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Neumann et al.

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[54] **PLATE TYPE ICE MAKER**

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[73] Assignee: **Reynolds Products Inc.,** Schaumburg, Ill.

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[21] Appl. No.: **557,410**

Related U.S. Patent Documents

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Appl. No.: **327,985**
Filed: **Jan. 30, 1973**

[52] **U.S. Cl.** **62/320;** 62/354

[51] **Int. Cl.²** **F25C 1/14**

[58] **Field of Search** 62/354, 320, 71, 346

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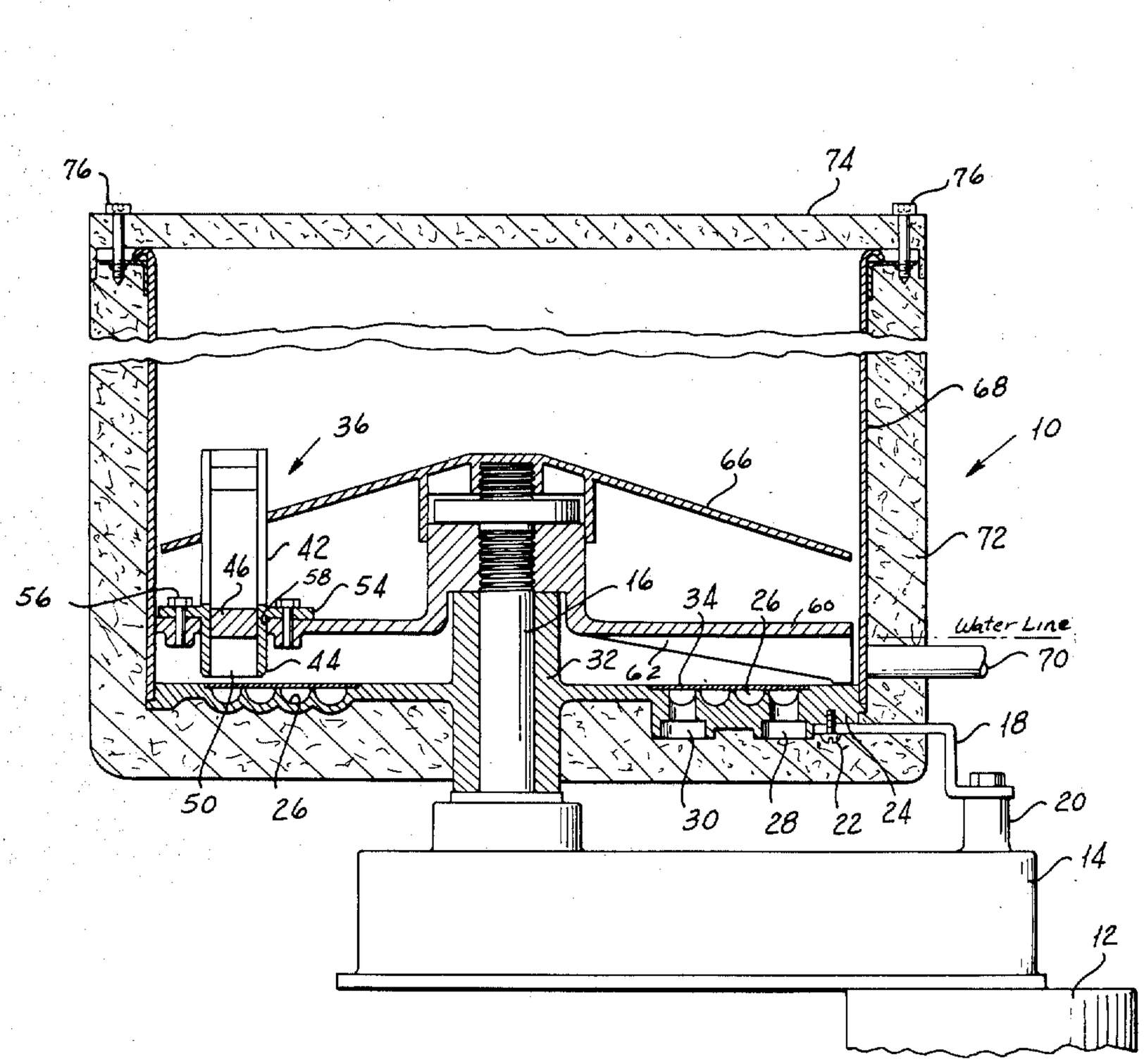
Primary Examiner—William E. Wayner
Attorney, Agent, or Firm—Shenier & O'Connor

[57] **ABSTRACT**

A plate type ice maker for forming chunks of hard ice in which a member provided with an ice-forming passage having a cutting edge at one end thereof is moved over a plane freezing surface to cause ice crystals scraped from the freezing surface by the cutting edge to be forced into the forming passage in which they are subjected to compressive forces sufficient to form a rod of hard ice which emerges from the other end of the passage and which engages a breaker surface which fractures the rod to form a hard piece of ice.

22 Claims, 8 Drawing Figures



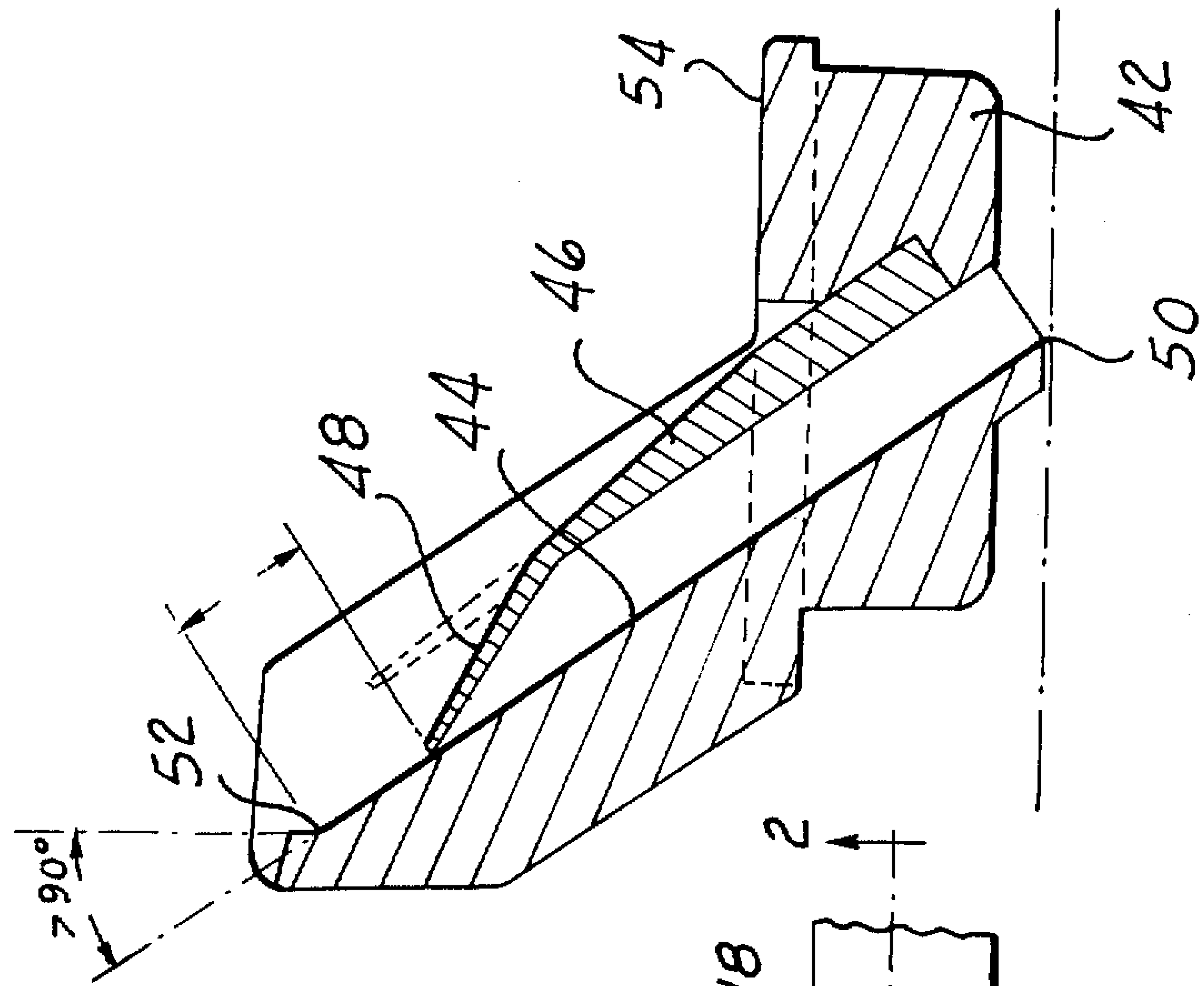
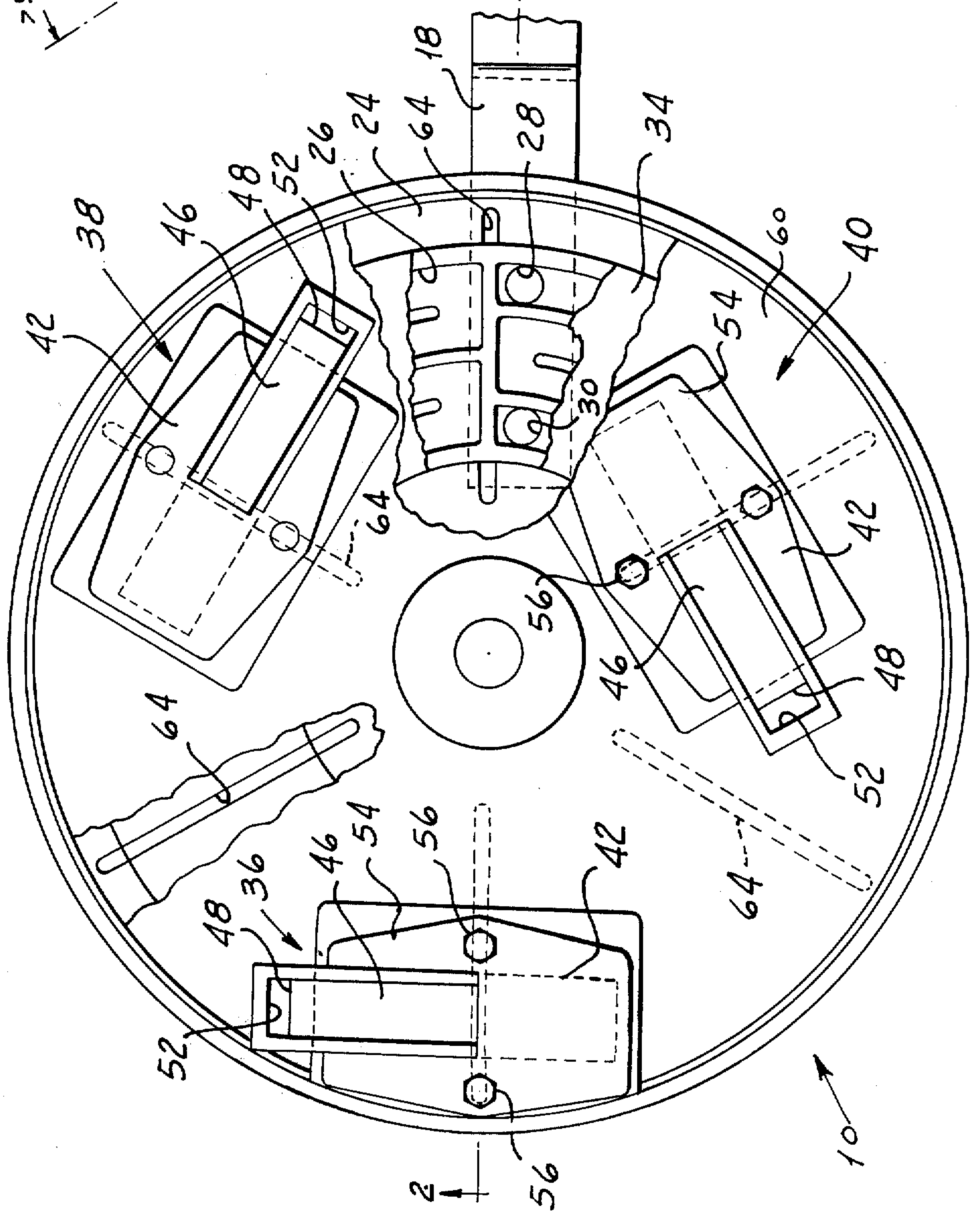

54
42
46
44
48
50
52
>90°

FIG. 3


2
18
64
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36
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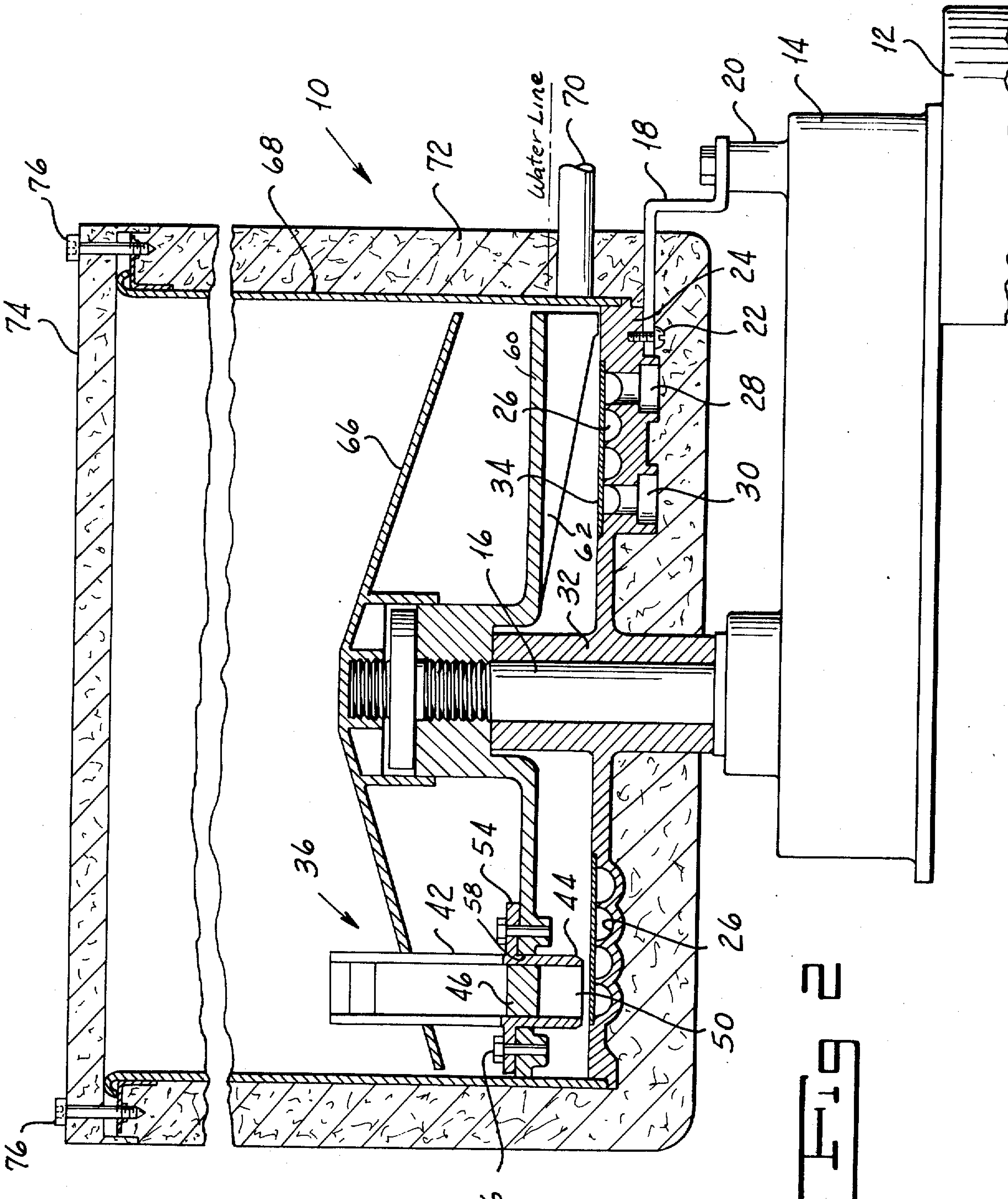
52
64
56
2
10

FIG. 1


76
74
68
10
72
Water Line
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18
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14
12
24
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28
26
60
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34
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76

Fig 2

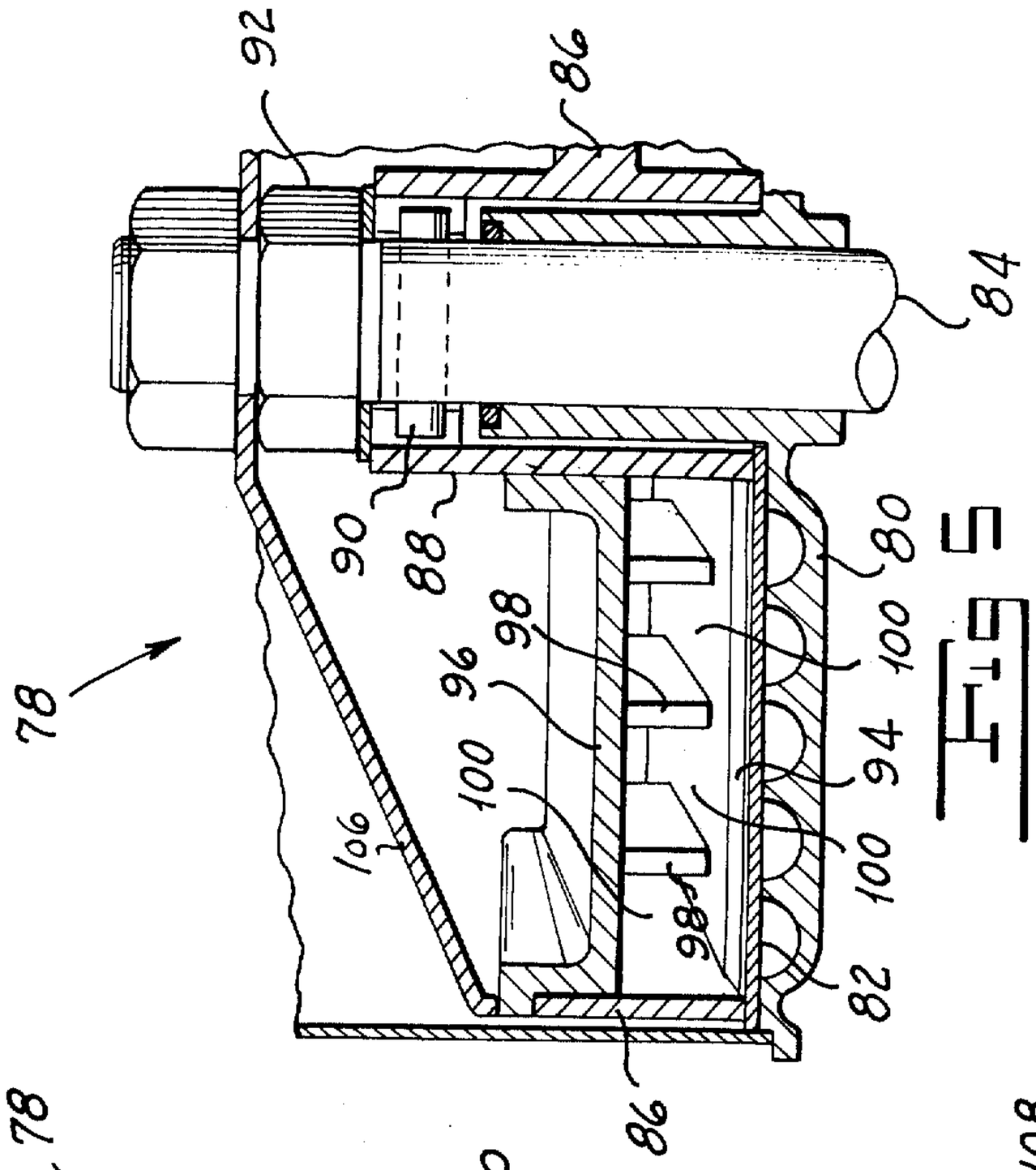


FIG. 3

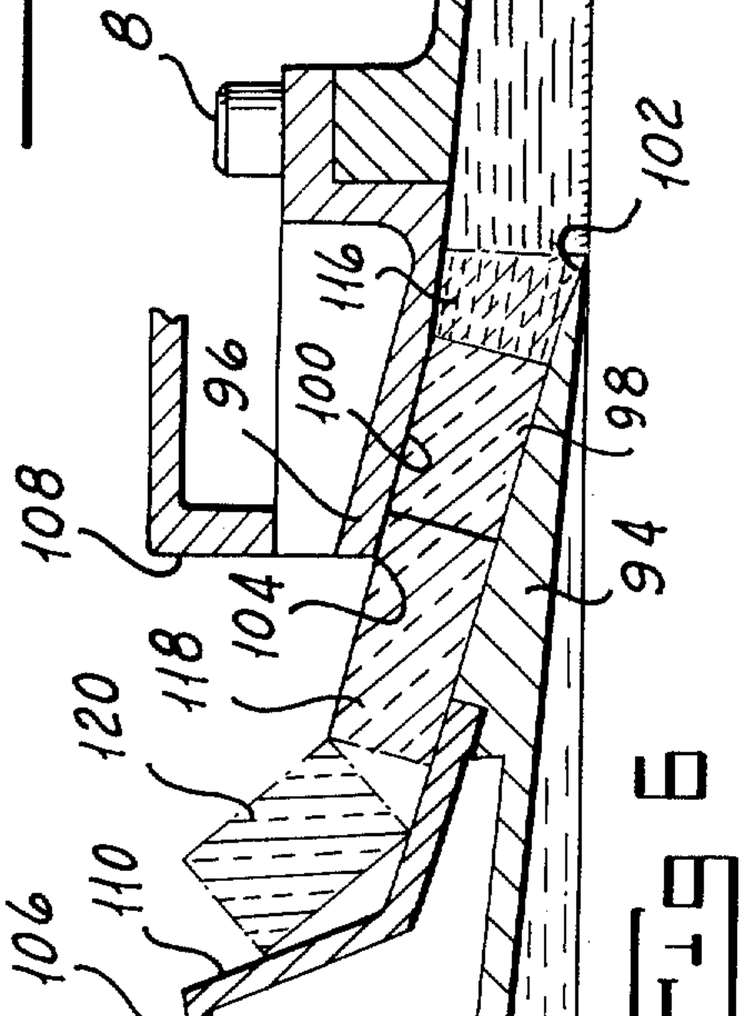


FIG. 5

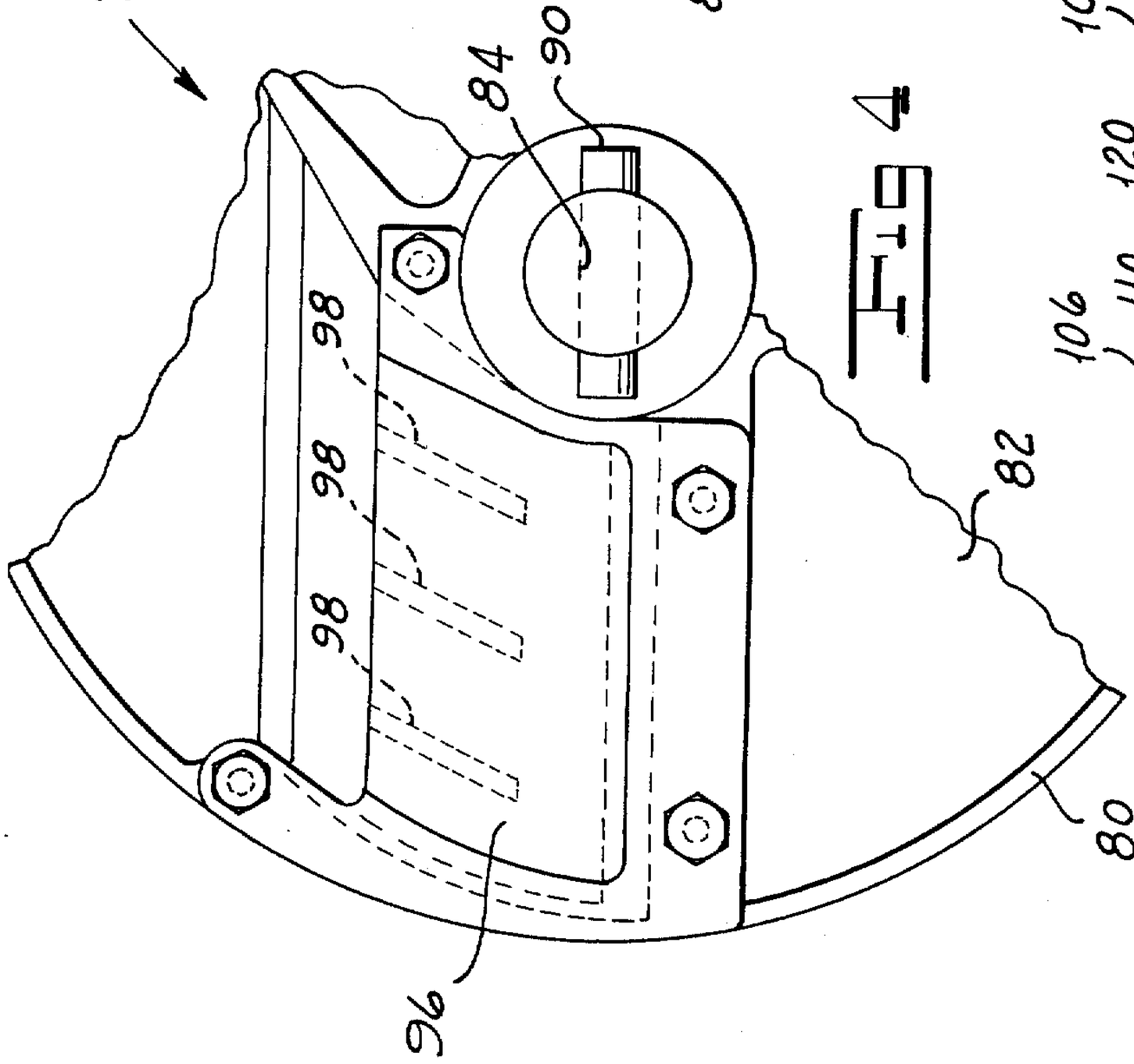


FIG. 4

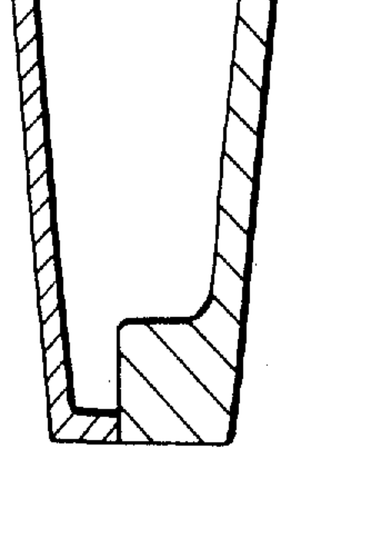
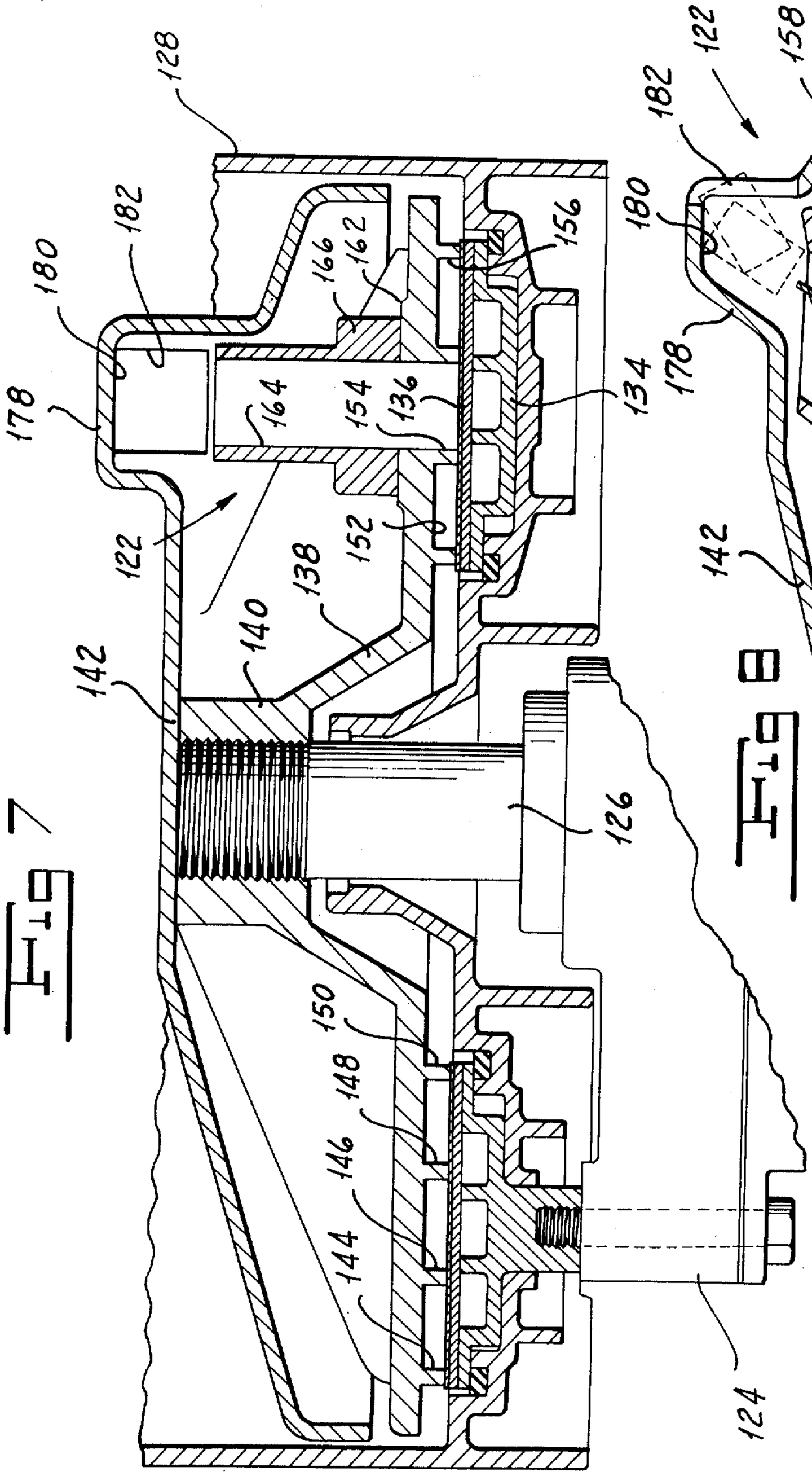


FIG. 6


128
182
180
178
122
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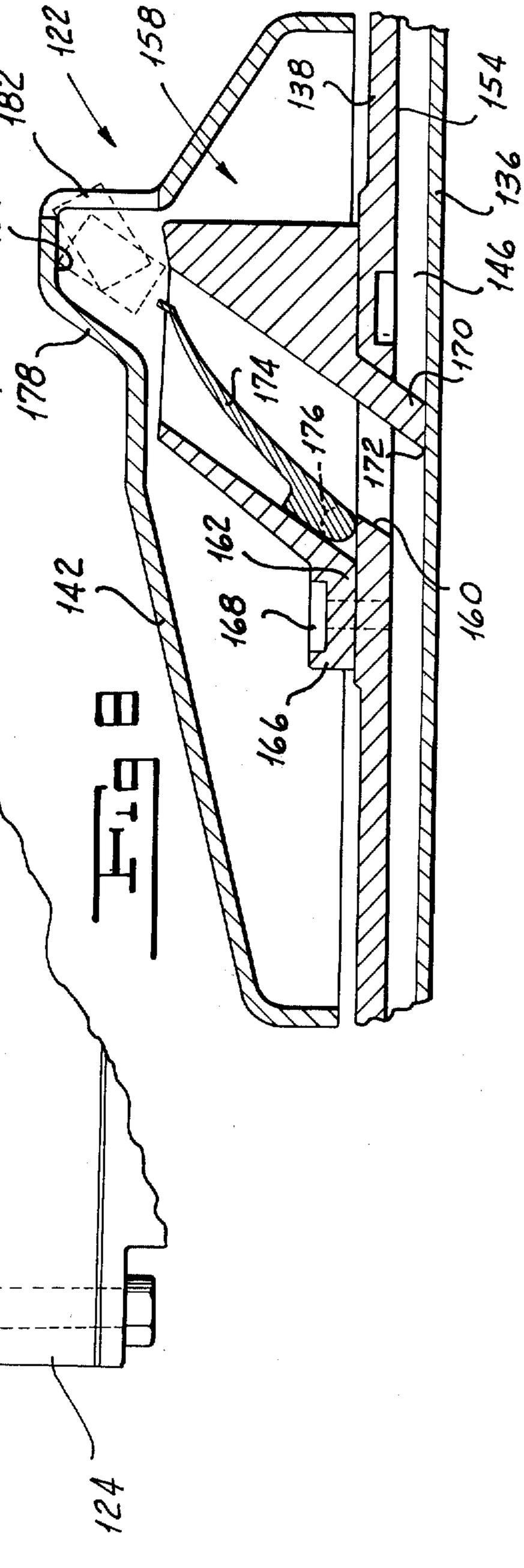
144
124

FIG. 7


182
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166
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FIG. 8

PLATE TYPE ICE MAKER

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

There are known in the prior art two general types of ice makers. The first of these which produces what is known in the art as flake or chip ice rather than hard ice includes an auger or the like which scrapes ice crystals from a tubular freezing surface and feeds the resultant slush ice outwardly through a die or the like to form flake or chip ice. Alternatively, a cylindrical freezing chamber can be employed and scraper blades on the outside of the chamber remove the ice crystals. In all ice makers of this type this chamber is vertical and of tubular or cylindrical shape. While ice makers of this type produce ice on a continuous basis, they embody the defect that the tubular evaporator configuration is mechanically weak and it requires various bearings and water seals. It is relatively costly to produce. In addition, the quality of ice produced on ice makers of this type is not consistent but is a function of the ambient temperature and the temperature of the incoming water and of the condition of the refrigerating equipment.

The other type ice maker known in the art is a "cube" ice maker in which water in a container is subjected to the action of a refrigerant. While some of the cube ice makers employ flat plate type evaporators, none of them produce ice on a continuous basis. That is to say, the freezing cycle is carried on until ice of the thickness of about one quarter to one half inch is formed and is then interrupted. Following interruption of the freezing cycle a harvest or defrost cycle is started. Thus, ice makers of this type do not produce ice on a continuous basis. While the ice is of high quality, the machine is extremely inefficient owing to the inherent insulating property of the ice itself. Stated otherwise, a relatively great refrigerating effort is required to produce ice of any appreciable thickness.

We have invented a plate type ice maker which overcomes the defects of ice makers of the prior art. Our plate type ice maker is adapted to produce chunks of hard ice on a continuous basis. It is more rugged than are auger type ice makers of the prior art. It is less expensive to manufacture than auger type ice makers. It is more efficient than are cube type ice makers of the prior art. It does not require the alternate freeze and harvest cycles of cube type ice makers of the prior art.

SUMMARY OF THE INVENTION

One object of our invention is to provide a plate type ice maker which overcomes the defects of ice makers of the prior art.

Another object of our invention is to provide a plate type ice maker which produces chunks of hard ice on a continuous basis.

A further object of our invention is to provide a plate type ice maker which is more rugged than are auger type ice makers of the prior art.

A still further object of our invention is to provide a plate type ice maker which is less expensive to produce than are auger type ice makers of the prior art.

Yet another object of our invention is to provide a plate type ice maker which is more efficient than are cube type ice makers of the prior art.

Yet another object of our invention is to provide a plate type ice maker for producing pieces of hard ice without the necessity for alternate freeze and harvest cycles.

Other and further objects of our invention will appear from the following description.

In general, our invention contemplates the provision of a plate type ice maker in which a cutting edge at the entrance to an ice-forming passage moves over a plane freezing surface to scrape crystals of ice from the surface and force them into the ice forming passage in which the slush ice is compressed to such a degree as to form a hard rod of ice which emerges from the passage and impinges on a breaker surface which fractures the rod thus to form pieces of hard ice.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings which form part of the instant specification and which are to be read in conjunction therewith and in which like reference numerals are used to indicate like parts in the various views:

FIG. **1** is a top plan view of one form of our plate type ice maker with parts removed and with other parts broken away.

FIG. **2** is a sectional view of the form of our plate type ice maker shown in FIG. **1** taken along the line **2—2** of FIG. **1.**

FIG. **3** is a sectional view of one of the ice rod forming units of the form of our plate type ice maker illustrated in FIGS. **1** and **2.**

FIG. **4** is a fragmentary top plan view of an alternate embodiment of our plate type ice maker with parts removed.

FIG. **5** is a sectional view of the embodiment of our ice maker illustrated in FIG. **4.**

FIG. **6** is a section view taken along a diametral chord of the form of our ice maker shown in FIGS. **4** and **5** to illustrate the mode of operation thereof.

FIG. **7** is a fragmentary sectional view of a further form of our plate type ice maker.

FIG. **8** is a fragmentary sectional view of the form of our plate type ice maker shown in FIG. **7** and taken along the path of movement of a cutter thereof to illustrate the operations thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. **1** to **3,** one form of our plate type ice maker indicated generally by the reference character **10,** includes a motor **12,** which provides the input to a gear box **14** having an output shaft **16.** A bracket **18** secured to a boss **20** on the gear box **14** is attached by means of a screw **22** or the like to an evaporator plate **24.** We form the upper surface of the evaporator plate **24** with a plurality of coil-forming channels **26.** Refrigerant may be introduced into the channels **26** through an inlet **28.** A return outlet **30** permits the refrigerant to pass back to the compressor (not shown).

Shaft **16** extends upwardly through a hollow hub **32** on the evaporator plate **24.** The arrangement is such that shaft **16** can rotate in the hub **32.** An annular freezer plate **34** is secured over the channels **26** by any suitable means known to the art. Refrigerant flowing through the channels **26** cools the plate **34** to permit ice crystals to form thereon in a manner to be described.

The form of our ice maker **10** shown in FIGS. **1** to **3** includes three cube or ice piece-forming units indicated generally respectively by the reference characters **36, 38** and **40.** Since all of the units **36, 38** and **40** are substantially identical we will describe only the unit **36** in detail. The unit **36** includes a chute-forming member **42** provided with an ice chute **44** which, together with a roof or top member **46,** forms a channel for the reception of slush ice. The roof member may be secured to the channel-forming member **42** in any suitable manner. It includes a resilient tip portion **48** adapted to move to the broken line position illustrated in FIG. **3** in response to movement of a rod of ice up the passage. The member **42** further is formed with a scraper edge **50** adapted to scrape ice crystals from the surface of the plate **34.** The leading edge of a rod of ice emerging from chute **44** passes under the tip **48,** forcing it to the broken line position and ultimately engages a breaker surface **52** located in a plane forming an angle of less than 90° with the plane of the chute base and a piece of ice breaks off the rod. The length L of the piece is approximately equal to the distance between surface **52** and the end of tip **48,** as indicated in FIG. **3.**

Member **42** is formed with a peripheral flange **54** adapted to receive screws **56** to secure the member **42** in an opening **58** in a support plate **60** threaded onto shaft **16** for rotation therewith. We provide the plate **60** with a number of reinforcing ribs **62.**

It is to be noted that the respective units **36, 38** and **40** are radially staggered as indicated in FIG. **1.** That is, unit **36** is radially positioned so that its edge **50** rides over the outermost portion of the surface of the plate **34.** Unit **38** is so positioned that its edge **50** rides over the central portion of the annular plate **34.** Unit **40** is furthest inboard so that its edge **50** rides over the innermost portion of the plate **34.** If desired, we may provide some overlap between the edges **50** of the various units. We provide the surface of the plate **34** with spaced radially extending grooves **64** for preventing a body of ice from moving along with the rotating support plate **60** when shaft **16** is driven.

We mount a cover plate **66** on the plate **60** for rotation therewith. As chunks of ice are formed in the various units in a manner to be described they are discharged at locations above the plate **66** so as to be retained thereon. Any water running off the formed ice passes downwardly over the edge of the plate **66.** We mount a surrounding wall **68** on the outer edge of plate **24** to provide a storage space for formed ice. The entire assembly is provided with an insulating jacket **72.** An inlet pipe **70** permits water to be introduced into the space over the freezer plate **34.** Preferably, we maintain the water at a level indicated by the dot-dash line in FIG. **2.** A cover **74** is adapted to be removably secured over the top of the wall **68** by any suitable means such for example as by screws **76.**

Referring now to FIGS. **4** to **6,** an alternate embodiment of our plate type ice maker indicated generally by the reference character **78** includes an evaporator plate **80** covered with a plate **82** providing the freezing surface. The output shaft **84** of a gear box or the like passes upwardly through the central hollow hub of the plate **80** and is secured to an extruding head support **86** by means of a key **90** or the like the ends of which engage recesses in the hub **88** of the support plate **86.** A nut **92** threaded onto shaft **84** is adapted to position the support **86** on the shaft.

The support **86** carries a scraper blade **94** adapted to move over the surface **82** when the support member **86** is driven by shaft **84.** It will be appreciated that the blade **94** may include more than one scraping edge, such for example as a second edge at a location circumferentially spaced around hub **88** from the edge shown in the drawings.

We mount a respective extruder ad **96** over each of the scraping edges of the blade **94.** The member **86** includes downwardly extending partitions **98** which, together with the upper surface of the scraping blade **94** provide extruding passages for the formation of ice. It will be seen that the space between the outer wall portion of support **86** and the hub **88** and between the top of head **96** and the cutting edge of blade **94** forms a plenum chamber just ahead of passages **100** in the direction of movement of the head **96.** Ice being scraped from plate **82** collects in the plenum chamber and is partially dewatered in the course of its passage therethrough. Finally it is forced into passages **100** wherein it is [extended] *extruded* to form hard ice.

Each of the passages **100** has an outlet **104** leading into a recess formed in the top of a drip ring **106** secured to shaft **84** for rotation therewith. Each recess **108** is provided with a surface **110** on which a rod of ice emerging from the outlet **104** impinges. In FIG. **6** we have indicated water by the reference character **112,** the thin film of ice on the surface of plate **82** by **114,** slush ice in the plenum chamber by the reference character **116,** the rod of ice by **118,** and a broken off ice piece by **120.**

Referring now to FIGS. **7** and **8,** we have illustrated yet another form of our plate type ice maker, indicated generally by the reference character **122.** The ice maker **122** includes a gear motor **124** having an output shaft **126.** A stationary housing **128** formed with a base **130** is secured to the gear motor housing by any suitable means such, for example, as by screws **132.** A refrigerant coil-forming member **134** supported on the base **130** carries a freezer plate **136** on the surface of which ice crystals form when water is supplied to the plate and when refrigerant flows in the coil-forming assembly **134.**

The ice maker **122** includes a cutter disc **138** formed with a hub **140** which is screwed onto or otherwise secured to the shaft **126** for rotation therewith. We provide a cover plate **142** secured to hub **140** in any suitable manner so as to be driven together with the cutter disc **138.**

The salient feature of the form of our plate type ice maker illustrated in FIGS. **7** and **8** is a plurality of circumferentially extending radially spaced ribs or walls **144, 146, 148** and **150** on the bottom of the cutter plate **138.** Pairs of adjacent ribs **144** and **146, 146** and **148,** and **148** and **150** provide confined passages **152, 154** and **156** for ice removed from the surface of plate **136** in a manner to be described.

Our ice maker **122** includes a plurality of ice rod-forming assemblies indicated generally by the reference character **158.** While we have illustrated only one assembly **158** in FIGS. **7** and **8,** it will readily be appreciated from the description hereinbelow that we provide three such assemblies, one for each of the channels **152, 154** and **156.** Each of these channels is provided with a respective opening **160** surrounded by a boss **162** for receiving an assembly **158.** Each assembly **158** is formed with an inclined passage **164** and with a base **166** secured to a boss **162** by any suitable means

such, for example, as by screws **168.** An extension **170** on the trailing wall of the inclined passage **164** extends downwardly through the opening **160** and to a location at which a scraper edge **172** thereon cooperates with the portion of the freezer plate **136** associated with the channel **154** for example.

Each assembly **158** includes a spring finger **174** analogous to the finger **46** of the form of our invention illustrated in FIGS. **1** to **3.** In the form of our ice cube maker illustrated in FIGS. **7** and **8** however, the fingers **174** are provided with pivotal supports **176** which mount the fingers on the assemblies **158.** As ice is scraped off the surface of the plate **136** by the scraper edge **172,** it builds up in the channel **154** and forces its way up the inclined passage **164** so as ultimately to engage the finger **174.** Upon continued rotation of the scraper plate **138,** the action of the finger **174** compresses the slush ice until ultimately a rod of ice emerges from the upper end of the inclined passage **164.**

We form the cover **142** with a respective prominence or boss **178** over each of the assemblies **158.** The underside of the top of each boss **178** provides a breaker surface **180.** As the rod moves upwardly out of the passage **164** its upper edge engages the surface **180** so that a cube of ice is broken off the upper end of the rod. It will readily be appreciated that the length of the cube or piece of ice broken off is determined by the distance between the upper end of the trailing edge of the passage **164** and the surface **180.** Pieces of ice thus broken off the upper end of the rod outwardly of the cover **142** through openings **182** in the bosses. This ice accumulates within the housing **128** over the cover **142.** It will be seen that any melt-down from the accumulated ice flows downwardly over the edges of the cover and back toward the freezer plate **136.**

In operation of the form of our invention illustrated in FIGS. **1** to **3,** water is introduced into the space over the surface of plate **34** through line **70.** A thin film of ice forms on top of the plate **34.** As shaft **16** rotates, the respective scraper or cutter edges **50** of the units **36, 38** and **40** traverse different portions of the upper surface of the plate **34** and scrape or cut ice from the film of ice as slush ice. The radial grooves **64** prevent any body of ice being moved along with the rotating units **36, 38** and **40.** It will be appreciated that as a cutting edge **50** removes ice from the film formed on the surface of plate **34,** a diametral track in line with the cutter is formed in the film of ice. Thus, the cut ice is contained within this track and is immediately forced up the inclined plane formed by the bottom of chute **44.** Owing to the fact that such a diametral track is formed, all ice is ultimately forced up the chute. In this manner, the slush ice is raised above the water level maintained in the freezing chamber. As more ice is forced up the chute, water is removed therefrom by elevating it above the water level. Ultimately the ice is forced against the spring tip **48** of the roof or top **46** of the chute **44.** The pressure exerted by this closure forces additional water out of the ice until sufficient force is exerted by the rod of ice on the tip **48** to force it to the broken line position shown in FIG. **3.** By this time, the ice emerging from the top of the chute is hard bar ice. Finally this bar of ice impinges on the surface **52** which is at an angle of less than 90° to the bottom of the chute. Owing to the fact that the ice is brittle, it will fracture at the end of the tip **48** in its broken line position to form a chunk of ice. The thus formed chunks of

ice collect on top of the cover **66** so as to provide a supply of hard chunks of ice.

It is to be noted that in the form of our invention shown in FIGS. **1** to **3** radial and thrust loads of the cutters are applied directly to the bearings of the gear motor output shaft. Moreover, since the three cutter edges are displaced from one another by 120° the leads and forces developed by the edges are relatively evenly distributed. The evaporator plate is mounted on the output shaft **16** so as to eliminate the possibility of misalignment between the freezing surface and the cutting edges **50.** Our arrangement eliminates the necessity for providing water seals and shaft bearings such as cause problems with auger type ice makers of the prior art.

In operation of the form of our ice maker shown in FIGS. **4** to **6,** the cutting edges of the blade **94** scrape slush ice off the film of ice **114** formed on the upper surface of plate **82** from the water **112.** This slush ice is forced into the plenum chamber leading into the passages **100,** in the course of movement through which it is extruded into the hard rod **118.** Ultimately the leading edge of the rod strikes surface **110** to break the rod into chunks of ice. The amount of compression exerted on the slush ice is determined not by the lead of an auger, as in auger type ice makers of the prior art, but rather by the quantity of ice collected in the plenum chamber. The quantity of ice thus collected is dependent upon the velocity of the cutter and the refrigeration conditions of the freezing surface. The quality of the extruded ice does not change. It requires only more or less revolutions of the device to produce ice of a given length and size.

In operation of the form of our invention illustrated in FIGS. **7** and **8,** the scraper edges **172** of the respective units **158** scrape ice crystals off the surface of plate **136.** In this form of our invention, the walls or ribs **144, 146, 148** and **150** form confined channels extending circumferentially of the plate **136** and in line with the cutting edges **172** and the entries of the inclined passages **164** of the units **158.** These passages ensure that ice scraped from the surface of plate **136** will enter the passages **164.** As this ice is formed upwardly along the inclined passages **164,** a rod of hard ice is formed in a manner similar to that in the operation of the form of our invention illustrated in FIGS. **1** to **3.** As a rod of ice emerges from the top of the inclined passage **164,** it strikes the breaker surface **180** so that pieces of hard ice break off and are discharged outwardly through outlets **182** to the storage area in housing **128** above the cover **142.**

It will be seen that we have accomplished the objects of our invention. We have provided a plate type ice maker which overcomes the defects of ice makers of the prior art. Our ice maker is adapted to make hard chunks of ice on a continuous basis. It does not require alternate freezing and harvest cycles. It is more efficient than are cube type ice makers of the prior art. It is more rugged and is less expensive to construct than are auger type ice makers of the prior art.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of our claims. It is further obvious that various changes may be made in details within the scope of our claims without departing from the spirit of our invention. It is,

therefore, to be understood that our invention is not to be limited to the specific details shown and described.

Having thus described our invention, what we claim is:

1. Apparatus for forming hard pieces of ice including in combination, means forming an extended freezing surface, means forming an extruding passage having an entry and an exit *and a bottom extending upwardly and away from said surface*, a gathering edge *provided on said passage forming means for movement therewith* adjacent to said entry, and means mounting said passage forming means for movement relative to said surface with said gathering edge adjacent to said surface to remove ice crystals from a film of ice on said surface and to deliver said ice crystals to said entry in the form of slush ice, *said passage forming means being provided with means for exerting a compressive force on slush ice delivered thereto so that slush ice* which enters said passage [and] emerges from said exit in the form of a hard rod of ice in response to relative movement between said passage forming means and said surface.

2. Apparatus as in claim **1** in which said surface is generally horizontal and in which said passage forming means is mounted above said surface.

3. Apparatus as in claim **2** including means for supplying water to a predetermined level over said surface and in which said passage exit is above said level.

4. Apparatus as in claim **3** in which said passage forms an inclined plane with reference to said surface from said entry to said exit.

5. Apparatus as in claim **4** including means for breaking said rod emerging from said exit.

6. Apparatus as in claim **5** [including] *in which said compressive force exerting means includes* means forming a plenum chamber between said gathering edge and said entry.

7. Apparatus as in claim **5** [including] *in which said compressive force exerting means includes* resilient means normally closing said exit, said resilient means adapted to be actuated by the ice emerging from said passage.

8. Apparatus as in claim **5** in which said breaker means comprises a surface making an angle of less than 90° with said inclined plane.

9. Apparatus for forming hard pieces of ice including in combination, means providing an extended ice forming surface, means forming an extrusion passage having an entry and an exit *and a bottom extending upwardly and away from said surface*, said passage forming means being provided with a gathering edge adjacent to said entry, means mounting said surface forming means and said passage forming means for relative rotary movement with said passage above said surface and with said gathering edge adjacent to said surface and with said exit above said entry, and means for driving said passage forming means and said surface forming means relative to each other to cause said gathering edge to remove ice from said ice-forming surface and to feed slush ice into said passage, *said passage forming means being provided with means for exerting a compressive force on slush ice fed thereto* to form a mass of hard ice emerging from said exit.

10. Apparatus as in claim **9** including means for breaking said mass of ice emerging from said exit.

11. Apparatus as in claim **10** in which said breaking means comprises a surface disposed at an angle to the direction of movement of said mass.

12. Apparatus as in claim **11** [including] *in which said compressive force exerting means include* resilient

means normally closing said exit. [, said resilient means exerting a compressive force on ice moving into said passage under the influence of said relative movement]

13. Apparatus as in claim **9** [including] *in which said compressive force exerting means includes* resilient means normally closing said exit [, said resilient means exerting a compressive force on ice moving into said passage under the influence of said relative movement] , said resilient means being actuated to open said exit in response to movement of a mass of hard ice toward said exit.

14. Apparatus as in claim **13** in which said resilient means is a leaf spring forming part of the wall of said passage.

15. Apparatus as in claim **14** including means forming a breaker surface making an angle with the direction of movement of said rod, said surface being spaced from said exit.

16. Apparatus as in claim **9** in which sad passage forming means forms a plurality of radially spaced passages.

17. Apparatus as in claim **16** in which said [passage forming means provide] *compressive force exerting means comprises* a common plenum chamber *formed by said passage forming means* between said gathering edge and the passage entries.

18. Apparatus as in claim **9** including a plurality of passage forming means, said passage forming means being radially and circumferentially spaced with reference to the axis of rotary movement thereof.

19. Apparatus for forming hard pieces of ice including in combination means providing a generally horizontally disposed annular extended ice forming surface, a plurality of hard ice forming units, each of said hard ice forming units having an inclined extruding passage therein extending from an entry to an exit, each of said units having a cutting edge adjacent to said entry, each of said units having resilient means normally closing said exit and having an ice breaker surface spaced from said exit and making an acute angle with the direction of inclination of said passage, means mounting said units at respective locations circumferentially spaced and radially spaced with respect to the center of said annulus for relative rotary movement of said units and said surface providing means around said center and with said cutting edges closely adjacent to said surface and means for driving said surface providing means and said mounting means relative to each other to cause said cutting edges to remove said ice from said surface and to feed slush ice into said passage entries to cause rods of ice to form in said passages and to cause said rods to actuate said resilient means to open said passage exit and to impinge on said breaker surfaces to provide said pieces of hard clear ice.

20. Apparatus as in claim **19** including means for supplying water to a predetermined level over said surface, said exits being positioned above said level.

21. Apparatus as in claim **9** in which said mounting means comprises means forming an elongated ice confining channel above and extending generally parallel to said ice forming surface, said passage opening into said channel.

22. Apparatus as in claim **19** in which said unit mounting means comprises means forming a plurality of radially spaced circumferentially extending channels over said ice forming surface, said extruding passage extending into respective channels.

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