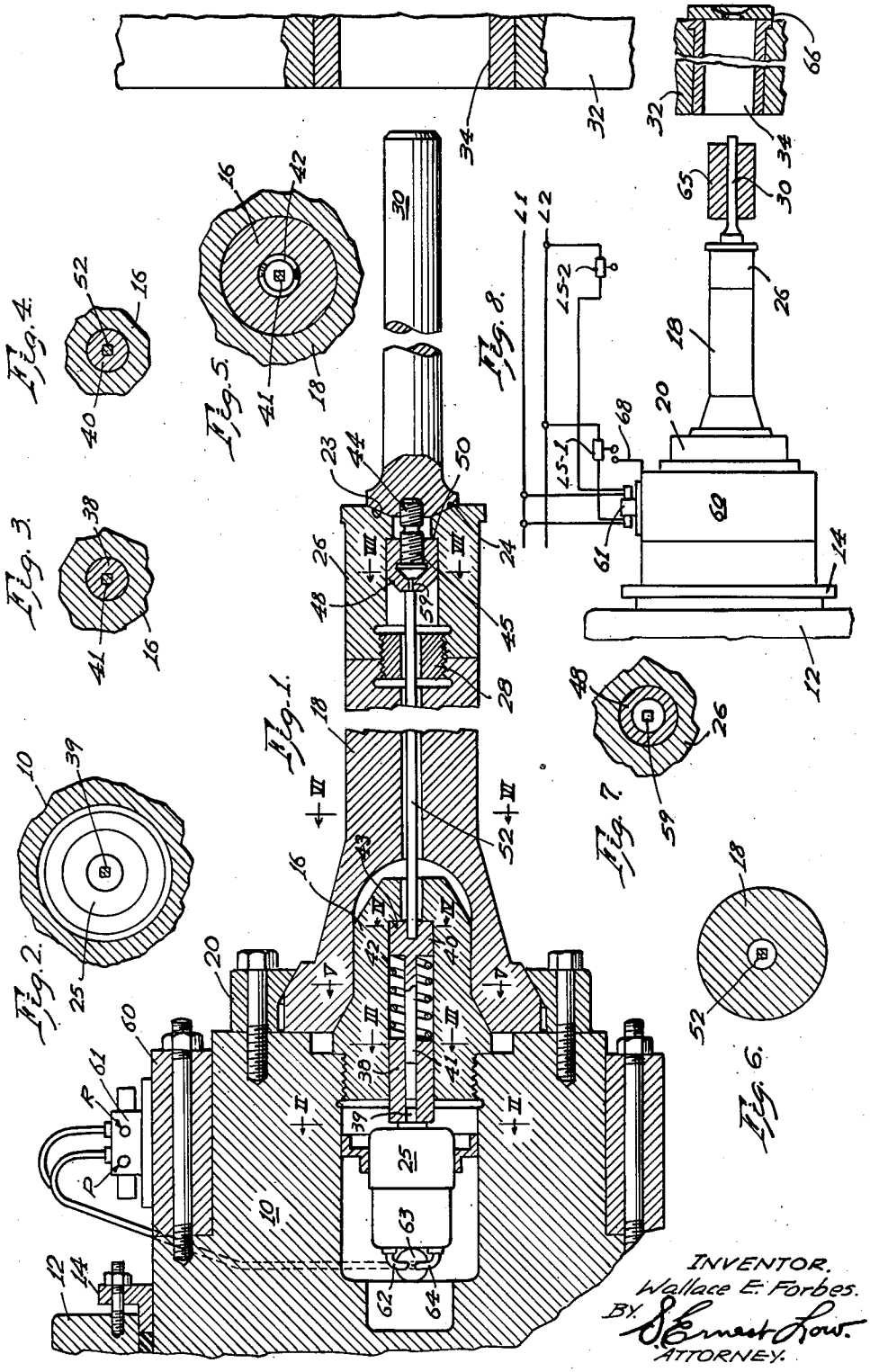
Oct. 22, 1957 W. E. FORBES 2,810,479

MATERIAL-DEFORMING APPARATUS

Filed Dec. 9, 1952



United States Patent Office 2,810,479 Patented Oct. 22, 1957

2,810,479

MATERIAL-DEFORMING APPARATUS

Wallace E. Forbes, New Kensington, Pa., assignor to Aluminum Company of America, Pittsburgh, Pa., a corporation of Pennsylvania

Application December 9, 1952, Serial No. 324,939

5 Claims. (Cl. 207—19)

This invention relates in general to material-deforming apparatus or equipment, such as forging, extrusion and draw presses, which incorporate ram and core devices as essential elements of their construction and operation. The invention is more specifically concerned with the provision of means for detachably securing a core or mandrel to a pressure-applying ram in the general type of material-deforming equipment mentioned above.

An object of the invention is to provide a coupling mechanism between a ram and a core in a material-deforming mechanism, which coupling permits ready and facile connection between the ram and core.

Another object of the invention is to provide a ram-core coupling device which is operable in response to movement of the ram or core.

A further object of the invention includes providing integrated material-deforming apparatus, incorporating a pressure-applying ram and a detachably securable core, which insures performance of repeated operating cycles involving positive attachment and detachment of the core to the ram.

Other objects and advantages of the invention will appear from a consideration of the following specification and accompanying drawings, in which:

Fig. 1 represents a partial medial sectional elevation through an extrusion press incorporating typical ram and core devices of the invention;

Fig. 2 represents a fragmentary sectional elevation taken on the plane II—II of Fig. 1;

Fig. 3 represents a fragmentary sectional elevation taken on the plane III—III of Fig. 1;

Fig. 4 represents a fragmentary sectional elevation taken on the plane IV—IV of Fig. 1;

Fig. 5 represents a fragmentary sectional elevation taken on the plane V—V of Fig. 1;

Fig. 6 represents a fragmentary sectional elevation taken on the plane VI—VI of Fig. 1;

Fig. 7 represents a fragmentary sectional elevation taken on the plane VII—VII of Fig. 1; and

Fig. 8 represents a diagrammatic illustration of a control system forming a part of the invention.

The production of tubular extruded products necessitates mechanism incorporating a pressure-applying ram and core arrangement, and it is in this connection that it has been elected to describe and explain the present invention. It should be understood, however, that the selection of an extrusion apparatus is in no way limiting in respect to the application and use of the invention.

In general terms, the invention is concerned with various forms and types of material-deforming apparatus in which a pressure-applying ram and core are employed as essential features of the apparatus. The ram normally performs the function of applying pressure on a material to displace and deform the same from its original shape to some new shape and/or cross-section which is determined by a core in co-operation with a female die. The ram and core elements are common to extrusion and forging equipment in which stock, in the form of a plastic mass, or forged or cast billets, is transformed from its original to some entirely new shape. Draw presses are also equipped with rams and cores which co-operate in their operation to deform or transform sheet material into drawn vessels, and the like.

With these general types of material-deforming apparatus as background, the invention relates to the particular manner and means of coupling the ram and core elements for ready detachability in accordance with an operating cycle of such an apparatus. The coupling means broadly comprises a power-driven coupling member supported interiorly of the ram and a complementary coupling member supported by the core and extending into the ram for positive engagement with the first-mentioned coupling member. The coupling members are preferably of the male-female type.

It will be observed on reference to the single sheet of drawings attached hereto that an extrusion press for the production of tubular extruded shapes or sections has been selected for the purpose of illustrating the invention. It will be apparent that the basic features of the extrusion press find their full equivalents in many other types of material-deforming apparatus.

The extrusion apparatus comprises a main pressure ram 10 suitably supported within a cylinder 12 provided with the usual sealing gland 14. The main ram 10 is usually tubular over at least a portion of its length to reduce its dead weight, and in the case of the present apparatus a pilot member 16 is secured within the interior bore of the main ram 10, as by screw-threaded engagement therewith. The pilot member 16 is preferably provided with a right cylindrical outer surface and projects axially forwardly away from the main ram 10.

A pressure-applying ram 18, centered on the pilot member 16, is affixed to the front face of the main ram 10, as by means of a retaining ring 20 engaging a tapered shoulder on the pressure-applying ram 18, the ring being secured by cap screws or the like to the front face of the main ram 10.

The pressure-applying ram 18 is provided with a nose piece 26 which is unitarily secured to the outward end of ram 18 preferably by means of an internally disposed tubular threaded coupling member 28, the nose piece 26 being otherwise hollow or tubular and providing an interior shoulder 50 adjacent its end opposite its connection to the pressure-applying ram 18. A core or mandrel member 30 is detachably connected to the pressure-applying ram 18 adjacent the nose piece 26.

Detachable connection of the mandrel 30 and ram 18 is acquired through the use of a coupling mechanism installed and supported, for the most part, within the interior of the ram 18. Power means is also provided for actuating the coupling mechanism, the power mechanism preferably including a suitable impact-type wrench 25 securably mounted within the forward end of the main ram 10. Many types of commercial hydraulic and pneumatic impact wrenches are available for this purpose.

The wrench 25 is equipped with a live or driven, projecting stub shaft 39, and the pilot member 16 and ram 18 are provided with axial cylindrical bores in alignment with stub shaft 39 and the aforementioned bore through the nose piece 26. Coupling members 38 and 40 are rotatably supported and guided within the cylindrical bore in pilot member 16, coupling member 40 being supported in thrust engagement with an internal shoulder 43 adjacent the overhung end of pilot member 16. The coupling members 38 and 40 are also urged or biased away from each other by means of a compression spring 42, coupling member 38 being provided with a central bore engaging the stub shaft 39 and a tang 41 formed integral with, or unitarily attached to, the coupling member 40.

A double-ended threaded male stud member 44—45 is threadly engaged to the core 30 by means of its threaded end 44. The opposite threaded end 45 of the male stud member extends or projects axially away from the core member 30 for detachable connection with a female dome nut 48 rotatably received and guided within the cylindrical bore in nose piece 26.

Female coupling nut 48 and coupling member 40 are coupled together by means of a drive shaft 52, an aperture or bore in the head of dome nut 48 receiving the reduced end 59 of coupling shaft 52, whereas its opposite end is received within a socket bore in coupling member 40. In the illustrations, a square geometric cross-section has been selected for purposes of providing positive interconnection between the several aforementioned elements, namely, interconnection between coupling 38, live stub shaft 39 and tang 41; interconnection between coupling 40, shaft 52 and female coupling nut 48. Manifestly, any non-circular cross-section could be employed in the coupling arrangement. It will now be appreciated that selected direction of rotation of speed wrench 25 will positively drive female coupling nut 48 to engage the same with, or disengage it from, the threaded end 45 of the male coupling stud. To insure engagement and disengagement of female nut 48 and the threaded end 45 of the male core stud, as distinguished from separation of the core 30 at the threads 44, the threads 44 are preferably selected in fine pitch, whereas threads 45 are preferably of multiple coarse pitch. It will likewise be observed that compression spring 42 permits axial movement of nut 48, drive shaft 52 and coupling member 40 axially to the left, as viewed in Fig. 1 of the drawing, a distance equal to the length of projecting threaded male member 45. This axial movement of the several previously named parts permits axial abutting engagement between the frusto conical enlarged end surface 23 of mandrel 30 and the complementary depressed surface 24 in the end of the nose piece 26 without threaded engagement between the coupling nut 48 and threaded male stud 45, the purpose of which will be explained hereinafter.

In the preferred mode of operation of the apparatus thus far described, a cast or forged tubular billet 65, within which the core 30 is loosely supported, is brought into alignment with the axes of rams 10 and 18, which are in axial alignment with the axis of a billet container 32 provided with the usual liner 34. As will be appreciated by one skilled in the art, the billet cylinder 32 and main ram cylinder 12 are tied together in pressure resistant columnar relationship. By controlling the admission of pressure to the cylinder 12, the main ram 10, pressure-applying ram 18 and nose piece 26 may be advanced to the right as viewed in Figs. 1 and 8 to charge the billet 65 and its internal core 30 into the cylinder 32. Continued movement of the aforementioned rams 10 and 18 and nose piece 26 serves to express the material of the billet 65 through the orifice formed between core 30 and a suitable aperture in a die plate 66 secured against movement at the discharge end of cylinder 32. It will be observed in the aforedescribed operation of the extrusion apparatus that core 30 was not positively secured to the ram 18. In fact, forward movement (left to right) of the apparatus does not require positive attachment of core 30 to the ram 18, the core 30 and nose piece 26 axially centralizing themselves in columnar abutting relationship on the complementary surfaces 23 and 24, as a result of plastic deformation and flow of the material of the billet 65 during an extrusion operation.

The overhung or front end of the main ram 10 is normally received within a cross-head 60 slidably supported upon some rigid portion of the extrusion press frame not shown. Mounted on the cross-head and movable therewith is a four-way, solenoid operated valve 61. Pressure lines 62 and 64 operatively connect the impact wrench 25 to the solenoid valve 61, an aperture 63 extending into the overhung tubular end of the main ram 10

permitting such connection. Pressure inlet P and exhaust or return outlet R serve to supply and return or exhaust suitable pressure medium to the valve 61 and impact wrench 25.

L1 and L2 (Fig. 8) represent conductors from any suitable electric power source, such as 110 volt 60 cycle current supply, across which the four-way solenoid valve is connected through limit switches LS–1 and LS–2. The limit switches are preferably fixedly located on some permanent portion of the press in position to be closed by a trigger member 68 shown as secured to and movable with cross-head 60. The location of limit switch LS–2 is such that movement of the extrusion press ram 18 and its associated elements from left to right will close the same on completion of an extrusion operation, at which time a relatively small unextruded heel portion of billet 65 will normally remain within the cylinder 32. Closing of limit switch LS–2 serves to energize the solenoid valve 61 to supply fluid pressure to impact wrench 25 actuating the same to couple female coupling nut 48 and male stud 45. The impact wrench is preferably timed to run for about three seconds, which is a sufficient period to complete the coupling operation. Retraction of the ram 18 and its associated parts from right to left withdraws the core 30 from the remaining billet heel, permits opening the press to remove the billet heel and returns the ram and core into posittion to receive a new charge. Just before press-charging relationship of the press is reached, limit switch LS–1 is closed which serves to energize solenoid valve 61 and direct fluid pressure to impact wrench 25 to reverse its operation and uncouple female coupling nut 48 from engagement with threaded male portion 45 of the core stud. The location of switch LS–1 and the period of operation of the impact wrench 25 are such that an operator is set to remove the core 30 at the time the ram 18 is fully retracted to the left in press-charging position.

The apparatus thus far described is in actual commercial use in a 3200 ton extrusion press engaged in the extrusion of light metals, such as aluminum, magnesium and their alloys. The cores 30 for this particular installation each run in weight from about 5 pounds for small to about 120 pounds for large tubular shapes. In commercial operation, each billet requires a separate core, the heat generated during extrusion necessitating a cooling-off period for a core following the extrusion of the billet with which it was employed. The core may also require preparation for reuse, such as cleaning and lubrication. Between six and eight billets are normally employed before the first core is returned to the press, the cycle of six to eight cores representing the time required to cool and otherwise prepare a particular core for reuse.

Time study on the 3200 ton press equipped with the coupling device of the invention has revealed the fact that the productivity of the press has been increased from between 10 to 30 percent over an eight hour shift of its operation. Expressing this in another way, and taking into consideration a range of cores running from 5 to 120 pounds weight, from 10 to 30 percent more billets are now capable of extrusion in an eight hour shift with the detachable coupling mechanism of the invention, as compared to the number of billets extruded in a press in which the core had to be manually attached and detached from its ram.

Full equivalents of the various mechanical elements can manifestly be substituted for the specific extrusion apparatus hereinabove described. Having clearly and distinctly described and explained the invention in terms of a specific extrusion apparatus, it is to be understood that no express limitations are to be employed to confine or limit the scope of the invention except as defined in the claims appended hereto.

What is claimed is:

1. In a metal forming press mechanism including a pressure-applying axially movable ram for exerting pressure on metal to be deformed, a core detachably secur-

able to the ram and co-operating with a die to confine and shape the metal under deformation, a rotatable coupling member supported within the ram and axially movable therein, a complementary coupling member secured to said core and extending into said ram in alignment and contact with the coupling member therein in end to end columnar abutting relationship of the core and ram, a power unit in driving connection with the coupling member within the ram, actuation of said power unit serving to axially advance said rotatable coupling member to make and axially retract said rotatable coupling member to break rigid coupling of the ram and core, and means responsive to movement of the ram and core for actuating said power unit.

2. In a press mechanism including an axially movable pressure-applying ram, a core and a female die, a coupling mechanism for detachably connecting the core and ram for unitary movement thereof in respect to the female die, said coupling mechanism comprising a rotatable coupling member resiliently depressibly supported within said ram and an extension on said core positionable in alignment and contact with the coupling member in the ram in end to end columnar abutting relationship of the core and ram, power means for driving the coupling member supported within said ram to axially advance the same into detachable connection with said extension on said core, and means responsive to movement of the ram and core for actuating the power means.

3. In a material-deforming press mechanism including an axially movable pressure-applying ram, a core and a female die, a coupling mechanism for connecting the core to the mandrel in axial alignment with the female die, said coupling mechanism comprising a resiliently depressible nut member rotatably supported and guided interiorly the ram for axial movement therein, a fluid pressure operated wrench in direct power-driving connection with said nut member, said wrench being secured interiorly the ram, said core having a threaded male stud in unitary extended connection therewith, said male stud being adapted to extend towards said nut member and being engageable thereby to positively couple the ram and core in end to end columnar abutting relationship and means responsive to movement of the core and ram for actuating said fluid pressure operated wrench.

4. In an extrusion apparatus having an axially movable ram and core in axial alignment with a material-confining cylinder and female die outlet therefrom, a rotatable coupling device for detachably connecting the ram and core, said coupling device comprising a resiliently and axially depressible connecting element supported and guided within the ram and a complementary rigid connecting element secured to and extending from said core, said connecting elements being in aligned contact in end to end columnar abutment of the core and ram, a power-actuatable member within said ram in positive connection with the first-mentioned connecting element, and a power supply for communication with the power-actuatable member, said power supply being connectable in communication with the power-actuatable member in response to movement of the ram and core towards and away from the female die.

5. A coupling mechanism for detachably securing a core and axially movable ram in a material-deforming apparatus comprising a female nut supported for rotation and axially guided movement within the ram, a male stud extending from the core for engagement within the female nut, said nut being axially displaceable within the ram a distance equal to the length of the male stud, power means within the ram in axial resilient lost-motion connection to said female nut, actuation of the power means rotatably advancing the female nut into threaded connection with the extending male stud for end to end columnar abutting relationship of the core and the ram, and means responsive to movement of the ram and core for actuating said power means.

References Cited in the file of this patent

UNITED STATES PATENTS

629,610	Robertson	July 25, 1899
1,165,031	Stahlnacke	Dec. 21, 1915
1,841,396	Benz	Jan. 19, 1932
1,859,753	Summey	May 24, 1932
2,198,826	Lansing et al.	Apr. 30, 1940
2,359,339	Wadell	Oct. 3, 1944
2,535,339	Woeller	Dec. 26, 1950
2,557,582	Turrettini	June 19, 1951