June 17, 1958 F. L. SMITH 2,839,254

ICING MACHINE

Filed March 20, 1956 7 Sheets-Sheet 1

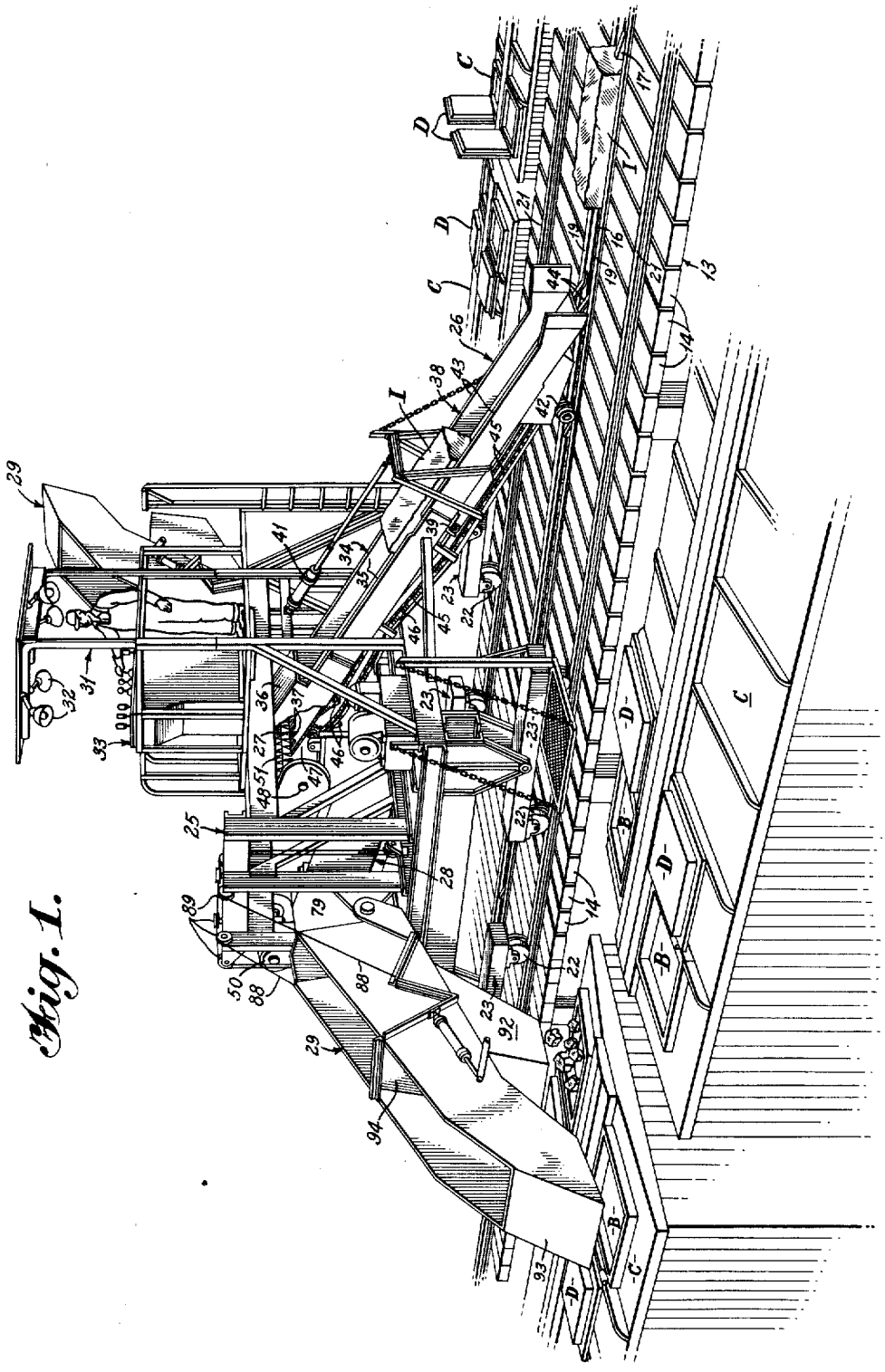


Fig. 1.

June 17, 1958 F. L. SMITH 2,839,254

ICING MACHINE

Filed March 20, 1956 7 Sheets-Sheet 2

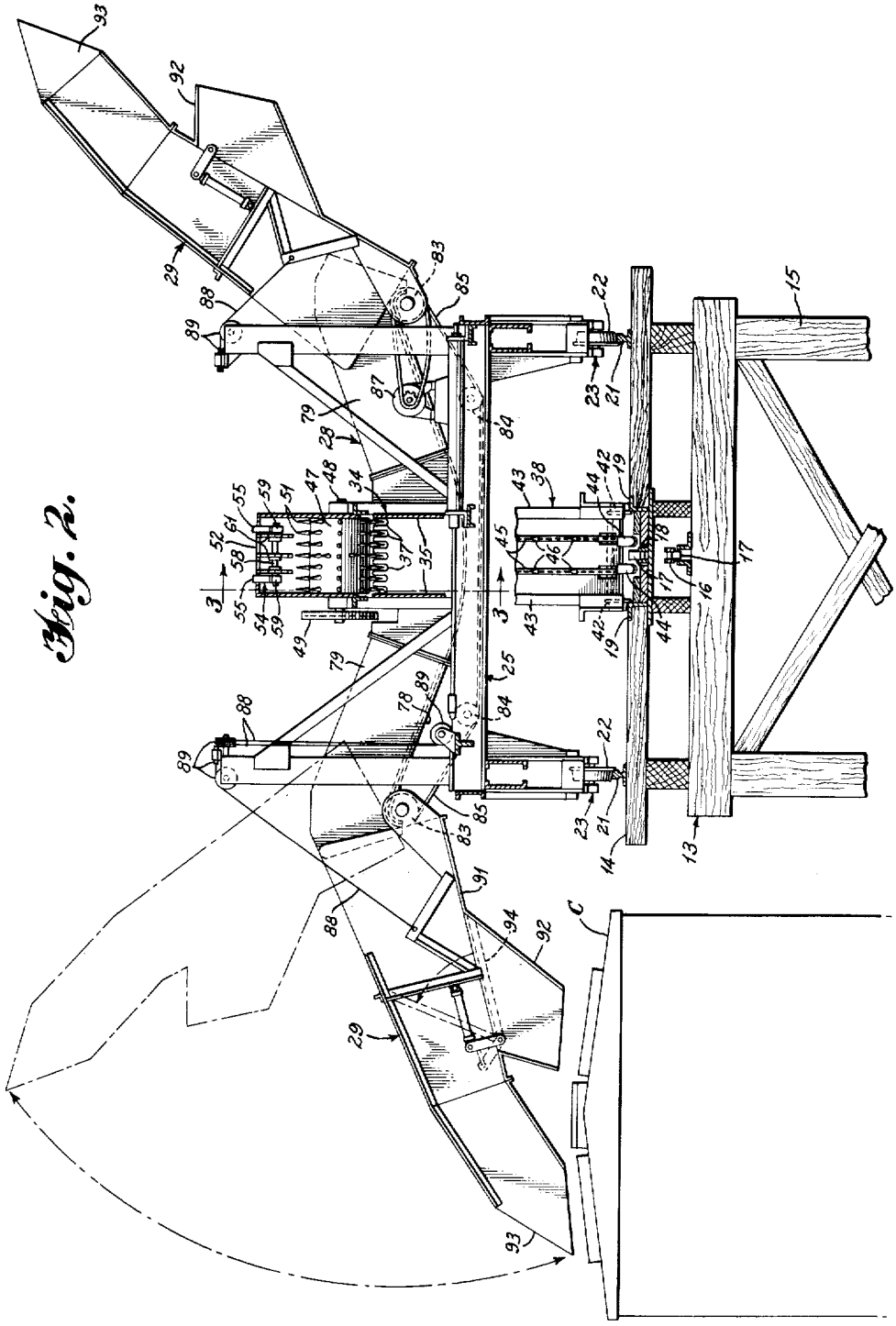


Fig. 2.

June 17, 1958 F. L. SMITH 2,839,254

ICING MACHINE

Filed March 20, 1956 7 Sheets-Sheet 3

Fig. 3.

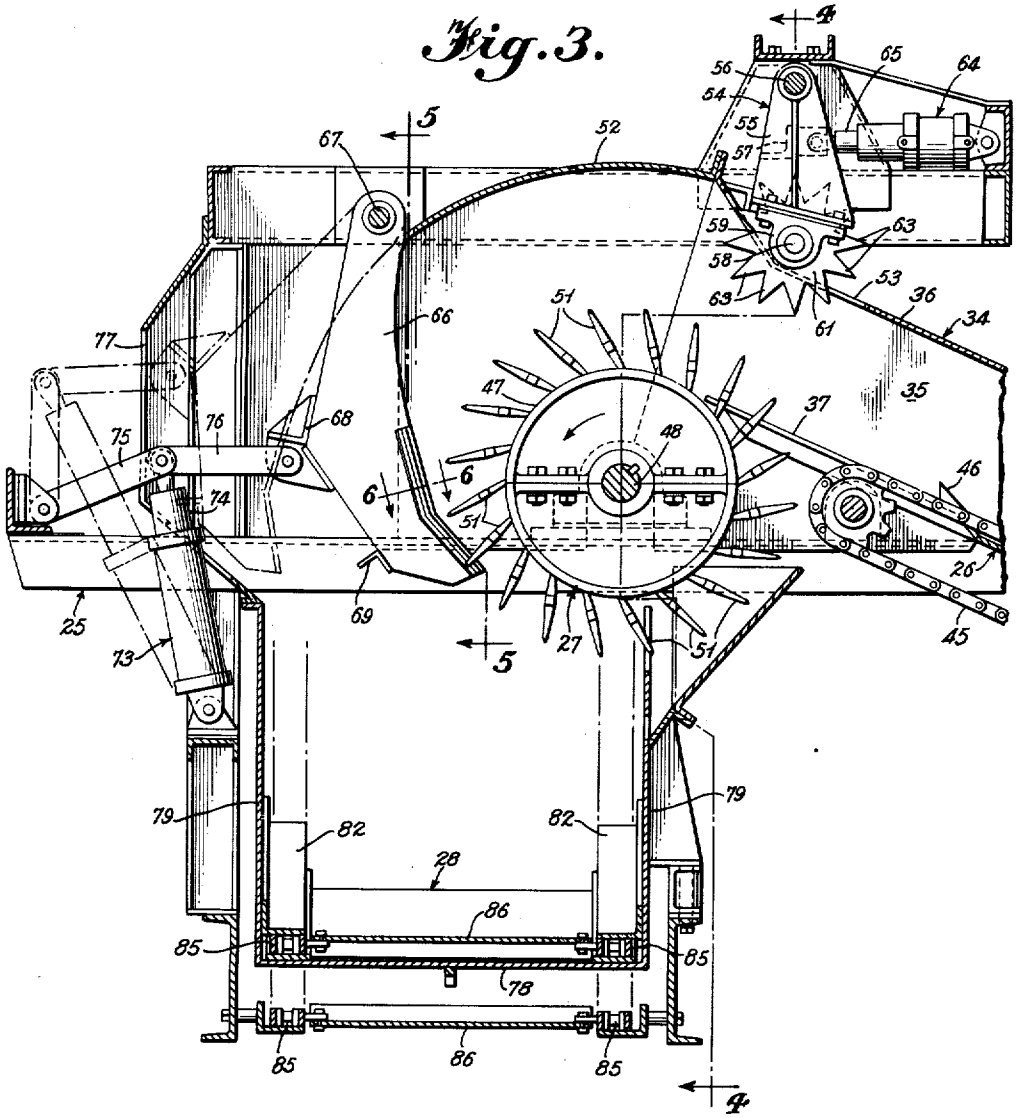
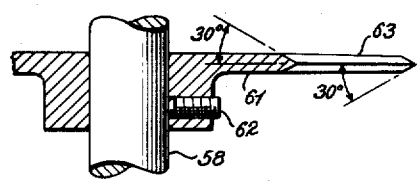


Fig. 9.

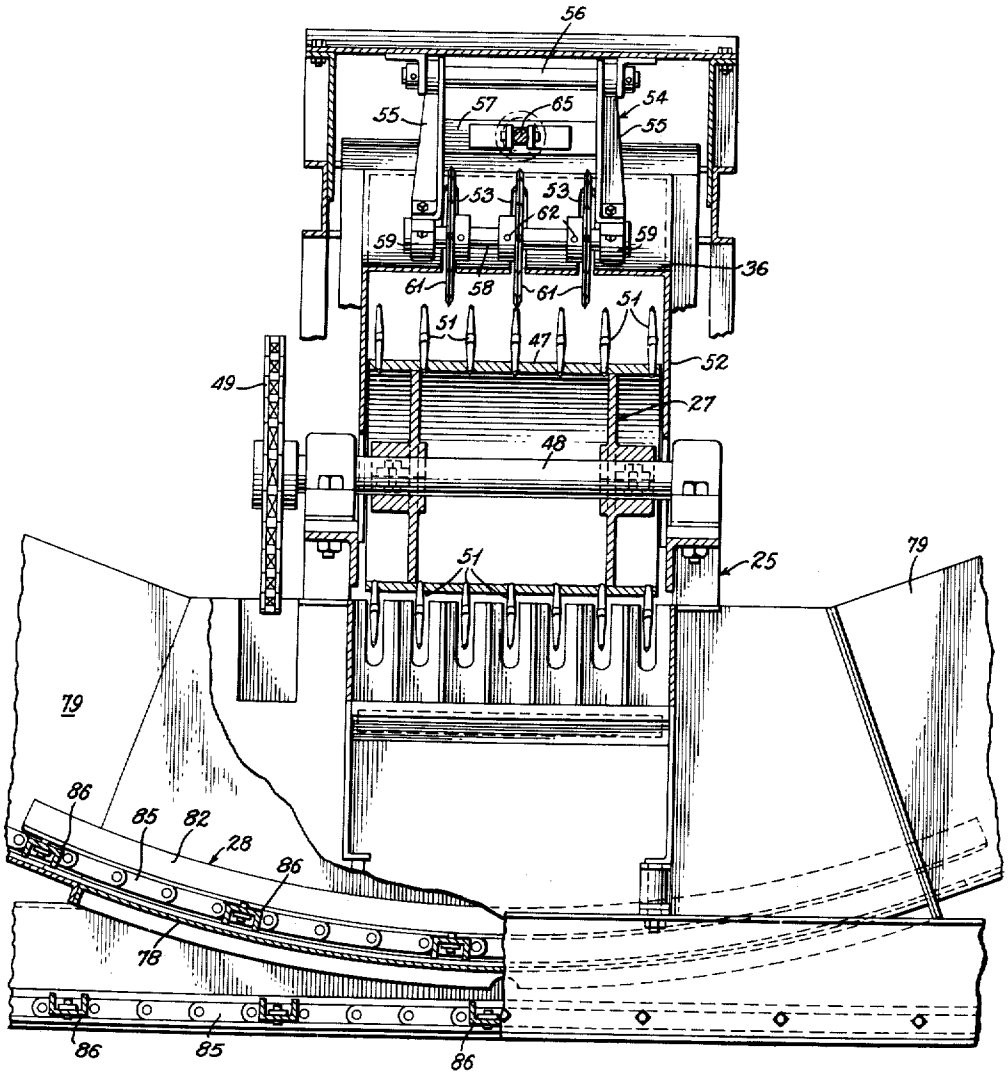


June 17, 1958 F. L. SMITH 2,839,254

ICING MACHINE

Filed March 20, 1956 7 Sheets-Sheet 4

Fig. 4.



June 17, 1958 F. L. SMITH 2,839,254

ICING MACHINE

Filed March 20, 1956 7 Sheets-Sheet 5

Fig. 5.

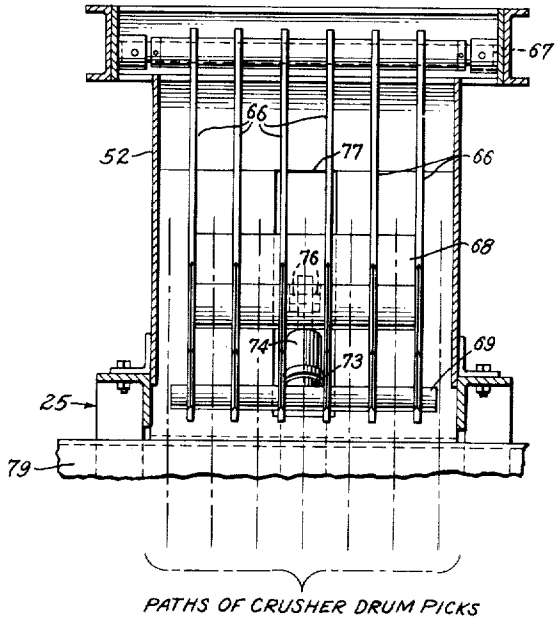
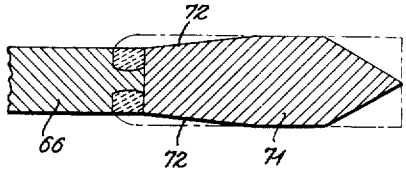


Fig. 6.



June 17, 1958 F. L. SMITH 2,839,254

ICING MACHINE

Filed March 20, 1956 7 Sheets-Sheet 6

Fig. 11.

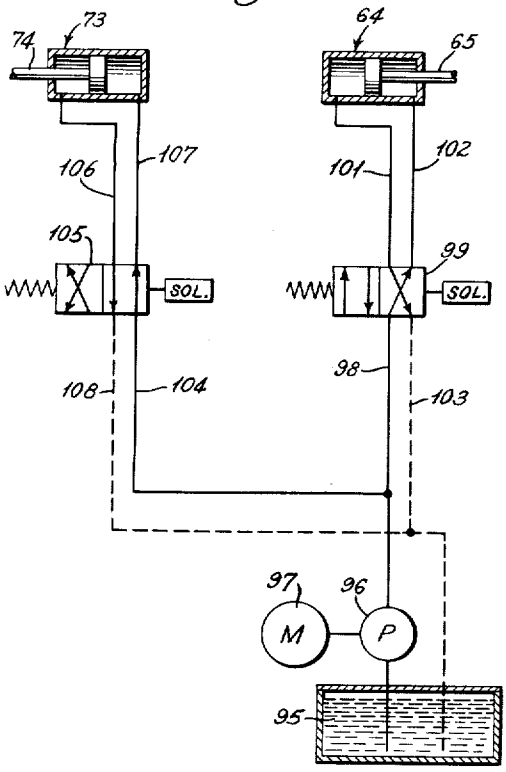


Fig. 10.

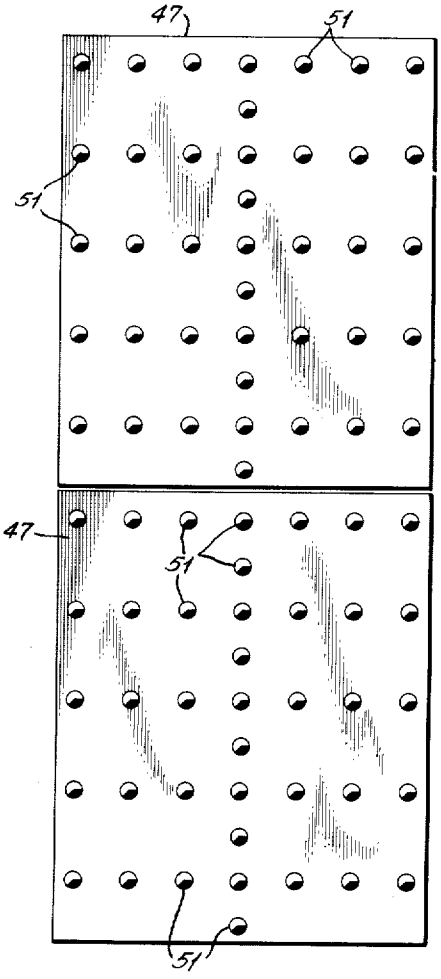


Fig. 7.

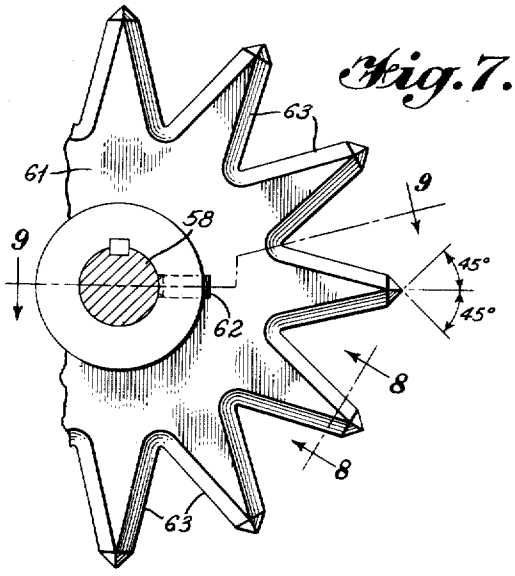
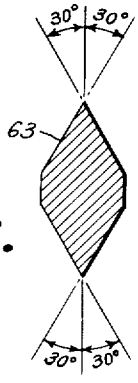


Fig. 8.



June 17, 1958 F. L. SMITH 2,839,254

ICING MACHINE

Filed March 20, 1956 7 Sheets-Sheet 7

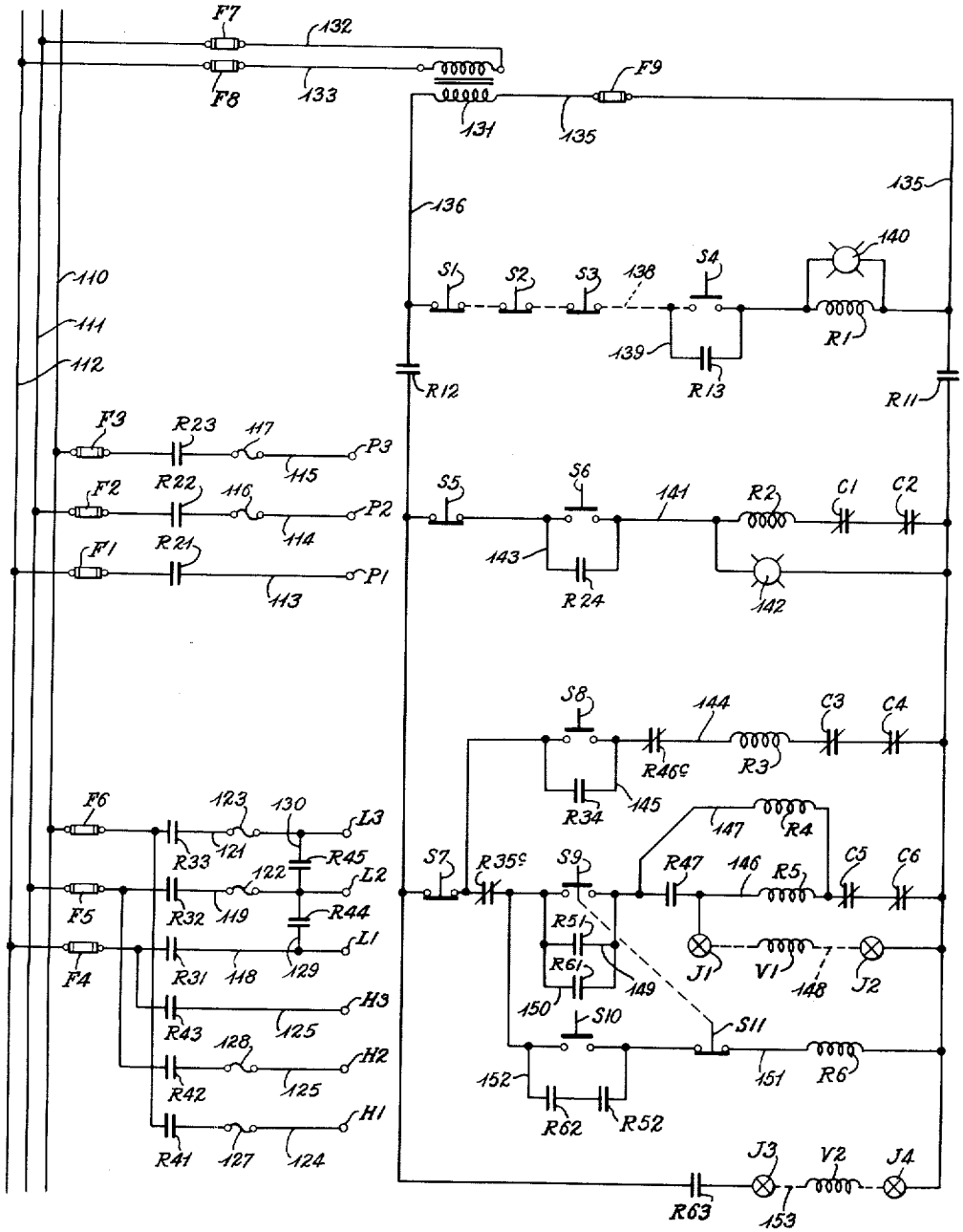


Fig. 12.

United States Patent Office 2,839,254 Patented June 17, 1958

2,839,254

ICING MACHINE

Frederick L. Smith, Maywood, Ill., assignor to Link-Belt Company, a corporation of Illinois

Application March 20, 1956, Serial No. 572,732

13 Claims. (Cl. 241—154)

This invention relates to new and useful improvements in machines for icing railway refrigerator cars and deals more particularly with the apparatus of such machines that is employed for handling cakes of ice of standard size and for conditioning and delivering the same to accomplish different types of refrigerating operations when introduced into the bunkers of such cars.

Railway refrigerator cars generally employ ice as the refrigerating medium for preserving perishable commodities which are transported over long distances. Of course, the bunkers of such cars must be supplied with the maximum amount of ice at the shipping point and lesser amounts must be added, when and where necessary, along the route of shipment. Further, it is essential to the proper refrigeration of the cars, for the different types of commodities being transported, that the average size of the particles, to which the cakes of ice are reduced, be adjustable.

Two important problems are presented in connection with the icing of railway refrigerator cars. First, the icing must be accomplished as quickly and efficienctly as passible so as not to tie up the icing dock and its equipment, and so as not to delay the movement of the train, any longer than is aboslutely necessary.

Secondly, the equipment employed for icing the cars must be designed and built to provide the greatest possible degree of dependability to avoid very costly shutdown periods. It will be appreciated that when a substantial number of railway cars must be iced at a given dock during each day, and the icing operation is performed manually, the company owning the icing facilities must employ, and have in readiness for use whenever a refrigerator train arrives, a substantial number of experienced laborers to handle the ice. Therefore, if an icing dock is completely mechanized and any part of the equipment fails, it is impossible for the operating company to locate and employ, on short notice, a sufficient number of experienced laborers to effect manual icing of the cars. For the above reasons, any failure of the equipment of a completely mechanized dock which cannot be repaired quickly may result in a delay which will cause spoilage of one or more complete trainloads of perishable commodities.

It is the primary object of the invention to provide a machine of durable construction for continuously receiving and reducing standard sized cakes of ice to smaller pieces of a selected average size and for distributing the smaller pieces to the ice bunkers of railway refrigerator cars.

A further important object of this invention is to provide apparatus for reducing standard sized cakes of ice to smaller pieces of a selected average size and for delivering the smaller pieces to refrigerator cars, the apparatus being quickly and easily adjustable to vary the selected average size of the smaller pieces of ice.

Still another important object of the invention is to provide a car icing machine employing a single driven

member for reducing cakes of ice of pieces having a selected smaller average size.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification in which like reference characters are employed to designate like parts throughout the same,

Figure 1 is a perspective view of a railway refrigerator car icing machine embodying the invention,

Figure 2 is an end elevational view of the machine illustrated in Fig. 1, partly broken away to show the ice crushing drum,

Figure 3 is a vertical sectional view taken on line 3—3 of Fig. 2,

Figure 4 is a transverse sectional view taken on line 4—4 of Fig. 3 and partly broken away to show the cross conveyor,

Figure 5 is a fragmentary vertical sectional view taken on line 5—5 of Fig. 3,

Figure 6 is a fragmentary sectional view of one of the secondary crusher blades taken on line 6—6 of Fig. 3,

Figure 7 is a fragmentary side elevational view of one the star wheels employed by the device,

Figure 8 is an enlarged sectional view taken on line 8—8 of Fig. 7,

Figure 9 is a fragmentary sectional view taken on line 9—9 of Fig. 7,

Figure 10 is a single plane projection of the cylindrical surface of the crusher drum showing the position of the picks thereon,

Figure 11 is a diagrammatic view of the hydraulic system for controlling the operation of the crusher unit, and

Figure 12 is a wiring diagram of the electrical circuits for controlling the operation of the crusher unit.

In the drawings, wherein for the purpose of illustration is shown the preferred embodiment of the invention, and first particularly referring to Figs. 1 and 2, there is shown a car icing dock that is designated in its entirety by the reference character **13**. This dock includes an elevated working platform formed of decking planks **14** which are supported by suitably reinforced trestlework **15**. an endless conveyor chain **16**, having pusher dogs **17** connected therein at spaced points along its length, is supported for movement of its active run in a guideway **18** which extends longitudinally along the dock **13** at or near the center of the latter. Angle members **19** are mounted on opposite sides of and in spaced relationship with the guideway **18** to engage and guide the movement of standard size manufactured cakes of ice I which are advanced along the dock by the pusher dogs **17**. The angle members **19** also function as guide tracks, as will be later described.

The dock **13** is preferably positioned between two sections of railway track so that conventional railway refrigerator cars C may be positioned on either or both sides of the dock. It is common practice, however, to successively ice only those cars on one side of the dock at a time so that, while the cars on either side are being iced, previously iced cars may be moved away from the other side of the dock and replaced by the cars to be iced. Conventional refrigerator cars C are provided with bunkers B for receiving the ice by means of which the cars are refrigerated and the top openings of the bunkers are normally provided with hinged covers D, as illustrated in Fig. 1.

Mounted adjacent opposite sides of the dock **13** are the longitudinally extending rails **21** for supporting and guiding the movement of the flanged wheels **22** of the trucks **23** at the four corners of a suitably fabricated frame **25**. This frame spans the portion of the dock **13** between the two rails **21** at an elevation which is sufficient to permit

movement of the cakes of ice I beneath the frame when desired. Certain of the wheels 22 are driven by a reversible drive mechanism, not shown, of any conventional type to permit traversing movement of the frame 25 longitudinally of the dock 13.

As illustrated in Figs. 1 and 2, the frame 25 has mounted thereon a pickup chute assembly 26, a crusher unit 27 and a cross conveyor assembly 28 having discharge chutes 29. In addition, there is provided an elevated control station 31 having flood lights 32 for night operations and a control panel 33 by means of which the operator can effect the various operating functions of the car icing device.

Referring now to Figs. 1 and 2 for a detail description of the pickup chute assembly 26, it will be noted that it includes a chute section 34 that is rigidly mounted on the frame 25 in an inclined position extending downwardly and outwardly from one end of the frame. The chute section 34 is provided with side boards 35 and its upper end portion is provided with a cover plate 36 extending between the tops of the two side boards. A series of laterally spaced notches 37 are formed in the upper end portion of the bottom of the chute section 34 for a purpose that will be later described.

A second chute section 38 is connected to the lower end portion of the first section 34 by a laterally arranged pin 39 which permits the chute section 38 to be pivoted vertically by operation of the fluid motor 41. In its lowered position, the chute section 38 is substantially aligned with the chute section 34 and when raised the chute section 38 is in a substantially horizontal position above the dock 13. When the chute section 38 is in its lowered position, its outer end portion is supported for movement along the dock 13 by flanged wheels 42 which engage the angle members 19. In order to permit the wheels 42 to follow any transverse irregularities in the members 19, the pin 39 may be pivotally connected to the chute section 34 in such a manner as to permit limited pivotal movement of the chute section 38 in a lateral direction. The side boards 43 of the second chute section 38 are flared outwardly at their lower ends and laterally spaced fork members 44 extend downwardly from the end of this chute section into positions on opposite sides of the conveyor chain 16 for lifting the cakes of ice I off of the dock 13 and into the chute assembly 26 as they are moved longitudinally of the dock by the pusher members 17.

Mounted on the chute assembly 26 are a pair of endless chains 45 which are trained around laterally spaced pairs of sprockets at the upper end of the chute section 34 and at the lower end of the chute section 38 for movement of their active runs upwardly along the bottoms of the two chute sections. Connected at longitudinally spaced points in each of the chains 45 are the members 46 which project upwardly from the chains for engaging the cakes of ice I that have been moved into the chute assembly to feed the cakes upwardly along the chute assembly 26.

Referring now to Figs. 3 to 10, inclusive, for a detail description of the ice crusher unit 27, and first particularly referring to Fig. 3, it will be noted that the crusher drum 47 is supported by its shaft 48 for rotation on the frame 25. This shaft is arranged to support the upper periphery of the drum transversely of and in substantially tangential relationship with the upper end portion of the chute section 34. As illustrated in Fig. 4, one end portion of the shaft 48 has mounted thereon a drive sprocket 49. This sprocket is operatively connected to an electric drive motor 50, see Fig. 1, for rotating the drum. It will be noted at this point that the drive motor 50 is of a conventional, two-speed type and that the rotation of the drum is such that the direction of movement of its periphery at the point of tangency with the chute section 34 corresponds with the direction of movement of the ice cakes I in the chute assembly 26.

Suitably attached to the peripheral wall of the drum

47 are a plurality of picks 51 which, as illustrated in Fig. 10, are arranged in transverse rows spaced circumferentially of the drums and extending longitudinally of its axis, and circumferentially extending rows axially spaced in respect to the drum axis, with the spacing between adjacent transverse rows being greater than the spacing between adjacent circumferential rows. All of the circumferential rows have picks in axial alignment while the middle circumferential row is provided with additional picks that are arranged between said aligned picks to provide said middle row with twice as many picks as the remaining circumferential rows. Referring now to Fig. 3, it will be noted that all of the picks 51 are mounted on the drum 47 in inclined positions relative to the radii of the drum so that the points of the picks project forwardly in the direction of rotation of the drum and so that the picks passing through the plane of the chute section 34 are substantially normal to the latter. Further, at the lower speed of operation of the drive motor 50 the linear velocity of the outer end portions of the picks 51 is substantially equal to the velocity of movement of the ice cakes by the pusher members 46 to minimize degradation of the ice as will be later described.

The drum 47 is positioned within a housing 52, the upper portion of which is arcuately formed and is spaced outwardly from the drum 47 and the picks 51 thereon at a greater radial distance from the latter than the cover 36 of the chute section 34 which is connected to and forms a continuation of the curved top of the housing 52. This increase in the radial spacing of the upper portion of the housing 52 provides space for the expansion of the volume of the ice after the initial breaking or crushing operation. The cover 36 of the chute section 34 is provided with three laterally spaced, longitudinally extending slots 53, as is best illustrated in Figs. 3 and 4. The slots 53 are located outwardly opposite the position of tangency between the drum and the bottom of the chute section 34.

Directly above the slots 53 there is provided a mount 54 having laterally spaced arms 55 which are pivotally connected to the frame 25 by the pivot pin 56. The middle portions of the arms 55 are rigidly connected to each other by the cross brace 57 and a shaft 58 extends between and is rotatably supported on the free ends of the arms 55 by bearing blocks 59. Mounted on the shaft 58, with the same lateral spacing therebetween as that of the slots 53, are three star wheels 61 which, as illustrated in Fig. 9, are rigidly connected to the shaft by set screws 62. As best illustrated in Figs. 3, 4 and 7, each of the star wheels 61 has a plurality of teeth 63 formed around its periphery. Each of the teeth 63 has its radial edges and its point sharpened to facilitate penetration of the ice cakes I, as will be later described.

Referring once again to Fig. 3, it will be noted that a fluid motor 64 is pivotally mounted on the frame 25 and has its operating plunger 65 pivotally connected to the cross brace 57 so that operation of the fluid motor will impart pivotal movement to the mount 54. When the plunger 65 is in its extended position, the mount 54 will be moved to the substantially vertical position of this figure at which time the teeth 63 will project through the slots 53 for penetration into the upper portions of the cakes of ice I moving through the upper end portion of the chute section 34. On the other hand, when the plunger 65 is retracted, the mount 54 will be swung away from its substantially vertical position and will move the star wheels 61 to an inoperative position at which the teeth 63 will no longer engage the cakes of ice I moving through the upper end portion of the chute section 34. The star wheels 61, therefore, are movable into and out of an operative position by the selective operation of the fluid motor 64 and, when in their lowered positions, will perform a primary crushing operation, as will be later described.

Referring now to Figs. 3, 5 and 6 for a detail descrip-

tion of the secondary ice crushing mechanism, it will be noted that a plurality of laterally spaced blades **66** are suspended from a pin **67** for limited pivotal movement within the side of the housing **52** opposite the discharge point of the chute assembly **26**. This pivotal movement of the blades **66** will place their lower end portions in closely spaced relationship with the drum **47**, as illustrated by the full-line showing of Fig. 3 and in radially outwardly spaced relationship with the drum **47**, as illustrated by the broken-line showing of Fig. 3. The rear edges of the blades **66** are rigidly connected to each other by the cross brace **68** and by an angle member **69**. The spacing between the blades is such that they are aligned with the spaces between adjacent circumferentially extending rows of picks **51** on the drum **47**. When the blades **66** are moved into their operative positions, in closely spaced relationship with the drum **47**, the picks **51** will move between adjacent blades.

As illustrated in Fig. 6, each blade **66** has a bar **71** welded to and extending along its inner edge at its lower end portion. Each bar **71** has a sharpened inner edge formed by grinding away the corners at the inner edge of the bar and the sides of each bar are ground to provide converging surfaces **72** so that pieces of ice which pass between the bars will not wedge between the blades. It will be noted that the inner edges of the blades **66** and the sharpened inner edges of the bars **71** are longitudinally curved so that when the blades **66** are moved into their inoperative positions, as illustrated by the broken lines in Fig. 3, the inner edges form a continuation of the curved top of the drum housing **52**.

Selective pivotal movement of the blades **66** into and out of their operative positions is produced by a fluid motor **73** which is pivotally mounted on the frame **25** and has its operating plunger **74** pivotally connected to the adjacent ends of two links **75** and **76**. The link **75** has its other end portion pivotally connected to the frame **25** and the other end of the link **76** is pivotally connected to the cross brace **68** so that extension and retraction of the plunger **74** will vary the angle between the two links **75** and **76** to cause the blades to swing toward and away from the drum **47**. An opening **77** is provided in the wall of the housing **52** to afford clearance for the above described operation of the fluid motor **74**.

Referring now to Figs. 2 to 4, inclusive, for a detail description of the cross conveyor assembly **28**, there is mounted on the frame **25** a transversely extending pan **78** the middle portion of which forms the bottom wall of the housing **52** and the opposite end portions of which are curved upwarly in opposite directions from the housing to the sides of the frame. Side boards **79** are provided for the pan **78** at each side of the housing **52**. Clearance is provided for the drive sprocket **49** on the drum shaft **48**. The housing is formed with side openings into the enclosed space above the pan. Mounted on each side wall **79** along the middle portion of the pan **78** is an angle member **82**, one flange of which provides a guide rail in vertically spaced relationship above the adjacent side edge of the pan **78**. At each end of the pan **78**, a pair of chain sprockets **83** are mounted in radial alignment with opposite side edge portions of the pan and additional pairs of chain sprockets **84** are mounted in radial alignment with the sprockets **83** beneath and spaced inwardly from the ends of the pan. A pair of chains **85** are trained over the radially aligned sprockets **83** and **84** with the active runs of the chains passing over opposite side edge portions of the pan **78** and beneath the hold-down rails provided by the angle members **82**. At longitudinally spaced points along their lengths, the chains **85** are connected by channel members **86** which function as pushers for moving the crushed pieces of ice that have dropped into the pan **78**. One of the pairs of sprockets **83** is driven by a reversible drive motor **87** of a conventional type so that the ice from the crusher unit **27** may be moved in either direction to the end portion of the pan from which it is to be distributed, as will be later described. It will also be noted that by alternate operation of the drive motor **87** in opposite directions, pieces of ice may be accumulated for subsequent distribution to either end portion of the pan **78**.

The discharge chutes **29** are pivotally mounted on the frame **25** to extend outwardly from the opposite ends of the pan **78**. Each discharge chute **29** is raised and lowered by a system of cables **88** and pulleys **89**. When in its lowered position, the bottom **91** of the chute underlies the associated end portion of the pan **78** and is inclined downwardly and outwardly therefrom. In the bottom **91** of the chute **29** there are provided a pair of spaced discharge spouts **92** and **93**. The spout **92** nearest the associated end portion of the pan **78** has a selectively operated gate **94** by means of which the spout **92** can be opened or closed so that pieces of ice moving down the chute will be discharged through the spout **92** or will pass over the gate **94** to the discharge spout **93**. By reference to Figs. 1 and 2, it will be seen that the spacing between the two discharge spouts **92** and **93** corresponds to the spacing between the access openings for the bunkers B of a conventional refrigerator car C.

Referring now to Fig. 11, it will be noted that the fluid motor **64** for moving the star wheels **61** between their operative and inoperative positions, and the fluid motor **73** for moving the blades **66** between their operative and inoperative positions are actuated by pressure fluid which is supplied from a sump **95** by a pump **96** driven by a motor **97**. Pressure fluid from the pump **96** flows through a branch line **98** to a solenoid operated valve **99** and into one or another of the two lines **101** or **102** leading from the valve to the fluid motor **64**, depending upon the position of the valve. The other line **101** or **102** communicates through the valve **99** with a return line **103** for the return of fluid from the motor **64** to the sump **95**. A second branch line **104** conducts pressure fluid from the pump **96** to a second solenoid operated valve **105** for flow into one or another of the two lines **106** or **107** leading from the valve to the fluid motor **73** in accordance with the position of the valve. The other line **106** or **107** communicates through the valve **105** with a liquid return line **108** for the return flow of fluid from the motor **73** to the sump **95**. It will be readily apparent, therefore, that the control of the energization of the solenoid operated valves **99** and **105** will control the operation of the fluid motors **64** and **73**, as will be later described.

Reference is now made to Fig. 12 for a detail description of the operation and control of the crusher unit **27**. The terminals **P1**, **P2** and **P3**, representing the pump motor **97**, are connected to the three wires **110**, **111** and **112** of an electrical supply circuit by lead wires **113**, **114** and **115**, respectively. These three lead wires have connected therein normally open contactors **R21**, **R22** and **R23** which are closed to actuate the motor **97** by energization of electromagnetic coil **R2** in the control circuit, as will be later described. The three lead wires are further provided with fuses **F1**, **F2** and **F3** and the lead wires **114** and **115** are provided with heater elements **116** and **117**, respectively, which will operate the contactors **C1** and **C2** in the control circuit to protect the motor **97** from operation in an overloaded condition.

The motor **50** for operating the crusher drum **47** is represented in part by the low speed terminals **L1**, **L2** and **L3** which are connected to the supply lines **110** to **112**, inclusive, by the lead wires **118**, **119** and **121**, respectively, through the normally open contactors **R31**, **R32** and **R33** and fuses **F4**, **F5** and **F6**. Further, the lead wires **119** and **121** are provided with heater elements **122** and **123**, respectively, for operating the contactors **C3** and **C4** in the control circuit to prevent operation of the motor in an overloaded condition. The contactors **R31**, **R32** and **R33** are closed by energization of the electromagnetic coil **R3** in the control circuit, as will be later described.

The motor 50 is further represented by the high speed terminals H1, H2 and H3 which are connected by the lead wires 124, 125 and 126 to the lead wires 121, 119 and 118, respectively, through normally open contactors R41, R42 and R43. The points of connection between the lead wires 124, 125 and 126 and their associated lead wires 121, 119 and 118, respectively, are located between the contactors R33, R32 and R31 and the fuses F6, F5 and F4. The lead wires 124 and 125 are provided with heater elements 127 and 128, respectively, for operating contactors C5 and C6 in the control circuit to prevent operation of the motor 50 in an overloaded condition. Contactors R41, R42 and R43 are closed by energization of an electromagnetic coil R4 in the control circuit, as will be later described, and additional, normally open contactors R44 and R45 are provided for closing circuits through the wires 129 and 130 between the lead wires 118 and 119, and 119 and 121, respectively.

A transformer 131 has its primary terminals connected to the supply lines 111 and 112 by lead wires 132 and 133 which are provided with fuses F7 and F8, respectively. Connected to the secondary terminals of the transformer 131 are two wires 135 and 136 which form the two sides of a control circuit between which the various elements of the control circuit are connected. The wire 135 is provided with a fuse F9 and the wires 135 and 136 have connected therein normally open contactors R11 and R12, respectively, the operation of which is controlled by energization of an electromagnetic coil R1, as will be later described. It will be noted at this point that all of the elements of the control circuit, with the exception of certain remote control units which will be specifically mentioned at a later time, are located at the control panel 33 of the operating station 31.

The electromagnetic coil R1 is connected into a line 138 between the wires 135 and 136 of the control circuit, the junctions between line 138 and the two wires 135 and 136 being between the contactors R11 and R12 and the secondary terminals of the transformer 131. Three normally closed push-button type switches S1 to S3, inclusive, and one normally open push-button type switch S4 are connected into the line 138 in series with the coil R1, the switches S2 and S3 being located at a remote point from the control panel 33 for emergency operation. A branch line 139 is connected in parallel with the normally open switch S4 through a normally open contactor R13 which is closed by energization of the coil R1, and a signal light 140 is connected in parallel with the coil R1 to indicate energization of the coil.

When the normally open switch S4 is closed, current will flow through the coil R1 and will close the three normally open contactors R13, R11 and R12 in branch line 139 and in the two wires 135 and 136. When the switch S4 is released, therefore, the circuit through the coil will remain closed through the branch line 139 and the remainder of the control circuit between the wires 135 and 136 will be readied for operation. The coil R1 will remain energized until the normally closed switch S1 at the control panel 33 is opened or one of the remotely controlled emergency switches S2 or S3 is opened.

The electromagnetic coil R2, for controlling the operation of the contactors R21, R22 and R23 and thereby controlling the operation of the motor 97, is connected into a line 141 between the wires 135 and 136 through a normally closed push-button type switch S5 and a normally open push-button type switch S6 and through two normally closed contactors C1 and C2 which will open to prevent operation of the motor 97 when the motor is overloaded and the current passing through the lead wires 114 and 115 is sufficiently high to cause the temperature of the heater elements to increase to a predetermined value. A signal light 142 is connected in parallel with the coil R2 and the contactors C1 and C2 to indicate whether or not the coil is energized, and a branch wire 143 is connected in parallel relationship with the switch S6 through a normally open contactor R24 that is operated by the coil R2. Operation of the normally open switch S6, therefore, will close the circuit to energize the coil R2 and to close the contactors R21, R22 and R23 for starting the motor 97 and the contactor R24 in branch line 143 so that when the switch is released the coil will remain in an energized condition. To stop the operation of the motor 97 the normally closed switch S5 is operated to open the circuit through the coil R2 at which time all of the contactors R21, R22, R23 and R24 will open so that the subsequent release of the switch S5 cannot re-energize the coil.

The electromagnetic coil R3, for controlling the flow of current to the low speed terminals L1, L2 and L3 of the motor 50 by operation of the contactors R31, R32 and R33, is connected into a line 144 between the wires 135 and 136 of the control circuit through a normally closed push-button type switch S7, a normally open push-button type switch S8, normally closed contactor R46c and two normally closed contactors C3 and C4. The contactors C3 and C4 are opened by an increase in the load on the motor 50 to such an extent that the current supplied to the low speed terminals L2 and L3 through the lead wires 119 and 121 will cause the temperature of the heater elements 122 and 123 to increase to a predetermined value. The normally closed contactor R46c is opened by energization of the electromagnetic coil R4, which also operates the normally open contactors R41, R42, R43, R44 and R45, to prevent energization of both of the coils R3 and R4 at the same time, as will be later described. A branch wire 145 is connected in parallel with the normally open switch S8 through an additional, normally open contactor R34 which is closed by energization of the coil R3. An additional, normally closed contactor R35c is operated by the coil R3 and is connected in series with the electromagnetic coils R4 and R5 to positively prevent energization of these coils when the coil R3 is energized, as will be later described.

The coil R5 which, when energized, closes the normally open contactors R51 and R52, is connected into a line 146 between the wires 135 and 136 of the control circuit through the normally closed switch S7, normally closed contactor R35c, a normally open push-button type switch S9, normally open contactor R47 and normally closed contactors C5 and C6 which are opened when the load on the motor 50 increases and the current supplied to the high speed terminals H1 and H2 through the lead wires 124 and 125 causes the temperature of the heater elements 127 and 128 to increase to a predetermined value. The coil R4 is connected in parallel relationship with the coil R5 and the contactor R47 through a branch line 147 and the electromagnetic coil V1 of the solenoid operated valve 99 is connected in parallel relationship with the coil R5 and the contactors C5 and C6 through a branch line 148 which leads through jacks J1 and J2 at the control panel 33 and to the remotely positioned valve 99. Two branch lines 149 and 150 are connected in parallel with the normally open switch S9 through normally open contactors R51 and R61, respectively, the contactor R51 being closed by energization of the coil R5 and the contactor R61 being closed by energization of a coil R6, as will be later described.

The electromagnetic coil R6 is connected into a line 151 between the wires 135 and 136 of the control circuit through the normally closed push-button type switch S7, normally closed contactor R35c, a normally open push-button type switch S10 and a normally closed push-button switch S11 which is coupled for operation with the switch S9 so that when the switch S9 is closed the switch S11 is opened and when the switch S9 is released the switch S11 is closed. A branch line 152 is connected in parallel relationship with the normally open switch S10 through normally open contactors R52 and R62 which are closed by energization of the coils R5 and R6, respectively.

The operating coil V2 of the solenoid operated valve 105 is connected between the wires 135 and 136 of the control circuit by a line 15[illegible] which leads from the remotely positioned valve through jacks J3 and J4, respectively, at the control panel 33 and through normally open contactor R63 which is closed by energization of the coil R6.

Assuming first that the switch S7 has been opened, all of the coils R3, R4, R5 and R6 will be de-energized and all of the normally open contactors R31 to R34, inclusive; R41 to R45, inclusive; and R47; R51 and R52; and R61 to R63, inclusive, will be opened by de-energization of the coils so that the motor 50 will be stopped and the subsequent release of the switch S7 will not effect re-energization of any one of the coils. The de-energization of coils R3 and R4 will also cause the normally closed contactor R35c and R46c to be closed. The coils V1 and V2 of the two solenoid operated valves 99 and 105 will also be de-energized so that the valves will effect movement of their associated fluid motors 64 and 73, respectively, to position the star wheels 61 and blades 66 in their inoperative positions.

The motor 50 may thereafter be set into operation by closing any one of the three switches S8, S9 or S10. If the switch S8 is closed, the coil R3 will be energized to close all of the normally open contactors R31 to R34, inclusive, and to open the normally closed contactor R35c so that current will flow to the low speed terminals L1 to L3, inclusive, of the motor 50 and the branch line 145 which is arranged in parallel relationship with the switch S8 will remain closed after the switch is released to prevent de-energization of the coil by the release of the switch.

The opening of the contactor R35c, however, will prevent energization of any of the coils R4, R5 and R6 or the coils V1 or V2 of the valves 99 and 105, respectively. The two solenoid operated valves 99 and 105, therefore, will remain in their positions for causing their associated fluid motors 64 and 73 to maintain the star wheels 61 and blades 66 in their inoperative positions. It might be noted at this point that for so long as the coil R3 is energized the coils R4 and R5 cannot be energized by closing of the switch S9 and the coil R6 cannot be energized by closing the switch S10 because of the open condition of the contactor R35c.

When the motor 50 is operating at its lower speed, it will be recalled that the linear velocity of the outer end portions of the picks 51 is substantially equal to the linear velocity of the cakes of ice I moving through the chute section 34 for engagement by the picks 51. The longitudinally arranged rows of picks 51, therefore, will engage the cakes of ice I along spaced lines across the bottoms of the cakes and will tend to break the cakes of ice into pieces along these lines. The average size of the pieces of ice to which the cakes are reduced by this operation is relatively large and, for purpose of commercial classification, is referred to as chunk ice.

As an example of the above described low speed operation for producing chunk ice, with the motor 50 operating at its low speed and being connected to the drum 47 to rotate the latter at a speed of twenty-nine revolutions per minute and with the diameter across the drum and between the points of the diametrically opposed picks being equal to twenty-seven and one-half inches, the cakes of ice I may be advanced along the chute section 34 at a velocity of one hundred and ninety feet per minute which substantially equals the linear velocity of the outer end portions of the picks 51.

Pieces of ice having a smaller average size than the chunk ice produced by the operation described above may be produced by the crusher unit 27 by opening the switch S7 to stop the motor 50 and by thereafter closing the switch S9 to energize the coil R4. When the coil R4 is energized, the normally closed contactor R46c is opened to positively prevent any closing of the normally open contactors R31 to R34, inclusive, and current will be supplied to the high speed terminals H1 to H3, inclusive, of the motor 50 through the contactors R41 to R43, inclusive. In addition, the contactor R47 in line 146 is closed to energize the coil R5 which in turn closes the contactors R51 and R52 which are connected in parallel relationship with the switches S9 and S10 through branch lines 149 and 152, respectively, so that the subsequent release of the switch S9 will not deenergize the coil R4. The coil R6, however, will not be energized because of the continued open condition of the switch S10 and contactor R62 arranged in parallel relationship therewith. In addition to energizing the coil R5, the closing of contactor R47 will complete a circuit through coil V1 of the solenoid operated valve 99 to move the valve to a position at which its associated fluid motor 64 will move the star wheels 61 to their operative position for engagement with the cakes of ice I in the chute section 34. The coil V2 of the valve 105, however, will remain in its de-energized condition and the blades 66 will be held in their inoperative positions by the fluid motor 73.

With the motor 50 operating at its higher speed and the star wheels 61 in their operative positions, the bottoms of the cakes of ice I passing upwardly along the chute section 34 will be engaged by the picks 51 traveling at a velocity considerably above the linear velocity of the cakes and the tops of the cakes of ice will at the same time be engaged by the freely rotatable star wheels. The cakes of ice will then be forced between the rotating picks and the star wheels 61 by the pusher members 46 to accomplish what is referred to as the primary crushing operation. During this primary crushing operation the picks and the star wheels function simultaneously and in cooperation to reduce the cakes of ice to pieces having an average size which is smaller than that of the previously described chunk ice and which is commercially classified as coarse ice. This coarse ice may be produced, for example, with a drum speed of fifty-eight revolutions per minute and with the cakes of ice being advanced along the chute section 34 at a velocity of one hundred and ninety feet per minute into a position for engagement by the picks 51 and the star wheels 61.

Pieces of ice of a still smaller average size may be produced by the crusher unit 27 by closing the switch S10 either while the coils R4 and R5 are energized or after the switch S7 has been opened to de-energize all of the coils R3, R4, R5 and R6. Closing the switch S10 while the coils R4 and R5 are energized will cause the three normally open contactors R61 to R63, inclusive, to be closed so that the second branch line 150 is closed in parallel relationship with the open switch S9, the branch line 152 is closed through the contactors R52 and R62 in parallel relationship with the switch S10 so that subsequent release of the switch will not de-energize the coil R6, and a circuit is closed through the coil V2 of the solenoid operated valve 105 to cause the fluid motor 73 associated with the valve to move the blades 66 to their operative positions.

If the switch S10 is closed to energize the coil R6 subsequent to the opening of the switch S7, the closing of the contactor R61 will energize the coils R4 and R5 in the same manner as closing the switch S9. In either event, the closing of the switch S10 will cause all of the coils R4, R5, R6, V1 and V2 to be energized so that the drum 47 will be rotated at its higher speed and the star wheels 61 and blades 66 will be moved to their operative positions. Under these conditions, the cakes of ice I moving through the upper chute section 34 will be subjected to a primary crushing operation to produce coarse ice as described above and the pieces of coarse ice will pass around the drum 47 to the operative position of the blades 66 where they are subjected to a secondary crushing action by the picks 51 forcing the ice through and between the blades. The average size of the pieces of

ice that have passed through the secondary crushing operation is substantially smaller than that of either the chunk or the coarse ice described above and is commercially classified as crushed ice.

The crusher unit **27** can be converted from the production of crushed ice to the production of coarse ice by closing the switch **S9** while the crusher is in operation. The closing of the switch **S9** opens the switch **S11** to de-energize the coil **R6** and open the normally open contactors **R51**, **R52** and **R53** so that the coil **V2** of the solenoid operated valve **105** is de-energized to cause the fluid motor **73** to move the blades **66** to their inoperative positions.

Referring once again to Figs. 1 and 2 for a brief description of the overall operation of the device for icing the railway refrigerator cars C, it will be noted that the apparatus is moved along the dock **13** on the rails **21** to a position at which the lowered chute **29** is aligned with the top openings of the bunkers B of a car on one side of the dock. The large cakes of ice I moved along the dock **13** by the pusher members **17** of the chain **16** will be advanced into the chute section **38** and will be moved upwardly along the chute assembly **26** by the pusher members **46** of the chains **45** irrespective of the position of the apparatus on the rails **21**. The cakes of ice I at the upper end section of the chute section **34** are introduced to the crusher unit **27** where they are reduced in size to either chunk, coarse or crushed ice as was previously described, and the pieces of ice from the crusher unit will fall into the middle portion of the pan **78** for movement to the selected end of the latter in accordance with the direction of operation of the chains **85**. At the selected end of the pan **78**, the particles of ice are discharged into the properly positioned discharge chute **29** for flow through the selected spout **92** or **93** into one or another of the bunkers B of the refrigerator car C with which the discharge spouts are aligned. The entire icing operation is controlled by a workman at the station **31** in accordance with the operation of the controls on the panel **33**.

It will be readily apparent that the apparatus will provide for the rapid and efficient icing of large numbers of refrigerator cars C and that since the drum **47** is the only driven member of the crusher unit **27**, there will be a minimum of maintenance and repair requirements for the crusher unit and any necessary repairs may be easily and quickly made.

It is to be understood that the form of this invention herewith shown and described is to be taken as a preferred example of the same and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described the invention, I claim:

1. In an apparatus for icing railway refrigerator cars, the combination comprising a drum mounted for rotation about a horizontal axis, means for guiding cakes of ice tangentially toward the top of said drum to bring the bottom portions of said cakes into engagement therewith, a plurality of picks mounted on said drum and projecting outwardly therefrom, means for rotating said drum to move the picks thereon in a direction corresponding to the movement of the cakes of ice toward said drum, primary ice crushing means mounted for free rotation and movable into and out of an operative position for engaging the upper portions of the cakes of ice above the point at which their bottom portions engage said drum, and secondary ice crushing means mounted for movement into and out of an operative position intermediate the paths of movement of said picks at a location that is spaced circumferentially of said drum from said primary crushing means.

2. Apparatus as defined in claim 1 further characterized by said picks being mounted on said drum in circumferentially extending rows that are spaced axially of said drum, said guide means including a chute having notches in its upper end portion for movement of said rows of picks therethrough into breaking engagement with the bottoms of the cakes of ice at the upper end portion of the chute, and said secondary crushing means comprising a plurality of blades mounted for joint movement to position their corresponding end portions in the spaces between adjacent rows of picks.

3. Apparatus as defined in claim 2 further characterized by said primary crushing means comprising a plurality of toothed wheels radially movable to an operative position for peripherally engaging the upper portions of the cakes of ice at the upper end portion of said chute, and a fluid motor for moving said wheels into and out of their operative positions.

4. Apparatus for icing railway refrigerator cars, comprising a cylindrical member mounted for rotation about a horizontal axis and having a plurality of picks mounted thereon to extend outwardly therefrom, means for rotating said member, means for moving cakes of ice tangentially of the upper portion of said member for engagement by said picks to break the cakes into pieces of ice of a given average size, primary crushing means selectively movable into and out of an operative position in the tangential path of movement of said cakes for cooperating with said picks to break said cakes into pieces of ice of a smaller average size, and secondary crushing means selectively movable into and out of operative, interpositioned relationship with said picks at a location that is spaced circumferentially from the point of tangency of said path for cooperating with said picks to provide pieces of ice of a still smaller average size.

5. Apparatus as defined in claim 4 further characterized by said picks being mounted on said drum in axially spaced rows of circumferentially aligned picks, and said secondary crushing means comprising a plurality of blades mounted for joint pivotal movement to selectively locate the corresponding end portions of the blades in operative positions between adjacent rows of said picks and in inoperative positions in outwardly spaced relationship with said picks.

6. Apparatus as defined in claim 4 further characterized by said primary crushing means comprising a plurality of wheels supported for rotary movement about an axis parallel to that of said cylindrical member and having their peripheral portions irregularly formed, and means for jointly moving said wheels to selectively locate their peripheral portions in operative positions for engaging the sides of the cakes of ice opposite the sides engaged by said picks and in inoperative positions out of said tangential path of movement of said cakes.

7. Apparatus as defined in claim 4 further characterized by means for varying the speed of rotation of said cylindrical member, first motor means for selectively moving said primary crushing means into and out of said operative position, second motor means for selectively moving said secondary crushing means into and out of said operative relationship, first control means for jointly increasing the speed of rotation of said member and actuating said first motor means to move the primary crushing means to said operative position, and second control means for jointly actuating said first control means and said second motor means to move said secondary crushing means to said operative relationship.

8. Apparatus for icing railway refrigerator cars, comprising a cylindrical member mounted for rotation about a horizontal axis, a drive for rotating said cylindrical member, a plurality of picks mounted on said member and projecting outwardly therefrom, means for advancing large cakes of ice through a path that is substantially tangential to the upper portion of said member and in a direction corresponding to that of the picks at the position of tangency to cause said picks to engage and break said cakes into pieces of ice of a given aver-

age size, primary ice crushing means mounted for selective movement into and out of an operative position for cooperating with said picks at said position of tangency to break said cakes into pieces of ice of a smaller average size, and secondary ice crushing means mounted for selective movement into and out of operative, interpositioned relationship with the paths of said picks at a location that is spaced circumferentially from said primary crushing means for cooperating with said picks to provide pieces of ice of a still smaller average size.

9. Apparatus as defined in claim 8 further characterized by said picks being arranged on said cylindrical member in circumferentially extending axially spaced rows with one centrally located circumferential row having a greater number of picks than any of the other circumferential rows, and said drive having means for adjusting the speed of rotation of said member to a value at which the linear velocity of said picks at said position of tangency is substantially equal to the velocity of advancing movement of said cakes to cause said picks to engage and tend to break said cakes along the longitudinal rows and at said centrally located circumferential row.

10. Apparatus as defined in claim 8 further characterized by said primary ice crushing means comprising a plurality of toothed wheels supported for rotation on a movable mount, and by drive means for moving said mount to selectively move said toothed wheels into and out of an operative position for engagement with the cakes of ice at said position of tangency, said cakes of ice being moved by said advancing means between and in crushing relationship with the picks and the operatively positioned wheels at said position of tangency.

11. Apparatus as defined in claim 8 further characterized by said secondary crushing means comprising a plurality of laterally spaced, rigidly connected blades supported for joint pivotal movement about an axis that is parallel with the axis of rotation of said cylindrical member and is spaced radially outwardly from the paths of said picks, and drive means for pivoting said blades to move the free end portions thereof into and out of their operative positions between the paths of said picks.

12. Apparatus for icing railway refrigerator cars, comprising a drum mounted for rotation about a horizontal axis, a drive for rotating said drum at variable speeds, a plurality of picks mounted on said drum and projecting outwardly therefrom, means for advancing cakes of ice through a path that is substantially tangential to the upper portion of said drum and in a direction corresponding to that of said picks at the position of tangency to cause said picks to engage and break said cakes into pieces of ice of a given average size, a plurality of toothed wheels mounted for joint movement into and out of operative positions for peripherally engaging the ice cakes at said position of tangency to cooperate with said picks to break said cakes into pieces of ice of a smaller average size, a first fluid motor for selectively moving said toothed wheels into and out of their operative positions, a plurality of blades mounted for joint movement into and out of operative positions between the paths of movement of the picks at a location that is spaced circumferentially from said toothed wheels for cooperating with said picks to provide pieces of ice of a still smaller average size, and a second fluid motor for selectively moving said blades into and out of their operative positions.

13. Apparatus as defined in claim 12 further characterized by means for regulating the drive for said drum to selectively adjust the speed of rotation of the latter to a first value at which the linear velocity of said picks is substantially equal to the velocity of movement of the cakes of ice by said advancing means and to a second higher value, first control means for jointly actuating said regulating means and said first fluid motor to simultaneously increase the speed of rotation of said drum to said higher value and move said toothed wheels to their operative positions, second control means for jointly actuating said first control means and said second fluid motor to simultaneously increase the speed of rotation of said drum to said higher value and move said toothed wheels and blades to their operative positions, and third control means for actuating said regulating means to adjust the speed of rotation of said drum to said first value and for simultaneously actuating said first and second fluid motors to move said toothed wheels and blades to their inoperative positions.

References Cited in the file of this patent

UNITED STATES PATENTS

2,063,431	Grayson	Dec. 8, 1936
2,435,030	Brady	Jan. 27, 1948
2,537,779	McLain	Jan. 9, 1951
2,587,872	McLain	Mar. 4, 1952