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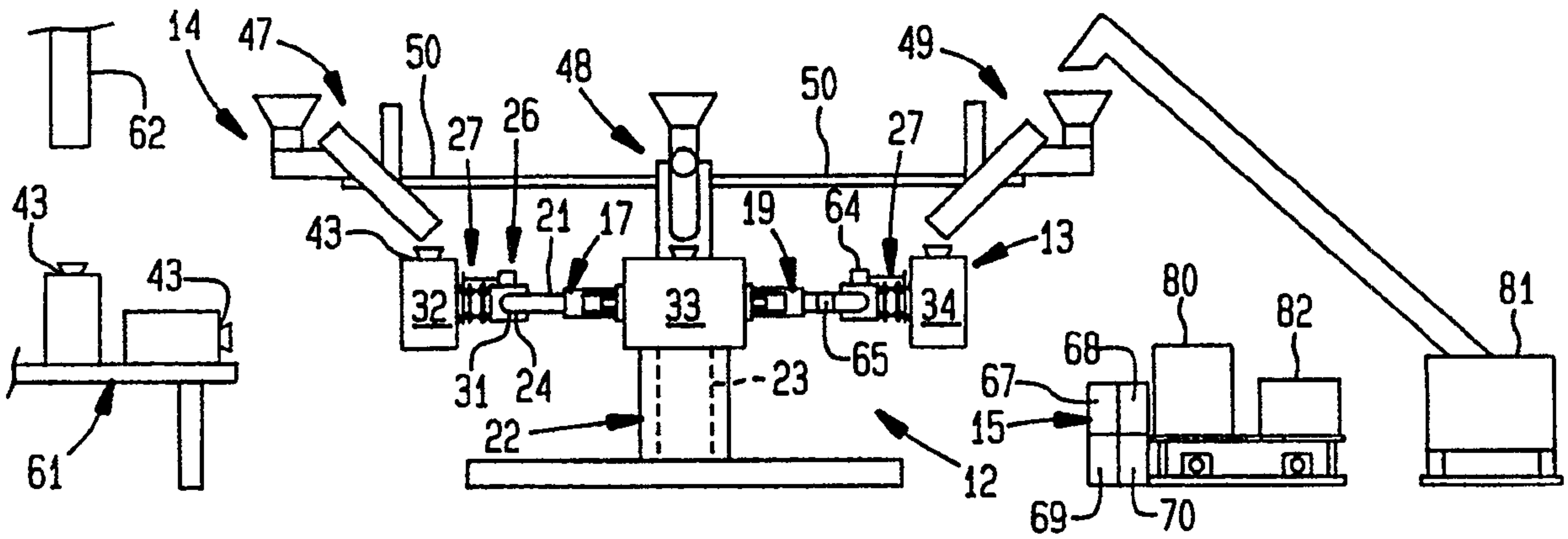
(54) Titre : TECHNIQUE, APPAREIL ET STRUCTURE DE ROTOMOULAGE A AXES MULTIPLES
(54) Title: MULTIAXIS ROTATIONAL MOLDING METHOD, APPARATUS AND STRUCTURE



(57) Abrégé/Abstract:
Multiaxis rotational molding apparatus and method of using such apparatus includes a plurality of spaced generally horizontally oriented arm members (17, 18, 19, 20) each having one end extending fron an upstanding frame section (22) with one mold assembly (32, 33, 34, 35) rotatably mounted adjacent a free end thereof. Each mold assembly includes a plurality of separable mold sections (36) including plate sections (38). A plurality of closely spaced movable vertically oriented enclosed mixing chambers (47, 48, 49) each including an upper liquid mixing section (51) and a lower liquid/solid particle mixing section (53) disposed below the upper liquid mixing section and connected thereto at an obtuse angle. A solid particle feeding hopper (54) is connected to the lower mixing section at a point above its connection with the upper mixing section. The control portion includes indexing mechanism (64, 65) sequentially orienting a dispenser of each mixing chamber with each mold assembly to control formation of molded structures continuously in a preselected multiaxis molding profile.

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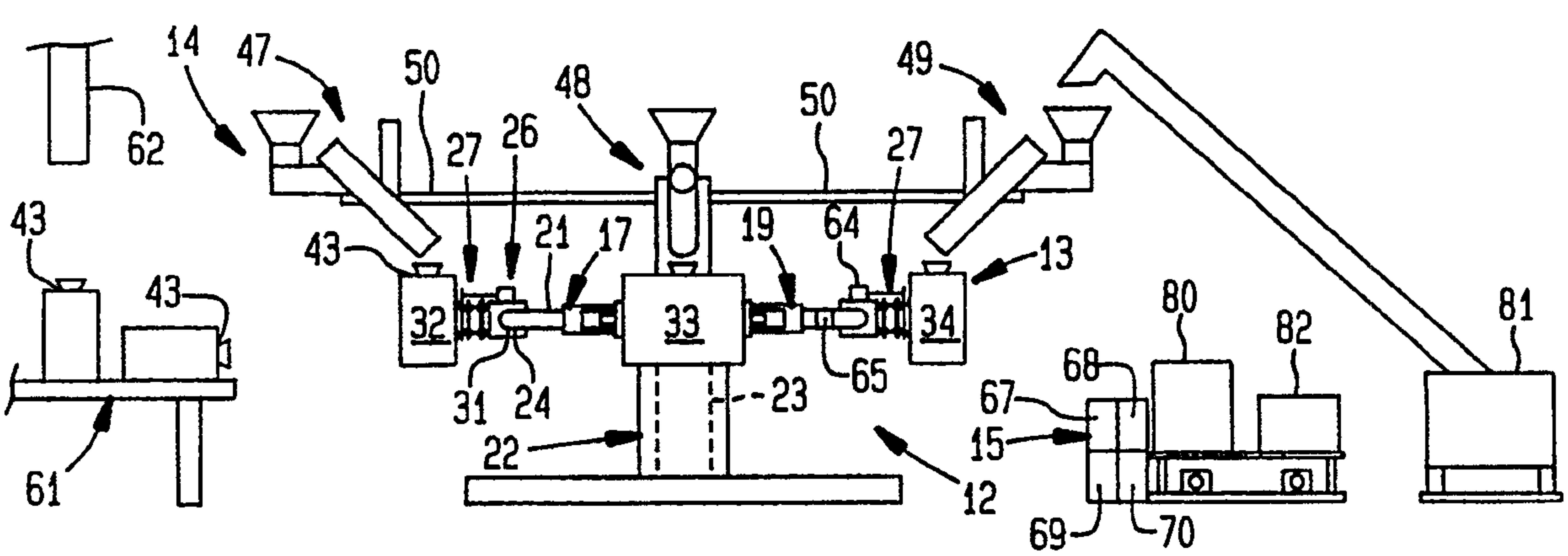


(57) Abstract

Multiaxis rotational molding apparatus and method of using such apparatus includes a plurality of spaced generally horizontally oriented arm members (17, 18, 19, 20) each having one end extending fron an upstanding frame section (22) with one mold assembly (32, 33, 34, 35) rotatably mounted adjacent a free end thereof. Each mold assembly includes a plurality of separable mold sections (36) including plate sections (38). A plurality of closely spaced movable vertically oriented enclosed mixing chambers (47, 48, 49) each including an upper liquid mixing section (51) and a lower liquid/solid particle mixing section (53) disposed below the upper liquid mixing section and connected thereto at an obtuse angle. A solid particle feeding hopper (54) is connected to the lower mixing section at a point above its connection with the upper mixing section. The control portion includes indexing mechanism (64, 65) sequentially orienting a dispenser of each mixing chamber with each mold assembly to control formation of molded structures continuously in a preselected multiaxis molding profile.

MULTIAXIS ROTATIONAL MOLDING METHOD, APPARATUS AND STRUCTURE

This invention relates to a novel molding method and apparatus and more particularly relates to a new multiaxis rotational molding method and apparatus.

The production of man-made plastic and resin articles is an industry that utilizes a high degree of automatically controlled continuous processing. However, for units of appreciable size, batch processing still is the rule rather than the exception. For example, in the production of fiberglass structures such as boats, it is customary to construct the hulls by hand. A plurality of resin and fiberglass layers are sequentially laminated on an open mold or a plurality of mixed resin/chopped fiber coatings are applied over the mold.

Such hand building procedures require a great amount of labor, supervision and continuous inspection to insure that a reasonable level of quality is achieved. This greatly increases the cost of the product.

The applicant's earlier patents listed above provide a novel method and apparatus for producing both large and small molded structures continuously. The apparatus includes unique combinations of components to produce a wide variety of different products. Achieving this capability requires a major capital investment. Also, personnel to utilize the broad parameters of the apparatus normally are highly trained and experienced.

The present invention provides a novel molding method and apparatus which not only overcome the deficiencies of present technology but also provide features and advantages not found in earlier expedients. The multiaxis rotational molding method and apparatus of the invention provide a means for the production of a large number of uniform high quality products rapidly and efficiently.

The multiaxis rotational molding apparatus of the present invention is simple in design and can be produced relatively inexpensively. Commercially available materials and components can be utilized in the manufacture of the apparatus. Conventional metal fabricating procedures can be employed by semi-skilled labor in the manufacture of the apparatus. The apparatus is durable in construction and has a long useful life with a minimum of maintenance.

The apparatus of the invention can be operated by individuals with limited mechanical skills and experience. A large number of high quality molded structures can be produced rapidly by such persons safely and efficiently with a minimum of supervision.

The molding method and apparatus of the invention can be modified to mold a wide variety of new structures. Variations both in product configuration and composition can be attained simply and conveniently with the method and apparatus of the invention. Even with such variations, uniformity and quality of product dimensions and shapes still are maintained without difficulty.

A novel method of the present invention for continuously forming integrally molded structures includes the steps of rotating a plurality of multisection mold assemblies about a plurality of axes. A supply of a first freshly formed polymerizable mixture is indexed into alignment with a first mold assembly. The first polymerizable mixture is flowed over surfaces of a first enclosed mold cavity within the first mold assembly. The flowing of the first mixture over the first mold cavity surfaces and formation of a first resin therefrom are monitored.

The supply of the first polymerizable mixture then is indexed into alignment with an adjacent second mold assembly. The first polymerizable mixture is flowed over surfaces of a second enclosed mold cavity within the second mold assembly. Simultaneously therewith, a supply of a second freshly formed polymerizable mixture is indexed into alignment with the first mold assembly. The second polymerizable mixture is flowed over the first resin within the second mold assembly. The flowing of the first and second mixtures within the first and second mold cavities and formation of first and second resins therefrom are monitored.

The supply of the first polymerizable mixture next is indexed into alignment with an adjacent third mold assembly. The first polymerizable mixture is flowed over surfaces of a third enclosed mold cavity within the third mold assembly. Simultaneously therewith, the supply of the second polymerizable mixture is indexed into alignment with the second mold assembly. The second polymerizable mixture is flowed over the first resin within the second mold assembly. The flowing of the first and second mixtures within the second and third mold cavities and formation of first and second resins therefrom are monitored.

The indexing of the supplies of the first and second polymerizable mixtures into alignment with succeeding mold assemblies and the flowing of the mixtures into the respective mold cavities is continued until all of the mold assemblies have received the mixtures. Also, the indexing and flowing of the mixtures and the formation of resins therefrom are monitored.

The rotation of the mold assemblies is continued throughout the steps of the continuous molding operation while monitoring individually each axis rotation of the mold assemblies. The monitored indexing and flowing of each mixture and the monitored formation of each resin are coordinated with each monitored axis rotation in a preselected profile to form the integrally molded structures of the first and second resins.

The mold sections of each mold assembly are separated after the integrally molded structure therein has achieved structural integrity within the mold cavity. The structure is removed from the separated mold sections and the steps are repeated to form a multiplicity of the molded structures on a continuing basis.

Advantageously, solid particles are introduced into the mold cavity of each mold assembly and the particles distributed in a preselected configuration before indexing the supply of the first polymerizable mixture into alignment with the respective mold assembly. Also, the flowing of at least one of the polymerizable mixtures into the mold cavity may be accomplished through a delivery conduit while it is being withdrawn through the mold cavity.

Preferably, each mold assembly is transferred to an adjacent mold receiving station prior to separating the mold sections and returning the mold assembly to a molding position for repeating the method of the invention. A plurality of mold assemblies may be provided for each molding position so molding can continue while other mold assemblies are being opened and being prepared for another molding cycle. Cavity changing inserts may be positioned into the mold cavity while the mold sections are separated.

Benefits and advantages of the novel multiaxis rotatable molding method and apparatus of the present invention will be apparent from the following description and the accompanying drawings in which:

Figure 1 is a side view of one form of multiaxis rotational molding apparatus of the invention;

Figure 2 is a fragmentary top view of the molding apparatus shown in Figure 1;

Figure 3 is an enlarged fragmentary side view of the mixing and molding portions of the molding apparatus shown in Figure 1;

Figure 4 is a further enlarged view in perspective of a mold assembly of the molding apparatus shown in Figure 1;

Figure 5 is a fragmentary side view of another form of multiaxis rotational molding apparatus of the present invention; and

Figure 6 is a left end view of the molding apparatus shown in Figure 5.

As shown in Figures 1-4 of the drawings, one form of multiaxis rotational molding apparatus 11 of the present invention includes a support portion 12, a molding portion 13, a mixing portion 14 and a control portion 15.

The support portion 12 of the multiaxis rotational molding apparatus 11 of the invention includes a plurality of arm members 17,18,19,20 disposed in a generally horizontal orientation. One end 21 of each arm member 17-20 extends from an upstanding frame section 22. Advantageously, the upstanding frame section 22 includes a central upstanding section 23 from which the arm members extend radially as shown in the drawings.

The molding portion 13 of the rotational molding apparatus 11 includes a plurality of mold supporting assemblies 26. One mold supporting assembly is rotatably mounted adjacent a free end 24 of each arm member 17-20. Each mold supporting assembly 26 includes an independently rotatable mold connector section 27. Each mold supporting assembly also includes a central passage 28 therethrough. The central passage extends from a rotatable connection 29 with the respective arm member and through the mold connector section 27.

The mold connector section 27 preferably includes spaced support sections 30 disposed along central passage 28 therethrough. Each arm member 17-20 advantageously also may include one or more pivotal connections 31 along its length.

The molding portion 13 further includes a plurality of mold assemblies 32,33,34,35. Each mold assembly includes a plurality of separable mold sections 36 forming a substantially enclosed mold cavity 37. As shown in Figure 4, mold sections 36 may include plate sections 38.

The plate sections may be substantially flat or may be of another configuration such as corresponding to that of a product being molded. The plate sections may include cavity surfaces with wear resistance, lubricity and/or other special properties with or without underlying foam as may be formed with the method of the invention.

Connecting means e.g. electromagnets 39 selectively secure the mold sections together. Also, connecting means 40 secure the assembled mold sections to mold connector section 27.

Advantageously, mold sections 36 include flanges 42 overlapping adjacent sections. Sections 36 may include an opening 43 therethrough which may be disposed concentrically with a delivery conduit 44 (Figure 3) during the molding operation. The delivery conduit preferably is capable of being withdrawn from the mold cavity 37 at a preselected rate.

A short tubular member advantageously may be affixed within an opening 43. The tubular member may function as a funnel 45 (Figure 3) to facilitate introduction of material into the mold cavity. Also, a tubular member may interconnect with a similar tube 46 (Figure 4) in an adjacent structural unit to provide communication between cavities of assembled structures.

The mixing portion 14 of the multiaxis rotational molding apparatus 11 of the present invention includes a plurality of closely spaced elongated enclosed mixing chambers 47,48,49. The mixing chambers are mounted in a generally vertical orientation on horizontal beams 50 extending from frame section 22. The mixing chambers and the mold assemblies are mounted for relative movement therebetween.

Each mixing chamber 47-49 includes an upper liquid mixing section 51 with a first rotatable mixing element 52 disposed therein. Each mixing chamber also includes a lower liquid/solid particle mixing section 53. The lower mixing section 53 is disposed below the upper mixing section 51. The lower mixing section 53 is connected to the upper mixing section at an obtuse angle.

A solid particle feeding hopper 54 is connected to the lower mixing section 53 at a point thereon above its connection with the upper mixing section 51. A second open rotatable mixing element 55 is disposed within the lower mixing section.

Advantageously, the mixing chambers 47-49 include separable housing sections 57 to facilitate cleaning thereof. If desired, the mixing portion also may include a solid particle feeding hopper 60 which is operable independently of the mixing chambers 47-49. As shown in the drawings, the molding apparatus 11 preferably includes mold assembly receiving stations 61 adjacent each arm member 17-20.

The control portion 15 of the molding apparatus 11 of the present invention includes actuating means including drive means 64,65 for each mold assembly. One drive means 64 rotates each mold supporting assembly 26 and the mold assembly 32-35 affixed thereto. Another drive means 65 rotates each mold supporting assembly 26 and the mold assembly affixed thereto along an axis generally perpendicular to the axis of rotation achieved with drive means 64. Other drive means may be provided for opening, closing, transferring mold assemblies, driving mixing elements, etc. as required.

The control portion 15 also includes programmable memory means 67, coordinating means 68, monitoring means 69 and circuitry therefor. The drive means 64,65 advantageously include gear motors, chains and sprockets connected thereto. Preferably, the gear motors are variable speed motors. The actuating means may activate other components such as pumps, valves, drives, electromagnets, etc. Preferably, the monitoring means 69 includes optical fibers 72 extending through the mold sections 36 as shown in Figure 4.

The coordinating means 68 advantageously includes a process controller 70 that initiates changes in the flows of materials and speeds of drives for each mold assembly to bring variations therein back to the respective rates specified in the programs present in the memory 67. This coordination commonly is achieved through the transmission of information such as digital pulses from the monitors and/or sensors at the control components to the process controller 70.

The operating information is compared with the preselected programming parameters stored in the memory 67. If differences are detected, instructions from the controller change the operation of the components to restore the various operations to the preselected processing specifications.

In the use of the multiaxis rotational molding apparatus 11 of the present invention, the designs of the structures desired first are established. Then, each design is programmed into the memory 67.

To start the operation of the apparatus 11, buttons and/or switches of a control panel (not shown) are depressed to activate the memory 67 and the other components of the control portion 15. The coordinating means 68 energizes drive means 64,65.

Also, monitors 69 and pumps, valves, etc. (not shown) are energized by the coordinating means 68 in the preselected sequences of the program stored in the memory 67. This causes the raw materials in reservoirs 80,81,82 to advance along inlet conduits toward the respective mixing chambers 47-49 located above each of the arm members 17-20 of the molding apparatus 11. For example, to mold a structure including a polyurethane resin, reservoir 80 may contain a liquid reactive resin forming material, reservoir 81 a particulate solid recyclable material and reservoir 82 and other reservoirs - colors, catalysts, etc. as required.

To produce high quality molded structures of the invention, it is important that the raw material delivered to each mixing chamber be uniform in volume and composition. This can be facilitated by providing a continuous flow of raw materials to each mixing chamber and the immediate transfer of each mixture therefrom onto the cavity surface of a mold assembly 32-35.

However, the volume of the mixture delivered will vary depending upon the particular incremental area being covered at any instant. Also, the delivery to a particular mold assembly will be terminated completely when a molded structure is being removed from that assembly.

Advantageously, a separate bypass conduit (not shown) is utilized from the end of each inlet conduit at a point adjacent a particular mixing chamber back to the respective reservoir. This construction provides for the delivery of a freshly formed uniform mixture from each mixing chamber even though the distance is considerable between the reservoirs and the mixing chambers which are located adjacent the mold assemblies. The control portion 15 coordinates the operation of the various system components so the required formulation flows onto the desired areas of a particular preselected mold cavity.

Rotation of each mold assembly 32-35 about an axis concentric with that of mold connector section 27 and rotational movement of the mold assembly about a second axis perpendicular to its concentric axis are started and continue while each freshly formed polymerizable mixture is transferred from a particular mixing chamber into each preselected cavity 37 of a mold assembly. The multiple axis rotational movement and any arcuate movement are continued to complete the flow of the mixture over all areas being covered within a particular mold cavity. All movements are controlled within the parameters stored in the memory 67.

For particular structures, the movements about the respective axes may be continuous and/or intermittent at changing rates. Also, it may be desirable to provide arcuate rotation, that is, movement about an arc such as a rocking motion. Monitors 69 located within each mold assembly 32-35 signal the process controller 70 when each polymerizable mixture has been distributed over the preselected areas of the respective mold cavity so the controller can initiate the next step of the molding method.

With the control components of the molding apparatus 11 activated, a first mixing chamber 47 is indexed into alignment with the first mold assembly 32. The first freshly formed polymerizable mixture flows from the mixing chamber into mold cavity 37 and flows over the cavity surface and a first resin layer is formed therein. The flowing of the first mixture over the cavity surfaces and formation of a first resin therefrom are monitored.

Thereafter, the first mixing chamber 47 is indexed into alignment with an adjacent second mold assembly 35 and the first polymerizable mixture flowed into the mold cavity thereof. Simultaneously therewith, a second mixing chamber 48 is indexed into alignment with the first mold assembly 32 and the second polymerizable mixture therein is delivered into the mold cavity of the first mold assembly 32 flowing over the first resin formed in the cavity. The flowing of the first and second mixtures within the first and second mold cavities and formation of a first and second resin therefrom are monitored.

Thereafter, the first mixing chamber 47 is indexed into alignment with a third mold cavity of an adjacent third mold assembly 34 and the first mixture therein flowed over the cavity surfaces. Simultaneously therewith, the second mixing chamber 48 is indexed into alignment with the second mold cavity of the second mold assembly 35 and the second mixture flowed over the first resin formed therein. The flowing of the first and second resins and formation of a first and second resin therefrom are monitored.

The indexing of the first and second mixing chambers 47,48 as well as mixing chamber 49 and solid particle hopper 60 into alignment with each mold assembly and the flowing of each mixture into each mold cavity of any additional mold assemblies is continued until all of the mold assemblies have received the mixtures according to the preselected molding parameters. The monitoring of the mixture flow, resin formation and mold assembly rotation is continued throughout the molding operation as well as the coordinating of this operating information with the preselected program profile.

When a molded structure within a mold cavity is sufficiently cured that it possesses structural integrity, rotation of the respective mold assembly is stopped and the mold assembly is transferred to an adjacent mold receiving station 61 with hoist means 62. The mold sections 36 are separated to free the structural unit.

The molded structure then may be set aside to complete the curing of the resin therein. During this period, the molded structure, free of the mold's restraint, stresses the high density outer skin or layer. This stressing of the skin increases the strength and puncture resistance thereof and also the structural strength of the unit itself.

The mold sections 36 are prepared for another molding cycle. This may include changing the position of one or more mold sections with respect to each other, the substitution of mold sections with different configurations and the like. Also, cavity changing inserts may be positioned against the plate sections,if desired.

The mold sections 36 then are assembled together and secured such as by energizing electromagnets 39. The mold assembly now is ready for repositioning on the adjacent arm member when the next mold assembly is removed therefrom.

Figures 5 and 6 illustrate schematically another form of rotational molding apparatus 86 of the present invention. The apparatus provides for the arrangement of a plurality of molding assemblies 87,88 in a straight line with mixing chambers 89,90 traveling from one mold assembly to the next along overhead tracks 91,92. In other respects, the apparatus may include components similar to those of apparatus 11 as described above.

The polymerizable mixtures employed to produce the structures of the invention are selected to be capable of reaction to form the particular resin desired in the final structure. Advantageously, the resin is a thermosetting resin such as a polyurethane or polyester. Should a polyurethane be desired, one reservoir 80,81,82 may contain an isocyanate and another reservoir may contain a polyol. More commonly, the reservoirs may contain different partially formed materials which upon mixing interact to form the desired polyurethane. Examples of such partially formed materials include so-called "A stage" resins and "B stage" resins.

Other resin forming systems may utilize a resin forming material in one reservoir and a catalyst in a second reservoir. Additional components can be pre-mixed with one of the resin formers, e.g. fillers, reinforcements, colors and the like.

The particulate solid additive material may be any of a wide variety of materials which impart special properties to the final structure such as wear resistance, lubricity, electrical, magnetic, temperature conductivity or isolation, and the like. Some inexpensive particulate materials generally are readily available at a particular job site. Natural mineral particulate material such as sand and gravel normally are present or can be produced simply by crushing rock at the site.

Waste or recycled materials which can be shredded or ground into particles of suitable size can be utilized. Particularly useful are particles formed by shredding or grinding discarded tires and similar products. Since the particles are encapsulated with the resin forming material and not saturated therewith, many different waste materials may be employed.

The above description and the accompanying drawings show that the present invention provides a novel multiaxis rotational molding method and apparatus which not only overcome the deficiencies and shortcomings of earlier expedients, but in addition provide novel features and advantages not found previously. The method and apparatus of the invention provide simple inexpensive means for producing uniform high quality products efficiently and at high rates of production.

The apparatus of the invention is efficient in its design and operation and is relatively inexpensive. Commercially available materials and components can be utilized in the fabrication of the apparatus using conventional metal working techniques and procedures.

Structures can be produced automatically with the apparatus of the invention by operators with limited experience and aptitude after a short period of instruction. The apparatus is durable in construction and has a long useful life with a minimum of maintenance.

The method and apparatus of the invention can be utilized to mold a wide variety of different products. Variations in structure, configuration and composition of the products can be achieved simply and quickly with the method and apparatus of the invention.

It will be apparent that various modifications can be made in the multiaxis rotational molding method and apparatus described in detail above and shown in the drawings within the scope of the present invention. The size, configuration and arrangement of components can be changed to meet specific requirements. For example, the mold assemblies and mixing chambers may be arranged differently with respect to one another. In addition, the number and sequence of processing steps may be different. Also, the apparatus may include other drive and actuating components and mechanisms.

These and other changes can be made in the method and apparatus described provided the functioning and operation thereof are not adversely affected. Therefore, the scope of the present invention is to be limited only by the following claims.

CLAIMS

1. Multiaxis rotational molding apparatus including a support portion, a molding portion, a mixing portion and a control portion; said support portion including an upstanding frame section, a plurality of spaced generally horizontally oriented arm members each having one end extending from said upstanding frame section; said molding portion including a plurality of mold supporting assemblies with one supporting assembly rotatably mounted adjacent a free end of each of said arm members, each of said mold supporting assemblies including an independently rotatable mold connector section, each of said mold supporting assemblies including a central passage therethrough from a rotatable connection with said arm member and through said mold connector section, a plurality of mold assemblies each including a plurality of separable mold sections forming a substantially enclosed cavity, said mold sections including a plurality of plate sections, connecting means selectively securing mold sections of one mold assembly together and to said mold connector section; said mixing portion including a plurality of closely spaced independently movable generally vertically oriented elongated enclosed mixing chambers mounted on said frame section adjacent said mold assemblies, each of said mixing chambers including an upper liquid mixing section with a first rotatable mixing element disposed therein, said mixing chamber including a lower liquid/solid particle mixing section disposed below said upper mixing section and connected thereto at an obtuse angle, a solid particle feeding hopper connected to said lower mixing section at a point thereon above its connection with said upper mixing section, a second open rotatable mixing element disposed within said lower mixing section, dispensing means extending from an outlet end of said lower mixing section of each mixing chamber; said control portion including indexing means disposed on said frame section sequentially orienting said dispensing means of said mixing chambers with each mold cavity, actuating means rotating each mold connector section and said mold assembly affixed thereto and actuating means pivoting each mold supporting assembly and said mold assembly affixed thereto with respect to said arm member, programmable memory means storing preselected operating

parameters, monitoring means sensing operating information from control components, circuitry transmitting signals from said monitoring means to coordinating means comparing said operating information with said operating parameters stored in said memory means and activating said indexing means and said actuating means to control formation of molded structures with said molding apparatus continuously in a preselected multiaxis molding profile.

2. Multiaxis rotational molding apparatus according to Claim 1 wherein said arm members extend radially from a central upstanding frame section.

3. Multiaxis rotational molding apparatus according to Claim 1 wherein said rotatable mold connector section includes spaced support sections disposed along said central passage therethrough.

4. Multiaxis rotational molding apparatus according to Claim 1 wherein plate sections include flanges overlapping adjacent plate sections.

5. Multiaxis rotational molding apparatus according to Claim 1 wherein said mixing portion includes a solid particle feeding hopper independently movable with respect to said movable mixing chambers.

6. Multiaxis rotational molding apparatus according to Claim 1 wherein said mixing chambers include separable housing sections.

7. Multiaxis rotational molding apparatus according to Claim 1 including drive means providing relative movement between said mixing chambers and said mold assemblies.

8. Multiaxis rotational molding apparatus according to Claim 1 wherein said dispensing means includes a delivery conduit extendable into said mold cavity through said central passage of said mold supporting assembly.

9. Multiaxis rotational molding apparatus according to Claim 1 wherein said control portion includes actuating means separating and assembling said mold sections.

10. Multiaxis rotational molding apparatus according to Claim 1 including a mold assembly receiving station adjacent said free end of each of said arm members.

11. Multiaxis rotational molding apparatus according to Claim 10 including means for transferring a mold assembly between said arm member and said adjacent mold receiving station.

12. Multiaxis rotational molding apparatus according to Claim 8 wherein said delivery conduit is capable of being withdrawn from said mold cavity at a preselected rate.

13. Multiaxis rotational molding apparatus according to Claim 1 wherein said plate sections include an opening therethrough.

14. A method of continuously forming integrally molded structures in a multiaxis rotational molding operation including the steps of rotating a plurality of multisection mold assemblies about a plurality of axes, indexing a supply of a first freshly formed polymerizable mixture into alignment with a first mold assembly, flowing said first polymerizable mixture over surfaces of a first enclosed mold cavity within said first mold assembly, monitoring said flowing of said first mixture over said first mold cavity surfaces and formation of a first resin therefrom, indexing said supply of said first polymerizable mixture into alignment with an adjacent second mold assembly, flowing said first polymerizable mixture over surfaces of a second enclosed mold cavity within said second mold assembly, simultaneously therewith indexing a supply of a second freshly formed polymerizable mixture into alignment with said first mold assembly, flowing said second polymerizable mixture over said first resin in said first mold assembly, monitoring said flowing of said first and second mixtures within said first and second mold cavities and formation of a first and second resin therefrom, indexing said supply of said first polymerizable mixture into alignment with an adjacent third mold assembly, flowing said first polymerizable mixture over surfaces of a third enclosed mold cavity within said third mold assembly, simultaneously therewith indexing said supply of said second polymerizable mixture into alignment with said second mold assembly, flowing said second polymerizable mixture over said first resin in said second mold assembly, monitoring said flowing of said first and second polymerizable mixtures within said second and third mold cavities and formation of a first and second resin therefrom, continuing said indexing of said supplies of said first and second polymerizable mixtures into alignment with succeeding mold assemblies and the flowing of said mixtures into the respective mold cavities until all of the mold assemblies have received said mixtures, monitoring said flowing of said mixtures and formation of resins therefrom, continuing said rotation of said mold assemblies throughout said steps of said continuous molding operation while monitoring individually each axis rotation of said mold assemblies, and coordinating said monitored flowing of each mixture and said monitored formation of each resin with

each monitored axis rotation in a preselected profile to form said integrally molded structures of said first and second resins, separating said mold sections of each mold assembly after said integrally molded structure therein has achieved structural integrity within said mold cavity, removing said integrally molded structure from said separated mold sections and repeating said steps to form a multiplicity of said integrally molded structures of said first and second resins on a continuing basis.

15. A method of continuously forming integrally molded structures according to the method of Claim 14 including the steps of transferring said mold assembly to an adjacent mold receiving station prior to separating said mold sections and removing said structure from said separated mold sections and thereafter returning said mold assembly to a molding position for repeating the above steps.

16. A method of continuously forming integrally molded structures according to the method of Claim 14 including the steps of introducing solid particles into said first mold cavity and distributing said particles into a preselected configuration before indexing said supply of said first polymerizable mixture into alignment with said first mold assembly.

17. A method of continuously forming integrally molded structures according to the method of Claim 14 including the step of changing the position of said mold sections with respect to each other prior to reassembling said mold sections and repeating the above steps.

18. A method of continuously forming integrally molded structures according to the method of Claim 14 including the step of providing a plurality of mold assemblies for each molding position so that molding can be continued while other mold assemblies are being opened and prepared for repeating the above steps.

19. A method of continuously forming integrally molded structures according to the method of Claim 14 including the step of flowing at least one of said polymerizable mixtures into said mold cavity while a delivery conduit is being withdrawn through said mold cavity.

20. A method of continuously forming integrally molded structures according to the method of Claim 14 including the step of flowing at least one of said polymerizable mixtures into said mold cavity through a preformed tubular insert extending through an opening in one of said mold sections.

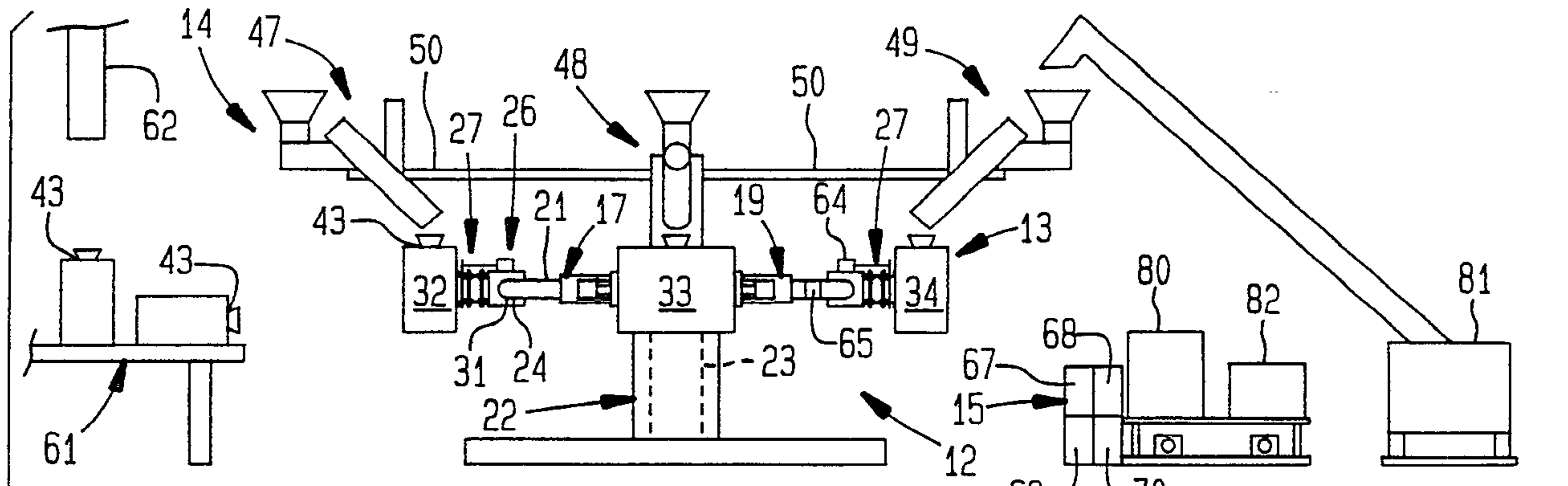


FIG. 1

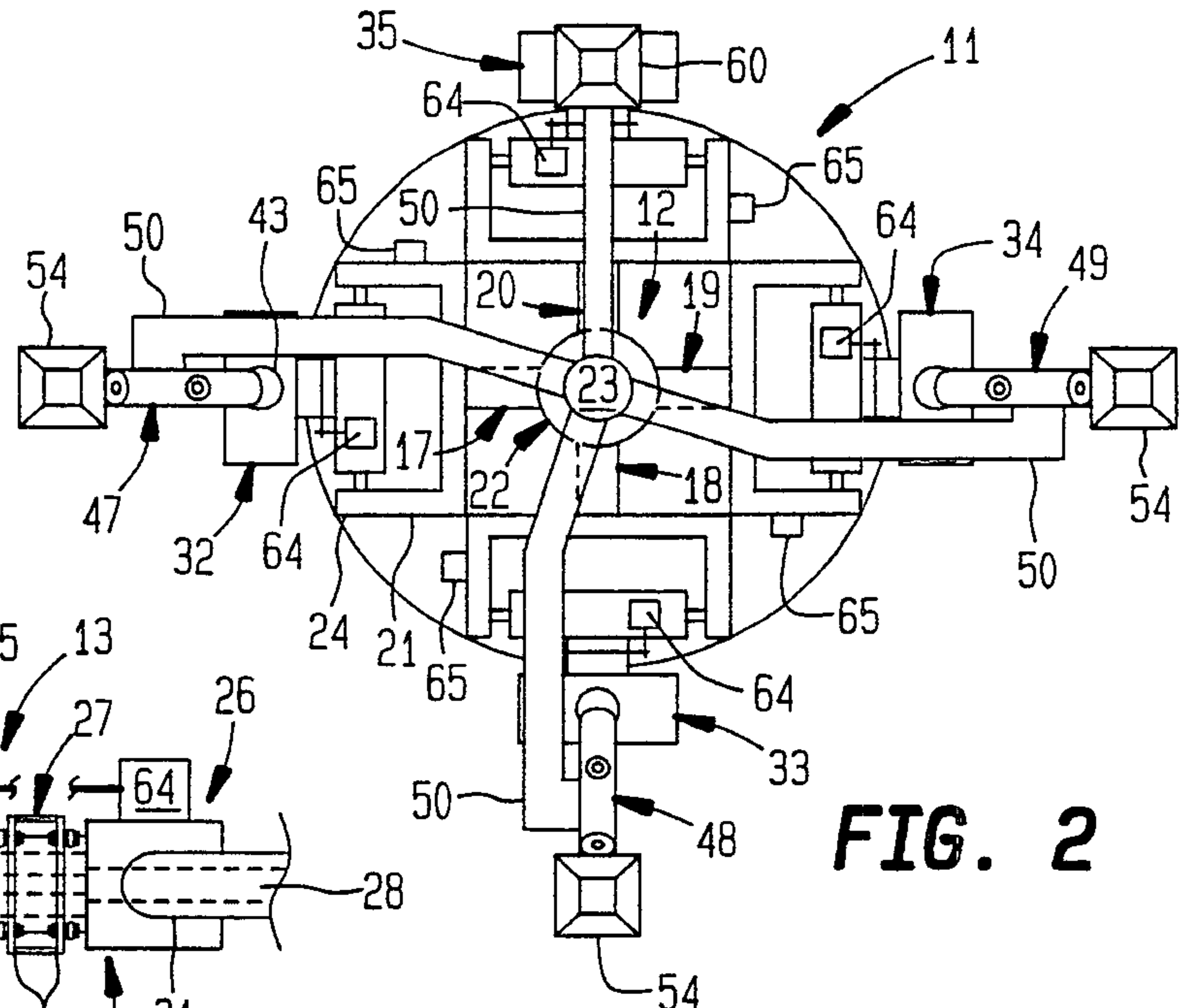


FIG. 2

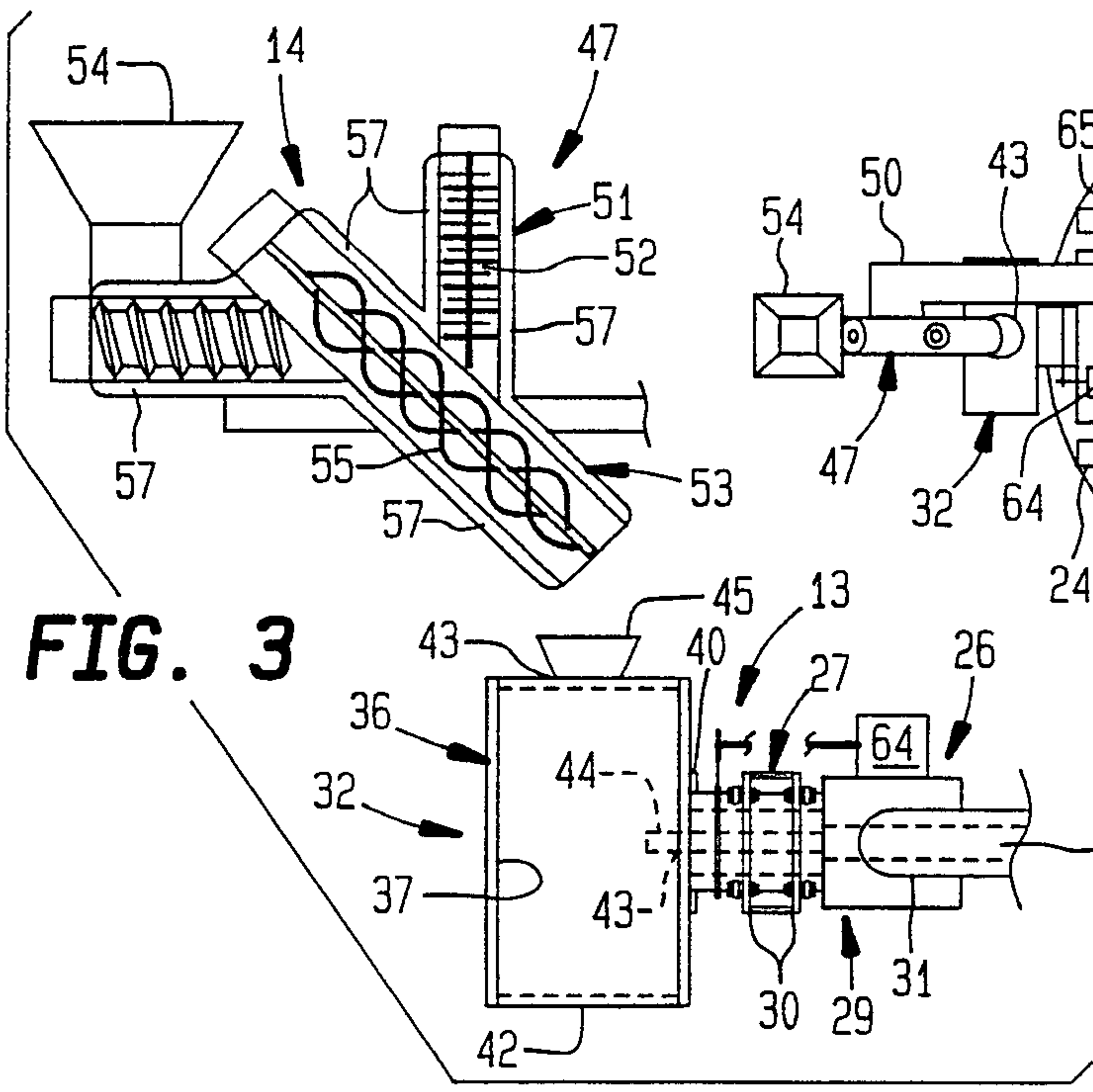


FIG. 3

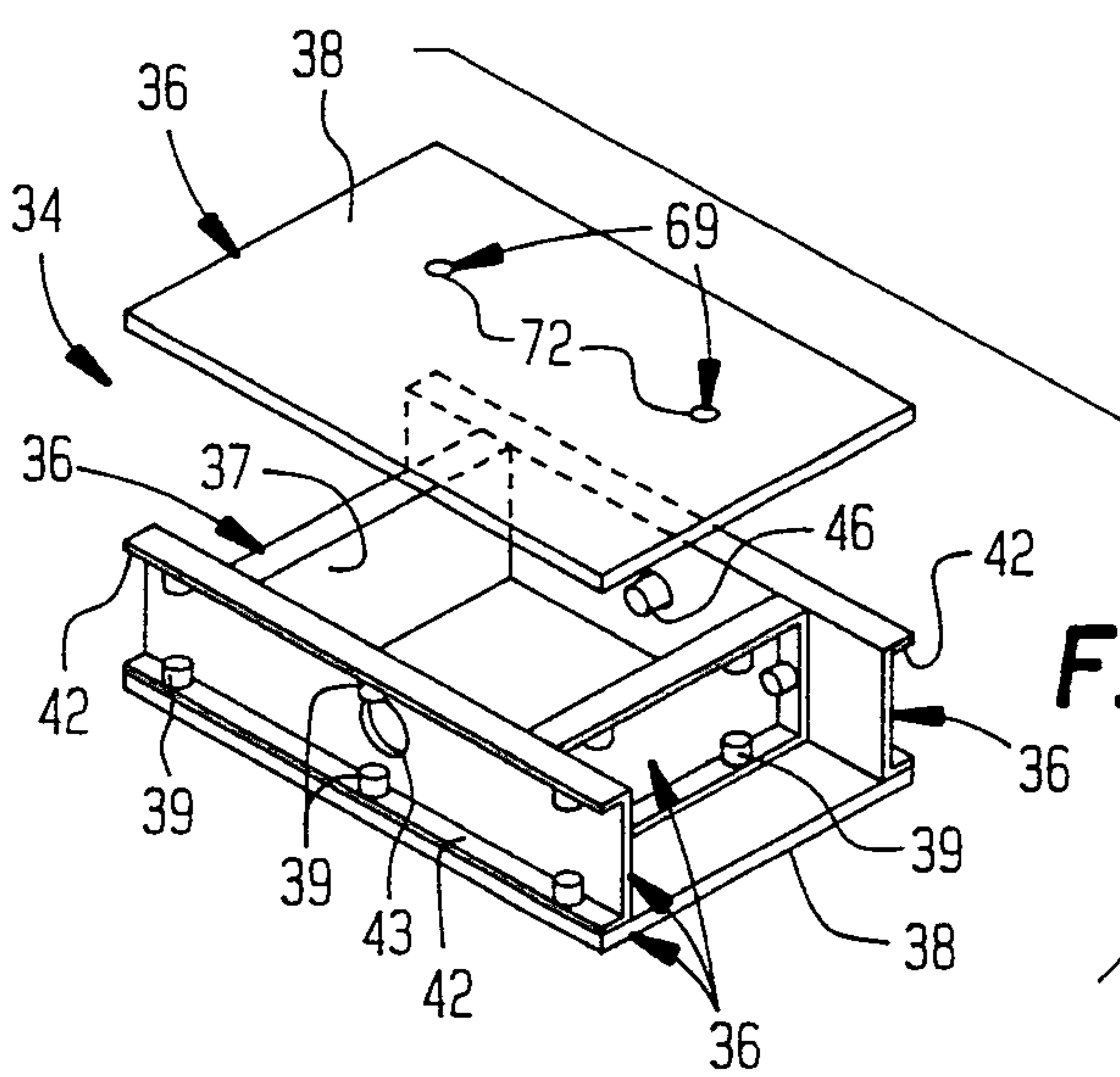


FIG. 4

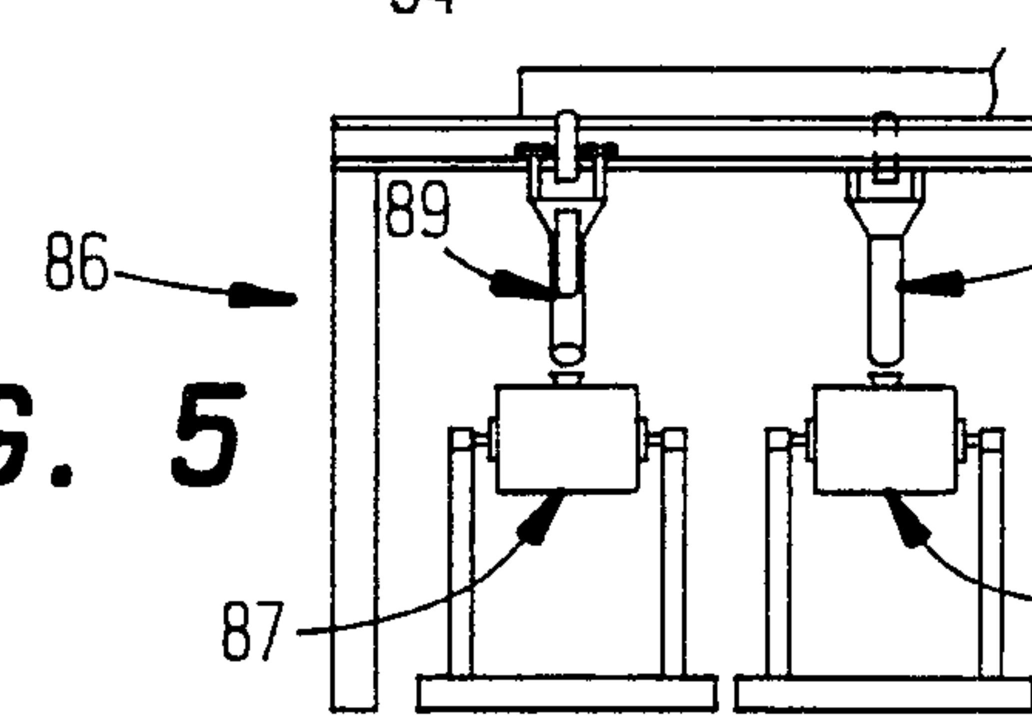


FIG. 5

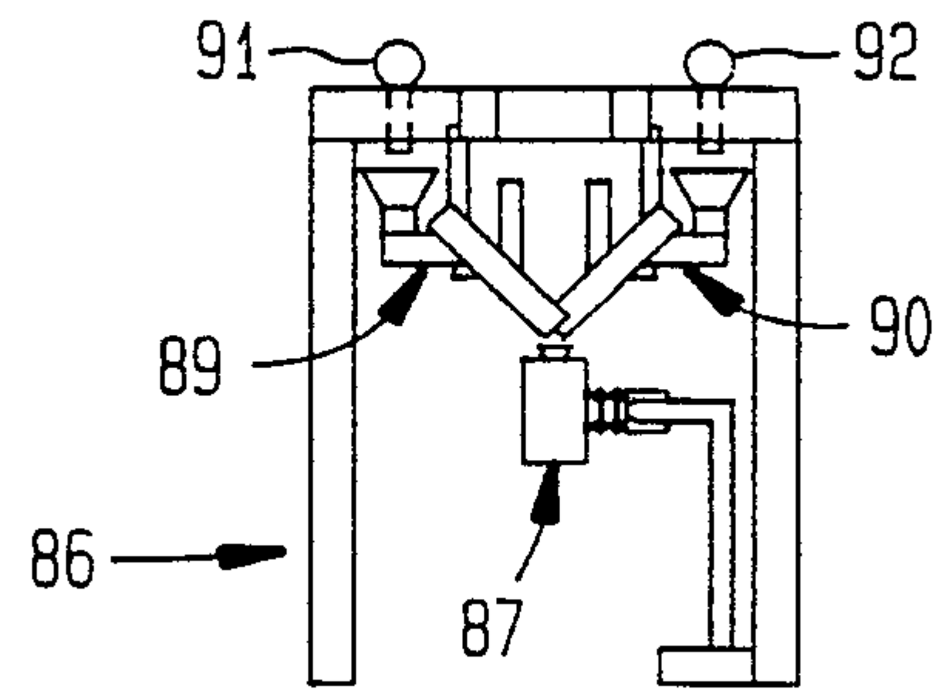
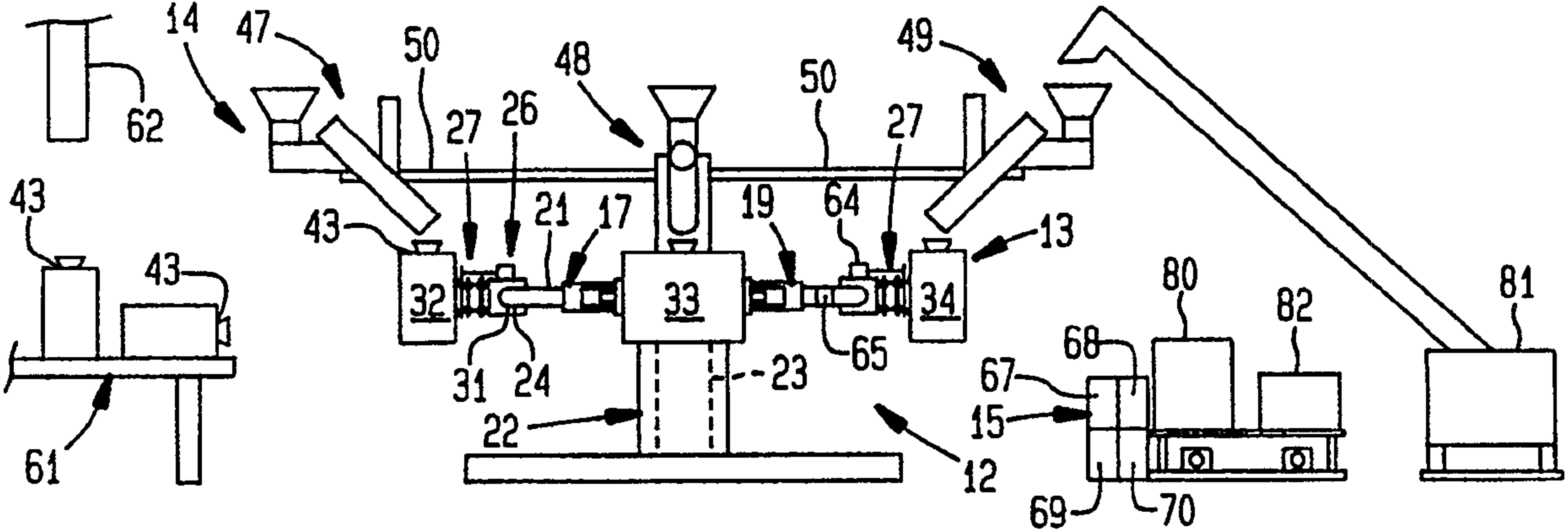


FIG. 6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