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R. B. WILLI
APPARATUS FOR COMPACTING AND EJECTING FLANGED
ARTICLES BY SINGLE PLUNGER ACTION

2,821,748

Filed May 8, 1953

2 Sheets-Sheet 1

FIG. 1

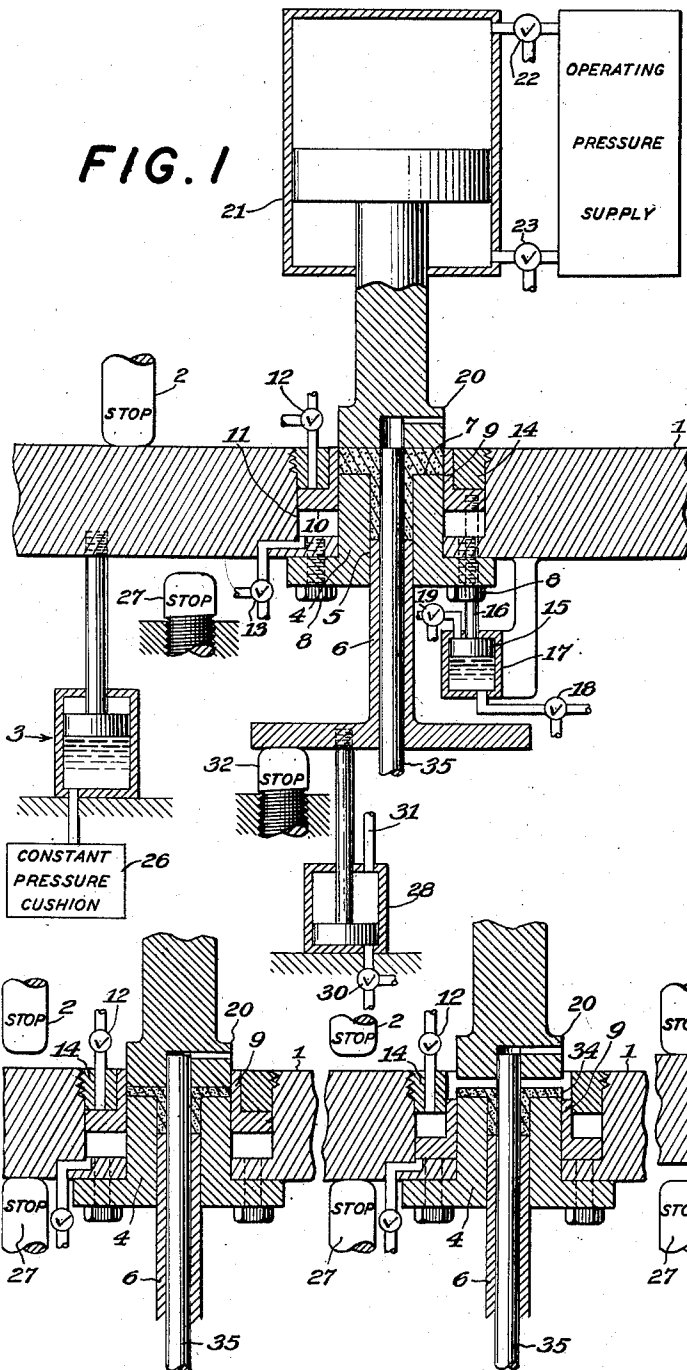


FIG. 2

FIG. 3

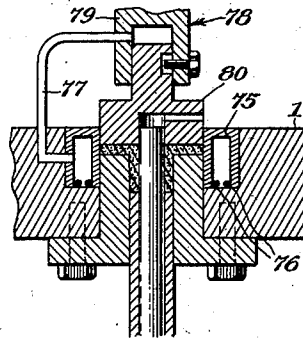
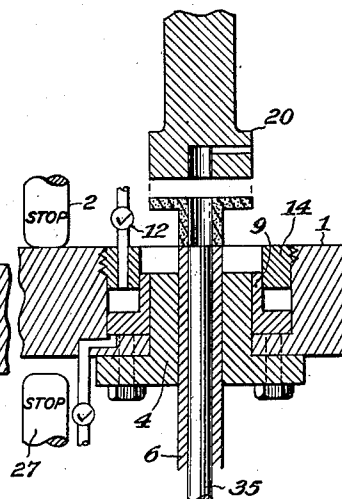


FIG. 11

FIG. 4



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FIG. 5

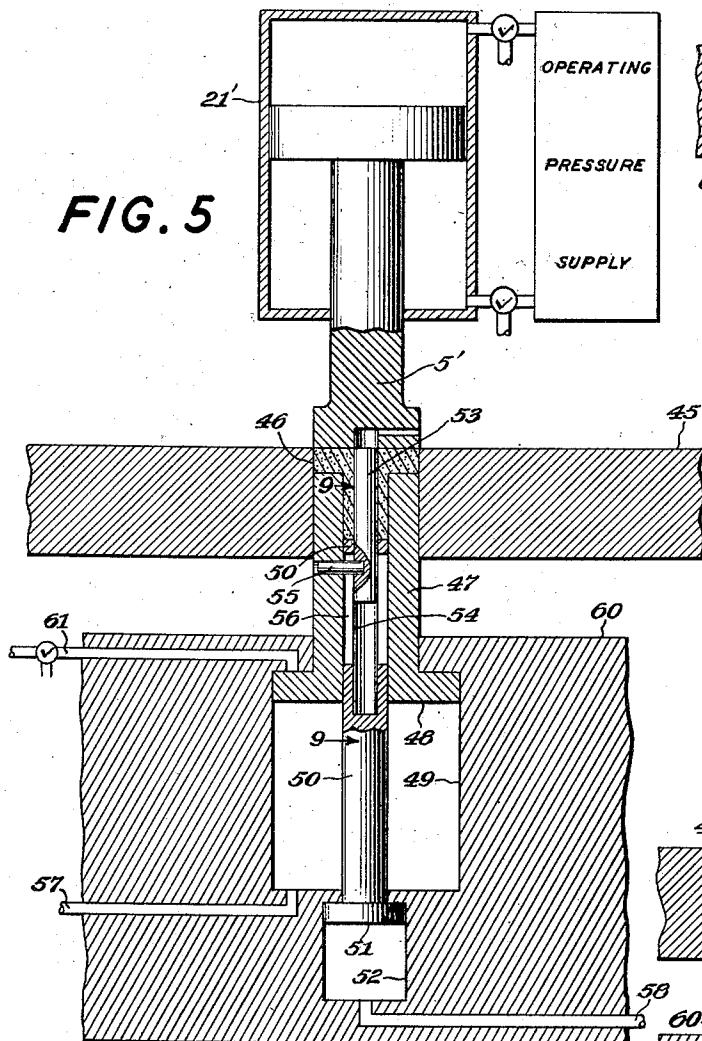


FIG. 10

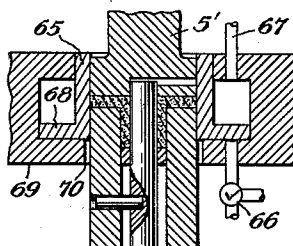


FIG. 9

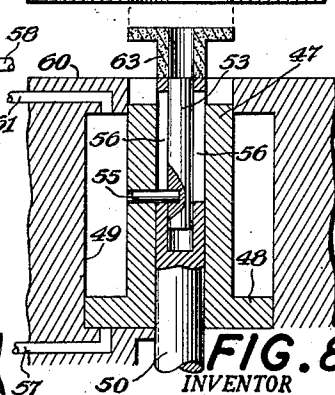
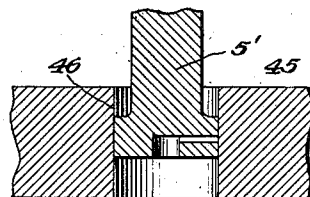
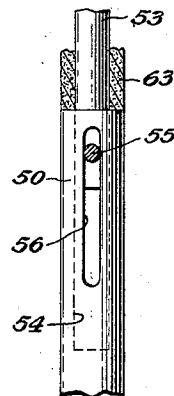


FIG. 8

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FIG. 6

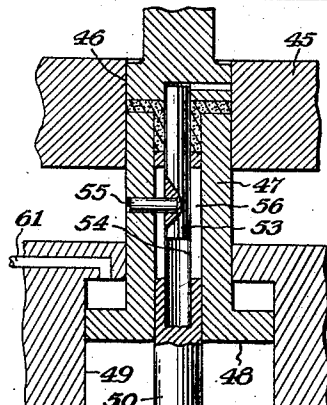
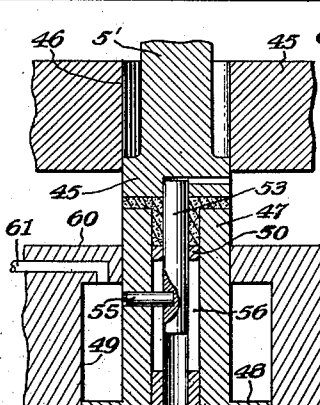


FIG. 7



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APPARATUS FOR COMPACTING AND EJECTING FLANGED ARTICLES BY SINGLE PLUNGER ACTION

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4 Claims. (Cl. 18-16.7)

This invention relates to pressing apparatus for forming flanged articles from loose materials such, for example, among others, as powdered metal.

It has heretofore been proposed to form flanged articles by employing a top punch and a plurality of movable concentric lower plungers disposed with their ends at offset die levels within a die cavity to form the flange and body. To eject such a formed article the top punch is raised and the two lower plungers then function as dual ejection plungers by being moved simultaneously for a certain distance while in their offset relation and then one of these plungers is moved by itself to complete ejection of the article. To perform these ejection movements of the two plungers requires actuating and control mechanisms of considerable precision of construction and operation to insure that the plungers move exactly simultaneously during the initial ejection movement in order to avoid cracking the flange of the article by introducing into the flange either bending forces arising from sliding frictional contact with the die wall or shearing forces arising from any relative movement between the dual concentric plungers at a time when only simultaneous ejection movement should be present.

It is an object of my invention to provide improved pressing apparatus that eliminates the hazards of dual plunger ejection by employing a single plunger for effectively ejecting the formed article from its die without the possibility of breaking the flange during the ejection operation.

A still further object is to provide an improved press with a single plunger for effectively and safely ejecting a formed article from its die and that is relatively simple and economical in construction, operation and maintenance and which has a high degree of precision for forming the article but does not require precision operating mechanism for the ejection.

Other objects and advantages will be more apparent to those skilled in the art from the following description of the accompanying drawings in which:

Fig. 1 is a diagrammatic partial sectional view of a pressing apparatus embodying my invention and showing the die cavity as initially filled;

Fig. 2 is a fragmentary section showing the article fully compressed;

Fig. 3 is a view similar to Fig. 2 but showing an initial stripping operation while the lower plunger remains stationary;

Fig. 4 shows the ejection of the article by the single movable lower plunger;

Fig. 5 is a modification employing a plurality of lower concentric plungers and a single top plunger whose operation broadly embodies certain of the ejection functions of the preferred modification of Figs. 1 to 4;

Fig. 6 is a partial view in section showing the flanged article fully compressed;

Fig. 7 is a further view showing the article ejected from the die cavity by the single top plunger while all

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of the plungers are maintained in their same fixed relation;

Fig. 8 is a further view showing a stripping operation of the formed article by one of the concentric plungers;

Fig. 9 is a fragmentary section taken substantially on the line 9-9 of Fig. 5;

Fig. 10 is a modification incorporating features of each of the previous modifications; and

Fig. 11 is a further modification of a die having a radially movable wall portion for releasing the edge of the flange.

In the modification shown in Figs. 1 to 4, I have provided a preferably floating die platen 1 normally biased upwardly against a stop 2 by a constant pressure piston and cylinder cushion 3. The die cavity consists of a member 4 fixed at all times with respect to platen 1 and provided with a bore 5 to receive a single lower plunger 6 for compressing the body of the article within bore 5. The upper shoulder 7 of member 4 forms one side of the flange of the article. The member 4 and its annular surface 7 could be formed as an integral part of the die portion of platen 1 but for the purpose of making different sizes of articles this member is preferably made removable as by bolts 8 secured in platen 1 and is axially adjustable by screw threads or shims between the platen 1 and flanges of member 4 thereby to vary the depth of the article body.

The upper portion of the die cavity is formed by a flange controlling sleeve 9 of circular form and telescopically mounted on the outer surface of member 4, the lower end of the sleeve being provided with a piston head 10 movable in a cylinder 11 which is supplied at its opposite ends with operating fluid pressure through passages controlled by three-way valves 12 and 13. An annular bushing 14 is threadedly secured in the die platen 1 to permit insertion of the piston 10 in its cylinder. Normally the sleeve is held in its upper position as shown in Fig. 1. The piston 10 can be supplemented by an external piston 15 connected by rod 16 to sleeve 9 while a cylinder 17 is suitably supported on die platen 1 to float therewith. Any number of such pistons and cylinders can be used and symmetrically arranged. Operating pressure to these cylinders would be admitted through passages controlled by three-way valves 18 and 19. Of course the piston and cylinder 15 and 17 could be used in place of piston 10. The top punch 20 is operated by any suitable mechanical or hydraulic power means shown herein for purposes of illustration as a piston and cylinder 21 supplied with operating pressure through passages controlled by three-way valves 22 and 23. Piston and cylinder 3 permits die platen 1 to float downwardly against a constant pressure cushion 26 which can be of the hydro-pneumatic type. Downward movement of the platen is limited by a vertically adjustable threaded stop 27. The bottom plunger 6 may be moved upwardly for an ejection operation either mechanically or hydraulically diagrammatically illustrated by a piston and cylinder 28 actuated by operating pressure supplied through a passage controlled by a three-way valve 30 while a source of constant pressure may be supplied through passage 31 to bias plunger 6 downwardly against a vertically adjustable threaded stop 32.

In operation the various elements will be initially in the position shown in Fig. 1 in which the die cavity is filled with loose material. The punch 20 will, of course, have been raised to permit filling of the cavity. Downward movement of punch 20 to the position shown in Fig. 2 compresses the material into the desired form of article during which time floating platen 1 moves downwardly over the stationary lower plunger 6 to permit uniform compaction of the material from its top and bottom plungers. Thereupon the flange control sleeve 9,

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as shown in Fig. 3, is moved downwardly by pressure supplied through valve 12 while the punch 20 is preferably first raised from contact with the formed article. The edge surface of the flange 34 of the article is thus stripped of its contact with the cavity wall-forming surface of sleeve 9. Hence, upon complete lifting of punch 20 the single lower actuating plunger 6 can be raised by the piston and cylinder 28 to eject the formed article as shown in Fig. 4 so that the flange is free of any destructive bending or shearing forces during ejection movement within the die by the actuating plunger 6. A stationary core rod 35 will at all times remain with its upper end in the plane of die platen 1 when in its raised position of Fig. 1. The lower plunger 6 will be raised to this same plane as shown in Fig. 4 during the ejection operation thereby permitting the article to be readily removed.

In the modification shown in Figs. 5 to 9, a fixed die platen 45 has a die cavity 46 with a top punch and operating mechanism identical to those of the first modification. An outer concentric plunger 47 is provided with a piston 48 operable within a stationary cylinder 49 while an inner plunger 50 is provided with a piston 51 in a stationary cylinder 52. The lower ends of cylinders 49 and 52 are supplied with constant fluid pressure to serve as a cushion. The core rod 53 slides within a bore 54 of inner plunger 50 and is rigidly connected to the outer plunger by a pin 55. This pin extends through a vertical slot 56 formed in the wall of the inner plunger.

In the operation of Figs. 5 to 9 the inner and outer lower concentric plungers are initially in the positions shown in Fig. 5 and the top punch 5' is raised by power means 21' (similar to 21) to permit the die cavity to be filled whereupon the top punch is moved downwardly to compress the powdered material against the yielding cushioning movement of the outer concentric plunger to the position shown in Fig. 6, the inner plunger 50 preferably being held in its initial position of Fig. 5 during the compression operation. The degree of cushion pressures in cylinders 52 and 49 determines the extent to which their pistons are held before yielding, these pressures being supplied from hydro-pneumatic cushions connected through passages 57 and 58. Notwithstanding that I employ dual concentric lower plungers I still effect ejection by a single actuating plunger and thus avoid the hazards of dual plunger ejection. This is done by continuing downward movement of the top punch so that it ejects the flanged article from the bottom of the fixed die platen 45 to the position shown in Fig. 7, the cushion pressures in cylinders 49 and 52 being such as to permit the dual bottom plungers to be yieldingly actuated under the actuating ejection movement of top punch 5'. To release the article after its ejection from the die, operating fluid pressure is admitted to the top of cylinder 49 through a pipe 61 to move the outer concentric plunger 47 downwardly together with the core rod 53 by reason of its pin connection 55 until the outer plunger is stripped down over the outside of the body 63 of the article as shown in Fig. 8. It will be noted that at the end of this movement the core rod 53 and the top of inner plunger 50 both lie in the plane of the top surface of stationary platen 60 so that the article can be readily removed. The pin 55 engages the lower end of slot 56 so that the constant pressure in cylinder 52 cannot raise plunger 50 until the operator allows piston 48 to raise. The top plunger 5' is preferably raised during the foregoing stripping action.

During ejection in the modification of Figs. 5 to 9 it will be noted that the actuating ejection movement of plunger 5' causes the lower dual plungers to be actuated thereby and hence the article flange is controlled by being supported from the lower dual plungers so that the flange while within the die is free of bending and shearing forces during the ejection movement.

In Fig. 10 I have utilized a stripping sleeve 65 in combination with the downward ejection arrangement of Figs. 5 to 9. To strip the sleeve from a formed flange

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in this modification the sleeve is moved upwardly by operating pressure from a suitable source controlled by a valve 66, acting against a constant cushion pressure supplied through a pipe 67 to the upper end of the chamber containing an operating piston 68 of the sleeve 65. The die platen 69 is slightly annularly recessed at 70 so that when sleeve 65 is raised it completely strips the flange, there then being full clearance for the depth of the die to permit the actuating top plunger 5' to move freely the article together with the inner and outer lower concentric plungers to eject the article downwardly from the bottom of the die cavity.

In the modification shown in Fig. 11, a radially movable flange controlling sleeve 75 is provided in place of the axially movable sleeve. The member 75 is of U-shape in cross section and cylindrical in plan view, the lower free ends of the U-shaped member being adequately sealed by flexible sealing rings 76. Fluid pressure may be admitted to or discharged from the sleeve interior through a passage 77 connected to a piston and cylinder 78 interposed between the top piston rod 79 and the top punch 80. Upon downward compressing movement of the top piston, pressure is generated by piston and cylinder 78 and thereby moves the inner flexible wall of the sleeve slightly inward to a flange forming position and upon raising the top piston the reduction of pressure in cylinder 78 will allow the resilience of the sleeve to contract away from the flange to free the same for ejection purposes. The compressing and ejection functions of the various plungers are otherwise the same as in the other modifications having similar plungers.

From the foregoing disclosure of the several modifications it is seen that I have provided very effective means whereby flanged articles may be ejected by movement of a single actuating plunger without introducing any destructive bending or shearing forces in the flange. This desirable single plunger operation is obtained even where, as in certain of the modifications, I employ the dual bottom plungers. In this case, movements of the plungers are of an actuated nature, instead of actuating, by reason of being subordinated to the initiating movement of the single top plunger. In the various modifications I am also able to obtain a compacting action at both ends of the article body thereby to produce a uniform density in the body. Even with compaction at opposite ends of the body I effectively eject the article from either the top or bottom of the die cavity by a single plunger action while at the same time controlling the flange so that it is free from damaging forces. This single plunger ejection operation completely eliminates the need of multiple ejection cams or other multiple power motors which have heretofore been required for sequentially effecting simultaneous and relative movements of dual plungers when they are used as actuating plungers for the ejection operation.

It will, of course, be understood that various changes in construction and arrangement of parts may be made by those skilled in the art without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. A pressing apparatus for forming from powdered material an article having a body and a flange comprising, in combination, a die platen having an axially extending die cavity, having two portions of different diameter joined by a stationary lateral shoulder against which the flange of the article is to be formed, a plunger extending into the smaller diameter portion of the cavity from the end thereof remote from said shoulder to compress one end of the article body, a plunger receivable in the larger diameter end of the die cavity in opposed relation to said shoulder to compress the entire flange against said shoulder and to compress the other end of the body, means for effecting an axial stripping movement relatively between the die and flange while the underside of the flange is supported by said shoulder until the flange is free within

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the die cavity thereby preventing the possibility of any bending or shearing forces being induced in the flange during subsequent ejection of the article, and means for ejecting the formed article from the die cavity by moving said plunger which is in the smaller diameter portion of the cavity as an actuating ejection element.

2. The combination set forth in claim 1 further characterized in that the flange stripping means comprises an axially movable sleeve which forms the wall against which the edge of the flange is formed, and means for axially moving said sleeve to strip it from the formed flange while the flange is supported on the shoulder.

3. The combination set forth in claim 1 further characterized in that the means forming the shoulder has a cylindrical outer surface, and the flange stripping means comprises a sleeve telescopically movable over said cylindrical surface so that the sleeve is stripped from the formed flange while the flange is supported on said shoulder whereupon movement of the actuating ejection plunger moves the formed article out of the die cavity with the flange entirely free of any friction at its edge.

4. A pressing apparatus for forming from powdered material an article having a body and a flange comprising, in combination, a die platen having an axial bore therein, an axially movable sleeve disposed within said bore to define the peripheral flange wall of the die cavity, means

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forming a shoulder integrally connected to the die platen and extending inwardly from said sleeve to support the underside of the flange, said shoulder forming means having an axial bore to form the article body, an ejection plunger disposed within said body bore, a plunger extending into the sleeve to compress powdered material therein in opposition to the other plunger, and means for ejecting the formed article from the die cavity by moving the annular member until it is axially free of the flange and then ejecting the article from the body bore by the ejection plunger.

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