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HYDRAULIC POWDER PRESS

Filed June 27, 1955

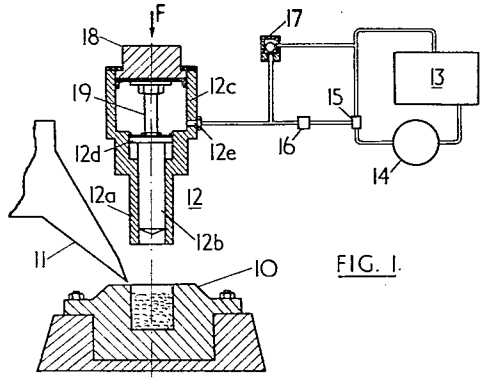


FIG. 1.

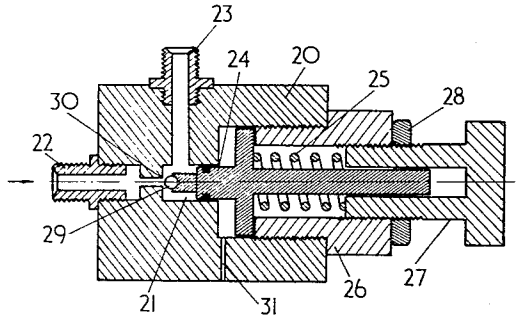


FIG. 2.

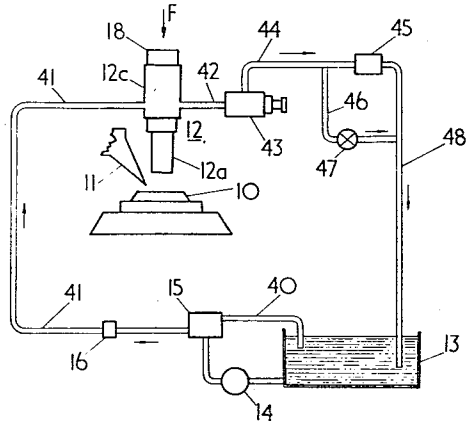


FIG. 3.

Inventors
Harry Rex Gregory
Maurice Kendall
by Stevens, Davis, Miller & Mosher
their attorneys

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HYDRAULIC POWDER PRESS

Harry Rex Gregory and Maurice Kendal, Cheltenham, England, assignors to Coal Industry (Patents) Limited, London, England, a British company

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Claims priority, application Great Britain July 2, 1954

3 Claims. (Cl. 18—16)

This invention relates to improvements in presses and one object of the invention is to provide a press for the manufacture of briquettes without a binder from materials in divided form, e. g. fine coal or metallic or non-metallic powders, according to the method described in our prior patent application Nos. 32,592/53 and 4,257/54.

In the method described in our said prior application a mass of particles while under pressure is caused to undergo angular shear strain of such magnitude and distribution as to produce a briquette of high strength.

The said prior patent application also describes a method of making a briquette wherein pressure is applied to a quantity of particles to form a compacted mass and thereafter while the mass is held under pressure, the whole mass or an external face thereof is caused to undergo a substantial change in shape or configuration to set up within the mass angular shear strain having such magnitude and distribtuion as to produce a briquette of high strength. Such change in shape or configuration may be general and take place over the whole mass or over the whole of one or more external faces, e. g. by distorting the cross section of the mass from a rectangle to a parallelogram or from a circle to an ellipse, or the change may be local, as for example by forming a recess or depression at some locality in an external face.

While the press of the present invention is envisaged as being of particular application to the manufacture of briquettes by the method described in the above mentioned prior patent application (which may be seen for fuller details) it is to be understood that the invention is not limited to this application but may also be applied to the manufacture of any other article which can be made by means of a press.

According to the present invention there is provided a press having a main ram for applying the working load during the working stroke, a multiple plunger tool having two or more relatively movable plungers for transmitting the load to the material to be treated, and a pressure fluid operated control system operative to control the relative movement of said plungers during the working stroke of the main ram.

The invention in another aspect consists in a press having a main ram for applying the working load during the working stroke, a multiple plunger tool having two or more relatively movable plungers for transmitting the load to the material to be treated, and a control system operated by fluid pressure derived from the reaction of the said material against the load applied by the main ram for controlling relative movement of the said plungers during the working stroke of the said ram.

The working load may be applied to the main ram by a mechanical or hydraulic system, and this system may be independent of and separate from the hydraulic system for controlling the relative movement of the plungers.

The invention in yet another aspect consists in a press having a main ram for applying the working load during the working stroke, a multiple plunger tool having two or more relatively movable plungers for transmitting the load

to the material to be treated, and a control system operated by fluid pressure derived from the reaction of the said material against the load applied by the main ram and arranged to maintain the said plungers against relative motion until the said fluid pressure reaches a predetermined level.

In one form of the invention the tool has two relatively movable plungers for transmitting the load to the material to be treated and the control system is arranged to maintain the said two plungers against relative motion until the said fluid pressure reaches a predetermined level, thereby enabling the whole or the greater part of the working load of the main ram to be applied to one only of the plungers after the said predetermined level of pressure is reached.

Preferably the control system is provided with a pressure sensitive device so constructed and arranged that when the said determined level of pressure is reached the device enables the pressure to fall to a value which is relatively low compared to the said predetermined level. The tool may have two plungers which are held together under the action of the pressure of the fluid, the said pressure falling to a relatively low value after a pre-determined maximum pressure has been reached whereby the whole or the greater part of the working load is then applied to the piston.

The two plungers may be in the form of two co-axial plungers of which one is in the form of an annulus and the other in the form of a piston working within the said annulus and the pressure operating the said control system may be obtained from the pressure of fluid in a chamber arranged within the plunger assembly.

Other features of the invention will appear from the following description given by way of example only with reference to the accompanying drawings in which:

Figure 1 is a diagram of an arrangement of a press according to the invention,

Figure 2 a sectional elevation of a relief valve, and

Figure 3 a diagram of a second arrangement of a press according to the invention.

Figure 1 illustrates a press arrangement comprising a mould 10 for retaining a mass of particles fed into it from a hopper 11, and a multiple plunger tool 12 attached to a main ram 18 for operating on said particles. The tool 12 has two relatively movable plungers 12_a, 12_b, an inner plunger 12_b being in the form of a piston slidably and co-axially mounted within an annular plunger 12_a. The latter is integral with cylinder 12_c providing a chamber for fluid and the plunger 12_b is integral with a piston 12_d which is itself secured to a main ram 18 by a pillar 19. A hydraulic circuit is coupled to a port 12_e of the cylinder 12_c, hydraulic fluid e. g. oil, being fed from a reservoir 13 by a pump 14 through a relief valve 15 and a non-return valve 16. A relief valve 17 provides a return path for the fluid to the reservoir 13 from the cylinder 12_c.

In operation a requisite quantity of particles of the material to be treated is fed from hopper 11 into mould 10, whereupon the tool 12 acting as a unitary assembly, i. e. with plungers 12_a and 12_b held together due to the hydraulic pressure, is caused to enter mould 10 by the action of mechanical or hydraulic means (not shown) operating to exert a working load F on the main ram 18. During this part of the working stroke the entire area of the upper surface of the particles in mould 10 is subjected to compressive force, the working load F being distributed between the two plungers 12_a and 12_b. If plunger 12_b is held in a retracted position relative to plunger 12_a (as shown in Figure 1) the effect of this operation is to form a compacted mass of particles of approximately cylindrical form but having a relatively short upstanding central plug on its upper surface.

As the compressed particles present an increasing re-

sistance to the tool the pressure of the fluid in chamber 12_c correspondingly increases until at a predetermined value depending on the setting of relief valve **17**, the fluid in chamber 12_c escapes through valve **17** to reservoir **13**. The plungers 12_a and 12_b are thus no longer held together and the whole (or at least the greater part) of the working load F is applied via plunger 12_b (which is driven forward relatively to plunger 12_a) to the central plug formed in the preceding operation so that the material in this plug is forced into the remainder of the compacted mass to form finally a briquette of substantially cylindrical form.

On releasing the pressure on the tool **12** the fluid pressure in cylinder 12_c falls, valve **17** and relief valve **15** close, and pump **14** is able to supply fluid to the cylinder 12_c recharging the ram for the next operation.

In Figure 2 is illustrated a relief valve for use in the system of Figure 3 and which valve is the subject of our British patent application No. 17,389/55. This relief valve comprises a hollow body **20** in which is a cylinder **21** to which fluid can be admitted through an inlet connection **22** and from which fluid can escape through an onlet connection **23**. A piston **24** is slidably arranged in the cylinder **21** and is loaded by a compression spring **25** which is located, and of which the pressure can be adjusted, by means of a screw-threaded sleeve **26** and a nut **27** with a lock nut **28**. Attached to the piston **24** is a valve ball **29** which can be held by the piston **24** against a seat **30** to close the inlet connection **22**. A vent hole **31** permits escape of any fluid which may leak past the piston **24**.

The relief valve of Figure 2 functions as follows:

When the valve ball **29** is on the seat **30** and there is no fluid pressure in the cylinder **21** the whole force of the spring **25** tends to keep the ball on its seat so that a high fluid pressure in the inlet connection **22** is necessary to unseat the valve ball. As soon as the valve ball is unseated the fluid pressure acts on the end surface of the piston **24** and therefore acts against the spring **25** so that the pressure in the cylinder **21** must fall to a low value relatively to that necessary to open the valve before the spring can return the ball to its seat. When the valve ball is held off its seat the valve offers only a low resistance to flow.

Figure 3 illustrates an arrangement comprising the mould **10**, hopper **11**, multiplunger tool **12** and ram **18** of Figure 1. From a reservoir **13** a pump **14** supplies hydraulic fluid under pressure through a relief valve **15** and a non-return valve **16** and a pipe **41** to the ram **12**, any excess fluid passing from the valve **15** through a pipe **40** back to the reservoir **13**. A pipe **42** connects to the ram cylinder 12_c a relief valve **43** which is constructed as shown in Figure 2. A pipe **44** is connected to the outlet of the relief valve **43** and leads to a low pressure relief valve **45**. A pipe **46** branching from the pipe **44** leads to a needle valve **47** through which fluid can pass to a pipe **48** to the reservoir **13**.

The arrangement shown in Figure 3 functions as follows. During the working stroke the fluid pressure in the cylinder 12_c is required to raise to a relatively high value (for example 3,000 lbs. per square inch) with little or no relative movement between the plungers 12_a and 12_b. However, as soon as this pressure is reached a rapid fall to a much lower value (for example 300 lbs. per square inch) is required, the bulk of the fluid being discharged from cylinder 12_c at this lower pressure. When the ram **19** is being raised the cylinder 12_c is full of fluid; when the ram **18** is forced down, the pressure of the fluid in cylinder 12_c increases and this pressure is transmitted through pipe **42** to valve **43**;

when the pressure is sufficient to open valve **43**, fluid passes through pipe **44** and valve **45** but the latter maintains the pressure within valve **43** at a value high enough to ensure that valve **43** does not close. At the end of the working stroke ram **18** is raised, whereupon the pressure in cylinder 12_c drops very rapidly and the pressure in valve **43** also drops so that this valve can close, whereupon valve **45** closes and the system is ready for the next cycle. The needle valve **47** permits a slow leak which dissipates any back pressure which may arise in the piping connecting valves **43** and **45** in the interval between successive operations. The needle valve **47** also enables the system to operate correctly even if there is a small leak through the valve **43** when the latter is closed; the setting of needle valve **47** is not critical. The construction and arrangement of valve **43** enables the transition from high pressure to low pressure in the cylinder 12_c to take place very rapidly.

The lower end of plunger 12_b may be of approximately conical form as shown in Figure 1 or it may be domed or flat. The lower edge of plunger 12_a may be flat, as shown, as it may be of frusto-conical form widening downwardly outwards.

It will also be understood that modifications may also be made in the relative positions of plungers 12_a and 12_b and the mode of application of the pressure. Thus for example the lower end of plunger 12_b may project beyond the lower end of plunger 12_a during the first part of the working stroke so as to form a recess in the material to be treated with a surrounding annular projection, and during the remainder of the working stroke the whole or the greater part of the working load may be transferred to the annular plunger 12_a so as to operate on the annular projection previously formed.

We claim:

1. A press comprising a main ram applying the working force, a solid inner plunger rigidly secured to said main ram, an annular outer plunger surrounding said inner plunger, a fluid-containing cylinder secured to said outer plunger and surrounding an end of said main ram, said main ram acting as a piston in said cylinder, and fluid-control means operatively connected to said cylinder and responsive to fluid pressure within said cylinder, said fluid-control means allowing the fluid pressure in said cylinder to build up to relatively high value during the working stroke, and then causing it to fall to a relatively low value.

2. A press as claimed in claim 1, said fluid control means comprising a relief valve comprising a body in which is a chamber with an inlet and an outlet, a valve element in said chamber, a spring resiliently loading said valve element to close said inlet to said chamber, and a valve piston fitting in said chamber and secured to said valve element, the cross-sectional area of said chamber being many times larger than that of said inlet.

3. A press as claimed in claim 2, said fluid-control means comprising a second relief valve operatively connected to said outlet and maintaining the fluid pressure in said chamber at a level such that said spring cannot overcome the fluid pressure on said valve piston to move said valve element to close said inlet after said valve element has been moved against the action of said spring by fluid pressure in said inlet.

References Cited in the file of this patent

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