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2,954,583

PRESSES

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

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1 Claim. (Cl. 18—16)

This invention relates to multiple plunger assemblies for presses, and one object of the invention is to provide an improved plunger assembly for 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 No. 470,106 now Patent No. 2,860,957.

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 distribution 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 plunger assembly 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, it is to be understood that the invention is not limited to this application but may also be applied to the manufacture of other articles which can be made by means of a press.

In our prior patent application No. 518,308 now Patent No. 2,809,395 we have described a press having a main ram for applying the working load during the working stroke, a multiple plunger tool or assembly 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.

Another object of the present invention is to provide an improved multiple plunger assembly for such a press.

According to the present invention there is provided a multiple plunger assembly for a press, comprising an inner plunger and outer annular plunger in which part of the inner plunger fits, and a fluid-filled chamber in which pressure is generated by the reaction of material compressed by the outer plunger, characterised in that the inner plunger is movably arranged in a plunger guide body. Preferably the inner plunger can be moved relatively to the plunger guide body and the outer plunger to eject compacted material from within the outer plunger.

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The inner plunger may be moved in the plunger guide body by means of a fluid-actuated piston, and may be spring-loaded. The outer plunger may be secured to a cylinder which moves on the plunger guide body, the said fluid-filled chamber being defined by the plunger guide body and the cylinder. The outer plunger may be adapted to act as a mould, and may for example be bell-mouthed for this purpose. Further and optional features of the invention appear from the following description and claims.

In the accompanying drawing a multiple plunger assembly for a press according to the invention is illustrated by way of example.

The illustrated multiple plunger assembly comprises a ram attachment piece 3 secured to the main ram 25 of a press. Secured to the ram attachment piece 3 is a plunger guide body 2, and a connection passage 26 communicated with a chamber 27 in the attachment piece 3. A cylinder 1 is arranged for movement on the guide body 2 and is provided with an adjustable cylinder cap 4 which screws on to the cylinder and is secured by a retaining ring 14 held by screws 21. A seal 15 located by a seal support ring 13 held by screws 28 is arranged to prevent leakage between the cylinder 1 and the body 2. The body 2 has an annular extension which extends into the base of the cylinder 1, and to prevent leakage here there is provided a seal 16 supported by a seal support ring 12. The cylinder is provided with inlet and outlet passages 29 and 30 communicating with the chamber 31.

To the lower end of the cylinder 1 an annular outer plunger or mould 5 is secured by screws 19. An inner plunger 6 can move up and down in the annular extension of the body 2 and is provided with a plunger end piece 7 retained in place by a grub screw 23. A seal 18 surrounds the end piece 7 and is held in place by a retaining ring 24.

To the inner plunger 6 is secured a plunger rod 32 on the upper end of which an ejection piston 8 is retained by means of a nut 10 and a washer 9. The inner plunger 6 is spring-loaded by a compression return spring 11 which urges the piston 8 upwardly, and the piston 8 is provided with a seal 17.

The body 2 is secured to the attachment piece 3 by means of screws 20, and a screw-threaded plug 22 obturates a passage leading to the chamber below the piston 8.

When the annular outer plunger 5 and the inner plunger end piece 7 are forced down into a mass of particles (which may or may not be constrained within a mould) the particles are compressed and reaction pressure gives rise to pressure in fluid in the chamber 31. When this pressure reaches a predetermined limit a relief valve in a control system (not shown) allows oil to escape from chamber 31 so that movement of the annular outer plunger 5 ceases, but movement of the inner plunger 6 with its end piece 7 continues, the top end of the plunger 6 being hard up against the guide body 2 so that the inner plunger 6 receives practically the whole force from the main ram 25.

After the compression is completed, the main ram 25 and the multiple plunger assembly are raised. Pressure is then supplied through the passage 26 to the chamber 27 to force down the piston 8 and rod 32 and plunger 6 with its end piece 7 so that the briquette within the annular plunger mould 5 is ejected. Release of the pressure in the chamber 27 allows the plunger 6 to rise under the action of the spring 11 so that the oil re-enters through connection 29 and recharges chamber 31—then assembly is ready for another operation.

The press provided with the assembly according to the invention produces a briquette of high quality because

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the pressure is applied from both ends and because the process as described in our prior patent application No. 470,106 is carried out. It further permits the ejection piston 8 to apply a longitudinal thrust through the plunger end piece 7 to the briquette during its ejection. This has great virtue in permitting a radial release of strain and thus minimising the incidence of incipient cracking.

The annular plunger 5 may enter a mould (not shown) dimensioned to provide a small clearance between the annular plunger and the sides of the mould, but satisfactory briquettes can be made even if the plunger 5 is moved forward into a bed of coal which is not confined in a mould which closely fits the plunger 5. This avoids the need for accurate indexing in a rotary table press arrangement, but may give rise to dust.

The drawing shows a plunger assembly with an anvil extractor jack or ejection piston 8 capable of applying a thrust of four tons and actuated by hydraulic pressure.

We claim:

A multiple plunger assembly for attachment to the ram of a moulding press, comprising a ram attachment piece, a plunger guide body secured to said ram attachment piece, a piston-like enlargement on said plunger guide body, a cylinder arranged for axial movement on said piston-like enlargement on said plunger guide body, an annular outer plunger secured to said cylinder, an inner plunger arranged for axial movement within said plunger guide body, a plunger end-piece secured to said

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inner plunger and arranged for axial movement within said outer plunger, an ejection piston secured to said inner plunger and fitting slidably in a chamber in said ram attachment piece, and a spring within said chamber acting on said ejection piston to withdraw said inner plunger further into said outer plunger, said cylinder and said chamber being provided with passages for the supply and escape of fluid under pressure, the arrangement being such that during moulding said inner plunger abuts said plunger guide body and there is direct transmission of force through said ram attachment piece, said plunger guide body and said inner plunger and said plunger end-piece to material within said outer plunger, and after moulding fluid under pressure admitted to said chamber acts on said ejection plunger in opposition to said spring for moving said inner plunger outwardly in said outer plunger.

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