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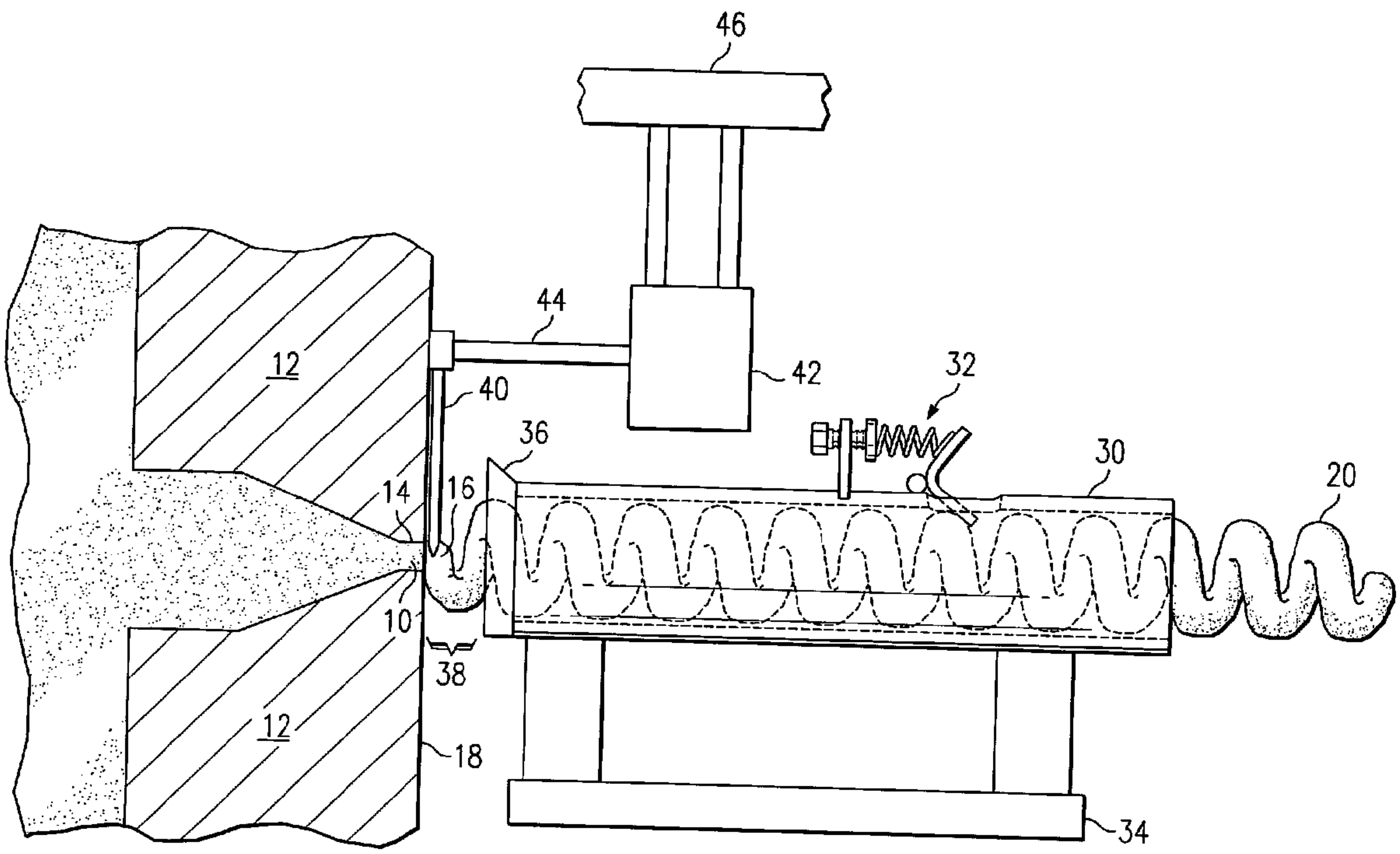
(54) Titre : PROCEDE ET APPAREIL AMELIORES PERMETTANT DE PRODUIRE UN EXTRUDAT DE CHOUX EN SPIRALE

(54) Title: IMPROVED METHOD AND APPARATUS FOR PRODUCING A CURLY PUFF EXTRUDATE



(57) Abrégé/Abstract:
The present invention utilizes a containment tube (30) to facilitate production of a curly puff extrudate (20) and a blade (40) to nick the extrudate (16) as it exists a die. A gap is provided between the tube and an extruder die (12) to allow a blade (40) access to the extrudate (16) as it exits an orifice (14) in the die (12). The blade (40) accesses the extrudate (16) while it is in a viscous melt, before the extrudate (16) has cooled and hardened. The blade (40) nicks the extrudate (16), as opposed to completely cutting it, thereby allowing the extrudate (16) to remain connected throughout processing such as curling in the containment tube (30). The gap also allows steam to be vented form the extrudate (16) as it exits the orifice (14) in the die (12). The curly puff extrudate (20) separates when fried or baked.

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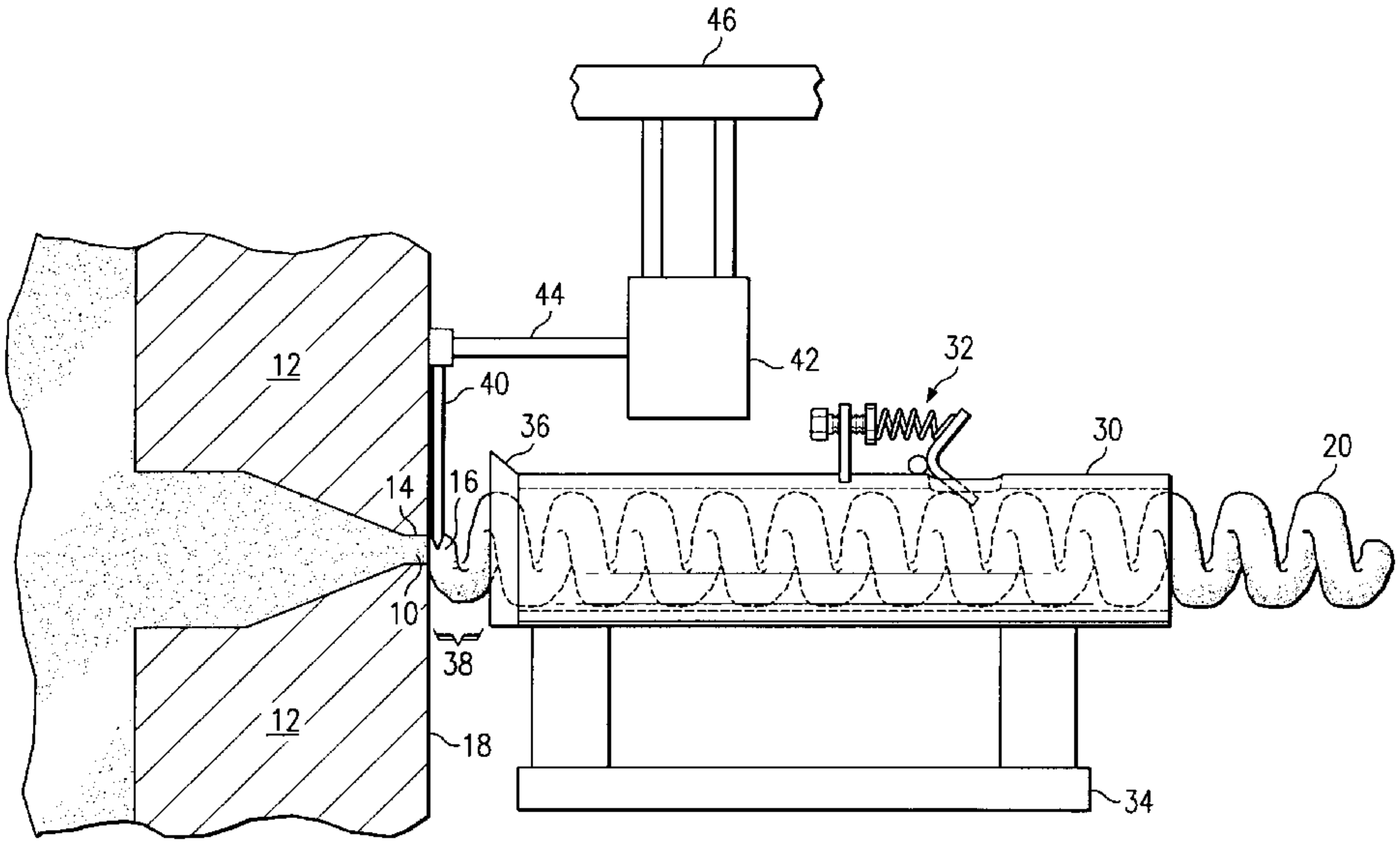
(54) **Title:** IMPROVED METHOD AND APPARATUS FOR PRODUCING A CURLY PUFF EXTRUDATE



(57) **Abstract:** The present invention utilizes a containment tube (30) to facilitate production of a curly puff extrudate (20) and a blade (40) to nick the extrudate (16) as it exists a die. A gap is provided between the tube and an extruder die (12) to allow a blade (40) access to the extrudate (16) as it exits an orifice (14) in the die (12). The blade (40) accesses the extrudate (16) while it is in a viscous melt, before the extrudate (16) has cooled and hardened. The blade (40) nicks the extrudate (16), as opposed to completely cutting it, thereby allowing the extrudate (16) to remain connected throughout processing such as curling in the containment tube (30). The gap also allows steam to be vented form the extrudate (16) as it exits the orifice (14) in the die (12). The curly puff extrudate (20) separates when fried or baked.

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BACKGROUND OF THE INVENTION

1. Technical Field

The present invention relates generally to the production of a puff extrudate and, specifically, to an improved process of producing a plurality of similarly shaped curly puff extrudate pieces from a single curly puff extrudate.

2. Description of Related Art

The production in the prior art of a puff extruded product, such as snacks produced and marketed under the Cheetos™ brand label, typically involves extruding a corn meal or other dough through a die having a small orifice at extremely high pressure. The dough flashes or puffs as it exits the small orifice, thereby forming a puff extrudate. The typical ingredients for the starting dough may be, for example, corn meal of 41 pounds per cubic foot bulk density and 12 to 13.5% water content by weight. However, the starting dough can be based primarily on wheat flour, rice flour, soy isolate, soy concentrates, any other cereal flours, protein flour, or fortified flour, along with additives that might include lecithin, oil, salt, sugar, vitamin mix, soluble fibers, and insoluble fibers. The mix typically comprises a particle size of 100 to 1200 microns.

The puff extrusion process is illustrated in **Figure 1**, which is a schematic cross-section of a die **12** having a small diameter exit orifice **14**. In manufacturing a corn-based puff product, corn meal is added to, typically, a single (i.e., American Extrusion, Wenger, Maddox) or twin (i.e., Wenger, Clextral, Buhler) screw-type extruder such as a model X 25 manufactured by Wenger or BC45 manufactured by Clextral of the United States and France, respectively. Using a Cheetos like example, water is added to the corn meal while in the extruder, which is operated at a screw speed of 100 to 1000 RPM, in order to bring the overall water content of the meal up to 15% to 18%. The meal becomes a viscous melt **10** as it approaches the die **12** and is then forced through a very small opening or orifice **14** in the die **12**. The diameter of the orifice **14** typically ranges between 2.0 mm and 12.0 mm for a corn meal formulation at conventional moisture content, throughput rate, and desired extrudate rod diameter or shape. However, the orifice diameter might be substantially smaller or larger for other types of extrudate materials.

While inside this orifice **14**, the viscous melt **10** is subjected to high pressure and temperature, such as 600 to 3000 psi and approximately 400° F. Consequently, while inside the orifice **14**, the viscous melt **10** exhibits a plastic melt phenomenon wherein the fluidity of the melt **10** increases as it flows through the die **12**.

It can be seen that as the extrudate **16** exits the orifice **14**, it rapidly expands, cools, and very quickly goes from the plastic melt stage to a glass transition stage, becoming a relatively rigid structure, referred to as a "rod" shape if cylindrical, puff extrudate. This rigid rod structure can then be cut into small pieces, further cooked by, for example, frying, and seasoned as required.

Any number of individual dies **12** can be combined on an extruder face in order to maximize the total throughput on any one extruder. For example, when using the twin screw extruder and corn meal formulation described above, a typical throughput for a twin extruder having multiple dies is 2,200 lbs., a relatively high volume production of extrudate per hour, although higher throughput rates can be achieved by both single and twin screw extruders. At this throughput rate, the velocity of the extrudate as it exits the die **12** is typically in the range of 1000 to 4000 feet per minute, but is dependent on the extruder throughput, screw speed, orifice diameter, number of orifices and pressure profile.

As can be seen from **Figure 1**, the snack food product produced by such process is necessarily a linear extrusion which, even when cut, results in a linear product. Consumer studies have indicated that a product having a similar texture and flavor presented in a "curl," "spiral," or "coil spring" shape (all of which terms are used synonymously by Applicant herein) would be desirable. An example of such spiral shape of such extrudate is illustrated in **Figure 2**, which is a perspective view of one embodiment of a spiral or curl shaped puff extrudate **20**. The apparatus for making curly puff extrudate is the subject matter of U.S. Patent Number 6,722,873 entitled "Apparatus and Method for Producing a Curly Puff Extrudate".

Curly puff extrudate **20** has proven difficult to cut into smaller, more manageable extrudate pieces. Some type of containment vessel such as a pipe or tube (terms used synonymously by the Applicant herein) is used for the curly puff extrudate production and a cutting device at the end of the tube results in surging and plugging within the tube, particularly during start-up and shutdown of the extruder. **Figure 3** illustrates a perspective view of a device involving a number of tubes **30** attached to a die face **18**. The exit end of each tube **30** is attached to an extruder face **23**. This arrangement then permits the attachment to the extruder face **23** of a circular cutting apparatus **24** having a number of individual cutting blades **26**. Such an arrangement is shown with ten tubes **30** connected to a die face **18**. Although not shown in **Figure 3**, the tube **30** and extruder face **23** configuration can be designed such that the dies **12** are allowed to vent until specific conditions are met (such as extrudate bulk density, specific mechanical energy, moisture content, screw speed, and die pressure), then the tube **30** can be rotated over the dies **12** by device of an additional rotatable plate (not shown) between the tubes **30** and the dies **12**.

However, cutting the curly puff extrudate **20** at the end of the tube **30** in a multiple tube **30** assembly is not preferable because the cutting blades **26** drag the curly puff extrudate **20** from one tube **30** to another which results in jagged and non-uniform ends of individual curly puff extrudate **20** pieces. **Figure 4** is an example of a piece of curly puff extrudate **20** cut with a device similar to the one in **Figure 3**. Additionally, when the curly puff extrudate **20** is produced in a multiple tube assembly, the tubes may not produce extrudate at the same rate, so a single cutter cutting multiple tubes will produce curly puff extrudate pieces of differing lengths.

This problem can be overcome by completely severing the extrudate at the die face when it is in the plastic melt state rather than the glass transition state. However, severing the extrudate at the die face disconnects the individual extrudate pieces and it is sometimes preferable to keep the extrudate connected for processing before separating the extrudate into individual extrudate pieces. Examples of processing include: conveying, seasoning, stretching, separating, or confining the extrudate in a containment vessel. Therefore, a need exists for an effective method of cutting the extrudate in the plastic melt state without completely separating the extrudate

Another problem with the apparatus in **figure 3** is that it does not allow for the release of steam and other hot gasses released from the expanding extrudate. The steam and other gasses promote surging and plugging within the tube. Therefore, a need also exists for an apparatus and method for venting steam and other hot gasses so they cannot enter the containment device.

It should be understood that while a need exist for an apparatus capable of cutting a curly puff extrudate without plugging a containment tube, the need is not limited to curly puff extrudate. A need also exists for an apparatus for cutting a sinusoidal puff extrudate as well as other types of linear and non-linear puffed extrudates.

Consequently, a need exists for an apparatus and method of cutting the puff extrudate into smaller puff extrudate pieces that will create smooth cuts at each end of the individual pieces. A need also exists for an apparatus and method that will prevent plugging of the tube during start-up, operation, and shutdown of the extruder. A need further exists for a method of releasing steam from the expanding extrudate. Moreover, a need exists for an apparatus and method of controlling the length of the individually cut puff extrudate pieces in a configuration with multiple orifices for each die.

SUMMARY OF THE INVENTION

The present invention comprises a nicking blade apparatus that nicks the curly puff extrudate rather than cutting it. The nicks create a series of weak points in the curly puff extrudate. The weak points are strong enough to keep the curly puff extrudate connected during the conveying process. However, when the curly puff extrudate is further processed in an oven or fryer, the curly puff extrudate breaks at the nicks, separating the curly puff extrudate into individual pieces.

In order to properly facilitate the nicking process while the extrudate is in the plastic melt state, the nicking should occur as close to the diehead as possible. The tube is separated from the diehead so that a blade may access the diehead orifice. The resulting separation also allows steam from the expanding extrudate to vent instead of proceeding through the tube. The release of steam allows the curly puff extrudate to flow more smoothly through the tube and helps prevent plugging and surging.

The proposed invention also comprises a tube positioning device that positions the tube over the diehead orifice during operation, but removes the tube away from the diehead orifice during start-up and shutdown. Removal of the tube from over the orifice is desired during start-up and shutdown because the extrudate tends to surge during these periods and plugs the tube. In order to facilitate nicks of different depths, a blade positioning device is also disclosed.

The preferred embodiment of the present invention utilizes a nicking blade for every orifice. However, as some die configurations will not allow a nicking blade for every orifice, a central blade apparatus for nicking multiple orifices is also disclosed.

The preferred embodiment of the present invention also utilizes an oven or fryer to separate the nicked curly puff extrudate. However, under certain circumstances, an oven or fryer is not preferable, so alternate separation devices are also disclosed. Alternative separation devices include a paddle wheel, a vibrating conveyer, and a tumbler.

The above as well as additional features and advantages of the present invention will become apparent in the following written detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will be best understood by reference to the following detailed description of illustrative embodiments when read in conjunction with the accompanying drawings, wherein:

Figure 1 is a schematic cross-section of a prior art puff extrudate die;

Figure 2 is a perspective view of a length of curly puff extrudate product;

Figure 3 is a perspective view of a puff extrudate face cutter applied to the curly puff extrudate production apparatus as disclosed in U.S. Patent Number 6,722,873;

Figure 4 is a perspective view of a piece of curly puff extrudate cut using a puff extrudate face cutter;

Figure 5 is a side view in elevation of one embodiment of the present invention;

Figures 6A-6C are side views in elevation of the positioning of the tube from start-up through operation for one embodiment of the present invention;

Figure 7 is a plan view of one embodiment of the present invention incorporating a configuration utilizing a single blade for each orifice;

Figures 8A-8C are side views of one embodiment of the present invention utilizing a single nicking blade for multiple orifices;

Figure 9 is a perspective view of piece of curly puff extrudate cut with the present invention; and

Figures 10A-10B are front views in elevation of the paddle wheel separator of the present invention.

DETAILED DESCRIPTION

Figure 5 is an elevation view of one embodiment of the present invention. Identical reference numerals will be used to identify identical elements throughout all of the drawings, unless otherwise indicated. As with the prior art, the extrudate **16** exits an orifice **14** in the die **12**. The cross-sectional diameter of the orifice **14** is dependent on the specific dough formulation, throughput rate, and desired rod (or other shape) diameter, but is preferred in the range of 1 mm to 14 mm. (The orifice **14** diameter is also dependent on the mean particle size of the corn meal or formula mix being extruded.)

If a curly puff extrudate **20** is desired, a tube **30** with a flapper **32** can be used. A flapper **32** puts pressure on the extrudate **16** exiting the orifice **14** so that curls will form in the extrudate **16**. A tube positioning device **34** is used to position the tube **30** in front of or away from the orifice **14**. The tube positioning device **34** is capable of moving the tube **30** in any direction relative to the die **12**. Examples of tube positioning devices are electrical servo motors, pneumatic actuators, hydraulic actuators, and mechanical screws. A tube blade **36** is also affixed to the end of the tube **30** closest to the die **12**.

A nicking blade **40** is positioned flush with the die face **18** and either rotates or oscillates about a shaft **44**. The nicking blade **40** and the shaft **44** are powered by a motor **42**, which is connected to a blade positioning device **46**. The blade positioning device **46** is capable of moving the motor **42**, the shaft **44**, and the nicking blade **40** in any direction relative to the die **12**. Examples of blade positioning devices **46** are electrical servo motors, pneumatic actuators, hydraulic actuators, and mechanical screws. In order to effectively nick the extrudate **16** exiting the orifice **14**, the nicking blade **40** is positioned such that the end of the nicking blade **40** only partially covers the orifice **14** when passing in front of the orifice **14**. Allowing the nicking blade **40** to completely cover the orifice **14** would completely sever the extrudate **16**, which would not allow the extrudate **16** to remain connected for additional processing. It should be understood that the extent to which the nicking blade **40** covers the orifice **14** determines the depth of the nick in the extrudate **16**. Deeper nicks will allow the extrudate **16** to break more easily, a property referred to here as breakability. Shallower nicks will allow the extrudate **16** to stay connected more easily, a property referred to here as connectivity. The amount of coverage over the orifice **14** is expressed as a coverage percentage that is equal to the length of the nicking blade **40** covering the orifice **14** divided by the orifice **14** cross-sectional diameter. The coverage percentage desired will depend on the type of viscous melt **10** and orifice **14** size. Coverage percentages of eighty to ninety percent have generally been found to be an acceptable balance between breakability and connectivity for the melt **10** and orifice **14** size described herein. If desired, the rate at which the nicking blade **40** nicks the extrudate **16** can be increased such that the nicking blade **40** nicks the extrudate **16** faster than the extrudate **16** curls. When this is done and the nicked extrudate **16** is separated, smaller "C" shaped pieces of extrudate are formed.

Another factor affecting the nick size is the nicking blade **40** tip shape. While pointed nicking blades **40** are capable of nicking the extrudate **16**, square edged nicking blades **40** (i.e. where the edge of the nicking blade **40** contains two ninety degree angles) have proven more effective at creating uniform nicks in the curly puff extrudate **20**.

During start up, the tube **30** is positioned away from the orifice **14** with the tube blade **36** placed firmly against the die face **18**. As the extruder starts and approaches operating parameters, it will extrude undesirable extrudate **16**. The extruder also extrudes an excess amount of hot gasses, such as steam, from the orifice **14** during start up. Steam and other hot gasses tend to cause plugging in the tube **30**. Positioning the tube **30** away from the orifice **14** allows the undesired extrudate **16** to bypass the tube **30** and prevents the undesired extrudate **16**, steam, and other hot gases from plugging the tube **30**. The motor **42** is generally not run during start up so that the start up extrudate **16** is not nicked. Alternatively, if the motor **42** is running, the blade positioning device **46** can position the moving nicking blade **40** such that the blade cutting radius **22** does not cover the orifice **14**, and the nicking blade **40** will not nick the extrudate **16** nor interfere with the positioning of the tube **30**. In this manner, the motor **42** and the nicking blade **40** can be brought up to operating speed without nicking the extrudate **16** or interfering with the positioning of the tube **30**. If desired, the nicking blade **40** can be positioned by the blade positioning device **46** such that it completely cuts the extrudate **16** exiting the orifice **14**. This method cuts the extrudate **16** into smaller pieces and eliminates the need for a separating device.

Figures 6A-6C illustrate the process of starting up and operating one embodiment of the present invention. When the extruder reaches its operational parameters, the tube positioning device **34** positions the tube **30** so that the tube blade **36** is flush with the die face **18** (See **figure 6A**). The tube positioning device **34** then quickly slides the tube **30** across the die face **18** until the orifice **14** is within the inside diameter of the tube **30** (See **figure 6B**). When the tube blade **36** passes over the orifice **14**, the tube blade **36** slices off the old extrudate **16** and allows the orifice **14** to extrude a new extrudate **16** into the tube **30**, where the flapper **32** will contact the extrudate **16** and cause it to curl and form the curly puff extrudate **20**.

After the tube positioning device **34** positions the tube **30** over the orifice **14**, the tube positioning device **34** moves the tube **30** away from the die **12** (See **figure 6C**). Separating the tube **30** from the die face **18** creates a gap **38**. The gap **38** allows gasses such as steam to escape from the expanding extrudate **16** and allows the nicking blade **40** to access the extrudate **16** as it exits the orifice **14**. Gap distances of 4-8 millimeters have been found to be a good balance between containing the curling extrudate inside the tube **30**, allowing the nicking blade **40** access to the extrudate **16**, and allowing sufficient release of steam. It should be understood that the gap **38** may vary depending on the pressure and temperature of the extrudate **16**, the back pressure created by flapper **32**, and the thickness of the nicking blade **40**.

It should also be understood that multiple embodiments of the orifice **14**, the nicking blade **40,** and the tube **30** can be implemented on a single die **12**. **Figure 7** is an illustration of a die **12** with four such embodiments. The blade cutting radius **22** is defined by the outer reach of the nicking blade **40** and is shown only partially covering the orifice **14**. The position of the nicking blade **40** shown in **figure 7** is preferable to other configurations, such as one in which the shaft **44** is closer to the edge of the die face **18**, because the blade cutting radius **22** does not extend beyond the perimeter of the die face **18**. Keeping the blade cutting radius **22** within the perimeter of the die face **18** helps prevent injury to people working in close proximity to the extruder and the die **12**. During operation of a die **12** with multiple orifices **14**, the extrudate **16** discharge rate may vary from one orifice **14** to another. The embodiment utilizing one nicking blade **40** for every orifice **14** is preferred because it allows an operator or automated controller to adjust the nicking blade **40** speed based on the extrudate **16** output rate and curling rate. By adjusting the speed of the nicking blade **40** to the output rate of the extrudate **16** of an individual orifice **14**, the distance between the nicks on the extrudate **16** from each individual orifice **14** can be precisely controlled and thus yield curly puff extrudate **20** pieces of uniform length.

In certain situations, an embodiment utilizing a nicking blade **40** for every orifice **14** may not be necessary or preferable. In these cases, a central nicking apparatus **62**, as shown in **figures 8A, 8B, and 8C**, utilizing a central nicking apparatus positioning device (not shown), a blade positioning device **64**, and at least one blade **60** can be utilized. The central nicking apparatus positioning device can move the central nicking apparatus **62** in any direction relative to the die **12**. Examples of central nicking apparatus positioning devices **62** are electrical servo motors, pneumatic actuators, hydraulic actuators, and mechanical screws. A central nicking apparatus **62** like the one utilized in **figures 8A-8C** can be used to cut or nick a plurality of orifices **14**. **Figures 8A-8C** are illustrations of the process of positioning the central nicking apparatus **62** into the center of the die face **18** such that the blades **60** of the central nicking apparatus **62** are able to nick multiple orifices **14**. In **Figure 8A**, the central nicking apparatus **62** is positioned close to the die face **18**. A motor (not shown) powers the central nicking apparatus **62**. As the central nicking device **62** begins to rotate, the centrifugal force, caused by the rotation of the central nicking apparatus **62**, forces opens the blades **60**. The blade positioning device **64** guides the blades **60** into position such that they will be parallel with the die face **18** when completely opened. Alternatively, the blade positioning device **64** can be actuated or otherwise controlled to force the blades **60** into position. In **Figure 8B**, the centrifugal force continues to expand the blades **60** and positions them adjacent to the die face **18**. The nicking apparatus **62** continues to rotate so that the blades **60** are moved into position and nick the extrudates **16** exiting the orifices **14** (See **figure 8C**). The blades **60** can also be extended far enough to completely sever the extrudates **16** exiting the orifices **14**.

Referring back to **figure 5**, after exiting the tube **30**, the curly puff extrudate **20** is generally transported to an oven for baking or a fryer for frying. The nicks in curly puff extrudate **20** are weaker than the rest of the curly puff extrudate **20** and, consequently, the curly puff extrudate **20** breaks into individual curly puff extrudate **20** pieces with little or no mechanical manipulation upon baking or frying. **Figure 9** is an example of a nicked curly puff extrudate **20** piece that has separated in a fryer.

In some applications, it may be desirable to separate the individual curly puff extrudate **20** pieces prior to baking, frying, or some other processing. In that case, there are a variety of devices that can be used to separate the nicked curly puff extrudate **20**. One type of separation device is a paddle wheel. **Figures 10A and 10B** are illustrations of a paddle wheel. In the embodiment disclosed in **figures 10A and 10B**, the curly puff extrudate **20** exits the tube **30** and travels along a conveyer belt, which is parallel to the shaft **70** of the paddle wheel. The view in **figures 10A and 10B** is that of the curly puff extrudate **20** being conveyed out of the page towards the viewer. Each paddle wheel comprises a shaft **70** connected to a motor (not shown). A plurality of paddles **72** are connected to the shaft **70**.

When the shaft **70** rotates, the paddles **72** come into contact the nicked curly puff extrudate **20 (Figure 10A)**. By this point, the curly puff extrudate **20** has cooled sufficiently to harden. When the paddles **72** come into contact with the curly puff extrudate **20**, the nicked curly puff extrudate **20** breaks at its weakest point, namely the nick. The individual curly puff extrudate **20** pieces then fall into a capture bin underneath the paddle wheel (**Figure 10B**). A guide **74** keeps the curly puff extrudate **20** from repositioning itself out of the reach of the paddles **72**.

It should be realized that a paddle wheel is not the only device for separating the individual curly puff extrudate **20** pieces. A tumbler could be employed to tumble the unseparated curly puff extrudate **20** until the curly puff extrudate **20** pieces break off. The curly puff extrudate **20** pieces could then be removed from the tumbler. The curly puff extrudate **20** can also be separated on a vibrating conveyer or a conveyer having steps or direction changes that facilitate product separation. Persons skilled in the art will also be aware of various other devices for separating nicked curly puff extrudate **20**.

While the present invention is disclosed in reference to curly puff extrudate **20**, it should be understood that the present invention could be employed with cylindrical, uniquely shaped, or any other type of extrudate **16**. Additionally, the present invention can be utilized any time there is an need for cutting or nicking of a quasi-solid effluent from any type of process.

It should further be understood that more than one die **12** could be routed into a single tube **30**. For example, a tube **30** can receive the extrudate **16** from two nearby orifices **14**. Further, dies **12** producing any number of shapes, such as a star or square cross section or more complex shapes, such as a cactus or pepper shape, can be used with the invention.

Any number of various types of extruders can be used with the invention, including twin screw and single screw extruders of any length and operating at a wide range of rotational speeds. Further, while the process has been described with regard to a corn-based product, it should be understood that the invention can be used with any puff extrudate, including products based primarily on wheat, rice, or other typical protein sources or mixes thereof. In fact, the invention could have applications in any field involving extrusion of a material that quickly goes through a glass transition stage after being extruded through a die orifice.

While the invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.

CLAIMS

What is claimed is:

1. A method of producing a plurality of extrudate pieces comprising:

extruding an extrudate such that said extrudate exits an extruder in a plastic melt stage;

nicking the extrudate while the extrudate is in the plastic melt stage with a nicking device; and

separating the extrudate into pieces delineated by the area of the nicks in the extrudate using a separation device.

2. The method of claim 1 wherein the nicking device is a blade.

3. The method of claim 2 wherein the blade nicks the extrudate exiting an orifice in a die.

4. The method of claim 2 wherein the blade nicks a plurality of extrudates exiting a plurality of orifices in a die.

5. The method of claim 1 further comprising: processing the extrudate; wherein the extrudate remains connected during processing.

6. The method of claim 5 wherein the processing comprises passing the extrudate through a containment vessel and applying a resistance to the extrudate to produce a non-linear extrudate.

7. The method of claim 6 wherein the nicking device accesses the extrudate through a gap in between a die and the containment vessel.

8. The method of claim 6 further comprising:

positioning the containment vessel away from an orifice in a die such that the extrudate does not pass through the containment vessel; and

repositioning the containment vessel in front of the orifice such that the extrudate passes through the containment vessel.

9. The method of claim 6 further comprising:

positioning the nicking device away from an orifice in a die of an extruder such that the nicking device does not nick the extrudate; and

repositioning the nicking device in front of the orifice such that the nicking device nicks the extrudate.

10. The method of claim 1 wherein the separation device is an oven.

11. The method of claim 1 wherein the separation device is a fryer.

12. The method of claim 1 wherein the separation device is a paddle wheel.

13. The method of claim 1 wherein the separation device is a tumbler.

14. The method of claim 1 wherein the separation device is a conveyer.

15. An apparatus for producing an extrudate comprising:

an extruder die comprising at least one orifice;

a nicking device located in front of the die; and

wherein the nicking device nicks an extrudate exiting the orifice in the die.

16. The apparatus of claim 15 wherein the nicking device is a blade.

17. The apparatus of claim 16 wherein the blade nicks the extrudate while the extrudate is in a plastic melt stage.

18. The apparatus of claim 16 wherein the blade nicks the extrudate from a plurality of the orifices.

19. The apparatus of claim 15 further comprising: a processing device; wherein the extrudate remains connected during processing.

20. The apparatus of claim 19 wherein the processing device is a containment vessel that applies a resistance to the extrudate to produce a non-linear extrudate.

21. The apparatus of claim 20 wherein the nicking device accesses the extrudate through a gap in between the die and the containment vessel.

22. The apparatus of claim 15 further comprising a separation device; wherein the separation device separates the nicked extrudate at the nicks.

23. The apparatus of claim 22 wherein the separation device is an oven.

24. The apparatus of claim 22 wherein the separation device is a fryer.

25. The apparatus of claim 22 wherein the separation device is a paddle wheel.

26. The apparatus of claim 22 wherein the separation device is a tumbler.

27. The apparatus of claim 22 wherein the separation device is a conveyer.

28. An apparatus for producing a non-linear extrudate comprising:

an extruder die comprising at least one orifice;

a containment vessel located in front of the die;

a containment vessel positioning device connected to the containment vessel;

a nicking device located in front of the die;

a nicking device positioning device connected to the nicking device;

wherein an extrudate exits the orifice and passes through the containment device;

wherein the nicking device nicks an extrudate exiting the orifice; and

wherein the nicking device accesses the extrudate through a gap in between the containment vessel and the die.

29. The apparatus of claim 28 wherein the nicking device is a blade.

30. The apparatus of claim 29 wherein the blade nicks the extrudate while the extrudate is in a plastic melt stage.

31. The apparatus of claim 29 wherein the blade nicks the extrudate from a plurality of orifices

32. The apparatus of claim 28 further comprising:

wherein the containment vessel positioning device positions the containment vessel away from the orifice such that the extrudate does not pass through the containment vessel; and

wherein the containment vessel positioning device repositions the containment vessel in front of the orifice such that the extrudate passes through the containment vessel.

33. The apparatus of claim 28 further comprising:

wherein the nicking device positioning device positions the nicking device away from the orifice such that the nicking device does not nick the extrudate; and

wherein the nicking device positioning device repositions the nicking device in front of the orifice such that the nicking device nicks the extrudate.

34. The apparatus of claim 28 further comprising: a separation device; wherein the separation device separates the nicked extrudate at the nicks.

35. The apparatus of claim 34 wherein the separation device is an oven.

36. The apparatus of claim 34 wherein the separation device is a fryer.

37. The apparatus of claim 34 wherein the separation device is a paddle wheel.

38. The apparatus of claim 34 wherein the separation device is a tumbler.

39. The apparatus of claim 34 wherein the separation device is a conveyer.

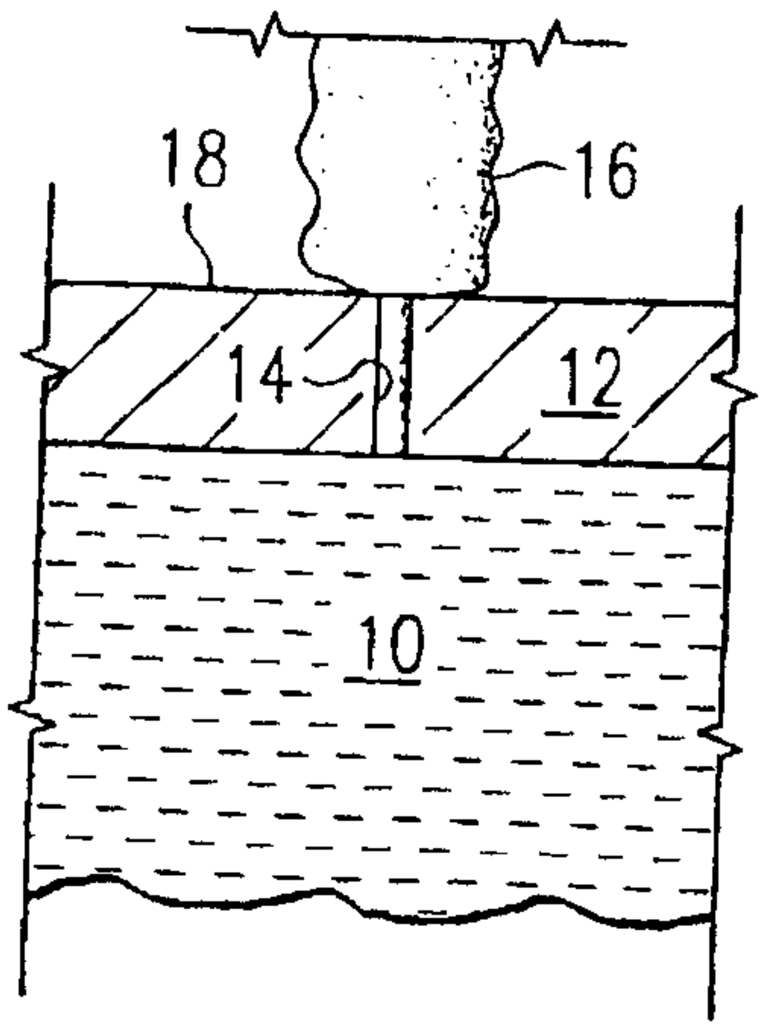

FIG. 1
(PRIOR ART)

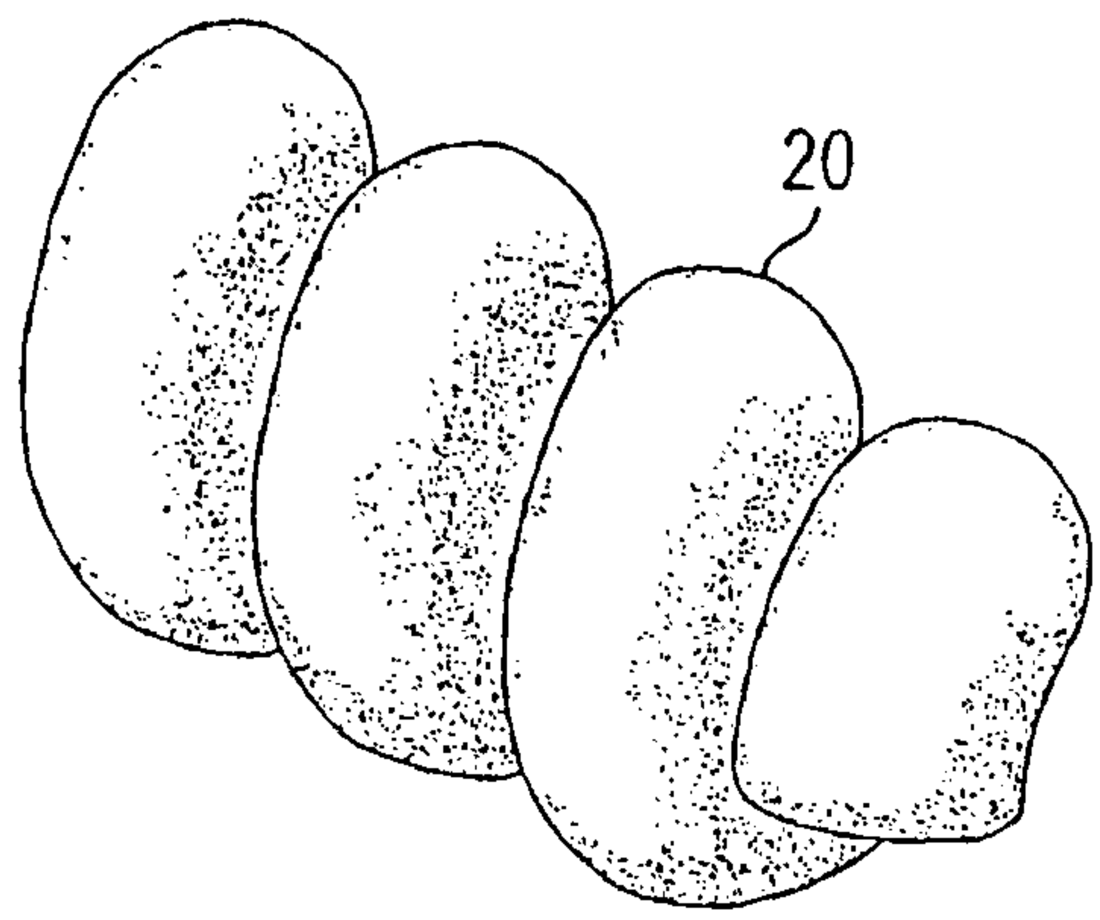

FIG. 2
(PRIOR ART)

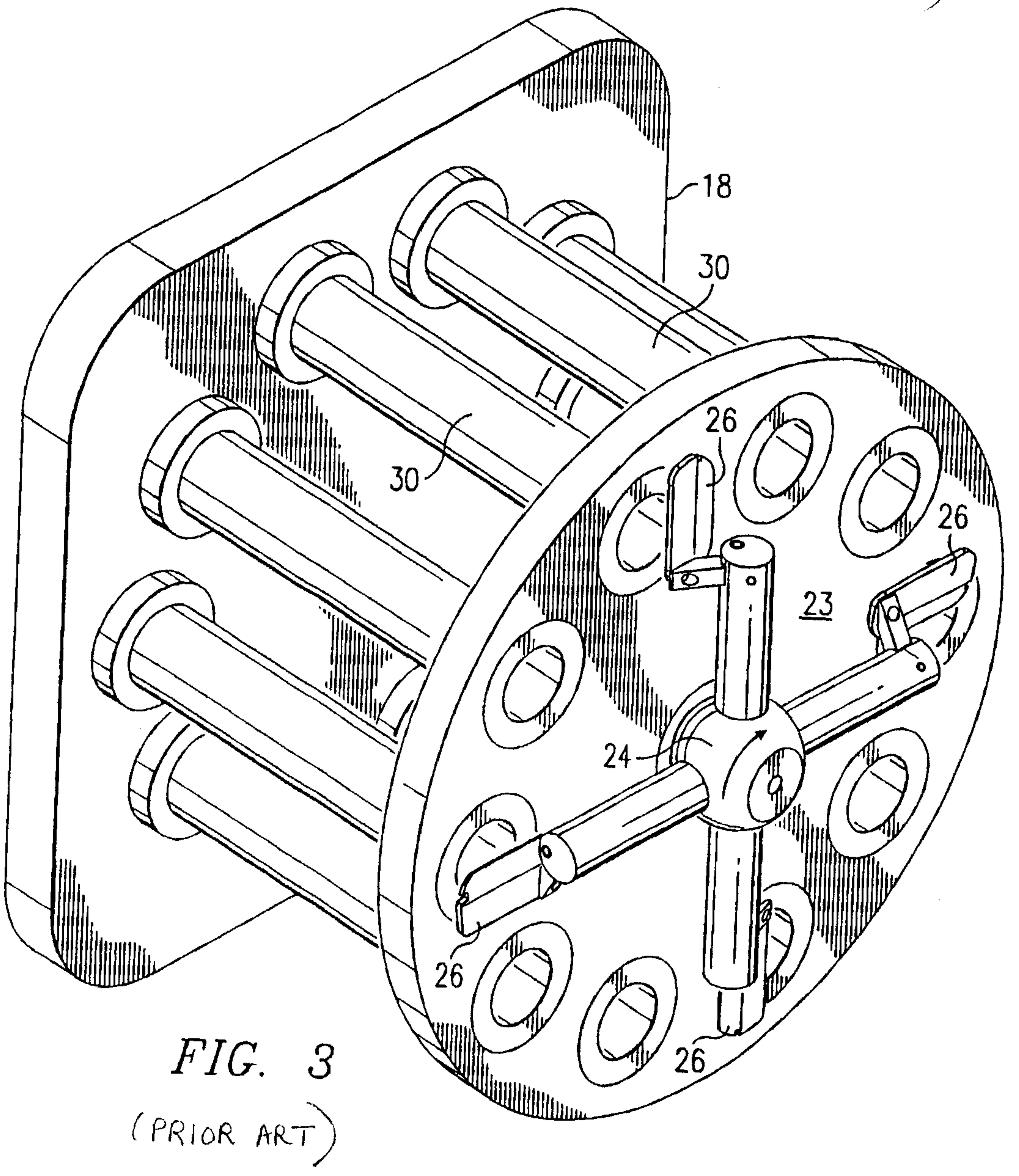

FIG. 3
(PRIOR ART)

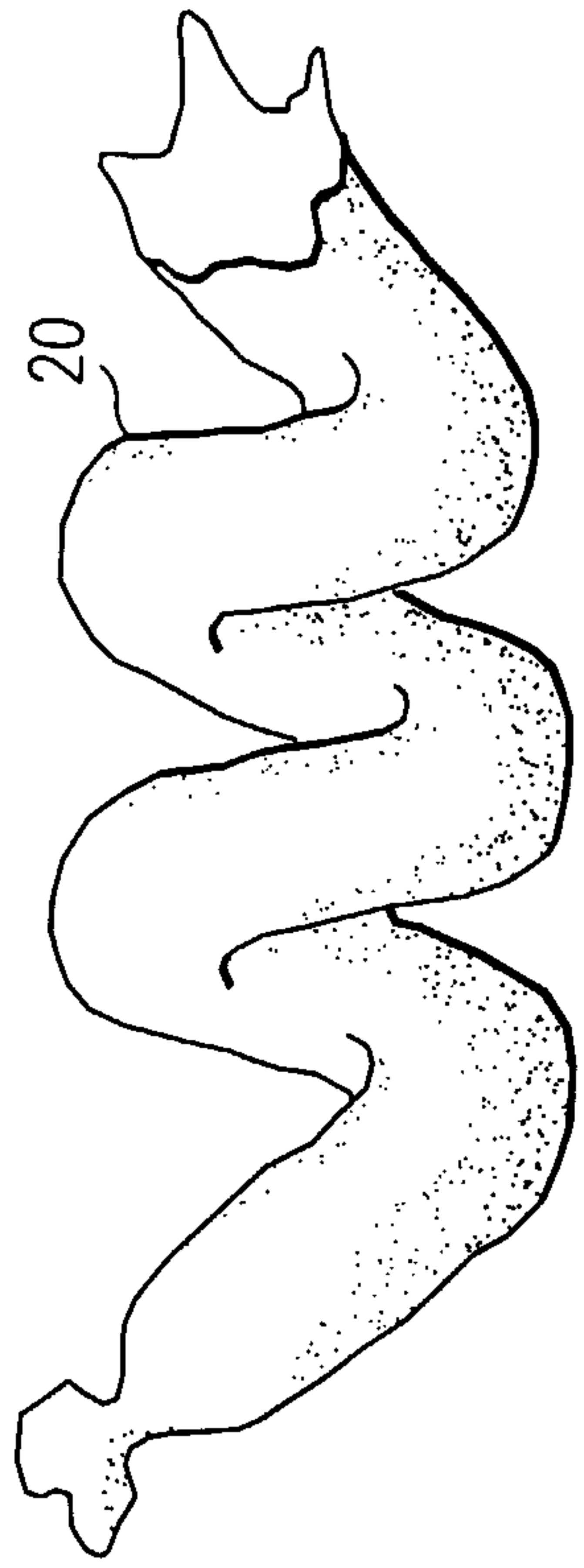

FIG. 4

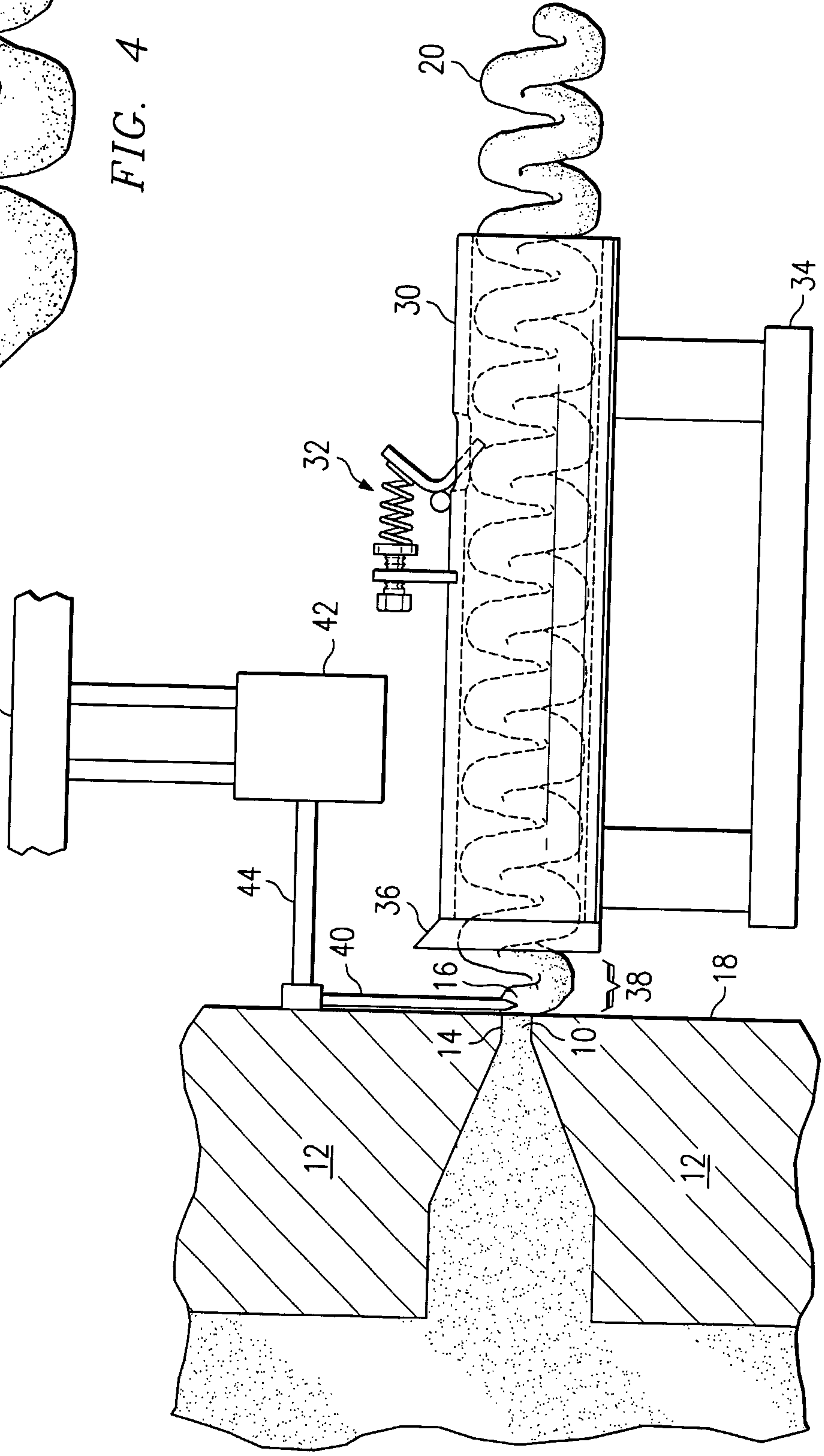

FIG. 5

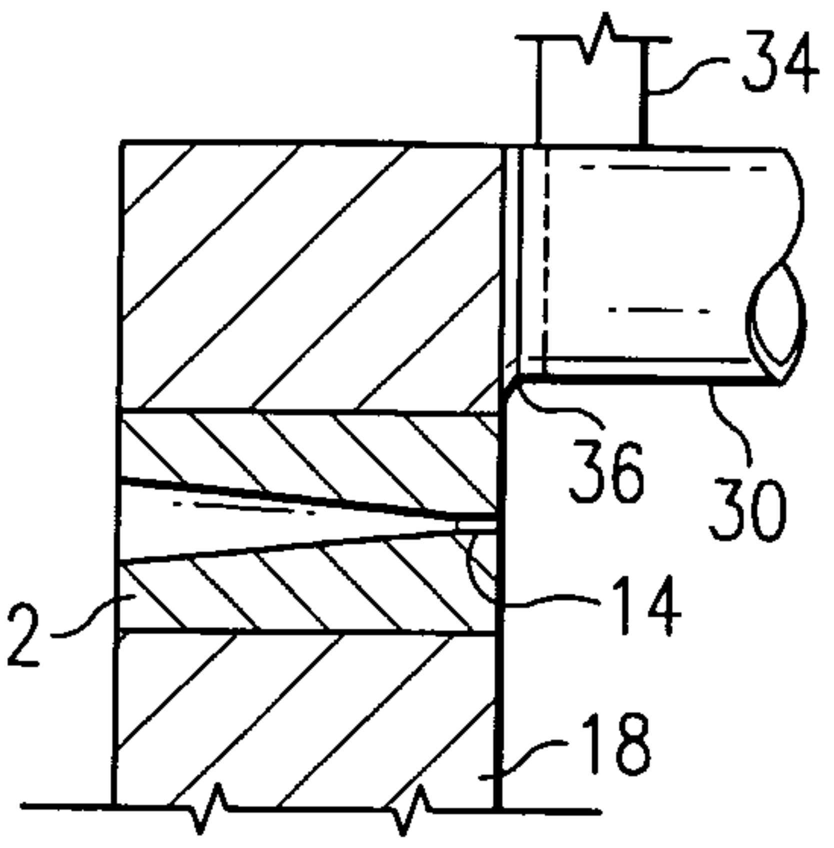

FIG. 6A

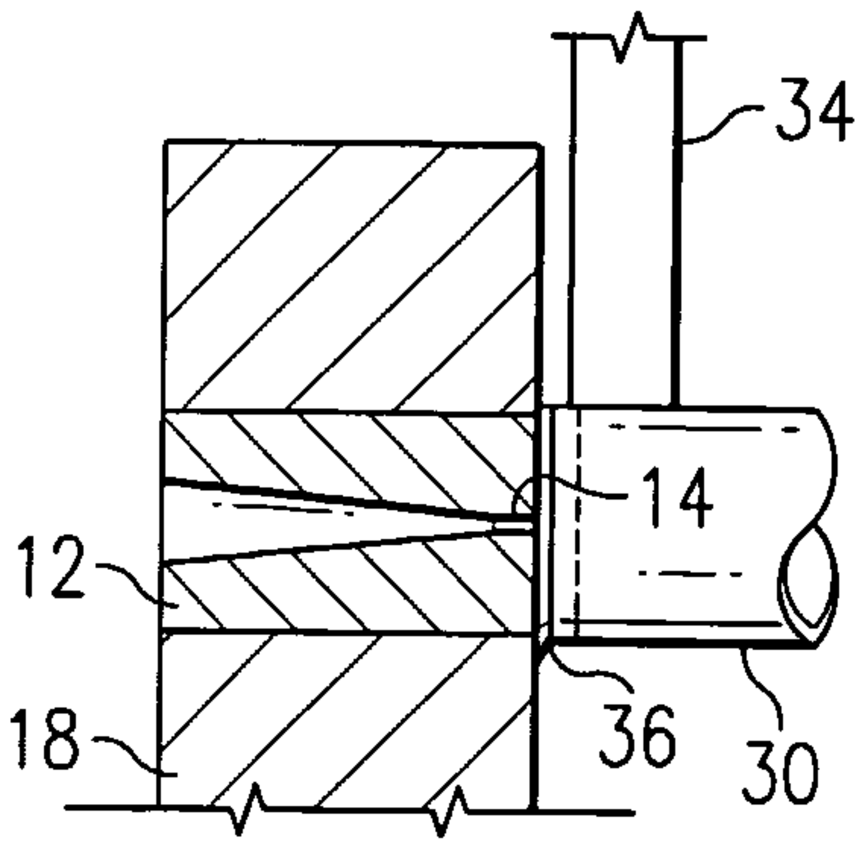

FIG. 6B

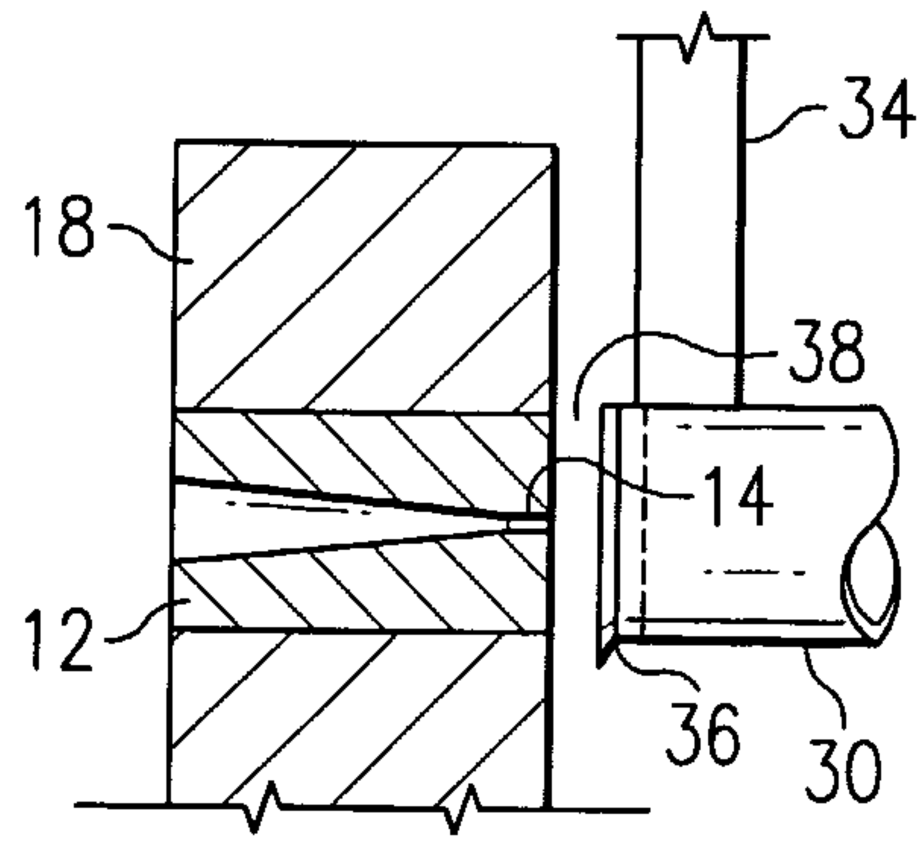

FIG. 6C

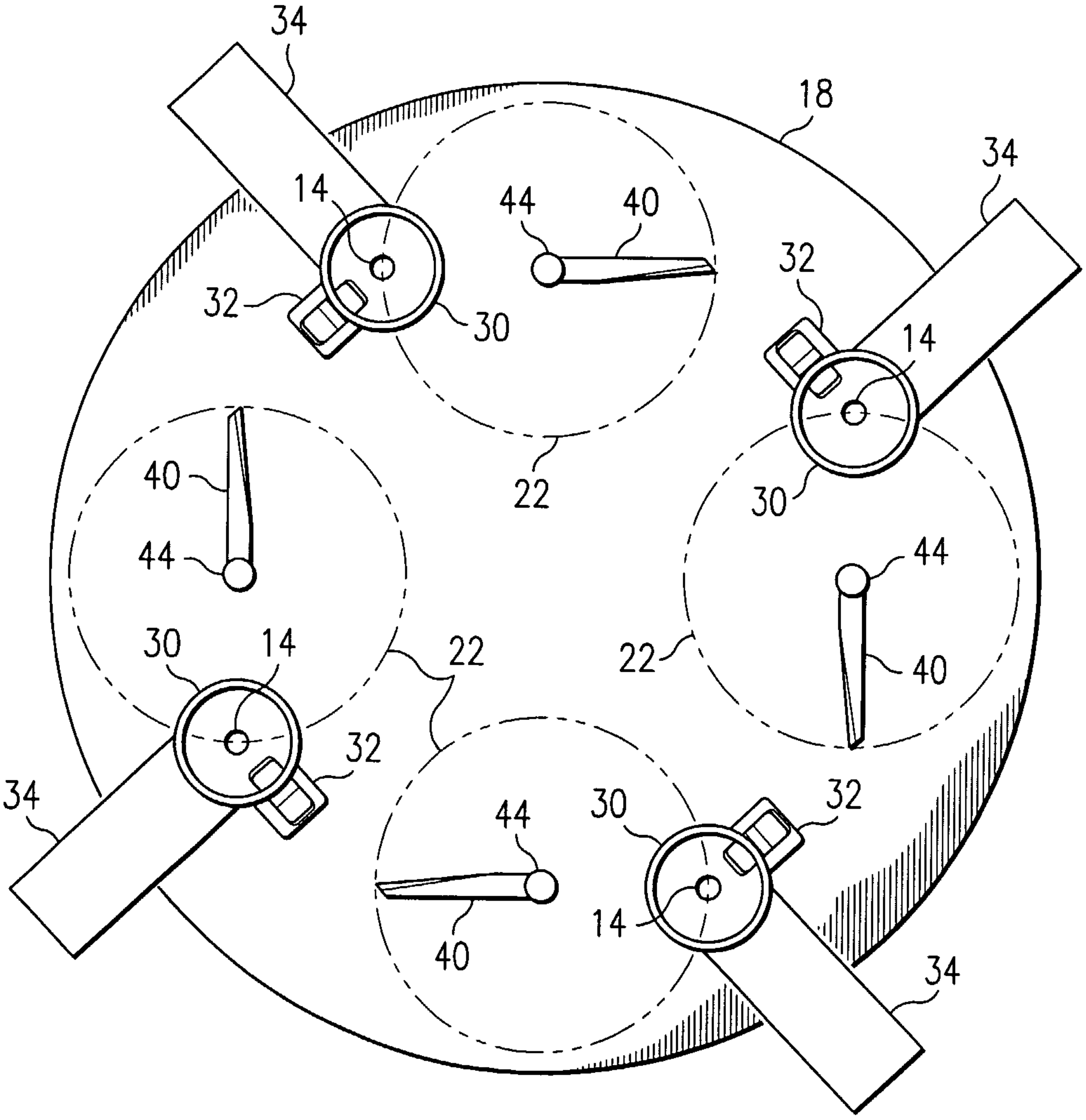

FIG. 7

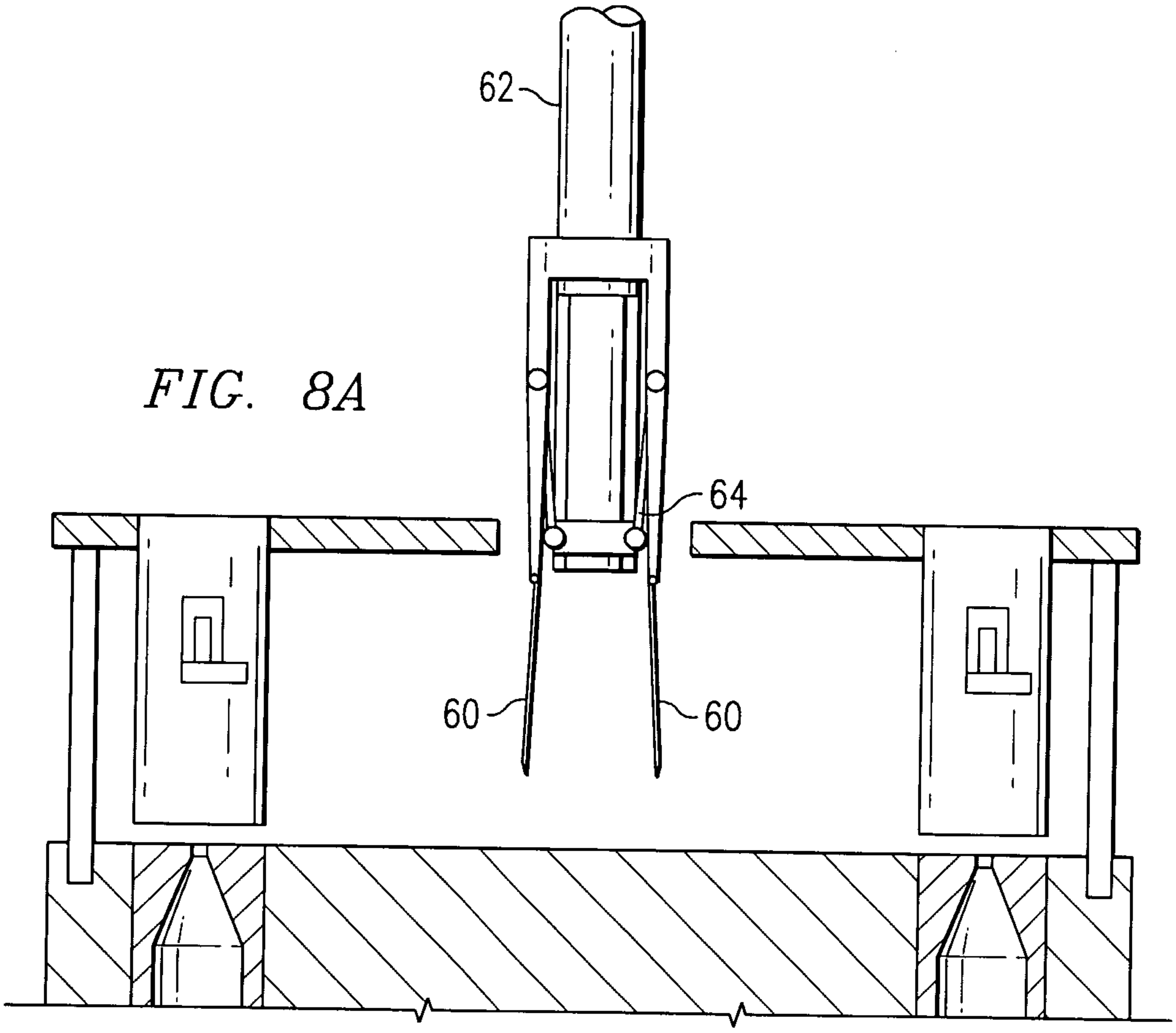

FIG. 8A

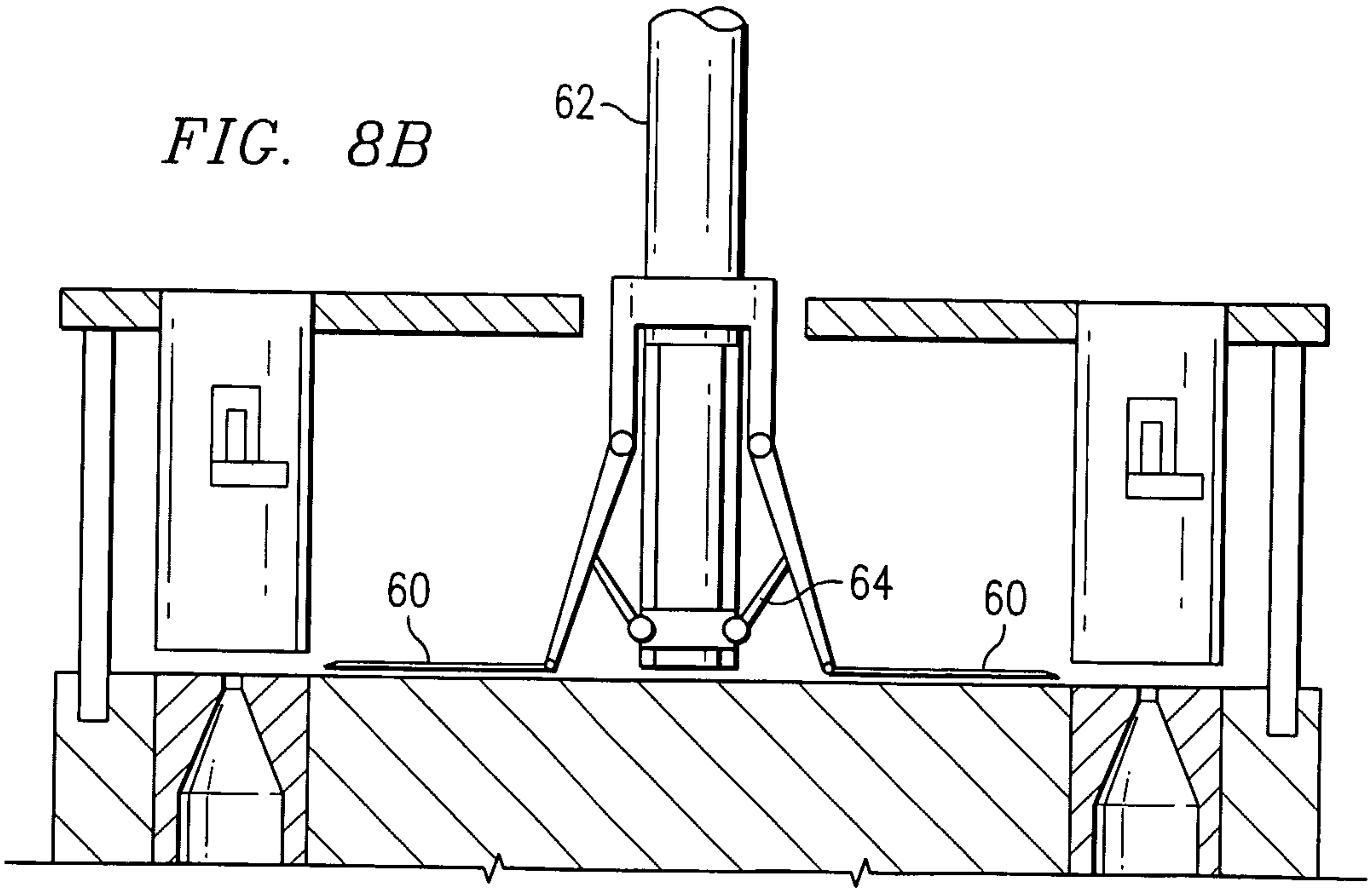

FIG. 8B

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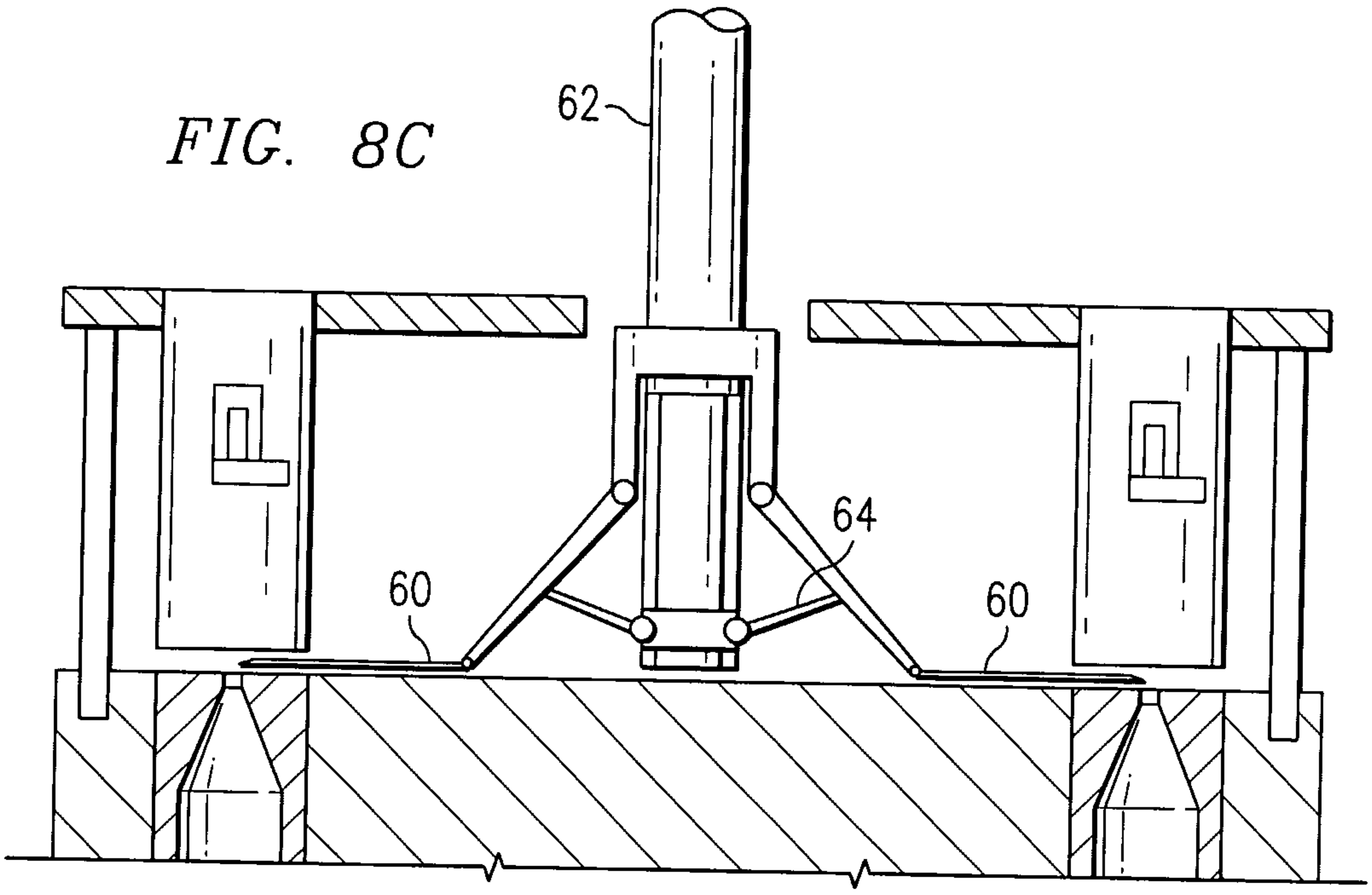
FIG. 8C



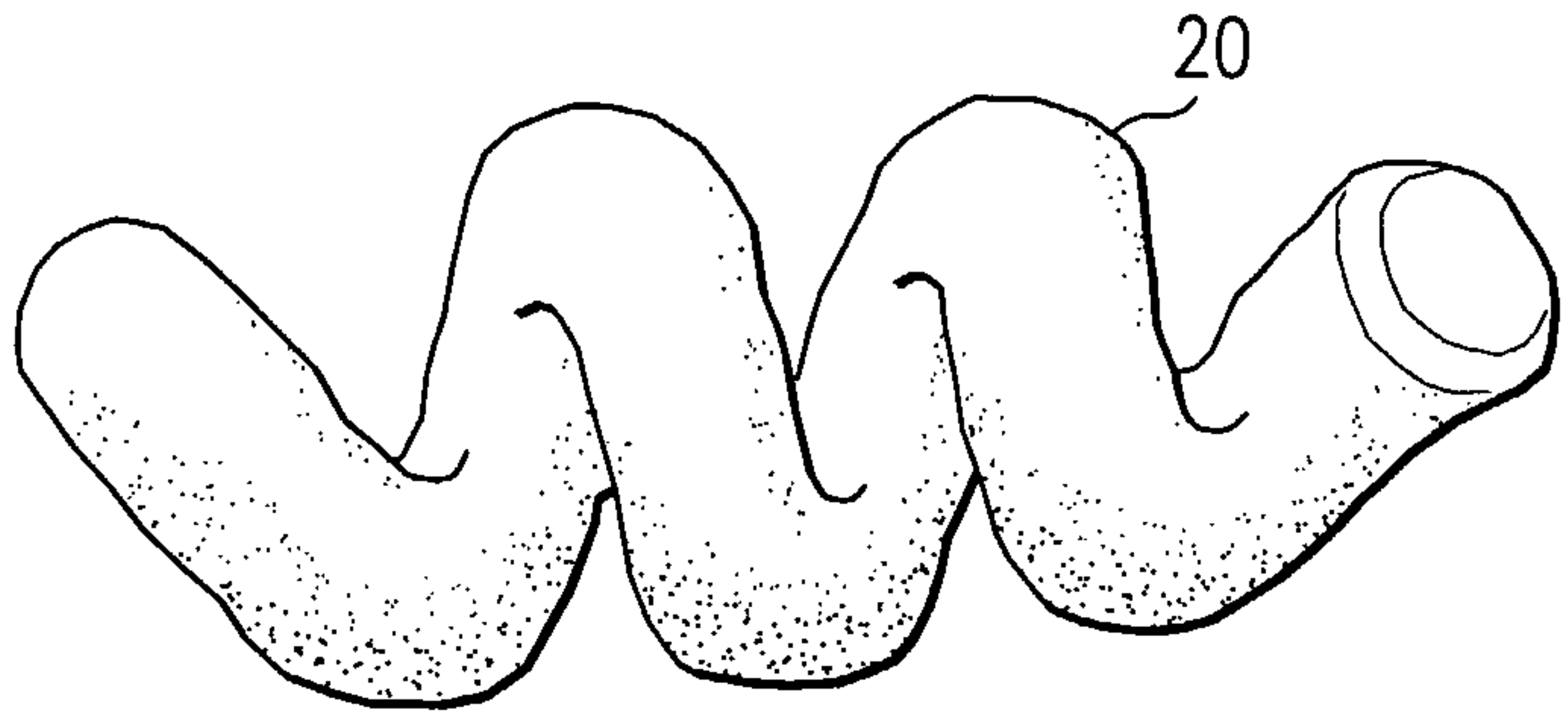


FIG. 9

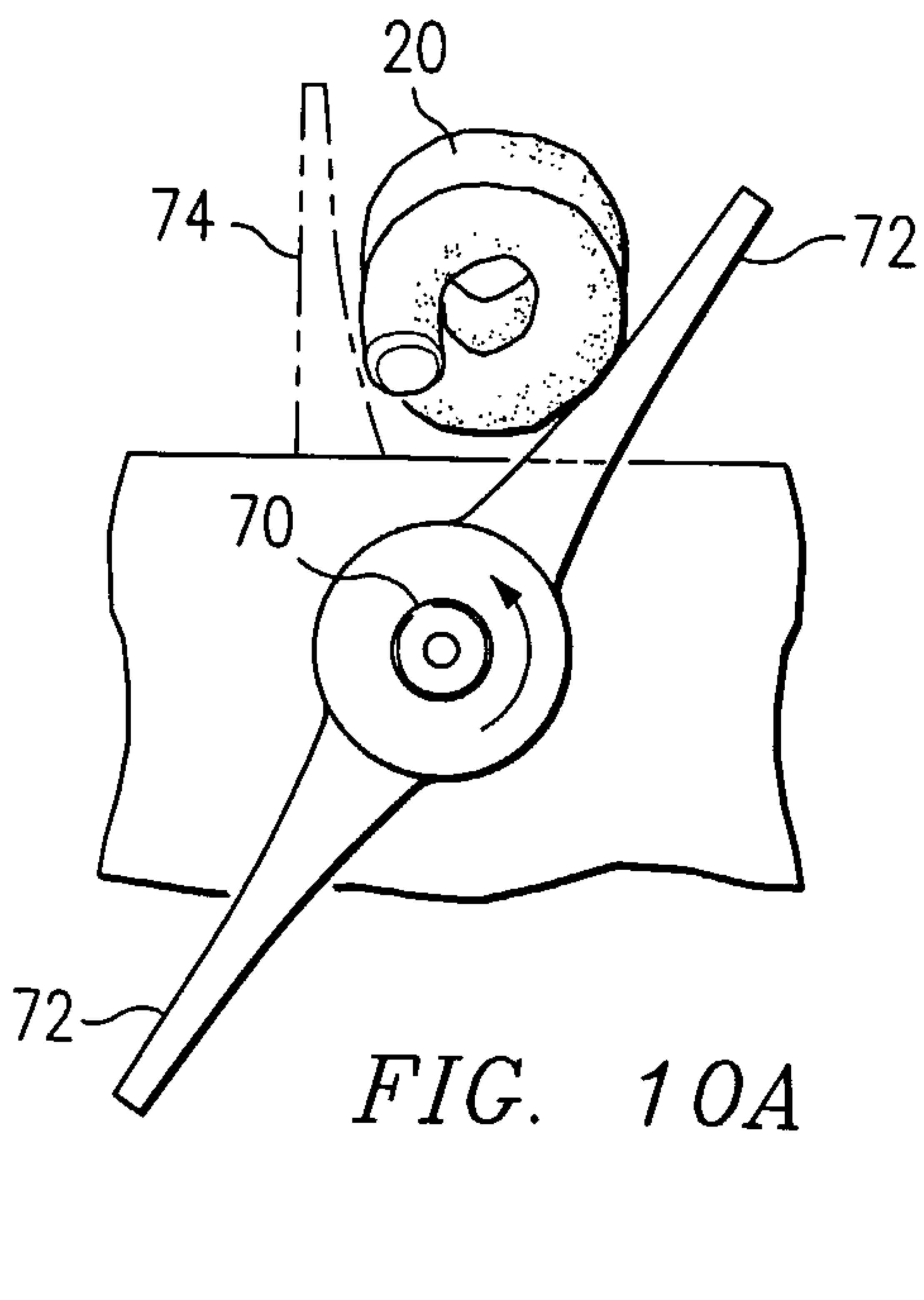


FIG. 10A

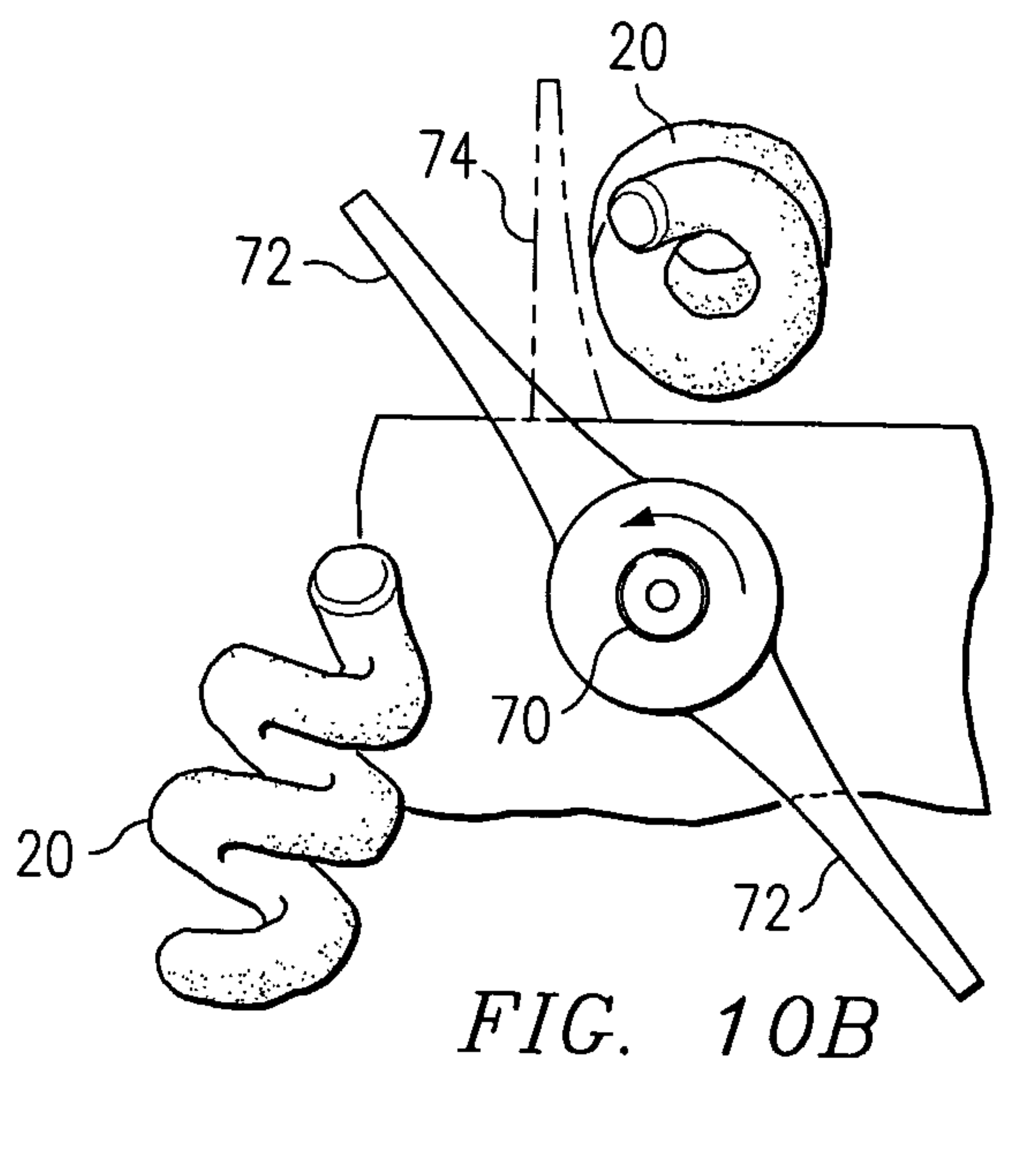
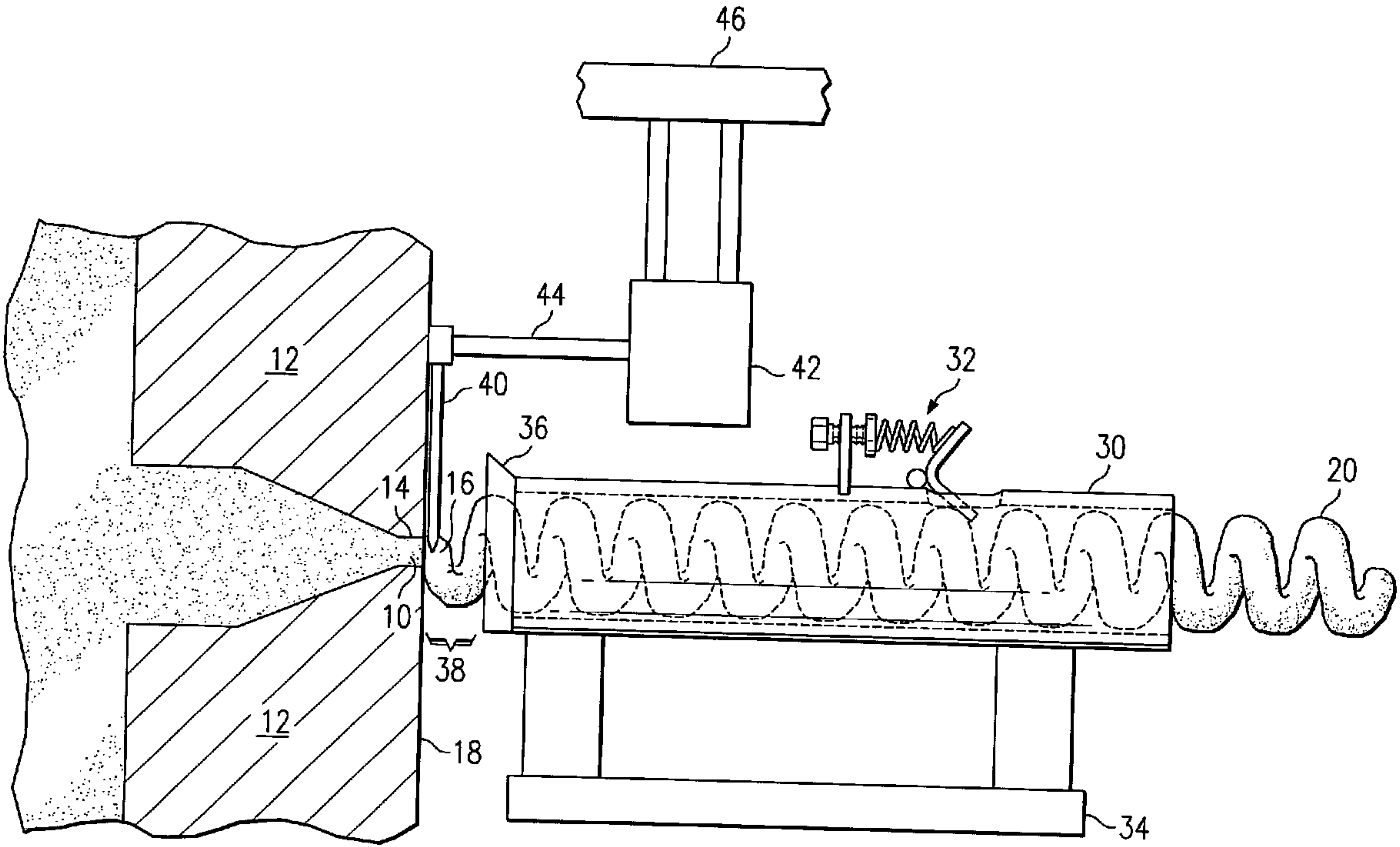


FIG. 10B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