March 2, 1965 R. S. KNAPP ETAL 3,171,605

ICE CRUSHER

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FIG. 2

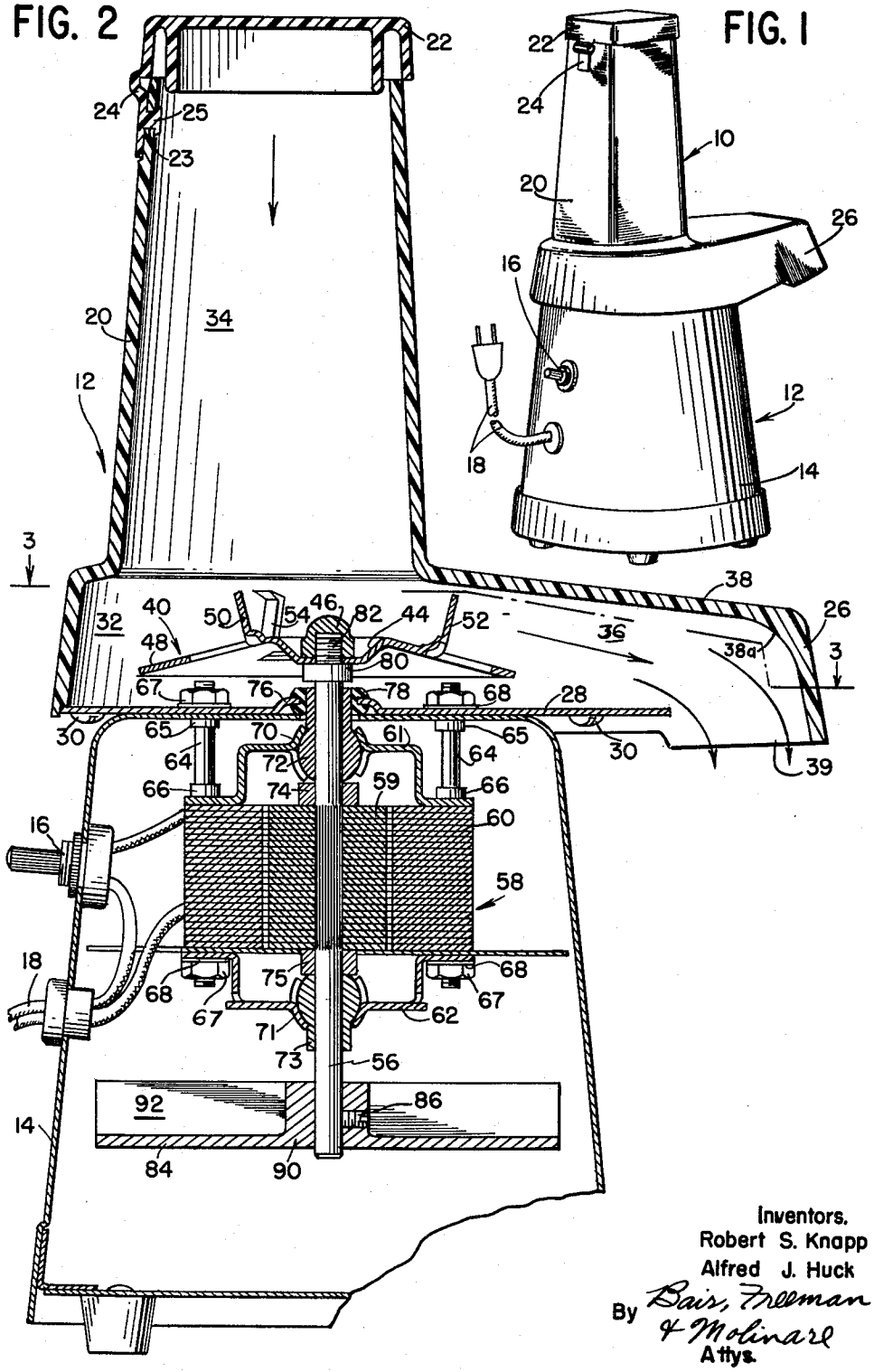


FIG. 1

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FIG. 3

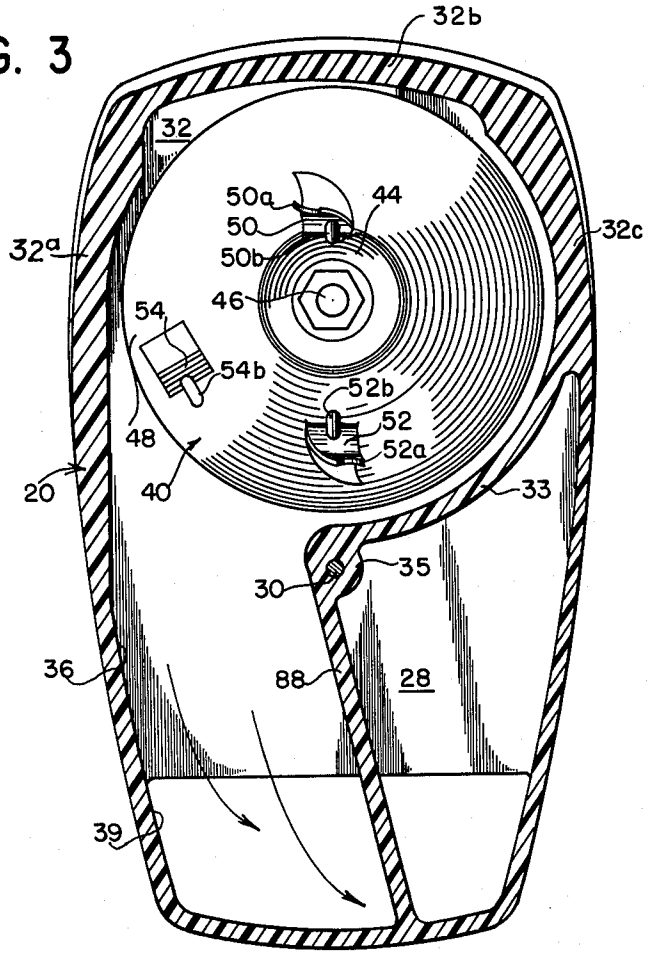
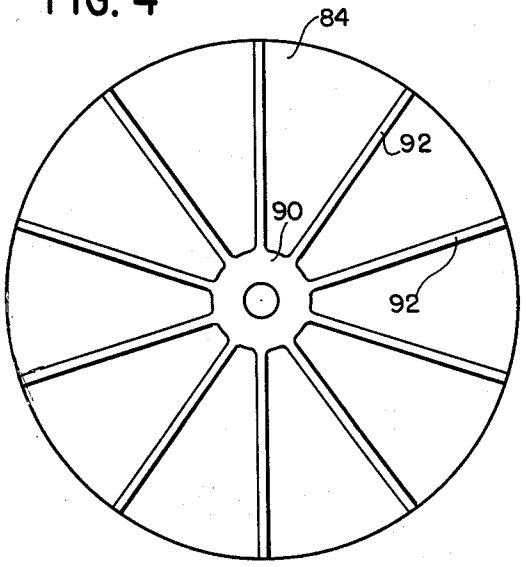


FIG. 4



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ICE CRUSHER

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1 Claim. (Cl. 241—257)

This invention relates to an ice crusher and more particularly to an ice crusher having rotatable ice-crushing means therein adapted to be driven by an improved and simplified construction.

Ice comminuters or crushers, of the type which receive ice in block, or cube, form and grind it up with rotatable means and then utilize the centrifugal force of the rotating means to discharge the ground up ice laterally of the motor drive for the ice crusher, have been employed in the home to provide ice for drinks and the like or for iced confection, as for example snow cones. Such ice crushers have utilized comparatively expensive, powerful, high speed motors of the A.C.-D.C. universal type which develop speeds on the order of 10,000 to 18,000 revolutions per minute. In view of the high cost of such motors, manufacturing practices suggest utilization of low-cost motors to drive the ice crusher. However, various low-cost motors have been tried, but such attempts have been unsuccessful. Some low-cost motors have adequately high speed but do not have sufficient power to effectively crush the ice cubes. Other low-cost motors of the shaded-pole induction type, for example, rotated more slowly but as soon as an ice block is dropped into the hopper of the ice crusher, the rotating crusher mechanism will stall.

Thus, one object of the present invention is to provide an improved ice crusher construction wherein the disadvantages and deficiencies of prior constructions are obviated.

Another object of this invention is to provide an improved ice crusher utilizing a relatively inexpensive shaded-pole induction motor for driving the rotating crusher mechanism within the ice crusher.

Another object of the present invention is to provide an improved ice crusher utilizing a small, inexpensive, limited-torque motor for driving the ice crushing means and having energy storage means connected to the motor for maintaining rotation of the motor during the ice crushing operation.

A still further object of the present invention is to provide an ice crusher having rotary ice-crushing means therein driven by a relatively small shaded-pole induction motor having an output in the range of only 4 to 16 watts and/or only 3 to 10 inch-ounces of torque, and utilizing flywheel means for the motor so that the weight of the flywheel combined with the weight of the ice-crushing means and rotating elements of the motor being in the range of 12 to 50 ounces, thereby producing a device which maintains rotation of the motor during ice-crushing operation.

Further objects and advantages of the invention will become apparent as the following description proceeds and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

A preferred embodiment of the invention is shown in the accompanying drawings, in which:

FIG. 1 is a perspective view showing the ice crusher construction of the present invention;

FIG. 2 is an enlarged vertical cross-sectional view of an ice crusher construction, as illustrated in FIG. 1;

FIG. 3 is a cross sectional view taken substantially on the line 3—3 of FIG. 2 and shows the interior of the ice crusher looking downwardly on the ice comminuting and centrifugal discharging means; and

FIG. 4 is a plan view of the flywheel construction of the present invention.

Referring now to the drawings, there is shown in FIG. 1 an ice crusher, indicated generally at **10**, mounted atop a base, indicated generally at **12**, within which is positioned a drive motor for driving ice crushing elements within the ice crusher **10**. The base **12** is of the type which may be used for food comminuting or drink blending machines, and includes a casing **14** from which extends an on-off control switch **16** for controlling the drive motor positioned within the base. Electric power may be supplied to the drive motor via the electric cord **18**. The details of the base **12** need not be disclosed herein, but the construction may, for example, be similar to that disclosed in United States Patent No. 2,585,255.

The ice-crushing mechanism is housed within a molded plastic casing **20**. A cover **22** is pivoted upon the casing **20** about the hinge means **24** to permit selective entry of individual ice cubes into the casing **20**. Crushed ice is to be discharged through the discharge means **26**, formed integrally with the casing **20**, into a suitable container (not shown).

Referring now to FIG. 2, there is illustrated a cross sectional view of the ice crusher construction of the present invention. As seen in FIG. 2, the hinge means **24** is formed integrally with cover **22** and includes stud means **25**, such as a pair of fingers, adapted to extend through openings **23** in the upright wall of casing member **20**. Inasmuch as the cover and hinge means are preferably formed from plastic, it is relatively simple to heat-upset the ends of the studs **25**, thereby providing fastening means for securing the hinge means to the casing member **20**. It will be understood that by virtue of the inherent resiliency in the hings means **24**, the cover **22** will normally be self-closing. The casing which is generally referred to at **10** hereinabove, includes both a mounting plate **28** and a molded casing member **20** formed of plastic and secured to the mounting plate by means of a plurality of screws **30** (FIG. 3). The hollow casing member **20** partially defines and surrounds an ice-crushing chamber, generally noted at **32**, within which the ice-crushing or comminuting takes place. The casing member **20** also defines an upright, first elongated passageway **34** through which ice in the form of blocks, or chunks, may be introduced or advanced downwardly toward and into the ice-crushing chamber **32**. There is also defined in the discharge means of casing **20** a second laterally extending elongated passageway **36**, which extends generally transversely of the first passageway **34**, and which communicates with the ice-crushing chamber **32** and through which comminuted, or crushed, ice is delivered laterally from the ice-crushing chamber **32**.

More specifically, the second passageway **36** is defined by an upper side **38** of the discharge means **26**, which is part of the casing member **20**, and by a lower side, which is part of the mounting plate **28**, and spaced upright sides, one of which is part of the exterior wall of discharge means **26** of the casing member **20** and the other being an interior wall **88** which is molded integral with the casing member **20**. The longitudinal axis of the second passageway **36** is laterally offset and transverse to the longitudinal axis of the first passageway **34** and the longitudinal axis of the second passageway **36** is also laterally offset from the axis of rotation of the ice-crushing means **40**, so that passageway **36** is, preferably, tangential of said means **40**.

The ice-crushing-and-discharging means **40** are essentially the same as that described in the co-pending application Serial No. 5,054 filed by Alfred J. Huck on January

27, 1960, now Patent No. 3,051,401. The ice-crushing-and-discharging means comprise a disc member **40** which is of generally frusto-conical in shape with a central dished portion **44** wherein is located a clamping nut **46** for fastening the disc member **40** to a rotatable shaft **56**. The greater portion of the disc member **40** is a frusto-conical part **48** which carries a pair of ice cutters **50** and **52** and an ice-ejector **54** thereon. The ice-crushing-and-discharging means is formed of sheet metal, and the ice cutters **50** and **52** and the ejector **54** are stamped out of the material of the disc and are bent transversely of the frusto-conical plane of the part **48**.

The positioning of disc **40** in ice-crushing chamber **32** locates the upper edges of the cutters **50** and **52** close to the lower terminus of the first passageway **34**, so that block ice entering the cutting chamber **34** is immediately engaged by the rapidly rotating cutters **50** and **52**, and is ground up. The longitudinal axis of passageway **34** is located rearwardly of the axis of disc **40**, as best seen in FIG. 2, so that there is little tendency of large pieces of ice being forced out of the device through passageway **36**. The ice-crushing means **40** also cooperates with the sides of the first passageway which seek to restrain the block of ice that is being fed into the ice-crushing chamber **32**, so that the rotary action of the disc **40** relative to the housing or casing **20** operates to impose ice-crushing forces to the block of ice advancing through first passageway **34**. The sides of chamber **32** defined by housing **20**, and which are located peripherally of and above the ice-crushing disc **40**, operate to provide jamming or abutment surfaces which cooperate with the rotatable ice-crushing disc **40** to insure that the relatively large blocks of ice are ground to relatively small flakes or chips before being discharged from the ice crusher.

It will be understood that these cooperatiing surfaces defined by housing **20** are plastic, and the relatively low heat conductivity of the plastic prevents ice accumulations on the surfaces of the housing **20**. The feature of having a housing **20** formed of plastic has been found to provide an advantage in that the shaved ice does not adhere to it and consequently there is no build-up of ice on the walls thereof which might interfere with proper operation of the device.

The particular disposition of the cutting disc **40** that is here utilized is also desirable with regard to the using of centrifugal force to discharge the ground-up ice from the device. The ground ice ejector **54** provides the necessary tangential impetus and the centrifugal force operates to throw the comminuted ice particles laterally through the passageway **36** from whence the particles are directed downwardly through discharge opening by means of the downwardly curved wall **38***a* which is an extension of the top wall **38** and which is spaced from the terminal end of the mounting plate **28** as best seen in FIG. 2.

The ice-crushing-and-discharging means **40** are driven by an improved drive mechanism housed within the casing **14**. Connected to and supporting the disc **40** is a shaft **56**, which is driven by a shaded-pole-start type induction motor **58**. The motor **58**, which includes a rotor **59** fixedly connected to the shaft **56** and a stator **60**, inductively connected to the rotor **59**, is fixedly positioned in the casing **14** by connecting means. The connecting means comprise tie rods **64** which extend through openings in the stator **60** and are connected to the top wall of the casing **14** and to the mounting plate **28**. Provided on each tie rod **64** is a first shoulder **65** and a second shoulder **66**. The upper end of each tie rod **64**, which is exteriorly threaded, extends through the top wall of the casing and the mounting plate, with the first shoulder **65** being in engagement with the top wall. A nut **67** is threaded on to the end of each tie rod to affix the upper end of the tie rod to the top of casing **14** and the mounting plate **28**. The lower shoulder **66** of the tie rod abuts the upper motor bearing bracket **61** and

the lower end of the tie rod is threaded to receive a nut **67** for securing the lower motor bearing brackets **62** and thus securing the motor **58** in casing **14**. Suitable lock washers **68** may be provided between each nut **67** and the abutting surface of the lower motor bearing bracket and mounting plate **28**, respectively.

Each motor bearing bracket **61** and **62** is provided with a spherical retaining portion **70** and **71** respectively, adapted to operatively support shaft bushings **72** and **73**. Upper and lower spacer means **74** and **75** are provided between the rotor **59** and the respective bushings **72** and **73**. The motor lead lines **18** are connected to a suitable source of power, as for example, a 120-volt alternating current supply, and the switch **16** is provided to control the energization of the shaded-pole induction motor **58**.

Provided in the opening **76** in mounting plate **28** is a grommet **78**, which encircles the upper bushing or bearing **72** and prevents the entrance of chipped ice or liquid from the ice-crushing chamber **32** into the motor compartment defined within casing **14**.

The upper end of shaft **56** carries a reduced threaded stud **82**, thereby defining an annular support shoulder **80** on the shaft **56**. A cap nut **46** engages the threaded stud **82** and supports the ice-crushing means **40** on the top of the shaft **56**.

The motor **58**, as aforenoted, is of the shaded-pole induction type and is preferably of very inexpensive construction with an output preferably in the range of only 4 to 16 watts and/or only 3 to 10 inch-ounces torque. Such limited torque motors normally would be unsuccessful for utilization as a driving means for an ice crusher means, such as at **40**, for there is a tendency for such low-output motors to stall.

By the present invention there is provided an energy storage means separate from the rotor of the motor and connected to the rotor for maintaining rotation of the motor during an ice-crushing operation. A very important feature of our invention is the coordinated cooperation between the ice-crushing means **40**, the limited torque induction motor **58**, and the energy storage means, or flywheel, which permits the use of a relatively inexpensive shaded-pole induction motor in an ice crusher and overcomes the tendency of such motor to stall. It will be understood that either a two-pole or a four-pole induction motor can be employed in our ice crusher construction.

We have determined that by critically balancing the combined weight of the rotating components of the ice crusher assembly as above defined, rotation of the aforenoted limited torque motor may be maintained during an ordinary ice-crushing operation. We have found that the weight of the energy storing means must be at least fifty percent of the weight of the remainder of the rotating assembly, which comprises the motor rotor **59** (including the shaft **56**) and the ice-crushing means **40**, and preferably the ratio of weight of energy storage means to weight of remainder of rotating assembly is about 2:1. Further, we have found that the combined weight of the rotating assembly in an ice crusher employing a small shaded-pole induction motor having an output in the range of only 4 to 16 watts and only 3 to 10 inch-ounces torque should preferably be in the range of 12 to 50 ounces. When the rotating assembly weighs less than 12 ounces there is insufficient flywheel effect to crush an ice cube without stopping the motor or slowing it excessively. When the rotating assembly weighs more than 50 ounces, the motor runs too slowly and tends to overheat.

In a practical application of this invention, it has been found that optimum ice-crushing action occurs when the energy storage means weigh about twice as much as the remainder of the aforesaid rotating assembly. Thus, when the total weight of the ice-crushing means **40** and rotor **59** and shaft **56** is about 8 ounces, we have achieved

excellent operational results with an energy storage means **85** weighing 14 ounces.

Turning now to FIG. 3, there is shown a cross sectional view taken substantially along the line 3—3 of FIG. 2. It is readily apparent that the passageway **36** is defined between the exterior wall of casing member **20** and by an interior wall **88** which is molded integral with the casing member **20**.

The ice-crushing chamber **32** is defined, in part, by portions of the casing member **20**, which include wall portions **33**, **32***a*, **32***b* and **32***c*. The walls **33** and **88** merge at an enlarged corner **35**, which serves as a convenient anchor place for one of the assembly screws **30**.

The ice-crushing-and-discharging means is provided with ice cutters **50** and **52** having cutter edges **50***a* and **52***a*, respectively, which face tangentially of disc **40**, so that rotation of the disc **40** causes the cutter edges **50***a* and **52***a* to bite into the ice and to comminute it under the action of the rapid rotation of the disc **40**. The edges of the ejector **54** face radially, so that the ejector **54** presents its broad face radially and operates to effect discharge of the comminuted ice through the tangentially extending lateral discharge passageway **36**. The cutters **50** and **52** are located at different spacings radially outwardly of the axis of rotation of the disc **40**, the first cutter **50** being located innermost and the second cutter **52** being located radially about midway between the inner cutter **50** and the ejector **54**, and the ejector **54** being located close to the outer periphery of the rotating disc **40**. The upstanding cutters and ejector are structurally reinforced by the formation of embossed or dimpled reinforcement ribs **50***b*, **52***b* and **54***b*, respectively, adjacent the junctures of the respective members with the frusto-conical plate portion **48**.

In FIG. 4 there is illustrated a plan view of the flywheel **84** of the present invention. The flywheel includes an annular hub portion **90** and a plurality of rigidifying rib elements **92** radiating outwardly from the hub portion **90**. During rotation, rib elements **92** cause the flow of air over motor **58** to cool the same. The hub **90** is adapted to be connected to the lower end of shaft **56** by suitable fastening means, such as set screw **86**. The weight of the rotating assembly is critical in producing the desired ice-crushing action. If there is not enough flywheel effect, then the motor will stop or will be slowed excessively in ice-crushing operation. If the weight is too great, then the motor will run too slowly and as a result will overheat when it runs continuously. By maintaining the total weight of the rotating assembly between 12 and 50 ounces, there has been provided sufficient energy storage to maintain rotation during the requisite operational limits of a small shaded-pole induction motor having an output in the range of 4 to 16 watts and 3 to 10 inch-ounces torque.

By the present invention, there has been provided an economical construction for an ice crusher utilizing a low-cost shaded-pole induction motor having suitable potential energy in the rotating mass assembly so that when this energy is supplemented by the energy represented by the running power of the motor, there is sufficient kinetic energy to crush individual cubes of ice.

Insofar as common subject matter is concerned, this invention is an improvement over the invention disclosed in copending application Serial No. 5,054 filed by Alfred J. Huck on January 27, 1960, now U.S. Patent No. 3,051,401.

While there has been shown and described a particular embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the inventive concept and, therefore, it is intended in the appended claim to cover all such changes and modifications as fall within the true spirit and scope of the invention. Thus, while the energy storage means is shown as flywheel **84**, it will be appreciated that energy storage means may be in different forms and different locations while still utilizing the princples of this invention.

We claim:

An ice crusher comprising, in combination, an upright passageway through which block ice may be introduced and advanced, an elongated passageway extending transversely to said upright passageway and through which crushed ice is to be discharged, means defining an ice crushing chamber with which said upright and elongated passageways communicate, ice-crushing-and-discharging means including a rotary member in said ice-crushing chamber positioned to receive a block of ice from said upright passageway, for grinding up the block ice into relatively small flakes and chips within the ice-crushing chamber, and for directing the flakes and chips tangentially through said discharge passageway while preventing migration of the ground-up ice below said ice-crushing and discharging means, an elongated upright shaft having its upper end connected to said rotary member, a shaded-pole induction motor providing a rotor on said upright shaft intermediate the ends of the shaft for rotating said shaft and said rotary member, said motor having an output in the range of only 4 to 16 watts and only 3 to 10 inch-ounces torque for driving said ice-crushing-and-discharging means, and a flywheel mounted on said upright shaft below the rotor, said flywheel being adapted to maintain the rotation of the motor during ice-crushing operation.

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