Fig. 3

POSITION JUST BEFORE END OF DOWN STROKE

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This
Fig-4

POSITION JUST BEFORE START OF RETURN MOVEMENT OF SLIDE

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PRESS FOR METAL STAMPING

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6 Sheets-Sheet 6

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**Fig-6**

C-CYCLE 10 PER MIN. ONE IN 6 SECONDS

N' CYCLE IN 3.2 SEC. 10 PER MIN.

CYCLES WITH MAX. SHUT HEIGHTS AND MAX. DRAWS.

C CYCLE 10 PER MIN. ONE IN 6 SEC.

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**Fig-7**

Cycles with Min. Shut Height

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**Fig-8**

N=C Presses, Same Strokes Per Min. - One in 6 Sec.

Idle

Approach

Pressure

Return

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Inventor.

Alois Karl Nowak

By: Mann and Brown
This invention relates to power presses and has for its principal object:

To make a fixed stroke drive such as an eccentric deliver a longer stroke to a tool carrying slide and vary that stroke to different die sets;

To increase the number of stroke cycles per minute, and hence the output of the press;

To make it practicable to use an eccentric or the like with a stroke approximately the same as the maximum depth of the draw part while providing the necessary or appropriate daylight; and

To reduce the draw speeds and increase the draw time and make it possible to use common drawing steel sheets while maintaining present production speeds, which now require special steels to prevent rupture.

Further objects and advantages of the invention will appear as the disclosure proceeds and the description is read with the accompanying drawings, in which—

Fig. 1 is a diagrammatic view of the essential features of the press showing the parts in idle position;

Fig. 2 is a similar view showing the parts in the position they assume at or near the end of the approach stroke;

Fig. 3 is a similar view showing the parts in the position they assume just before the start of the return movement of the slide;

Fig. 5 is a similar view showing the parts in the position they assume as the slide approaches the end of the up stroke; and

Figs. 6, 7, and 8 are charts showing the comparative curves of a conventional press and the new press embodying the present invention.

GENERAL DESCRIPTION

The press includes a bed 10 adapted to receive a tool 11 to cooperate with a tool 12 carried by a slide 13 arranged to reciprocate in guides 14.

A motor 15 drives a countershaft 16 having a flywheel 17 and an air clutch 18 and driving a main shaft 19 through gearing 20. The main shaft is equipped with an eccentric 21 cooperating with an eccentric strap 22 and a rod 23 to drive a ram 24 having a double acting piston 25 in a main or ram cylinder 26 between the stuffing box 27 and the closed head 28.

A passage 29 connects the main cylinder below the piston 25 with the upper end of an auxiliary or press cylinder 30 fitted with a double acting piston 31 connected by a rod 32 with the slide and operating between a stuffing box 33 and the piston 31 of the press cylinder.

Associated with the cylinders is a tank 35 for hydraulic liquid, which is connected by a passage 36 with the press cylinder 30 below the piston 31, and it, in turn, is connected by a passage 37 with the main cylinder 26 above the main piston 25, and that passage is equipped with a spring seated check valve 38. The main cylinder above the piston 25 is also connected with the tank 35 by a passage 39 equipped with a spring seated check valve 40 in a chamber 41 on the side of the main cylinder.

The press cylinder 30 is connected with the tank 35 through a prefill valve casing 42 having a spring seated prefill valve 43, the stem 44 of which is associated with (shown superimposed upon) a piston 45 in a cylinder 46 formed in the upper end of the prefill valve casing 42 and in communication with the main cylinder 26 through a passage 47. The piston 45 has an operating rod 48 passing out through the top of the cylinder 45 to actuate the switch 1.

The passage 36 connecting the tank 35 with the press cylinder 30 below the piston 31 has a pull-back valve including a casing 50, a valve head 51, and a stem 52 with a superimposed piston 53 operating in a cylinder 54 formed in the upper end of the casing 50. The piston 53 has an operating rod 55 adapted to actuate a switch 3.

The passage 36 also has a holding valve 57 in a casing 58 and normally seated by a spring 59 to prevent flow from the passage 36 through an auxiliary holding valve passage 60 to the tank 35, or vice versa.

The pull-back valve and the holding valve are controlled by a hydraulic system including a pilot pump 62 having an intake pipe 63 leading from the tank 35 and an outlet pipe 64 leading back to the tank 35 but equipped with a pressure limiting valve 65 adapted to maintain a suitable pressure in the control system.

A pipe 66 connected with the outlet 64 of the pilot pump is, in turn, connected by a pipe 67 with the cylinder 68 of a solenoid valve A, and that cylinder is connected with the tank 35 by a pipe 69 and with the cylinder 54 of the pull-back valve by pipe 70. The solenoid valve A has a piston valve 71 in the cylinder 68 normally biased by the spring 72 and operated on suitable occasion by a solenoid in a familiar manner.

The pipe 66 connected with the outlet 64 of the pilot pump 62 is also connected with a pipe
The slide 13 is equipped with a cam 89 adapted to operate a limit switch D as the slide approaches the work to initiate the stroke of the mechanical drive.

A control lever 81, pivoted and fulcrumed at 82 on the main shaft 19, is connected by a link 83 and suitable pivots with the ram 24, and is operated in unison with it but with a multiplied movement, depending upon the design. The control lever 81 has a connecting rod 84 through which it operates a control rod 85 having an upper cam 89 adapted to operate a switch D and a lower cam 87 adapted to operate a switch E. The rod moves through suitable guides 86, two of which are equipped with brackets 89 in which is mounted a screw 90 carrying the switches D and E and by which they are adjusted in unison.

**OPERATION**

*Idle position (shown on sheet 1)*

The flywheel 17 is rotating and the air clutch 18 is disengaged. The eccentric 21 with its plunger 24 is idle in the "up" position. The check valves 36 and 40 at each side of the plunger in the main cylinder 26 are seated by their springs. The prefixed valve 43 on top of the press cylinder 30 is held open by its pilot piston 45 under pressure within the main cylinder above the piston 25 connected to the pilot cylinder 46 through the passage 47. The solenoid A is energized, placing its piston valve in position where the pilot pressure of the pump 62 is blocked and the pilot cylinder 54 above the pull-back valve is connected with the tank through the discharge pipe 68. The pull-back valve 51 is closed by its spring. The solenoid H is de-energized, thereby placing its piston valve in position where the tank connection is blocked and the pilot pressure is admitted behind the holding valve 51, holding it firmly against its seat. The control link 81 on the eccentric shaft and its control rod are in their up position. The press piston 31 and the slide 13 are in their up position.

**Starting the Cycle of Operation**

The operator starts the cycle of the press by pushing a cycle button 100, which causes the solenoid A to be de-energized, permitting the piston valve 71 to shift to its upward position, blocking the tank connection 69 and admitting pilot pressure from the pump 62 into the pilot cylinder 54 of the pull-back valve. The pull-back valve is open, thereby connecting the auxiliary cylinder 30 beneath the piston 31 with the tank 35, and gravity forces the slide and the piston downward, the fluid beneath the piston being discharged into the tank.

The downward movement of the press piston 31 produces a partial vacuum in the press cylinder 35 above the piston, and atmospheric pressure on the hydraulic fluid in the tank 35 opens the prefill valve 43 against its closing spring, and hydraulic fluid flows from the tank into the press cylinder 30 above the piston, keeping it filled as the piston descends during its approach or closing stroke. (See Fig. 2.)

**The Draw or Working Stroke**

As the slide descends, the cam 80 strikes the limit switch D (Fig. 2), which is so adjusted that the switch will be operated when the upper die 12 is just above contact with the work. Operating the switch D energizes the solenoid A, shifting the piston valve into position (Fig. 3) where the pilot pressure in the pump 62 is blocked and the pressure in the pilot cylinder of the pull-back valve is exhausted to the tank, when the pull-back valve is closed by its spring, cutting off further exhaustion of fluid from beneath the piston 31 and checking the slide, which latter ends the creation of partial vacuum in the auxiliary cylinder above the piston 31, and the prefill valve is closed automatically by its spring.

The stems or operating rods 45 and 55 of the valves I and B close an electric circuit, which operates the well-known solenoid air valve, admitting air into the chute 16 and causing it to engage, thereby starting the rotation of the eccentric.

Operating the limit switch D has also energized the solenoid H, which relieves the holding valve of the pilot pressure and permits it to cushion the drop of the slide and upper die when the pull-back valve closes (Fig. 3). The spring 59 of the holding valve will, of course, be adjusted according to the weight to be cushioned.

The rotation of the eccentric 21 moves the plunger piston downwardly, and the displacement beneath it is forced through the passage 29 into the press cylinder above the piston 31, forcing the latter and the slide downward against the work. (Fig. 3.) During this movement, the displacement in the cylinder 30 beneath the piston 31 pushes the hydraulic fluid through the holding valve into the tank 35.

The displacement in the main cylinder 26 by the downward movement of the main piston 25 produces a partial vacuum above piston 25, which is filled by a fluid under atmospheric pressure from the tank through the check valve 40.

As the ram 24 approaches the down position, the control rod 88 brings the cam 87 into operating contact with the switch G. (Fig. 3.) The ratio between the arms of the lever 81 corresponds to the difference between the effective upper area of the piston 25 and the lower area of the piston 31, which, for example, may be assumed to be 3:1. This would give the stroke of the control rod three times the length of the stroke of the ram 24. Hence, while the ram and slide make their pressure stroke, the control rod with its cams 86 and 87 makes a longer stroke, three times as long.

At the end of the down stroke, the cam 87 operates the limit switch G, which de-energizes the solenoid H of the holding valve, shifting the piston valve into a position blocking the exhaust connection and admitting the pilot pressure behind the holding valve 57. Switch G simultaneously de-energizes the solenoid A, shifting the piston valve into position, blocking the exhaust connection, and admitting pilot pressure into the pilot cylinder 54 of the pull-back valve 51, opening that valve. (See Fig. 2.)

**Diezel at Bottom of Stroke (Sheet 4)**

The eccentric 21 and the plunger 24 begin their up stroke, releasing the pressure on the fluid in the system, and the pilot pressure in the pull-back valve 51 comes on and the pump 62 opens the pull-back valve 51. As the piston 25 of the plunger moves upwardly, its displacement in the cylinder 26 above the piston forces liquid through the check valve 38 and the passage 37, the cylinder 36, and passage 35 through the pull-back valve into the tank 35.
Hence, the piston 31, and with it the slide and the upper die 12, will remain or dwell in the down position on the work.

The displacement in the cylinder 26 below the piston 25 will produce a partial vacuum in the cylinder, which will be filled by atmospheric pressure forcing hydraulic fluid from the tank through the prefill valve.

The up stroke of the plunger 24 produces a corresponding but more rapid up stroke of the control rod 65 and the upper cam 86, and eventually brings that cam into operating contact with the switch E.

Return stroke of the slide (sheet 5)

Operating the limit switch E energizes the solenoid A, shifting the piston valve into position, blocking the pilot pressure, and exhausting the pilot cylinder 63 into the tank, and the pull-back valve 51 is closed by its spring, arresting the flow of fluid from the passage 56 into the tank.

The continued upward movement of the piston 25 with the slide 24 and upper die will move the plunger 24 and the pull-back valve 51, and the piston 25 will be at the top of its stroke.

The pressure in the main cylinder 26 above the piston 25 is transmitted through the passage 47 and opens the prefill valve 43, allowing free flow from above the piston 31 into the tank.

(See Fig. 5.)

During the remainder of the upward movement of the eccentric, the displacement above the piston 25 is communicated from the passage 32 to the cylinder 26 below the piston 31 and moves that piston with the slide in a speed determined by the ratio between the upper area of the piston 25 and the lower area of the piston 31, heretofore assumed to be 3:1.

The upward movement continues until the eccentric reaches its top position, when the cam or other familiar device (not shown) operates another limit switch, releasing the air clutch as the parts reach the assumed position shown in Fig. 1.

The springs on the prefill and pull-back valves are actuated by the flow of hydraulic fluid, and hence the closing is very quick and positive as distinguished from the slow acting valves of prior presses.

COMPARISON WITH CONVENTIONAL MECHANICAL PRESS

(Figs. 6, 7, and 8)

In Fig. 6, the symmetrical curve 110 indicates the cycle of a conventional press ("C") having a 20-inch stroke eccentric with 10 cycles per minute or 1 in 6 seconds.

The unsymmetrical curve 111 indicates the cycle a press made according to this invention ("N") with a 10-inch stroke eccentric, a cycle in 3.2 seconds, or 15 per minute. And the sharp incline 112 indicates the quick approach followed by the maximum draw 113, the dwell 114, and the rapid up stroke 115. (With this same setting, any less draw can be made, in which case a quick approach would remain the same for the setting of the switch D but the remainder of the approach would be governed by the movement of the eccentric.)

This chart (Fig. 6) shows the curves and cycles with the presses set for maximum shut height and maximum draw.

Fig. 7 gives a comparison between the same conventional press and a press made according to this invention with a 10-inch stroke eccentric and set for a minimum shut height. The cycle of the "N" press is 4 seconds or 15 per minute as against 10 per minute of the conventional press.

Fig. 8 shows a comparison of the two presses having the same number of strokes per minute. The shaded areas 126 and 121 indicate the corresponding portions of the 10-inch maximum draw stroke and indicate the relatively greater drawing time and slower drawing speed provided by the "N" press of this invention.

Thus, these charts show how the new press of this invention makes it possible to increase the number of stroke cycles per minute, and hence the output, or to increase the drawing time and reduce the drawing speed with the same number of stroke cycles per minute, or increase the drawing speed some and to a lesser extent the number of stroke cycles per minute.

Alongside the charts in Figs. 6 and 7, the control rod and adjustable mounting for the limit switches D and E are illustrated, and a comparison between Figs. 6 and 7 indicates how the length of the stroke of the press made according to this invention may be adjusted to suit the varying requirements of the draw and different sets of dies.

SLIDE ADJUSTMENT, UP OR DOWN

The adjustment of the slide up or down to vary the height of the opening between the top of the bed and the face of the slide—the shut height—with this press is accomplished with means similar to that disclosed in my prior application Ser. No. 770,033, filed August 22, 1947.

In the diagram, Fig. 1, a solenoid operated inching valve F, shown at the lower right, is connected to the branch pipe 13 by a pipe 122 and to the connection 36 by a pipe 123, and there is a return pipe 124 to the tank 35 which serves both the inching valve F and the piston valve of the holding valve H. The inching valve is operated by the buttons 128 on the control board 127 (Fig. 1). Pressing one of those buttons will add fluid to the system and lower the slide while pressing the other will reduce the fluid in the system and correspondingly raise the slide.

In a press such as illustrated in the diagrams 1-5 with a 10-inch stroke eccentric, it will be satisfactory to set the limit valve 65 to 500 pounds, and thus maintain in the pilot system supplied by the pump 62 a constant pressure of that amount available by operating the several valves A, H, and F.

PRESSURE RELIEF VALVE

In order to limit the maximum pressure and therefore the maximum stress that can be placed upon the press, the system is provided with a pressure relief valve 130 which may be arranged to be operated by a solenoid C controlling communication between the system and the tank 35.

For convenience in indicating the pressure during any part of the operation, the system is provided with a pressure gauge 131.

I claim:

1. In a press, a slide, a mechanical drive including a reciprocable element to which a varying force is mechanically applied with the stabilizing assistance of a fly wheel and a hydraulic transmission between the slide and the drive including a main cylinder, a ram in the main cylinder, a piston connected with the slide, an auxiliary...
lary cylinder for the piston in hydraulic connection with the main cylinder, a tank for hydraulic fluid in communication with both cylinders, valve means for said communication, means to operate said valve means to place said auxiliary cylinder in communication with said tank to lower the slide by gravity and fill the auxiliary cylinder, means actuated by the slide to start the mechanical drive, and means actuated by the mechanical drive for returning the slide to its raised position during the upstroke of the reciprocable element.

2. In a press, a slide, a mechanical drive and a hydraulic transmission between the slide and the drive including a main cylinder, a ram in the main cylinder, a piston connected with the slide, an auxiliary cylinder for the piston in hydraulic connection with the main cylinder, a tank for hydraulic fluid in communication with both cylinders, valve means for said communication, means to operate said valve means to place said auxiliary cylinder in communication with said tank to lower the slide by gravity and fill the auxiliary cylinder, means actuated by the slide to start the mechanical drive, and means actuated by the mechanical drive to operate said valve means on the up stroke.

3. In a press, a slide, a mechanical drive and a hydraulic transmission between the slide and the drive including a main cylinder, a ram in the main cylinder, a piston connected with the slide, an auxiliary cylinder for the piston in hydraulic connection with the main cylinder, a tank for hydraulic fluid in communication with both cylinders, a spring seated pull-back valve and a spring seated prefill valve for said communication, control means for opening the pull-back valve to initiate the approach stroke of the slide, means actuated by the slide during the approach stroke to effect the closing of the pull-back valve and start the mechanical drive on its down stroke, and means actuated by the mechanical drive during its up stroke to open the pull-back valve to initiate the up stroke of the slide.

4. In a press, a slide, a mechanical drive and a hydraulic transmission between the slide and the drive including a main cylinder, a ram in the main cylinder, a piston connected with the slide, an auxiliary cylinder for the piston in hydraulic connection with the main cylinder, a tank for hydraulic fluid in communication with both cylinders, valve means for said communication, means to operate said valve means to place said auxiliary cylinder in communication with said tank to lower the slide by gravity and fill the auxiliary cylinder, and limit means actuated, one by the slide during its approach stroke to initiate the down stroke of the mechanical drive, and one actuated by the mechanical drive during its up stroke to initiate the up stroke of the slide.

5. In a press, a slide, a mechanical drive and a hydraulic transmission between the slide and the drive including a main cylinder, a ram in the main cylinder, a piston connected with the slide, an auxiliary cylinder for the piston in hydraulic connection with the main cylinder, a tank for hydraulic fluid in communication with both cylinders, valve means for said communication, means to operate said valve means to place said auxiliary cylinder in communication with said tank to lower the slide by gravity and fill the auxiliary cylinder, and limit means actuated, one by the slide during its approach stroke to initiate the down stroke of the mechanical drive, and one actuated by the mechanical drive during its up stroke to initiate the up stroke of the slide, said limit means being adjustable simultaneously to vary the shut height of the press.

6. In a press, a slide, a mechanical drive including a reciprocable element to which a varying force is mechanically applied with the stabilizing assistance of a fly wheel and a hydraulic transmission between the slide and the drive including a main cylinder, a ram in the main cylinder, a double acting piston connected with the slide, an auxiliary cylinder for the piston in hydraulic connection with the main cylinder, a tank for hydraulic fluid in communication with both cylinders, valve means for said communication, means to operate said valve means to place both sides of said piston in communication with said tank to lower the slide by gravity and fill the auxiliary cylinder, and a holding valve in the communication between the lower part of the auxiliary cylinder and the tank to cushion the descent of the slide.

7. In a press, a slide, a mechanical drive and a hydraulic transmission between the slide and the drive including a main cylinder, a ram in the main cylinder having a double acting piston, an auxiliary cylinder, a double acting piston in the auxiliary cylinder and connected with the slide, a fluid connection between the main cylinder below the piston and the auxiliary cylinder above the piston, a tank for hydraulic liquid, a fluid connection between the tank and the auxiliary cylinder below the piston, a spring seated prefill valve for the last mentioned connection, a fluid connection between the main cylinder above the piston and the auxiliary cylinder below the piston, a fluid connection between the tank and the auxiliary cylinder below the piston, a spring seated pull-back valve therein, means to open the pull-back valve to initiate the approach stroke of the slide, means actuated by the slide during its approach stroke to initiate the down stroke of the ram piston, and means actuated by the mechanical drive during the up stroke of the ram piston to initiate the up stroke of the slide.

8. In a press, a slide, a mechanical drive and a hydraulic transmission between the slide and the drive including a main cylinder, a ram in the main cylinder having a double acting piston, an auxiliary cylinder, a double acting piston in the auxiliary cylinder and connected with the slide, a fluid connection between the main cylinder below the piston and the auxiliary cylinder above the piston, a tank for hydraulic liquid, a fluid connection between the tank and the auxiliary cylinder above the piston, a spring seated prefill valve for the last mentioned connection, a fluid connection between the main cylinder above the piston and the auxiliary cylinder below the piston, a fluid connection between the tank and the auxiliary cylinder below the piston, a spring seated pull-back valve therein, means to open the pull-back valve to initiate the approach stroke of the slide, means actuated by the slide during its approach stroke to initiate the down stroke of the ram piston, and means actuated by the mechanical drive during the up stroke of the ram piston to initiate the up stroke of the slide.
inder for the piston in hydraulic connection with the main cylinder, a tank for hydraulic fluid in communication with both cylinders, means between the tanks and the auxiliary cylinder to permit the slide to descend independently of the ram and to automatically fill the auxiliary cylinder as the slide descends, and means actuated by the mechanical drive for returning the slide to its raised position during the upstroke of the reciprocable element.

10. In a press, a slide, a mechanical drive and a hydraulic transmission between the slide and the drive including a main cylinder, a ram in the main cylinder, a piston connected with the slide, an auxiliary cylinder for the piston in hydraulic connection with the main cylinder, a tank for hydraulic fluid in communication with both cylinders, means including a spring seated pull-back valve to permit the slide to make an approach stroke independent of the ram, means including a prefill valve to fill the auxiliary cylinder from the tank, the slide so moves, means actuated by the slide during its approach stroke to initiate the draw stroke of the ram, and means actuated by the mechanical drive during the up stroke of the ram to close the pull-back valve.

11. In a press, a slide, a mechanical drive and a hydraulic transmission between the slide and the drive including a main cylinder, a ram in the main cylinder, a piston connected with the slide, an auxiliary cylinder for the piston in hydraulic connection with the main cylinder, a tank for hydraulic fluid in communication with both cylinders, means including a spring seated pull-back valve to permit the slide to make an approach stroke independent of the ram, means including a prefill valve to fill the auxiliary cylinder from the tank as the slide so moves, means actuated by the slide during its approach stroke to effect the closing of said valves to initiate the draw stroke of the ram, and means actuated by the mechanical drive during the up stroke of the ram to open the pull-back valve.

12. In a press, a slide, a mechanical drive and a hydraulic transmission between the slide and the drive including a main cylinder, a ram in the main cylinder, a piston connected with the slide, an auxiliary cylinder for the piston in hydraulic connection with the main cylinder, a hydraulic tank in communication with the auxiliary cylinder, a valve means for said communication, means to operate said valve means to place said auxiliary tank to lower the slide by gravity and fill the auxiliary cylinder, means actuated by the slide to effect closing of said valve means and start the mechanical drive, and a holding valve associated with said connection to balance the slide.

13. In a press, a slide, a mechanical drive and a hydraulic transmission between the slide and the drive including a main cylinder, a ram in the main cylinder having a double acting piston, an auxiliary cylinder, a double acting piston in the auxiliary cylinder and connected with the slide, a fluid connection between the main cylinder below the piston and the auxiliary cylinder above the piston, a tank for hydraulic liquid, a fluid connection between the tank and the auxiliary cylinder above the piston, a spring seated prefill valve for the last mentioned connection, a fluid connection between the main cylinder above the piston and the auxiliary cylinder below the piston, a fluid connection between the tank and the auxiliary cylinder below the piston, a spring seated pull-back valve therein, means to open the pull-back valve to initiate the approach stroke of the slide, means actuated by the slide during its approach stroke to initiate the down stroke of the ram piston, and a holding valve to relieve the pressure below the piston in the auxiliary cylinder.

14. In a draw press, the combination of a slide, an intermittently operated mechanical drive for the slide including a device for applying variable pressure during the draw stroke, an extensible connection between the drive and the slide, means independent of said drive for extending said connection to move the slide from full open position through a substantial part of its approach stroke, means responsive to a predetermined extension of said connection for starting the mechanical drive, and means for returning the slide to said full open position.

15. In a draw press, the combination of a slide, an intermittently operated mechanical drive for the slide including a device for applying variable pressure during the draw stroke, an extensible connection between the drive and the slide, means independent of said drive for extending said connection to move the slide from full open position through a substantial part of its approach stroke, means for locking the connection in said extended position, means for applying the mechanical drive to the slide through said locked extended connection, and means for retracting the connection and returning the slide to full open position.

16. In a draw press, the combination of a slide, a mechanical drive for the slide including a device for applying variable pressure during the draw stroke, an extensible connection between the drive and the slide, means independent of said drive for extending said connection to move the slide from full open position through a substantial part of its approach stroke, means for locking the connection in said extended position, means for applying the mechanical drive to the slide through said locked extended connection, and means for retracting the connection and returning the slide to full open position, said last named means including a speed multiplication device.

17. In a draw press, the combination of a slide, a mechanical drive for the slide including a device for applying varying pressure during the draw stroke, an extensible connection between the drive and the slide including a fluid column, means for varying the amount of fluid in said column to thereby change the effective length of said extensible connection, valve means adapted to seal egress of fluid from said column to form thereby a solid fluid column connection between said drive and said slide, means for opening said valve means at the start of the press cycle to permit the slide to fall by gravity through a substantial part of its approach stroke, and means for closing said valve means and substantially simultaneously starting the mechanical drive in response to movement of the slide to the limit of its approach stroke.

18. In a draw press, the combination of a slide, a mechanical drive for the slide including a fly-wheel-stabilized device, an extensible connection between the drive and the slide including a fluid transmission device having a first set of piston and cylinder elements operatively connected to the drive and a second set of piston and cylinder elements operatively connected to the slide, a pair of fluid conduits connecting the hydraulic spaces above and below the piston of one of said
sets with the hydraulic spaces below and above, respectively, the piston of said second set, the effective piston area exposed to one of said hydraulic spaces associated with said first set of piston and cylinder elements being different than the piston area exposed to the communicating hydraulic space in the second set of piston and cylinder elements, whereby the strokes of said two sets of piston and cylinder elements are unequal in at least one direction of movement.

19. The combination as set forth in claim 18 in which a fluid reservoir is in communication through separate passageways with both of said conduits, and valve means in said passageways for varying the amount of fluid in said conduits and hydraulic spaces for extending and retracting said extensible connection.

20. In a press, a slide, a mechanical drive for the slide having harmonic motion, a hydraulic transmission between the slide and the drive including a ram, a hydraulic pull-back for the slide, a tank for hydraulic fluid in communication with the transmission and the pull-back, valve means for said communication, control means to operate the valve means to vent the pull-back to the tank to lower the slide by gravity and to open the connection between the tank and the hydraulic transmission, and means responsive to a predetermined downward movement of the slide to start the mechanical drive.

21. In a press, a slide, a mechanical drive for the slide having harmonic motion, a hydraulic transmission between the slide and the drive including a ram, a hydraulic pull-back for the slide, a tank for hydraulic fluid in communication with the transmission and the pull-back, a pull-back valve for the communication between the hydraulic pull-back and the tank, and a preset valve for the communication between the tank and the hydraulic transmission.

22. In a press, a slide, a mechanical drive for the slide having harmonic motion, a hydraulic transmission between the slide and the drive including a ram, a hydraulic pull-back for the slide, a tank for hydraulic fluid in communication with the transmission and the pull-back, valve means for said communication, and control means constructed and arranged to open communication between the tank and both the pull-back and the hydraulic transmission for the approach stroke, to close communication between the tank and the transmission during the drawing stroke, and to open communication between the tank and transmission and close the communication between the tank and the pull-back for the return stroke.

23. In a press, a slide, a reciprocating drive for the slide having harmonic motion, a hydraulic transmission between the drive and the slide including a cylinder and a piston within said cylinder, a hydraulic pull-back associated with the transmission, a hydraulic tank in communication with the transmission and the pull-back, and valve means constructed and arranged for intermittently opening and closing said communication to vent the pull-back to the tank for an approach stroke of said slide and simultaneously vent the transmission to the tank to charge the transmission for a subsequent draw stroke, and thereafter to close communication between the pull-back and the tank and vent the transmission for a return stroke.

24. In a press, the combination of a slide, an intermittently operated mechanical drive for the slide including a device for applying variable pressure during the draw stroke, an extensible connection between the drive and the slide, means independent of said drive for extending said connection to move the slide from full open position through a substantial part of its approach stroke, means responsive to a predetermined extension of said connection for starting the mechanical drive, a hydraulic transmission between the slide and the drive and including a cylinder and a piston therein, valve means to supply fluid to the transmission during the approach stroke, and force actuated valve means to vent said transmission during the return of said slide to said full open position.

ALOIS KARL NOWAK.

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