United States Patent [19]

Hagen

[11] **3,797,267**

[45] **Mar. 19, 1974**

[54] **ICE RAKE CONTROL**

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[73] Assignee: **Turbo Refrigerating Company,** Denton, Tex.

[22] Filed: **Nov. 15, 1972**

[21] Appl. No.: **306,712**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 273,327, July 19, 1972.

[52] **U.S. Cl.** **62/233,** 62/344

[51] **Int. Cl.** **F25c 5/18**

[58] **Field of Search** 62/233, 344

[56] **References Cited**

UNITED STATES PATENTS

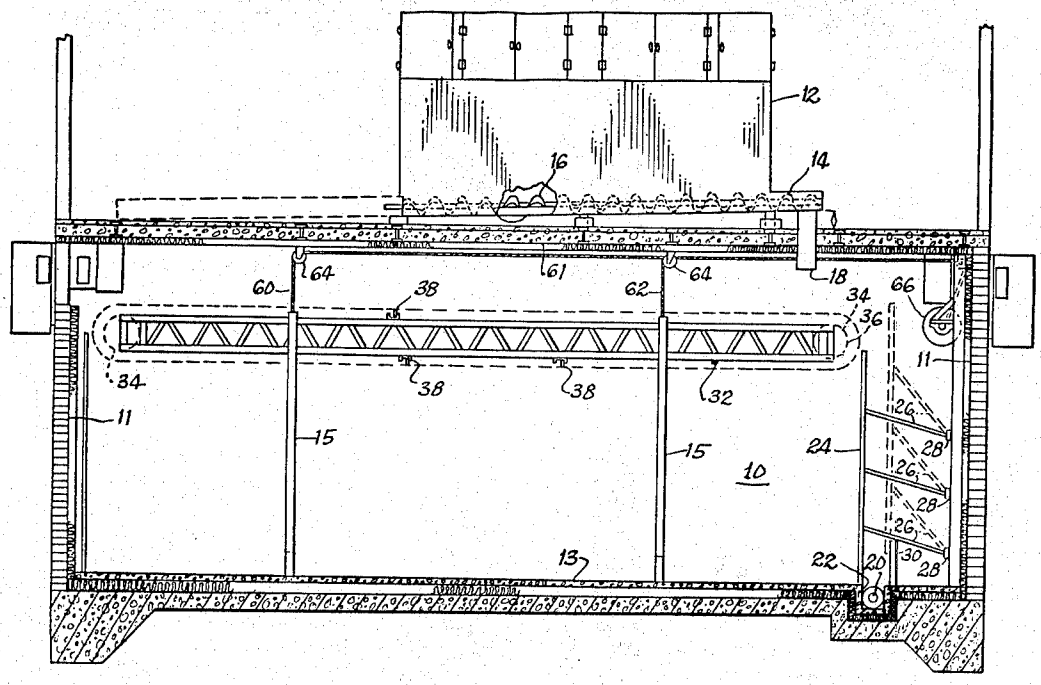
2,222,024,	11/1940	Field	62/344
2,791,103	5/1957	Guild	62/344
3,587,241	6/1971	Hagen	62/63
3,190,083	6/1965	Miller	62/349
3,074,252	1/1963	Tippmann et al.	62/347
3,246,481	4/1966	Douglas et al.	62/320

Primary Examiner—William E. Wayner
Assistant Examiner—William E. Tapolcai, Jr.

[57] **ABSTRACT**

A control system for an ice rake in ice making apparatus comprising means to activate the ice rake to raise the ice rake at predetermined intervals for a predetermined period of time when ice is supplied to the ice making apparatus and means to simultaneously energize the ice rake to drive the flites of the ice rake in a forward direction for a predetermined time and to drive the flites in a rearward direction for another predetermined time.

11 Claims, 5 Drawing Figures



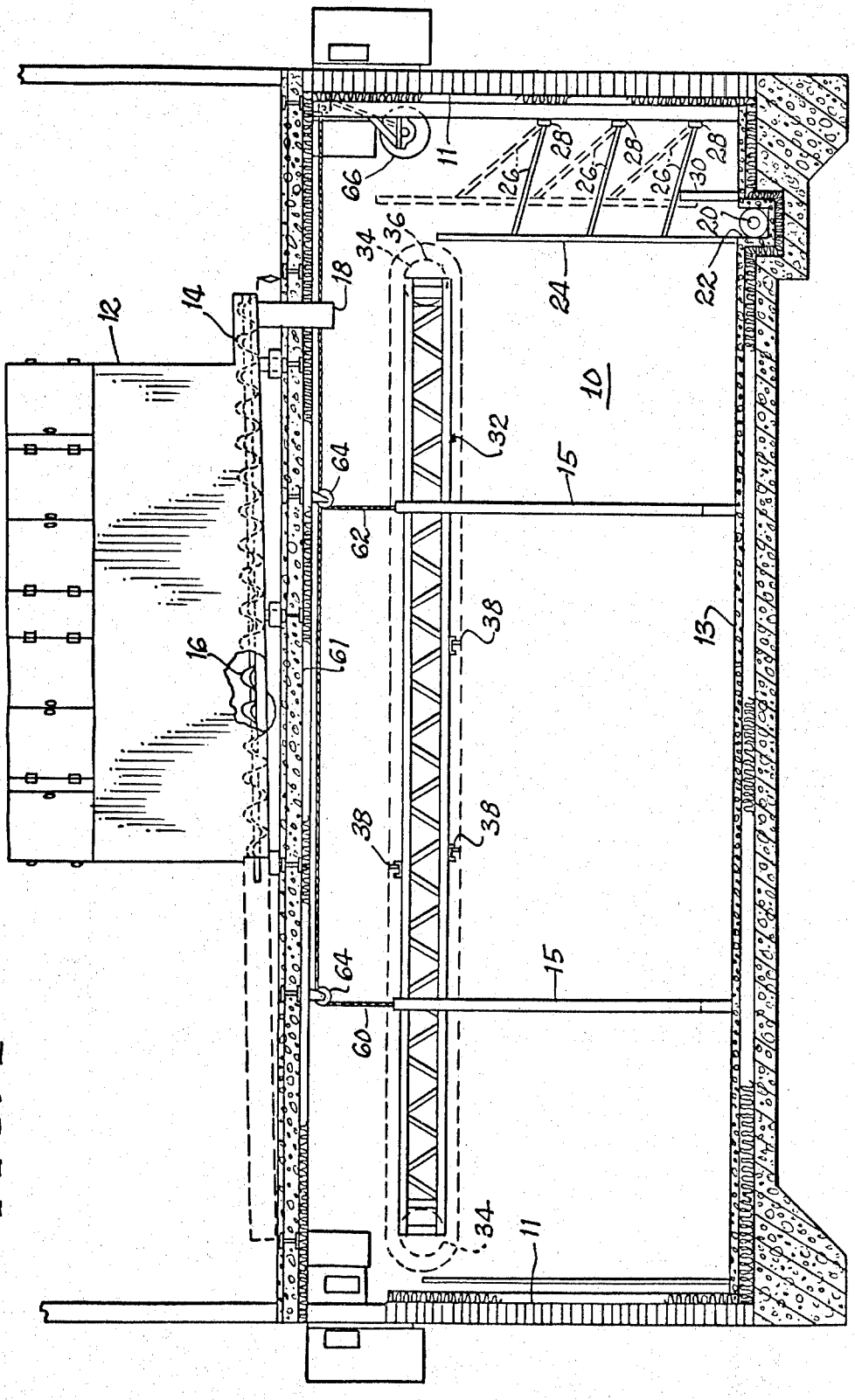

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FIG. 1

FIG. 2

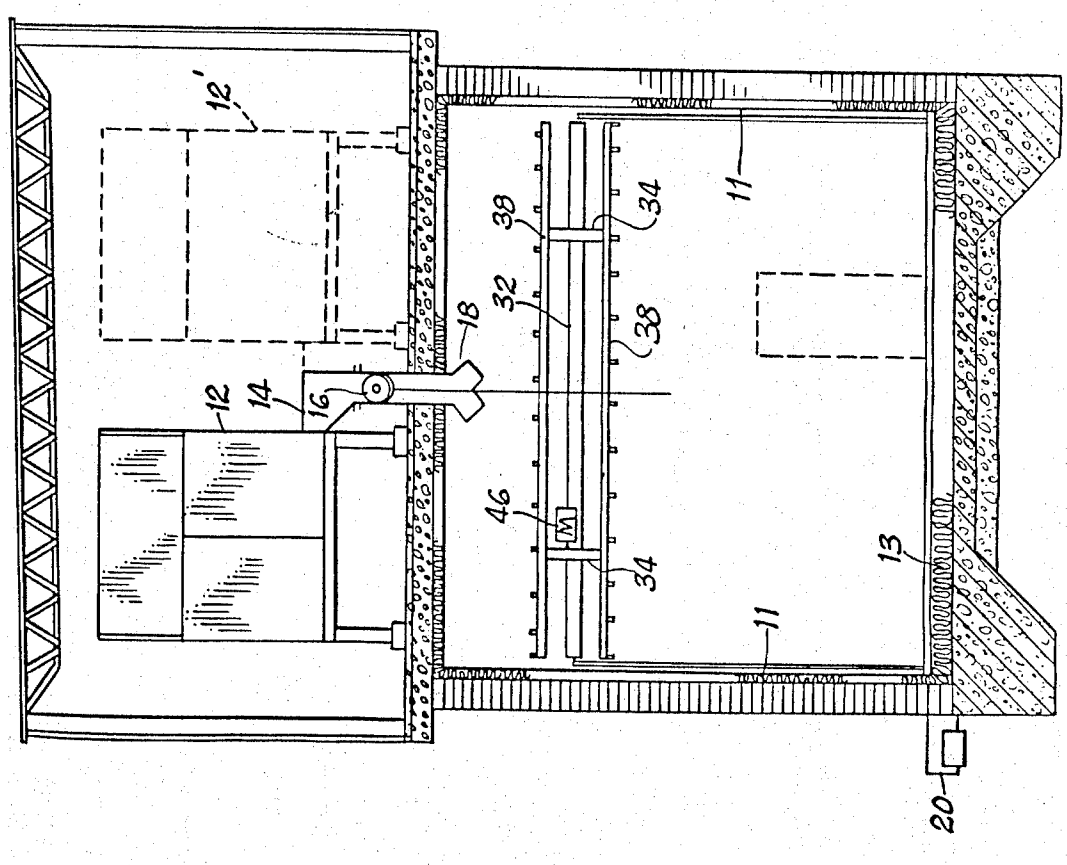


FIG. 4

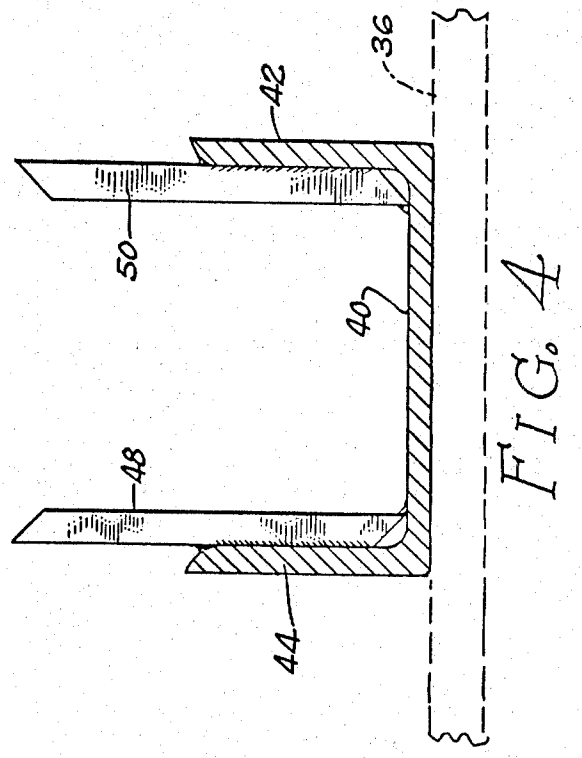


FIG. 3

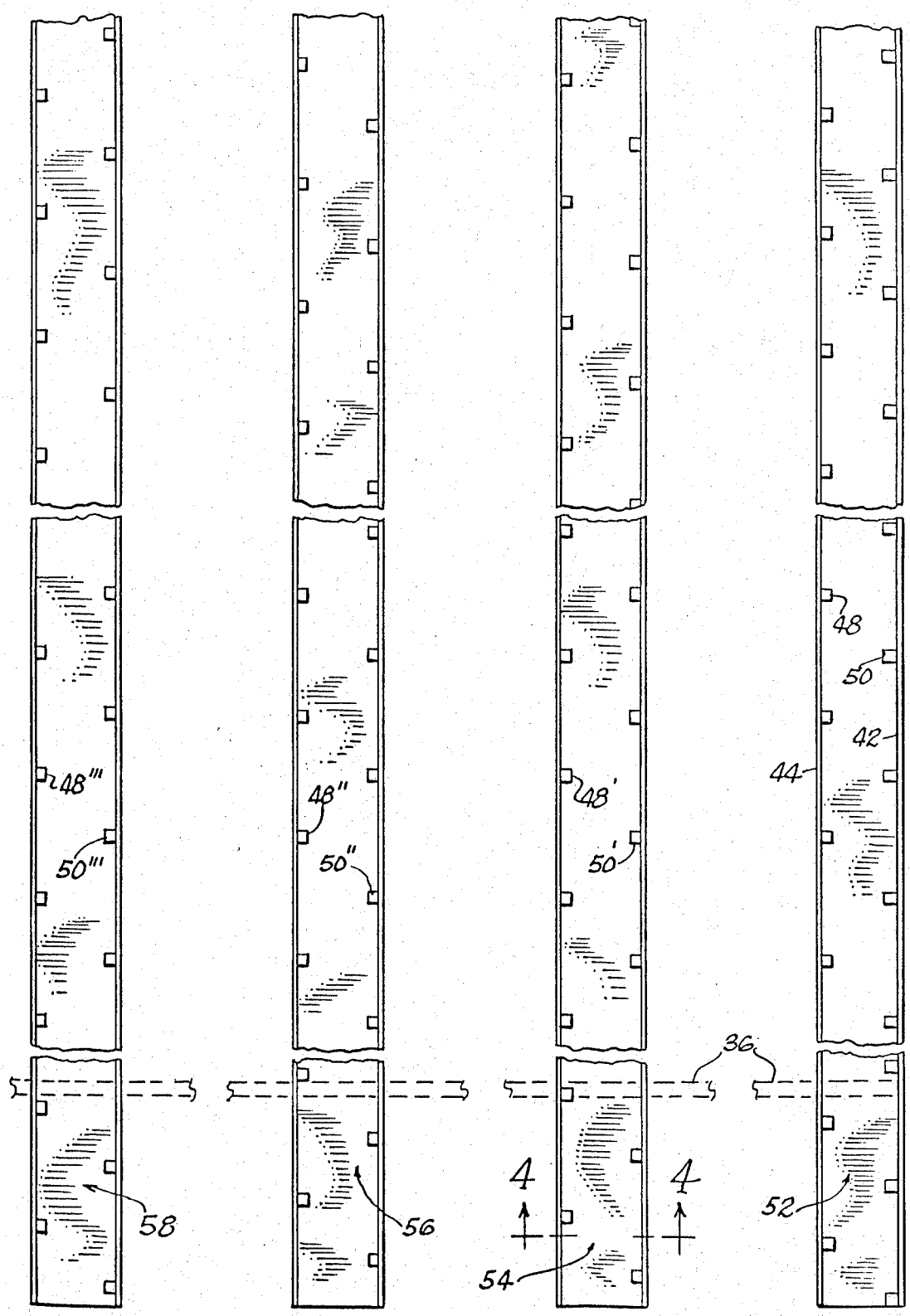
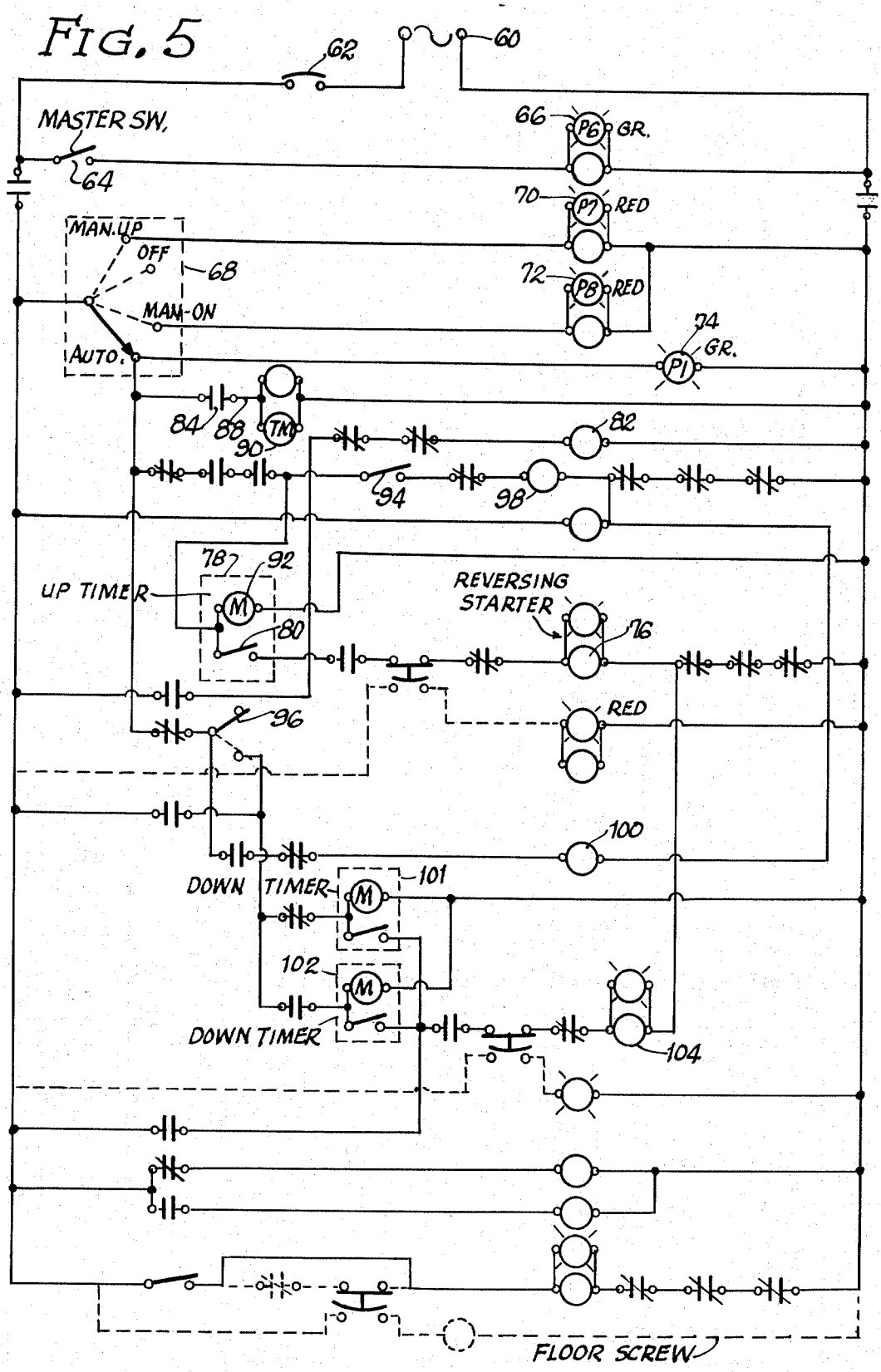


FIG. 5


62
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AUTO.
84
88
90
TM
82
94
98
78
92
UP TIMER
M
80
REVERSING STARTER
76
RED
96
100
DOWN TIMER
101
102
DOWN TIMER
104
FLOOR SCREW

ICE RAKE CONTROL

This is a continuation-in-part of my copending application Ser. No. 273,327, filed July 19, 1972.

This invention relates to the manufacture of ice in bulk, and more particularly to apparatus for the manufacture, storage, and dispension of large quantities of ice.

A variety of apparatus for use in the manufacture of large quantities of ice are now known to those skilled in the art. Representative ice-making machines are described in U.S. Pat. Nos. 3,074,252, 3,190,083, 3,246,481, 3,546,896, 3,587,241, and others. Commercial installations for the manufacture of ice, and particularly fragmented ice, generally include ice-making machines which actually form the ice and which are elevated above a bin, such as on a second floor of the installation. The ice makers discharge fragmented ice into a conveyor which in turn discharges the ice through an opening into the bin.

However, the automatic and sanitary handling of bulk, fragmentary ice once it is discharged into such a bin presents exceedingly difficult and specialized problems. Fragmented ice, when stored in a bin, can change characteristics during storage. For example, flakes of thin ice tend to break into smaller pieces akin to snow. Under certain temperature conditions, pieces of ice can fuse together. In addition, portions of ice in the lower part of a pile tend to fuse under the weight of a pile.

As a result of the foregoing special problems, fragmented ice in bulk cannot be regarded as being made up of discrete particles and is not even a product having definite handling properties. Fragmentary ice in bulk has no definite angle or repose. Consequently, fragmentary ice in bulk form is virtually incapable of flowing out of a large bin by gravity.

The inability of fragmented ice in bulk to flow with gravity has been previously recognized, and the art has sought to employ a device known as an ice rake for many years to facilitate the handling of ice. An ice rake is a type of a drag conveyor which contacts the top of a pile of the ice and is maintained in contact therewith by a system of cables by which the rake is suspended. The ice rake has been found to be the only mechanism for use in the handling and storage of bulk fragmentary ice. However, such ice rakes are subjected to extremely high stresses during use, with the result that breakage of the ice rake is a common occurrence. It is not uncommon for an ice rake to sustain breakage within ninety days of use.

Such ice rakes of the prior art are formed of a plurality of channel members which are displaced about a structural member, such as on a chain or the like. The channel members each have teeth fixed thereto, and the teeth on each of the channel members are in alignment. As the structural member is maintained just above the level of the ice in the bin, the structural members are advanced in either a forward or rearward direction in the bin to uniformly distribute the fragmented ice over the length of the bin. However, if the bin is being filled at a rate even slightly greater than the rate at which the rake is being raised, the rake tends to be buried in the ice. As the channel members having the teeth fixed thereto are displaced within the bin, the teeth tend to be broken off by ice which has become fused. Even where the teeth are not broken off, the

aligned teeth tend to simply form continuous grooves in the surface layer of the ice in the bin, and the subsequently lowering of the entire ice-rake mechanism brings the channel members into contact with the top layer of ice, and results in breakage of the channel members or the mechanism by which such channel members are mounted.

In my copending application Ser. No. 273,327, filed July 19, 1972, there is disclosed and claimed an improved ice rake in which the teeth of the ice rake are staggered on adjacent flites of the rake. In this way, the teeth on the successive flites of the rake are laterally offset from the teeth of the preceding flites to provide grooves in the surface of the ice which are spaced sufficiently close together to enable the flange portions of the flites to break off the ridges of ice without damage to the ice rake mechanism.

This invention is addressed to a control system for the displacement of an ice rake assembly to provide uniform distribution of the ice throughout a storage bin.

It is accordingly an object of the present invention to provide an ice rake and control means therefor to facilitate the uniform distribution of ice in a storage bin during loading and unloading of the bin.

It is a related object of the invention to provide an ice rake and control means therefor in which the movement of the ice rake is programed to avoid overstressing of the rake and in which the optimum distribution of raking directions and raking times is achieved for any variation in the rate of loading and/or the point of loading of ice into the bin.

These and other objects and advantages of the invention will appear more fully hereinafter, and, for purposes of illustration, but not of limitation, an embodiment of the invention is shown in the accompanying drawing in which:

FIG. **1** is a side view in elevation of preferred ice-making apparatus for use with this invention;

FIG. **2** is an end view in elevation of the apparatus shown in FIG. **1**;

FIG. **3** is a view illustrating the staggered relationship of the teeth in the flites of the ice rake preferably employed with this invention;

FIG. **4** is a sectional view taken along the lines **4—4** in FIG. **3**; and

FIG. **5** is a schematic view of the control system employed with the ice rake mechanism.

The concepts of the present invention reside in a control system for apparatus for use in the manufacture, storage, and/or dispensation of ice which includes means for generating fragmented ice in bulk and a bin positioned to receive the fragmentary ice from the generating means. In accordance with the preferred practice of the invention, the bin is provided with an ice rake including a frame and a plurality of flites carried on the frame and movable along the frame. Each of the flites of the ice rake is in the form of a channel member, preferably having a U-shaped cross section.

The invention will be described by reference to the ice rake control system of this invention as used in the operation and control of the ice rake system described in the earlier copending application referred to above. However, the ice rake control system can also be employed in the operation and control of ice rake systems known to the prior art. It has been found that the control system of the invention provides optimum distribu-

tion of raking directions and times for any variation in the rate of ice production and point of entry of ice into the bin to thereby prevent the ice rake from being subjected to excess stresses.

Referring now to the drawings for a more detailed description of the invention, there is shown in FIGS. **1** and **2** ice-making apparatus for operation with the control system of the invention The apparatus includes a storage bin or compartment **10** having suitably insulated walls **11** and floor **13** which is supplied with bulk fragmentary ice by ice generating or forming means **12** which can advantageously be one of the ice-making machines of the type described in the foregoing U.S. patents. The bulk fragmentary ice is discharged as it is formed into a conveyor such as a screw conveyor **14** provided with auger **16** to convey the ice to a discharge chute or aperture **18** communicating with the bin.

As will be appreciated by those skilled in the art, the apparatus contemplates one or several ice-forming units **12** to supply bulk fragmentary ice to the bin **10,** depending somewhat on the size of the bin. For example, the ice-forming units can be positioned side by side as illustrated by units **12** and **12'** in FIG. **2** and/or units can be distributed longitudinally along the bin **10.**

Bulk, fragmentary ice can be discharged into the bin **10** at any point in the bin since the ice rake serves to distribute the ice over the length of the bin as more fully described hereinafter. Thus, the discharge opening **18** of the conveyor can be positioned near the forward end of the bin as illustrated in FIG. **1** of the drawing, or, if desired, it can be positioned at any other point along the longitudinal axis of the bin.

The ice contained in the bin can be discharged from the bin in a variety of ways. In the preferred embodiment illustrated in FIG. **1** of the drawing, the floor **13** of the bin is provided with a transversely extending conveyor **20** such as a screw conveyor which is positioned in a recess **22** formed in the floor **13** toward the forward end of the bin.

The bin is also provided with a door **24** which is mounted on a plurality of support arms **26** which are pivotally fixed to the forward wall **11** at **28.** In this way, the door can be displaced upwardly away from the floor **13** and toward the wall **11** to which it is fixed as shown by the broken lines in FIG. **1.** In the closed position shown in solid lines of FIG. **1,** the door is positioned between the interior of bin **10** and the recess **22** to prevent ice in the bin from falling into the recess **22.** As the door **24** is raised upwardly and toward the wall **11** of the bin, the door is advanced toward the wall **11** to expose the recess **22** to the bulk, fragmentary ice contained in the bin **10** to permit the ice to engage the conveyor **20** in recess **22** for removal of ice from the bin **10.**

To prevent ice from falling behind the door **24,** that is, between the door **24** and the wall **11,** the floor **13** is preferably provided with a vertical wall member **30** which is positioned between the conveyor recess **22** and the forward wall **11** at a height sufficient to form a barrier, with the door **24,** to prevent ice from becoming lodged behind the door.

The ice-rake mechanism is shown in FIGS. **1** to **4** of the drawings. As is perhaps best illustrated in FIGS. **1** and **2** of the drawing, the ice rake includes a structural member or frame generally designated at **32.** Each end of the frame **32** is provided with a pair of laterally spaced pulleys or sprockets **34.** The pulleys or sprockets are rotatable and carry two or more spaced endless chains **36** or the like which are capable of traveling in a longitudinal path about the frame **32.** Fixed to the chains **36** are a plurality of flites **38** of the ice rake which extend across substantially the entire width of the bin **10** (see FIG. **2**) and which are spaced each from the other along the endless chains **36** longitudinally in the bin.

Each flite **38** of the rake includes a channel member formed of a base **40** and a pair of spaced flange elements **42** and **44,** as seen in FIG. **4.** Thus, the channel members have a generally U-shaped cross section, and extend substantially over the width of the bin **10.** As is also shown in FIG. **4,** the base **40** of the channel member is fixed to the chains **36** in any convenient manner such that the flange elements extend away from the chains **36** and away from frame **32.**

At least one of the pulleys **34** is adapted to be driven by a motor or the like **46,** as can be seen in FIG. **2** of the drawing. It is generally preferred that the motor **46** be capable of driving the endless chains **36** having the rake flites fixed thereon in both directions. Thus, the flites **38** shown below the frame **32** in FIG. **1** of the drawing are capable of being advanced in a forward direction, that is, toward the bin door **24** as well as in the rearward direction, that is, away from the bin door **24.**

As indicated above, one of the preferred features of the present invention resides in the use of rake teeth **48** and **50,** as shown in FIG. **4** of the drawing, which are fixed to the flange members **44** and **42,** respectively, of the rake flites. The teeth **48** and **50** as described above preferably take the form as narrow projections which can, for example, simply be welded to the channel members, as shown in FIG. **4** of the drawing. In order to prevent overstressing of the teeth **48** and **50,** the teeth are generally of a fairly narrow width, for example, of the order of 1 to 3 inches, although wider or narrower teeth can be used as desired.

It is preferred that the teeth on adjacent flites be staggered relative to each other. One suitable arrangement of such staggered teeth is shown in FIG. **3** of the drawing, which illustrates the use of four flites. For the sake of clarity, these four flites are illustrated in a side-by-side arrangement to demonstrate the staggered-teeth arrangement. As is shown in FIG. **3,** flite No. **1,** which is generally designated as **52** in the drawing, includes teeth **48** and **50** fixed to alternating flange elements **44** and **42,** respectively. The adjacent flite, or flite No. **2,** which is generally designated as **54,** includes a plurality of teeth **48'** and **50'** which are out of longitudinal alignment with the corresponding teeth **48** and **50** of the first flite **52.** In other words, the teeth **48** and **50** of flite **52** are staggered relative to teeth **48'** and **50'** of flight **54.**

Similarly, the third flite, which is generally designated and **56,** includes teeth **48''** and **50''** which correspond to teeth **48** and **50** of flite **52.** Teeth **48''** and **50''** of flite **56** similarly correspond to teeth **48'** and **50'** of flite **54,** except that teeth **48'** and **50'** are staggered relative to teeth **48'** and **50'** of the adjacent flite **54.**

The fourth flite, which is generally referred to as **58** in FIG. **3** of the drawing, includes teeth **48'''** and **50'''** which correspond to the teeth of flites **52, 54,** and **56.** It is generally preferred that the teeth **48'''** and **50'''** of flites **58** be staggered relative to the teeth of at least one of the adjacent flites **56** and **52.**

Thus, as the flites **52, 54, 56,** and **58,** fixed to the endless chains **36,** are advanced in either the forward or rearward directions in the bin **10,** the teeth **48** and **50** on each flite penetrate into the ice to cut tracks or grooves in the surface of the ice layer contained in the bin **10.** Since the teeth of adjacent flites are staggered relative to each other, the teeth of successive flites do not simply track in the grooves formed by the teeth of the preceding flites, but, on the contrary, cut new grooves in the surface of the ice adjacent to those grooves cut by the teeth of the preceding flites to thereby form closely spaced ridges in the surface of the ice layer. These relatively narrow ridges can easily be broken away as the flange members **44** and **42** of each flite contact the surface of the ice.

As will be appreciated by those skilled in the art, the staggering of the teeth of each flite serves to decrease the width of the ridges formed in the surface of the ice without increasing the number of teeth employed on the flites and consequently without increasing significantly the power required to drive the flites through the ice. Since the ridges formed in the surface of the ice are more closely spaced, they are characterized by less strength and are susceptible to being broken away and carried along by the flange elements of the rake as the channel members or flites of the rake are advanced in one direction or another in the bin.

In order to adjust the height or elevation of the rake within the bin so that the flange members on each flite of the rake on the under side of the frame **32** can be maintained just above the surface of the ice contained in the bin **10,** the frame **32** of the ice rake can be suspended from the ceiling **61** of the bin by means of a pair of cables or the like **60** and **62,** the ends of which are fixed to the rake and pass over pulleys **64** to a suitable motor-driven winch **66** or the like. By activating the winch **66,** the frame **32** and consequently the flange elements **44** and **42** of each flite of the rake can be maintained at the desired level within the bin. As shown in FIG. **1,** it is sometimes desirable to provide the longitudinal walls of the bin **10** with guide means **15** to prevent any forward or rearward movement of the rake while in use.

The control system for the ice rake assembly of this invention is schematically illustrated in detail in FIG. **5** of the drawing. The control mechanism is powered by a power supply **60** which is operatively connected through a circuit breaker **62** to a master switch **64** and an indicator light **66** designated as P **6** in the drawing. The indicator light, for example, can be a green light which, when illuminated, indicates that the power is on. Also included in the circuit is a switch **68** which permits the ice rake to be displaced manually upwardly, shut off manually downwardly and placed in the automatic position. The master switch **68** is preferably provided with an indicator light **70** which is designated as P **7** in the drawing to indicate that the ice rake is being raised manually when illuminated. Similarly, the switch **68** is provided with an indicator light **70, 72** which is shown in the drawing as P **8** to indicate that the ice rake is being lowered manually. The "automatic" position of the switch **68** is preferably provided with an indicator light **74** which is designated as P **1** in the drawing to indicate that the control system is switched in the automatic position.

When the ice is being loaded into the bin as described above, the rake assembly is raised in the bin by the periodic running of the hoist motor **66** in the up direction. The raising of the ice rake can be accomplished by energizing one side of a reversing starter **76** which is shown in the drawing as HU. The upward movement of the ice rake within the bin is controlled by the up-timer **78** which includes two timer modules, a frequency module which can be adjusted, for example, from 0 to 30 minutes, and a duration module which can be adjusted, for example, to 0 to 3 minutes. The setting of the frequency module will periodically energize the duration module.

For example, if the frequency module is set to 4 minutes and the duration module is set to 18 seconds, the frequency module will close the switch **80** to energize the hoist motor starter **76** for a period of 18 seconds. Thus, every 4 minutes the rake mechanism will be raised for an 18 second period. When the frequency module of switch **80** energizes, a latch relay **82** designated as STR in the drawing is momentarily energized to close the contacts of latch relay **84** to permit flow of current from wire **86** to wire **88** and thereby energize the timer module **90.** Relay **84** is a latch relay and consequently remains closed once energized until mechanically opened. The up-timer **78** which includes the timing motor **92** preferably drives a shaft with a mechanical protrusion or pawl (not illustrated in the drawing for purposes of simplicity) and after one complete revolution, the pawl mechanically disengages the contacts of the latch relay **84** to consequently stop the timer motor **92.** Thus, every time the frequency motor **92** of the up-timer **78** closes, the reversing timer receives a single impulse and the timing motor **92** runs through one revolution. In each instance, the starting and finishing position of the timing motor **92** is the same.

As shown in FIG. **6** of the drawing, the output of the timer motor **92** is connected to two cams each of which can be adjusted so that an arc of its circumference has a smaller radius than the radius of the remaining circumference. A microswitch bearing on the circumference of the cam can thus be activated when the cam rotates through the aforementioned arc to contact the microswitch. The two microswitches are illustrated in the drawing as **94** and **96,** respectively. When the first microswitch **94** is closed, the rake is caused to be displaced about the frame in the reverse direction since microswitch **94,** when energized, energizes the coil of a reversing starter **98.** When the second microswitch **96** is energized, the rake is caused to run in a forward direction by energizing the other coil of the reversing starter **100.** By adjusting the two cams on the starter motor **92,** the rake can be caused to run in reverse for a given period of time, come to rest and then run forward for the same or a different period of time to coordinate the running of the rake with the time during which it is being raised.

Thus, every time the reversing starter is energized to raise the rake for a predetermined period of time, the up-timer **78** is likewise activated to cause the rake to be driven in the forward and reverse directions for the same or different times as predetermined by cams on the timer motor **92.** Consequently, the drive of the rake can be coordinated with the raising of the rake mechanism to provide optimum ice distribution in the bin regardless of the rate of ice production or the point of entry of ice into the bin and thereby substantially prevent overstressing of the rake flites and teeth.

The control system also preferably includes a pair of down-timers **100** and **102** as shown in FIG. **5** of the drawing, with the former being adapted to lower the ice rake mechanism by energizing the down reversing starter **104** with no ice production and the latter to lower the ice rake mechanism by energizing the reversing starter **104** when there is ice production.

In the operation of the apparatus of this invention the rake is raised at a rate corresponding to the rate at which ice is fed to the bin from the discharge opening **18** during filling of the bin. As the bin is being filled with ice from the ice-making machine **12,** the rake is activated by the control system of the invention as described above to uniformly distribute the bulk fragmentary ice through the bin.

When it is desired to discharge ice from the bin by way of the conveyor **20,** the door **24** is opened or raised to the position shown in broken lines in FIG. **1** whereby the ice is capable of contacting the conveyor screw **20** in the recess **22.** When unloading the bin, the rake flites on the under side of the frame **32** are continuously advanced in the forward direction to continuously advance ice in the bin from the rearward end of the bin toward the front whereby the ice is discharged by way of the conveyor **20.** As the ice is being discharged from the bin, the rake is lowered by way of cables **60** and **62** to permit the flites of the rake to scrape the ice from the top of the bin and cause it to fall into the conveyor **20** in the recess **22** of the floor.

In view of the foregoing, it will be apparent that I have provided a new and improved control system for use in the manufacture, storage, and dispensation of fragmentary ice in bulk which facilitates the handling of ice both in the loading and unloading of storage bins. The ice rake control system of this invention represents a significant improvement in the art, since the ice rake embodying the feature of this invention is subjected to significantly reduce stresses in use and consequently enjoys a drastically longer useful life.

It will be likewise apparent that various changes and modifications can be made in the details of construction, procedure, and use without departing from the spirit of the invention, especially as defined in the following claims.

I claim:

1. An ice-making apparatus comprising means to form bulk fragmentary ice, a storage bin positioned to receive ice from the means to form ice, means to remove ice from the bin, an ice rake mechanism positioned in the bin and adapted to be raised and lowered in the bin, said ice rake mechanism including rake flites adapted to be driven in a forward direction and a rearward direction in the bin to distribute ice in the bin, means to raise and lower the ice rake mechanism and means to drive the flites in the forward and rearward direction in the bin, the improvement of a control system for the ice rake mechanism comprising starter means to activate the means to raise the ice mechanism at predetermined intervals for a predetermined period of time when ice is being supplied to the bin and means to simultaneously energize the means to drive the flites to drive the flites in a forward direction for a predetermined time and to drive the flites in a rearward direction for another predetermined time.

2. Apparatus as defined in claim **1** wherein the means to energize the means to drive the flites are activated by the starter means.

3. Apparatus as defined in claim **1** wherein the starting means includes a reversing starter to activate the means to raise the ice rake mechanism, and timing means including frequency timer means to control the invervals at which the time to raise the ice rake mechanism are activated and duration timer means to control the period during which the means to raise the ice rake mechanism are activated to raise the ice rake mechanism.

4. Apparatus as defined in claim **3** which includes switching means activated by the timing means, said switching means being adapted to activate the means to drive the flites to drive the flites in a forward direction for a predetermined period of time and to drive the flites in a rearward direction for another predetermined period of time.

5. Apparatus as defined in claim **1** wherein the flites include channel members extending transversely to the frame across the bin, each of the channel members including at least one flange member extending downwardly from the frame member to engage the ice to displace the ice in the bin and a plurality of teeth fixed to the flange member adapted to penetrate the ice in the bin, with the teeth fixed to flange members of adjacent flites being staggered relative to each other whereby the teeth on adjacent flites penetrate the ice at closely spaced intervals to leave narrow ridges in the ice which can be fractured by contact with the flange members of each flite as the flites are advanced in the bin by the drive means.

6. Apparatus as defined in claim **5** wherein each channel member includes a pair of spaced, parallel flange members.

7. Apparatus as defined in claim **6** wherein both of the flange members of each flite have teeth fixed thereto, with the teeth of each flange member of each flite being staggered relative to each flange member.

8. Apparatus as defined in claim **5** wherein the ice rake is suspended in the bin at a level slightly above the level of the ice in the bin.

9. Apparatus as defined in claim **5** wherein the means to remove the ice from the bin includes conveyor means located adjacent to one end of the frame member.

10. Apparatus as defined in claim **9** wherein the floor of the bin includes a recess therein, and the conveyor means is positioned in the recess.

11. Apparatus as defined in claim **9** wherein the means to remove ice from the bin also includes a door panel, said door panel being mounted adjacent to the conveyor means on a plurality of pivoted arms whereby the door is adapted to be raised upwardly and away from the conveyor means to permit ice in the bin to engage the conveyor means for removal from the bin.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,797,267 Dated March 19, 1974

Inventor(s) William F. Hagen

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 35, change "or" to -- of --

Column 8, line 11, change "time" to -- means --

Signed and sealed this 16th day of July 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents