April 4, 1944. C. O. BALLOU 2,345,552

CUSHIONING MEANS

Filed Nov. 11, 1942 2 Sheets-Sheet 1

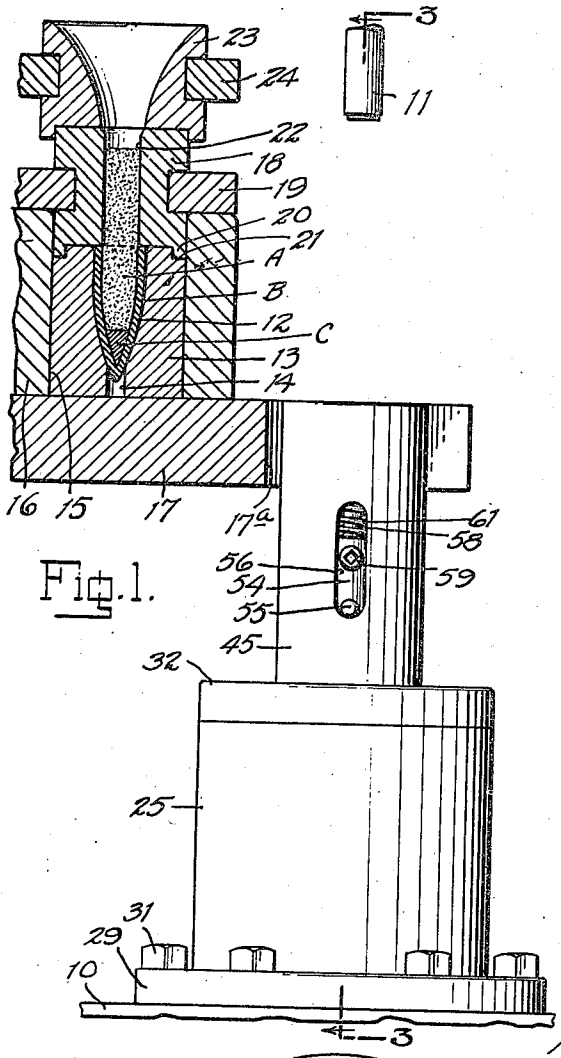

Fig. 1.

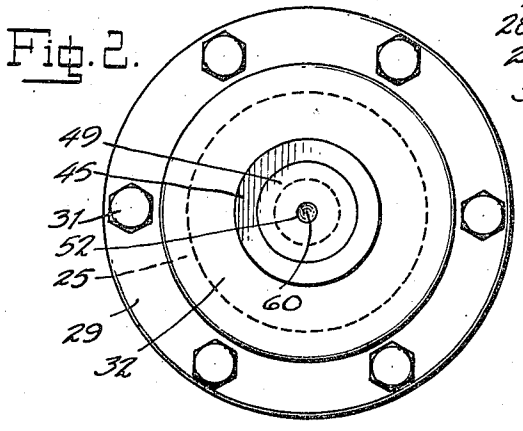

Fig. 2.

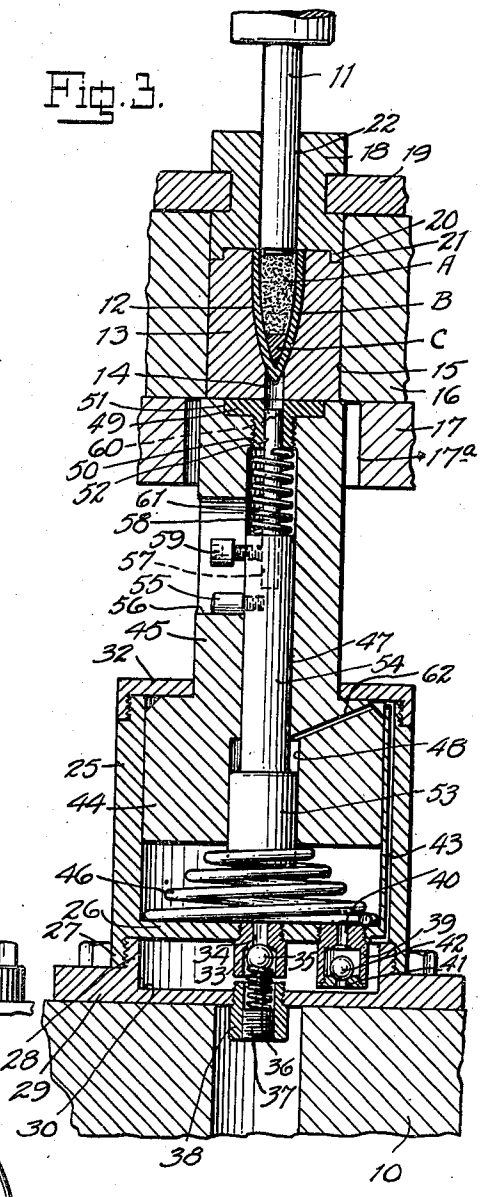

Fig. 3.

INVENTOR
CHARLES O. BALLOU.
BY
D. Vernon Smythe
ATTORNEYS

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Fig. 4.

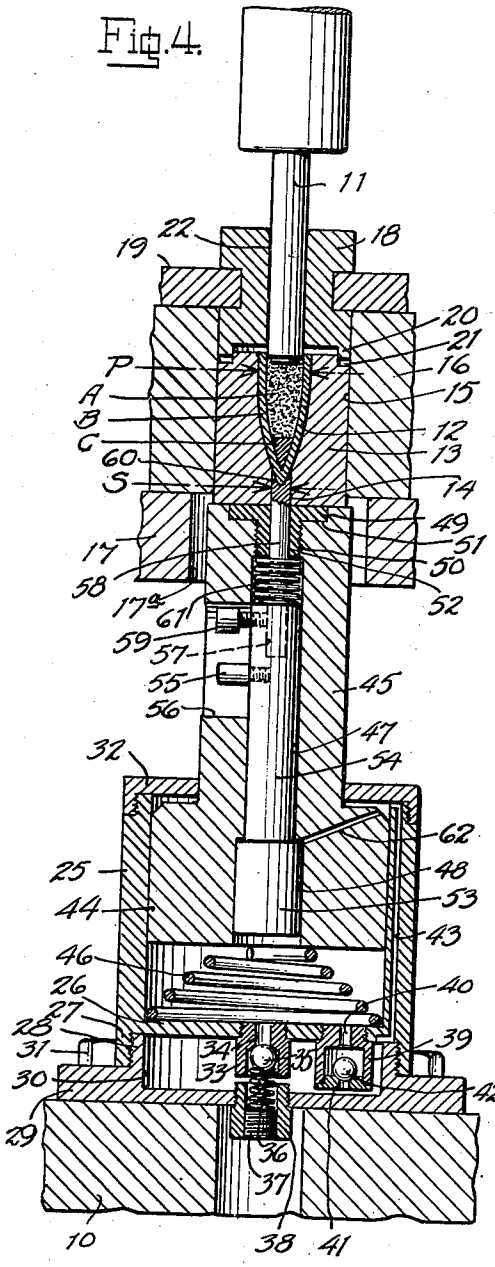
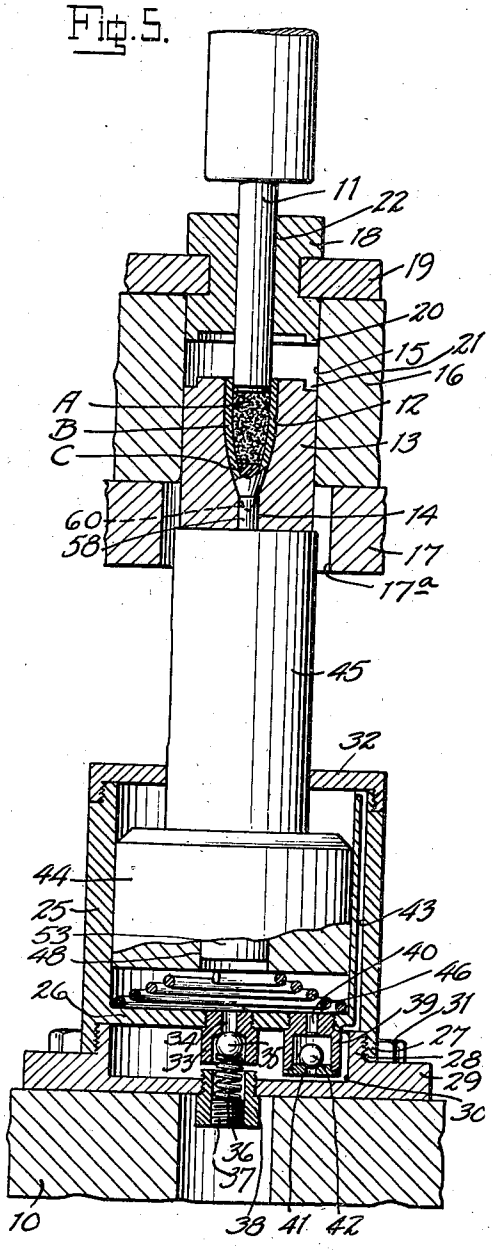


Fig. 5.



INVENTOR
CHARLES O. BALLOU.
BY
D. Dexter Smythe
ATTORNEYS

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UNITED STATES PATENT OFFICE

2,345,552

CUSHIONING MEANS

Charles O. Ballou, Denver, Colo., assignor to Remington Arms Company, Inc., Bridgeport, Conn., a corporation of Delaware

Application November 11, 1942, Serial No. 465,227

10 Claims. (Cl. 86—30)

The present invention relates to a hydraulic support for dies, or the like, and, while the invention may find application in numerous die supporting or similar operations, it is especially adapted in the disclosure illustrated herein to provide a hydraulic cushion support for the compacting die and punch employed in compacting tracer powder in tracer bullet jackets. In the production of tracer bullets the tracer powder must be compacted into the bullet jacket under very high pressure, for example in the order of 70,000 pounds per square inch, so that the powder is in a substantially solid mass within the jacket to insure slow burning during the trajectory of the bullet, the timing of this slow burning being calculated so that the tracer is visible during the entire trajectory. A particular object of the invention is to provide a support whereby the pointed end of the jacket, which is disposed in the ejector passage provided in the base of the die, is supported during the compacting operation in such manner that the outer surface of the bullet jacket will not become ringed or ridged and the point will not be extruded downwardly into the ejector passage, it being pointed out in this connection that the extreme pressure necessary in the compacting operation and the downwardly tapered shape of the jacket and the die pocket supporting it are such that unless the point end of the jacket is effectually supported to oppose and balance the downward pressure such ridging and extrusion will occur.

A further object of the invention is to provide a support by means of which the point end of the jacket having a relatively small area is supported in proportionally balanced relation against the pressure of the compacting die having a substantially larger pressure applying area, and to provide such means which will automatically maintain such balanced relation as the pressure increases through compacting the charge.

Another object of the invention is to provide a hydraulic cushion support including supporting means for the bullet jacket point adapted to be engaged within the die through the exertion of relatively light pressure, so that there is no tendency to ring the jacket or extrude the point during the engaging operation of the point supporting means.

Heretofore mechanical means have been employed to support the die and allow it to move downward after the completion of the compaction, such means being in the form of counterweighted levers. However, the inertia effect of the counter-weights produces undue pressure upon the bullet jacket when they are accelerated from rest and rings and ridges and extrusion of the bullet points occurs. It is an object of the present invention to provide hydraulic cushion support means by which the die and the bullet engaged therein are supported during the compacting operation, and wherein the die is allowed to move downwardly as soon as the pressure exceeds a predetermined limit, without undue inertia effect and with the point of the bullet jacket continuously supported against extrusion as the die moves downward.

With the above and other objects in view, an embodiment of the invention is shown in the accompanying drawings, and this embodiment will be hereinafter more fully described with reference thereto, and the invention will be finally pointed out in the claims.

In the drawings—

Fig. 1 is a side elevation of the hydraulic cushion support, showing the die block, powder charging block and funnel block in vertical section, the latter being in charging position out of vertical line with the cushion support and punch of the press.

Fig. 2 is a plan view of the hydraulic cushion support, the die supporting frame means illustrated in Fig. 1 being removed for the sake of clearness.

Fig. 3 is a vertical sectional view, taken along the line 3—3 of Fig. 1, showing the die block in vertically aligned position upon the hydraulic support, and showing the punch lowered to the point where the tracer powder is pressed from the charging block completely into the bullet jacket preparatory to compacting.

Fig. 4 is a vertical sectional view, showing the parts in the position during compacting of the tracer bullet.

Fig. 5 is a vertical sectional view showing the parts in the position after compacting with the die moved downwardly as the press completes its downward movement.

Similar reference characters indicate corresponding parts throughout the several figures of the drawings.

Referring to the drawings, the hydraulic cushion support, according to the illustrated exemplary embodiment of the invention, is adapted to be installed upon the bed 10 of a press having a vertically reciprocating head in which the compacting punch 11 is supported, this punch being adapted to engage and compact the powder charge A within the bullet jacket B supported in the pocket 12 of the die block 13, this

die block being provided centrally at its lower end with a cylindrical ejector passage 14 extending upwardly to the base of the pocket 12 for the purpose of receiving an ejector stem to disengage the bullet jacket from the die after completion of the compacting operation. Within the point of the jacket there is provided a ballast slug C, usually of lead. The point of the jacket extends downwardly into the ejector passage 14 and is so disposed in relation to the upper edge of the passage 14 that the compacting pressure within the jacket tends to produce rings or ridges upon the outer surface of the jacket and to extrude the point into the ejector passage.

In practice, the die is loaded outside of the press, being supported within a cylindrical opening 15 of a carrier frame 16 supported upon a horizontal platform 17, having its upper surface flush with the upper surface of the cushion support and provided with an opening 17a in which is engaged the upper end of the cushion support. The cylindrical passage 15 of the carrier frame is deeped than the height of the die and is engaged by the lower end of a powder charging block 18 carried in a frame 19, and provided at its lower end with an annular flange 20 engaging an annular peripheral recess 21 in the upper end of the die to register the charging block with the die block. The charging block 18 is provided centrally with a vertical cylindrical passage 22 in axial line with the pocket of the bullet jacket, and adapted to receive the powder charge which is fed therein through a funnel block 23 supported in a frame 24, the measured powder charge in its loose state filling the jacket and extending upwardly in the passage 22 of the block 18. After charging, the funnel block is removed and the die block is moved into vertical line with the hydraulic cushion support and punch of the press, the charging block 18 remaining in place in the frame 16 during the compacting operation.

The hydraulic cushion support comprises a hydraulic cylinder 25 provided at its lower end with a bottom wall 26 and an internally threaded peripheral downwardly extending rim flange 27, within which is screwed the upwardly extending externally threaded cylindrical wall 28 of a flanged base member 29, provided with a cylindrical recess 30, of substantially the same diameter as the internal diameter of the hydraulic cylinder 25, and constituting a sump chamber below the bottom wall 26 of the hydraulic cylinder for receiving the hydraulic fluid, preferably oil, from the cylinder as it is displaced therefrom. The flanged base 29 is rigidly secured to the bed 10 of the press by means of bolts 31. Upon the upper end of the chamber there is screwed a centrally apertured top or cover member 32.

The interior of the hydraulic cylinder 25 is in communication with the sump chamber 30 through a spring-loaded pressure control valve and a sump return valve, the pressure control valve comprising a ball sealing sleeve member 33 screwed into the wall 26 and provided with a central passage 34 having at its lower end a ball seat against which the ball 35 is engaged through the pressure of a spring 36 supported at its lower end upon an adjustable regulating screw 37 provided in a bushing member 38 screwed in the base of the sump chamber, the upper edge of this bushing member being spaced from the lower edge of the sleeve member 33 to provide an annular space through which the hydraulic fluid may flow into the sump chamber when the valve is unseated through hydraulic pressure exerted upon the ball in excess of the spring pressure, as will presently more fully appear.

The sump return valve comprises a valve chamber member 39 screwed into the wall 26, provided at its upper end with a passage 40 and at its lower end with a passage 41 normally closed by the check ball 42 engaged with the seat at its inner end, this passage being disposed close to the bottom of the sump chamber to draw the hydraulic fluid from the sump chamber through the return valve into the hydraulic cylinder on creation of suction in the cylinder during upward return movement of the piston therein, as will presently more fully appear. The wall of the hydraulic cylinder 25 is provided with a duct 43 extending from the upper end of the cylinder to the sump chamber, and constituting a weep hole for the flow of displaced air between the upper side of the piston in the cylinder and the sump chamber.

Within the hydraulic cylinder 25 there is engaged a main piston member 44 provided with a cylindrical stem 45 extending upwardly through the central aperture of the cover member 32, the upper end of this stem constituting the supporting surface upon which the die 13 is supported. This main piston 44 is supported in its raised position by means of a spiral piston return spring 46 disposed in the hydraulic cylinder between the lower face of the piston and the bottom wall 26. The main piston is provided with an axial cylindrical bore 47 having at its lower end a cylindrical secondary piston chamber 48 and at its upper end a flanged bearing member 49 screwed into the upper threaded end portion 50 of the bore and seating in an annular recess 51 in the upper end of the stem 45, this bearing member having a cylindrical passage 52 corresponding in diameter to and registering with the ejector passage of the die.

Within the secondary piston chamber 48 there is engaged a secondary piston member 53 provided with a stem 54 slidably engaged in the bore 47, its downwardly moved position being limited by a stop pin 55 secured thereto and disposed in a vertical slot 56 provided in the main piston stem 45. At its upper end the stem 54 is provided with a chuck pocket 57, in which the lower end of the cartridge case supporting stem member 58 is secured by a set screw 59 disposed in the slot 57, its upper end being engaged in the passage 52 of the bearing member 49, and having a pocket 60 formed therein shaped to fit the point end of the bullet jacket where the latter projects downwardly in the passage 14 of the die. Between the upper end of the secondary piston stem 54 and the bearing member 49 there is provided in surrounding relation to the bullet point supporting stem member 58 a helical spring 61 normally pressing the secondary piston downwardly with respect to the main piston.

A duct 62 is provided between the upper end of the secondary piston chamber 48 and the upper side of the main piston 44, and constitutes a weep hole between the chamber 48 and the upper end of the main piston cylinder in communication through the weep hole duct 43 with the sump chamber.

The areas of the main piston and the secondary piston have a direct relation with the pressure and supporting areas within the upper and lower ends of the die, the ratio of the area

of the main piston to the area of the secondary piston being equal to the ratio of the lateral area at the upper end of the die pocket, indicated by the arrow line P, to the lateral area of the stem passage 14 at the lower end of the pocket, indicated by the arrow line S, so that the supporting pressure of the stem against the point end of the bullet jacket, and which is created by hydraulic pressure against the secondary piston, is opposed and balanced with respect to the compacting pressure of the punch at the upper end of the bullet jacket, and which compacting pressure is transmitted to the main piston.

In operation, the bullet jacket B is placed in the die block 13, the charging block 18 is engaged upon the upper end of the die block, and the funnel block 23 is engaged with the charging block, the charge of tracer powder A being placed in the bullet jacket and extending in its non-compacted loose state upwardly in the charging block. This operation is performed at a suitable station removed from vertical alignment with the press. Thereupon the funnel block is removed, and by means of the frame 16 the die block and the charging block are moved upon the support 17 into vertically aligned relation with the hydraulic cushion support and the punch in the press. Thereupon the press starts the cycle of operation, moving the punch 11 downwardly into the passage 22 of the charging block and pressing the loose powder into the bullet jacket as shown in Fig. 3.

The pressures of the springs 25 and 61 are sufficiently strong to maintain the main piston against downward movement and the secondary piston against relative upward movement during this preliminary pressing of the powder into the bullet jacket, so that the die block does not move downwardly and separate from the charging block, which is sustained against downward movement by its supporting frame 24, until all of the powder within the charging block is pressed downwardly into the bullet jacket. At this point sufficient pressure builds up within the partially compacted powder to overcome the forces of the springs 25 and 61, so that continued downward movement of the punch moves the die block and the main piston downwardly, causing the contained hydraulic fluid within the hydraulic cylinder to press the secondary piston upwardly against the force of its spring 61 and projecting the bullet jacket supporting stem 58 upwardly into the passage 14 of the die to engage and support the point of the bullet jacket as shown in Fig. 4. During this action the hydraulic fluid is retained in the cylinder by the spring loaded ball valve 35, as well as the sump return check valve 42, which checks the flow of the fluid from the cylinder to the sump, the resisting pressure of the spring 36 of the valve 35 being calculated as in excess of the pressure of the spring 61, as well as in excess of the predetermined compacting pressure that it is desired to apply to the powder charge.

With the main and secondary pistons in the position shown in Fig. 4, wherein the hydraulic fluid supports both the main and secondary pistons against downward movement, the punch continues its downward movement to compact the powder within the bullet jacket into the predetermined substantially solid state, the downward pressure upon the die and the main piston produced by this compacting action causing the secondary piston to maintain the stem 58 in supporting relation with the point of the bullet jacket with a pressure that is at all times opposed and balanced with respect to the compacting pressure, so that the production of rings or ridges upon the surface of the bullet jacket and extrusion of the point in the passage 14 is effectually prevented.

As soon as the compacting pressure has reached the point where the powder is at the predetermined substantially solid state, at which point the downward pressure upon the main piston becomes in excess of the predetermined pressure of the spring loaded ball valve, this ball valve opens, and during the continued downward movement of the punch the main piston moves downwardly as a hydraulically supported cushion for the die. This downward movement continues until the press reaches its lower dead center position, as shown in Fig. 5. As the press moves upwardly and the pressure of the punch is lifted, the main piston moves upwardly under the pressure of the spring 25 and the secondary piston is moved downwardly with respect to the main piston under the pressure of the spring 61, this movement of the pistons causing the hydraulic fluid in the sump chamber to be drawn through the sump return valve filling the hydraulic cylinder as the main piston moves to its upper starting position, as shown in Fig. 3. During the movements of the pistons the contained air at the upper portion of the sump chamber and at the upper sides of the pistons flows through the weep hole ducts 43 and 62.

As the press moves to its upper position the punch 11 moves out of the charging block, and thereupon the die block is transferred to another station where the tracer bullet is removed therefrom by engaging a suitable ejecting tool in the ejector hole 14.

The form of the invention illustrated in the drawings and described herein is typical and illustrative only, and it is evident that the invention is capable of embodiments in other forms, all falling within the scope of the appended claims, which are to be broadly construed.

What is claimed is:

1. In a support for a die, or the like, wherein the die or the like has an article ejecting passage in its underside, a main die supporting member adapted to have movement in line with the direction of pressure applied to the die, a secondary supporting member having parallel movement relatively to said main die supporting member and engageable in said ejecting passage of said die to engage and support the article therein, supporting means for said die supporting member, sustaining means cooperating between said supporting member and said main and secondary supporting means having a predetermined sustaining pressure, and releasing means for said sustaining means adapted to release said sustaining pressure when the pressure on the die exceeds a predetermined point.

2. In a support for a die, or the like, wherein the die or the like has an article ejecting passage in its underside, a main die supporting member adapted to have movement in line with the direction of pressure applied to the die, and including a main hydraulic piston, a hydraulic cylinder for said piston, a secondary supporting member having parallel movement relatively to said main die supporting member and engageable in said ejecting passage of said die to engage and support said article therein, and including a secondary hydraulic piston operatively connected to said

hydraulic cylinder, said hydraulic cylinder being engaged by said main piston whereby hydraulic sustaining pressure is applied to said main piston and said secondary piston, and releasing means for the hydraulic fluid in said cylinder operable to release said fluid when the pressure on the die exceeds a predetermined point.

3. In a support for a die, or the like, wherein the die or the like has an article ejecting passage in its underside, a main die supporting member adapted to have movement in line with the direction of pressure applied to the die, and including a main hydraulic piston and a hydraulic cylinder therefor, a secondary supporting member having projecting and retracting parallel movement relatively to said main die supporting member and engageable through projection in said ejecting passage of said die to engage and support said article therein, and including a secondary hydraulic piston operatively connected to said hydraulic cylinder, said hydraulic cylinder being engaged by said main piston whereby hydraulic sustaining pressure is applied to said main piston and said secondary piston, yieldable means normally retaining said secondary supporting member in retracted position and yieldable under a predetermined projecting pressure applied to said secondary piston through hydraulic pressure in said cylinder, and releasing means for the hydraulic fluid in said cylinder operable to release said fluid when the pressure on the die exceeds a predetermined point.

4. In a support for a die, or the like, wherein the die or the like has an article ejecting passage in its underside, a main die supporting member adapted to have movement in line with the direction of pressure applied to the die, and including a main hydraulic piston and a hydraulic cylinder therefor, a secondary supporting member having parallel movement relatively to said main die supporting member and engageable in said ejecting passage of said die to engage and support said article therein, and including a secondary hydraulic piston operatively connected to said hydraulic cylinder, said hydraulic cylinder being engaged by said main piston whereby hydraulic sustaining pressure is applied to said main piston and said secondary piston, releasing means for the hydraulic fluid in said cylinder operable to release said fluid when the pressure on the die exceeds a predetermined point, and spring means arranged between said cylinder and said main piston adapted to impart return movement thereto upon lifting of the pressure on the die.

5. In a support for a die, or the like, wherein the die or the like has an article ejecting passage in its underside, a main die supporting member adapted to have movement in line with the direction of pressure applied to the die, and including a main hydraulic piston and a hydraulic cylinder therefor, a secondary supporting member having projecting and retracting parallel movement relatively to said main die supporting member and engageable through projection in said ejecting passage of said die to engage and support said article therein, and including a secondary hydraulic piston operatively connected to said hydraulic cylinder, said hydraulic cylinder being engaged by said main piston whereby hydraulic sustaining pressure is applied to said main piston and said secondary piston, yieldable means normally retaining said secondary supporting member in retracted position and yieldable under a predetermined projecting pressure applied to said secondary piston through hydraulic pressure in said cylinder, releasing means for the hydraulic fluid in said cylinder operable to release said fluid when the pressure on the die exceeds a predetermined point, and spring means arranged between said cylinder and said main piston adapted to impart return movement thereto upon lifting of the pressure on the die.

6. In a support for a die, or the like, wherein the die or the like has an article ejecting passage in its underside, a main die supporting member adapted to have movement in line with the direction of pressure applied to the die, and including a main hydraulic piston and a hydraulic cylinder therefor, a secondary supporting member having projecting and retracting parallel movement relatively to said main die supporting member and engageable through projection in said ejecting passage of said die to engage and support said articles therein, and including a secondary hydraulic piston communicating with said cylinder, said hydraulic cylinder being engaged by said main piston whereby hydraulic sustaining pressure is applied to said main piston and said secondary piston, yieldable means normally retaining said secondary supporting member in retracted position and yieldable under a predetermined projecting pressure applied to said secondary piston through hydraulic pressure in said cylinder, a fluid receiving chamber in connection with said cylinder, a spring-loaded valve controlling the flow of fluid from said cylinder to said chamber operable to release said fluid from said cylinder when the pressure on the die exceeds a predetermined point, and a return check valve permitting flow of said fluid from said chamber to said cylinder, and spring means arranged between said cylinder and said main piston adapted to impart return movement thereto upon lifting of the pressure on the die.

7. In a support for a die, or the like, wherein the die or the like has an article ejecting passage in its underside, a main die supporting member adapted to have movement in line with the direction of pressure applied to the die having an axial bore, and including a main hydraulic piston and a hydraulic cylinder, said piston having a secondary piston chamber in its face extending to said axial bore and communicating with said cylinder, a secondary supporting member having parallel movement in said axial bore relatively to said main die supporting member and engageable in said ejecting passage of said die to engage and support said article therein, and including a secondary hydraulic piston engaged in said secondary piston chamber, said hydraulic cylinder being engaged by said main piston whereby hydraulic sustaining pressure is applied to said main piston and said secondary piston, and releasing means for the hydraulic fluid in said cylinder operable to release said fluid when the pressure on the die exceeds a predetermined point.

8. In a support for a die, or the like, wherein the die or the like has an article receiving pocket in its upper side, and an article ejecting passage in its underside having a smaller lateral area than the lateral area of said pocket, a main die supporting member adapted to have movement in line with the direction of pressure applied to the die, and including a main hydraulic piston and a hydraulic cylinder therefor, a secondary supporting member having parallel movement relatively to said main die supporting member and engageable in said ejecting passage of said die to engage and support said article therein, and including a

secondary hydraulic piston connected to said hydraulic cylinder, the ratio of the areas of said main and secondary pistons being substantially equal to the ratio of said lateral area of said pocket to said lateral area of said ejecting passage, said hydraulic cylinder being engaged by said main piston whereby hydraulic sustaining pressure is applied to said main piston and said secondary piston, and releasing means for the hydraulic fluid in said cylinder operable to release said fluid when the pressure on the die exceeds a predetermined point.

9. In a support for a powder compacting die for bullet jackets, wherein the die has a bullet jacket receiving pocket in its upper side and an ejecting passage in its underside, a main die supporting member adapted to have movement in line with the direction of pressure applied to the powder containing bullet jacket in said die, and including a main hydraulic piston and a hydraulic cylinder therefor, a secondary supporting member having parallel movement relatively to said main die supporting member and engageable in said ejecting passage of said die to engage and support said bullet jacket therein, and including a secondary hydraulic piston communicating with said hydraulic cylinder, said hydraulic cylinder being engaged by said main piston whereby hydraulic sustaining pressure is applied to said main piston and said secondary piston, and releasing means for the hydraulic fluid in said cylinder operable to release said fluid when the compacting pressure on the powder exceeds a predetermined point.

10. In a support for a powder compacting die for bullet jackets, wherein the die has a bullet jacket receiving pocket at its upper side and a cylindrical ejecting passage in its underside into which the bullet jacket point projects, the lateral area of said passage being substantially smaller than the lateral area of the upper portion of said pocket, a main die supporting member adapted to have movement in line with the direction of pressure applied to the die, and including a main hydraulic piston and a hydraulic cylinder therefor, a secondary supporting member having parallel movement relatively to said main die supporting member having a pocket formation in its end engageable in said ejecting passage of said die to engage and support the point of the bullet jacket therein, and including a secondary hydraulic piston communicating with said hydraulic cylinder, the ratio of the areas of said main and secondary pistons being substantially equal to the ratio of said lateral area of said pocket to said lateral area of said ejecting passage, said hydraulic cylinder being engaged by said main piston whereby hydraulic sustaining pressure is applied to said main piston and said secondary piston, and releasing means for the hydraulic fluid in said cylinder operable to release said fluid when the compacting pressure on the powder exceeds a predetermined point.

CHARLES O. BALLOU.

CERTIFICATE OF CORRECTION.

Patent No. 2,345,552. April 4, 1944.

CHARLES O. BALLOU.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, line 23, for the word "deeped" read --deeper--; line 64, for "sealing" read --seating--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 15th day of August, A. D. 1944.

Leslie Frazer

(Seal) Acting Commissioner of Patents.

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