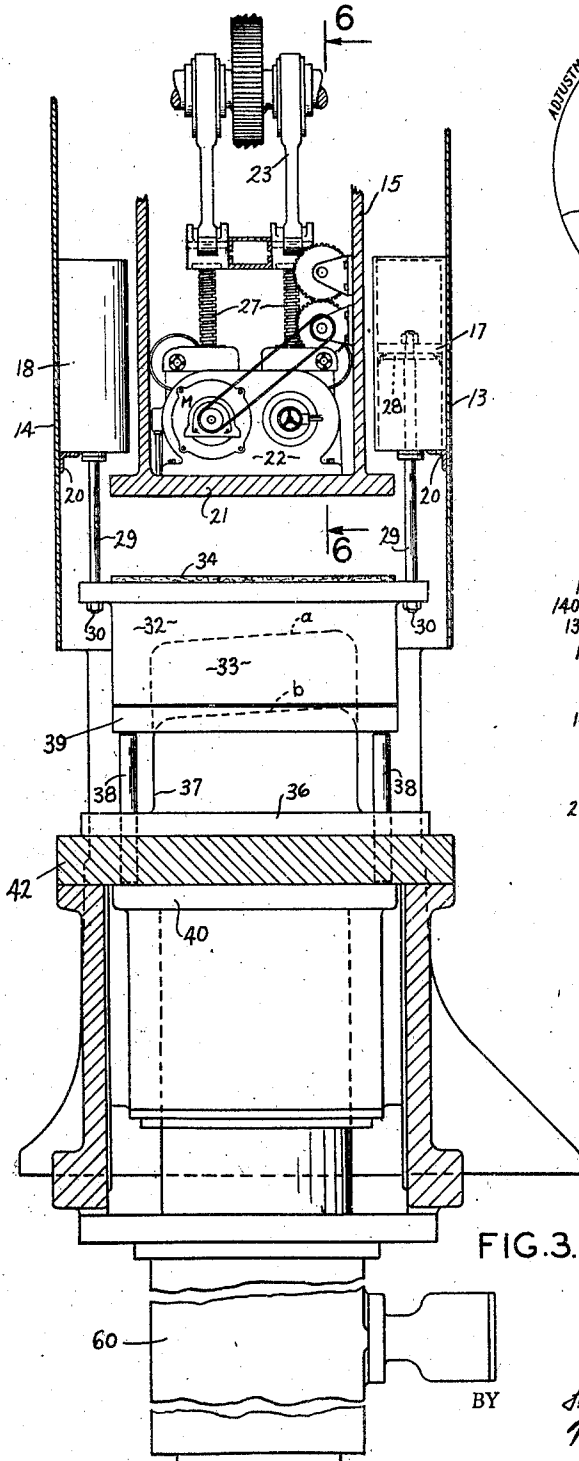


FIG. 3.

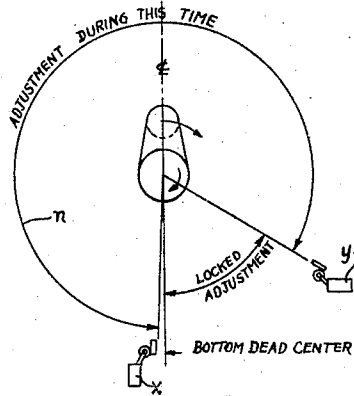


FIG. 7.

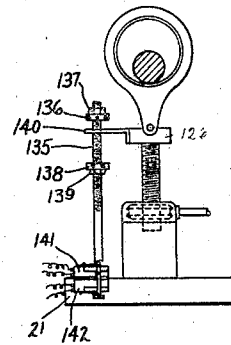


FIG. 8.

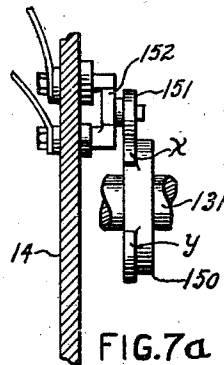


FIG. 7a

INVENTOR.
FREDRICH J. RODE.

BY *Ray, Macklin, Schlick*
Williams, Chilton and Sedler.
AT TORNEYS.

Aug. 19, 1947.

F. J. RODE

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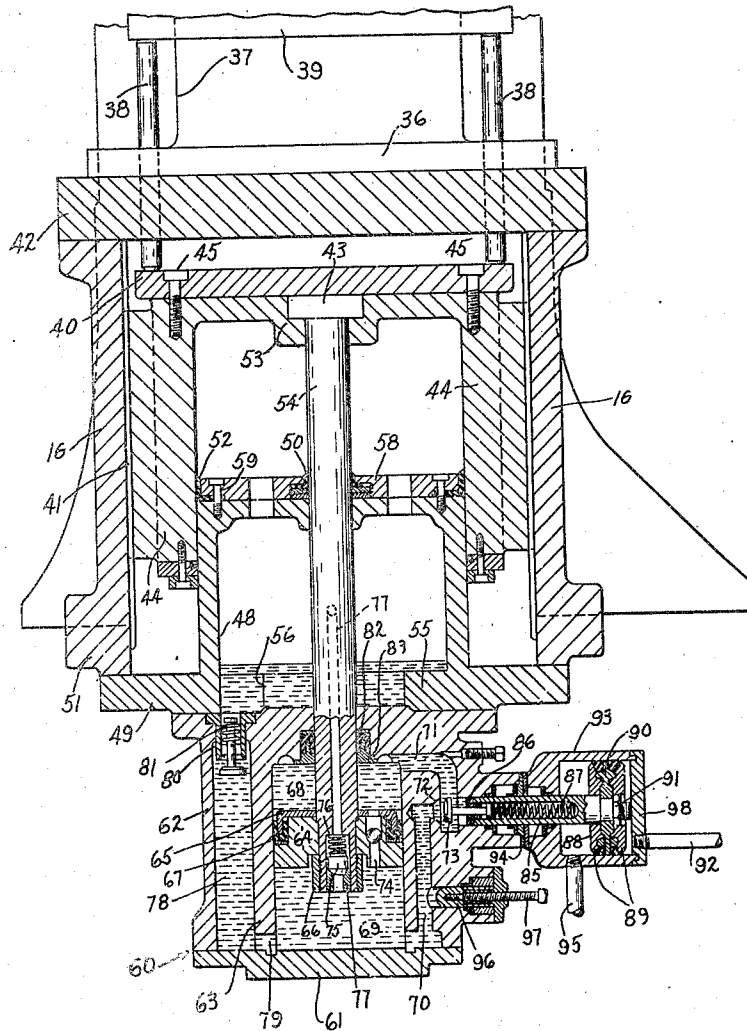


FIG. 4.

INVENTOR.
FREDRICH J. RODE.

BY

Fray Macklin, Grohlich
Williams, Chilton and Isler.
ATTORNEYS.

Aug. 19, 1947.

F. J. RODE

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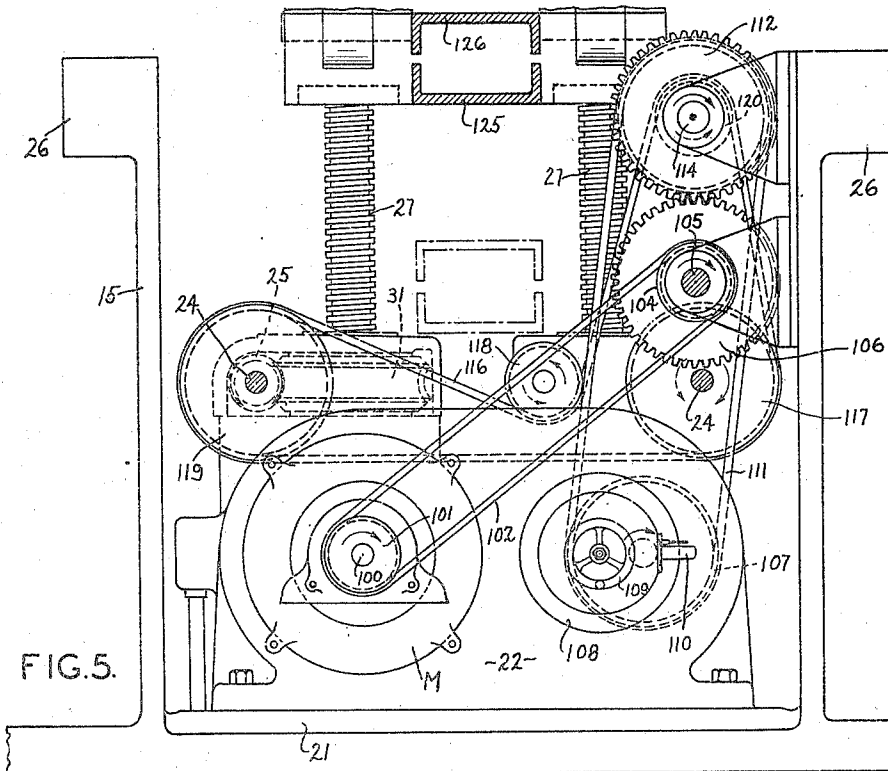


FIG. 5.

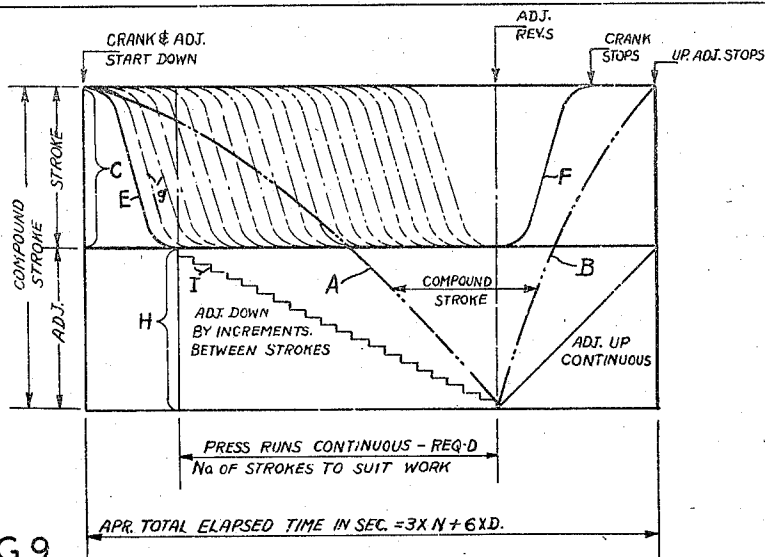


FIG. 9.

INVENTOR.
FREDRICH J. RODE

BY

Fay, Macklin, Eobrich
Williams, Schiltron and Delev.
ATTORNEYS.

Aug. 19, 1947.

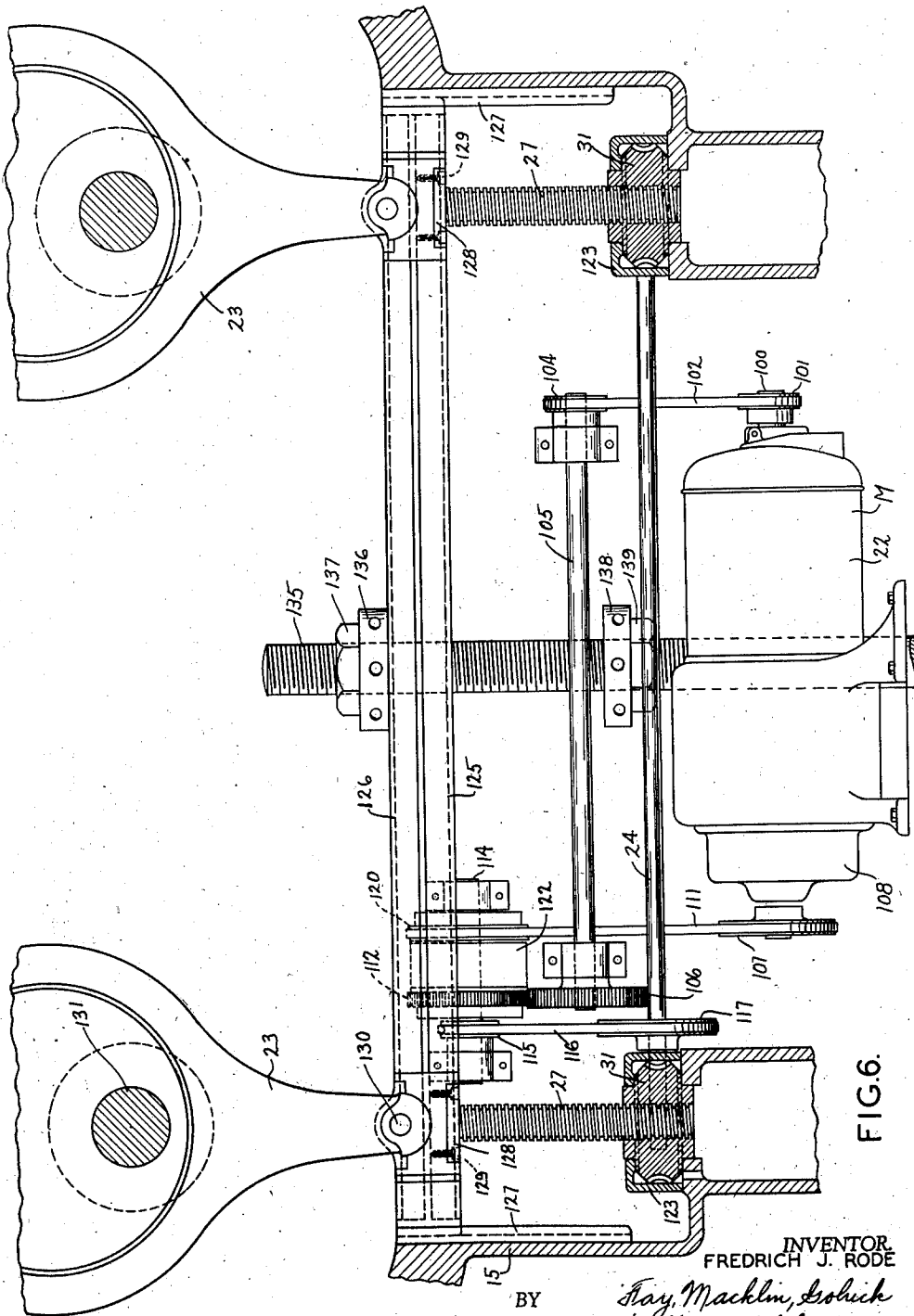
F. J. RODE

2,426,155

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5 Sheets-Sheet 5



INVENTOR
FREDRICH J. RODE

BY

Ray, Macklin, Lohick
Williams, L. Hilton and Sisk
ATTORNEYS.

UNITED STATES PATENT OFFICE

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INCREMENT PRESS

Fredrich J. Rode, Toledo, Ohio, assignor to E. W. Bliss Company, Brooklyn, N. Y., a corporation of Delaware

Application August 4, 1942, Serial No. 453,563

24 Claims. (Cl. 113—38)

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This invention relates to improvements in metal working machines, more particularly machines of the type in which a ram carrying the upper die is mounted for reciprocating movement in the upper part of a press, while the lower die is located on a bed in the lower part of said press, and in which the cooperating dies for the working of the metal are moved to progressively closer relative positions as the work formation proceeds.

More particularly, the invention relates to mechanism for increasing the length of the die carrying ram by predetermined increments for each work performing stroke in an operative cycle. In order to bring this about the ram is caused to perform two downward movements, one component of which consists in the usual reciprocating movement of the ram while the other component is a movement in downward direction resulting in a mechanically effective lengthening of the ram relative to the crank axis. To effect the latter movement the device is provided with an adjustment member which is in engagement with a drive transmission means that in turn is, for part of each ram cycle, connected by clutch means to a variable speed drive mechanism. The time during which the clutch connection is effective is during the non-working part of the ram cycle; for the remaining time of each stroke, that is the time while the ram is performing work, the clutch is disengaged and the adjusting member stays at rest. Apart from the variable speed drive mechanism the device is provided with a constant speed drive mechanism, which is also connected or disconnected to the drive transmission means by the clutch means already mentioned, at a time when one cycle of operation has come to an end and the machine is to be restarted. At this time the ram has been extended to its greatest length and has to be returned to the original position in order to be again capable of undergoing an increment increase in length.

A further object of the invention is to provide means by which the above mentioned ram operating mechanism may be reliably actuated and accurately controlled. These means comprise a stop mechanism and a plurality of limit switches, the functioning of which will be more fully explained in the following specification and annexed drawings.

In said annexed drawings:

Fig. 1 is a front view of the machine;

Fig. 2 is a side view of the same;

Fig. 3 is likewise a side view, on a larger scale, with some parts broken off and some parts shown in section;

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Fig. 4 is a section through the lower part of the machine illustrating the die cushion and the locking device for the same;

Fig. 5 shows parts of the ram adjusting mechanism located in the interior of the ram;

Fig. 6 is a section on line 6—6 of Fig. 3 likewise showing parts of the ram adjusting and operating mechanisms;

Figs. 7, 7A and 8 are illustrations of the operation of the control switches; and

Fig. 9 is a diagram of the operating cycle.

Referring more particularly to Figs. 1 and 2 of the drawings, 10 is a frame of the press supporting a crown 11 in which the mechanisms for reciprocating and for moving the ram in increments are mounted.

A top portion 12 covers the crown and forms a casing for such parts of the drive mechanisms as extend beyond the crown. A front plate 13 and a rear plate 14 serve for covering the machinery between the uprights of the frame.

The frame is supported by legs 19, between which is arranged a base portion 16 housing the lower die-supporting mechanism. Extending from said portion 16 downwardly is a locking device 60 which is shown in Fig. 4 and described with reference thereto.

Referring to Fig. 3, the upper part of the machine is shown to comprise a ram 15 of hollow construction, housing within its confines an electric motor M in a casing 22, which is mounted on a bottom plate 21 of said ram. Arranged within the ram also are the other elements of the mechanism for causing the increment increase of the ram length. This latter mechanism comprises a number of gears and two adjustment screws 27, all of which are shown more fully in Figs. 5 and 6 and described with reference thereto. The uppermost part of the drawing shows dual eccentric mechanism 23 for reciprocation of the ram, which is a continuously driven mechanism independently of the drive for increment increase of the ram length.

The plates 13 and 14 carry angle arms 20 which support counter-balance cylinders 17 and 18, and which serve to suspend the upper die mechanism in operative relation to the lower die mechanism independently of the ram when the latter is in up position. Within each of these four cylinders a piston 28 is mounted for vertical movement on a rod 29. The upper part of the cylinder is filled with air, which is compressed when the piston moves upward and acts as a cushion. Rods 29 are secured by screws 30 to a casting 32 which carries the upper die 33. As shown in the draw-

ing the die is in its up position shown in dotted lines at *a*. Any suitable pressure fluid connections, (not shown) to cylinders 18 may be used for exerting a lifting pressure on pistons 17 to raise the upper die 33 for blank insertion. A plate 34 of fiber board is secured to the top of casting 32 in order to avoid metal to metal contact when the ram is moved down to operate the upper die. The lower part of the machine contains a die set 36 mounted on a supporting bolster 42 which forms part of the machine frame. The die set carries the lower die 37 which has a contour *b* corresponding to the contour *a* of the upper die and cooperating therewith in the metal forming operation. Slidably received for traversing die set 36 and bolster 42 in their vertical movement are two pins 38 which support a die plate 39 on their top. This die plate serves for holding a blank to be worked upon by the two dies. The die plate 39 is secured by means of said pins 38 to a pressure pad 40 which forms part of the cushioning and locking mechanism more fully illustrated in Fig. 4 and described below with reference thereto.

In Fig. 4 the base portion 16 comprising the press bed is shown housing a cushion cylinder 44 which is slidably mounted in guideways 41. The cushion cylinder is secured to pressure pad 40 by means of screws 45 and moves up and down with the same.

Disposed within cylinder 44 is a piston 48 rigidly connected to the machine frame 10 by means of an outwardly extending flange 49 which is in abutment with a shoulder 51 at the bottom of the frame and secured thereto by means not shown. Stationary piston 48 has a second inwardly extending flange 55 with a bore 56, by which it is connected to a passage in a locking device, generally designated by numeral 60 and more fully described below.

A piston rod 54 extends through cushion cylinder 44 and piston 48 and projects therefrom down into the locking device 60. The rod 54 is held by a plate 43 in a recessed portion 53 on top of cylinder 44. A guide bearing 50 on the top of the piston 48 guides the upper reach of the piston rod 54. A packing 52 is disposed between piston and cylinder 44 and held by a retainer plate 58 secured by screws 59 to the piston head. Passageways through both said head and plate 58 connect the interiors of piston 48 and cushion cylinder 44.

The locking device 60 comprises a casting 62 having a cylindrical portion 63 which houses a piston head 64, carried at the bottom end of rod 54 engaging a stepped portion thereof and being fastened thereto by a nut 66. Above and below piston head 64 oil chambers 68 and 69 are provided, the upper oil chamber being sealed by packing 67 held down by a retainer plate 65 on the one hand, and by packing 82 held in place by retainer 83, on the other hand. The bottom of casting 62 is closed by a plate 61.

From the lower oil chamber 69 a conduit 70 leads up to a valve port 72 for a valve 73. From there a conduit 71 connects to upper oil chamber 68. As shown in the drawing the oil chambers are in communication, which is only interrupted when valve 73 closes the port 72. The functioning of this valve will be explained below.

The locking device is, moreover, provided with a number of operating valves within the different parts thereof which operate to lock and to release oil within and from the locking mechanism. A ball check valve 74 is provided in pis-

ton head 64 which opens in upward direction when the pressure differential in oil chambers 69 and 68 is sufficient to produce an unbalanced pressure effect on the valve. A second valve 75 for permitting oil to be forced from oil chamber 69 to the interior of piston 48 is provided within rod 54. The valve is controlled by a spring 76 which normally holds valve 75 down to close a conduit 77 and will open when pressure in 69 surpasses the spring pressure plus the pressure in the cushion cylinder 44. Another valve 80 controls branch passage 78, connected to chamber 69 by a bore 79 valve 80 is likewise spring controlled as at 81, and gives access to piston 48 through the bore 56 in flange 55.

Valve 73 is mounted in a hollow piston rod 85 capped by a plug 86 of packing material. Rod 85 accommodates a spring 87 which serves for controlling valve 73 and holding it against seat 72.

Rod 85 has mounted on its other end a piston head 88 consisting of two metal disks 89 with an interposed disk 90 of rubber or the like which provide an airtight fitting of the piston head within a cylinder 93, in which it is slidably mounted. A nut 91 serves for assembling the piston head and rod 85. Cylinder 93 has an air connection 92 in plate 98 and a second air connection 95, both connections leading it to a pressure line. The cylinder is attached to casting 62 by flanged rings at 94.

The locking device operates in the following manner: As the ram comes down and transmits pressure through the intermediate parts to the pins 38, these pins will depress the pressure pad 40, forcing downward movement of the cushion cylinder 44 and rod 54 with locking piston 64. This causes oil to flow from the lower side to the upper side of piston 64, that is from chamber 69 to chamber 68, through check valve 74 and also through passage 70, 71. When the pressure pad 40 and piston 64 are at the down position corresponding to the end of the ram down stroke, the air cylinder piston 88 is moved by admission of air (operated by automatic controls not shown) through connection 92 to move to the left in Fig. 4, causing valve 73 to close and thereby preventing any return passage of oil through passage 71, 70. This locks the pressure pad 40 in its down position. Further inward movement of the air piston will cause valve 73 and piston rod 85 to telescope, thus causing the cushion cylinder 44 to be depressed slightly beyond its ram depressed position. At the proper moment air will be exhausted through connection 92 and air admitted through 95 to push piston 88 back to the right and open valve 73. The lock on pressure pad 40 is released thereby and it is allowed to return to its top position under the influence of the cushion pressure.

The operation of the pneumatic device controlling the locking of the pressure pad is effected by cam controlled valves (not shown) actuated by the eccentric shaft and thereby timed with the up and down movement of the ram.

Near the bottom of casting 62 below valve 73 a speed adjustment mechanism is shown comprising a plug 96 and a screw 97 for advancing and retracting the same to control the quantity of oil passing through conduit 70, thus affording regulation of the rate of the movement of the cushion cylinder.

Referring more particularly to Fig. 5, the ram 15 is shown with shoulder portions 26 which are mounted in a known way for vertical sliding

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movement in guideways (not shown) of the machine frame.

As mentioned before a motor housing 22 is mounted on the bottom plate 21 of ram 15; said housing accommodates a motor M which furnishes power for a constant speed drive and a variable speed drive, respectively, and all of which mechanism is carried by the ram mechanism. The constant feed drive serves the purpose of shortening the effective length of the ram mechanism and the variable speed drive serves the purpose of increasing the effective length of the ram mechanism.

The constant speed drive mechanism comprises a gear 106 carried on a shaft 105 on which a pulley 104 is mounted. Connection to said pulley is made from the motor shaft 105 by means of a pulley 101 on said shaft 100 and belting 102.

Another drive connection is arranged within the housing 22 from the motor to a pulley 107. This device serves to effect speed reduction and to drive the adjustment mechanism at a different speed than that imparted thereto by gear 106. The speed may be varied according to the requirements of the particular case, this variation of speed being the means for determining the increment of increase in the ram length. The speed varying mechanism is enclosed in the motor housing and is of known construction; it is, therefore, not shown in the drawings. A hand wheel 109 (see Fig. 5) is mounted on part 108 of the motor housing for adjusting the speed and an indicator member 110 shows the amount of speed reduction obtained by said adjustment.

Gear 106 is in mesh with a second gear 112 mounted on a shaft 114 which, as may be best seen from Fig. 6, also carries a clutch 122 and two pulleys 120 and 115. Shaft 114 is either driven at constant speed in reverse direction through gear 112, if the clutch causes the shaft to engage with the gear. Or shaft 114 may be driven at variable speed by a connection through a belt 111, to pulley 107 of the variable speed mechanism.

From the pulley 115 on shaft 114 an endless belt 116 connects to a wheel 117 on the one side, and under an idler roll 118 to a second wheel 119; this wheel is mounted on the other side of the ram symmetrically to wheel 117. Belt 116 after having passed over wheel 119 comes back to wheel 117. Each of these wheels is operatively connected to one of two shafts 24 which extend through the width of the machine and have worms 25 formed at both their ends (see Fig. 6). The mechanism thus contains four worms on two worm shafts 24, each worm engaging a worm wheel 31 which in turn drives one of the four adjustment screws 27. For this purpose the worm wheels 31 are interiorly provided with a thread to match that of screws 27. The worm wheels 31 are mounted in cages 123 which are rigidly secured to a portion of the ram 15. Both Figs. 5 and 6 show the ram in its lowermost position, by reason of the full extension of the adjustment mechanism at the end of a cycle of operations.

Extending across the width of the ram 15 are two channel bars 125 and 126 which are slidably mounted in guideways 127 formed in the ram structure. The lower bar 125 is connected to the screws 27 by reinforcing plates 128 screwed to the bars as at 129. Fig. 5 shows the bars in section in the two extreme positions they may occupy relative to the plate 21, the one closer to plate 21 being shown in dotted lines.

The upper channel bar 126 is connected by pins

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130 to the straps 23 of two eccentrics 131, which are continuously driven by a motor (not shown) and which in turn effect the reciprocation of ram 15.

Intermediate of said eccentrics a mechanism is arranged which serves to prevent any further lengthening movement of the ram in downward direction than the desired total extension; the same mechanism also serves for stopping the shortening movement of the ram to the starting position. This mechanism is associated with the lower varying reciprocating part of the ram mechanism and the bed or frame of the machine or with the upper and lower ram parts as desired.

The stop mechanism shown comprises a threaded rod 135 extending freely through an opening in a bracket 140 secured to one of the members 126 (Figs. 6 and 8). The lower end of the rod 135 is operatively associated with a switch mechanism supported by the lower adjustable part of the ram mechanism. Mounted on said rod 135 and in engagement with the threads thereof are an upper adjustable collar 136 and a lower adjustable collar 138 which are adjustable manually and which are held in place by lock nuts 137 and 139 respectively. As stated, rod 135 passes freely through an opening in the bracket member 140 in the upward and downward travel of the plate 21 of the ram mechanism relative to the bars 125 and 126. The member 135 when moved up or down by the respective collars, actuates a two-way limit switch (see Fig. 8), the upper limit switch being designated by 141 and the lower limit switch by 142. These switches, when tripped by the rod 135 are adapted to operate air valves on clutch 122 which will cause the clutch to engage either the variable or the constant speed drive gear as required by the operation of the machine and as described below. Thus, when the desired lengthened or shortened condition of the ram is reached, further relative movement of the ram parts is stopped by the co-action of the collars 136 and 138 with the member 135 as aforesaid.

The way in which the increment increase of the length of ram 15 is effected is illustrated in Fig. 7. In the example there illustrated the ram is assumed to perform twenty strokes per minute which means that it will take three seconds for an up and down movement. Of this time one-half second is required for the active stroke, and two and a half seconds remain for the adjustment drive to operate free of any working load. This time comprises the up stroke, which takes one and a half seconds and approximately two-thirds of the down stroke equalling one second.

Fig. 7 shows the up stroke and the unloaded down stroke by line *n* corresponding to an angle of 300°; during this time the worms 25 are driven from the variable speed drive over pulleys 107 and 115, the left-hand side of clutch 122 (Fig. 6) being engaged on account of the closing action of a limit switch at position *x* controlling a line which opens a solenoid valve controlling the air line to clutch 122. The length of the ram 15 is thereby increased by one increment, for example, one quarter of an inch. After the ram has moved up to the full length and has descended for one second, the limit switch at position *y* is opened which causes disconnection of the left-hand side of the clutch without causing connection of the right-hand side, that is to say, the clutch remains entirely disengaged during the last 60° representing the working stroke of the

ram. The adjustment device is, therefore, inactive and the ram remains without change of length during this half of a second. Such a switch is shown in Fig. 7a with the stations *x* and *y* indicated on a cam 150 fixed upon the crankshaft 131. The high part of the cam extends through 300° and actuates a roller 151 insulated from switch arm 152 which closes and opens contacts in the solenoid line, the latter being mounted on the machine frame 14. As soon as the ram reaches bottom dead center, or, more accurately, shortly after that point, limit switch *x* is tripped and operates the air valve which again causes the engagement of the variable speed drive by clutch 122, left-hand side.

This cycle of operation continues for a predetermined number of strokes. If a workpiece eight inches deep is to be drawn in increments of one quarter inch, 32 strokes will be performed in the way described. The ram has then attained its greatest length and should be returned to starting position. This part of the operation is illustrated in Fig. 8.

As soon as the ram plate 21 reaches the lowermost position switch 142 is tripped through the medium of the collar 136 and rod 135. This switch operates an air valve that will cause the right-hand side of clutch 122 to become engaged and to connect the worms to the constant speed drive which causes the lower part of the ram mechanism to travel up in one drive the whole length for which it had been moved down in 32 increments. When the lower end of the ram reaches the uppermost point relative to the upper part of the ram, bracket 140 contacts the collar 138 and trips limit switch 141, thereby disconnecting the worms from the constant speed drive. The ram mechanism is now in position for the next cycle of operations.

In Fig. 9 a working diagram shows the compound up and down stroke performed by the ram under the operation of the eccentric and the adjustment mechanism. Time elapsed during the stroke is marked on the abscissas; during this time a compound stroke in downward direction represented by a curve A, in upward direction by curve B, is performed. I is an increment by which the length of the ram is increased during each stroke, the total length of increase being shown by H. The curves E and F drawn in full lines are the first down stroke and the last up stroke performed under crank operation, whereas the series of dotted curves *g* are a representation of the following crank strokes as they would occur under crank operation if this were not combined with the action of the adjusting mechanism to perform a compound stroke. In the formula at the bottom of the diagram the total elapsed time in seconds for a complete cycle is given as $3 \times N + 6 \times D$, in which formula *N* designates the number of strokes and *D* the depth of each increment.

Operation

The work is accomplished in the following manner:

The adjustment limit collar 136 is normally set and locked at a depth that is to be the maximum depth. This arrangement remains unchanged while the machine is operated for the desired quantity of articles to be drawn. The collar 138 is set to the desired up position of the lower part of the ram relative to the upper part thereof. The variable speed drive is then adjusted to give the desired increment increase, in

our example the increase of one-quarter inch per stroke in $2\frac{1}{2}$ seconds.

After the blank has been properly placed, the press is started by push button; at the time of the starting the ram is in up position. During each separate stroke of the press the worms acting on worm gears 31 are running the lower end of the ram down to lengthen the ram, from the time the crank passes bottom center until it returns up and over top and down to within approximately 60 degrees of bottom center again, where clutch 122 is disengaged. As mentioned before, the clutch remains entirely free of engagement through the working part of each stroke of the ram. The variable speed drive is not stopped or reversed during the entire run; the adjustment control is accomplished by clutch operation only.

After a succession of 32 strokes to attain the required depth of draw in this case as assumed, the crank is stopped through limit switch 142 operated by the previous setting on the adjustment collar 136. At the same time, the clutch 122 is engaged on the up adjustment side which is driven at constant high speed off the motor shaft. The crank has come to rest in the up position of the press stroke and the adjustment continues up until the opposite limit switch 141 responsive to the adjustment collar 138 disengages the up side of the adjusting clutch, allowing the adjustment mechanism to run free while the finished part is removed and the next blank placed ready for the start of the next progressive run.

Both the main motor for driving the crankshaft and motor M for the adjustment mechanism are running continuously. The eccentric is operated by a main clutch as usual started by push button and stopped automatically by limit switch 142 as described above.

If desired, the ram adjustment may be intermittent to the extent that the variable speed clutching would only take place after a number of incomplete work pieces had been fed into and removed from the press with only one stage or intermediate operation having been performed thereon. An occasion for such use will be found when the metallurgical properties of the work blank are such as to require an ageing or rest period between each forming, drawing or forging operation.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

1. In a machine of the class described, a ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die, means adapted to move said ram by increments to progressively closer positions with said die holder as the metal working proceeds, said means comprising continuously operated mechanism for reciprocating said ram during a cycle of operation, another mechanism for lengthening said ram by increments during said cycle and means for automatically operating and controlling said last mentioned mechanism.

2. In a machine of the class described, a ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die, means adapted

to move said ram by increments to progressively closer positions with said die holder as the metal working proceeds, said means comprising a plurality of continuously operated drive members for reciprocating said ram during a cycle of operation, a plurality of members for lengthening said ram by increments during said cycle and electric means for automatically controlling the operation of said lengthening members.

3. In a machine of the class described, a ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die, continuously operated means for reciprocating said ram during an operative cycle, means adapted to move said ram by increments to progressively closer positions with said die holder as the metal working proceeds, said means comprising a variable speed drive mechanism, an adjusting member in fixed relation to said ram, a drive transmission means in engagement with said adjusting member for increasing the length of said ram by increments during said cycle, clutch means to connect and disconnect respectively said drive transmission means to said variable speed drive mechanism and electric means for controlling said clutch and said ram lengthening means.

4. In a machine of the class described, a ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die, continuously operated means for reciprocating said ram during an operative cycle, means adapted to move said ram by increments to progressively closer positions with said die holder as the metal working proceeds, said means comprising a variable speed drive mechanism, an adjusting member in fixed relation to said ram, a drive transmission means in engagement with said adjusting member for increasing the length of said ram by increments during said cycle, clutch means to connect and disconnect respectively said drive transmission means to said variable speed drive mechanism and electric means for controlling said clutch and said ram lengthening means, the length of said increments being determined by the rate of speed of said variable speed drive mechanism.

5. In a machine of the class described, a ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die, continuously operated means for reciprocating said ram during an operative cycle, means adapted to move said ram by increments to progressively closer positions with said die holder as the metal working proceeds, said means comprising a variable speed drive mechanism, an adjusting member in fixed relation to said ram, a worm and worm wheel in engagement with said adjusting member for increasing the length of said ram by increments during said cycle, clutch means to connect and disconnect respectively said worm with said variable speed drive mechanism over a predetermined part time of the ram stroke and electric means for controlling said clutch and said ram lengthening means.

6. In a machine of the class described, a ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die, continuously operated means for reciprocating said ram during an operative cycle, means adapted to move said ram by increments to progressively closer positions with said die holder as the metal working

proceeds, said means comprising a variable speed drive mechanism, an adjusting member in fixed relation to said ram, a drive transmission means in engagement with said adjusting member for lengthening said ram by increments during said cycle, clutch means to connect said drive transmission means over a predetermined part time of a stroke to said variable speed drive mechanism and to disconnect said drive transmission means for the remainder of said stroke, and electric means for controlling said clutch and said ram lengthening means.

7. A machine as claimed in claim 5, characterized by the fact that a plurality of adjusting members and a corresponding plurality of drive transmission means are used for operating the increment lengthening of the ram.

8. In a machine of the class described, a ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die, continuously operated means for reciprocating said ram during an operative cycle, means adapted to move said ram by increments to progressively closer positions with said die holder as the metal working proceeds, said means comprising a variable speed drive mechanism, an adjusting member in fixed relation to said ram, a drive transmission means in engagement with said adjusting member for increasing the length of said ram by increments during said cycle, clutch means to connect said drive transmission means to said variable speed drive mechanism during the idle stroke of said ram and electric means for causing the connection of said clutch means during said idle stroke and the disconnection of said clutch means during the operating stroke of said ram respectively.

9. In a machine of the class described, a ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die, continuously operated means for reciprocating said ram during an operative cycle, means adapted to move said ram by increments to progressively closer positions with said die holder as the metal working proceeds, said means comprising a variable speed drive mechanism, an adjusting member in fixed relation to said ram, a drive transmission means in engagement with said adjusting member for increasing the length of said ram by increments during said cycle, clutch means to connect said drive transmission means to said variable speed drive mechanism during the idle stroke of said ram and electric means for causing the connection of said clutch means during said idle stroke and the disconnection of said clutch means during the operating stroke of said ram respectively, the length of said increments being determined by the ratio of the idle stroke and the working stroke.

10. In a machine of the class described, a ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die, continuously operated means for reciprocating said ram during an operative cycle, means adapted to move said ram by increments to progressively closer positions with said die holder as the metal working proceeds, said means comprising a variable speed drive mechanism, a constant speed drive mechanism, an adjusting member in fixed relation to said ram, a drive transmission means in engagement with said adjusting member for lengthening said ram by increments during said cycle, clutch means adapted to connect said drive trans-

mission means to said variable speed drive mechanism or to said constant speed drive mechanism, and electric means for causing connection of said clutch to said variable speed drive mechanism during the idle stroke of said ram, causing disconnection of said clutch during the operative stroke of said ram and causing connection of said clutch to said constant speed drive mechanism during the return of said ram to its upper starting position at the end of an entire working cycle.

11. In a machine of the class described, a reciprocating ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die, means adapted to lengthen said ram by increments as the metal working proceeds, and means for automatically operating and controlling said first mentioned means, said means comprising a member for determining the entire increase of length of said ram and means associated therewith to return said ram to the position of short-est length.

12. In a machine of the class described, a reciprocating ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die, means adapted to lengthen said ram by increments as the metal working proceeds, and means for automatically operating and controlling said first mentioned means, said means comprising a member for predetermining the extent of the ram lengthening and means associated therewith to shorten said ram to a starting position.

13. In a machine of the class described, a reciprocating ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die, means adapted to lengthen said ram by increments as the metal working proceeds, and means for automatically operating and controlling said first mentioned means, said means comprising a member for predetermining the extent of the ram lengthening and electric means associated therewith to shorten said ram to a starting position.

14. In a machine of the class described, a ram, an upper die mounted in said ram, a die holder adapted to support a lower die for cooperation with said upper die, means adapted to move said ram by increments to progressively closer positions with said die holder as the metal working proceeds, said means comprising a plurality of continuously operated drive members for reciprocating said ram during a cycle of operation, a plurality of members for lengthening said ram by increments for each stroke during said cycle and electric means for automatically controlling the operation of said lengthening members.

15. In a machine of the class described, a ram, an upper die mounted in said ram, a die holder adapted to support a lower die for cooperation with said upper die, means adapted to move said ram by increments to progressively closer positions when said die holder as the metal working proceeds, said means comprising a plurality of continuously operated drive members for reciprocating said ram during a cycle of operation, a plurality of members for lengthening said ram by increments for a series of strokes during said cycle and electric means for automatically controlling the operation of said lengthening members.

16. In a machine of the class described, a ram,

an upper die mounted in said ram, a die holder adapted to support a lower die for cooperation with said upper die, continuously operated means for reciprocating said ram during an operative cycle, means adapted to move said ram by increments to progressively closer positions with said die holder as the metal working proceeds, said means comprising a variable speed drive mechanism, an adjusting member on said ram, a drive transmission means in engagement with said adjusting member for increasing the length of said ram by increments during said cycle, clutch means to connect and disconnect respectively said drive transmission means to said variable speed drive mechanism and electric means for controlling said clutch and said ram lengthening means.

17. In a machine of the class described, a ram, an upper die mounted in said ram, a die holder adapted to support a lower die for cooperation with said upper die, continuously operated means for reciprocating said ram during an operative cycle, means adapted to move said ram by increments to progressively closer positions with said die holder as the metal working proceeds, said means comprising a variable speed drive mechanism, an adjusting member in fixed relation to said ram, mechanical means in engagement with said adjusting member for increasing the length of said ram by increments during said cycle, clutch means to connect and disconnect respectively said mechanical means with said variable speed drive mechanism over a predetermined part time of the ram stroke and electric means for controlling said clutch and said ram lengthening means.

18. In a machine of the class described, a ram, an upper die mounted in said ram, a die holder adapted to support a lower die for cooperation with said upper die, means adapted to move said ram by increments to progressively closer positions with said die holder as the metal working proceeds, said means comprising a plurality of continuously operated drive members for reciprocating said ram during a cycle of operation, a plurality of members for lengthening said ram by increments during said cycle and electric means for automatically controlling the operation of said lengthening members, said ram lengthening members and said control means being placed within the confines of said ram.

19. In a machine of the class described, a reciprocating ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die throughout a series of progressing work performing steps, a depressible die plate for holding a work blank, means adapted to increase the effective length of said ram by increments to progressively depress said die plate as the metal working proceeds, means for automatically operating and controlling said first mentioned means, means for holding the die plate at each depressed position and means for restoring the die plate to an initial work blank holding position.

20. In a machine of the class described, a reciprocating ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die throughout a series of progressing work performing steps, a depressible die plate for holding a work blank, means adapted to increase the effective length of said ram by increments to progressively depress said die plate as the metal working proceeds, means for automatically oper-

ating and controlling said first mentioned means, means for holding the die plate at each depressed position for a time interval corresponding to the operative stroke of said ram and means for restoring the die plate thereafter to an initial work blank holding position.

21. In a machine of the class described, a reciprocating ram, an upper die mounted to be moved by said ram, a die holder adapted to support a lower die for cooperation with said upper die throughout a series of progressing work performing steps, a depressible die plate for holding a work blank, means adapted to increase the effective length of said ram by increments to progressively depress said die plate as the metal working proceeds, means for automatically operating and controlling said first mentioned means, means for holding the die plate at each depressed position for a time interval corresponding to the operative stroke of said ram and means for restoring the die plate thereafter to an initial work blank holding position, said means for holding the die plate comprising a stationary piston and a movable cylinder, said cylinder being operated by hydraulic means and controlled by pneumatic means.

22. An increment press having a frame, the frame having a bed portion; a pair of die actuator elements each supported in spaced relation to the other for reciprocatory movement on the frame and one of the elements supporting a die; crank means operatively connecting the frame to the other of the elements for reciprocating said element through a lineal range, one extreme of which occurs proximate to said bed portion, while acting on the die supporting element means powered independently of the crank means, operatively interposed between the crank means and the crank operated element to predeterminately vary the relative proximity to the bed of the range of said element's reciprocation and controller means associated with the crank means to be in operative synchronism therewith for controlling the period of operation of said independently powered means.

23. An increment press having a frame, the frame having a bed portion; a die actuator element supported for reciprocatory movement on the frame, a die supporting element mounted on the frame and operably disposed intermediate the actuator element and the bed portion, crank means operatively connecting the frame to the actuator element for reciprocating the element

through a lineal range, one extreme of which occurs proximate to said bed portion; an independently powered, intermittently operated mechanism operatively interposed between the crank means and the actuator element to predeterminately vary the relative proximity to the bed of the range of said element's reciprocation, controller means driven by the crank means of the press for controlling the period of action of said mechanism and a reversing means effective to cause the independently powered mechanism to restore the actuator element to an initial position relative to the crank means which position is remote from the bed.

24. In an increment press having a frame, a pair of die actuator elements, each supported in spaced relation to the other for reciprocatory movement on said frame; means for reciprocating the first of said elements; crank means operatively connecting the frame to the second of said elements for reciprocating the second element through a range extending toward and away from one extreme of the first element's reciprocatory movement; an intermittently operated mechanism operatively interposed between the crank means and the second element for modifying the operative connection afforded by said mechanism to predominantly vary the effective range of the second element's reciprocation relative to said extreme while the second element is moving through a part of its reciprocatory cycle and controller means operated by the crank mechanism of the press for controlling the action of the said mechanism during each cycle of operation of the crank means.

FREDRICH J. RODE.

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