Dec. 10, 1968 P. VINSON 3,414,940

TOOL CAPSULE FOR POWDER COMPACTING PRESS

Filed April 21, 1966 2 Sheets-Sheet 1

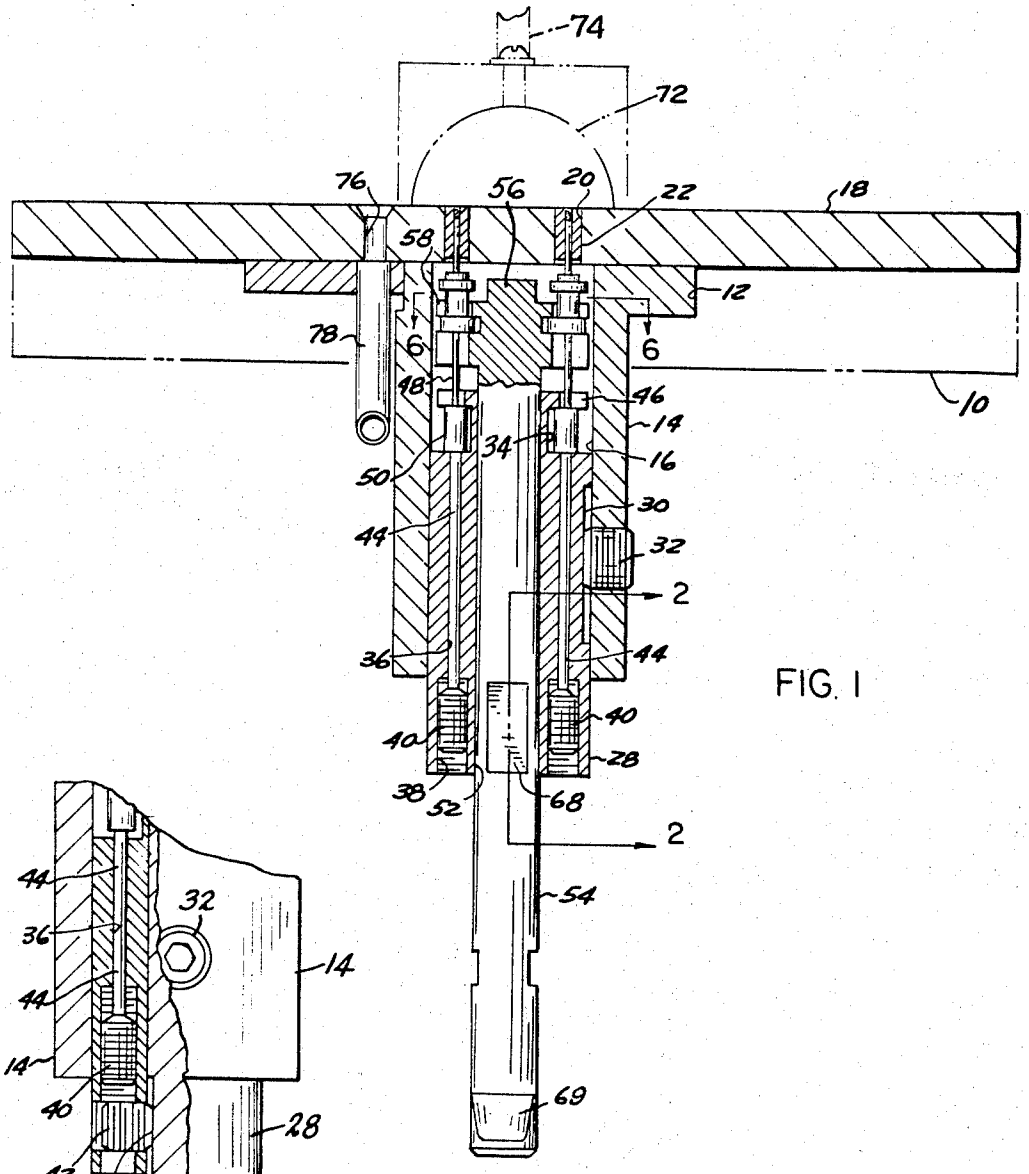


FIG. 1

FIG. 2

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FIG. 4

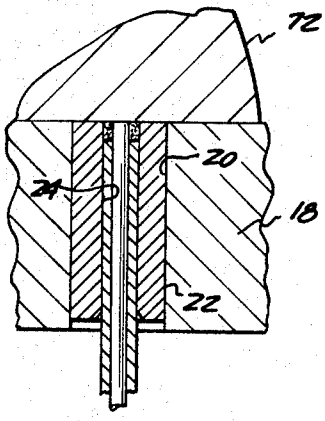
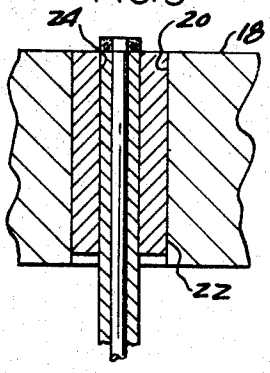


FIG. 5



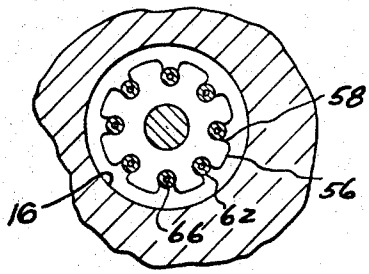
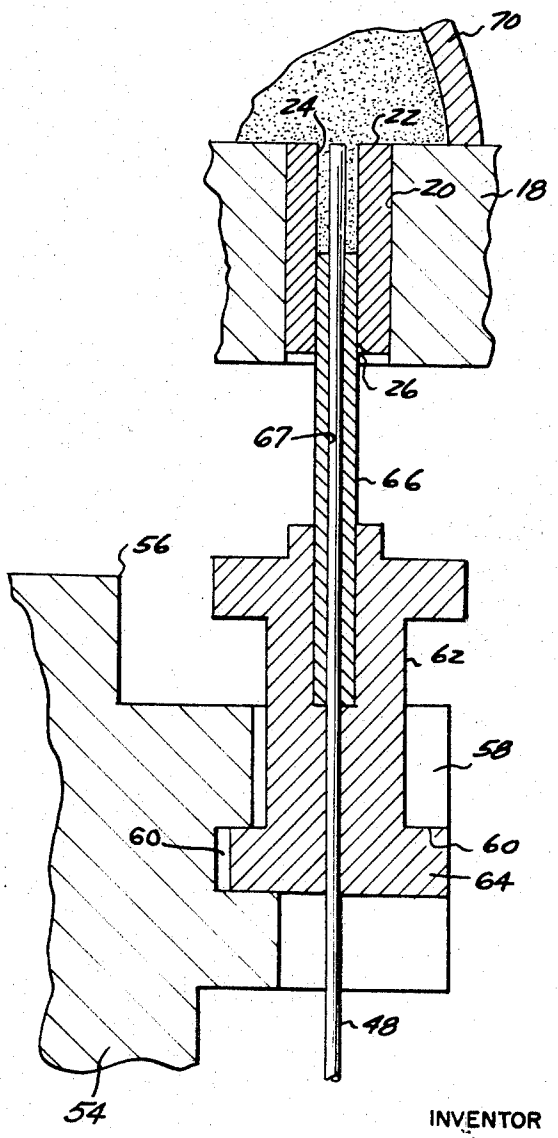


FIG. 6

FIG. 3



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TOOL CAPSULE FOR POWDER COMPACTING PRESS

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Filed Apr. 21, 1966, Ser. No. 544,285
2 Claims. (Cl. 18—16)

ABSTRACT OF THE DISCLOSURE

A unitary tool capsule for mounting on a powder compacting press and having a die plate provided with a plurality of die cavities, a housing disposed below the die plate and holding a plurality of hollow punches each disposed in one of the die cavities. The punches are collectively actuated by a common actuating member permitting free radial individual displacement of the punches, and a core rod is disposed within the longitudinal bore of each punch. The core rods are fixedly but adjustably mounted on the end of a sleeve which is in turn adjustably but fixedly mounted in the housing.

This invention relates to powder compacting presses and more particularly to an improved tool capsule assembly for such presses having means providing an accurate adjustment of the die cavity dimensions to insure a more precise dimensional control over the finished compacted article.

The present invention is an improvement over a tool capsule of the character provided as part of the powder compacting press disclosed in co-pending application Ser. No. 450,427 filed Apr. 23, 1965, now abandoned, in continuing applications Ser. Nos. 529,733 and 529,734, filed Feb. 24, 1966, now U.S. Patents 3,328,840 and 3,344,213, respectively, in continuing application Ser. No. 529,842, filed Feb. 24, 1966, now U.S. Patent No. 3,328-842, and in continuing application Ser. No. 618,230, filed Feb. 23. 1967. The powder compacting press described and claimed in the co-pending patent application consists of a machine for the purpose of manufacturing cores, beads, pellets, and the like made of powdered ferrite, glass, or other comparable powdered substances capable of forming a product upon the application of a pressure in a confined molding cavity. The primary purpose of the machine is the manufacture of computer memory cores which are normally toroidal, pills such as pharmaceuticals, balls for ball point pens, porous bearings and bushings, and the like. Computer memory cores and porous bearings, and bushings normally have a toroidal or cylindrical shape, while pharmaceuticals may take the form of tablets such as aspirin tablets, and balls for ball point pens are formed with a spherical shape.

Small compacted articles often require a high degree of dimensional control. For instance ferrite memory cores have dimensions ranging from approximately .005 to .015 inch in thickness, and from approximately .005 to .025 inch in diameter, and the tolerance of these dimensions normally must be held to within one tenth of a thousandths of an inch. In addition to dimensional control, the density of compacted articles of this character such as memory cores must also be held accurate, thereby making it necessary that the amount of powder placed in each die cavity of the press must be substantially the same and must be repetitively maintained within extremely close limits. The finished density of all the finished cores must be the same, that is, it must be uniform and accordingly, the compressing of the powdered material must be exact and repeatedly constant. If these dimensional and denstiy specifications are not held within close tolerances the play back level from the cores in a memory bank will not be substantially constant from core to core. In order to realize acceptable dimensional tolerances, it is necessary that the press be capable of accurate adjustment of the movements of several component parts within at least 15 millionths of an inch, and that precautions be taken to insure correct fill of each die cavity.

In the preferred embodiment of the powder compacting press as disclosed in the aforementioned co-pending application, the articles are compacted and formed in a multi-cavity die. The finished articles are automatically ejected from the die, picked up by a vacuum suction head and delivered into vials or bottles. A flipper assembly, which is part of the press, is mounted movably transversely over the die plate and carries a secondary powder hopper, an anvil, and a vacuum pick up head. The secondary powder hopper which is supplied with powder from a primary hopper connected thereto by means of a flexible tubing, is first positioned over the die cavities, which are filled with powder to overflow, the punches are displaced upwardly so as to expel from the die cavities a predetermined amount of excess powder, the hopper is removed while wiping the die plate surface clean from excess powder and replaced by the anvil which is in turn positioned on the upper surface of the die and over the die cavities.

The powder in each die cavity is then compacted against the anvil by the way of the punches. The anvil is removed from its position over the die cavities and replaced by the vacuum pick-up head. The punches are then displaced so as to bring their upper ends substantially flush with the opening of each die cavity, so that the finished compacted articles are ejected from the die cavities and picked up by the vacuum pick-up head. The vacuum pick-up head is then moved from over the die cavities and disposed over a series of apertures arranged in a disposition similar to the arrangement of the die cavities in the die, preferably in a circle, and the finished articles dropped through the apertures into separate vials or bottles.

In the aforementioned co-pending patent application, the preferred tool capsule for forming an article having a toroidal shape comprised a die plate having a plurality of equiangularly spaced bores arranged in a circle, a punch associated with each of the bores and adapted to be displaced in the bore to form a cavity for the powder between the head of the punch and the surface of the die plate, and a core rod associated with each of the punches and axially slidable in a longitudinal bore in the punch. During the compacting cycle, the core rod would be displaced upwardly in the cavity so that its head would be flush with the surface of the die plate and then the powder disposed around the core rod would then be compressed by the punch moving toward the anvil disposed over the cavity. Thus the movements of both the core rods and the punch would have to be precisely controlled during each cycle.

The present invention represents an improvement over the aforementioned apparatus in that each of the core rods are adjusted to be flush with the upper surface of the die plate and then it is held stationary in this position during the operation of the machine, while the punches are displaced axially in the cavities in a regular cycle to form compacted toroidal shaped articles. Thus the instantaneous position of only a single movable member in the die cavity need be controlled thus insuring a more accurate dimensional control.

A major problem associated with high production automatic powder compacting presses of this character is the maintainance of a high degree of surface finish of the various members exposed to the powder and associated with the dimensional tolerance of the finished articles. To

insure a high degree of acceptable dimensional tolerances, the die plate and the punches are normally formed of a hardened tool steel or tungsten carbide and the surface of the die plate and the anvil normally provided with a super finish. However, some powdered substances, for instance powdered ferrite, used in the formation of computer memory cores have highly abrasive properties. Thus the upper surface of the die plate tends to become rounded with wear as the flipper assembly which traverses the die plate sweeps the excess powdered ferrite from the surface of the die plate prior to moving the anvil into engagement over the filled cavities. This sweeping action tends to wears the die plate so that acceptable dimensional tolerances are soon lost. In addition, the upper ends of the punches become worn due to their repeated compaction of the powdered ferrite. Normally the conventional tool capsule has to be disassembled and the working surface of the die plate refinished, and the core rods refinished or replaced depending upon the amount of wear which has developed, and then the various components reassembled for further utilization.

The tool capsule illustrating the preferred embodiment of the present invention reduces the time and effort involved in renovating the working surfaces of the die plate and the core rods by providing a structure in which the die plate, core rods, punches, punch holder, and the related parts are removed as one complete assembly from the press, and all the parts refinished by turning the assembly face down on a conventional lapping disk. The configuration of the several components is such that each of the working surfaces abut the lapping disk and are simultaneously finished or lapped.

It is, therefore, an object of the present invention to provide a tooling capsule for a powder compacting press constructed to insure more reliable and repetitive control of dimensional tolerance by reducing to a minimum the number of moving parts associated with the finished member or article during each cycle.

It is another object of the present invention to reduce the time and effort in renovating the working surfaces of the tool capsule in a powder compacting press by providing such a capsule in which all of the working surfaces may be refinished without disassembling the capsule.

Still further objects and advantages of the present invention will become apparent to one skilled in the art upon reference to the following detailed description and the accompanying drawings in which like reference numeral represent like parts throughout the several views and in which;

FIGURE 1 represents a schematic cross sectional view of a tool capsule according to the present invention and including an anvil disposed over the die cavities;

FIGURE 2 is a sectional view as seen from line **2—2** of FIGURE 1;

FIGURE 3 is an enlarged sectional view of the tooling capsule shown in the die cavity fill position;

FIGURE 4 is a fragmentary enlarged sectional of the tooling capsule shown in the press position;

FIGURE 5 is a fragmentary enlarged sectional view of the tooling capsule shown in the eject position; and

FIGURE 6 is the sectional view as seen from lines **6—6** of FIGURE 1.

Now referring to the drawings and in particular to FIGURE 1, a powder compacting press (not shown) comprises a table portion **10** having a counter bore **12** in which is seated a preferred tool housing **14**. The tool housing **14** is generally cylindrical in shape and defines an axial bore **16**.

A die plate **18** preferably having a flat upper surface is disposed on top of the housing **14** and is held to the upper surface of the table **10** and to the tool housing by suitable means (not shown) such as clamps, screws or the like. The axis of the tool housing bore **16** is disposed normally to the upper surface of the die plate **18**.

The die plate **18** is provided with a plurality of mutually parallel bores **20** preferably disposed in a circular arrangement around the axis of the bore **16** and having a regular peripheral spacing. Associated with each of the bores **20** is a die bushing **22** preferably formed of a hard material such as a carbide and which is press fitted or otherwise fastened into the bore **20**. Now as can best be seen in FIGURE 3 the die bushing **22** is inserted in the bore **20** such that its upper end is flush with the upper surface of the die plate **18**, and has a length which terminates just short of the lower surface of the die plate.

Each of the die bushings **22** is provided with a longitudinal bore **24** which extends normally inwardly from the upper face of the die plate **18** and is provided with a chamfered portion **26** at the lower end thereof, as best seen in FIGURE 3.

Now referring to FIGURE 1, an elongated cylindrical sleeve member **28** is slidably disposed within the bore **16** of the tool housing **14**. The cylindrical sleeve member **28** has formed on its outer surafce a flattened surface **30** which is adapted to register with a set screw **32** carried by housing **14**. Thus it can be seen that the cylindrical sleeve member **28** may be adjusted up and down within the bore of the tool housing **14** and then locked in place for a purpose which will subsequently be described.

Adjacent to the upper end of the cylindrical sleeve member **28** is an annular slot **34**. A plurality of bores **36** extend longitudinally through the wall of the cylindrical sleeve member **28** from the annular slot **34** to terminate at the lower end with a threaded passage **38** which accommodates a set screw **40**. The bores **36** have an identical angular and radial disposition with respect to the axis of the sleeve member **28** as the bores **20** in the die plate have with the housing bore **16**, there being one bore **36** which is associated with each of the bores **20**. Thus it is to be understood that the bores **36** are identical with one deviation which can best be seen in FIGURE 2. One of the bores **36** is shortened to accommodate a set screw **42** which is radially adjustable at the lower end of the member **28** for a purpose which will be subsequently noted. It is to be understood that each of the set screws **40** is adapted to be adjusted upwardly and downwardly by an elongated tool (not shown) which may be inserted through the opening to the threaded passage **38** provided at the lower end of the member **28**.

An elongated rod member **44** is provided for each of the bores **36** and is slidably disposed therein. The rods **44** have a length sufficient such that their upper end extends slightly into the annular slot **34** and extend downwardly through the bore **36** such that the lower end of the rod **44** will normally abut the upper end of the set screw **40**. Thus there will be in the case of an eight die tool capsule seven similarly shaped rod members and one short rod member to accommodate the shortened bore **36** associated with the set screw **42**.

A plurality of regularly spaced radial slots **46** are formed inwardly from the upper end of the cylindrical member **28** with one slot **46** aligned with each of the bores **36**.

Still referring to FIGURE 1, an upwardly extending elongaated core rod **48** is associated with each of the radial slots **46** and has an enlarged lower end **50**. The lower end **50** has a length which is slightly less than the width of the annular slot **34** so that the enlarged end **50** may be inserted radially into the slot with the core rod **48** registering in the radial slot **46**.

The slots **46** are adapted so that each of the core rods **48** may be axially aligned with the die bushing bores **24**. The core rods **48** have a diameter to accommodate the bore of a toroidally shaped article and have a length sufficient so the upper ends thereof may be disposed flush with the upper surface of the die plate **18**.

The cylindrical sleeve member **28** is provided with an axial bore **52** in which is slidably disposed an elongated

punch holder **54**. The punch holder **54** has an enlarged upper end **56** which is provided with a plurality of radial slots **58** corresponding to the die bushing bores **24** as can best be seen in FIGURE 6. Thus it can be seen that each of the core rods **48** extends upwardly through one of the radial slots **58** in the upper end of the punch holder **54**. As can best be seen in FIGURE 3, an annular groove **60** is formed in the enlarged end **56** of the punch holder and carries a plurality of cylindrical members **62** each of which have an enlarged lower end **64** which is seated in the groove **60**. Each of the members **62** is provided with an axially extending elongated cylindrical punch **66** which extends upwardly therefrom to register in a die bushing. The outer diameter of each of the punches **66** accurately fit the inner diameter of each of the die bushings **22**, and each punch has a longitudinal bore **67** having an inner diameter closely fitting the core rod **48**. Each punch **66** is thus slidably guided over each core rod **48** such that it is free for up and down movement.

The punch holder **54** has a flat portion **68** which as can best be seen in FIGURE 2 registers with the set screw **42**. Thus it can be seen that the punch holder **54** can be locked with respect to the cylindrical member **28** by means of the screw **42**. The lower end of the punch holder **54** is provided with a notched portion **69** which is adapted to engage an actuating member (not shown).

Prior to installation in the compacting press, the various components of the preferred tool capsule are assembled with respect to one another as follows. The cylindrical sleeve member **28** carrying the core rods **48** and the punches **66** is moved upwardly in the housing **14** until the punches are inserted into the die bushing **22** assisted by the chamfered portions **26**. The punches **66** are moved upwardly such that they are substantially self-aligned within the die bushings **22**, each of the core rods **48** is then locked to the cylindrical sleeve member **28** by the set screws **40** which force the rods **44** upwardly to abut the enlarged end of the core rods and lock them between the upper end of the rods **44** and the upper inner face of the slot **34**. The cylindrical sleeve member **28** is then moved upwardly until the upper ends of the core rods **48** are flush with the upper surface of the die plate **18**. The sleeve member **28** is then locked to the tool housing **14** by the adjusting set screw **32**. The punches **66** can now freely slide up and down the core rods **48** and within the die bushing bores **24**.

The lower set screw **42** is normally engaged to lock the punch holder **54** with the sleeve member **28** when the tool capsule is not assembled with the compacting press. When the preferred tool capsule is seated in the compacting press, the lower end of the punch holder normally is engaged with an actuating member (not shown) and which is adapted to reciprocate the punch holder during the various steps of the pressing cycle so that the locking screw **42** is disengaged.

For purposes of illustration, a typical powder compaction cycle includes a powder filling step, a compression step and an ejection step. Briefly the filling step is diagramatically illustrated in FIGURE 3 and comprises a powder supply device or what is commonly referred to as a hopper **70** which is disposed over the die bushing bore and which fills the cavity defined by the bore **24** and the upper end of the punch **66**. For this step the punch **66** is displaced a suitable distance from the upper surface of the die plate **18**, when the cavity is filled with a powdered material the punch **66** is then displaced slightly upward to expel excess powder and to insure that the cavity space is filled with powder. The hopper **70** is then removed by means (not shown) and the upper surface of the die plate wiped clean of any excess powder which can be accomplished by the hopper being moved transversely across the upper surface of the die plate. The upper surface of the die plate is preferably polished to a super finish so that there is no possibility of any grains of powder remaining on this surface after the wiping step.

Referring to FIGURES 1 and 4, an anvil **72** supported by anvil holder **74** is transferred over the filled die cavity and the punch holder **54** actuated to force the punches **66** upwardly such as to compress the powder contained in the cavities against the anvil to form the compacted finished articles. The anvil is then removed from over the die cavities and the punches **66** preferably displaced upwardly so that their ends are substantially flush with the upper surface of the die plate **18** so that they eject the finished articles which may be picked up by any suitable means and preferably deposited in a plurality of passages **76**, one of which is shown in FIGURE 1. Each passage **76** delivers the finished article through a conduit **78** which discharges the finished article to a vial or bottle (not shown).

Because of the highly abrasive properties of some of the powdered substances utilized in presses of this character the upper surface of the die plate **18** and the upper end of the core rods **48** tend to become rounded and worn. The wearing surfaces of the preferred tool capsule can be renovated by removing the capsule from the compacting press and inverting it so that the die plate **18** abuts a conventional lapping tool. By disengaging the set screw **32**, the core rods **48** and the punches **66** are free to move downwardly to abut the lapping tool so that all of the worn surfaces are simultaneously ground to the desired finish. Thus it can be seen that the improved tool capsule can be renovated without disassembling the various parts. Furthermore, it can be seen that a more precise dimensional control of the finished articles can be maintained in the improved tool capsule because of the fewer number of moving parts whose relative movements have to be controlled.

It can also be seen that the construction of the tool capsule of the present invention provides for assembling the core rods and the punches in an appropriate housing in such manner that the core rods are individually precisely positioned longitudinally relatively to the sleeve holding all the core rods, while the sleeve is in turn precisely positioned longitudinally relatively to the housing. The punches are actuated in unison by means of a common actuating member, and the punches and core rods, although accurately located along a longitudinal axis, are substantialy free to float radially such as to permit the punches to align themselves within the die bushings.

Although I have described only one preferred embodiment of my invention it will be apparent to anyone skilled in the art to which the invention pertains that various changes and modifications may be made therein without departing from the spirit of the invention as expressed in the scope of the appended claims.

I claim:

1. A unitary tool capsule for making articles compacted of powder, said tool capsule comprising:

a die plate adapted to be mounted in an appropriate aperture in a machine base;

said die plate having a plurality of substantially circularly arranged die cavities, each of said die cavities being shaped as a right cylindrical bore open on both ends;

a housing mounted below said die plate;

a plurality of punches in said housing each having an end engaged in one end of each of said die cavities and reciprocable therewithin, each of said punches snugly fitting within each of said die cavities;

an enlarged portion on the other end of each of said punches operatively connected to a punch actuating member having a plurality of radial slots each affording passage to the body of each of said punches and a peripheral groove defining a recess adapted to receive snugly a plurality of said enlarged portions, wherein each of said punches is free to radially

float relatively to said punch actuating member for self-centering relatively to each of said cavities and is positively longitudinally reciprocated by said punch actuating member with substantially no back lash;

a longitudinal bore extending from end to end in each of said punches;

a plurality of core rod members each slidably and snugly disposed within said longitudinal bore and having an end projecting through the enlarged end portion of said punch;

an enlarged portion on said projecting end of each of said core rod members for connection to an end of a sleeve member slidably disposed in said housing and having a plurality of radial slots affording passage to the body of each of said core rod member and a peripheral groove defining a recess adapted to receive snugly a plurality of said enlarged portions for holding of said core rod members independently of said punches, wherein each of said core rod members is free to radially float relatively to said rod member holding member for self-centering relatively to each of said punch longitudinal bores;

individual adjusting means for each of said core rod members to longitudinally adjust the position of each of said core rod members relatively to said sleeve member; and

adjusting means for said sleeve member to longitudinally adjust the position of said sleeve member relatively to said housing.

2. The unitary tool capsule of claim 1 further comprising means for locking said punch actuating member relatively to said sleeve member.

References Cited

UNITED STATES PATENTS

1,541,357	6/1925	Johnson	18—16.5 X
1,127,994	8/1938	Davis et al.	18—16.5 X
2,338,491	1/1944	Cutler	18—16.5
2,640,325	6/1953	Haller	18—16.5 X
2,867,844	1/1959	Hall	18—16.5
3,060,506	10/1962	Uschmann	18—16.5
3,132,379	5/1964	Crane	18—16.5
3,328,840	7/1967	Vinson	18—16
3,328,842	7/1967	Vinson	18—16.5
3,227,416	1/1966	Fessel	18—36 X

J. HOWARD FLINT, JR., *Primary Examiner.*

U.S. Cl. X.R.

18—16.5

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,414,940 December 10, 1968

Paul Vinson

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading to the printed specification, lines 4 and 5, "Pentronix, Inc., Lansing, Michigan" should read -- Pentronix, Inc., a corporation of Michigan --.

Signed and sealed this 10th day of March 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents