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Smith et al.

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[45] **May 15, 1973**

[54] **DEFLECTION COMPENSATION SYSTEM FOR PRESS**

[75] Inventors: **Joseph E. Smith,** Birmingham; **Georges D. DeTroyer,** Grosse Ile; **Raymond P. DeSantis,** Royal Oak, all of Mich.

[73] Assignee: **Wolverine-Pentronix, Inc.,** Lincoln Park, Mich.

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[52] **U.S. Cl.** **425/78,** 425/345, 425/406, 425/414

[51] **Int. Cl.** **B30b 11/04**

[58] **Field of Search**.....425/78, 168, 128, 425/351, 414, 214, 141, 149, 344, 415, 195

[56] **References Cited**

UNITED STATES PATENTS

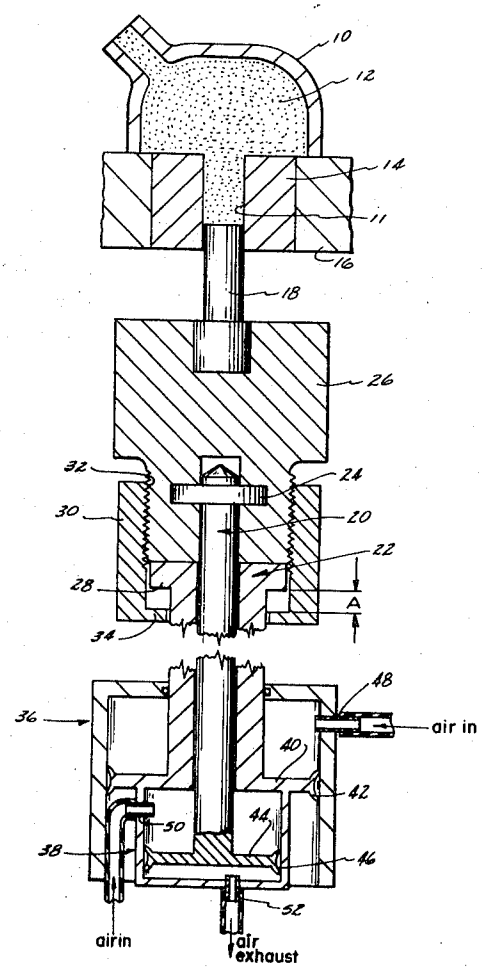
2,762,178	9/1956	Haller	425/414 X
2,810,929	10/1957	Willi	425/78 X
2,821,748	2/1958	Willi	425/78
2,932,063	4/1960	Belden et al.	425/414 X
3,149,373	9/1964	Gehl	425/128
3,154,812	11/1964	Haller	425/78
3,168,759	2/1965	Johannigmon	425/78
3,172,156	3/1965	Belden	425/78
3,191,232	6/1965	Haller	425/78
3,337,916	8/1967	Smith	425/351
3,464,089	9/1969	Smith	425/78
3,524,220	8/1970	Davison	425/78
3,561,056	2/1971	Smith et al.	425/168 X
3,611,498	10/1971	Hedin	425/414
3,647,332	3/1972	Schmaus	425/78
3,664,784	5/1972	Sibley	425/351 X
3,669,582	6/1972	Smith	425/78
3,671,164	6/1972	El Hara et al.	425/414
3,671,157	6/1972	Smith	425/78

Primary Examiner—J. Howard Flint, Jr.
Attorney—Robert C. Hauke, et al.

[57] **ABSTRACT**

A system for providing for compensation for deflection during a compacting press operation. The system is operable in conjunction with a separate inner and outer ram arrangement so that immediately after press operation and throughout the press eject operation there is provided a preloading of the inner ram upwardly in supporting relationship to the part. A predetermined space is provided between the inner and outer rams. The particular space adjustment means provided for deflection compensation also permits adjustment where it is necessary to provide overfill or underfill where these conditions are required.

5 Claims, 5 Drawing Figures



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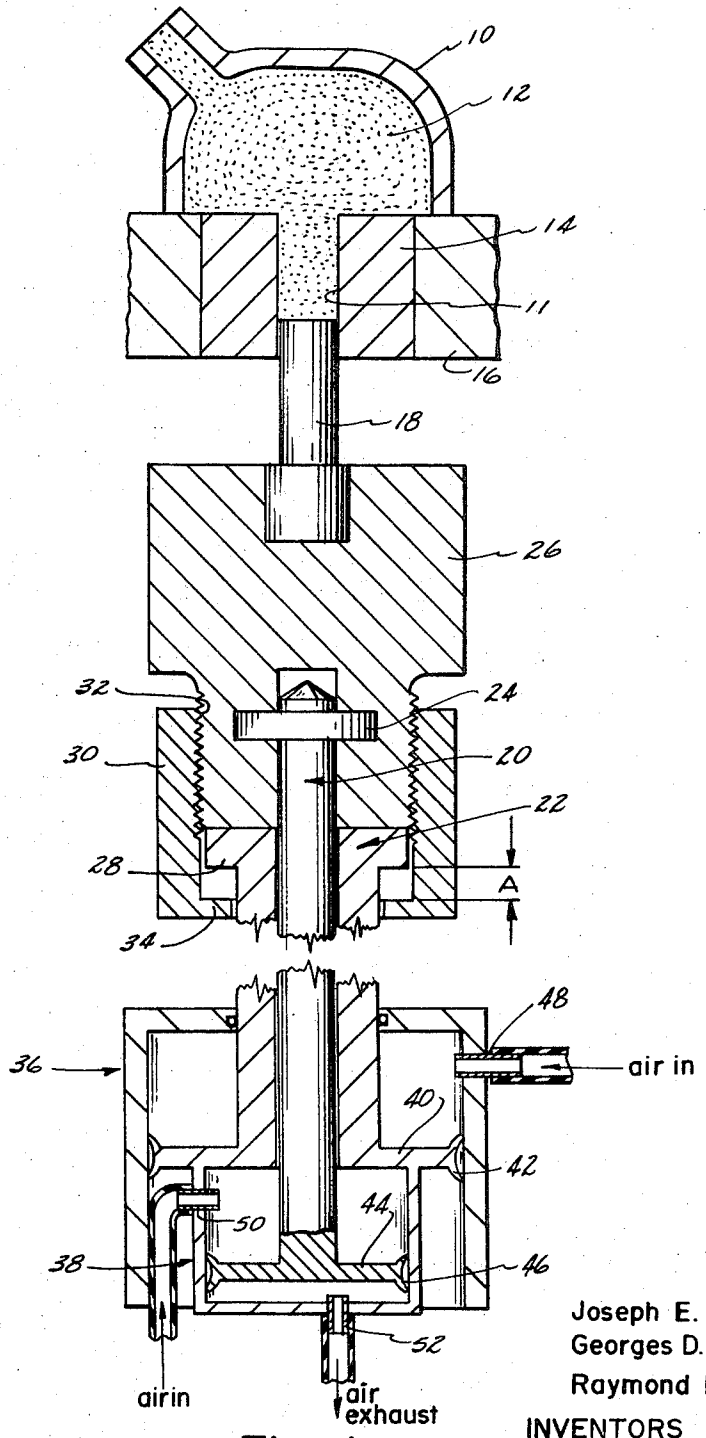
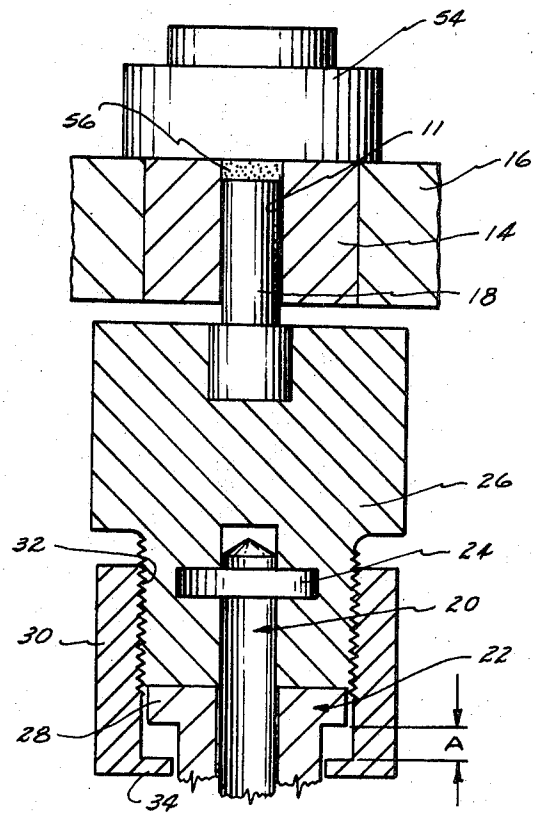


Fig-1

Joseph E. Smith
Georges D. DeTroyer
Raymond P. DeSantis
INVENTORS
BY
Hauke Gifford & Patalidis
-Attorneys-



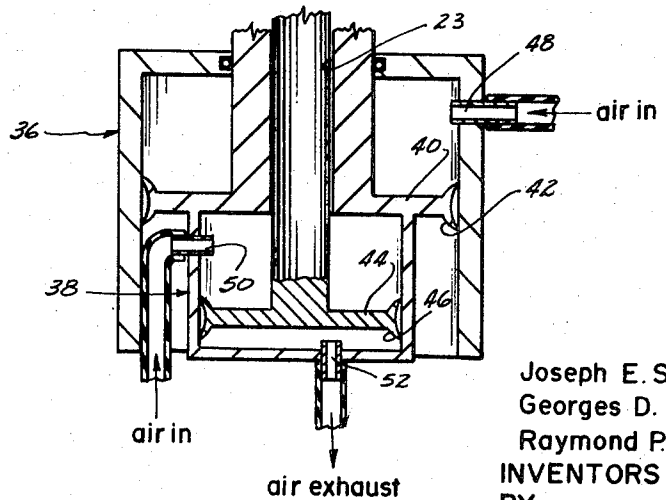
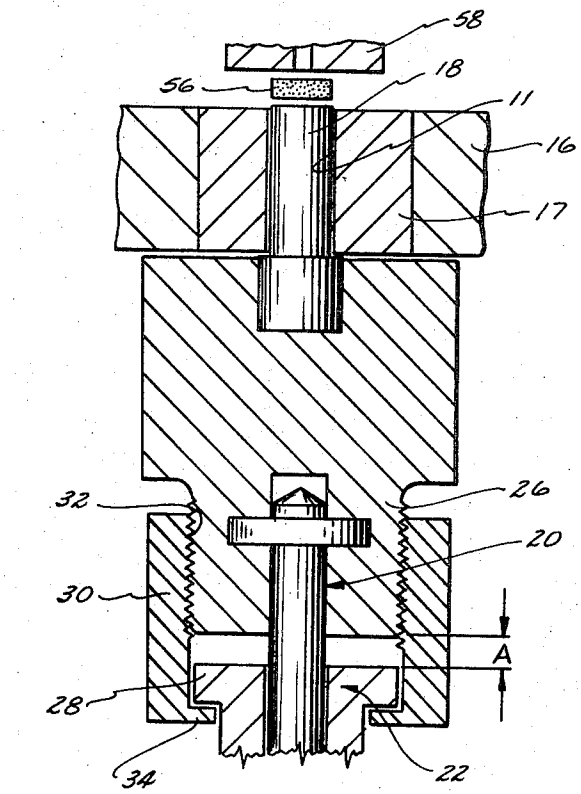


Fig-2

Joseph E. Smith
Georges D. DeTroyer
Raymond P. De Santis
INVENTORS
BY
Hauke Gifford & Patalidis
-Attorneys-



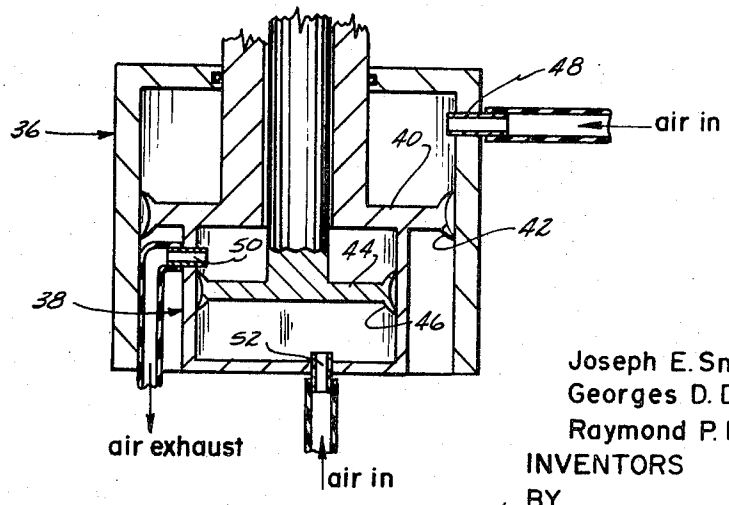


Fig-3

Joseph E. Smith
Georges D. Detroyer
Raymond P. DeSantis
INVENTORS
BY
Hauke Gifford & Patalides
-Attorneys-

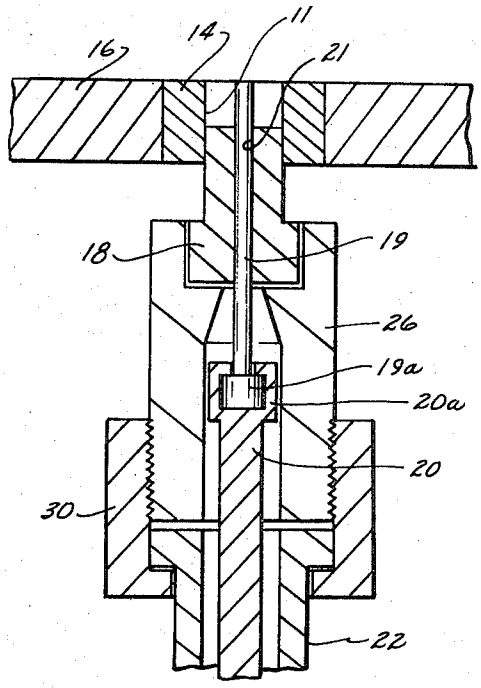


Fig-4

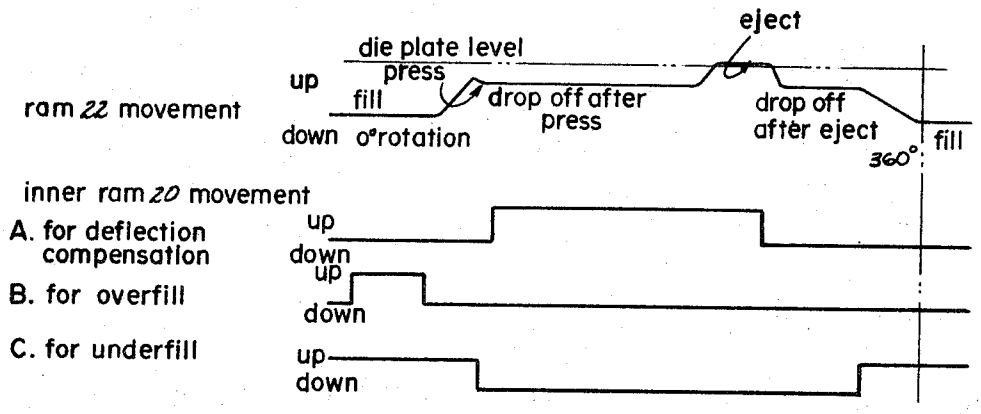


Fig-5

Joseph E. Smith
Georges D. DeTroyer
Raymond P. DeSantis
INVENTORS
BY
Hauke Gifford & Patalidis
-Attorneys-

DEFLECTION COMPENSATION SYSTEM FOR PRESS

BACKGROUND OF THE INVENTION

In precision press operation, particularly where the parts are relatively thin and fragile and are subject to tight tolerances such as for example integrated circuit substances, it is necessary to provide some arrangement to relieve the initial press force by which the compacting is accomplished. Various types of ram construction to relieve the press force have been provided, which include complex resilient tool punch constructions and cushioning air arrangements. Reference is made to U.S. Pat. No. 3,561,056 issued to Joseph E. Smith et al. for "Tool Set for Powder Compacting Press" for a showing of a press adaptable for us with the present invention. That patent is of common ownership with the present application.

BRIEF SUMMARY OF THE INVENTION

The present invention provides a deflection compensation system employing a particular adjustable spacing device coupled between the separate inner and outer press rams. As hereinbefore mentioned, after the powdered material has been compacted, the initial withdrawal of the punch force from the underside of the part may cause thin or fragile parts to be damaged by the suction effect created by the downward movement of the punch away from the part. In addition, the force of compacting during the press operation is typically transmitted through a cam mounted on a cam shaft and connected to one end of a lever-like treadle. During the press compacting stroke, a conSiderable load is exerted on the several internal elements of the machine. This causes these elements to deflect elastically a considerable amount. As soon as the punch is withdrawn from the part, these members return to their original state leaving a space between the part and the punch. This can cause damage to the part. The system according to the present invention allows the punch tool to remain in supporting contact with the compacted part after pressing without exerting any substantial force, while permitting relief of the greater part of the compacting pressure exerted on the part during the compacting process. In addition, the several movements of the press rams are controlled through a pneumatic cylinder arrangement which is particularly adapted for the double ram control and for the operation of the deflection compensation system according to the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention, together with its advantages and features, will be best understood by reference to the accompanying specification and to the several drawings in which like parts are referred to by like numerals, and wherein:

FIG. 1 is a longitudinal cross-sectional view of a press showing the various press parts in their fill operation position, with parts broken away to simplify the showing of the embodiment;

FIG. 2 is a view substantially similar to FIG. 1 in which the press and rams are illustrated in their press position;

FIG. 3 is a view substantially similar to those of FIGS. 1 and 2 but illustrating the eject position of the press and rams;

FIG. 4 is a cross-sectional view showing a somewhat modified embodiment of the present invention in which a modification of the parts is made to control core rod operation; and

FIG. 5 is a diagram illustrating the timing of the relative movements of the inner and outer rams during a full cycle of press operation.

DETAILED DESCRIPTION

FIG. 1 shows the basic ram and press parts which are ordinaril1 employed in a precision press for compacting powdered materials for use in computer memory cores, beads, pellets, porous bushings and the like. In the initial fill position, as it is shown in FIG. 1, a powdered material feed shoe 10 is placed over a die cavity 11 provided in a die bushing 14, which in turn is held in the die plate 16. The punch tool 18 is shown as it is positioned in the lower end of the die bushing 14 during the fill operation of the press. The press operating mechanism is shown below the punch tool 18 and incudes as its major parts a pair of separate rams, namely, an inner ram 20 and an outer ram 22. The inner ram 20 has formed near its upper end an annular extension 24, which is coupled through a series of intermediate elements to punch stem 26. The outer ram 22 has an annular extension at its upper end, denoted by the numeral 28. During the fill operation as illustrated in FIG. 1, the upper surface of the extension 28 of the outer ram 22 will be seen to be in engagement with the lower surface of the punch stem 26. A threaded nut 30 is mounted on a matching thread portion 32 formed on the outside diameter of the lower end of the punch stem 26. The threaded nut 30 further includes at its lower end a lip 34, which is adapted to retain the outer ram 22 in its drop-off position, as will be shown in FIG. 3 hereinafter. The nut 30 is adjustable by turning to vary the distance "A" to provide exactly the degree of compensation required for deflection during the subsequent press operations, as will be shown in FIGS. 2 and 3 hereinafter.

The biasing system for the inner ram 20 and outer ram 22 is shown at the bottom of the FIG. 1 drawing. The drive system is a pneumatic system, including an outer cylinder 36 and an inner air cylinder 38. It will be seen that the respective air cylinders serve to drive the inner ram 20 and the outer ram 22, one independently of the other or in unison depending upon the particular cycle of operation being carried out. It will be noted that the lower end of the outer ram 22 terminates in a cylindrical, annular extension 40, having around its outer edge a seal 42 engageable with the inner walls of the cylinder 36. There is formed centrally through the outer ram 22 a longitudinal, cylindrical opening 23, which telescopically retains the lower part of the inner ram 20 for reciprocal movement therein. The inner ram 20, terminating at its lower end in a cylindrical, annular extension 44, likewise has an outer seal 46 in slidable engagement with the inner surface of the inner air cylinder 38.

In the fill operation illustrated in FIG. 1, the air flow is, as indicated by arrows, inwardly through a pair of ports 48 and 50, formed in cylinders 36 and 38, respectively, with exhaust provided through a lower port 52 positioned at the bottom of the cylinder 38. Accordingly, there is a downward biasing force provided against both the inner ram 20 and the outer ram 22 to

permit the filling of the die plate **16** opening with the powdered material for the part.

FIG. **2** illustrates the parts in their position for a compacting press operation. At the upper end of the drawing, an anvil **54** has replaced the outer feed shoe **10.** The anvil **54** is positioned in abutment with the upper surface of the die plate **16.** Both the inner ram **20** and the outer ram **22** are provided with a downward, biasing force through the operation of the respective air cylinders **36** and **38** after the manner shown in FIG. **1.** In the press operation position, through a suitable cam operating mechanism not shown, the entire ram system including the rams **20, 22** and their associated parts are driven upwardly to apply a force to compact the part **56.** Reference may be made to the aforementioned U.S. Pat. No. 3,561,056 for an example of a cam operating mechanism suitable for ram operation. It will be noted that during the press operation, as shown in FIG. **2,** the projection **28** at the upper end of the outer ram **22** continues in engagement with the lower surface of the punch stem **26** as both rams are moved upwardly together in a press stroke.

FIG. **3** illustrates the position of the parts in the eject operation of the press. The pneumatic drive system, as illustrated in FIGS. **1** and **2,** has been changed and through a suitable valve control system the direction of air is as shown, with a continuous flow in at the ports **48** and **52** and at the same time air exhaust from the port **50.** In this manner immediately following the press operation, it will be seen that the inner ram **20** is provided with a continuing upward force to bias the punch **18** upwardly against the part **56,** while simultaneously the press force is relieved by a downward movement of the outer ram **22.** In addition, following the press operation and throughout the eject cycle, as illustrated in FIG. **3,** there is a drop-off of the outer ram **22** so that at its upper end the upper surface of extension **28** is out of contact with the lower end of the punch stem **26.** Spacing is predetermined by threaded nut **30** which provides a clearance preset with the spacing "A."

The eject operation includes positioning of a vacuum pickup head **58** adjacent to the upper end of the part **56** so that the part can be removed from the upper end of the die bushing. At the conclusion of the eject operation, the air flow path is restored to the same state as was illustrated in FIGS. **1** and **2,** with air flow in at the ports **48** and **50** and air flow out at the port **52.** Both the inner ram **20** and the outer ram **22** are again subjected to a downward biasing force in preparation for a repetition of the press sequence, beginning with the fill operation as it was illustrated in FIG. **1.**

FIG. **4** shows an alternate embodiment of the invention which provides a core rod **19** for providing a central opening in the part **56.** The parts are modified in the manner shown so that the core rod **19** is centrally journalled in a longitudinal opening **21** formed in the punch **18.** The cord rod **19** is connected to the upper end of the inner ram **20.** The connection includes a lower flange **19*a***, which is retained within a cylindrical opening **20*a*** at the enlarged upper end of the inner ram **20.** This connection permits the core rod **19** to move upwardly and downwardly independently of the movement of the tool punch **18.** This provides a distinct advantage where the parts formed are relatively long and densely compacted. It is possible to reduce the eject force, as well as core rod wear, by allowing the core rod **19** to be pulled up with the part during the eject operation until the expansion of the part **56** once out of the die cavity permits it to become freed from the core rod **19.** The core rod **19** is then retracted in the usual mode of operation downwardly with the inner ram **20.**

DESCRIPTION OF OPERATION

The description of operation will now be made with respect to the movements of the main operating elements, namely the inner ram **20** and the outer ram **22.** Reference is made to the timing diagram of FIG. **5** which substantially assists in clarifying the relative movement of the parts during the several different stages of operation. With respect to deflection compensation, it will be seen that at the beginning of the fill operation, both the inner ram **20** and the outer ram **22** are preloaded downwardly. This keeps the punch stem **26** lower surface against the upper end of the outer ram, as illustrated in FIG. **1.** This condition is also illustrated in FIG. **2** and it continues throughout the entire fill operation and until just after the press operation is completed. Immediately following the press operation and throughout the eject operation, thP inner ram **20** is preloaded upwardly so that the space "A" exists between the bottom end of the punch stem **26** and thP upper end of the outer ram **22.** This condition is best shown in the FIG. **3** drawing. It will be appreciated that the adjustment for the amount of deflection compensation may be readily accomplished by starting press operation with the threaded nut **30** up tight so that the space "A" does not initially exist. As press try-out is made, the nut **30** is gradually turned to increase the space "A" until the parts being produced cease to show any indication of "buckling." At this point, the deflection compensation setting is sufficient fo the parts being made and the nut **30** can be locked in this position.

As has already been indicated, the deflection compensation system and the adjusting nut **30,** together with the pneumatic ram drive arrangement disclosed, facilitate providing for overfill in the operation of the press. To provide for overfill, both the outer ram **22** and the inner ram **20** are preloaded downwardly in the usual manner with the punch stem **26** maintained in abutment against the upper surface of the outer ram **22.** The timing is different since relatively early in the fill position of the rams there is a drop-off of the inner ram **20.** The overfill operation is clarified in the timing diagram of FIG. **5,** with respect to the up and down movement of the inner ram **20.** The overfill arrangement pushes some of the powder material **12** back out of the filled cavity, into the powder feed shoe **10,** before it moves away at the conclusion of the fill operation. The amount of overfill may be adjusted by selective rotation of the threaded nut **30.**

For underfill operations, the inner ram **20** is preloaded upwardly from the start of the fill operation until the powder feed shoe **10** moves away from the die cavity. This timing is shown by the diagram of FIG. **5.** Just before the press operation is initiated the inner ram **20** is preloaded downwardly so that the load of powder material **12** in the cavity moves downwardly, thus creating an air space above it in the die bushing **14.** This particular mode of operation can be quite important when upper punches are used to allow the upper punch to enter the cavity without precompacting the powder from the top. Here again, the amount of underfill is readily preset by adjustment of the threaded nut **30.**

It will thus be seen that there has been provided an improved deflection compensation system for a compacting press, which system provides for ready adjustment for overfill and underfill in the manner desired. In a like manner, the deflection compensation system and ram arrangement can be simply altered to provide for core rod movement when it is required for production of an apertured part.

What is claimed is:

1. A deflection compensation system for a press for compacting powder materials by a tool through successive fill, press and eject operations, said deflection compensation system comprising a pair of concentric rams defining an inner ram rigidly connected to a support member for the tool and an outer ram operable independently of said inner ram and having an end engageable with an end of the tool support member means for biasing both rams downwardly during said fill operation; means for driving said outer ram during said press operation with the end of said outer ram in driving engagement with the end of said tool support member; said biasing means operative to continue the upward biasing of the inner ram and tool support member subsequent to retraction of the outer ram and during said eject operation; and adjustable spacing means disposed proximate the adjacent ends of said tool support member and said outer ram, said spacing member means comprising a sleeve member adjustably threaded on the end of the said tool support member, said sleeve member comprising an abutment engageable with said outer ram for maintaining the end of said tool support member and the end of said outer ram in relative longitudinal spaced relationship.

2. The combination as set forth in claim 1 wherein separate fluid biasing means are operatively connected to said inner and outer rams.

3. A deflection compensation system for a cyclically operated press comprising an inner ram and an outer ram telescopically disposed one within the other; a press tool holder and a press tool mounted on an end of said inner ram; an operating means for providing reciprocation of said outer ram toward and away from a part; first abutment means for rigidly coupling said outer and inner rams during reciprocation of said outer ram in a direction toward said part during a work cycle of said press; second abutment means for rigidly coupling said outer and inner rams during reciprocation of said outer ram away from said part; and controllable biasing means for controllably reciprocating one ram relative to the other within the limits provided by said first and second abutment means.

4. The deflection compensation system of claim 3 wherein said first and second abutment means are adjustable one relative to the other.

5. The deflection compensation system of claim 3 wherein said controllable biasing means comprises a cylinder mounted on one of said rams, a double acting piston mounted on the other of said rams reciprocable in said cylinder, and means for introducing fluid in said cylinder for reciprocating said piston.

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