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(54) Title: FLUID FLOW CONTROL ASSEMBLY

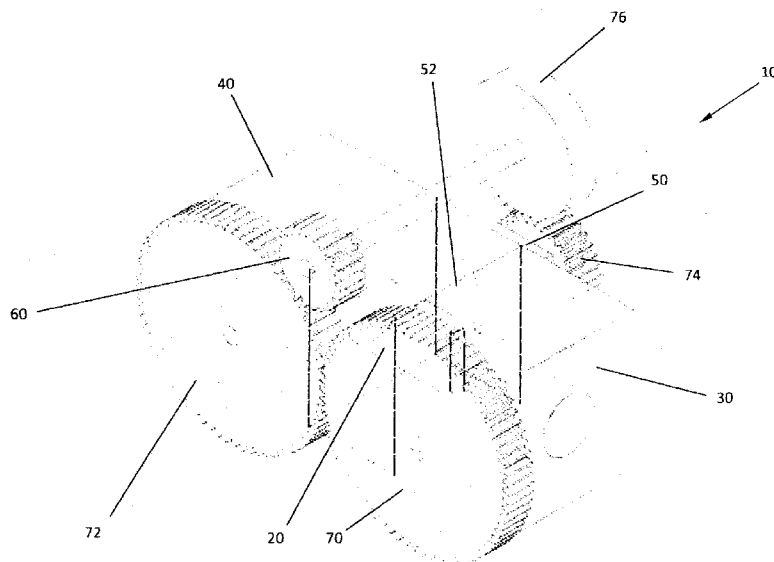


FIG. 1

(57) Abstract: Disclosed herein is a fluid flow control assembly (10, 10'). The assembly comprises a fluid conduit (20), and first (30), second (40) and third (50) valves in fluid flow communication with the fluid conduit (20). An actuator is provided to control opening and closing of the first, second and third valves. The actuator is adapted to provide at least the following configurations of the first valve (30), the second valve (40) and the third valve (50): the first and second valves being in open configurations whilst the third valve is in a closed configuration; and the first and second valves being in closed configurations whilst the third valve is in an open configuration.





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"Fluid flow control assembly"Cross-Reference to Related Applications

The present application claims priority from Australian Patent Application No. 2011901141 the content of which is incorporated herein by reference.

5 The present disclosure relates to a fluid flow control assembly and more particularly to a fluid flow control assembly for providing double block and bleed of fluid pressure. The assembly has been developed primarily for use in chemical, petroleum, agricultural as well as mining applications, in particular where high pressure fluid hazards are present. However, the assembly may also find application in the
10 control of corrosive or potentially hazardous fluids

Known double block and bleed valve assemblies use interlocked methods where a first action is performed before at least one additional action, and/or with the double-block involving one action and the bleed involving a second action.

15 In known valve assemblies, when fluid is dissipated and the line subsequently closed off, a small leak from the block valve can disadvantageously re-energise the line to potentially harmful pressures. Such leakage can also be dangerous when the fluid concerned is corrosive or otherwise harmful.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is not to be taken as an admission that
20 any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed before the priority date of each claim of this application.

Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated
25 element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

In a first aspect, the present disclosure provides a fluid flow control assembly comprising:

- a fluid conduit;
- 30 a first valve in fluid flow communication with an upstream end of the fluid conduit, the first valve comprising:
 - a first valve chamber having a first inlet port and a first outlet port;
 - a first valve seat associated with the first valve chamber;
 - a first valve member associated with the first valve chamber and having a
35 closed configuration in which the first valve member selectively sealingly engages the first valve seat to restrict fluid flow between the first inlet port and the first outlet port and an open configuration in which the first valve member selectively sealingly

disengages the first valve seat to facilitate fluid flow between the first inlet port and the first outlet port;

a second valve in fluid flow communication with a downstream end of the fluid conduit, the second valve comprising:

5 a second valve chamber having a second inlet port and a second outlet port;

a second valve seat associated with the second valve chamber;

10 a second valve member associated with the second valve chamber and having a closed configuration in which the second valve member selectively sealingly engages the second valve seat to restrict fluid flow between the second inlet port and the second outlet port and an open configuration in which the second valve member selectively sealingly disengages the second valve seat to facilitate fluid flow between the second inlet port and the second outlet port;

15 a third valve in fluid flow communication with a portion of the fluid conduit intermediate the first valve and the second valve, the third valve comprising:

a third valve chamber having a third inlet port and a third outlet port;

a third valve seat associated with the third valve chamber;

20 a third valve member associated with the third valve chamber and having a closed configuration in which the third valve member selectively sealingly engages the third valve seat to restrict fluid flow between the third inlet port and the third outlet port and an open configuration in which the third valve member selectively sealingly disengages the third valve seat to facilitate fluid flow between the third inlet port and the third outlet port;

25 an actuator associated with the first valve member for moving the first valve member into and out of sealing engagement with said first valve seat, the actuator also being associated with the second valve member for moving the second valve member into and out of sealing engagement with said second valve seat, and the actuator also being associated with the third valve member for moving the third valve member into and out of sealing engagement with said third valve seat, wherein the actuator is adapted to provide at least the following configurations of the first valve, the second valve and the third valve:

the first valve member and the second valve member being in their open configurations whilst the third valve member is in its closed configuration; and

35 the first valve member and the second valve member being in their closed configurations whilst the third valve member is in its open configuration.

The actuator may also be adapted to provide the following configuration of the first valve, the second valve and the third valve: the first valve member and the second

valve member being in their closed configurations whilst the third valve member is in its closed configuration.

The actuator may comprise a drive train having a primary drive element and a plurality of secondary drive elements driven by actuation of the primary drive element.

5 The plurality of secondary drive elements may comprise drive elements associated with each of the first, second and third valve members. Timing and sequencing of opening and closing of the first, second and third valves may be achieved by varying the ratios of the drive elements in the drive train and/or by disengaging one or more of the secondary drive elements in the drive train from the primary drive element (eg. by
10 removing teeth from the primary and/or secondary drive elements) at particular intervals. The drive train may comprise gears, a chain drive, camming mechanisms, mechanical linkages, or any combination of such drive train elements or similar.

The first valve may be a ball valve. The second valve may be a ball valve. The third valve may be a ball valve.

15

An embodiment of the presently disclosed valve will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic first side perspective view of an embodiment of an assembly according to the present disclosure;

20 Fig. 2 is a schematic first side view of the assembly of Fig. 1, shown in an open configuration, with the first and second valves open and the third valve closed;

Fig. 3 is a schematic opposite side view of the assembly of Fig. 1, shown in the open configuration of Fig. 2;

25 Fig. 4 is a schematic opposite side perspective view of the assembly of Fig. 1, shown in the open configuration of Fig. 2;

Fig. 5 is a schematic cross sectional view of the assembly of Fig. 1, taken along line 5-5 of Fig. 2;

Fig. 6 is a schematic first side perspective view of the assembly of Fig. 1, shown in a double blocked configuration, with the first, second and third valves all closed;

30 Fig. 7 is a schematic first side view of the assembly of Fig. 1, shown in a double blocked configuration of Fig. 6;

Fig. 8 is a schematic opposite side view of the assembly of Fig. 1, shown in a double blocked configuration of Fig. 6;

35 Fig. 9 is a schematic opposite side perspective view of the assembly of Fig. 1, shown in a double blocked configuration of Fig. 6;

Fig. 10 is a schematic cross sectional view of the assembly of Fig. 1, taken along line 10-10 of Fig. 7;

Fig. 11 is a schematic first side perspective view of the assembly of Fig. 1, shown in a double blocked and bleed configuration, with the first and second valves closed and the third valve open;

Fig. 12 is a schematic first side view of the assembly of Fig. 1, shown in a double blocked and bleed configuration of Fig. 11;

Fig. 13 is a schematic opposite side view of the assembly of Fig. 1, shown in a double blocked and bleed configuration of Fig. 11;

Fig. 14 is a schematic opposite side perspective view of the assembly of Fig. 1, shown in a double blocked and bleed configuration of Fig. 11;

Fig. 15 is a schematic cross sectional view of the assembly of Fig. 1, taken along line 15-15 of Fig. 12;

Fig. 16 is a schematic first side perspective view of another embodiment of an assembly according to the present disclosure;

Fig. 17 is a schematic second side perspective view of the assembly of Fig. 16;

Fig. 18 is a schematic first side view of the assembly of Fig. 16, shown in an open configuration, with the first and second valves open and the third valve closed;

Fig. 19 is a schematic opposite side view of the assembly of Fig. 16, shown in the open configuration of Fig. 18;

Fig. 20 is a schematic cross sectional view of the assembly of Fig. 16, taken along line 20-20 of Fig. 18; and

Fig. 21 is a schematic first side view of the assembly of Fig. 16, shown in a double blocked and bleed configuration, with the first and second valves closed and the third valve open;

Fig. 22 is a schematic opposite side view of the assembly of Fig. 16, shown in the double blocked and bleed configuration of Fig. 21; and

Fig. 23 is a schematic cross sectional view of the assembly of Fig. 16, taken along line 23-23 of Fig. 21.

Referring to the drawings, and initially to Figs. 1 to 15, there is shown a fluid flow control assembly 10. The assembly comprises a fluid conduit 20, and first 30, second 40 and third 50 valves in fluid flow communication with the fluid conduit 20.

The first valve 30 in fluid flow communication with an upstream end of the fluid conduit 20 and comprises a first valve chamber 31 having a first inlet port 32 and a first outlet port 33. A first valve seat 34 is associated with the first valve chamber. A first valve member 35 is associated with the first valve chamber 31 and has a closed configuration in which the first valve member 35 selectively sealingly engages the first valve seat 34 to restrict fluid flow between the first inlet port 32 and the first outlet port

33 and an open configuration in which the first valve member 35 selectively sealingly disengages the first valve seat 34 to facilitate fluid flow between the first inlet port 32 and the first outlet port 33.

5 The second valve 40 is in fluid flow communication with a downstream end of the fluid conduit 20 and comprises a second valve chamber 41 having a second inlet port 42 and a second outlet port 43. A second valve seat 44 is associated with the second valve chamber 41. A second valve member 45 is associated with the second valve chamber 41 and has a closed configuration in which the second valve member 45 selectively sealingly engages the second valve seat 44 to restrict fluid flow between the
10 second inlet port 42 and the second outlet port 43 and an open configuration in which the second valve member 45 selectively sealingly disengages the second valve seat 44 to facilitate fluid flow between the second inlet port 42 and the second outlet port 43.

The third valve 50 is in fluid flow communication with a portion of the fluid conduit 20 intermediate the first valve 30 and the second valve 40 and comprises a third
15 valve chamber 51 having a third inlet port 52 and a third outlet port 53. A third valve seat 54 is associated with the third valve chamber 51. A third valve member 55 is associated with the third valve chamber 51 and has a closed configuration in which the third valve member 55 selectively sealingly engages the third valve seat 54 to restrict fluid flow between the third inlet port 52 and the third outlet port 53 and an open
20 configuration in which the third valve member 55 selectively sealingly disengages the third valve seat 54 to facilitate fluid flow between the third inlet port 52 and the third outlet port 53.

An actuator comprising a drive train, which in the illustrated embodiment takes the form of gear train, is associated with the first 35, second 45 and third 55 valve
25 members for moving these valve members into and out of sealing engagement with their respective valve seats 34, 44, 54. The gear train comprises a primary drive gear 60 and secondary gears 70, 72 and 74 each associated with a respective one of the first 35, second 45 and third 55 valve members and driven, directly or indirectly, by rotation of the primary drive gear 60. An intermediate gear 76 is provided between the primary
30 gear 60 and the secondary gear 74 associated with the third valve 50.

Timing and sequencing of opening and closing of the first 30, second 40 and third 50 valves is achieved by varying the ratios of the gears in the gear train and/or by disengaging one or more of the secondary gears 70, 72, 74 from the primary drive gear (eg. by removing teeth from the primary and/or secondary gears) at particular intervals.

35 The gear train is adapted to provide the following configurations of the first 30, second 40 and third 50 valves:

the first valve member 35 and the second valve member 45 being in their open configurations whilst the third valve member 55 is in its closed configuration;

the first valve member 35 and the second valve member 45 being in their closed configurations whilst the third valve member 55 is in its closed configuration;

5 and

the first valve member 35 and the second valve member 45 being in their closed configurations whilst the third valve member 55 is in its open configuration.

These configurations are achieved by virtue of the assembly 10 being configured as follows. In the configuration shown in Figs. 1-5, valve 30 and valve 40 are open,
10 with their respective valve members 35 and 45 being sealingly disengaged from the respective valve seats 34 and 44, and with valve 50 being closed, with its valve member 55 being in sealing engagement with its valve seat 54. However, rotation of the primary gear 60 by 270 degrees clockwise into the configuration shown in Figs. 6-10 causes secondary gear 70 and secondary gear 72 to rotate by 90 degrees (due to the meshing
15 engagement of primary gear 60 and secondary gear 72 and meshing engagement of secondary gear 72 and secondary gear 70), respectively in a clockwise and an anticlockwise direction, which in turn actuates valve members 35 and 45 to move into sealing engagement with their respective valve seats 34 and 44 and thereby to close valves 30 and 40. During this movement of the primary gear 60, intermediate gear 76
20 rotates through 270 degrees due to being mounted on the same shaft as the primary gear 60. However, the intermediate gear transfers no rotation to secondary gear 74 during this rotation, as the intermediate gear 76 has no teeth from 0 degrees to 270 degrees. Accordingly, the valve member 55 remains sealingly engaged with its valve seat 54 and maintains valve 50 closed. At the end of this 270 degree rotation of the primary gear
25 60, the mesh between the primary gear 60 and the secondary gear 72 is disengaged (as the primary gear only has teeth from 0 degrees to 270 degrees), and as a result the primary gear 60 is disengaged from both the secondary gear 72 and the secondary gear 70. Rotation of the primary gear 60 by a further 60 degrees clockwise, into the configuration shown in Figs 11-15, rotates the intermediate gear 76 by 60 degrees due
30 to the primary gear 60 and the intermediate gear 76 being mounted on the same shaft. This rotation of the intermediate gear 76 rotates the secondary gear 74 by 90 degrees due to the intermediate gear 76 having teeth from 270 degrees to 330 degrees and due to the ratio between the secondary gear 74 and the intermediate gear 76 being 1:2. This rotation of the secondary gear 74 moves the valve member 55 out of sealing
35 engagement with its valve seat 54 to open valve 50 and dissipate fluid pressure from the portion of the fluid conduit 20 between the first 30 and second 40 valves to atmosphere. However, valves 30 and 40 remain closed due to secondary gears 70 and

72 being disengaged from the primary gear 60 during this further rotation by 60 degrees of the primary gear 60. Accordingly, in the configuration shown in Figs. 11-15, double block and bleed is achieved.

5 A second embodiment of the valve assembly 10' is shown in Figs. 16 to 23, and has many features in common with the first embodiment described above, where corresponding reference numerals indicate corresponding features with corresponding functionality. In the second embodiment, however, timing of opening/closing of the valves 30, 40, 50 is achieved by the gear ratios of the gears 60, 70, 72, 74, 76 in the drive train and without the need to remove any gear teeth. Fig. 20 is a horizontal cross
10 sectional view through the assembly 10' in a configuration where the first 30 and second 40 valves are open and the third valve 50 is closed. Fig. 23 is a horizontal cross sectional view through the assembly 10' in a configuration where the first 30 and second 40 valves are closed and the third valve 50 is open (i.e. a double blocked and bleed configuration).

15 The first 30, second 40 and third 50 valves are ball valves in the illustrated embodiments. However, other valve types may also be used.

It will be appreciated that the illustrated assemblies 10 and 10' achieve an integrated approach to double block and bleed, which is not provided by the prior art. The assemblies 10 and 10' achieve the three actions of double-blocking and bleeding
20 with the rotation of the primary gear 60 to achieve safe isolation of the fluid conduit 20. The assemblies 10 and 10' are configured to remove the ability to dissipate fluid and then close off the fluid conduit 20, which in prior art double-block and bleed valves allows a small leak from the block valve to re-energise the line to potentially harmful pressures. A benefit of the presently disclosed assembly 10 is that the fluid conduit 20
25 is isolated by closing of valves 30 and 40 before it is dissipated via valve 50, which reduces the amount of vented fluid. The straight through configuration of the fluid conduit 20 also reduces pressure drop. The presently disclosed assemblies 10 and 10' can be adapted to chemical, petroleum, agricultural as well as mining applications, in particular where high pressure hazards occur or in applications involving control of
30 potentially hazardous fluids.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the embodiments of the assembly 10 and 10' disclosed herein without departing from the broad general scope of the present disclosure. The present embodiments are, therefore, to be considered in all respects as
35 illustrative and not restrictive. Examples of possible modifications include, but are not limited to:

- bleeding on one or both sides of the valves 30 and 40 in addition;

- reduced weight of gears (current design is for 180Nm; however in some applications approx 120Nm or less may be sufficient);
- incorporation of a chain drive, camming mechanisms, mechanical linkages, or any combination of such drive train elements or similar instead of or in addition to a gear train; and/or
- varying the number of and configuration of gears in the gear chain.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the above-described embodiments, without departing from the broad general scope of the present disclosure. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

CLAIMS:

1. A fluid flow control assembly comprising:
 - a fluid conduit;
 - a first valve in fluid flow communication with an upstream end of the fluid
 - 5 conduit, the first valve comprising:
 - a first valve chamber having a first inlet port and a first outlet port;
 - a first valve seat associated with the first valve chamber;
 - a first valve member associated with the first valve chamber and having a
 - closed configuration in which the first valve member selectively sealingly engages the
 - 10 first valve seat to restrict fluid flow between the first inlet port and the first outlet port
 - and an open configuration in which the first valve member selectively sealingly
 - disengages the first valve seat to facilitate fluid flow between the first inlet port and the
 - first outlet port;
 - a second valve in fluid flow communication with a downstream end of the fluid
 - 15 conduit, the second valve comprising:
 - a second valve chamber having a second inlet port and a second outlet
 - port;
 - a second valve seat associated with the second valve chamber;
 - a second valve member associated with the second valve chamber and
 - 20 having a closed configuration in which the second valve member selectively sealingly
 - engages the second valve seat to restrict fluid flow between the second inlet port and
 - the second outlet port and an open configuration in which the second valve member
 - selectively sealingly disengages the second valve seat to facilitate fluid flow between
 - the second inlet port and the second outlet port;
 - 25 a third valve in fluid flow communication with a portion of the fluid conduit
 - intermediate the first valve and the second valve, the third valve comprising:
 - a third valve chamber having a third inlet port and a third outlet port;
 - a third valve seat associated with the third valve chamber;
 - a third valve member associated with the third valve chamber and having a
 - 30 closed configuration in which the third valve member selectively sealingly engages the
 - third valve seat to restrict fluid flow between the third inlet port and the third outlet port
 - and an open configuration in which the third valve member selectively sealingly
 - disengages the third valve seat to facilitate fluid flow between the third inlet port and
 - the third outlet port;
 - 35 an actuator associated with the first valve member for moving the first valve
 - member into and out of sealing engagement with said first valve seat, the actuator also
 - being associated with the second valve member for moving the second valve member

into and out of sealing engagement with said second valve seat, and the actuator also being associated with the third valve member for moving the third valve member into and out of sealing engagement with said third valve seat, wherein the actuator is adapted to provide at least the following configurations of the first valve, the second valve and the third valve:

the first valve member and the second valve member being in their open configurations whilst the third valve member is in its closed configuration; and

the first valve member and the second valve member being in their closed configurations whilst the third valve member is in its open configuration.

2. A fluid flow control assembly according to claim 1, wherein the actuator comprises a drive train having a primary drive element and a plurality of secondary drive elements driven by actuation of the primary drive element.

3. A fluid flow control assembly according to claim 2, wherein the plurality of secondary drive elements comprises drive elements associated with each of the first, second and third valve members.

4. A fluid flow control assembly according to claim 3, wherein timing and sequencing of opening and closing of the first, second and third valves is achieved by varying the ratios of the drive elements in the drive train.

5. A fluid flow control assembly according to claim 3 or claim 4, wherein timing and sequencing of opening and closing of the first, second and third valves is achieved by disengaging one or more of the secondary drive elements in the drive train from the primary drive element at particular intervals.

6. A fluid flow control assembly according to any one of claims 2 to 5, wherein the drive train comprises one or more of the following drive train elements: gears, a chain drive, camming mechanisms, and mechanical linkages.

7. A fluid flow control assembly according to any one of the preceding claims, wherein the first valve comprises a ball valve.

8. A fluid flow control assembly according to any one of the preceding claims, wherein the second valve comprises a ball valve.

9. A fluid flow control assembly according to any one of the preceding claims, wherein the third valve comprises a ball valve.

10. A fluid flow control assembly according to any one of the preceding claims, wherein the actuator is adapted to provide the following configuration of the first valve, the second valve and the third valve: the first valve member and the second valve member being in their closed configurations whilst the third valve member is in its closed configuration.

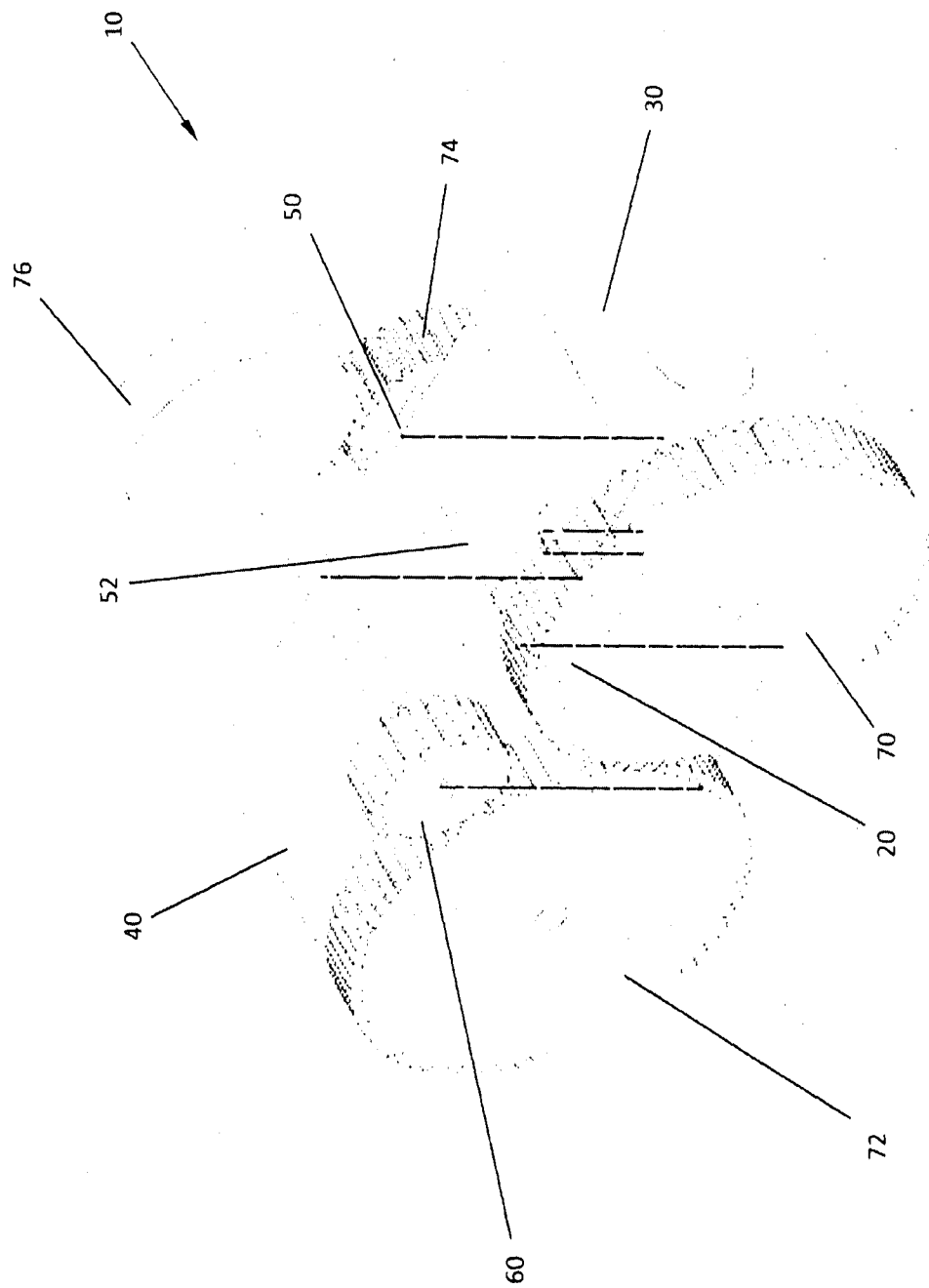


FIG. 1

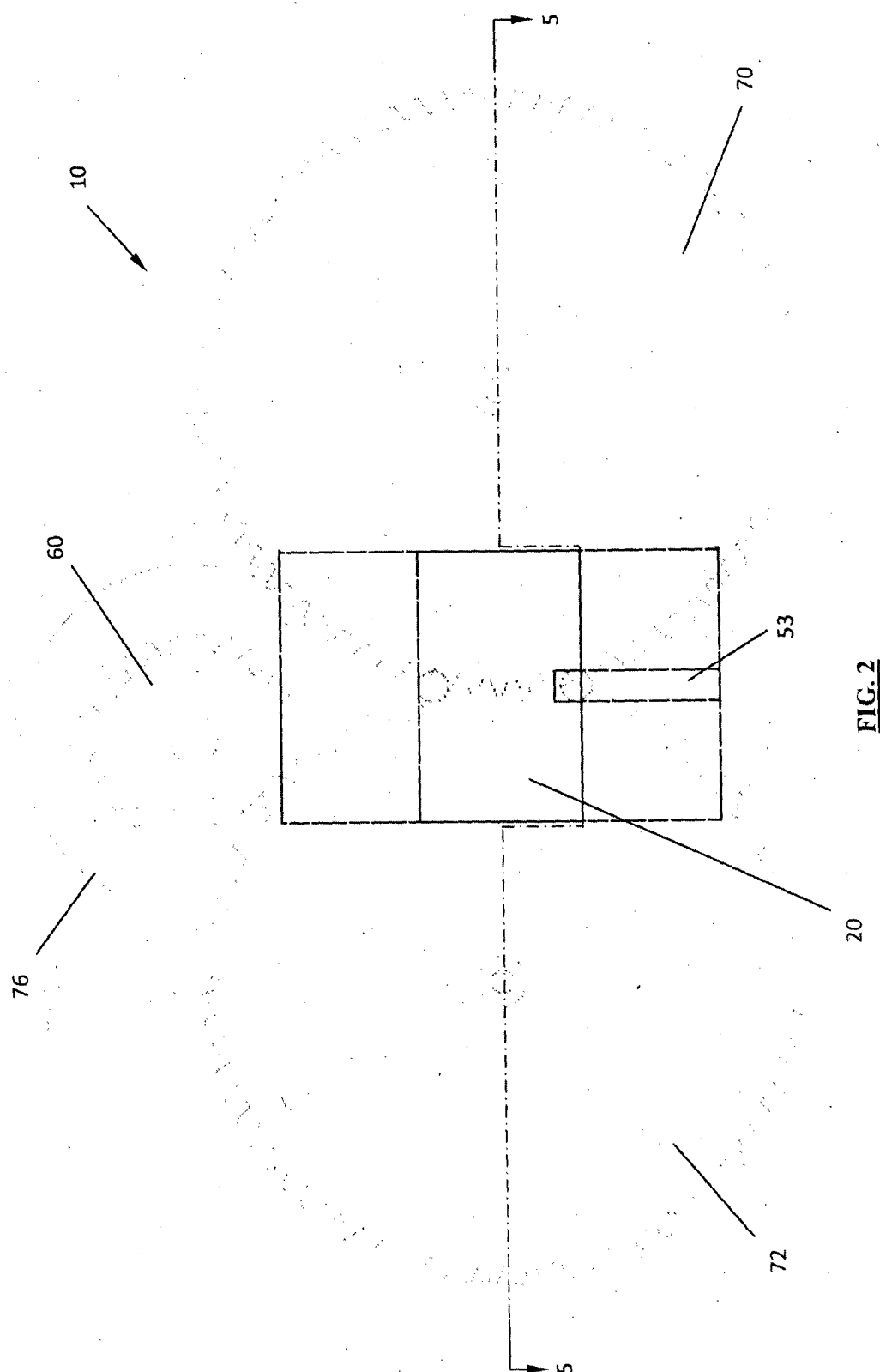
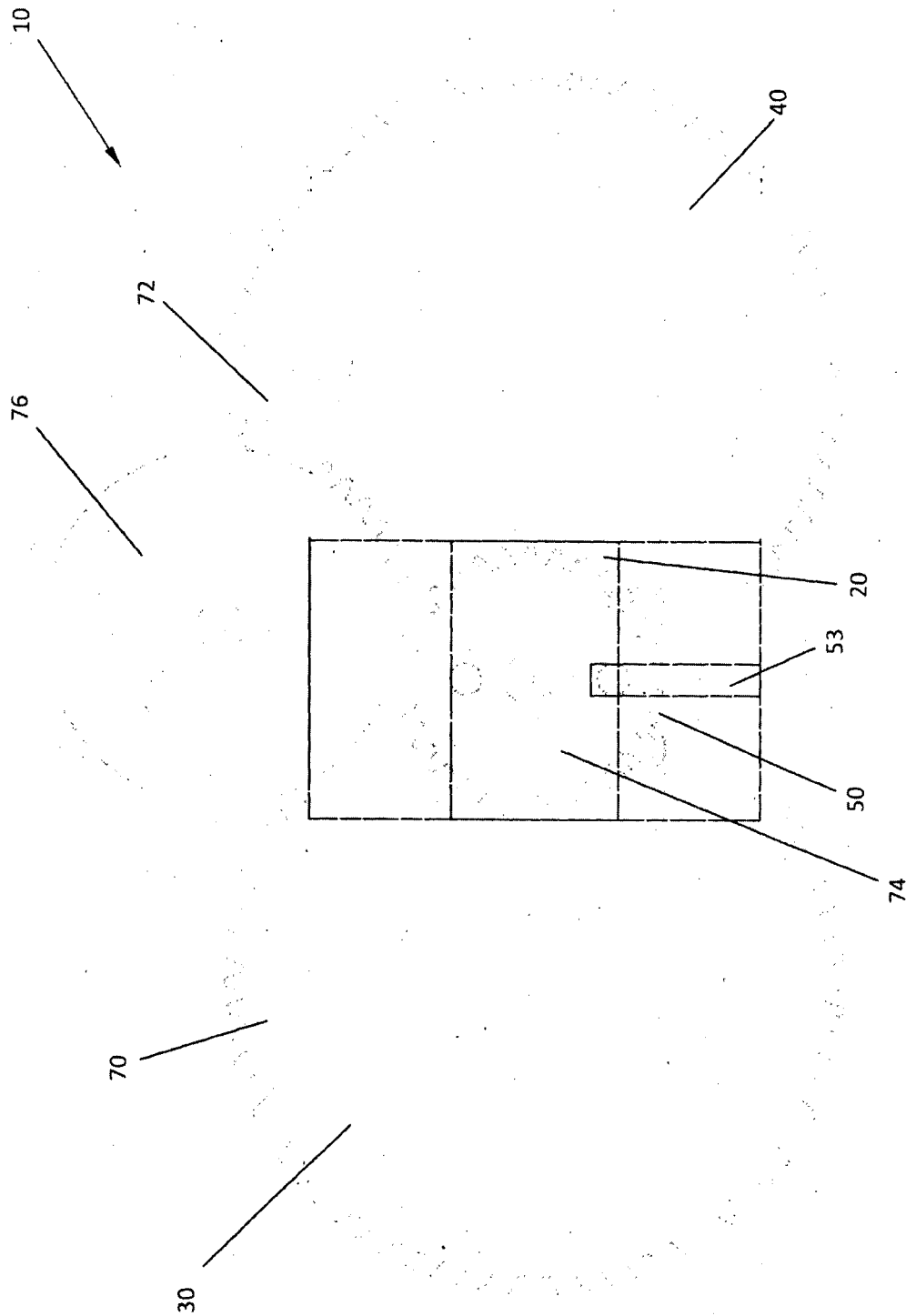


FIG. 2



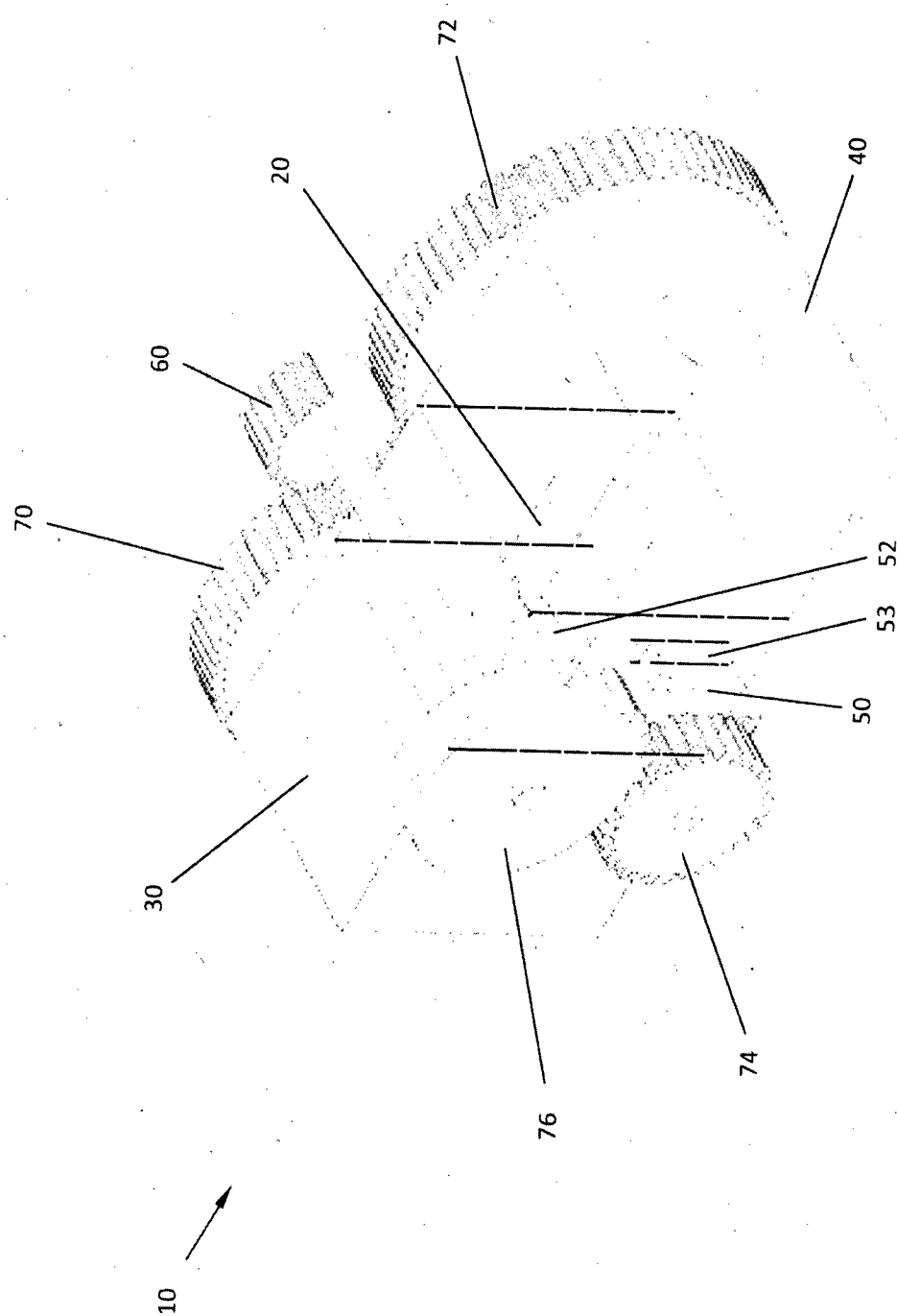
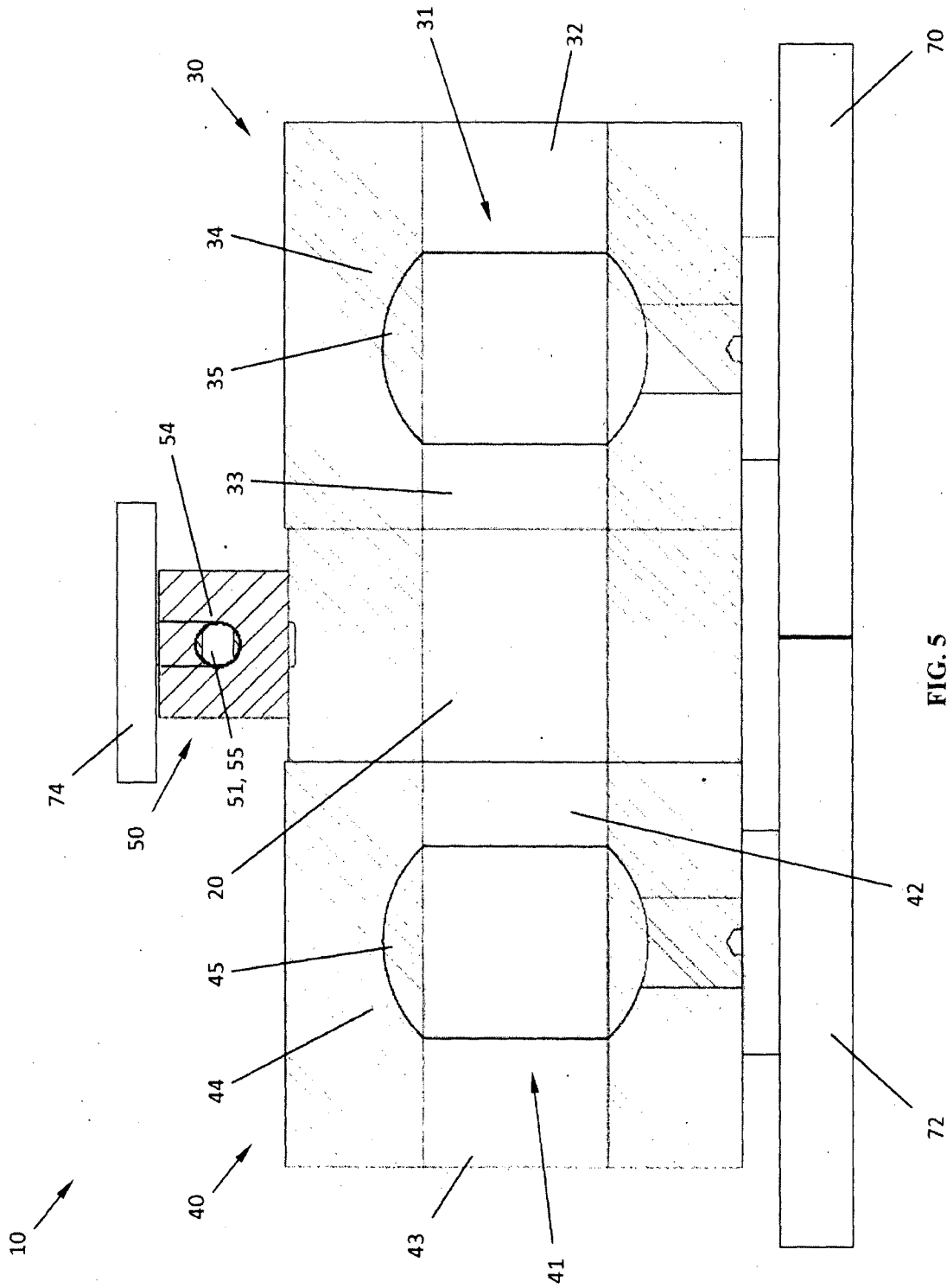


FIG. 4



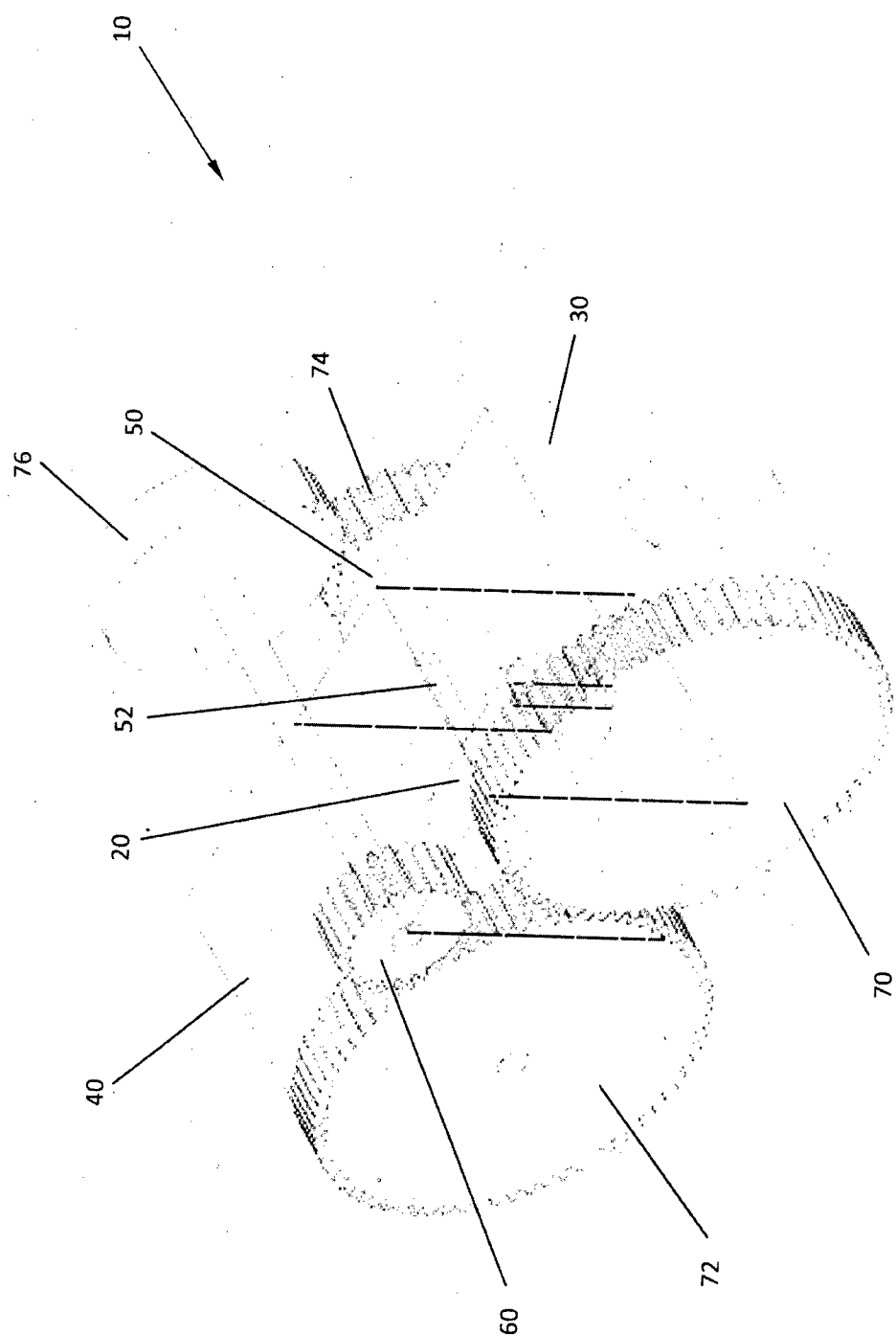


FIG. 6

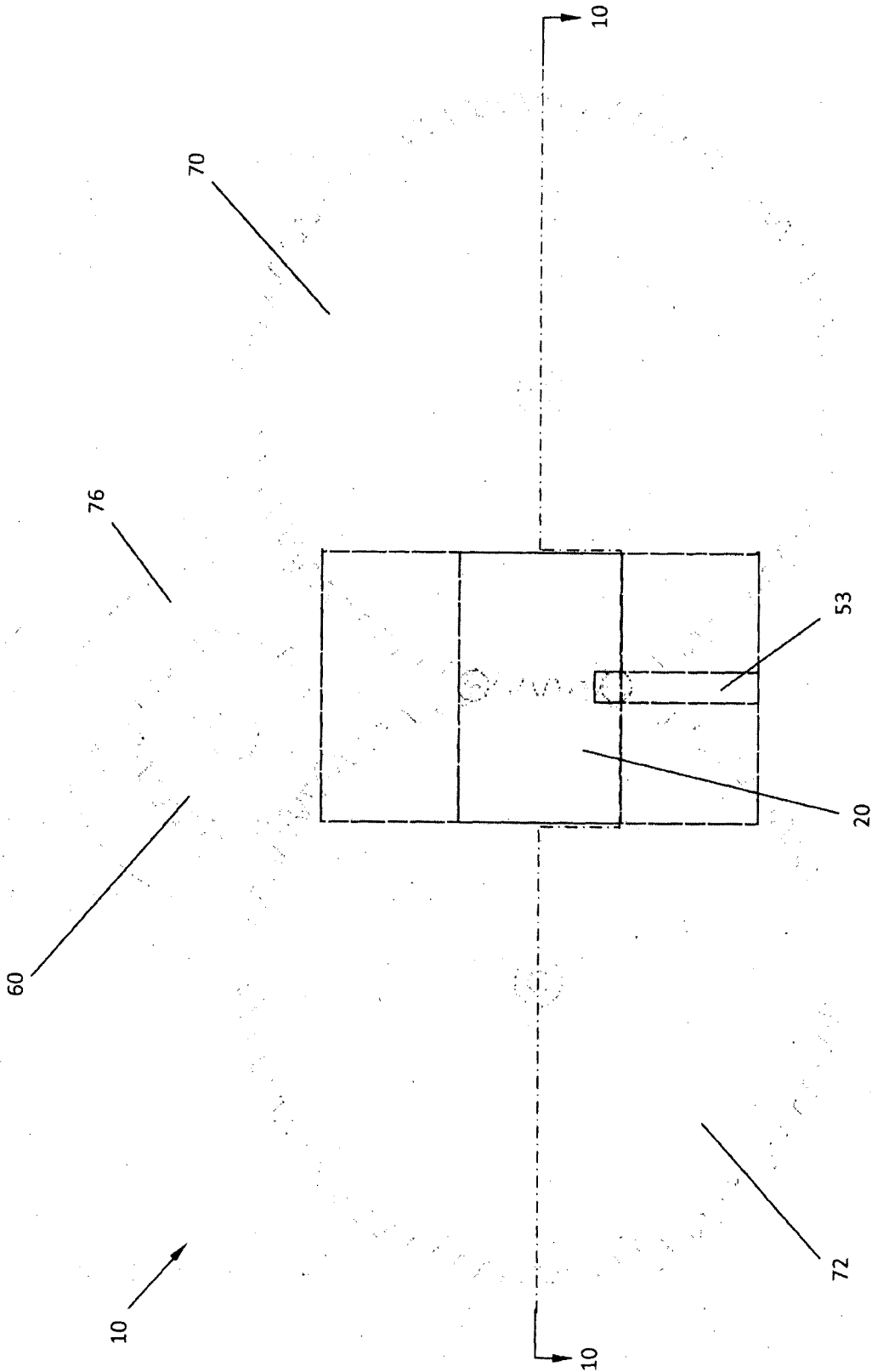
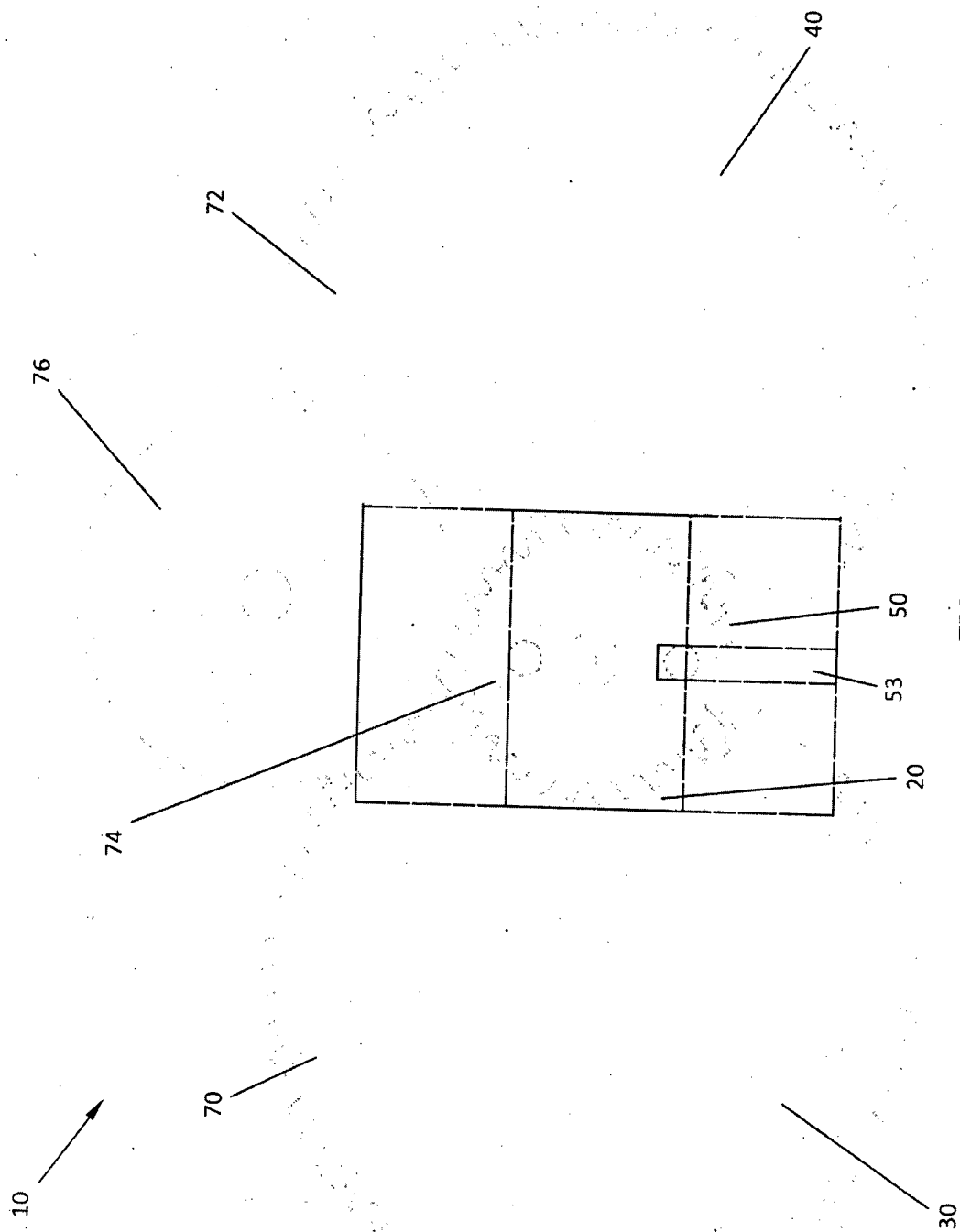


FIG. 7



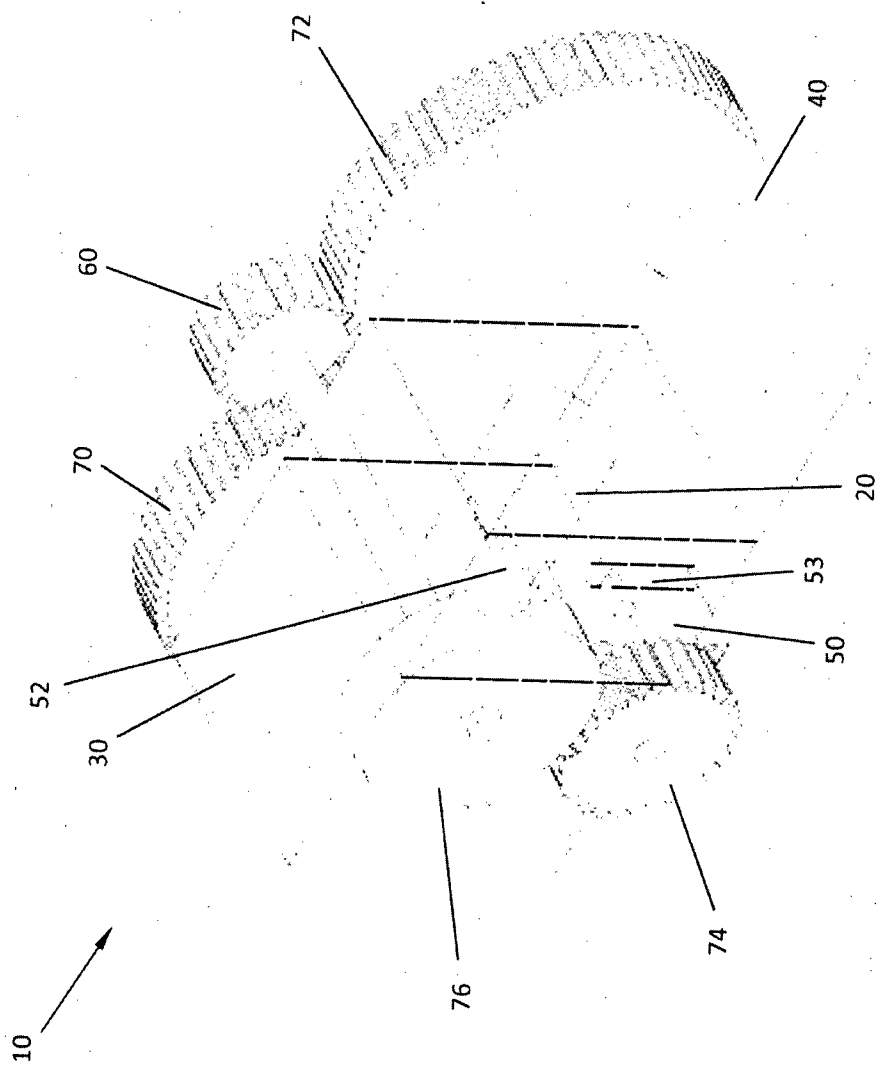
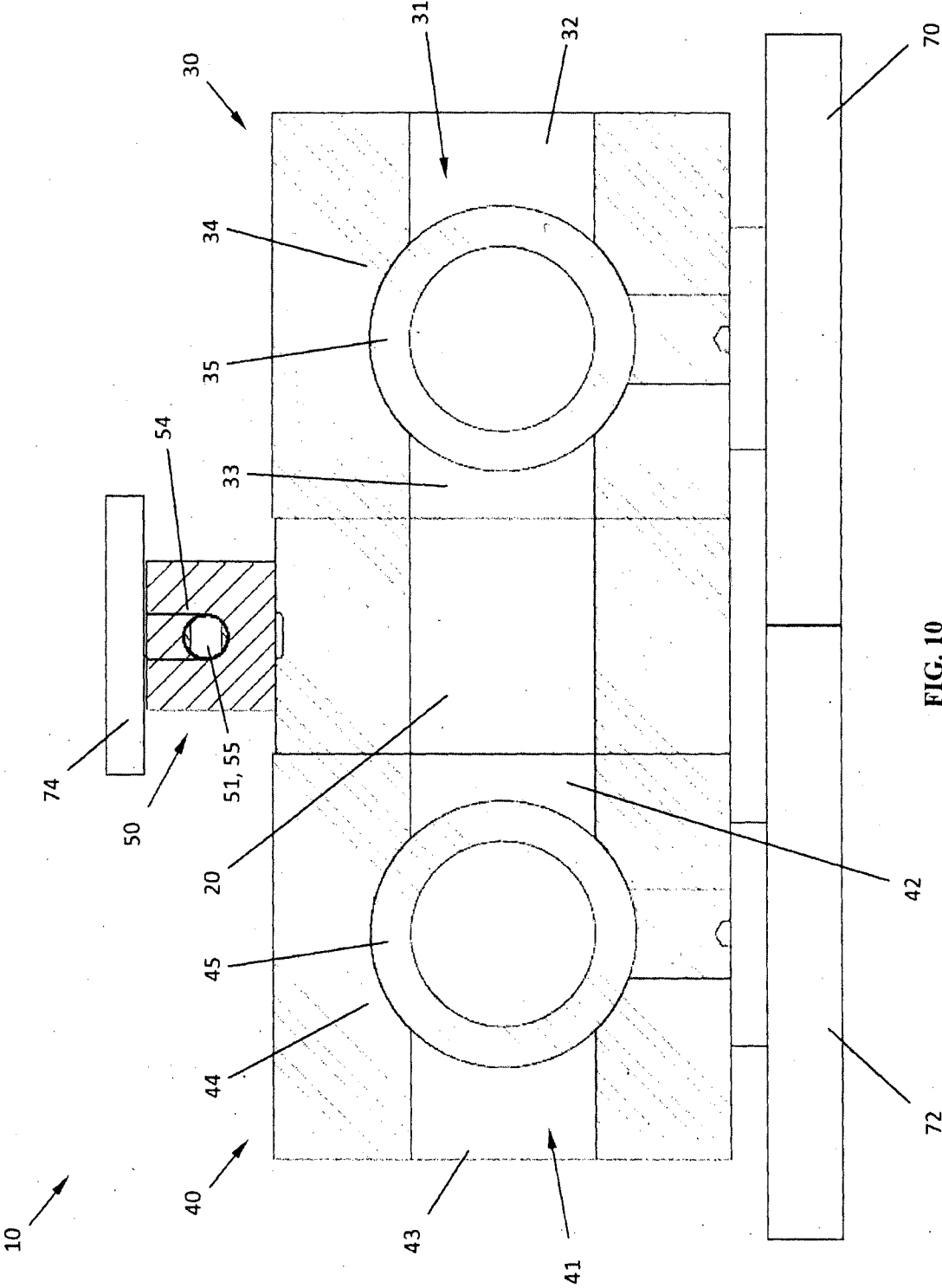


FIG. 9



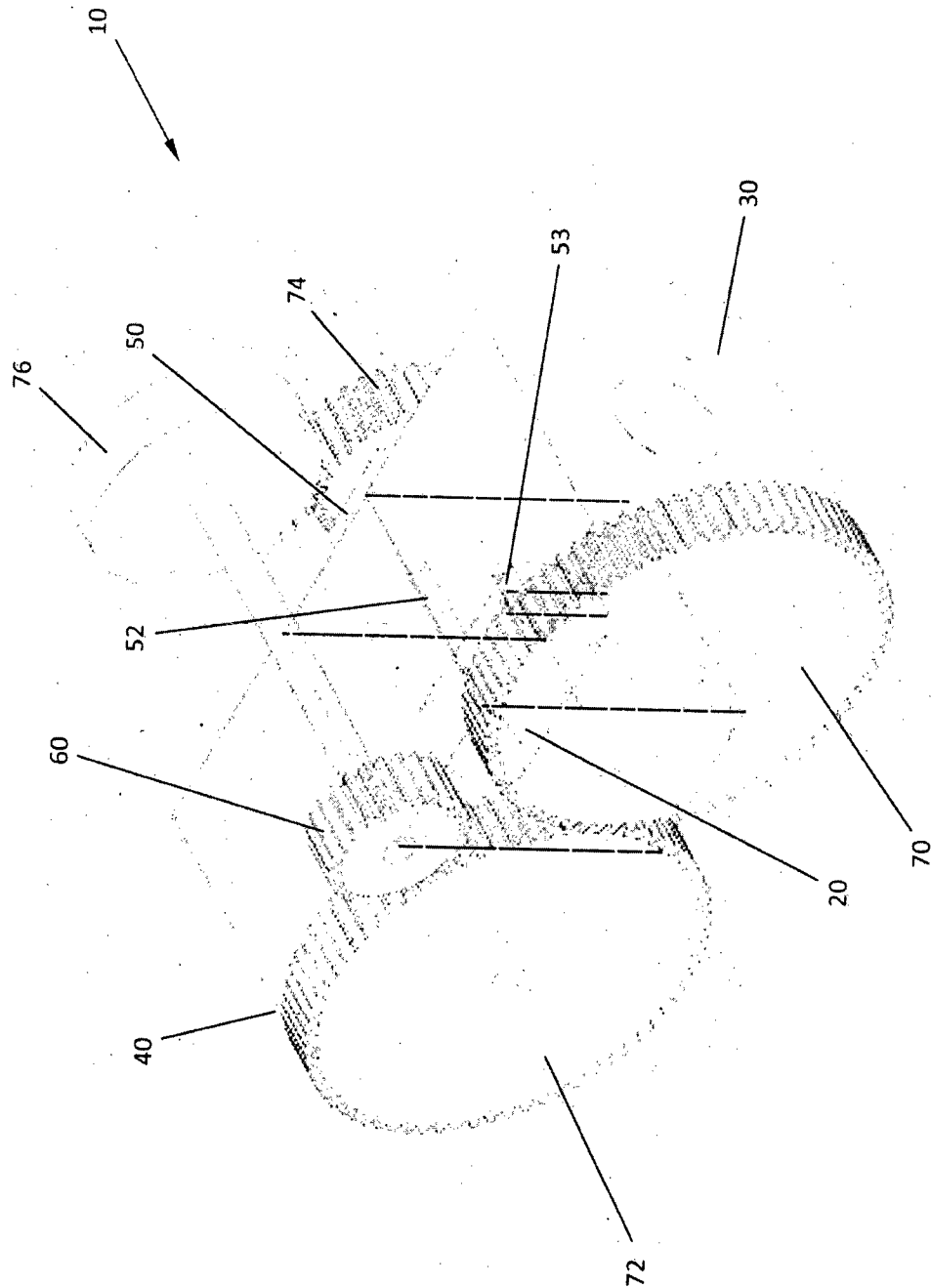
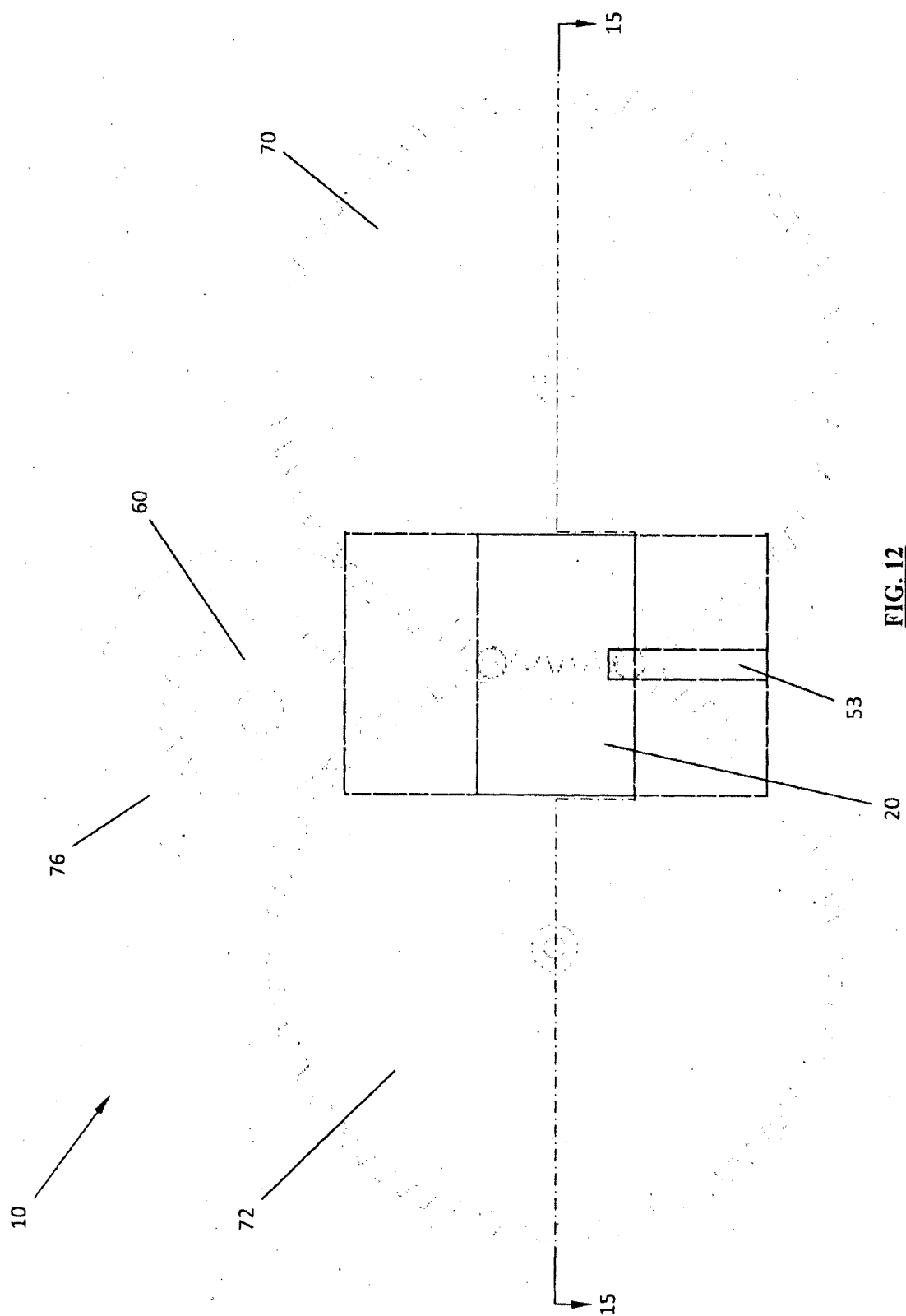


FIG. 11



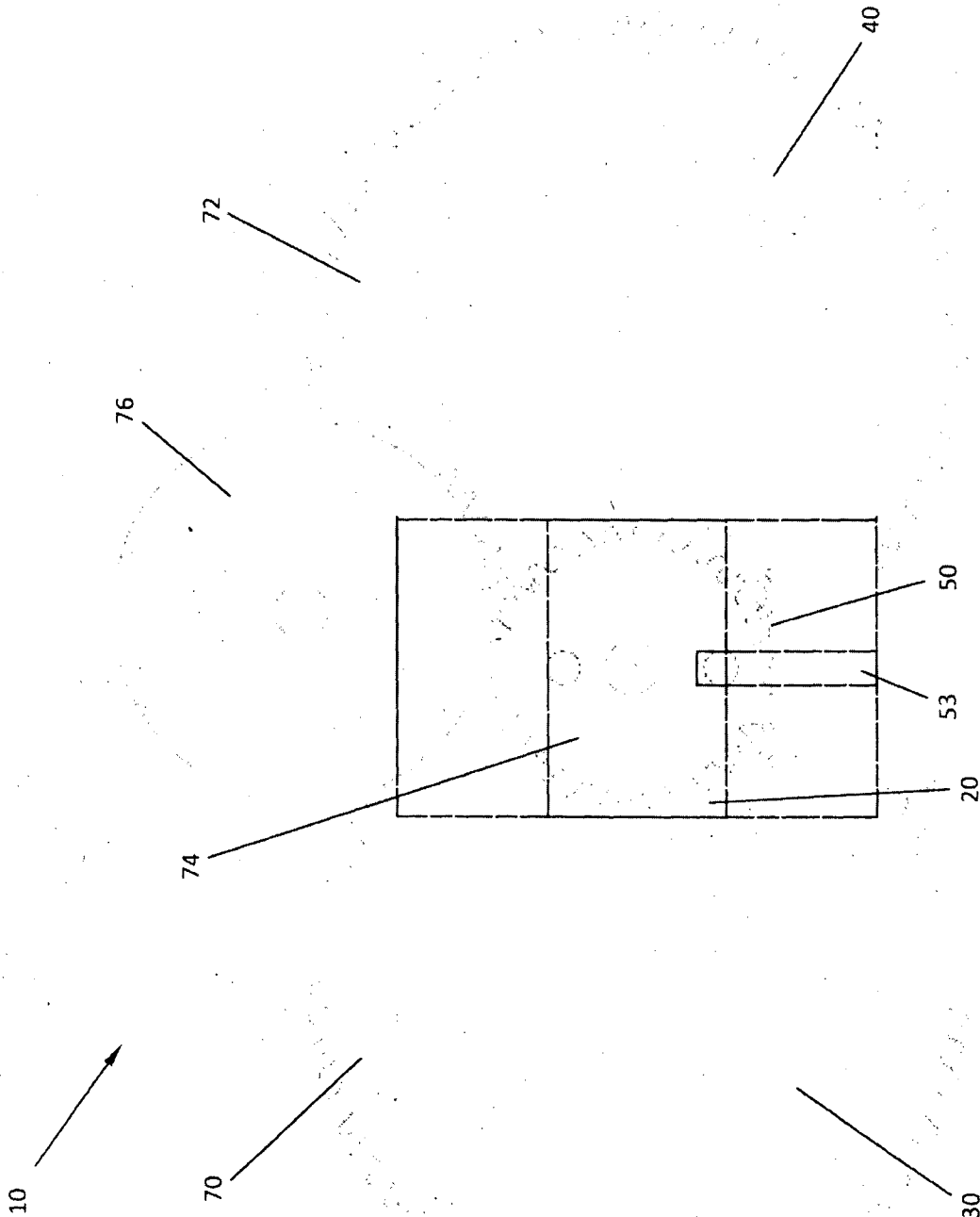
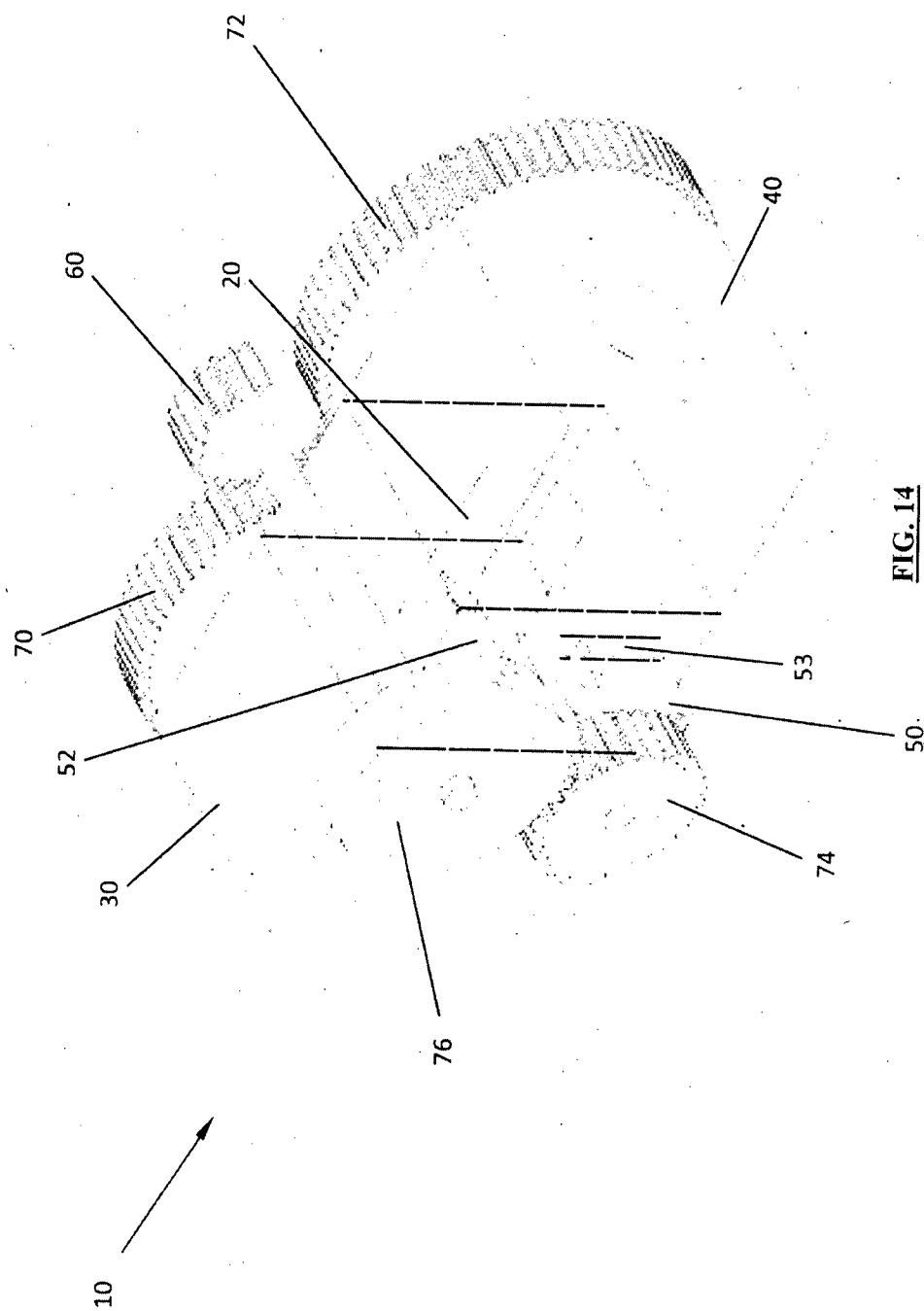
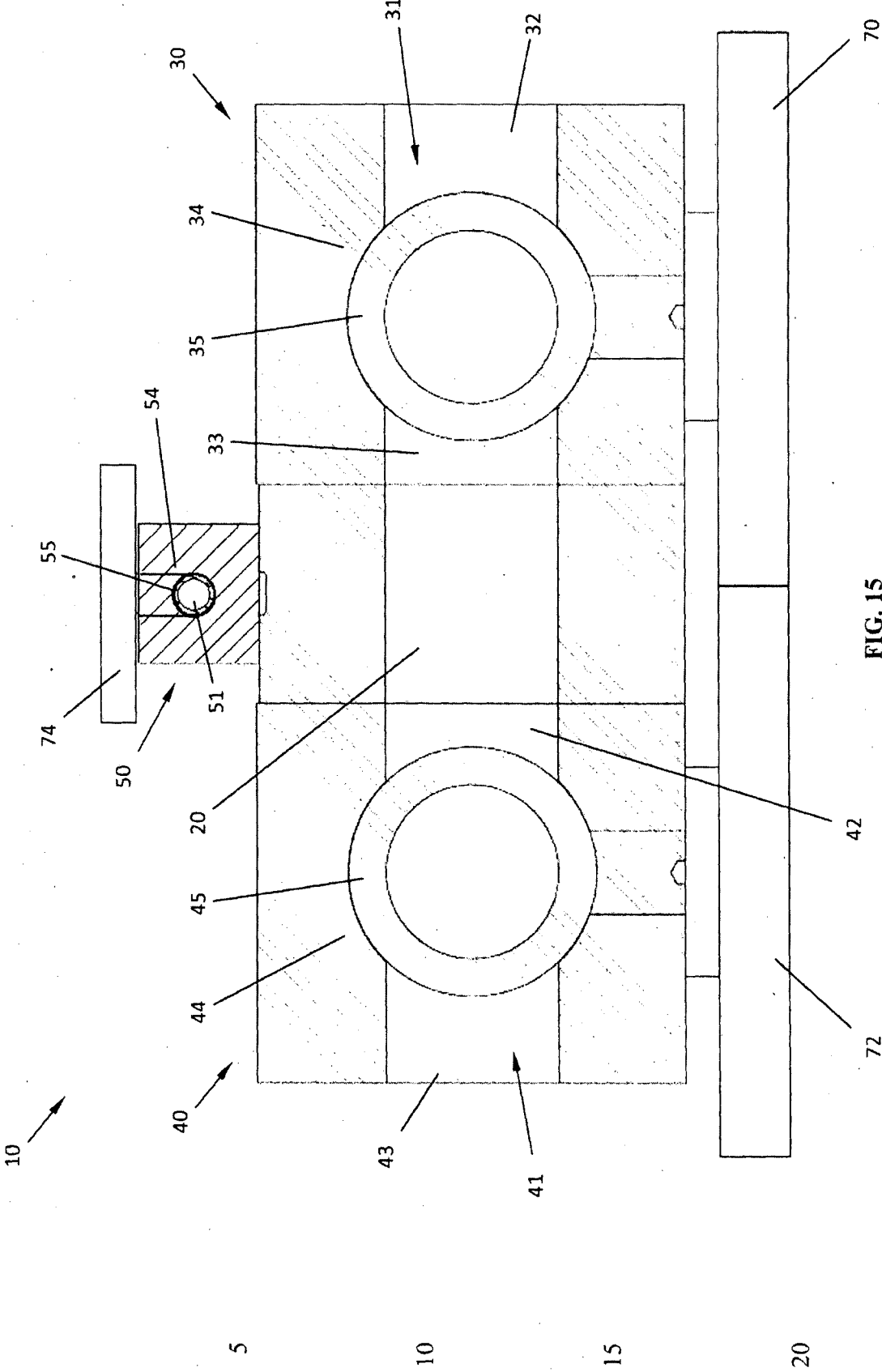


FIG. 13





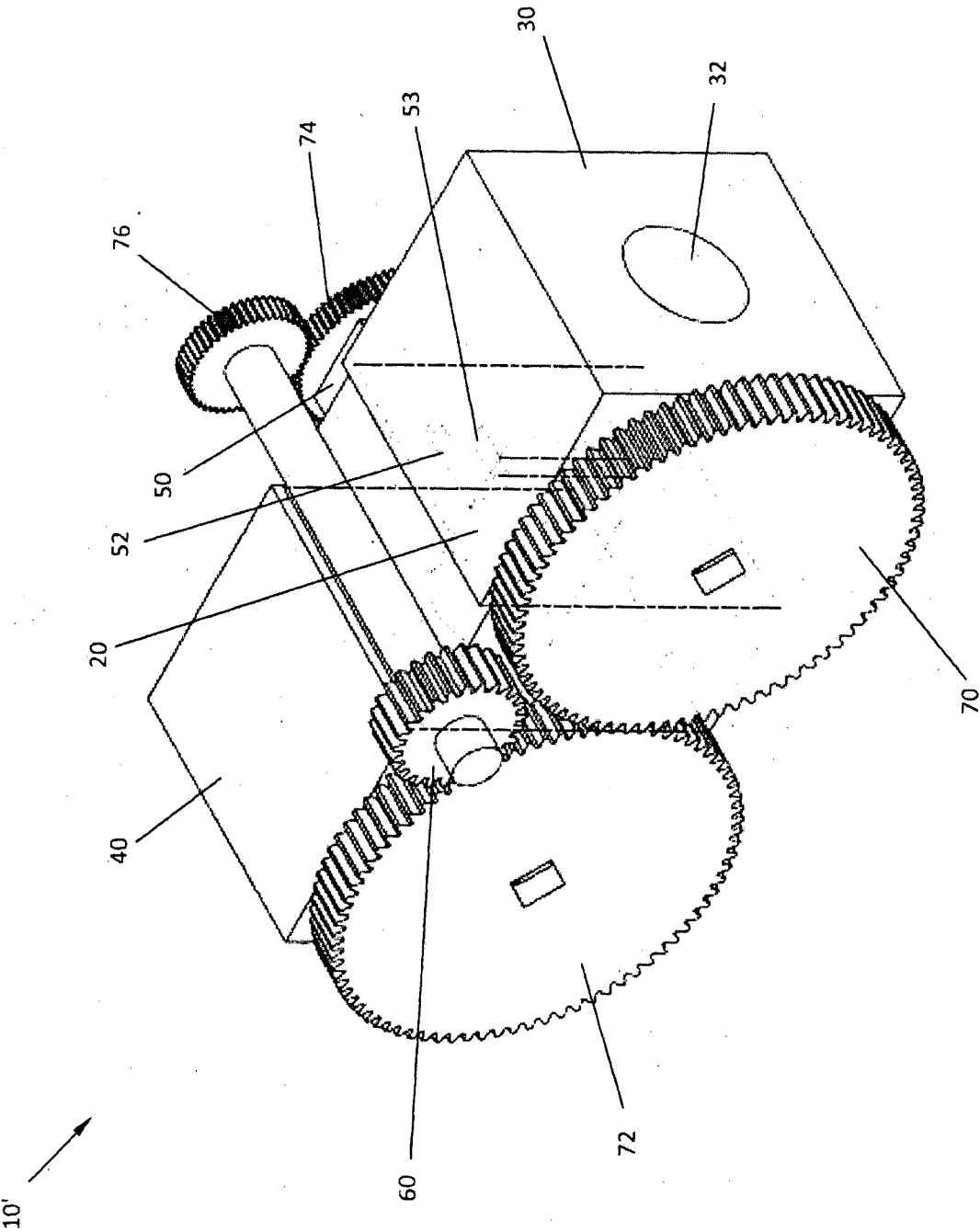
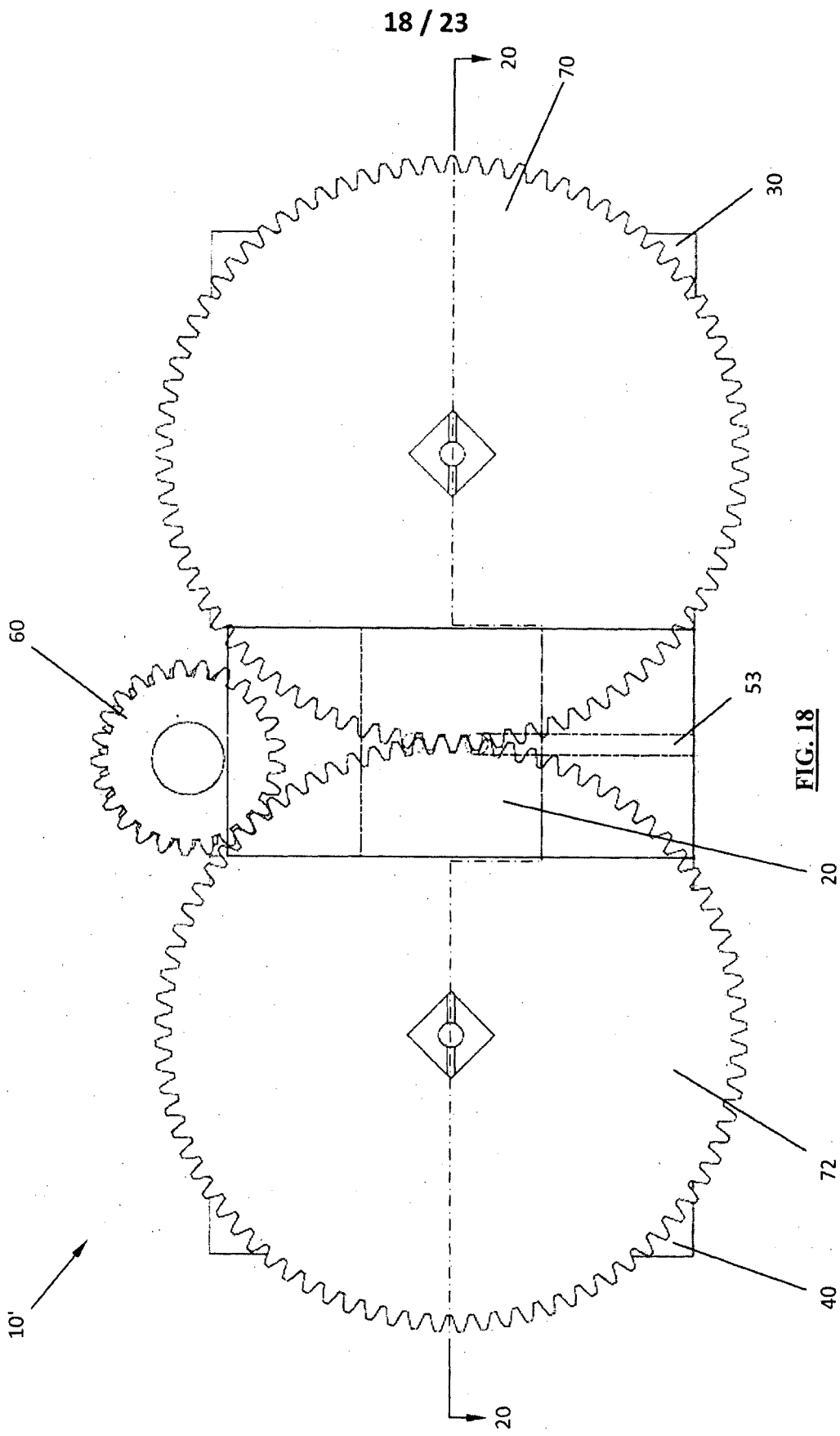
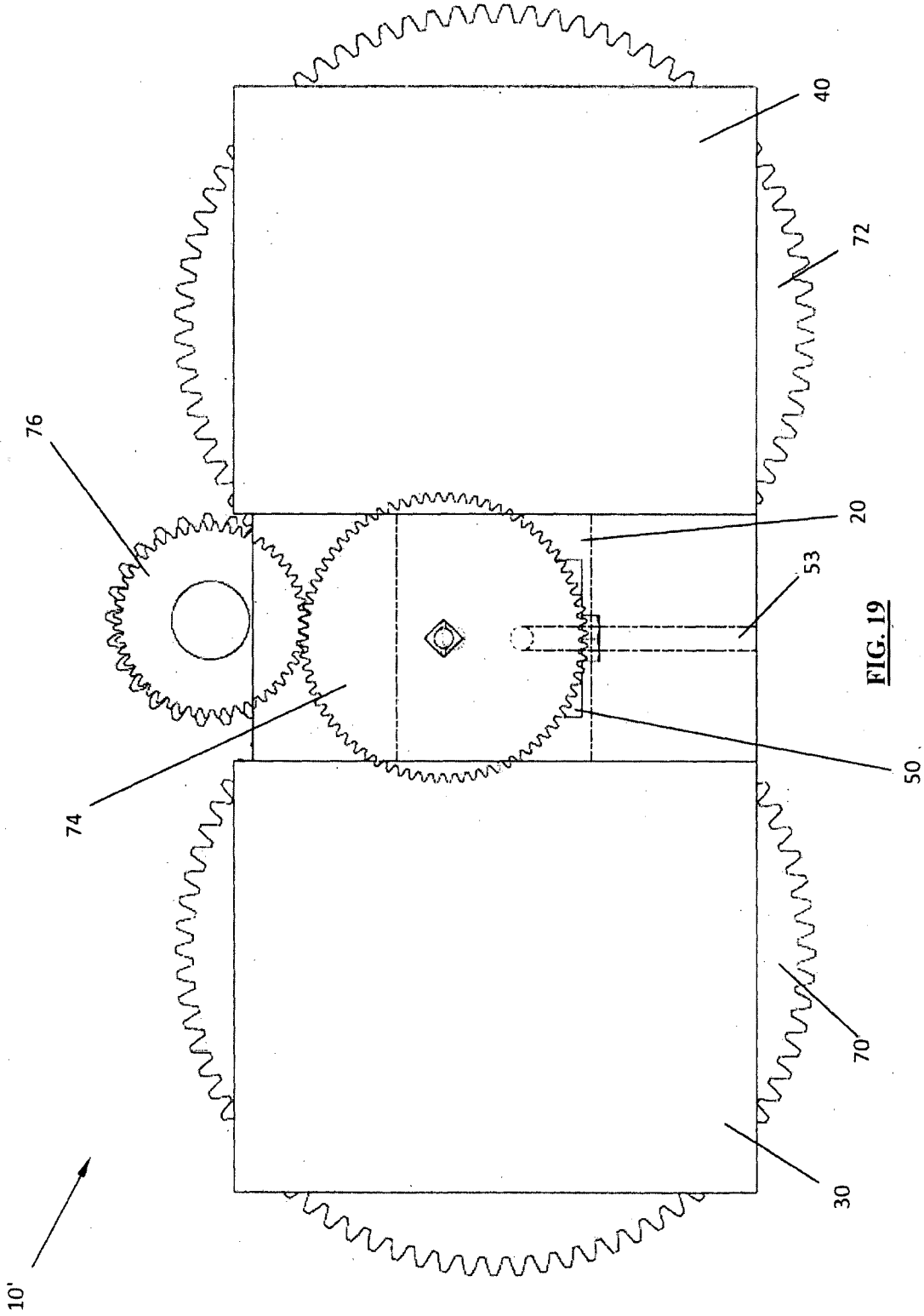
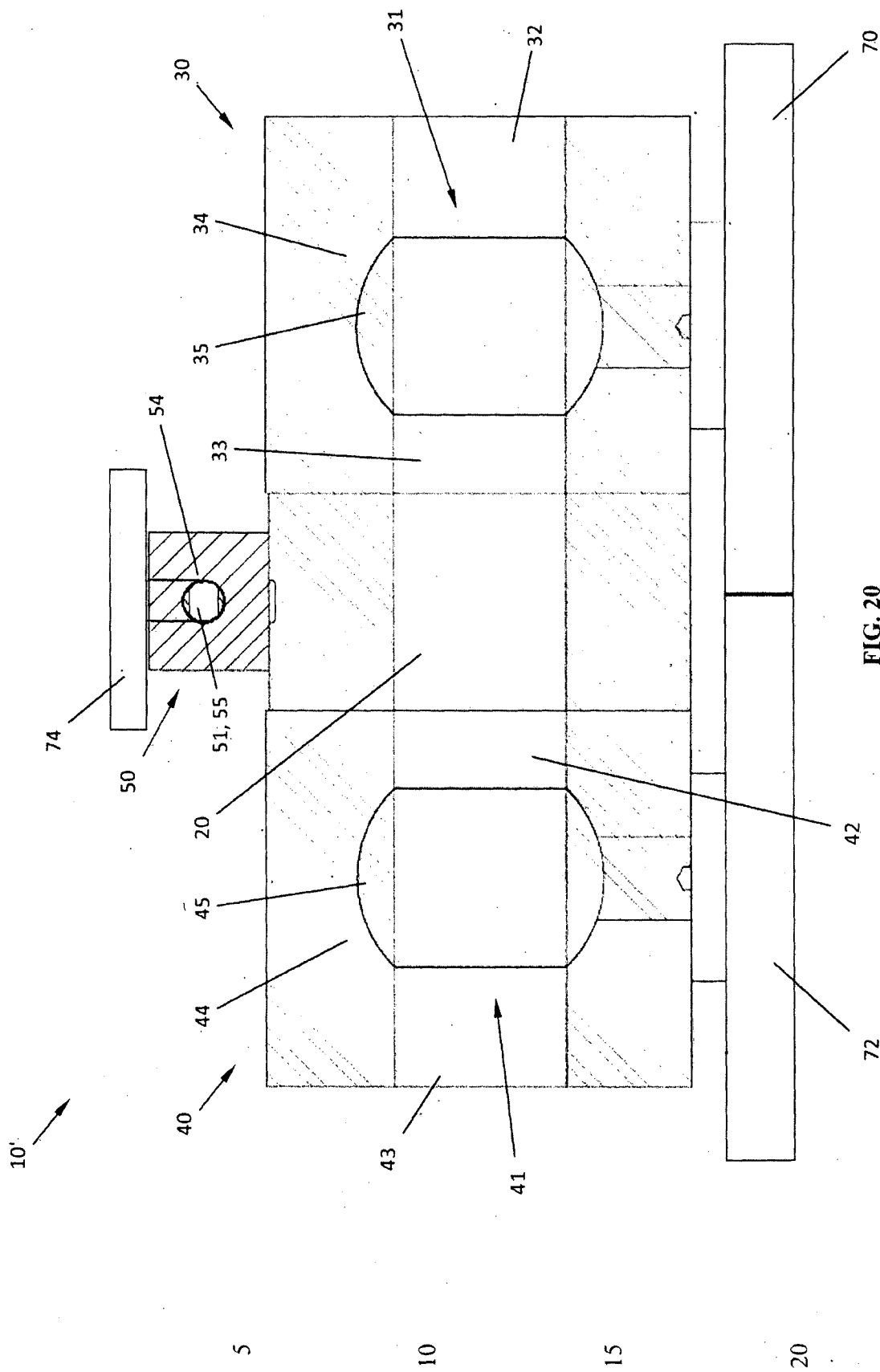
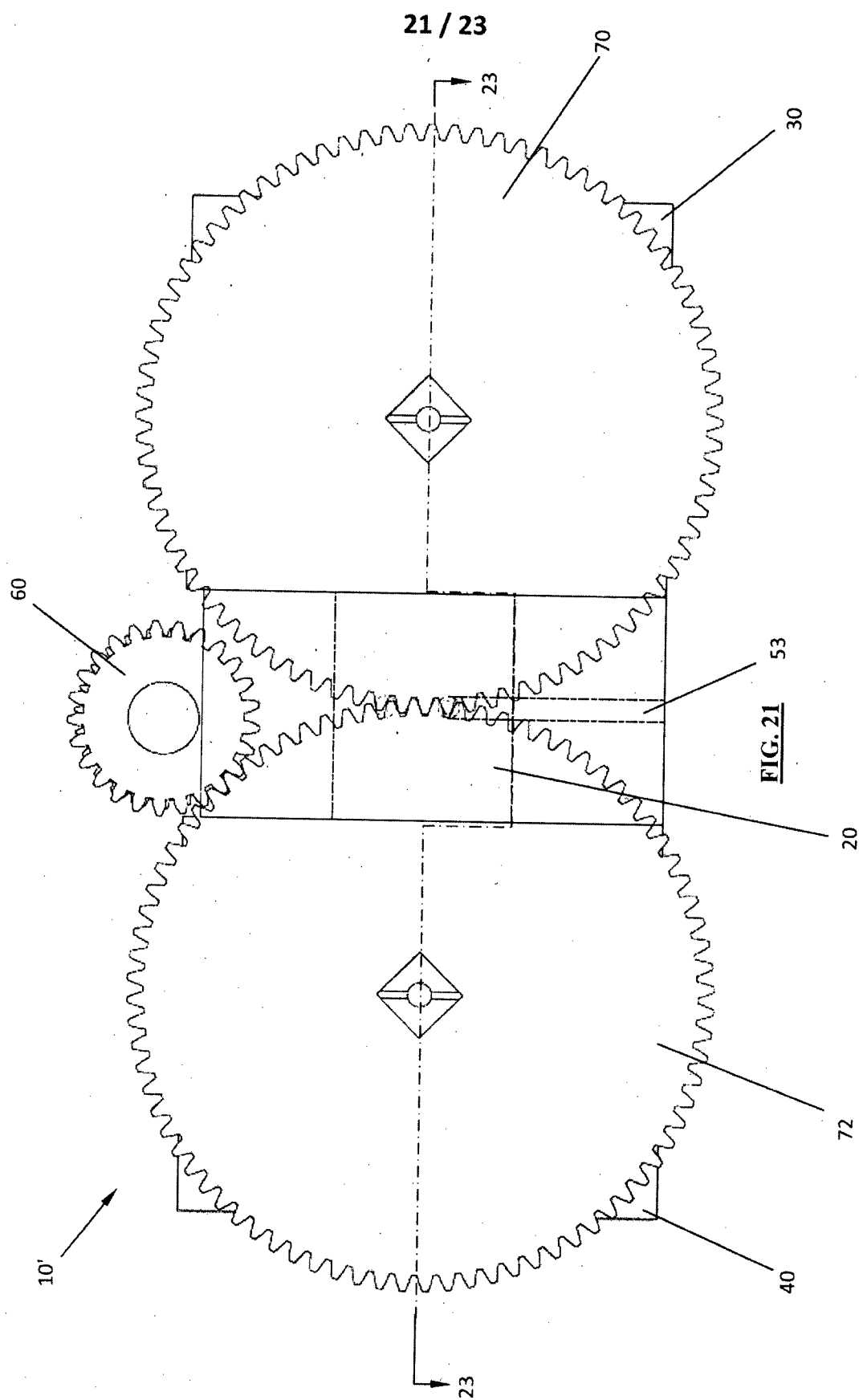


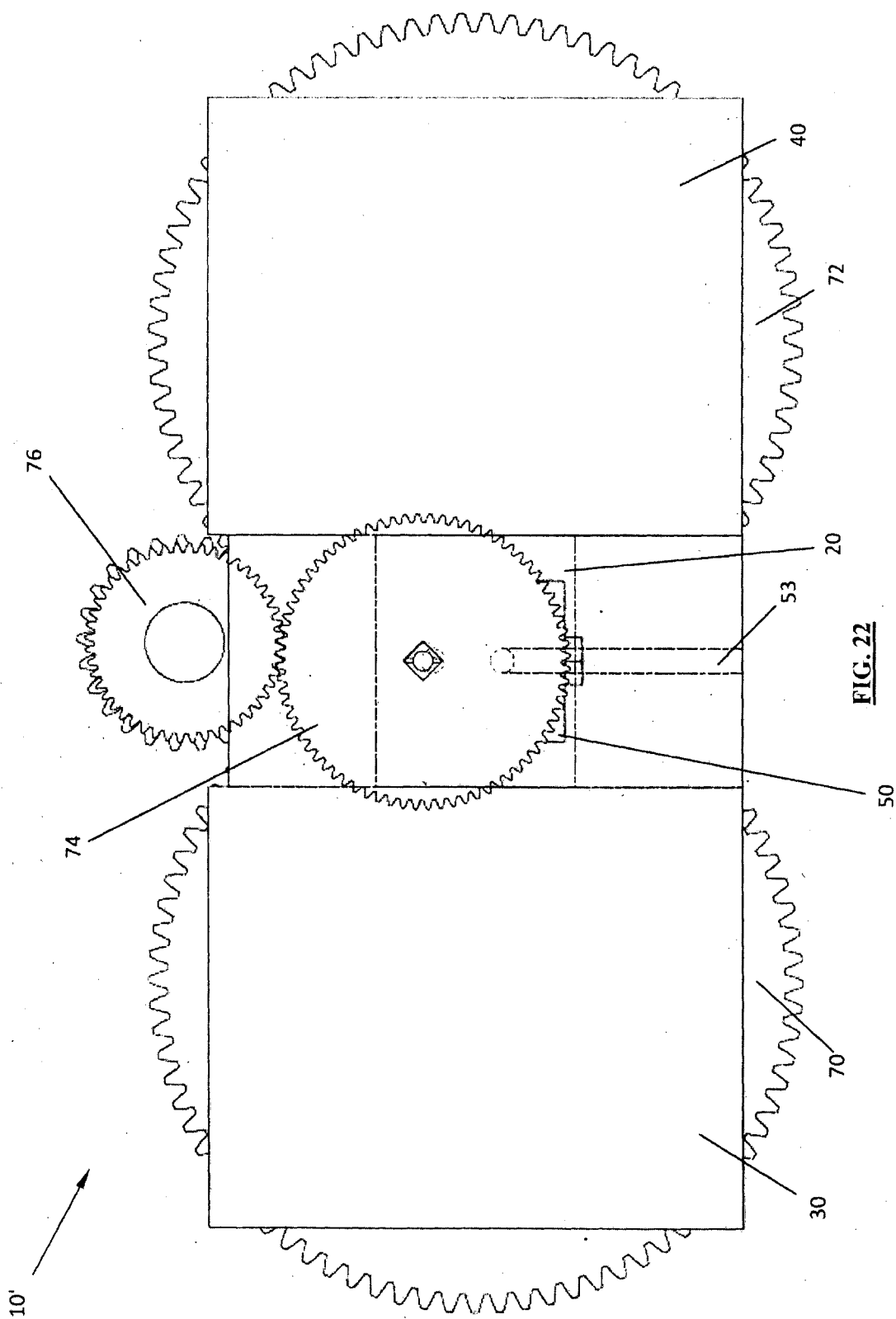
FIG. 16

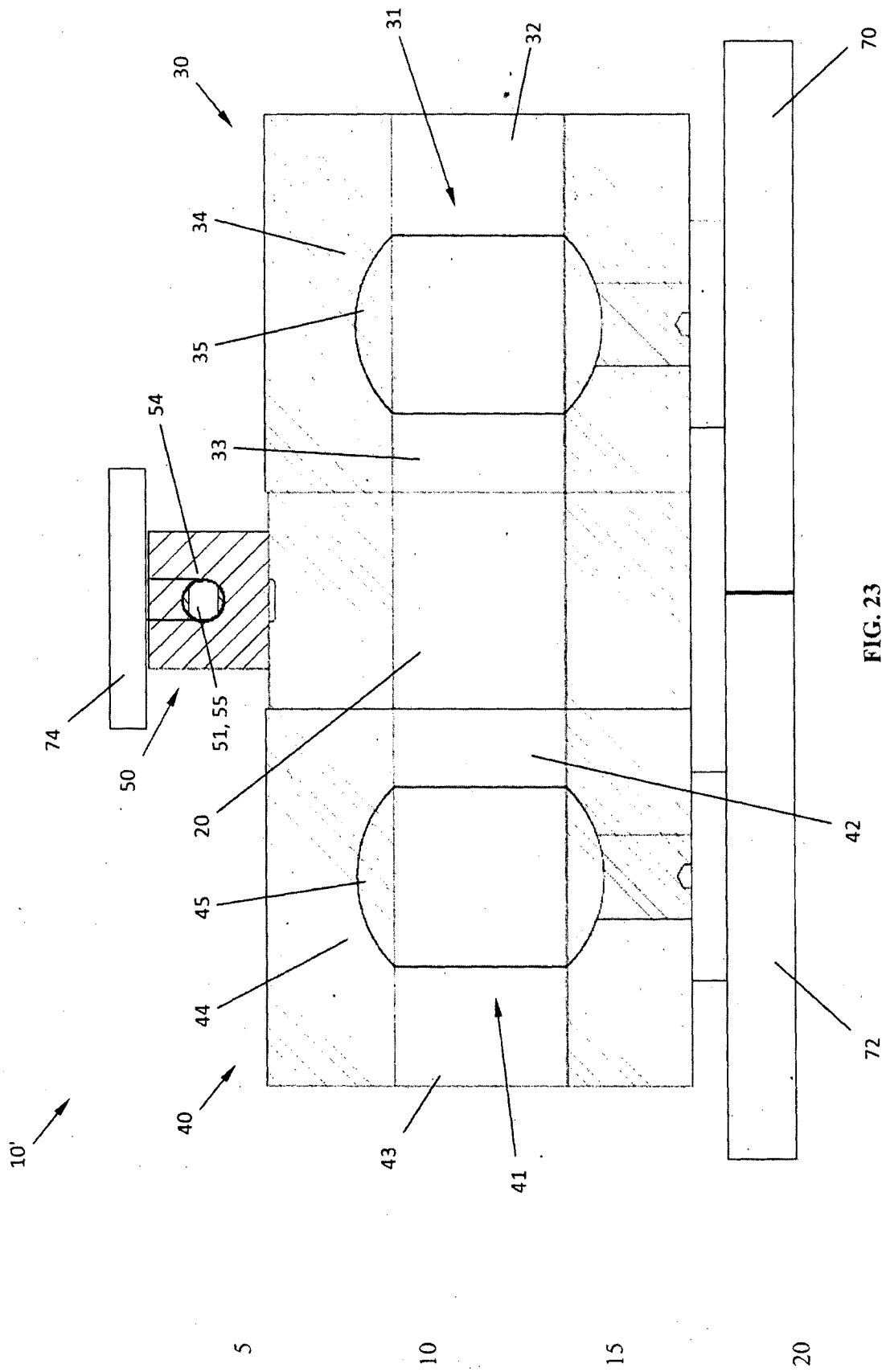












INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2012/000317

A. CLASSIFICATION OF SUBJECT MATTER

F16K 11/14 (2006.01) F16K 31/44 (2006.01) F16K 31/53 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI: /IC/EC F16K11, F16K51, F16K31/44, F16K31/53 & Keywords (Three, Multi, Valve, Block, Isolate, Bleed, Double Block, Vent, Intermediate, Middle, Common, Single, Associated, Actuator, Gear, Drive Train, Mesh) and similar terms; Google Patent & Keywords (Dobule Block, Three, Multi, Valve, Bleed, Vent, Simultaneous, Single, Common, Actuator) and similar terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



See patent family annex

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
23 August 2012

Date of mailing of the international search report
25 June 2012

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INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2012/000317
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4846225 A (SCOBIE et al.) 11 July 1989 See figs. 1-25; column 6, lines 5-16 & column 9, lines 55-61.	1-4, 6-9
X	US 3007489 A (BIDDLE) 07 November 1961 See figs. 1-3 & column 1, lines 63-66.	1-4, 6-9
A	US 2010/0140522 A1 (CHANG et al.) 10 June 2010 See abstract & figs. 1-7.	1-10

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. PCT/AU2012/000317	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
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		BR 8904706 A	01 May 1990
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End of Annex			