



(22) Date de dépôt/Filing Date: 2001/07/06

(41) Mise à la disp. pub./Open to Public Insp.: 2002/01/09

(30) Priorité/Priority: 2000/07/09 (09/612,614) US

(51) Cl.Int.⁷/Int.Cl.⁷ B01J 20/12, A01K 1/015

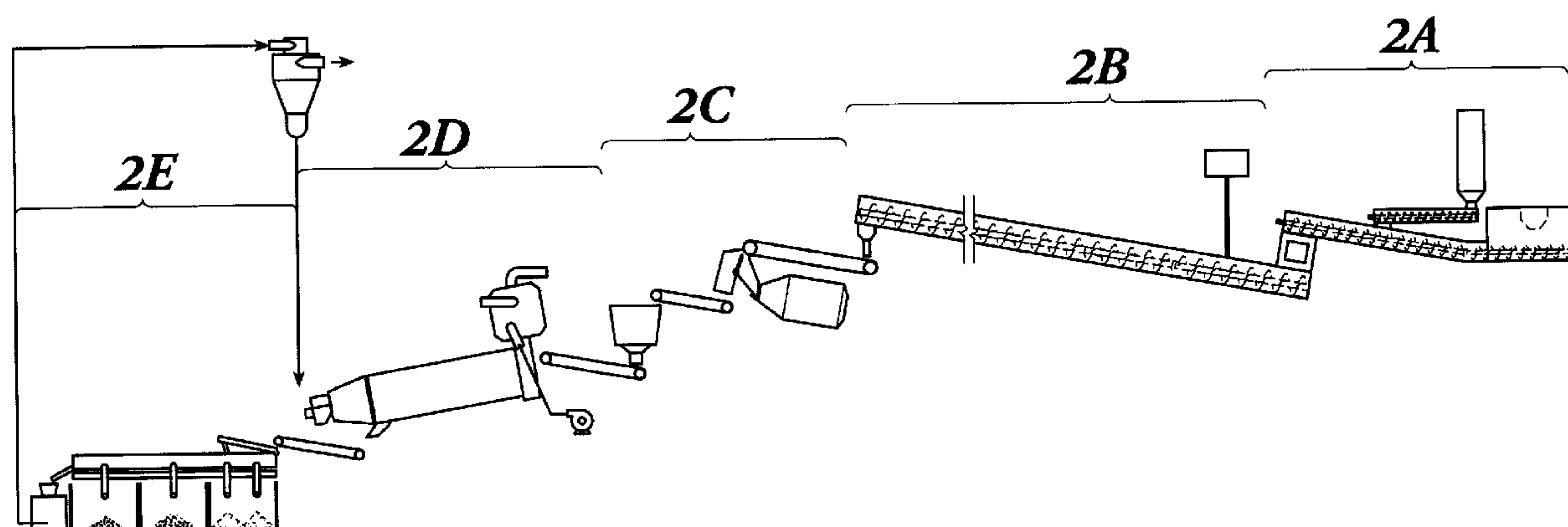
(71) Demandeur/Applicant:
ODOR CONTROL TECHNOLOGIES, LLC, US

(72) Inventeurs/Inventors:
MCCLELLAN, JEFFERY L., US;
EYDE, DANIEL T., US

(74) Agent: SMART & BIGGAR

(54) Titre : METHODE DE PRODUCTION DE PARTICULES ABSORBANTES

(54) Title: METHOD OF MANUFACTURE OF ABSORBANT PARTICLES



(57) Abrégé/Abstract:

A process for manufacturing a moisture absorbent, moisture swellable particle. According to the process, calcium montmorillonite clay in powder form is processed through a cationic exchange reactor which provides intimate mix/shear forces to form an agglomerated particle. A soda ash (sodium carbonate) solution provides the exchange of calcium cations in the montmorillonite clay with the sodium cations in the soda ash solution to provide an aerated, agglomerated, moisture swellable calcium-sodium bentonite particle which includes a lower weight/volume ratio than the natural occurring mined sodium bentonite. As a result of the process of the present invention, the non-moisture swelling calcium montmorillonite is converted to a calcium-sodium montmorillonite which is highly moisture swellable and which possesses inherent odor control properties. An additional benefit of the present process is the capability of utilization of all of the raw material with little or no waste to produce a marketable odor controlling clumping litter product, and the ability to add a number of other odor controlling additives as powders which are intimately mixed into the litter particle for maximum efficacy, rather than added as discrete granules which would weaken the clump and which are less effective.

ABSTRACT

A process for manufacturing a moisture absorbent, moisture swellable particle. According to the process, calcium montmorillonite clay in powder form is processed through a cationic exchange reactor which provides intimate mix/shear forces to form an agglomerated particle. A soda ash (sodium carbonate) solution provides the exchange of calcium cations in the montmorillonite clay with the sodium cations in the soda ash solution to provide an aerated, agglomerated, moisture swellable calcium-sodium bentonite particle which includes a lower weight/volume ratio than the natural occurring mined sodium bentonite. As a result of the process of the present invention, the non-moisture swelling calcium montmorillonite is converted to a calcium-sodium montmorillonite which is highly moisture swellable and which possesses inherent odor control properties. An additional benefit of the present process is the capability of utilization of all of the raw material with little or no waste to produce a marketable odor controlling clumping litter product, and the ability to add a number of other odor controlling additives as powders which are intimately mixed into the litter particle for maximum efficacy, rather than added as discrete granules which would weaken the clump and which are less effective.

Express Mail No. EL502556792US

5

METHOD OF MANUFACTURE OF ABSORBENT PARTICLES

1. Field of the Invention:

10 This invention relates to processes for manufacturing moisture absorbent materials. Specifically, this invention relates to the manufacture of a clumping, odor controlling cat litter.

2. Background of the Invention:

15 Moisture absorbent particles have many uses, both industrial and domestic. One particularly large domestic use is in the pet products industry as cat litter. Cat litter is a broad term for waste and odor absorbent products useful for many different types of animals, however, cats being the most plentiful due to their popularity as pets and their ease in house-breaking. It is desirable to provide a cat litter material which is capable of absorbing urine and odors associated with animal waste.

20 Swelling and binding of the litter particles, commonly known as clumping, is particularly desirable in a cat litter product. This is because the clumped mass including the liquid waste contained therein, could be easily and integrally removed and discarded. Thus, the source of odor in the litter box is conveniently removed without the necessity of changing out the entire box. Initially, it was determined that attapulgite and sepiolite
25 clay particles, upon absorbing moisture, swell and bind together as a mass. These were the initial clumping litter products.

5 Materials traditionally used as clumping cat litter due to their moisture absorbent characteristics include bentonite (montmorillonite) clays and attapulgite and sepiolite. Such bentonite clays include sodium montmorillonite, calcium montmorillonite, potassium montmorillonite, lithium montmorillonite (hectorite) magnesium montmorillonite (saponite), or some combination of those clays. However, the moisture
10 absorbing characteristics of these clays are not equal. Sodium bentonite was found to have good clumping properties and was less expensive than the other clays. Accordingly, sodium bentonite is the product used in most cat litter products from the least expensive generic product to the more expensive premium brands.

 Calcium montmorillonite, in comparison, typically has poor swelling and
15 binding (clumping) properties and is considered of less value. As a result, calcium montmorillonite is commonly used in non-clumping traditional and less expensive, economy cat litter products.

 The industry found that sodium bentonite worked in this application as well forming a better and harder clumping product. Patents assigned to American Colloid
20 Company; RE33,983; 5,129,365; 5,317,990; 5,386,803; 5,503,111; 5,452,684; and, 5,577,463 are examples. The result of this, however, was to create a new market for sodium bentonite for cat litter purposes, although there are still limitations to the clumping litters based on sodium bentonites. They help control odor by assisting in the removal of the odorous products but have no independent odor controlling properties. A
25 need, therefore, exists for products with inherent odor control properties, which possess

5 enhanced moisture absorbing (swelling) and clumping characteristics comparable to sodium bentonite clay and a lower bulk density.

Using present manufacturing processes, bentonite clay is selectively mined from large deposits using open pit mining methods. After mining the bentonite clay is dried then sized by crushing and screening. Sizes between 3400 to 300 microns are
10 considered acceptable for cat litter. A problem with sodium bentonite clumping cat litter products is their high weight/volume ratio typically 60-70 lbs/cuft. A significant amount of cat litter product is necessary to fill a litter box, and cat litter boxes are changed every one to two weeks, depending upon the number of cats, to avoid odor problems. As a result, it is necessary to purchase a sufficient volume of cat litter in order
15 to avoid frequent trips to the pet store or pet aisle of a grocery store. Moreover, as with most products, there are certain economics to be gained through the purchase of larger volumes. The problem is that the container for sufficient volume and economy of litter product is generally heavy, approximately 60 lbs. per cubic feet. Such weights are awkward and, in some cases, impossible for people to handle. A need, therefore, exists
20 for an effective moisture swellable cat litter product with a reduced weight/volume ratio similar to conventional litters, typically 42-46 lbs/cuft.

5

SUMMARY OF THE INVENTION

The present invention is a process for manufacturing a moisture absorbent particle having usages such as for cat litter. In the process, calcium montmorillonite clay is intimately mixed with a solution of sodium carbonate. This mixing process forces the exchange of calcium cations in the montmorillonite with the sodium cations in the sodium carbonate solution and the formation of an agglomerated particle.

It has been found that the cat litter product manufactured according to the present process includes inherent odor control characteristics not found in traditional, naturally occurring sodium bentonite clay. The product manufactured by the present process swells and clumps when subjected to animal liquid waste (urine) but also absorbs (or neutralizes) the odor of this waste. Moreover, the product absorbs odor associated with animal solid waste (feces) in the same manner.

As a result of the process of the present invention, non-swelling calcium montmorillonite is converted to the sodium form becoming a swelling, clumping bentonite with the additional benefit of having ammonia neutralizing properties. Accordingly, although manufacturing costs may arguably be slightly greater than processing the naturally occurring product, the value added to the raw material are a result of the process far exceeds any increase in cost of manufacture.

The manufactured agglomerated particle is very porous with internal air spaces resulting in a final product which includes a lower weight/volume ratio than the naturally occurring mined product. The final product also has a lower weight than the additive weight of constituent components.

5 A lower weight/volume ratio is desirable for a variety of reasons: (1) less weight
for the consumer to carry for the same volume; (2) less shipping costs from
manufacturer to retailer; and, (3) a higher cost per pound for the manufacturer yet still
providing the retailer the ability to sell the same volume for the same price as heavier
scoopable cat litter products. The weight/volume ratios of the manufactured final product
10 is approximately 40 lbs./cubic feet, while the naturally occurring product weight/volume
ratio is approximately 60 lbs./cubic feet.

As a result, more volume is obtained per pound. This allows for lighter containers
containing the same volume as the natural occurring product. Alternatively, for the same
weight, the customer receives a greater volume. This allows the product manufactured by
15 the process of the present invention the possibility of being sold for a higher price per
pound.

An additional benefit of the process of the present invention is that almost 100%
of the raw material can be processed to produce a useable product. However, with the
present process, the small particles (fines) can be reprocessed into a usable size particle.
20 This means that all of the raw material is processed to a usable form subject to de
minimus waste associated with manufacturing (lost through spills, dust, residue, etc.).

Additional additives such as zeolites or activated carbon powder may also be
introduced in the process for enhanced odor control. It is also contemplated that
bacteriostatic properties could be provided to the manufactured particle by the addition of
25 a bacteriostat to the soda ash solution. Other additions are also contemplated as needed
by a particular application.

5 It is thus an object of the present invention to chemically modify calcium montmorillonite to make a clumping litter product.

 An additional object of the present invention is to provide a process for manufacturing a chemically modified calcium montmorillonite product that possesses inherent odor controlling properties.

10 A still further object of the present invention is to manufacture a moisture absorbent, moisture swellable product.

 Another additional object of the present invention is to manufacture a moisture absorbent sodium bentonite particle which has a lower weight/volume ratio than naturally occurring sodium bentonite.

15 A yet further object of the present invention is to provide a process for manufacture of a moisture absorbent particle which is capable of utilizing all of the raw material.

 A better understanding of the invention and its objects and advantages as well as further objects will become apparent to those skilled in this art from the following
20 detailed description, taken in conjunction with the attached drawings, whether is shown and described only the preferred embodiment of the invention, simply by way of illustration of the best mode contemplated for carrying out the invention. As will be realized, the invention is capable of modifications and various obvious respects, all without departing from the scope of the invention. Accordingly, the description should
25 be regarded as illustrative in nature and not as restrictive.

5

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an overall process sketch of the method of manufacture of an absorbent particle of the present invention identified with its component substeps.

FIG. 2A depicts the reactant stream introduction substep 2A of FIG. 1.

FIG. 2B depicts the particle manufacture substep 2B of FIG. 1.

10 FIG. 2C shows the particle shaping substep 2C of FIG. 1.

FIG. 2D depicts the particle drying substep 2D of FIG. 1.

FIG. 2E shows the particle separation substep 2E of FIG. 1.

FIG. 3 is a view taken along line 3-3 of FIG. 2A.

FIG. 4 is a detail view of the double ribbon flighting of FIG. 2B.

15 FIG. 5 is a detail view of the cut and fold auger flighting of FIG. 2B.

FIG. 6 is a cross sectional view taken along line 6-6 of FIG. 4 showing the cross section of the double ribbon auger flighting of the present invention.

FIG. 7 is a cross section view taken along line 7-7 of FIG. 5 depicting the cut and fold auger flighting of the present invention.

20 FIG. 8 is a back view of the shaking conveyer detailing the apparatus for reducing large particles in size and reprocessing those particles through the shaking conveyer.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The process of the present invention can be seen, generally, in FIG. 1. With reference to FIG. 1, the process can be broken down for the purpose of illustration into five main substeps: (1) reactant stream introduction (2A); (2) particle manufacture (2B); (3) particle shaping (2C); (4) particle drying (2D); and (5) particle separation (2E). This general description is for the purpose of illustration herein and shall not be considered limiting. According to this process, a useful clumping litter with odor control properties, and a lowered bulk density may be manufactured from calcium montmorillonite using an ion exchange reaction. An incremental increase in the product utility (and thereby value) is thus achieved.

Throughout this specification, the preferred equipment is referenced. It should be understood, however, that this equipment is provided to illustrate the best mode known at the time for carrying out the invention. The use of equivalent equipment or equipment such as extruders or pin mills that achieve the same end product should be understood to fall within the scope of this invention.

Reference will now be made to FIGS. 2A and 3 in the preferred process of manufacturing an absorbent particle. In the process, calcium montmorillonite clay in powder form (approximately -10 mesh) is deposited and stored in a dump hopper 10. At the bottom of the dump hopper 10, there is an auger 12 for conveying the calcium montmorillonite to the upstream end of a mix/auger 14. By varying the size or speed of rotation of the auger 12, the amount of clay processed into mix/auger 14 can be

controlled. A predetermined amount of calcium montmorillonite in powder form is delivered by auger 12 into the mix/auger 14 to create a reactant stream.

The mix auger 14 functions to transport the reactant stream from the dump hopper 10 to a reaction mix unit 16. In the event that additional additives to the clay are desired, such additives are introduced into mix auger 14 such as through bag silo 18 to mix with the calcium montmorillonite (reactant stream) and thereby conveyed to the reaction mix unit 16.

In the preferred embodiment, a zeolite, preferably one with a high surface area and good odor control and sorption characteristics like chabazite is contained within bag silo 18 and discharged into the reactant stream by a metering conveyer 20. The chabazite particle size is preferably minus 60 mesh and is added in an amount so as to provide an end product that is 1-15% by weight.. Natural zeolites are hydrated aluminosilicate minerals available commercially. Natural zeolites are frequently used in water treatment, and sorption applications. In the present process, however, the zeolite is introduced to provide its odor elimination properties.

Another additive contemplated in the present process activated carbon is added in powder form of 50-150 micron particles also for the purpose of odor control/elimination. The powder activated carbon becomes incorporated into the litter as the particles are manufactured according to the present process and functions to absorb gas molecules in the final product providing a superior odor adsorbing product.

The zeolite and activated carbon are useful for drawing odors from the surrounding air. The manufactured product of the present invention itself has odor

control properties which eliminate the odor of the animal waste itself. The odor control additives thereby enhance the inherent odor control properties of the manufactured product.

Once the additives are introduced (if any) into mix auger 14, the reactant stream is conveyed by mix auger 14 and deposited into reaction mixer unit 16. It is within reaction mixer unit 16 that ion exchange takes place and the manufacture of the desired particle.

Reference is next made to FIG. 2B for a discussion of reaction mixer unit 16. Reaction mixer unit 16 is a 60' long reaction chamber in the preferred embodiment. The length of reaction mixer unit 16 is divided into two major phases. The first phase includes subjecting the reactant stream to a thorough mixing/agitation process, and the second phase includes mixing/agitation/shear of the particles comprising the reactant stream and also includes ion exchange. A resultant particle is agglomerated.

The length of the reaction mixer unit 16 is set at a 10 degree incline and powered by motor 17. The total 60' length is divided into auger flighting, each flight being 12' in length. The mixing/agitation/action phase within reaction mixer unit 16 is accomplished by a 12' double ribbon auger flighting 22. The shear/mixer/agitation/ion exchange and particle agglomeration phase is carried out by cut and fold auger flighting 24. In the preferred embodiment, there are four (4) cut and fold auger flighting segments, each 12' in length. Reaction mixer unit 16 comprised of its two phases operates at a speed of 60 rpm in order to convey a desired discharge of 19 cubic tons per hour weighing approximately 45-50 lbs./cubic feet.

The solution for providing ion exchange is introduced into the reactant stream in reaction mixer unit **16** from a reservoir **26** through a conduit and sprayed onto the reactant stream (discussed further below). A soda ash (sodium carbonate) solution is the preferred solution for carrying out the ion exchange in the present process. Soda ash is readily available commercially and known for use in ion exchange in water softening systems. The soda ash solution is obtained by dissolving dry sodium carbonate (Na_2CO_3) in water. A 15% solution is acceptable for the present purpose. It has been found that sodium carbonate ranges of 0.1-10% by weight of the final product dry are acceptable in the present process where 1.0- 2% is believed to be an optimal addition. It has been found that the lower the sodium content in the final product, the better odor control properties it possesses. It is, however, preferred that enough sodium be present in the modified final product to provide the desired clumping properties.

If desired, a bacteriostat may be added to the soda ash solution to be introduced into the manufactured particle. By way of example, it has been determined that a bacteriostat manufactured by Stepan Company, Northbrook, Illinois, marked BTC-1010 is suitable for this purpose. However, it is understood that other bacteriostat solutions from other manufacturers could be substituted. The desired concentration of bacteriostat in the soda ash solution is 1,200 ppm.

In the preferred embodiment, for the purpose of exemplification only, the capacity of soda ash reservoir **26** is 1,300 gallons. Accordingly, in order to obtain the desired concentration of bacteriostat, 1.56 gallons of BTC-1010 is added to the 1,300 gallon charge of soda ash solution.

FIG. 4 is a detailed view of double ribbon auger flighting **22** of FIG. 2B. As can be seen, double ribbon auger flighting **22** includes an outer ribbon **28** and an inner ribbon **30**. The double ribbon auger flighting **22** acts to convey the reactant stream while providing thorough mixing and agitation of the particles conveyed therethrough.

5 Agitation of the reactant stream causes heat which facilitates the cationic exchange occurring within the cut and fold auger segment.

Outer ribbon **28** includes a 2" wide blade with a 12" inner diameter, while inner ribbon **30** includes a 1" blade and 9" outer diameter in the preferred embodiment. Such double ribbon auger configurations are available commercially. Outer ribbon **26** and
10 inner ribbon **28** are mounted on and supported from a 5" diameter central pipe **32**. The soda ash solution for ion exchange is conveyed within conduit **34** above the reactant stream. A series of spray nozzles, collectively **36**, direct a spray of soda ash solution onto the reactant stream as it is conveyed along double ribbon auger flighting **22**. The soda ash is then mixed throughout the reactant stream by double ribbon auger flighting **22**.

15 FIG. 6 depicts double ribbon auger flighting **22** from a cross section showing outer ribbon **28** and inner ribbon **30** supported from central pipe **32**. FIG. 6 also shows a second soda ash conduit **38** and representative spray nozzle **40** which is positioned behind and not shown in FIG. 4. The purpose of two sets of nozzles directed toward both sides of double ribbon auger flighting **22** along its length is to apply the soda ash solution
20 evenly onto the reactant stream.

Referring back to FIG. 2B, cut and fold auger flighting **24** provides intimate mixing, shearing, and agitation of the particles of the reactant stream saturated with soda

ash solution to facilitate displacement of the calcium cations out of the bentonite clay to be replaced with sodium cations from the soda ash solution as a result of an ion exchange reaction.

FIG. 5 is a detail of cut and fold auger flighting **24** of FIG. 2B. Cut and fold auger flighting is known commercially to provide intimate mixing, agitation, and shear. Cut and fold auger flighting **24** includes blade **38** on a 5" center shaft **40**. Screw blade **38** is 16" in diameter and is notched along its outer circumference. The reactant stream covers a 45% area of screw blade **38** such that 70% of the reactant stream is conveyed and 30% is dropped so as to be worked back into the reactant stream thereby providing the intimate mixing/agitation/shear described above. The mixing/agitation in the presence of the soda ash solution causes agglomeration of the powder particles together to form a manufactured particle.

Soda ash conduit **34** of FIG. 4 is in fluid communication with reservoir **26** (FIG. 2B) and extends through both double ribbon auger flighting **22** and cut and fold auger flighting **24**. Spray nozzles **36** extend from soda ash conduit **34** so as to introduce the soda ash solution along the entire length of reaction mixer unit **16**.

FIG. 7 depicts cut and fold auger flighting **24** in cross section. Notches **46** in blade **42** allow material in the reactant stream to be dropped and folded back into the reactant stream. Soda ash conduit **38** and spray nozzles **40** aid in the even application of soda ash solution into the reactant stream.

As the reactant stream moves through reaction mixer unit **16**, in particularly cut and fold auger flighting **24**, and upon addition of the soda ash solution, the powder of the

cationic exchanged calcium montmorillonite agglomerates together to form a porous sodium bentonite particle. The addition of the soda ash solution, after ion exchange, causes the agglomerated particle to swell due to the hydrophilic characteristic of sodium. As a result of this process, a sodium bentonite agglomerated particle is manufactured.

5 The water in the soda ash solution serves three purposes in the agglomeration process: (1) the water puts the sodium carbonate in solution; (2) serves as a transport means to infuse the sodium into the calcium montmorillonite powder to facilitate ion exchange; and (3) serves an agglomeration and lubricity function thereby cementing the powder particles together. The agglomerated sodium bentonite particle now
10 manufactured is very porous containing internal air pockets.

Once the agglomerated particles are manufactured, the reactant stream is conveyed for further processing. A belt conveyer 48 transports the reactant stream to a shaper/mixer 50. The shaper/mixer 50 aids in shaping the agglomerated particles into generally spheroidal agglomerations. In the preferred embodiment, shaper/mixer 50 is
15 comprised of a truck mixer, such as a standard cement mixer, mounted on a skid and capable of rotation by rollers 52. Once the reactant stream reaches the shaper/mixer 50, the process becomes a batch process in that a batch of agglomerated particles is supplied to shaper/mixer 50 and then rolled therein.

Once the step of shaping/mixing is completed, the batch reactant stream is
20 transferred from shaper/mixer 50 through a transfer point 54 and supplied to a conveyor 56 such that the shaped agglomerated particle may be conveyed to surge hopper 58. Surge hopper 58 acts to shake the agglomerated particles thereby separating adjacent

particles to form a granulated mixture of individual agglomerated particles. Surge hopper 58 also acts to control the volume of granulated mixture processed through the dryer as shall be next described. As a result, the moisture content of the manufactured particles is controlled. The desired moisture content of the agglomerated particles before drying is approximately 25-40 % by weight with approximately 34% believed to be optimal.

From surge hopper 58, the granulated mixture is transferred via a conveyor 60 to a dryer 62. Reference is next made to FIG. 2D. Dryer 62 is in a declined orientation so as to assist the flow of the granulated mixture along its length. Dryer 62 may be a rotating sand dryer, a fluid bed dryer, or a straight air dryer. The dryer 62 illustrated in the drawings is a rotating dryer having a firing cone 64 at which the temperature is approximately 1600-1700 F. Dryer 62 is rotated by a plurality of rollers, collectively 66. The heated rotation of the particles in the dryer acts to remove moisture and form the agglomerated particle. It is in the heated, mixing action of the dryer that most of the particle shaping takes place.

The granulated mixture is conveyed through dryer 62 and has a residency time of approximately 8 minutes. The exit temperature of the granulated mixture is approximately 250 F. The rolling and heating action of dryer 62 accomplishes the purpose of removing moisture from the manufactured particles comprising the granulated mixture. When the manufactured particle dries, it shrinks and cements together. Also, the zeolite and other additives are cemented within the particle.

Fresh air is input into dryer 62 through several air intakes 68. An air pump 70 is ducted to a heat exchanger 72 to provide fresh air and evacuate dead air. The dead air is

taken off through a heat exchanger/steam vent 74 which is exhausted into an emissions control device (not shown) such as a cyclone for the recovery of aerosolized materials. Thus, all emissions, including vaporized water and any aerosolized small powder (dust) are recovered. Heat exchanger 72 is also ducted to fresh air ducts via conduit 76. A dried granule mixture 78 is thus output from dryer 62 and deposited on a conveyer 80.

Reference is next made to FIG. 2E wherein the dry granule mixture 78 is conveyed by conveyer 80 onto a shaking conveyor 82. The shaking conveyor 82 functions as a separator for receiving the dried particles of the granulized mixture 78 for separation based upon particle size to form piles of segregated product particles. The dry granule mixture is passed over screens of various mesh sizes to segregate the product which is then dispensed into piles through chutes 84, 86, 88, and 90.

Particles larger than one-half inch are conveyed from shaking conveyor 82 through chute 90 and deposited into a roll mill 92. Roll mills such as roll mill 92 are available commercially. Roll mill 92 mechanically reduces the size of the manufactured particle which exits chute 90 which is then evacuated to a cyclone separator and is deposited on conveyer 80 for reprocessing through shaking conveyor 82.

Reference is made to FIG. 8 which shows shaking conveyor 82 from a back view. Oversized particles exit through chute 90 and into roll mill 92 and are mechanically reduced in particle size therein. Once reduced, the particles are conveyed via duct 94 by a vacuum created by cyclone separator 96 which follows the schematic dotted path shown on FIG. 8. From the duct 94 the particles are received into the suction inlet 98 of cyclone separator 96 wherein the particles are rotated within cyclone separator 96 and fall out

through exit 100 onto conveyer 80. Air is exhausted through exhaust 102. Exhaust 102 may contain particle dust and is therefore ducted to the emission recovery system.

The particles which are mechanically reduced in size by roll mill 92 and processed through cyclone separator 96 and deposited on conveyer 80 are then processed
5 through shaking conveyer 82 in the manner described above.

Referring back to FIG. 2E, the particles exiting through chutes 84 pass through a 20 mesh sieve screen and are collected in a first bin 104. These particles are usually considered too fine and are simply reprocessed as described above and thereby remanufactured into a useable particle size. Thus, substantially all raw material becomes
10 useful.

The remaining particles are preferably divided into two or more groups. The screen sizes utilized to divide these particles may vary, but are generally between 40 mesh up to 6 mesh. As an example, particles passing through a 12 mesh sieve screen may be exited through chute 88 into a bin 106. Larger particles may be passed through
15 an 8 mesh sieve screen and exited through chute 86 into a bin 108. According to this example, particles which are too large to pass through the 8 mesh sieve screen are processed through chute 90 into roll mill 92 as described above.

The manufactured particles according to the present process are useful and suitable for use as a waste absorbent product such as cat litter. Thus a highly useful
20 product is obtained.

While the invention has been described with a certain degree of particularity, it is manifest that many changes may be made in the details of construction without departing

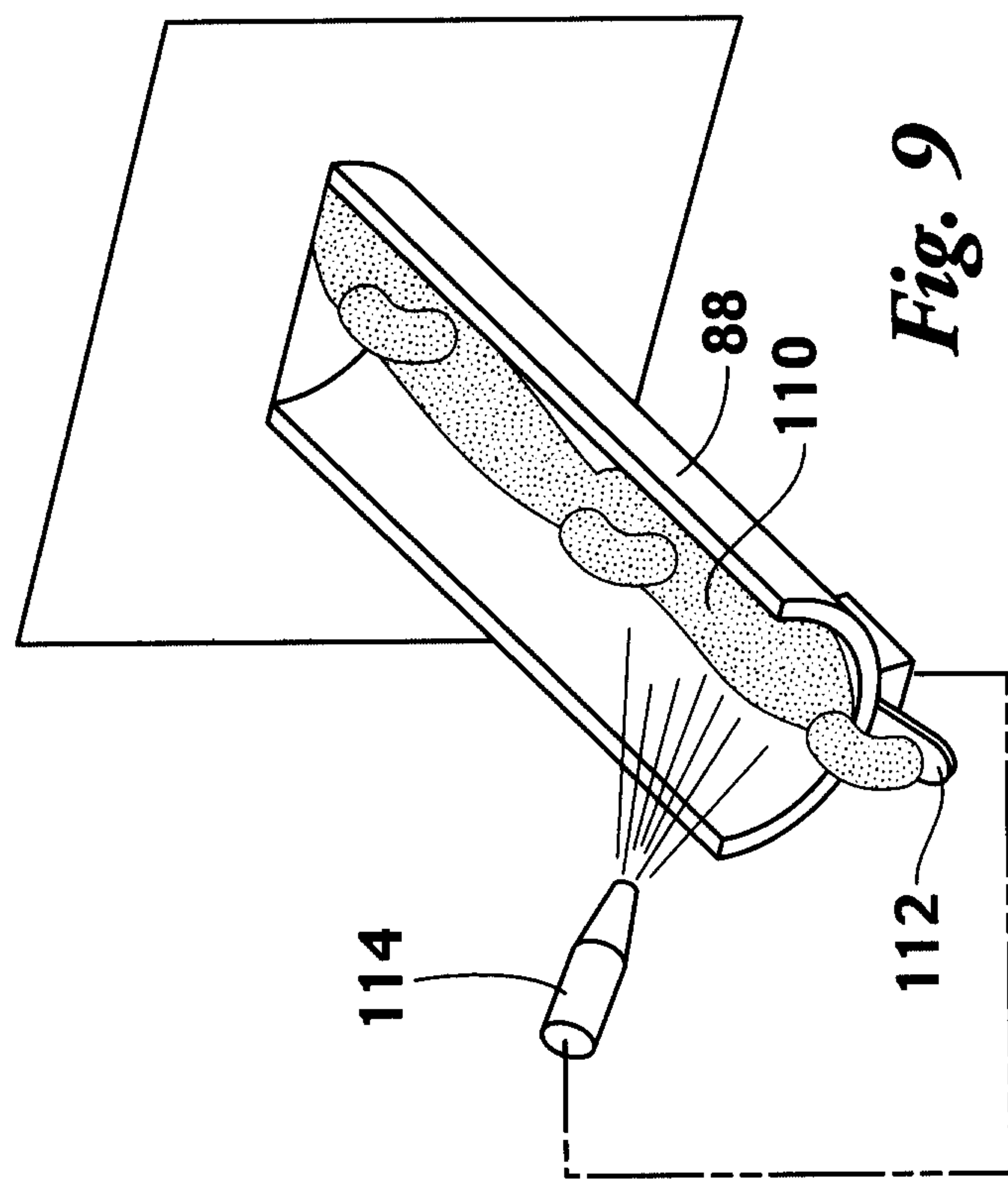
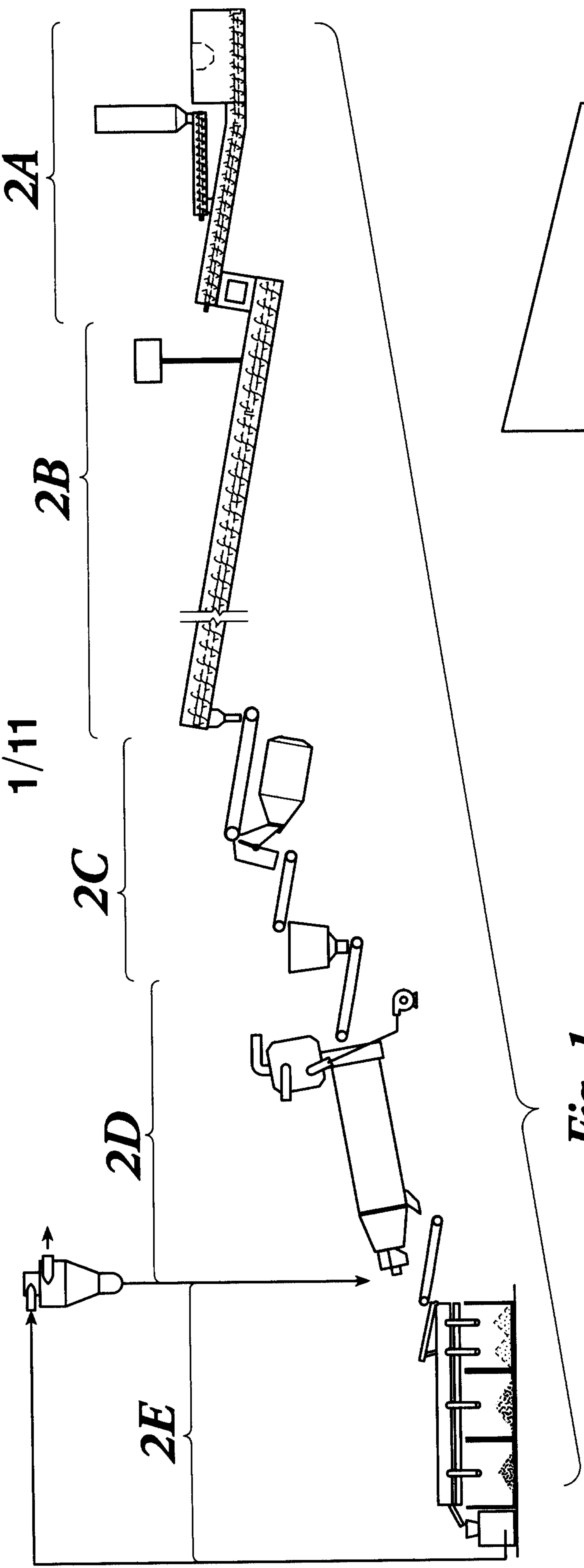
from the spirit and scope of this disclosure. It is understood that the invention is not limited to the embodiment set forth herein for purposes of exemplification, but is to be limited only by the scope of the attached claim or claims, including the full range of equivalency to which each element thereof is entitled.

CLAIMS**What is claimed is:**

- 1 1. A method of manufacture of moisture absorbent, moisture swellable particles,
2 comprising:
3 obtaining calcium montmorillonite clay;
4 chemically modifying said calcium montmorillonite clay by an ion exchange
5 reaction;
6 drying said chemically modified calcium montmorillonite clay.
- 1 2. The method of claim 1 wherein said calcium montmorillonite clay is obtained in
2 powder form.
- 1 3. The method of claim 2 including the step of forming an agglomerated particle
2 from said powder.
- 1 4. The method of claim 3 including the further step of shaping said agglomerated
2 particles to form a manufactured particle.

- 1 5. The method of claim 3 wherein the agglomerated particle is formed as a result of
2 mixing said calcium montmorillonite clay in an ion exchange solution.
- 1 6. The method of claim 5 wherein said ion exchange solution and said calcium
2 montmorillonite clay are mixed in a cut and fold auger.
- 1 7. The method of claim 5 wherein said ion exchange solution is sodium carbonate.
- 1 8. The method of claim 4 further including the step of separating the manufactured
2 particles by size.
- 1 9. The method of claim 8 wherein the manufactured particles are separated by
2 screening preselected sizes.
- 1 10. The method of claim 9 including the further step of reshaping any manufactured
2 particles which are not of the preselected screen sizes.

Smart & Biggar
Ottawa, Canada
Patent Agents



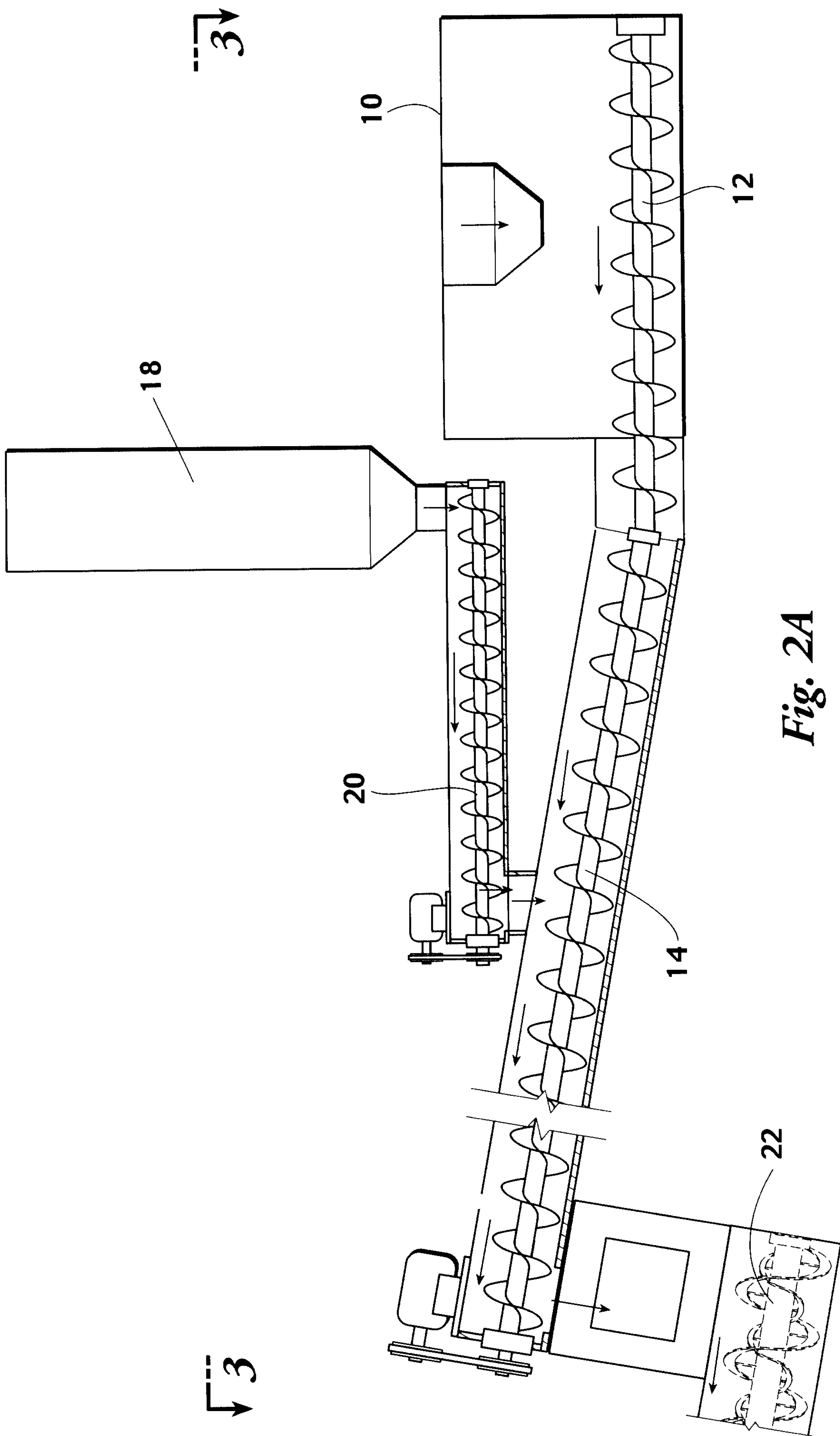


Fig. 2A

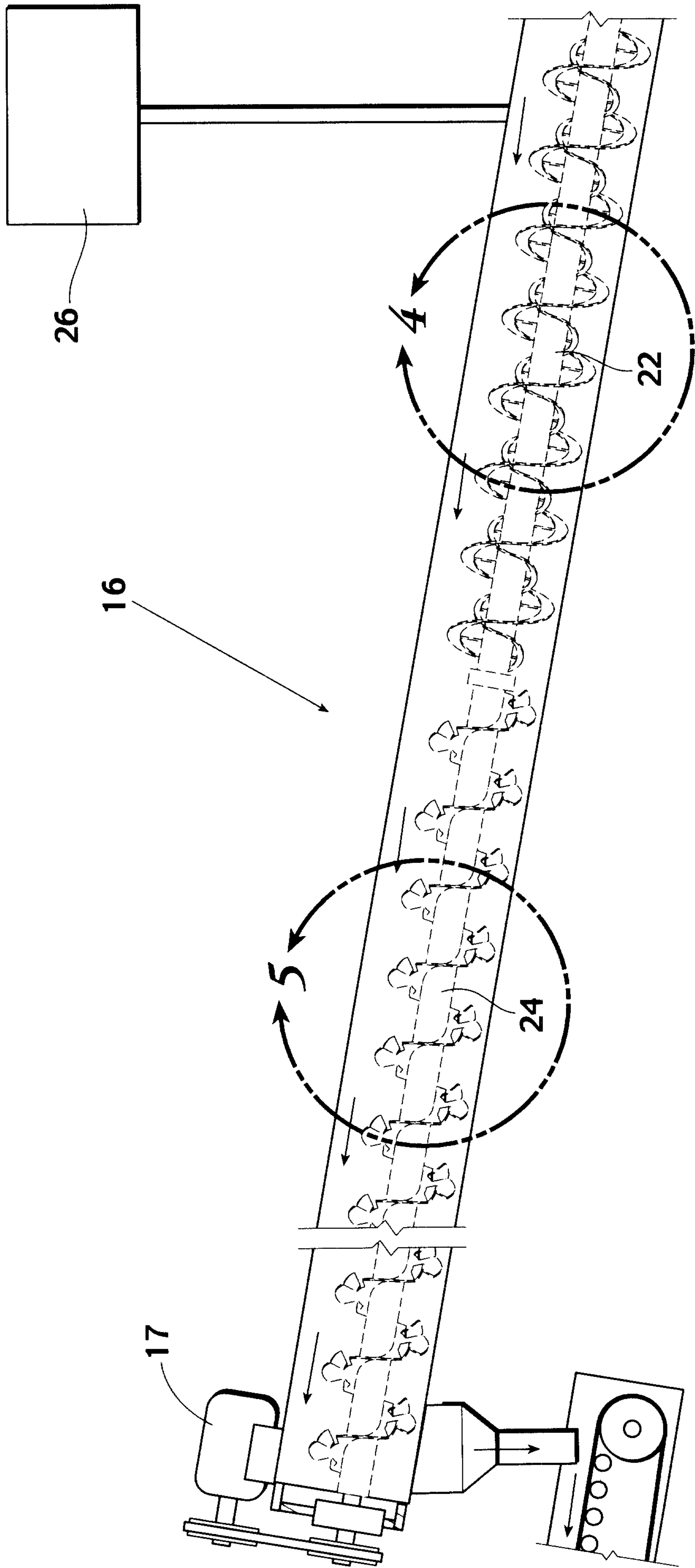


Fig. 2B

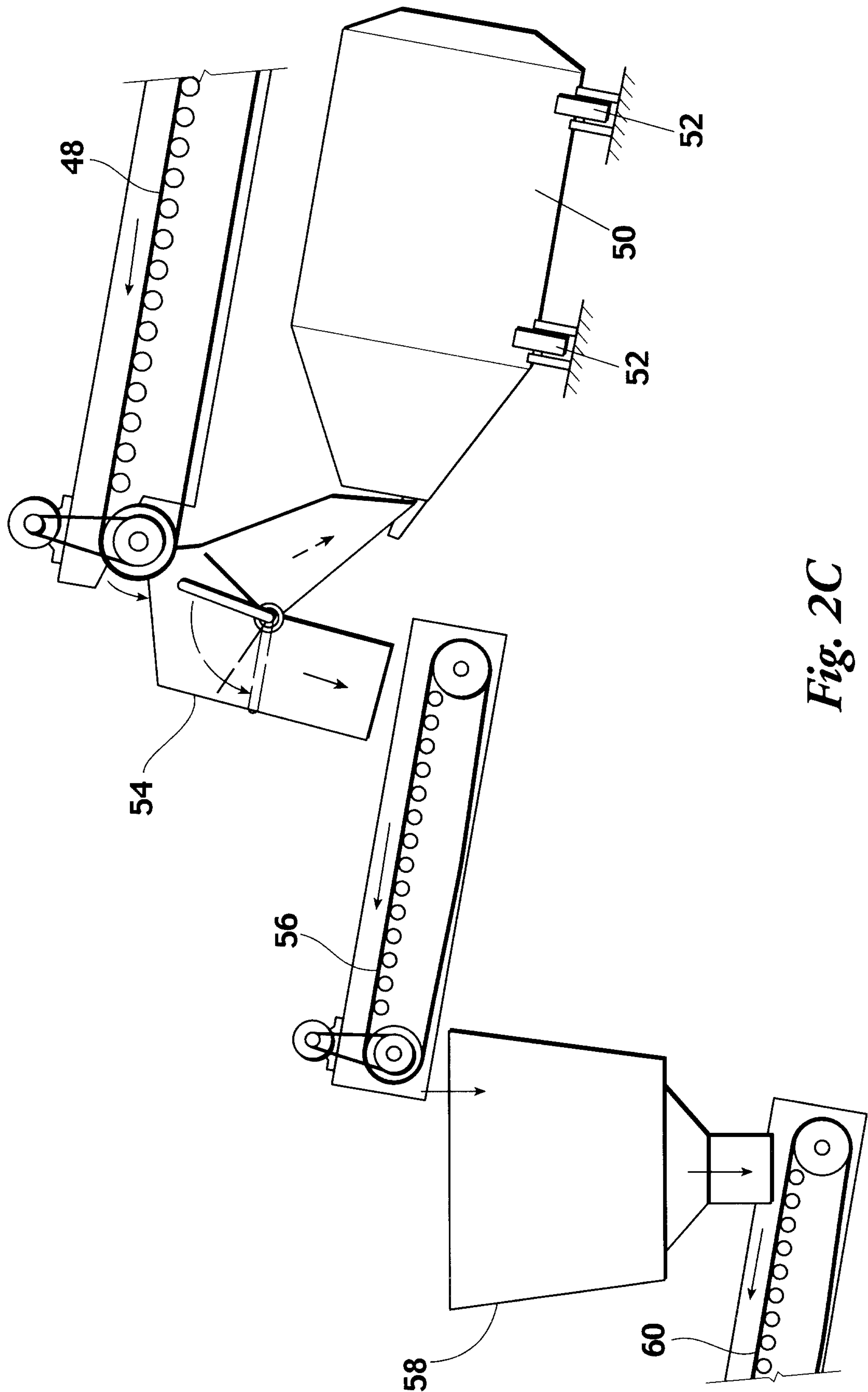


Fig. 2C

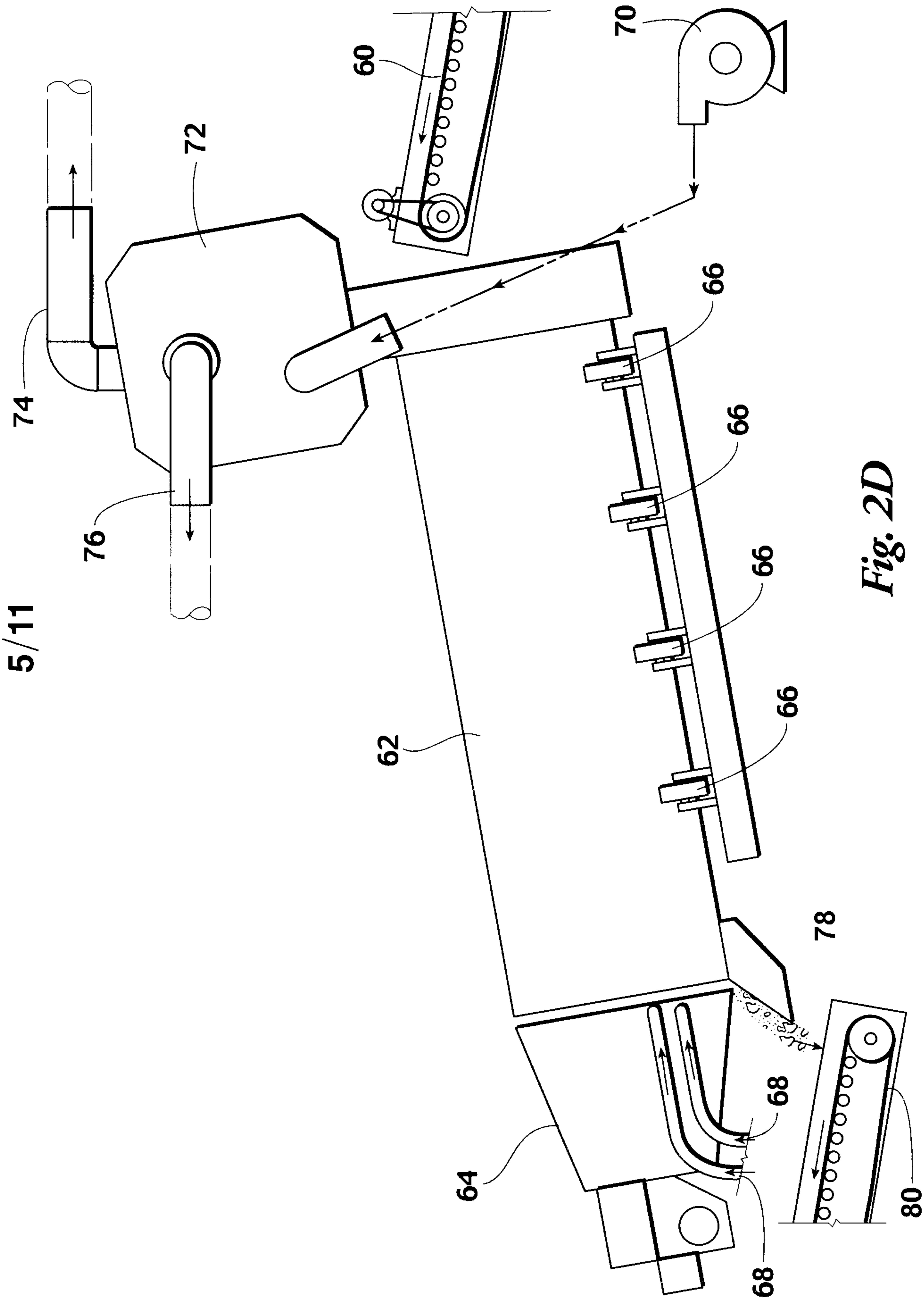


Fig. 2D

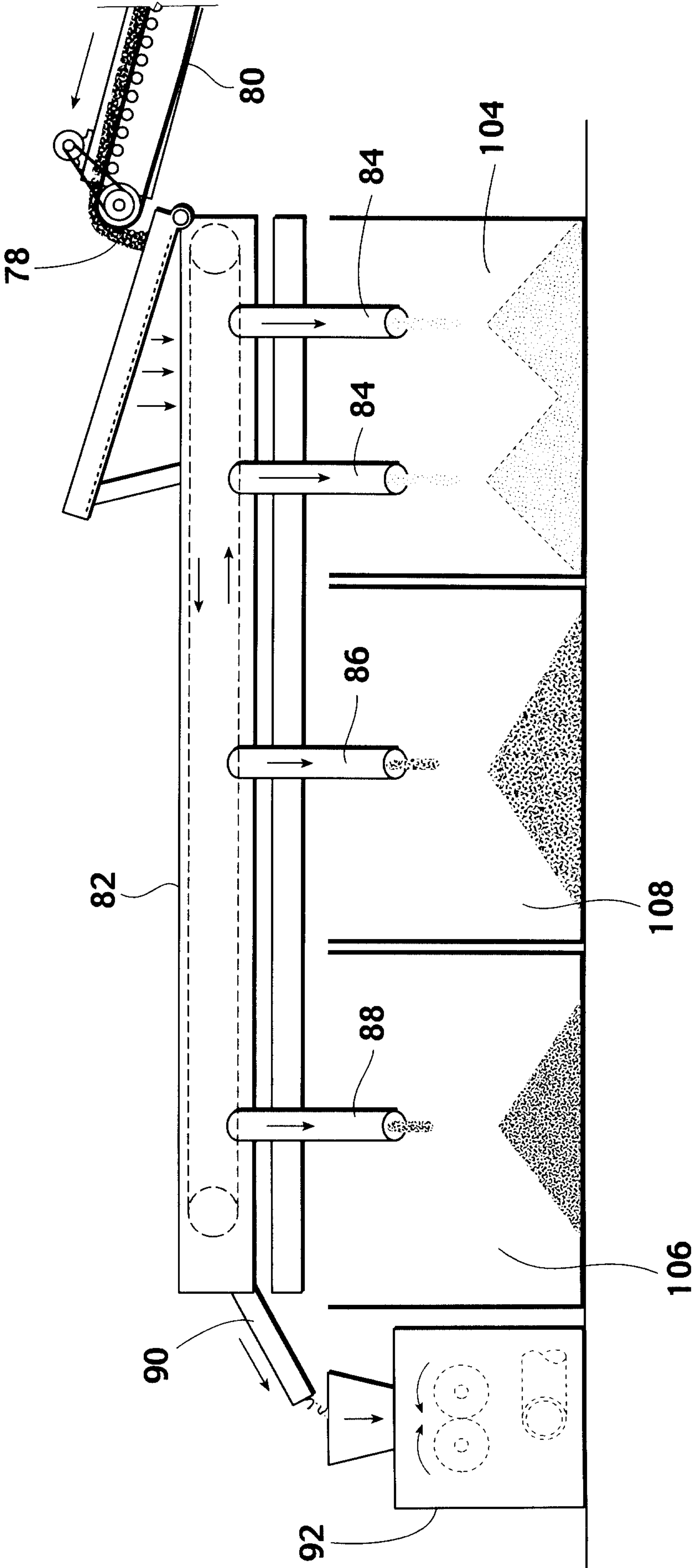
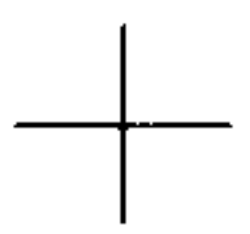


Fig. 2E



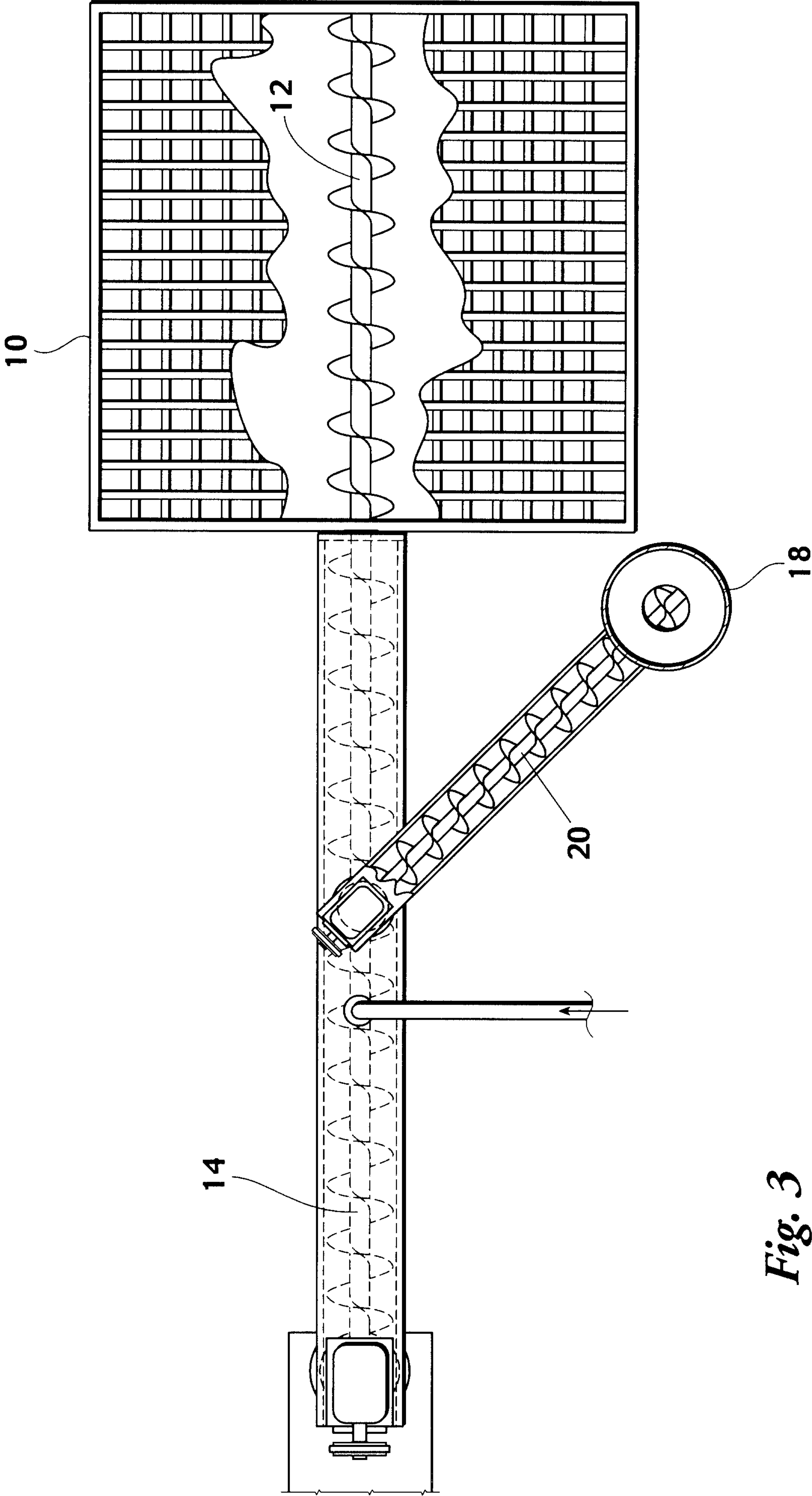
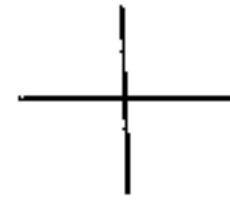
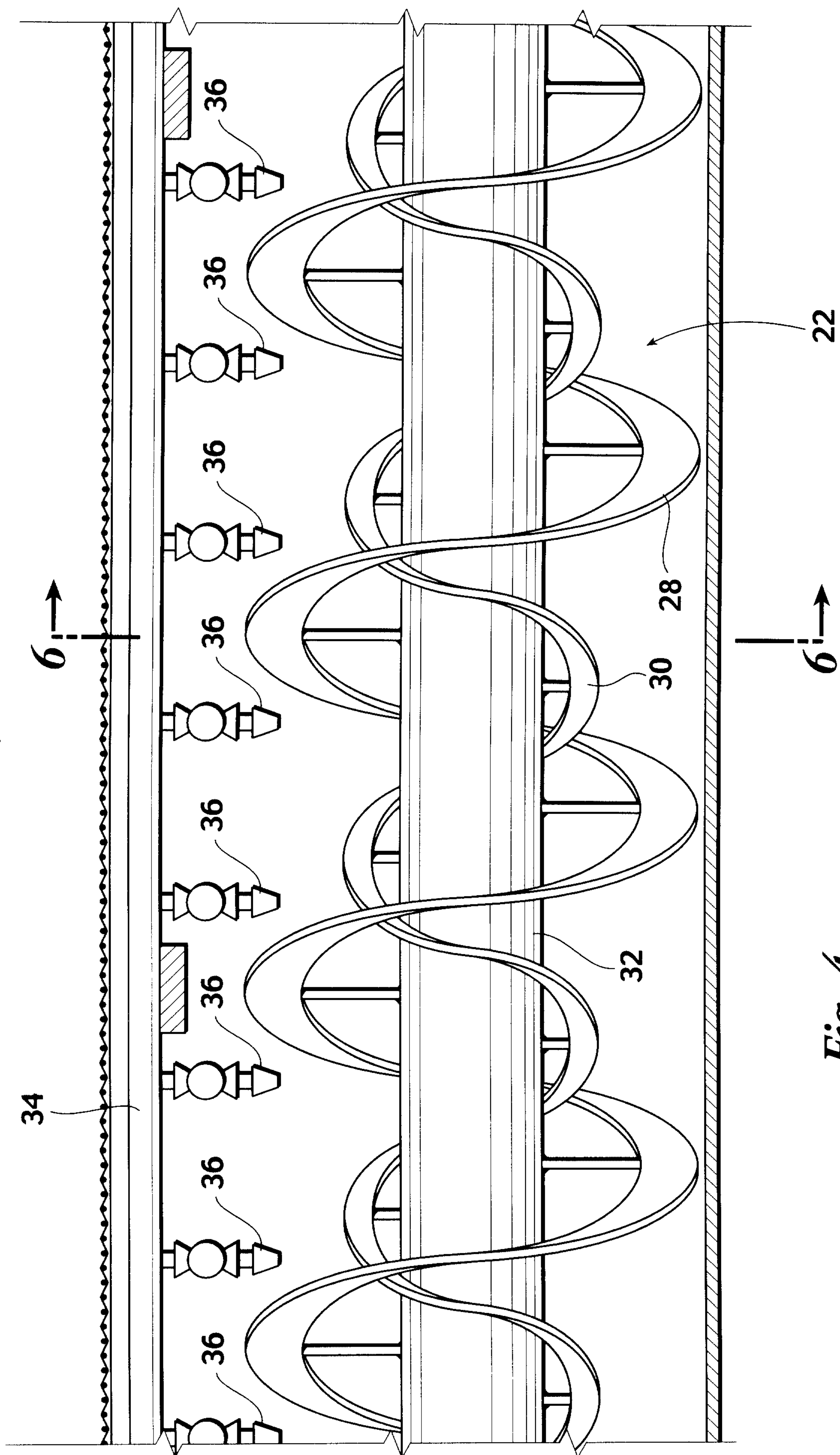


Fig. 3





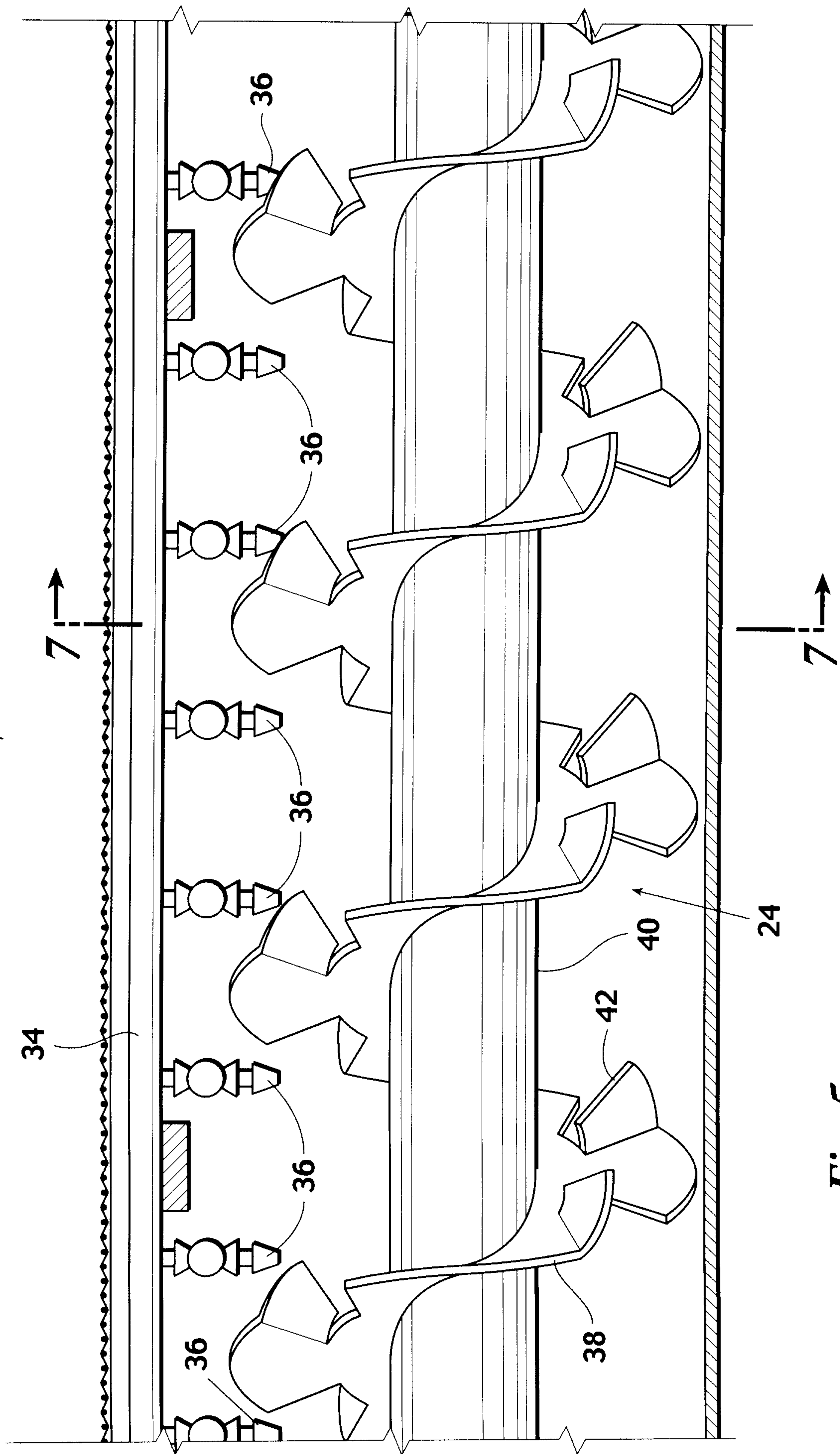
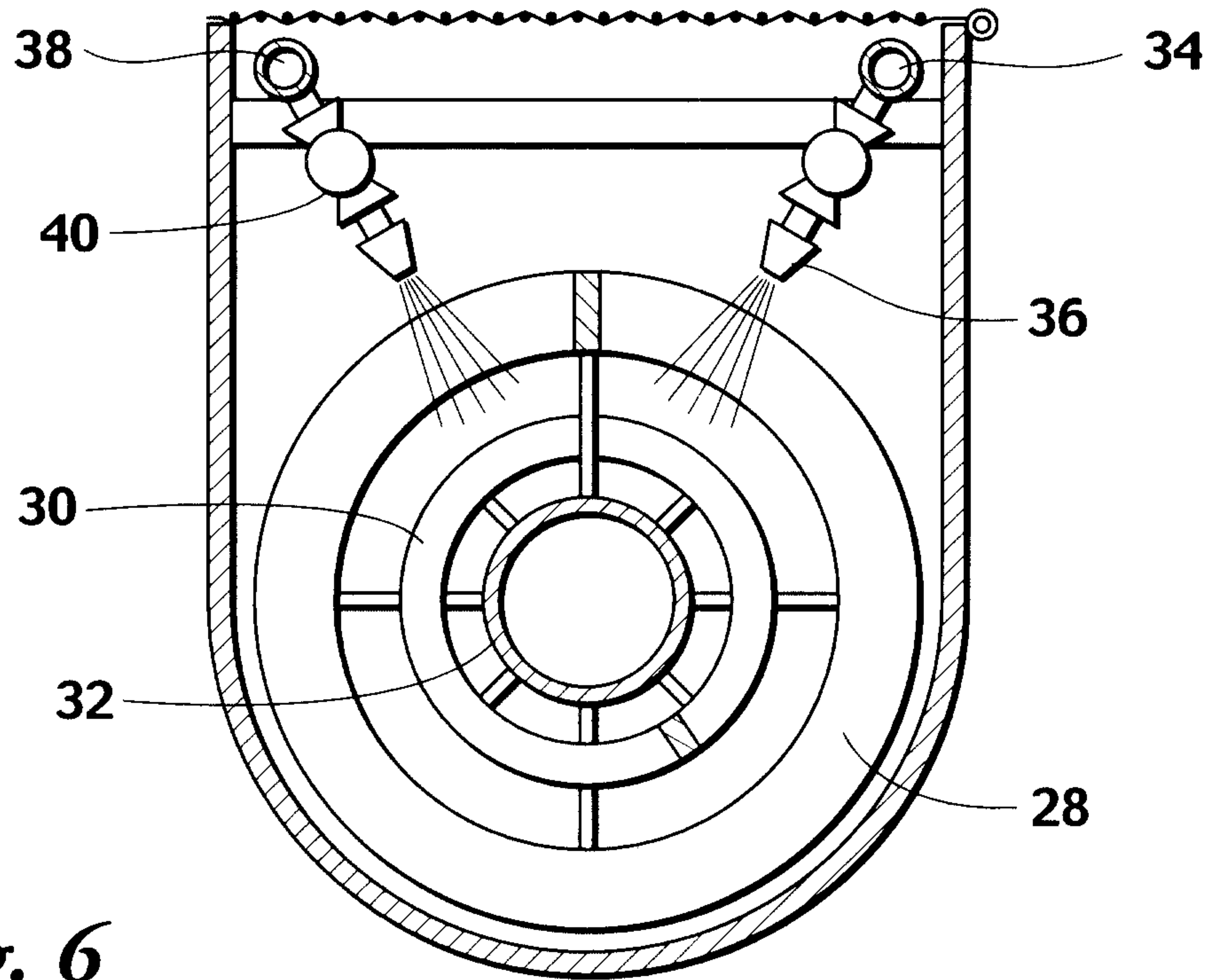
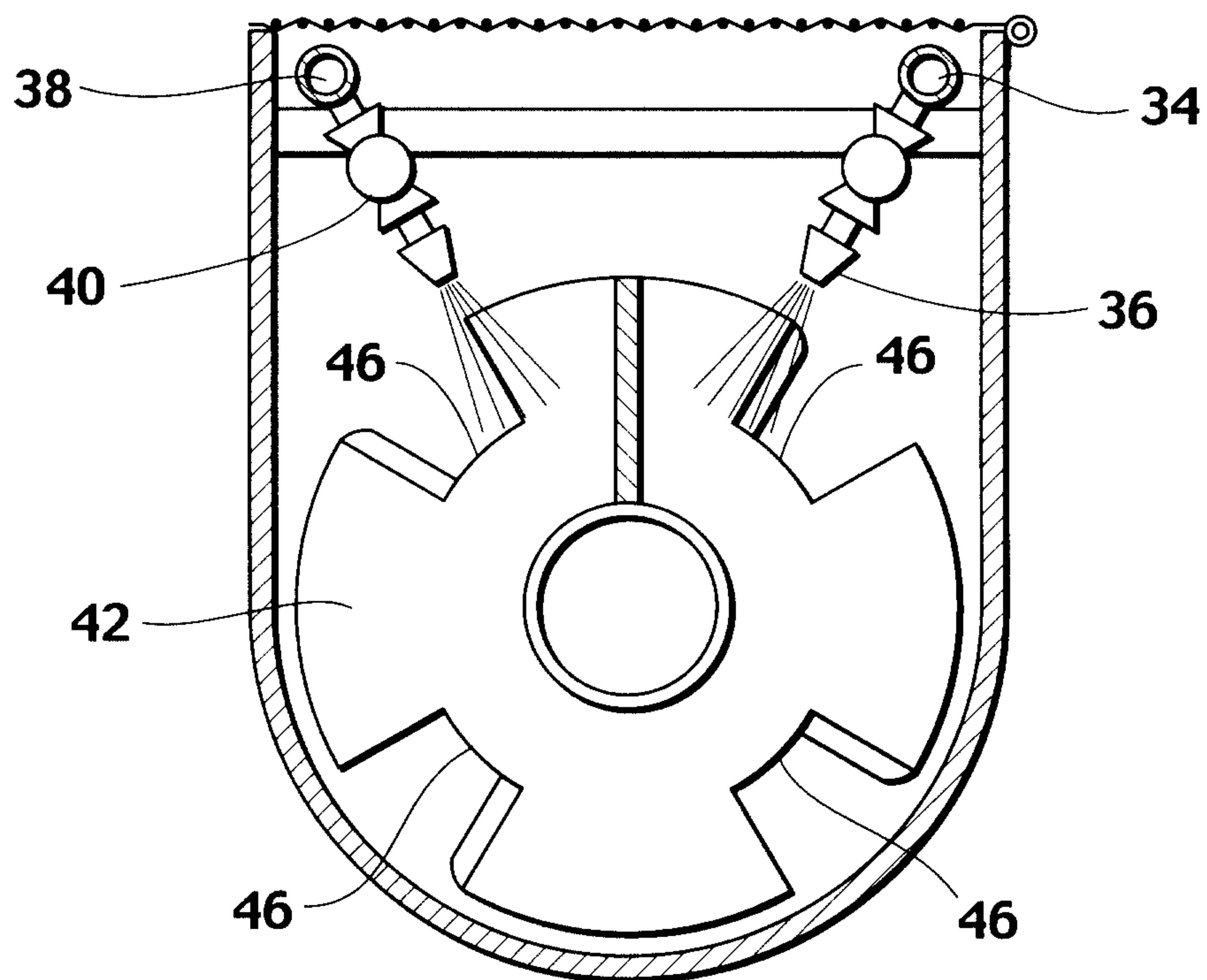


Fig. 5

10/11

*Fig. 6**Fig. 7*



11/11

