

May 24, 1932.

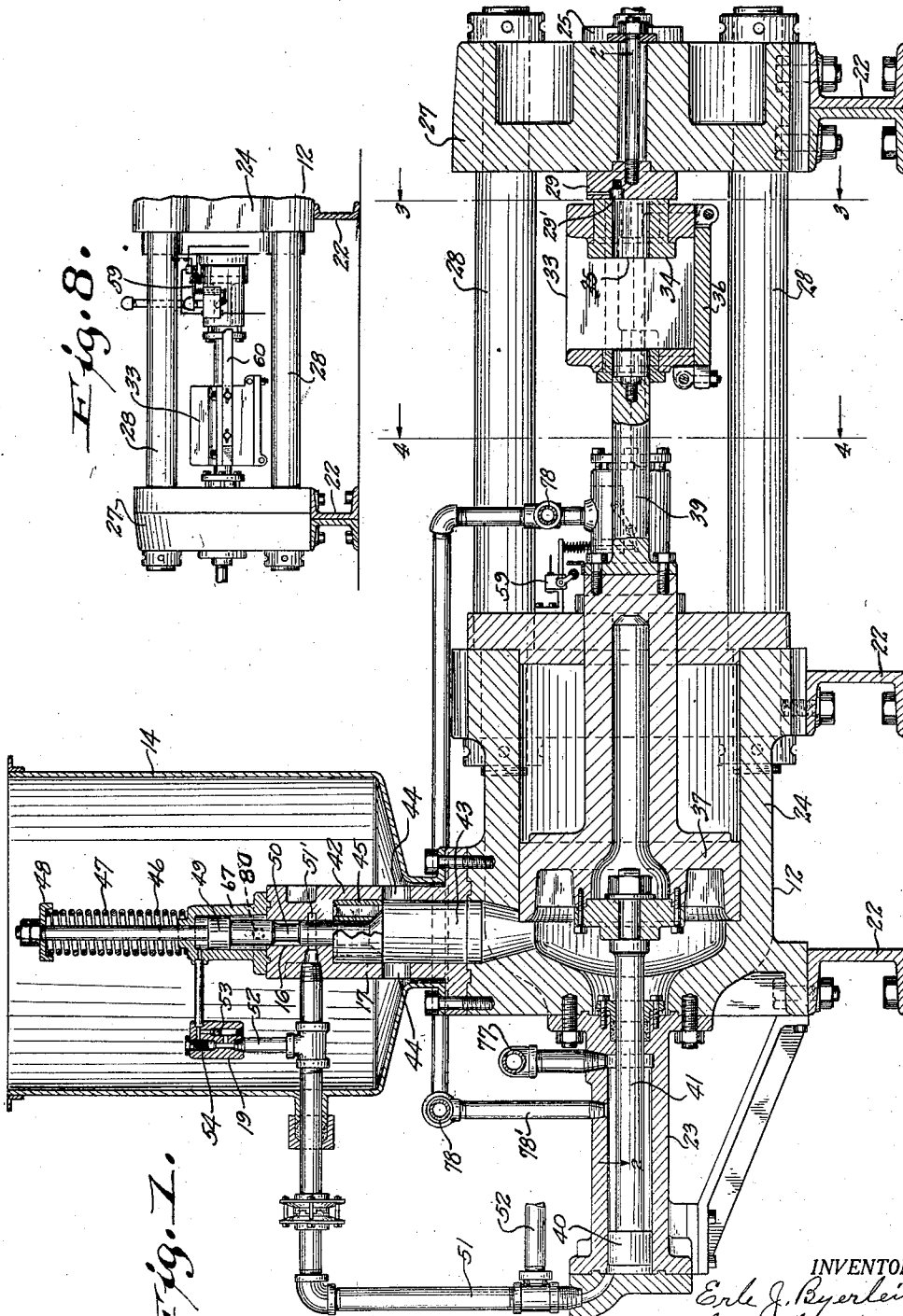
E. J. BYERLEIN ET AL

1,860,075

BRIQUETTING MACHINE

Filed March 1, 1930

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

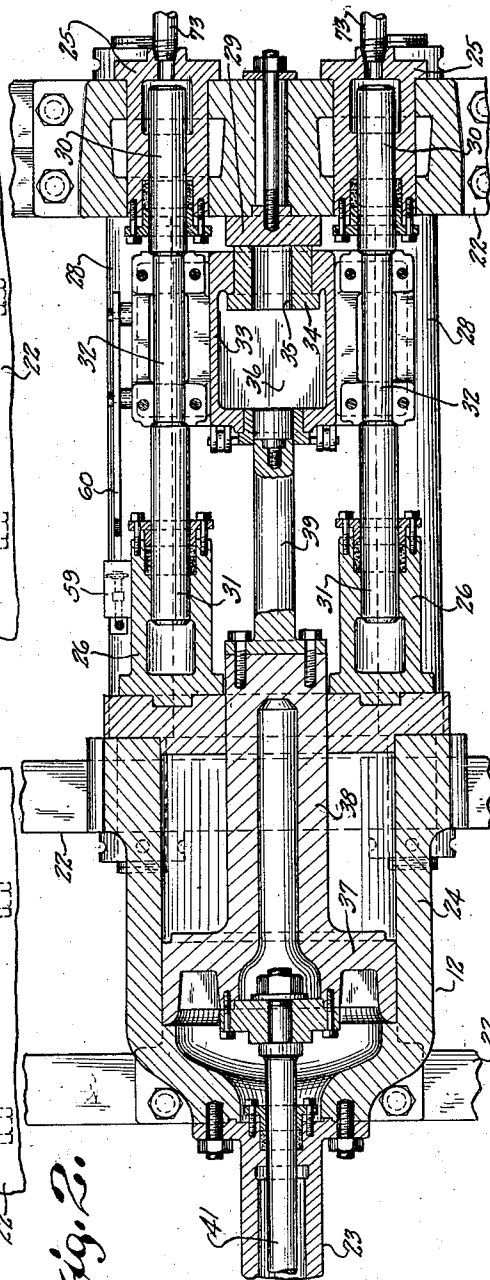
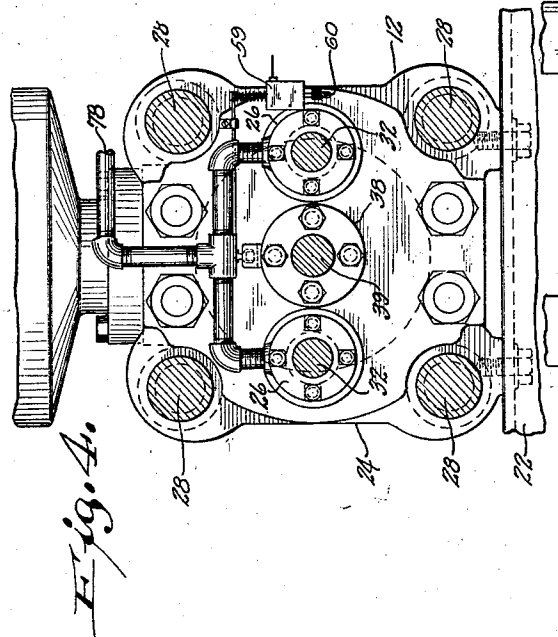
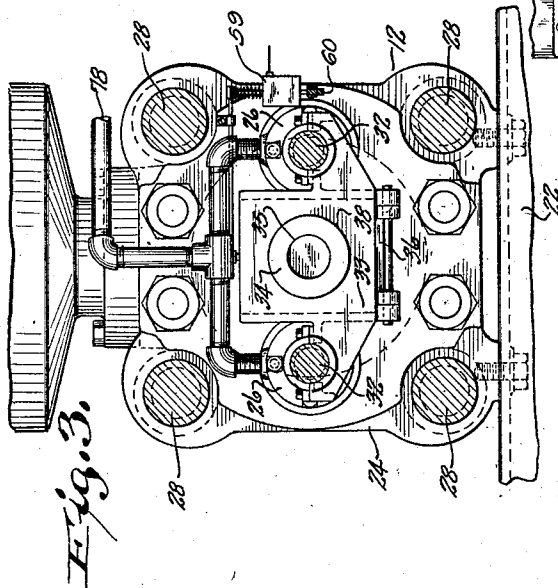


Fig. 2.

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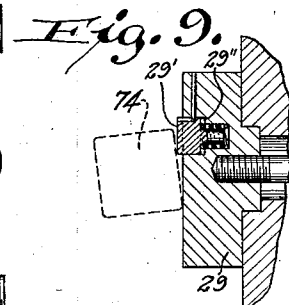
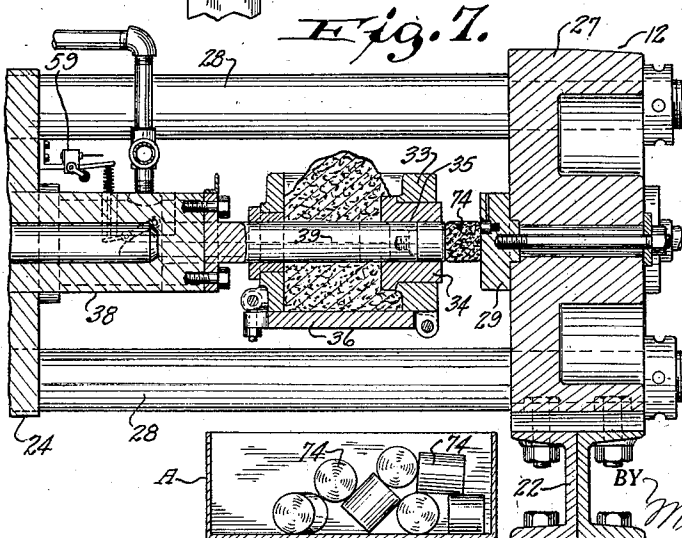
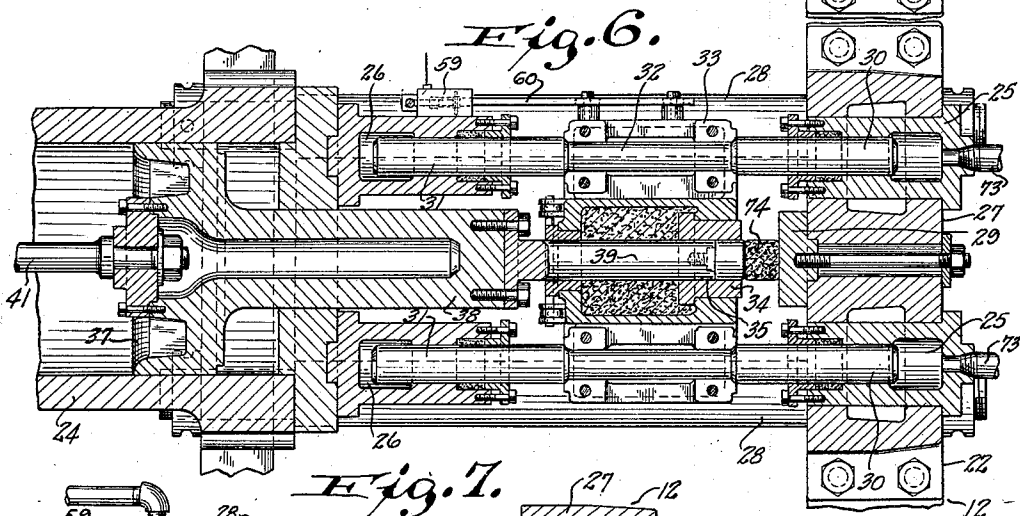
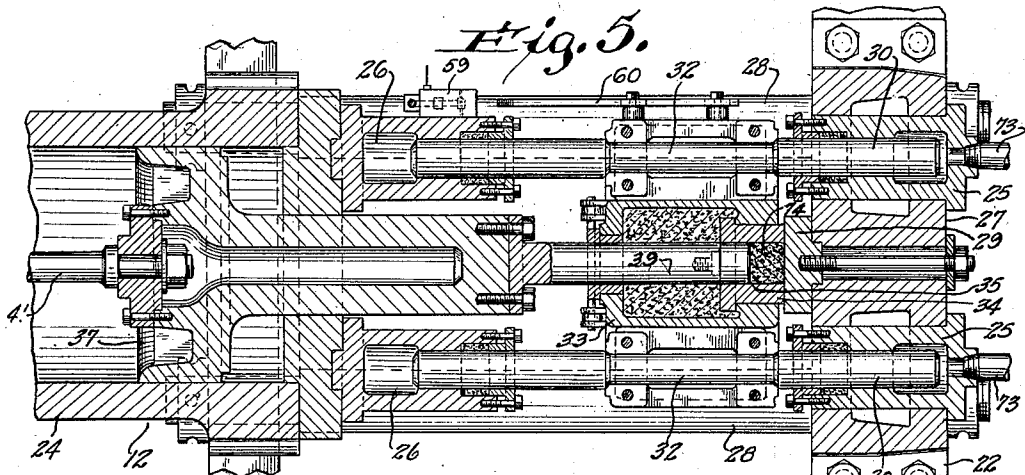
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BRIQUETTING MACHINE

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4 Sheets-Sheet 4

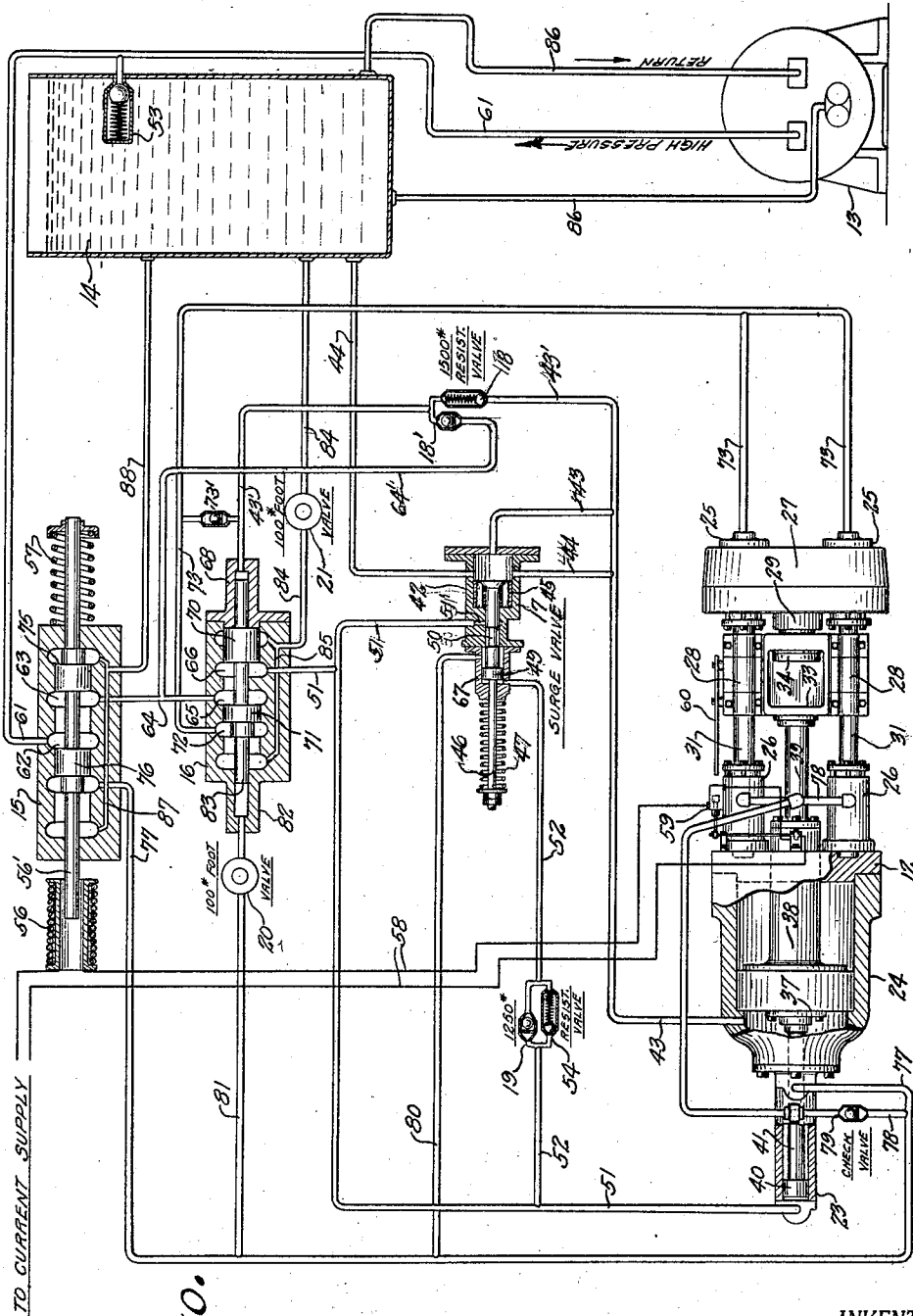


Fig. 10.

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UNITED STATES PATENT OFFICE

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BRIQUETTING MACHINE

Application filed March 1, 1930. Serial No. 432,395.

This invention relates to improvements in briquetting machines, more particularly, although not solely, adapted for compressing metal borings and cuttings into briquettes.

It is one of the objects of the present invention to provide a briquetting machine which is adapted to exert considerable pressure upon batches of loose material to form briquettes therefrom of such solidity or density as to provide briquettes which will hold their shape, and in the case of metal, permit the easy handling and melting thereof.

A further object of the invention is to provide a briquetting machine which will apply a comparatively light pressure with considerable movement to initially separate a batch of material from the supply mass and then automatically increase the pressure on the briquette under formation to the predetermined degree to complete the forming operation.

A further object of the invention is to provide a briquetting machine in which the briquette after formation is held in position while a portion of the forming means is stripped from the briquette preparatory to discharging the completed briquette from the machine.

A further object of the invention is to provide a briquetting machine in which a compound piston and cylinder construction is used having novel means controlling the rapid feed of the fluid medium to the large cylinder while the smaller piston is under pressure and initially compressing the material preparatory to the final augmented pressure used in completing the briquette.

A further object of the invention is to provide a briquetting machine which will always compress the material forming the briquette to a predetermined density regardless of the amount of material being formed into a briquette.

A further object of the invention is to provide a briquetting machine having electrical

means for automatically controlling the continuous operation of the parts.

A further object of the invention is to provide a briquetting machine which is of simple construction, is strong and durable and is well adapted for the purpose described.

With the above and other objects in view, the invention consists of the improved briquetting machine and its parts and combinations as set forth in the claims, and all equivalents thereof.

In the accompanying drawings in which the same reference characters indicate the same parts in all of the views:

Fig. 1 is a central longitudinal sectional view of the improved briquetting machine;

Fig. 2 is a central horizontal sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view taken on line 3—3 of Fig. 1;

Fig. 4 is a similar view taken on line 4—4 of Fig. 1;

Fig. 5 is a horizontal sectional detail view showing the piston plunger in its forward batch compressing position;

Fig. 6 is a similar view showing the material holder and die in briquette stripping position;

Fig. 7 is a vertical sectional detail view showing the parts in the same position as in Fig. 6;

Fig. 8 is a detail side view of a portion of the machine showing one of the electric controlling devices;

Fig. 9 is a sectional detail view of the wear plate; and

Fig. 10 is a diagrammatic view of the complete briquetting machine and its controls, a portion of the machine proper being shown in section.

Referring to the drawings and more particularly to the diagrammatic view shown in Fig. 9, the reference numeral 12 indicates the briquetting machine proper, 13 the power pump, 14 the pressure fluid storage tank, 15

an electrically operated solenoid controlling valve, 16 a four-way controlling valve, 17 a three-way controlling valve, 18 and 19 resistance valves, and 20 and 21 automatic pressure foot valves. The parts thus briefly mentioned are all connected together and form part of the complete structure and later will be more specifically described.

Now referring to the briquetting machine proper the numeral 22 indicates channeled frame members upon which are mounted compressor cylinders 23 and 24 and stripper cylinders 25 and stripper return cylinders 26. The secondary compressor cylinder 24 which is of comparatively large size is spaced from the fixed frame member 27, against which the briquettes are compressed, by brace bars 28. Said brace bars take the compressor strain and are therefore equi-distantly spaced around the compressor cylinder 24. A removable wear plate 29 mounted on the fixed frame member 27 takes the direct wear of the compression and can be easily replaced when worn. The stripper cylinders 25 are carried by the fixed frame members 27 and said cylinders have pistons 30 which are connected to and form part of the pistons 31. Said pistons 31 extend into the aligned stripper return cylinders 26 mounted on the forward end of the compressor cylinders 24. Medial portions 32 of the pistons 30—31 are reduced in diameter to have a hopper 33 clamped thereto. A die member 34 having a circular bore 35 extending therethrough in axial alinement with the wear plate 29 is mounted in the outer end portion of the hopper 33. A drop door 36 is hinged to the lower side portion of the hopper 33 to permit cleaning said hopper.

The large secondary compressor cylinder 24 is provided with a piston 37 formed with an integral piston rod 38 which extends through the forward end of the cylinder. A cylindrical plunger or die ram 39 bolted to the forward end of the piston rod 38 extends reciprocally into the hopper 33 in axial alinement with the bore 35 of the die member 34 which it snugly fits.

The primary cylinder 23 is of comparatively small diameter and its piston 40 is provided with a piston rod 41 which reciprocally extends through the rear end of the secondary cylinder 24 and is bolted rigidly to the secondary piston 37 and always reciprocates therewith. As thus arranged the primary piston initially moved the plunger 39 the greater portion of its movement and power is then applied to the secondary piston to complete the stroke with sufficient pressure to complete the compression of the briquettes.

To permit the comparatively quick movement of the primary piston, it is necessary to provide means for quickly feeding the power medium, such as oil, to the secondary cylinder, and to accomplish this result the oil storage tank 14 is positioned above and is

mounted directly on the secondary cylinder 24. A valve casing 42 mounted on the said secondary cylinder 24 extends upwardly into the tank 14 and is formed with a large bore 43 opening into the secondary cylinder 24 to the rear of its piston 37. Transverse openings 44 open communication between the storage tank 14 and the bore 43 so that the oil can freely and quickly flow from the tank to the secondary cylinder while the oil under pressure is forcing the primary piston 40 forwardly to initially compress the material.

A tubular valve piston 45 slidably positioned within the bore 43 is provided with an upwardly extending stem 46 which projects through the upper portion of the valve casing 42 and is encircled by a coiled spring 47. The spring is interposed between the upper portion of the casing and a cap 48 mounted on the upper end of the valve stem 46 to yieldingly hold the valve in its upper position. The said valve when in its lower position closes the port openings 44 leading to the secondary cylinder 24. The valve stem 46 is formed with a small drive piston 49 and a valve recess 50 for controlling the flow of the oil under pressure to the secondary cylinder.

A pipe 51 connected to the rear end of the primary cylinder 23 extends upwardly therefrom and into the storage tank 14 and is also connected to the valve casing port 51 at a point a short distance above the bore 43 and below the valve recess 50 when the valve is in its upper position as shown in Fig. 1. A branch pipe 52 provided with a relief valve 53 is connected to the valve casing 42 above the small valve piston 49 to move said valve piston downwardly when the pressure in the branch pipe increases to a predetermined extent to overcome the tension of the valve spring 54. When the valve 45 is moved downwardly the port openings 44 will be closed and the recess valve portion 50 will open communication between the duct 51' and the bore 43 and permit the oil to flow into said bore and through the bore 55 of the valve 45 and then into the secondary cylinder to move the secondary piston to complete the crushing stroke of the plunger 39.

In case the plunger would be checked in its movement, the pump would build up and increase the pressure on the oil and the increased pressure would open the relief valve 53 and relieve the pressure and prevent damage to parts. The relief valve may be located at any desirable point in the line to discharge into the tank.

The oil under pressure is controlled by the piston valves within valve casings 15, 16 and 17 before mentioned, which may be of any ordinary construction and operated in any manner desired. In the form shown the master valve 15 is moved by an electric solenoid 56 in one direction against the tension of a coiled spring 57. Current to the solenoid is sup-

plied from a source of electrical supply and the wires 58 lead to a switch 59 mounted on one of the return stripper cylinders. An arm 60 mounted on and moving with the hopper member operates the switch to complete the circuit when the hopper moves rearwardly to strip the briquette from the die, and breaks the circuit to the solenoid when the hopper moves forwardly to briquette forming position.

When the solenoid is de-energized as shown the oil under pressure from the pump 13 will be forced through the pipe 61 to the ports 62 and 63 and thence through the pipe 64 to the ports 65 and 66 of the valve 16. From the port 66 the oil will flow through the pipe 51 to the primary cylinder 23 and force the piston thereof forwardly to initially compress the material. While the primary piston is being moved forwardly the oil from the tank is free to flow from the tank 14 through the ducts 44 and 43 and the valve 45 and into the secondary cylinder 24 to permit the rapid movement of the piston 37 thereof. The resistance of the material being compressed will cause the pump to build up increasing pressure on the oil with the result that at a predetermined pressure, the spring pressed valve 54 of the valve casing 19 will open and permit the oil to flow through the branch pipe 52 to the cylinder 67 of the slide valve 17 and move the piston 49 thereof to the right or downwardly. This movement will slide the valves 45 and 50 to close the flow of oil through the ports 44 and open the flow through the ducts 51' and 43 to the secondary cylinder 24. The pressure of the pump will now be also directed against the secondary piston, and due to its larger diameter will cause the plunger to exert approximately 675,000 pounds pressure against the partly compressed material to further compress it into a solid briquette which in the case of metal cuttings will form an integral mass.

The briquettes will vary in length due to the fact that the stroke of the plunger is controlled by pressure, and further that the amount of material forced from the hopper into the die may vary, but in all cases the material will be subjected to substantially the same pressure.

When the briquette has been compressed to the predetermined extent the resistance of the material to further movement of the plunger will cause the pump to build up the pressure on the oil sufficient to open the resistance valve 18 and permit the oil to flow through the branch pipe 43' to the small cylinder 68 of the valve casing 16 and move the valve piston 69 thereof to the left. This movement will cause the piston valve 70 to close the port 66 and the duct 51 and the piston valve 71 to open communication between the ports 65 and 72. A branch duct 64' hav-

ing a check valve 18' connects the duct 64 to the duct 43' above the resistance valve 18 to permit the flow through the duct 64' when the pressure in the duct 43' exceeds the pressure in the duct 64'. With the valves in this position the pressure to the primary and secondary cylinders will be cut off and said parts will remain stationary. This will permit the fluid under pressure to flow from the pump through the solenoid valve 15, duct 64, valve 16 and ports 65 and 72 to ducts 73 extending and connected to the stripper cylinders 25. A check valved duct 73' extends from the duct 43' to the duct 73 to equalize the pressure on the outer sides of the valves 70 and 71 when said valves are at rest. The pressure exerted upon the stripper pistons 30 will force said pistons rearwardly and as the hopper 33 and die 34 are carried by portions of the pistons, the die 34 will be stripped from the briquette 74 just formed. It is to be understood that while the stripping operation is taking place the plunger, as before mentioned, remains in its forward position and holds the briquette against the wear plate 29. The rearward movement of the hopper 33 through the intermediary of the switch arm 60 and switch 59 completes the circuit to the solenoid 56 and energizes the coil thereof to draw the solenoid core 56' to the left against the tension of the retrieving spring 57. The piston valves 75 and 76 connected to said core 56' will be moved to the left and disconnect the pressure fluid from the duct 64 and connect it to the duct 77 leading to the front portion of the primary cylinder 24 to move the piston rearwardly to the left. This movement will force the plunger 39 rearwardly to release the briquette 74 which will drop into the receptacle A positioned below the machine. A yielding plunger 29' mounted in the wear plate 29 and normally projecting outwardly a slight distance serves to prevent the briquette from sticking to the wear plate. When the plunger is pressed inwardly during the formation of a briquette, the inner portions of the plunger will rest against a shoulder 29'' while the outer face of the plunger is flush with the outer face of the wear plate.

Almost simultaneously with the last mentioned movements the medium under pressure will flow through the ducts 78 to the rear portions of the stripper return cylinders 26 and force the stripper return pistons 31 forwardly and the hopper 33 to its normal charging position. The check valve 79 and the branch pipe 78' prevent direct return of the fluid medium to the duct 77 but permit it to return to said pipe through the primary cylinder.

When the primary piston reaches the end of its stroke the pressure medium can then flow through the primary cylinder upwardly through the duct 78' to the pipe 78 and to the

return stripper cylinders 26 to return the parts to their normal positions.

While the medium under pressure is flowing through duct 77 it will also flow through branch duct 80 leading to the cylinder 67 and assist the spring 47 to force the piston 49 to the left (Fig. 10) in position to repeat the cycle of operations. At the same time the pressure on the fluid medium will build up to overcome the pressure of the foot valve 20 and the fluid will pass through the duct 81 into the piston valve cylinder 82 and actuate the piston 83 thereof to move the piston valves 70 and 71 to the right to their initial positions as shown in Fig. 10.

A return duct 84 extending from the valve casing 16 to the storage tank 14 is intersected by the automatic pressure foot valve 21 to permit the return of the fluid to the tank when the pressure is sufficient to overcome the resistance of the valve. The end of the duct connected to the valve casing 16 is in communication with the valve duct 85 which connects the opposite ends of the bore of the valve casing together to permit the fluid medium to surge back and forth as the piston valve is reciprocated therein.

The numeral 86 indicates the return pipes extending from the storage tank to the pump.

A duct 87 connecting the outer end portions of the bore of the valve casing 15 is connected to the storage tank 14 by a pipe 88 to permit excess fluid medium to return to the tank.

It is to be understood that the fluid medium which has flowed into the different cylinders will be discharged therefrom through the same ducts.

While the invention has been described as a briquetting machine, it is to be understood that the invention contemplates the method of making briquettes in which the briquettes are all compressed to substantially the same extent regardless of the amount of material in each briquette.

From the foregoing description it will be seen that it is only necessary to supply the hopper with metal cuttings or other material and the machine will continue to form the briquettes from the scrap material quickly and economically. It will also be seen that in forming briquettes of scrap metal cuttings, that the briquettes will be compressed to such an extent as to have the appearance of being solid blocks of metal, and which blocks or briquettes may be easily melted for further use. It will be further seen that the operation of forming the briquettes is very simple and is well adapted for the purpose described.

What we claim as our invention is:

1. A briquetting machine, comprising a die member, a hopper for holding loose material adjacent thereto, a plunger, a primary cylinder having a piston for moving the plunger to force material from the hopper into the die

and to initially compress said material to a predetermined extent, a secondary cylinder of larger diameter having a piston for moving the plunger with greater pressure for completing the compression of the material, means for supplying fluid under pressure to the primary cylinder and fluid freely to the secondary cylinder during the initial compressing of the material, means for supplying fluid under pressure to the secondary cylinder after the initial compression, and means for stripping the die from the completed briquette while the plunger remains in its compressing position.

2. A briquetting machine, comprising a die member, a hopper for holding loose material adjacent thereto, a plunger, a primary cylinder having a piston for moving the plunger to force material from the hopper into the die and to initially compress said material to a predetermined extent, a secondary cylinder of larger diameter having a piston for moving the plunger with greater pressure for completing the compression of the material, means for supplying fluid under pressure to the primary cylinder and fluid freely to the secondary cylinder during the initial compressing of the material, means for supplying fluid under pressure to the secondary cylinder after the initial compression, means for stripping the die from the completed briquette while the plunger is holding the completed briquette, and means for returning the plunger to its initial position to release the briquette.

3. A briquetting machine, comprising a die member, a hopper for holding loose material adjacent thereto, a plunger, a primary cylinder having a piston for moving the plunger to force material from the hopper into the die and to initially compress said material to a predetermined extent, a secondary cylinder of larger diameter having a piston for moving the plunger with greater pressure for completing the compression of the material, means for supplying fluid under pressure to the primary cylinder and fluid freely to the secondary cylinder during the initial compressing of the material, means for supplying fluid under pressure to the secondary cylinder after the initial compression, means controlled by the resistance of the material to be compressed for stopping the supply of pressure fluid to the secondary cylinder while maintaining the plunger in briquette holding position and stripping the die from the briquette, and means for returning the plunger to its initial position to release the briquette.

4. A briquetting machine, comprising a frame, a hopper for holding loose material, a die member adjacent the hopper, a plunger extending into the hopper in alinement with the die, a primary cylinder having a piston for moving the plunger to force material from the hopper into the die and against a

frame part and to initially compress said material to a predetermined extent, a secondary cylinder of larger diameter having a piston for moving the plunger with greater pressure for completing the compression of the material, a pump and a fluid holding tank positioned to supply fluid under pressure to the primary cylinder and at the same time permit fluid to quickly and freely flow from the tank to the secondary cylinder during the initial compressing of the material, a valve controlled by the resistance of the material being compressed for directing fluid under pressure to the secondary cylinder to cause the complete compression of the material, the resistance of the material to said complete compression stopping the fluid pressure flow to the secondary cylinder and directing it to cause the die to move to strip the briquette formed from the material while the plunger is holding the briquette against the frame part, and other means for directing the fluid under pressure to cause the parts to move to their initial positions and to release the completed briquette.

5. A briquetting machine, comprising a frame, a hopper for holding loose material, a die member adjacent the hopper, a plunger extending into the hopper in alinement with the die, a primary cylinder having a piston for moving the plunger to force material from the hopper into the die and against a frame part and to initially compress said material to a predetermined extent, a secondary cylinder of larger diameter having a piston for moving the plunger with greater pressure for completing the compression of the material, a pump and a fluid holding tank positioned to supply fluid under pressure to the primary cylinder and at the same time permit fluid to quickly and freely flow from the tank to the secondary cylinder during the initial compressing of the material, a valve controlled by the resistance of the material being compressed for directing fluid under pressure to the secondary cylinder to cause the complete compression of the material, the resistance of the material to said complete compression stopping the fluid pressure flow to the secondary cylinder and directing it to cause the die to move to strip the briquette formed from the material while the plunger is holding the briquette against the frame part, and electrical means actuated by a movable part of the machine for directing the fluid under pressure to cause the parts to move to their initial positions and to release the completed briquette.

6. A briquetting machine, comprising a frame, a hopper for holding loose material, a die member adjacent the hopper, a plunger extending into the hopper in alinement with the die, a primary cylinder having a piston for moving the plunger to force material from the hopper into the die and against a

frame part and to initially compress said material to a predetermined extent, a secondary cylinder of larger diameter having a piston for moving the plunger with greater pressure for completing the compression of the material, a pump and a fluid holding tank positioned to supply fluid under pressure to the primary cylinder and at the same time permit fluid to quickly and freely flow from the tank to the secondary cylinder during the initial compressing of the material, a valve controlled by the resistance of the material being compressed for directing fluid under pressure to the secondary cylinder to cause the complete compression of the material, the resistance of the material to said complete compression stopping the fluid pressure flow to the secondary cylinder and directing it to cause the hopper and die to move rearwardly to strip the briquette from the die while the plunger is holding the briquette against the frame part, electrical means actuated by the movement of the hopper and die for directing the fluid under pressure to cause the plunger to move rearwardly to its initial position to release the completed briquette and to also cause the fluid under pressure to move the hopper and die forwardly to their initial positions, said forward movement actuating the electrical means to cause the parts to again start their cycle of movements.

7. A briquetting machine, comprising a frame having spaced guides, a hopper slidably mounted on the guides, a die member carried by the hopper, a primary and a secondary cylinder positioned in endwise relation on the frame and to which the guides are connected, a primary piston within the primary cylinder, a secondary piston within the secondary cylinder, a plunger connected to said pistons and extending into said hopper to force material therefrom into the die, a frame part against which the material in the die is forced, stripper and stripper return cylinders having connected together pistons to which the hopper is connected, a storage tank positioned above the secondary cylinder and having a valve casing extending upwardly therein from the secondary cylinder, said valve casing having ducts and ports leading from the tank to the cylinder to permit the free flow of fluid from the tank to the cylinder, a fluid pressure pump, ducts connecting the pump to the tank and the cylinders and the tank valve casing, pressure responsive valves controlling the flow of pressure fluid through said ducts, and a main valve controlled by the movement of the die for controlling the movement of the other valves.

8. A briquetting machine, comprising a frame having spaced guides, a hopper slidably mounted on the guides, a die member carried by the hopper, a primary and a secondary cylinder positioned in endwise rela-

tion on the frame and to which the guides are connected, a primary piston within the primary cylinder, a secondary piston within the secondary cylinder, a plunger connected to said pistons and extending into said hopper to force material therefrom into the die, a frame part against which the material in the die is forced, said frame part having a yielding member for forcing the completed briquette away from the frame part, stripper and stripper return cylinders having connected together pistons to which the hopper is connected, a storage tank positioned above the secondary cylinder and having a valve casing extending upwardly therein from the secondary cylinder, said valve casing having ducts and ports leading from the tank to the cylinder to permit the free flow of fluid from the tank to the cylinder, a fluid pressure pump, ducts connecting the pump to the tank and the cylinders and the tank valve casing, pressure responsive valves controlling the flow of pressure fluid through said ducts, and a main valve controlled by the movement of the die for controlling the movement of the other valves.

9. A briquetting machine, comprising a die member, a hopper member moving therewith for holding loose material, a plunger member, a primary cylinder and piston for moving the plunger to force material from the hopper member into the die member and partly compressing the material in said die member, a secondary cylinder and piston for further moving the plunger to complete the compression of the material, a storage tank positioned above the secondary cylinder for supplying a fluid to the secondary cylinder freely by gravity for a portion of the stroke of the secondary piston and for supplying the fluid under pressure for the completion of the stroke of the said secondary piston, a pump for applying power to the fluid medium, stripper and stripper return pistons and cylinders, ducts for supplying the fluid to all of said cylinders, and means controlling the application of the pump pressure to the fluid.

10. A briquetting machine, comprising a die member, a hopper member moving therewith for holding loose material, a plunger member, a primary cylinder and piston for moving the plunger to force material from the hopper member into the die member and partly compressing the material in said die member, a secondary cylinder and piston for further moving the plunger to complete the compression of the material, a storage tank positioned above the secondary cylinder for supplying a fluid to the secondary cylinder freely by gravity for a portion of the stroke of the secondary piston and for supplying the fluid under pressure for the completion of the stroke of the said secondary piston, a pump for applying power to the fluid medium, a pressure moved reciprocal valve controlling the flow of the fluid from said storage tank to the secondary cylinder, stripper and stripper return pistons and cylinders, ducts for supplying the fluid to all of said cylinders, and means controlling the application of the pump pressure to the fluid.

In testimony whereof we affix our signatures.

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