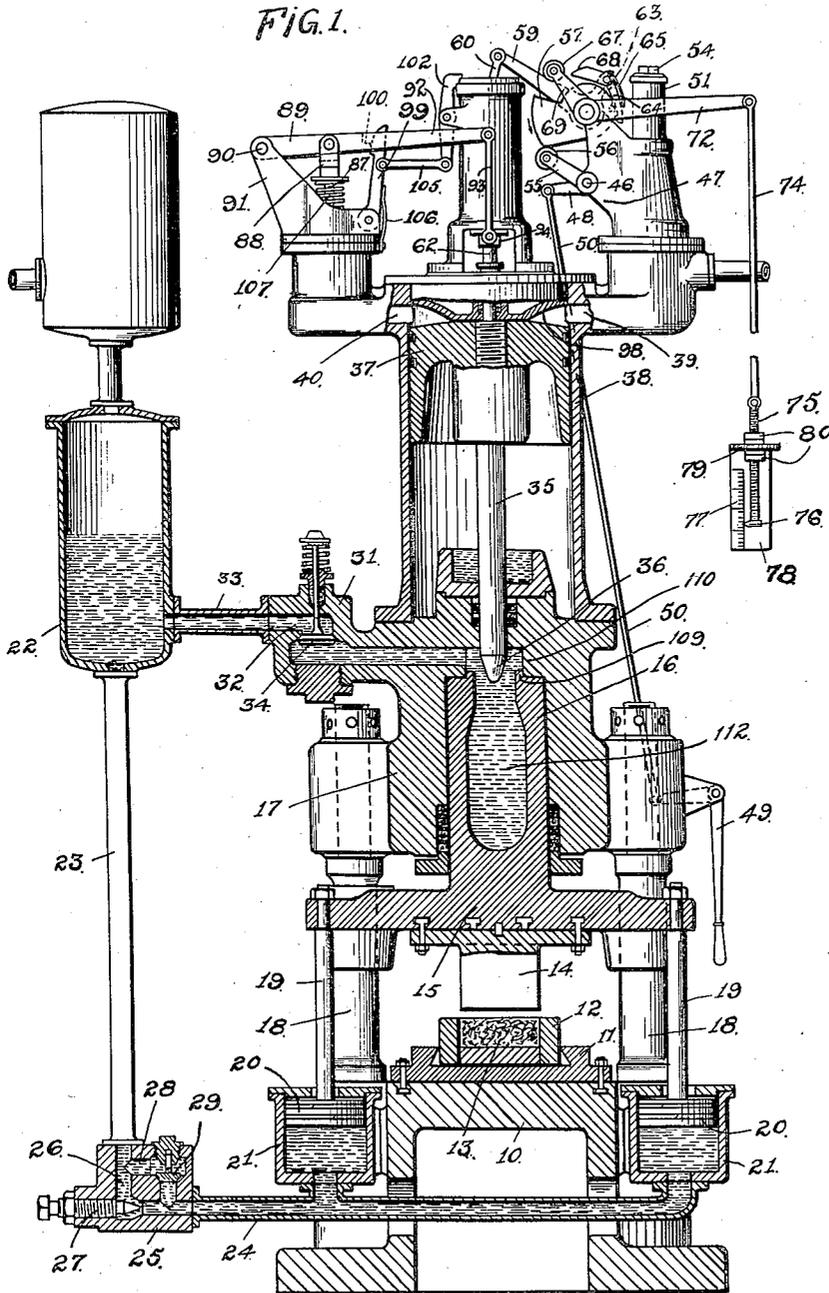


L. F. KRISTUFEK.
PRESS OR IMPACT APPARATUS.
APPLICATION FILED FEB. 9, 1916.

1,230,492.

Patented June 19, 1917.

4 SHEETS—SHEET 1.



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4 SHEETS—SHEET 2.

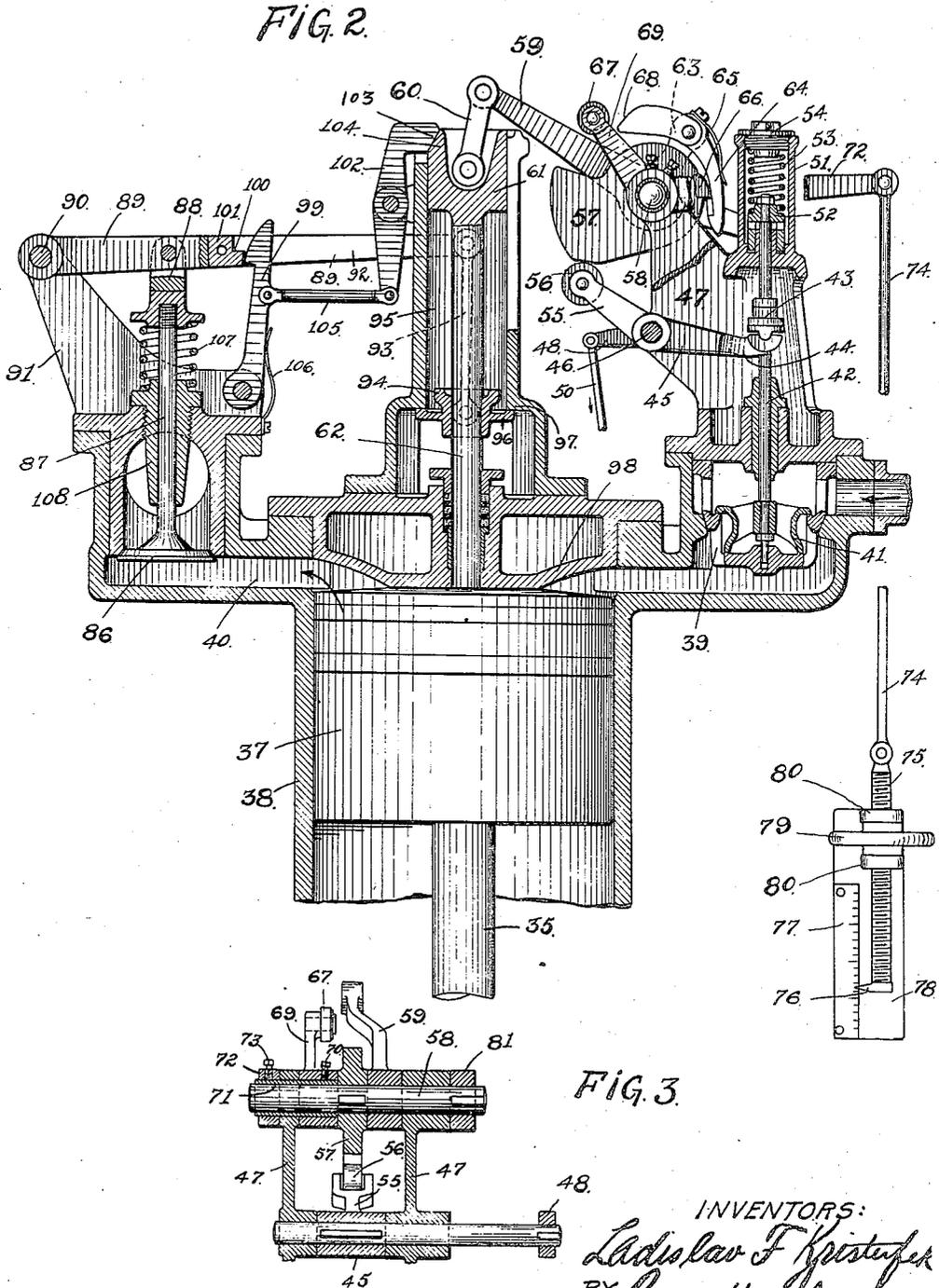


FIG. 3.

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4 SHEETS—SHEET 3.

FIG. 4.

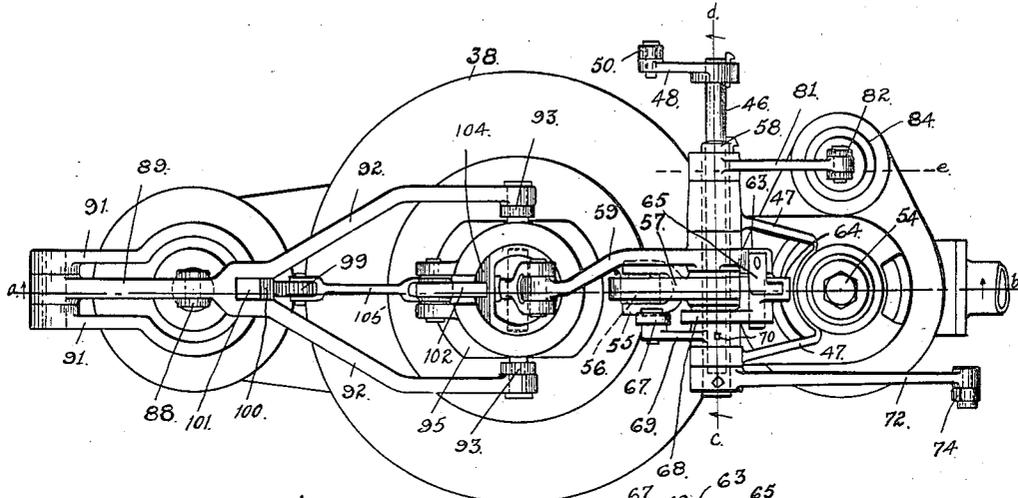
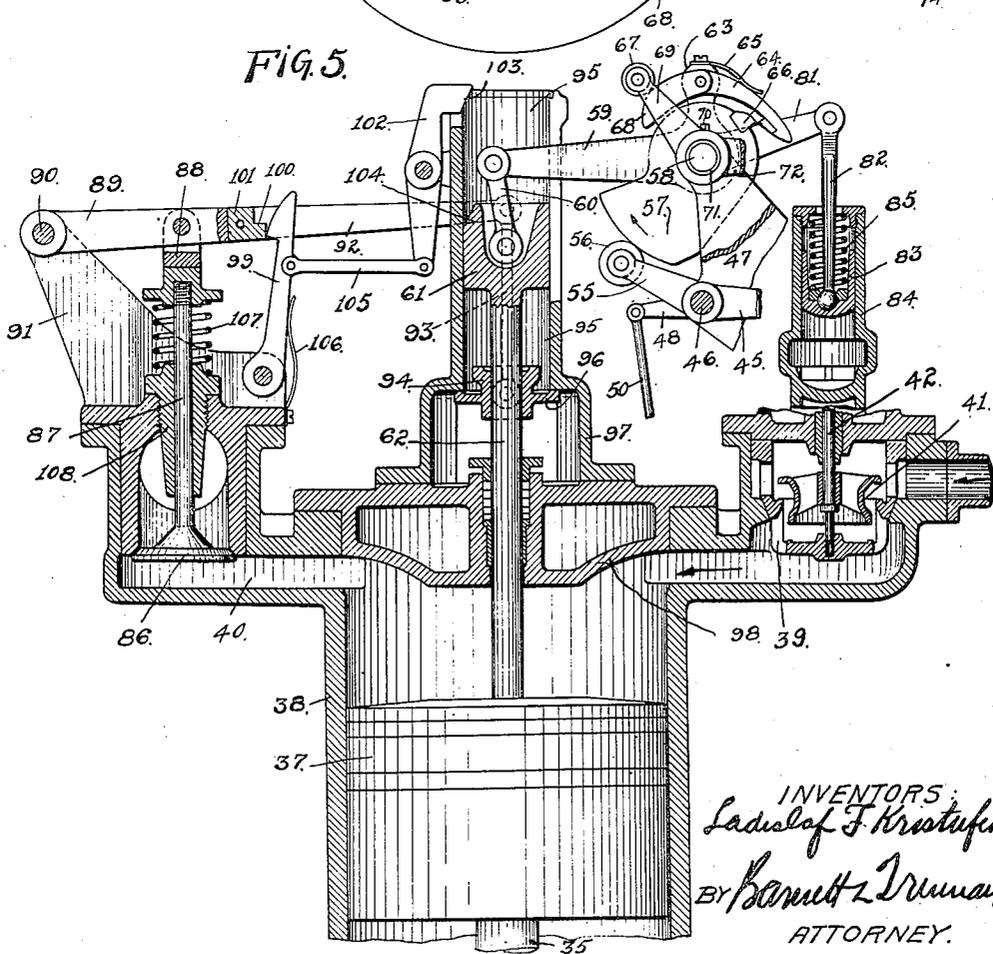


FIG. 5.

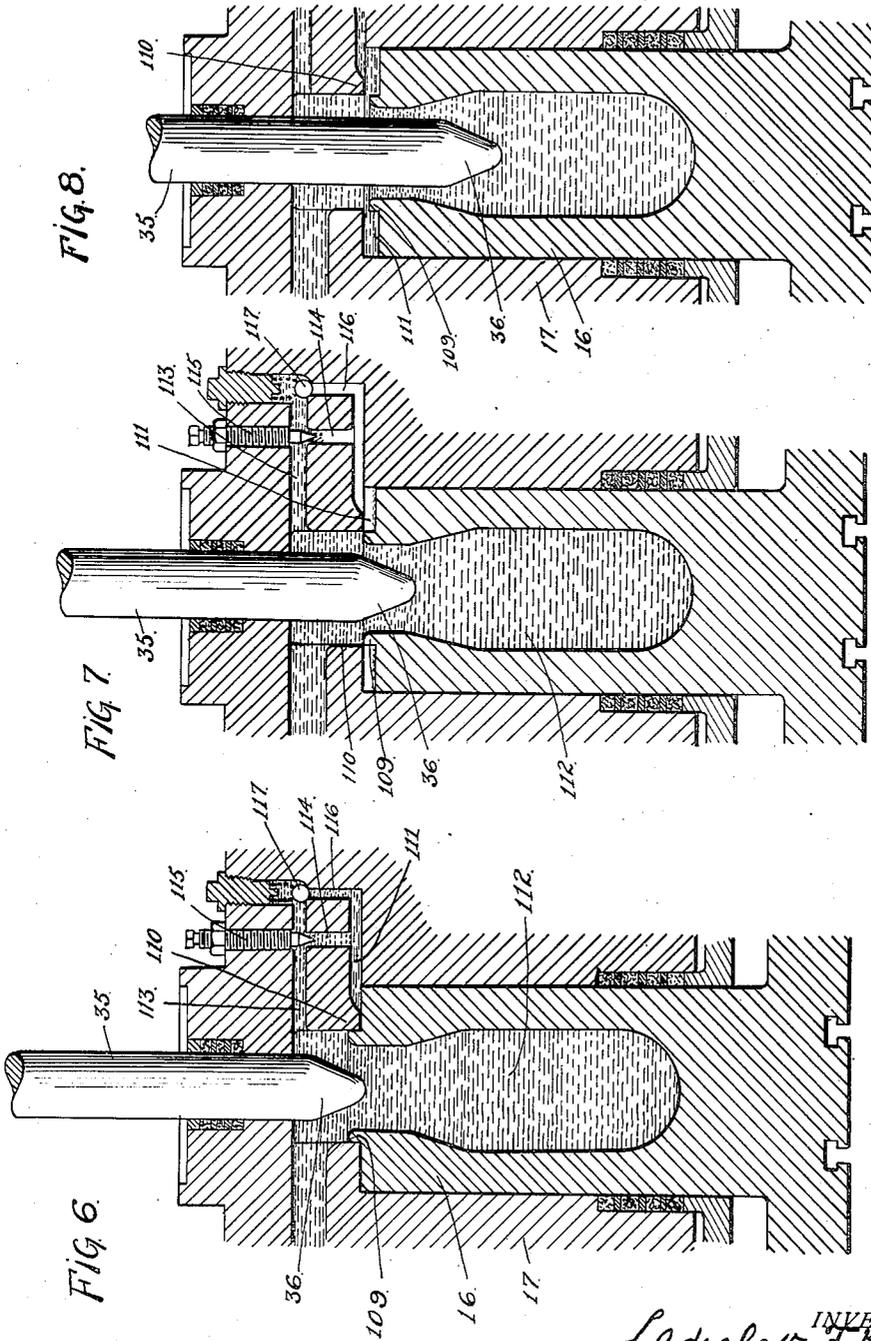


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PRESS OR IMPACT APPARATUS.

1,230,492.

Specification of Letters Patent. Patented June 19, 1917.

Application filed February 9, 1916. Serial No. 77,174.

To all whom it may concern:

Be it known that I, LADISLAV F. KRISTUFEK, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Presses or Impact Apparatus, of which the following is a specification.

My invention relates to apparatus for exerting pressures or producing striking impulses, and one of the principal objects of the invention is to provide certain improvements in machinery of this type whereby such machinery will be more effective in its operation and the cost of running the same reduced.

A more specific object is to provide a hydraulic press or other apparatus for exerting pressures or producing impacts of such character that steam or other expansible fluid may be used economically and effectively as a motive fluid. In this connection the invention consists in providing certain means whereby the last part of each power stroke of the apparatus is intensified and in utilizing the expansive force of the steam, cut off from the source of supply for driving the hydraulic plunger or power element of the apparatus during this part of its stroke. The invention makes it possible to use the expansive force of steam in power presses, such as briqueting presses for example, or other like apparatus, with the result that machinery of this sort may be operated more economically than has been heretofore possible.

Viewed more narrowly, my invention has for an object particularly to make certain improvements upon the impact apparatus described and claimed in the application for United States Letters Patent of Marius P. Jacomini filed February 9, 1916, Serial No. 77172. In the apparatus shown in this application the effective capacity of the hydraulic cylinder is suddenly increased during the power stroke of the machine so as to momentarily diminish the resistance of the pressure transmitting fluid with the result that the plunger acquires a very considerable momentum subsequently imparted to the work through the ram or impact element. The improvements of my invention consist, in the first place, in providing the apparatus with a steam cut-off valve which operates automatically to cut off the steam from the

power cylinder at approximately the time that the resistance in the pressure transmitting fluid is decreased; the further forward movement of the plunger being effected solely by the expansive force of the steam in the cylinder. In the second place, my invention provides a different, and as I consider it, a more convenient means for effecting the enlargement of the capacity of the hydraulic cylinder as above mentioned.

My invention provides further means for regulating the extent to which the resistance in the pressure transmitting connection is diminished by varying the extent to which the capacity of the hydraulic cylinder is enlarged and means for regulating the hydraulic pressure tending to return the ram to its initial position; these adjustments giving the apparatus the flexibility and capacity for operation under different conditions and to produce different results which increases the value of the machine very considerably.

My invention consists further in a novel method of utilizing steam or other expansible fluid as a motive fluid and subsequently non-compressible fluid as a pressure transmitting means in the operation of pressing or producing striking impulses upon an article or material.

The invention is illustrated, in a preferred embodiment, in the accompanying drawings wherein—

Figure 1 is a sectional elevation of a steam operated hydraulic briqueting press constructed in accordance with the principles of the invention.

Fig. 2 is an enlarged longitudinal sectional view of the steam cylinder and the mechanism for controlling the inlet and exhaust valves thereof, being taken on line *a-b* of Fig. 4.

Fig. 3 is a section taken on line *c-d* of Fig. 4.

Fig. 4 is a plan view of the upper portion of the apparatus.

Fig. 5 is a view similar to Fig. 2 but taken on line *a-e* of Fig. 4.

Figs. 6, 7 and 8 are sectional views of the ram, hydraulic cylinder and plunger showing the ram and plunger in different operating positions.

Like characters of reference designate like parts in the several figures of the drawings.

The base 10 of the machine supports an

anvil block 11 having thereon a lower form or die 12 containing the material 13 to be briqueted. The upper or movable die 14 is carried by the cross head 15 on the ram 16.

5 The latter reciprocates in a hydraulic cylinder 17 which is supported by pedestals 18 on the base of the machine. Attached to the cross head 15 are rods 19 having pistons 20 at their lower ends which operate in lifting cylinders 21. 22 is an accumulator tank connected by a pipe 23, 24 with the cylinders 21.

10 25 is a fitting interposed between pipe sections 23, 24 having a duct 26 in which is arranged an adjustable needle valve 27. This needle valve controls the flow of fluid from the accumulator tank to the lifting cylinders.

15 28 is a by-pass around the needle valve provided with a check valve 29 which permits the flow of fluid from the lifting cylinders to the accumulator tank but prevents movement of the fluid through the by-pass in the opposite direction. Compressed air or other pressure fluid is maintained in the accumulator tank at relatively constant pressure.

20 This pressure transmitting fluid consists preferably of oil.

The hydraulic cylinder 17 is formed with a web 31 having a duct 32 which communicates with the accumulator tank through pipe 33. 34 is a check valve arranged to permit the flow of fluid from the accumulator tank into the hydraulic cylinder while preventing movement of the fluid in the opposite direction.

35 The plunger 35 is preferably tapered at its extremity, as shown at 36, and is carried by a piston 37 in the steam cylinder 38. The latter has an inlet port 39 and an exhaust port 40.

40 41 is the inlet valve for the steam cylinder which is controlled by the following mechanism: Valve 41 is carried on a stem 42 which is provided with an abutment 43 for the forked end 44 of a lever 45 which is keyed to a shaft 46 mounted in bearings on the webs 47 forming a part of the framework of the machine. Shaft 46 is rocked by means of an operating arm 48 connected to the bell crank lever 49 on the lower part of the machine (Fig. 1) by a link 50. The upper end of the stem 42 enters the dash pot 51 and is provided with a seat member 52. A spring 53 is interposed between the seat member and the plug 54 which closes the end of the dash pot.

55 The lever 45 is formed with an upwardly projecting extension 55 carrying a roller 56 adapted to bear against a cam 57 keyed to a shaft 58 supported in bearings in the webs 47. Loosely mounted on the shaft 58 is a bell crank, one arm of which 59 is connected by a link 60 with an enlargement or head 61 formed on a rod 62 which is rigidly connected with the steam piston 37. The other arm 63 of the bell crank, 59, 63, carries a

pivoted dog 64 pressed by a leaf spring 65 and adapted to engage a lug 66 on the cam 57. 67 is a roller adapted to be engaged by the cam shaped nose 68 of dog 64, the roller being carried on an arm 69 rigidly secured by set screw 70 to a sleeve 71 loose on shaft 58. 72 is an arm fixed to sleeve 71 by a set screw 73 and connected by a link 74 with an adjusting screw 75 which carries a pointer 76 operating in connection with a scale 77 on a fixed bracket 78. The adjusting screw 75 is moved up and down by a nut 79 which works between webs 80 on the bracket 78. The shaft 58 has keyed thereto a lever 81 to which is connected by link 82 (Fig. 5) a piston 83 arranged within a dash pot cylinder 84. A spring 85 is interposed between the piston and the top of the cylinder.

The exhaust valve 86 is automatically controlled by the following mechanism: 85 The stem 87 of the valve bears against a forked member 88 pivoted to a lever 89 fulcrumed at 90 on stationary webs 91, 91, forming part of the framework of the machine. The forked ends 92 of the lever 89 are connected by links 93 with a sleeve 94 which is slidably arranged upon rod 62. The upper end of the sleeve projects into the cylindrical guide 95 in which the head 61 of the rod slides. The sleeve has a flange 96 which normally bears against the under side of the enlarged portion 97 of the guide 95. The structure 95, 97 is supported upon and secured to the head 98 of the steam cylinder 38. 99 is a dog pivoted between webs 91 and adapted to engage a shoulder 100 on a block 101 arranged in the fork of lever 89. 102 is a trip lever pivoted to the guide 95 and provided with a cam face 103 adapted to be engaged by the cam face 104 on the head 61. The trip lever is connected with dog 99 by link 105. 106 is a leaf spring which bears against the dog 99 and 107 a helical spring interposed between the forked member 88 which carries the exhaust valve stem and a gland 108 through which the stem of the exhaust valve passes.

The enlargement of the capacity of the hydraulic cylinder whereby the resistance of pressure transmitting fluid is momentarily decreased, is preferably brought about by the arrangement shown in detail in Figs. 6 to 8 inclusive, which are different position figures showing the same parts. The ram 16 is formed at its upper end with an upstanding flange 109 which overlaps the neck portion 110 of the cylinder. When the ram moves downwardly a space or chamber 111 is provided which is put into communication with the main space 112 within the ram. The pressure transmitting fluid rushes into the chamber 111 whereby its resistance to the movement of the plunger momentarily ceases. A duct 113, 114 leads from the main space 112 in the hydraulic cylinder to the

space or chamber 111. 115 is a needle valve which is adjustable and projects into the portion 114 of this duct. 116 is a by-pass and 117 a check valve arranged in the by-pass which permits the outflow from chamber 111 into the main space in the hydraulic cylinder while preventing flow through the by-pass in the opposite direction.

Operation.—The machine shown in the drawings provides for manual control, that is, each power stroke is brought about by manipulation of control lever 49. The movements of the parts of the apparatus during each cycle of operation of the machine are automatic. Obviously if desired the actuation of the machine might be automatic throughout. As shown, steam is admitted to the steam cylinder 38 by raising lever 49 which unseats valve 41 against the pressure of spring 53. The movement of the valve is effected by rocking the lever 45, 55 from the position shown in Fig. 2 to that shown in Fig. 5. The cam 57 is drawn down against the pressure of spring 85 by the downward movement of the steam piston 37 which carries with it rod 62, head 61 and bell crank 59, 63. Plunger 35 exerts pressure against the fluid within the hydraulic cylinder, forcing the ram downwardly by a pressure which overcomes the upward hydraulic pressure against pistons 20. The die 14 is brought against the work 13 exerting an initial pressure thereon.

As soon as the flange 109 on the upper end of the ram clears the neck 110 of the hydraulic cylinder 17, the fluid in the main space within the ram and cylinder rushes into the chamber 111 so that the pressure connection between the plunger and ram is momentarily destroyed. The plunger makes a jump downwardly, acquiring very considerable momentum. This, in turn, is imparted to the ram as the displacement effected by the movement of the plunger compensates for the increased capacity of the cylinder due to the opening of chamber 111. About the time that the plunger makes its forward jump the nose 68 of dog 64 comes into contact with the roller 67. The dog is rocked to trip the cam 57 (Fig. 5) and spring 53 closes the inlet valve 41, shutting off the supply to the steam cylinder. The expansive force of the steam within the cylinder completes the stroke of the plunger. The expansive force of the steam operating against the plunger which for the moment encounters practically no resistance, imparts a very rapid movement to the plunger which, when such movement is transmitted to the ram, causes the latter to deliver a sharp, quick impulse of very great force against the work. When the steam plunger reaches the bottom of its power stroke the head 61 strikes against the sleeve 94, pushing it downwardly far enough so that the dog 99

will engage the shoulder 100 on the lever 89. The exhaust valve 86 is opened by this movement of lever 89. It remains open until at the end of the back stroke the cam face 104 on head 61 engages the cam 103 on the trip lever 102 and draws the dog out of engagement with lever 89. Spring 107 then closes the exhaust valve.

Adjustments.—During the down stroke of the plunger a certain amount of oil will be forced past valve 115 into the chamber 111 partly filling the same before the chamber is opened up to the main space in the ram and cylinder, the amount depending upon the adjustment of the valve. By this adjustment, therefore, the decrease in the resistance of the pressure transmitting fluid to the movement of the plunger may be varied so as to vary the jump of the plunger and hence the force of the intensification of the power stroke of the apparatus.

By setting the pointer 76 at different places on scale 77 the position of roller 67 may be varied so as to change the time, relative to the other movements of the machine, at which the steam is shut off from the steam cylinder 38. By adjusting the needle valve 27 the action of the pressure fluid on the lifting pistons 20 may be regulated so that the return stroke of the ram will be properly timed with reference to the other operative movements of the apparatus.

It will be understood from the foregoing that the invention is not to be considered as limited to the concrete embodiment thereof shown and described. The same principles of operation may be applied to a considerable variety of power driven presses or impact apparatus of one sort or another. The mechanical devices and constructions by which the principles of my invention are adapted to any particular type of machinery are a matter of relatively small importance. I, therefore, do not wish to be understood as limiting the invention to the precise constructions, arrangements and devices shown and described except so far as certain of the claims herein are by their language so limited.

I claim:

1. In apparatus of the character described, the combination of a power element, an impact element, means providing a pressure transmitting fluid between the same, the resistance of which is momentarily diminished during the power stroke of the apparatus, and regulating means for varying the extent to which said resistance is diminished.

2. In apparatus of the character described, the combination of a power element, an impact element, confining means for a pressure transmitting fluid interposed between said elements, the capacity of which is increased during the power stroke of the apparatus so as to suddenly diminish the resistance of

said fluid, and regulating means for varying the extent to which said resistance is diminished.

3. In apparatus of the character described, the combination of a power element, an impact element, confining means for a pressure transmitting fluid interposed between said elements comprising a chamber which is put into communication with the main space within the confining means during the power stroke of the apparatus, and means for varying the effective size of said chamber at the time it is put into communication with the main space.

4. In apparatus of the character described, the combination of a power element, an impact element, confining means for a pressure transmitting fluid interposed between said elements comprising a chamber which is put into communication with the main space within the confining means during the down stroke of the apparatus, a duct leading from said main space into said chamber, and adjustable means for regulating the flow of fluid through said duct.

5. In apparatus of the character described, the combination of a power element, an impact element, confining means for a pressure transmitting fluid interposed between said elements comprising a chamber which is put into communication with the main space within the confining means during the down stroke of the apparatus, a duct leading from said main space into said chamber, and a needle valve which is adjustable to regulate the flow of fluid through said duct.

6. In apparatus of the character described, the combination of a power element, an impact element, confining means for a pressure transmitting fluid interposed between said elements comprising a chamber which is put into communication with the main space within the confining means during the down stroke of the apparatus, a duct leading from said main space into said chamber, adjustable means for regulating the flow of fluid through said duct, and a by-pass and check valve which permit the outflow from said chamber but prevent inflow thereto except as controlled by said adjustable means.

7. In apparatus of the character described, the combination of a hydraulic cylinder, a plunger and a ram in said cylinder, said cylinder and ram constructed so as to provide a chamber by the movement of said ram into which pressure fluid within the cylinder is suddenly admitted after the ram has traveled a certain distance in its power stroke.

8. In apparatus of the character described, the combination of a hydraulic cylinder, a plunger, a ram in said cylinder, said cylinder and ram constructed so as to provide a chamber into which pressure fluid within the cylinder is suddenly admitted after the

ram has traveled a certain distance in its power stroke, a duct leading from the interior of the cylinder into said chamber, and an adjustable valve for controlling the flow through said duct.

9. In apparatus of the character described, the combination of a hydraulic cylinder, a plunger, a ram in said cylinder, said cylinder and ram constructed so as to provide a chamber into which pressure fluid within the cylinder is suddenly admitted after the ram has traveled a certain distance in its power stroke, a duct leading from the interior of the cylinder into said chamber, an adjustable valve for controlling the flow through said duct, and a by-pass and check valve which permit the outflow of fluid from said chamber while preventing the inflow thereto except as controlled by said adjustable valve.

10. In apparatus of the character described, the combination of an impact element, a driven element and means for driving the same comprising a cylinder adapted to receive an expansible fluid, means constituting a pressure transmitting connection interposed between the driven element and the impact element, the resistance of which is momentarily diminished during the power stroke of the apparatus, and means for shutting off fluid from said cylinder at approximately the time the resistance of said connection is diminished.

11. In apparatus of the character described, the combination of an impact element, a driven element, and means for driving the same comprising a cylinder adapted to receive an expansible fluid, containing means for a pressure transmitting fluid interposed between said elements, the capacity of which is momentarily increased during the power stroke of the apparatus, and means for shutting off the expansive fluid from said cylinder at approximately the time that the capacity of the containing means is increased.

12. In apparatus of the character described, the combination of an impact element, a driven element, and means for driving the same comprising a cylinder adapted to receive an expansible fluid, containing means for a pressure transmitting fluid interposed between said elements, the capacity of which is momentarily increased during the power stroke of the apparatus, means for shutting off the expansive fluid from said cylinder at approximately the time that the capacity of the containing means is increased, and means for varying the extent to which the capacity of the containing means is increased.

13. In apparatus of the character described, the combination of an impact element, a driven element and means for driving the same comprising a cylinder adapted

to receive an expansible fluid, containing means for a pressure transmitting fluid interposed between said elements and comprising a chamber adapted to be put into communication with the main space within said containing means during the power stroke of the apparatus, and means for shutting off the expansive fluid from said cylinder approximately at the time that said chamber is put into communication with the main space within the containing means.

14. In apparatus of the character described, the combination of an impact element, a driven element and means for driving the same comprising a cylinder adapted to receive an expansible fluid, means constituting a pressure transmitting connection interposed between the driven element and the impact element, the resistance of which is momentarily diminished during the power stroke of the apparatus means for shutting off fluid from said cylinder at approximately the time the resistance of said connection is diminished, and means for varying the exact time at which the expansible fluid is shut off from the cylinder.

15. In apparatus of the character described, the combination of an impact element, a driven element and means for driving the same comprising a cylinder adapted to receive an expansible fluid containing means for a pressure transmitting fluid interposed between said elements and comprising a chamber adapted to be put into communication with the main space within said containing means, a duct leading from said main space to said chamber, an adjustable valve to control the flow through said duct, and means for shutting off the expansible fluid from said cylinder at approximately the time that said chamber is put into communication with said main space.

16. In apparatus of the character described, the combination of an impact element, a driven element and means for driving the same comprising a cylinder adapted to receive an expansible fluid, means constituting a pressure transmitting connection interposed between the driven element and the impact element, the resistance of which is momentarily diminished during the power stroke of the apparatus, and automatically operated means for shutting off fluid from said cylinder at approximately the time the resistance of said connection is diminished.

17. In apparatus of the character described, the combination of an impact element, a driven element and means for driving the same comprising a cylinder adapted to receive an expansible fluid, means constituting a pressure transmitting connection interposed between the driven element and the impact element, the resistance of which is momentarily diminished during the power stroke of the apparatus, automatically op-

erated means for shutting off fluid from said cylinder at approximately the time the resistance of said connection is diminished, and means for varying the exact time at which expansible fluid is shut off from said cylinder.

18. In apparatus of the character described, the combination with a steam cylinder provided with inlet and exhaust ports, a piston in said cylinder provided with a hydraulic plunger, a hydraulic cylinder in which said plunger operates, a ram in said hydraulic cylinder, the aforesaid parts comprising means whereby the effective capacity of the hydraulic cylinder is suddenly increased during the power stroke of the apparatus, inlet and outlet valves for the steam cylinder, and automatically operating means for closing said inlet valve and opening and closing said exhaust valve.

19. In apparatus of the character described, the combination with a steam cylinder provided with inlet and exhaust ports, a piston in said cylinder provided with a hydraulic plunger, a hydraulic cylinder in which said plunger operates, a ram in said hydraulic cylinder, the aforesaid parts comprising means whereby the effective capacity of the hydraulic cylinder is suddenly increased during the power stroke of the apparatus, inlet and outlet valves for the steam cylinder, automatically operating means for closing said inlet valve and opening and closing said exhaust valve, and means for adjusting the time at which said inlet valve is closed.

20. In apparatus of the character described, the combination with a steam cylinder provided with inlet and exhaust ports, a piston in said cylinder provided with a hydraulic plunger, a hydraulic cylinder in which said plunger operates, a ram in said hydraulic cylinder, the aforesaid parts comprising means whereby the effective capacity of the hydraulic cylinder is suddenly increased during the power stroke of the apparatus, inlet and outlet valves for the steam cylinder, automatically operating means for closing said inlet valve and opening and closing said exhaust valve, and means for varying the extent to which the effective capacity of said hydraulic cylinder is increased.

21. In apparatus of the character described, the combination with a steam cylinder provided with inlet and exhaust ports, a piston in said cylinder provided with a hydraulic plunger, a hydraulic cylinder in which said plunger operates, a ram in said hydraulic cylinder, the aforesaid parts comprising means whereby the effective capacity of the hydraulic cylinder is suddenly increased during the power stroke of the apparatus, inlet and outlet valves for the steam cylinder, automatically operating means for

closing said inlet valve and opening and closing said exhaust valve, hydraulically operated means for returning said ram to its initial position, and means for adjusting the operation thereof so as to time the same in conformity with the other operative movements of the apparatus.

22. In apparatus of the character described, the combination with a source of supply of expansible motive fluid, of a cylinder having an inlet port arranged to communicate with said source of supply and an exhaust port, valves to control said ports respectively, a piston in said cylinder, an impact element, means providing a pressure transmitting connection between said piston and impact element, the resistance of which is momentarily decreased during the power stroke of the apparatus, means for opening said inlet valve, and mechanism operated by the movement of said piston for closing said inlet valve and opening the exhaust valve.

23. In apparatus of the character described, the combination of a ram, a plunger, a hydraulic cylinder, a chamber which is put into communication with the hydraulic cylinder during the power stroke of the apparatus, a motive fluid cylinder adapted to receive an expansible fluid and provided with inlet and exhaust ports, valves to control said ports, a piston in said motive fluid cylinder connected with said plunger, means for opening said inlet valve, and mechanism automatically operated for closing the inlet valve and opening and closing said exhaust valve.

24. In hydraulically operated apparatus, the combination with a hydraulic cylinder, a ram, a plunger and a steam cylinder, a piston for operating said plunger, said cylinder having inlet and exhaust ports and valves to control the same, of mechanism for automatically closing said inlet valve comprising a bell crank connected with said piston so as to be rocked thereby, a dog carried by said bell crank, a spring against the force of which the valve is opened, a cam engaged by said dog which serves to hold the valve open, and a trip device for tripping said dog to release the cam.

25. In hydraulically operated apparatus, the combination with a hydraulic cylinder, a ram, a plunger and a steam cylinder, a piston for operating said plunger, said cylinder having inlet and exhaust ports and valves to control the same, of mechanism for automatically closing said inlet valve comprising a bell crank connected with said piston so as to be rocked thereby, a dog carried by said bell crank, a spring against the force of which the valve is opened, a cam engaged by said dog which serves to hold the valve open, and a trip device for tripping said dog to release the cam which is

adjustable to vary the point at which the dog is tripped.

26. In hydraulically operated apparatus, the combination with a hydraulic cylinder, a ram, a plunger and a steam cylinder, a piston for operating the plunger, said cylinder having inlet and exhaust ports and valves to control the same, of a rocking member for opening said inlet valve, a spring against the force of which the valve is opened, a cam which holds said valve open, a bell crank connected with said piston provided with a dog adapted to engage said cam, a trip for the dog, means for adjusting the position of the same, and a spring adapted to move the cam to free said valve when the dog is tripped and disengaged from the cam.

27. In hydraulically operated apparatus, the combination with a hydraulic cylinder, a ram, a plunger and a steam cylinder, a piston for operating the plunger, said cylinder having inlet and exhaust ports, and valves to control the same, of a rocking device for opening and closing the exhaust valve comprising a rod carried by said piston, a sleeve on said rod, a lever on which said exhaust valve is supported, links connecting said lever with the sleeve, a dog which engages said lever to hold said exhaust valve open, a head on said rod adapted to engage said sleeve so as to open the exhaust valve and to engage said rocking device to disengage the dog from said lever, and a spring to seat the exhaust valve.

28. The method of utilizing an expansible motive fluid for the operation of impact apparatus which consists in momentarily reducing the connection between the power driven element and the impact element and shutting off the flow of the expansive motive fluid to said driven element, and confining a volume of said motive fluid so that it acts expansively against said driven element at the time the resistance of said connection is reduced.

29. The method of utilizing an expansible motive fluid for the operation of hydraulic impact apparatus which consists in momentarily reducing the resistance of the pressure transmitting fluid against the power driven and impact elements by increasing the capacity of the means confining said pressure transmitting fluid and shutting off the flow of expansible motive fluid to the driven element and confining a volume of said fluid so that it will act expansively against said driven element at the time the resistance of the pressure transmitting fluid is reduced.

30. The method of utilizing an expansible motive fluid for the operation of hydraulic impact apparatus which consists in momentarily reducing the connection between the driven element and the impact element by

putting into communication with the hydraulic cylinder a space into which a portion of the pressure transmitting fluid may enter, varying the effect of such reduction of resistance by allowing a regulatable flow of fluid from the cylinder to said space before the space is put into direct communication with the interior of the cylinder, and shutting off the flow of the expansive motive fluid to said driven element, and confining a volume of said motive fluid so that it acts expansively against said driven element at the time the resistance of the pressure transmitting fluid is reduced.

31. The method of intensifying the power stroke of a hydraulic impact apparatus which consists in putting in direct communication with the hydraulic cylinder, a space into which the pressure transmitting fluid may enter suddenly so that the resistance of the pressure transmitting fluid is momentarily decreased and varying the extent of the decrease of said resistance by allowing a certain amount of the pressure transmitting fluid to flow regulatably into said space before the space is put in direct communication with the cylinder.

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