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Deprez et al.

[11] **3,865,533**

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[54] **MEANS FOR SECURING AND REMOVING MOLDS FROM COMPACTING APPARATUS**

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[73] Assignee: **The Gleason Works,** Rochester, N.Y.

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[52] **U.S. Cl.** ..... **425/405 H,** 425/86, 425/443, 425/450

[51] **Int. Cl.** **B30b 5/02,** B30b 11/00

[58] **Field of Search** ..... 425/405 H, 450

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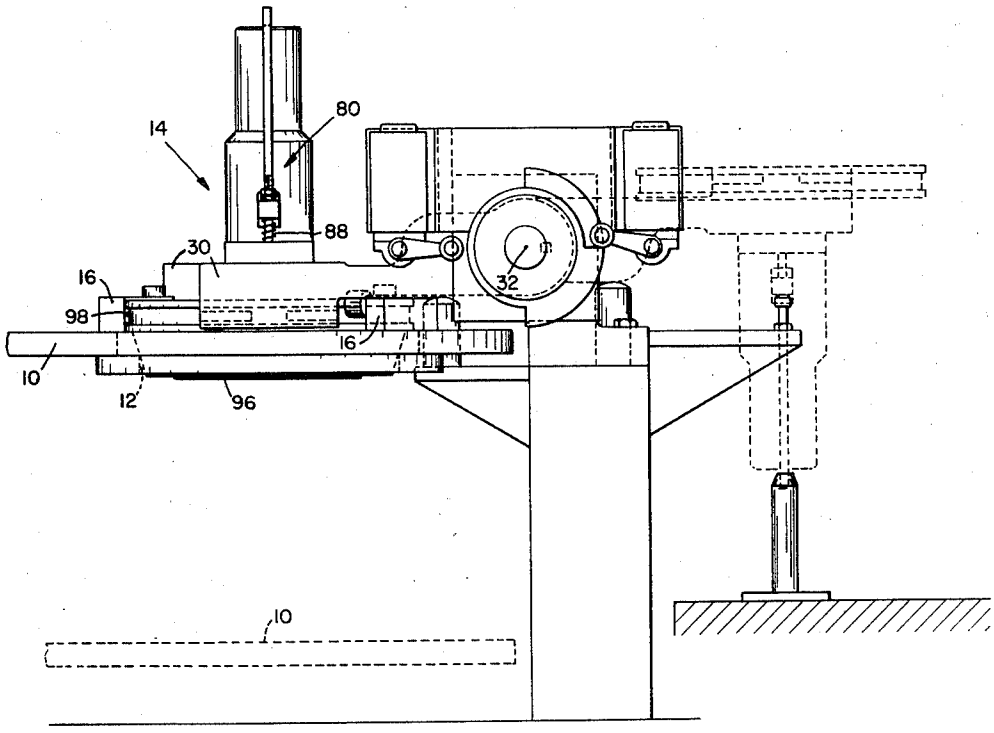
Primary Examiner—J. Howard Flint, Jr.

Attorney, Agent, or Firm—Ralph E. Harper

[57] **ABSTRACT**

Individual mold assemblies are releasably secured to a table by latching means in the form of pivotally mounted finger elements which can swing into and out of engagement with a base structure associated with each mold assembly. A separate dumping means functions to engage and lift each mold assembly from the table, so that a part can be dumped therefrom, and the dumping means operates to automatically release the pivotally mounted finger elements from their engagement with a mold assembly when the dumping means is moved to a position for engaging and lifting the mold assembly.

10 Claims, 6 Drawing Figures



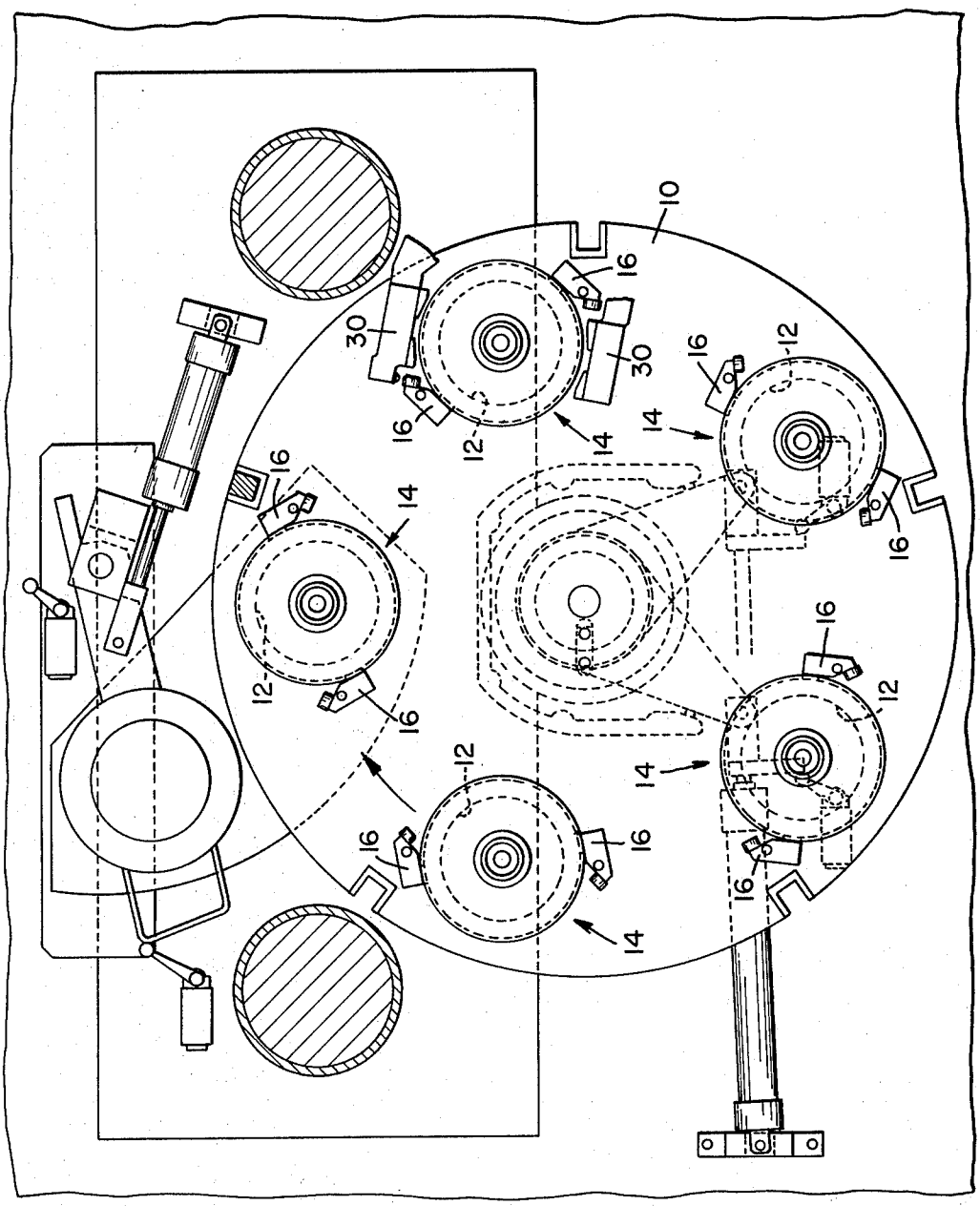


FIG. 1

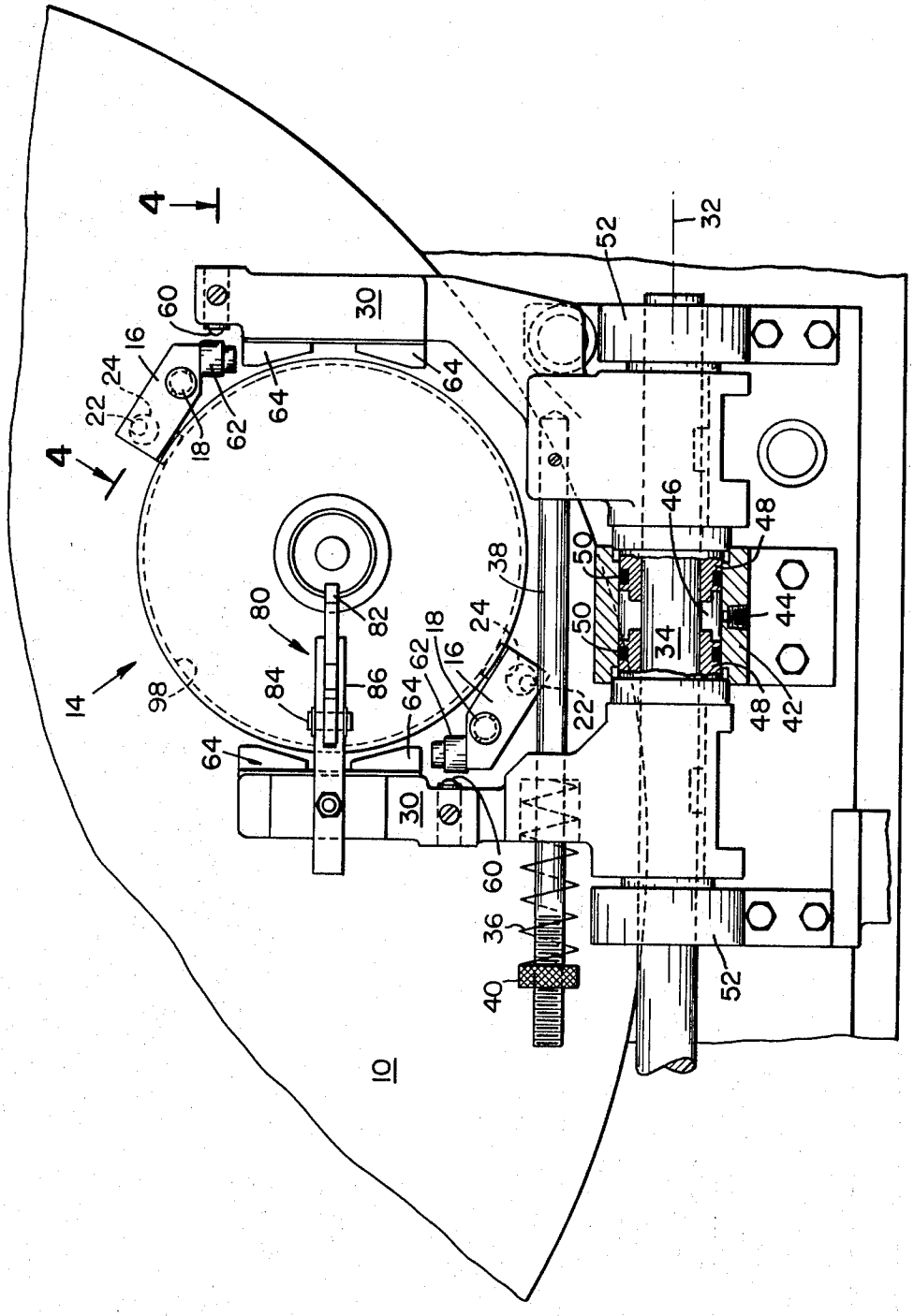

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FIG. 2

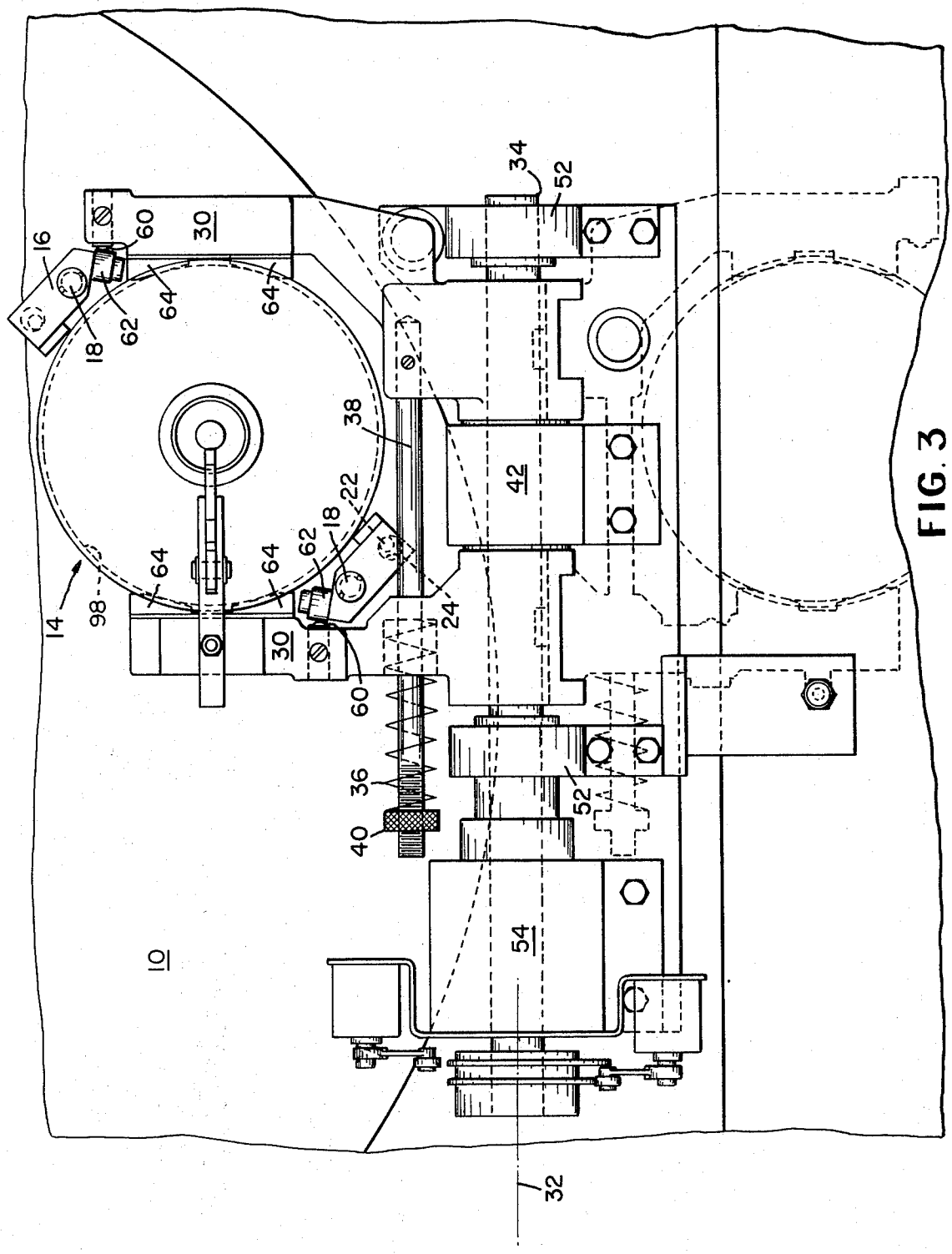
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FIG. 3

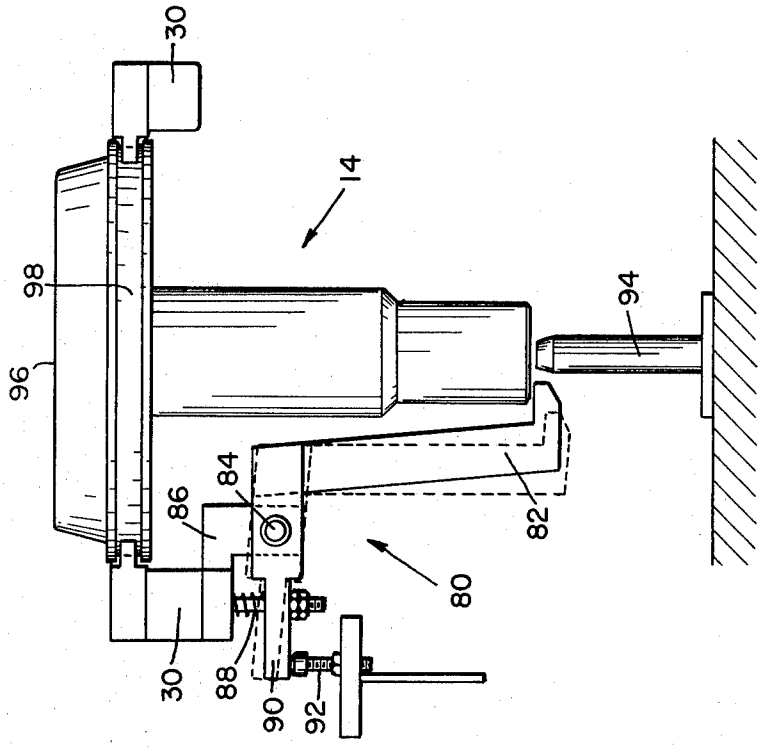

FIG. 6

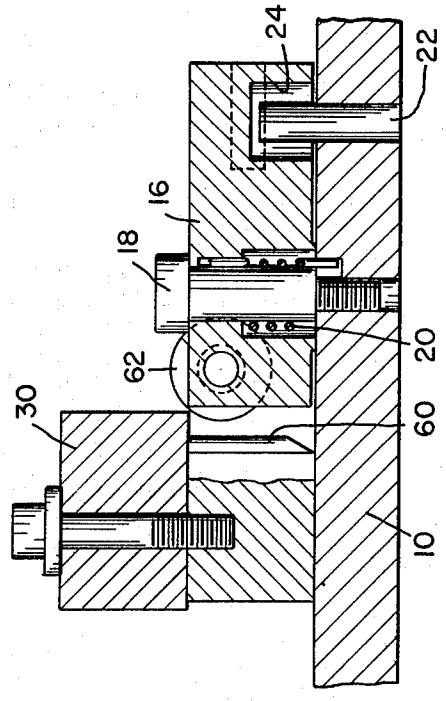

FIG. 4

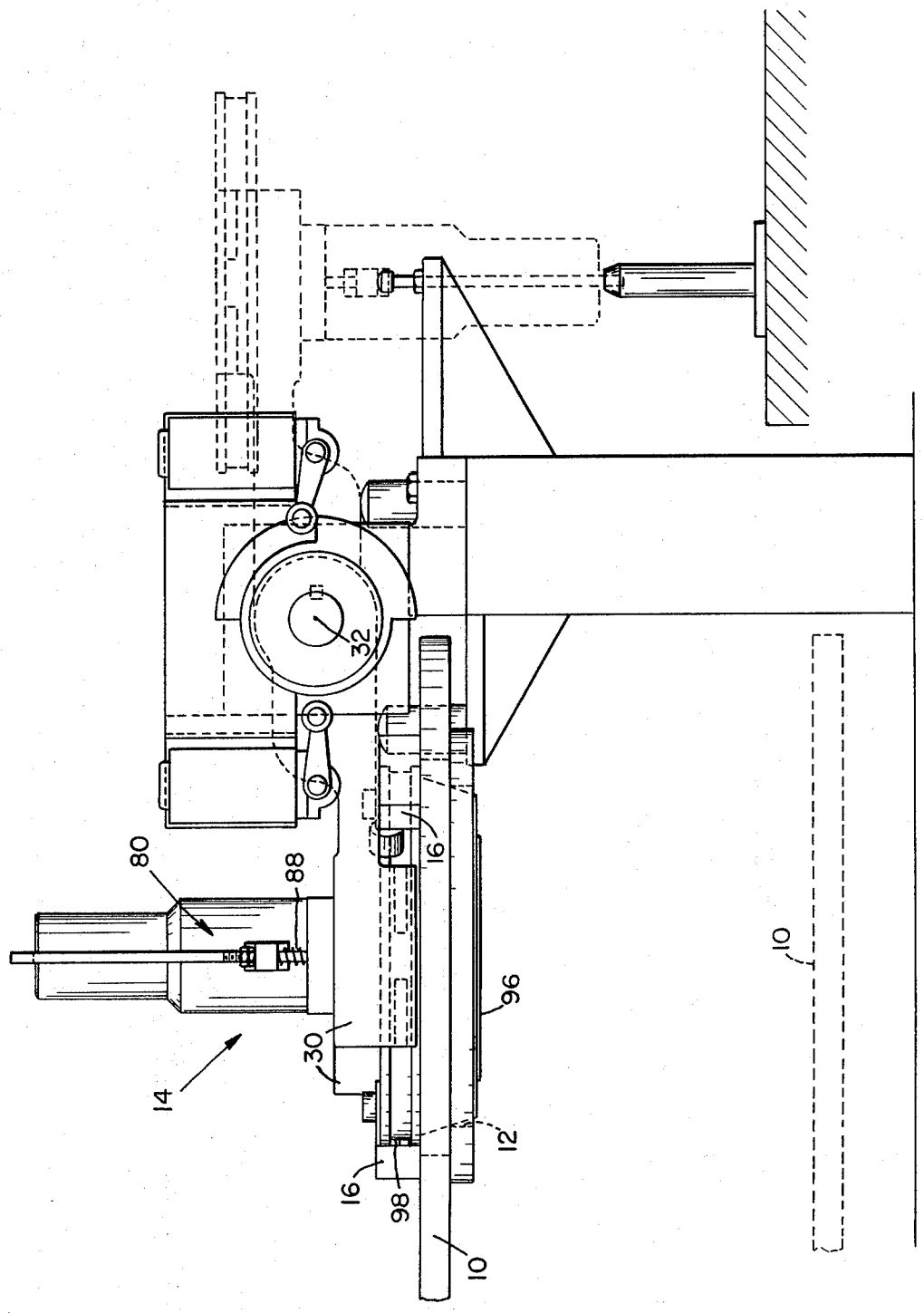

FIG. 5

MEANS FOR SECURING AND REMOVING MOLDS FROM COMPACTING APPARATUS

BACKGROUND AND BRIEF DESCRIPTION OF INVENTION

The present invention relates to improvements in powder compacting apparatus of the type which includes a rotating table or other supporting surface for advancing a series of mold assemblies into and out of a compacting chamber where a powder material within each mold assembly can be compacted into a more dense and coherent form. The invention is more specifically concerned with an improved means for releasably securing individual mold assemblies to a table means so that the mold assemblies can be retained thereon during a compacting operation and removed therefrom after the compacting operation is completed.

Generally it is known in the art to provide for a table means or other supporting surface for a plurality of upright molds which can receive charges of a powder material, after which they are inserted into a bottom entry compacting chamber where the powder material is isostatically compacted into a relatively dense and coherent form. Devices of this type are illustrated in U.S. patent **3,698,843,** for example, and in a copending application Ser. No. 469,980, entitled "Compacting Apparatus Having Improved Rotating Table Means For Indexing Molds To And From A Compacting Chamber" filed May 15, 1974 by Thomas A. Deprez. It is also known to provide for a part removal means with devices of the type described in the aforesaid patent in which there is provided a means for stripping an elastomeric mold from a formed part so that the formed part can be grasped and removed from a supporting surface.

The present invention is primarily directed to improved latching and removal devices which cooperate to alternately secure and release a mold assembly relative to a table means so that a very precise and concentric relationship can be maintained between certain critical portions of the mold assembly. In accordance with the present invention, the entire mold assembly is lifted and removed from a supporting surface when it is desired to remove a part therefrom. In this way, there is no requirement for stripping an elastomeric portion of the mold assembly away from the remainder of the assembly in order to make a compacted part accessible for removal. Thus, the arrangement of the present invention provides for a lifting and dumping of the entire mold assembly, and this allows a replacement of the entire assembly back onto the supporting surface without disrupting critical relationships which are designed into the various portions which make up the mold assembly.

In a preferred embodiment of the invention, there is provided a latching means, mounted on a table or other supporting structure for securing a mold assembly to the supporting structure. In the type of apparatus described in the aforesaid application, in which each mold assembly is inserted into a compacting chamber by a lifting action of the table, the latching means has an additional function of positively engaging a portion of the mold assembly as the mold assembly is withdrawn from the compacting chamber so as to assure an easy extraction of the mold assembly from the compacting chamber. The present invention also provides for a separate dumping means for engaging, lifting and removing an individual mold assembly from the supporting surface after the mold assembly has been released from the latching means, to thereby provide for a removal of the part from the mold assembly. Preferably, the dumping means comprises a pair of spaced apart jaw elements mounted on a common axis so that the jaw elements can be rotated about the axis to engage and move a mold assembly from an upright position to an upside down position for dumping of a part therefrom. The dumping means also functions to automatically release the latching means out of engagement with a mold assembly when the dumping means is moved into an operative position for engaging and lifting the mold assembly.

These and other features and advantages of the present invention will become apparent in the more detailed discussion which follows. In that discussion reference will be made to the accompanying drawings as briefly described below.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a top plan view of a circular table means having a plurality of apertures formed therethrough for receiving an equal number of individual mold assemblies;

FIG. **2** is a top plan view, in enlarged scale, of a segment of the table means shown in FIG. **1,** illustrating latching means and a dumping means in relative positions which provide for a securement of a mold assembly to the table means;

FIG. **3** is a view similar to the view of FIG. **2,** but the dumping means is shown in a position in which the latching means have been released from engagement with the illustrated mold assembly so that the mold assembly can be lifted and swung to a new position (shown by dashed lines) for dumping a part therefrom;

FIG. **4** is a cross sectional view, in elevation, as seen on line **4—4** of FIG. **2**;

FIG. **5** is an elevational view showing the latching means and dumping means of FIGS. **2** and **3** as they would appear when a mold assembly is engaged by the lifting means for movement to a dumping position (shown in dashed lines); and

FIG. **6** is an elevational view at right angles to the view of FIG. **5,** showing a holding means for retaining a part within a mold assembly while the mold assembly is moved to the illustrated dumping position.

DETAILED DESCRIPTION OF INVENTION

FIG. **1** illustrates a top plan view of a circular table means **10** having a plurality of apertures **12** formed therethrough for receiving individual mold assemblies **14** in each aperture. The table means **10** is of a type which can be indexed and lifted and lowered to successively advance the mold assemblies **14** to and from a bottom entry compacting chamber (not illustrated) for compacting a powder material, such as a ferrous metal powder which is compacted as an intermediate step in a process for forming fully dense, high strength gear parts. The basic compacting apparatus with which the rotating table **10** is associated does not form a separate part of the present invention, and the descriptions and drawings of the aforesaid copending application are incorporated herein by reference to the extent necessary to supply background information on equipment of this type. Generally, the rotating table means **10** functions to carry each mold assembly **14** to and from various

stations located around the table means so that the mold assembly can be filled with a powder material, subjected to isostatic compacting, and advanced to a position where the compacted part can be removed therefrom. The present invention is concerned with an improved combination of elements for releasably securing each mold assembly **14** to the table means **10** and for lifting each mold assembly away from the table means at a dumping station for removing a part therefrom.

FIGS. **2** and **3** illustrate specific details of the improvements of the present invention. As illustrated, each mold assembly **14** is secured in its respective position relative to the table means **10** by a latching means which includes finger elements **16.** The finger elements are mounted on the table means so as to pivot about pin members **18,** and each finger element is arranged to pivot from the position shown in FIG. **2,** where it is in engagement with a portion of the mold assembly **14,** to the position shown in FIG. **3,** where it is out of engagement with the mold assembly **14.** As shown in greater detail in FIG. **4,** each finger element **16** is fastened to the table means **10** by the pin member **18** which defines the pivot axis for the finger element. A coil spring element **20** is carried around each pin member **18** and within a bore of each finger element **16** to normally urge the finger element into a position for engaging and latching a mold assembly relative to the table means **10.** The spring element **20** is secured at one end to a portion of the finger element and at its other end to a portion of the pin member **18** or the table means **10.** A limit pin **22** is fixed to the table means **10** to be received within a bore or recess **24** formed into the finger element **16.** The limit pin **22** and the bore **24** define limits of pivotal movement of each finger element, as can be appreciated by comparing the positions of the finger elements shown in FIGS. **2** and **3.** In the illustrated embodiment, a pair of finger elements **16** positioned on opposite sides of a mold assembly **14** constitute a latching means for that particular mold assembly. However, it is contemplated that a lesser or greater number of finger elements may be used in specific applications, if desired.

From the above discussion, it can be seen that the releasable latching means functions to normally retain each mold assembly **14** in its respective position (which may be in a mating condition with an aperture **12,** for example) relative to a supporting surface, and each latching means is designed to be releasable from its securing position relative to a mold assembly so that the mold assembly can be lifted and removed from the supporting surface for purposes of dumping a part therefrom. The dumping operation is carried out by a separate dumping means which includes an assembly having a pair of spaced apart jaw elements **30** mounted on a common axis **32** so that the jaw elements **30** can be brought into engagement with a mold assembly **14** for lifting and moving the mold assembly from its upright position on a supporting surface to an upside down position which results in a dumping or removal of a part therefrom. This change in orientation of the mold assembly is illustrated in FIG. **5.**

Referring to FIGS. **2, 3** and **5,** it can be seen that the jaw elements **30** are secured to a common shaft member **34** which defines a common axis of rotation **32** for the jaw elements. Each jaw element **30** is separately keyed or fastened to the shaft member **34** so as to provide for limited axial movement along the shaft member. Movement of the jaw elements along the shaft member **34** defines positions of engagement (as shown in FIG. **3**) and disengagement (as shown in FIG. **2**) of the pair of jaw elements **30** relative to a mold assembly **14.** The two jaw elements **30** are normally urged toward each other to effect a gripping engagement of a mold assembly through the action of a spring means **36** carried on a rod member **38** which interconnects portions of the two jaw elements **30** with each other. As shown in the drawings, the rod member **38** can be secured at one end to a portion of a housing associated with one of the jaw elements **30** (the right hand jaw element as viewed in FIGS. **2** and **3**), and from there, the rod member **38** passes through an opening in a corresponding housing structure of the opposite jaw element so as to permit relative motion between the opposite jaw element and the rod member **38.** The spring means **36** is compressed between the housing of the opposite jaw member and a nut **40** (threaded onto the rod member **38**) so as to normally urge the two jaw members **30** towards each other.

As shown in FIG. **2,** the jaw members **30** can be moved away from each other to release a mold assembly from a gripping engagement therewith by a hydraulic means which includes a cylindrical structure **42** for receiving a hydraulic fluid from a source (not shown) through an inlet **44** and into a chamber **46** defined around a portion of the shaft member **34** of the gripping assembly. Housing structures associated with the separate jaw members **30** include cylindrical portions **48** which are shaped to be received within the cylinder structure **42,** and known sealing gaskets **50** are provided to contain hydraulic fluid introduced into the chamber **46.** In this way the circular portions **48** of the separate jaw elements **30** function as pistons within the cylinder structure **42,** and an introduction of a pressurized hydraulic fluid into the chamber **46** functions to drive the separate jaw elements **30** in opposite directions away from each other so as to disengage the dumping assembly from a mold assembly **14.** Movement of the jaw elements **30** away from each other is limited by a pair of mounting brackets **52** or other equivalent structures which function to limit the travel of each jaw element **30** along the shaft member **34.**

As shown in FIGS. **3** and **5,** the shaft member **34** is keyed to a hydraulic motor means **54** of known design so that a rotational movement can be imparted to the shaft member **34** about its axis **32.** The motor means **54** can comprise any known structure for effecting a rotational movement back and forth for 180° of travel, or any other desired range of rotation, for moving the dumping assembly from the position shown in full lines in FIG. **5** to that shown in dashed lines in the same figure. Various limit switches and other controls are provided, as are well known in the art, to automatically control operation of the dumping assembly during each cycle of operation.

A particular feature of the latching means and dumping means of the present invention provides for an automatic disengagement of the latching means each time the dumping assembly is brought into an operative position for engaging and removing a mold assembly from the table means **10.** This feature can be appreciated from the views shown in FIGS. **2** and **3** wherein it can be seen that protruding surface **60** carried by the jaw elements **30** are arranged to contact cylindrical bearing

surfaces **62** of each finger element **16** so as to pivot each finger element to the position shown in FIG. **3** to thereby release a mold assembly **14** from its latching engagement with the finger elements **16.** As the jaw elements **30** move toward each other to disengage each of the finger elements **16,** there is a simultaneous engagement of gripping portions **64** of the jaw elements **30** with a portion of each mold assembly **14.** Thus, the dumping means and the latching means cooperate to provide for an engagement of one during disengagement of the other.

A normal operating cycle of the dumping assembly would start with the jaw elements **30** out of the line of travel of a mold assembly **14** during indexing of the table means **10** to bring a mold assembly into position for dumping of a part therefrom. The jaw elements **30** would be in the positions shown in FIGS. **2** and **5,** ready to receive a mold assembly therebetween when the table **10** is raised (to the position shown in FIG. **5**) to its upper limit position. Then, hydraulic fluid would be released from the chamber **46** so that the spring means **36** could urge the jaw elements **30** towards each other to trip the finger elements **16** out of engagement with the mold assembly and to bring the jaw elements **30** into gripping engagement therewith. From there, the cycle would continue with actuation of the motor means **54** to remove the mold assembly **14** from the table means **10** so as to move the position of the mold from an upright orientation to an upside down orientation as shown in FIG. **5.** A part would be dumped or removed from the mold assembly while in the upside down orientation, and the dumping assembly would be in a position to return the empty mold assembly to the table means and to begin another cycle of operation.

FIGS. **5** and **6** illustrate an optional feature of the present invention which provides for holding a part within the confines of the mold assembly **14** during a movement of the mold assembly from its normally upright position on a supporting surface to the upside down position shown in these figures. This feature includes a holding means **80** which is carried by one of the jaw elements **30** of the dumping assembly so as to contact and retain a part within the mold assembly while the mold assembly is being turned over to the position shown in FIG. **6.** The holding means includes a finger member **82** pivotally mounted at **84** to a bracket **86** secured to one of the jaw elements **30** of the dumping assembly. The finger element **82** is urged by a spring means **88** to a position which normally covers a portion of the open end of the mold assembly **14** so that a part cannot fall prematurely from the confines of the mold assembly until the finger element **82** has been moved out of the way. Pivotal movement of the finger element **82** out of its retaining position is accomplished by a contact of a tail portion **90** of the finger element **82** with an adjustable stop **92** positioned at a dumping station so as to cause the finger element **82** to move to the dashed line position shown in FIG. **6.** By selecting a placement of the stop **92,** the holding means can be controlled to release a part from the mold assembly at a selected time or position in a dumping cycle. The stop **92,** or any equivalent structure, can also function to tap the mold assembly in a way which will loosen and release any part which may be sticking to a core rod or other structure of the mold assembly. FIG. **6** also illustrates a receiving pin **94** for receiving a part having a bore therethrough from the mold assembly **14** after the finger element **82** has been moved out of its retaining position by contact with the stop pin **92.** The receiving pin **94** may be carried on a conveyor or other transfer equipment for moving parts away from the dumping zone for further processing or handling in an automated system.

FIG. **5** also illustrates details of construction for a type of mold assembly **14** which includes a base structure **96** having a continuous groove or other recessed formation **98** formed into a surface thereof for receiving portions of the finger elements **16.** The portion of each finger element which enters the recessed formation **98** is of a shorter vertical dimension (as seen in the FIG. **5** orientation) than the height of the recessed formation so that the mold assembly can move for a limited distance along its axis during a compacting operation without releasing the finger elements **16.** This relationship is described more fully in the context of requirements of a compacting apparatus in my aforesaid patent application.

Having described a specific embodiment of the present invention, it can be appreciated that the improvements of the present invention offer a number of advantages: critical relationships between certain portions of a mold assembly can be maintained during filling, compacting, and part removal steps of an overall operation; individual mold assemblies are latched to a supporting surface during certain periods of the operation to assure precise insertion and removal of the mold assemblies relative to a compacting vessel; and broken parts and pieces of parts are completely removed from each mold assembly by the dumping action which is provided. Equivalent structures can be substituted for those which have been shown and described. For example, the jaw members **30** of the dumping means can be urged toward each other by hydraulic means or by a spring element carried (in tension) within the chamber **46** instead of with the spring **36** and rod **38.** Equivalent structures and functions are intended to be included in the definitions of the claims which follow.

We claim:

1. In powder compacting apparatus of the type which includes a supporting means having a plurality of openings formed therethrough for receiving and supporting a plurality of mold assemblies which contain compacted parts after they have been formed from a powder material, the improvement in means for securing and removing said mold assemblies from said supporting means, comprising:

latching means mounted on said supporting means for securing said mold assemblies in their respective positions relative to said openings formed in the supporting means, said latching means being releasable from securing positions relative to said mold assemblies so that the mold assembly can be lifted and removed from the supporting means when the latching means are released.

2. The apparatus of claim **1** wherein each mold assembly includes a base structure which can be fitted into one of said openings in the supporting means, and wherein said latching means comprise pivotally mounted finger elements which can swing into and out of engagement with said base structure of a mold assembly.

3. The apparatus of claim **2** wherein said base structure includes a recessed formation in a surface thereof for receiving portions of said finger elements, said re-

cessed formation being of a sufficient size and shape to permit limited axial movement of a secured mold assembly relative to the supporting means.

4. The apparatus of claim **1**, and including a dumping means for engaging, lifting, and removing an individual mold assembly from the supporting means after the mold assembly has been released from said latching means, so that a formed part can be removed or dumped from the mold assembly.

5. The apparatus of claim **4** wherein said dumping means includes a pair of spaced apart jaw elements mounted on a common axis so that said jaw elements can be moved toward and away from each other along said axis to engage and disengage a mold assembly.

6. The apparatus of claim **5** and including (a) a spring means for normally urging said pair of jaw elements toward each other to effect a gripping engagement of the jaw elements with a mold assembly and (b) hydraulic means for urging said pair of jaw elements away from each other to release a mold assembly from said gripping engagement.

7. The apparatus of claim **4** wherein said dumping means includes means for automatically releasing said latching means out of engagement with a mold assembly when the dumping means is moved into engagement with the mold assembly.

8. The apparatus of claim **4** and including rotating means for swinging said dumping means about said axis so that a mold assembly having a part therein can be moved from an upright position to an upside down position to thereby dump a part therefrom.

9. The apparatus of claim **8** and including a holding means for retaining a part within said mold assembly while the mold assembly is being moved to an upside down position, and further including means for releasing said holding means so that a part can fall from the mold assembly at a selected time or position.

10. The apparatus of claim **9** wherein said holding means is carried by said dumping means so as to automatically contact a mold assembly when the dumping means is brought into engagement with the mold assembly.

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