Aug. 29, 1961 E. J. KOCHER ET AL 2,997,861

ART OF PRODUCING ICE BRIQUETTES

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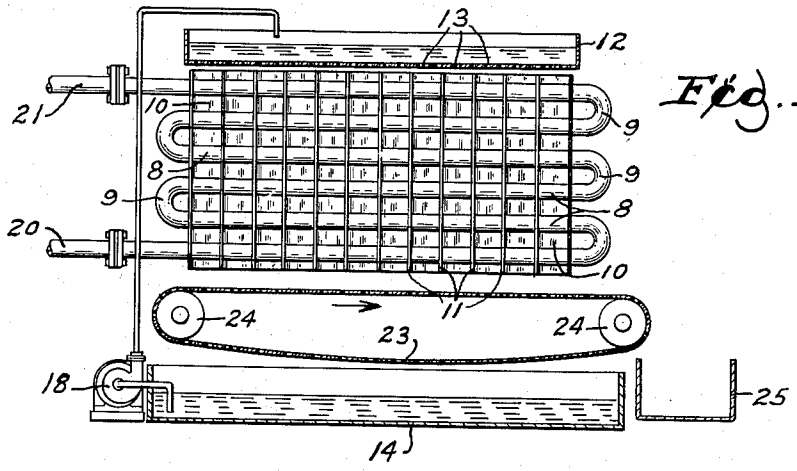
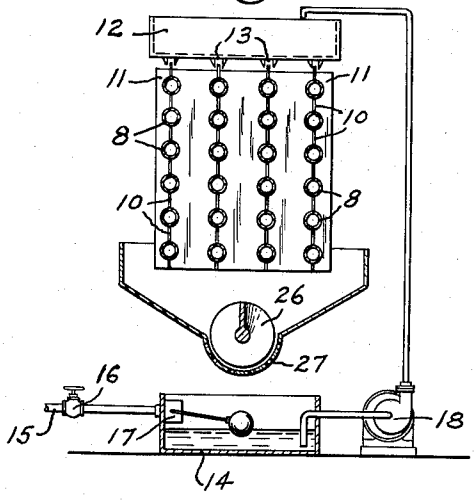


Fig. 1

Fig. 2



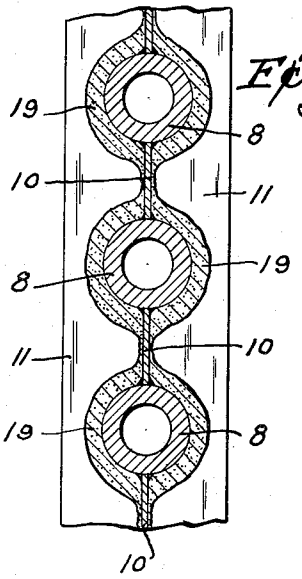


Fig. 3

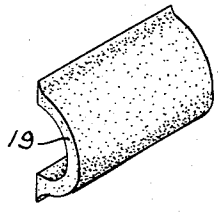


Fig. 4

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Fig. 5

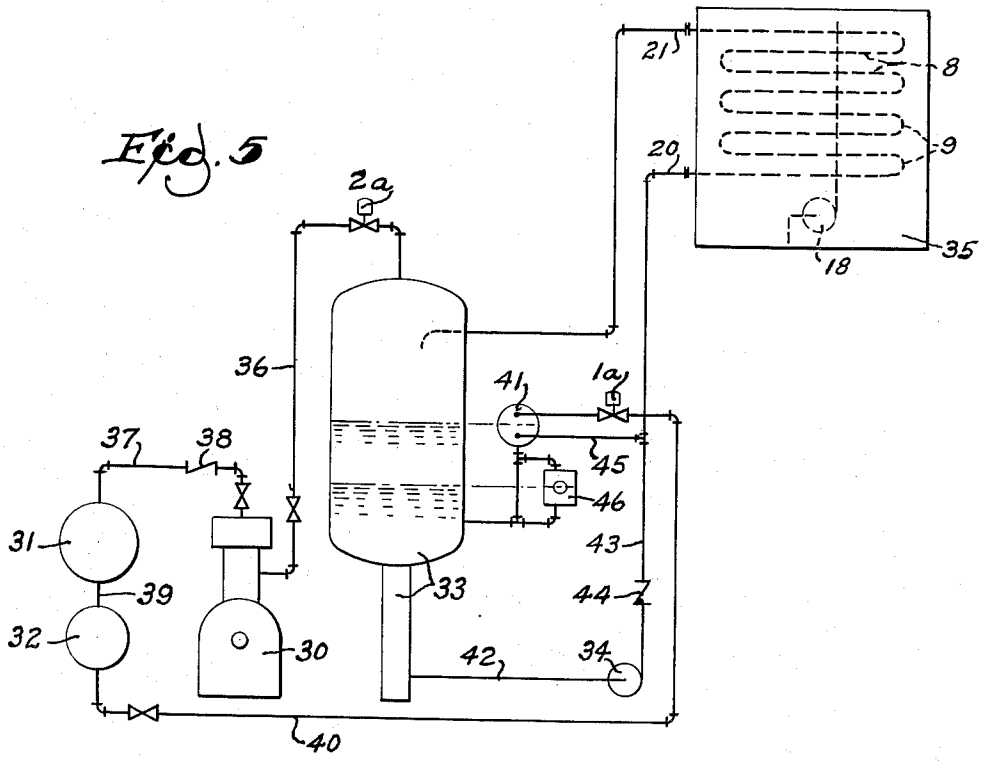
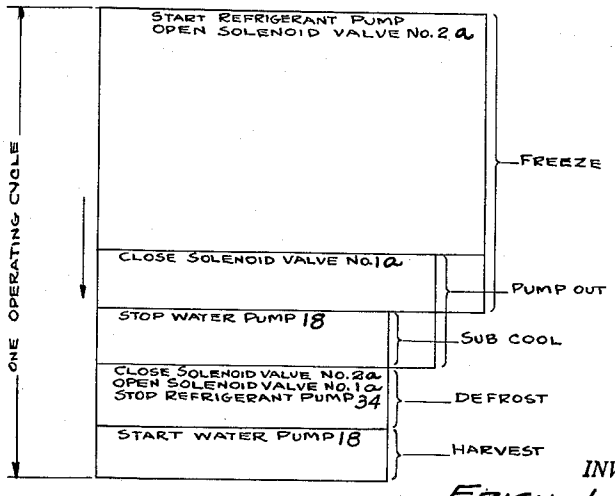


Fig. 6



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ART OF PRODUCING ICE BRIQUETTES

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The present invention relates generally to improvements in the art of producing ice briquettes, and it relates more specifically to an improved method of and apparatus for effecting commercial production of solid ice briquettes or pieces.

The primary object of this invention is to provide an improved method of and apparatus for producing ice briquettes or the like in a simple but highly effective manner, and some of the more important specific objects thereof are as follows:

To provide an improved method of commercially producing solid ice bodies or pieces adapted to be utilized to cool diverse commodities, and which are of such shape that large surface area is exposed to the commodity per unit of volume of each piece while also promoting quick melting and therefore rapid cooling of the commodity.

To provide simple but highly efficient apparatus for effecting practical exploitation of the improved method at high speed and with great volume.

To provide an improved method and apparatus for producing ice briquettes shaped to prevent large surface contact areas between adjoining pieces when piled in bulk, thus making the briquettes readily separable after prolonged storage periods.

To provide improved equipment for commercially producing the improved briquettes, which can be easily installed and operated at moderate cost, and which is also devoid of complicated parts and mechanism for scraping or cutting ice from the forming surfaces.

To provide a method of simultaneously and automatically producing large quantities of ice briquettes with the aid of a simple refrigeration system embodying few moving parts such as a standard compressor and briquette conveyor, and in which the maintenance cost is reduced to a minimum.

To provide an improved article of manufacture in the form of a crescent shaped ice briquette or body which can be rapidly and economically produced in various sizes.

These and other more specific objects and advantages of the present invention will be apparent from the following description.

A clear conception of the several steps involved in the improved process of producing the briquettes and of the construction and operation of apparatus for commercially exploiting the new method, may be had by referring to the drawings accompanying and forming a part of this specification in which like reference characters designate the same or similar parts in the various views.

FIG. 1 is a somewhat diagrammatic side elevation of a briquette forming unit adapted to produce ice pieces in accordance with the present method, this equipment being provided with a perforated belt conveyor for transferring the finished briquettes from the production unit;

FIG. 2 is a similarly diagrammatic transverse vertical section through several briquette forming coils of a unit similar to that of FIG. 1, but showing a screw type of conveyor for transferring the finished briquettes from the unit;

FIG. 3 is an enlarged fragmentary vertical section through one of the briquette producing coils showing the manner in which the ice deposits are formed on the external surfaces of the freezing tubes;

FIG. 4 is a perspective view of one of the final crescent shaped solid ice briquettes or pieces;

FIG. 5 is a diagram of one type of refrigeration system adapted to be used to produce the improved briquettes in accordance with the present method; and

FIG. 6 is a timing diagram depicting the automatic operation of the refrigeration system of FIG. 5.

While the invention has been shown and described herein as being advantageously applicable to a method and installation for producing solid ice pieces or briquettes from water with the aid of a particular type of refrigeration system, it is not intended to restrict the improved method to this specific embodiment; and it is also contemplated that specific descriptive terms employed herein be given the broadest possible interpretation consistent with the actual disclosure.

Fundamentally, the present invention involves a method of producing solid ice briquettes of approximately crescent or C-shape, by causing successive films of liquid to be deposited upon several vertically separated substantially horizontal cold tubes each having thereon longitudinal and transverse external fins which divide the external tube surfaces into local segregated freezing zones or areas within which the briquettes are formed, and by subsequently heating or partially defrosting the freezing surface areas of the tubes to remove the finished briquettes by gravity.

As shown in FIGS. 1 to 4 inclusive of the drawings, the briquette producing unit for carrying on the steps of this improved method, preferably comprises one or more banks of vertically superimposed parallel horizontal ice freezing tube sections **8** connected by end headers or bends **9**, and each of which sections is provided with longitudinal and transverse fins **10**, **11** respectively; a liquid distributing pan **12** located above the tube sections **8** and having lower slots or orifices **13** therein formed to deliver films of liquid by gravity along the opposite sides of the longitudinal fins **10** and of the freezing tubes **8** between the transverse fins **11**; a liquid collecting and supply pan **14** located below the tube sections **8** and being provided with a fresh liquid inlet pipe **15** having a shut-off valve **16** therein and a float valve **17** associated with its delivery end; an intermittently operable liquid pump **18** for transferring liquid from the lower pan **14** into the upper pan **12**; a conveying and excess liquid separating device disposed between the tube sections **8** and the pan **14** for removing the final ice briquettes **19** in relatively dry condition from the producing unit; and means for periodically alternately causing refrigerating and heating medium to flow through the tube sections **8** and bends **9**.

The pipes or tube sections **8** and the fins **10**, **11** are preferably formed of good heat conducting metal, and the fins **10**, **11** cooperate to form local pockets or restricted surface areas on the several tube sections **8**, of proper size to produce crescent shaped briquettes **19** of the desired dimensions, as shown in FIGS. 3 and 4. The coils formed by the tube sections **8** and end bends **9**, are provided with lower and upper connections or conduits **20**, **21** respectively for conducting refrigerant and heating media to and from the tubes in a manner to be later explained, and the lower pan **14** should be amply supplied with liquid such as water while the pump **17** should be normally operated to constantly maintain an ample supply of this liquid within the upper pan **12** while briquettes **19** are being produced.

The briquette discharge and excess liquid drainage device may be of any suitable type adapted to perform its intended function. As shown in FIG. 1, this device comprises a perforated endless belt **23** coacting with end pulleys **24** and adapted to be driven so that its upper stretch will constantly advance in the direction of the arrow toward a briquette collecting or receiving receptacle. As

shown in FIG. 2, the device comprises a helical conveyor screw **26** constantly rotatable within a perforated trough **27** and which is also adapted to be driven so as to deliver the ice briquettes **19** into a collecting receptacle **25** located beyond an end of the lower pan **14**. In both devices, the perforations in the belt **23** and trough **27** serve to drain excess liquid from the briquettes **19** before the latter are delivered into a collecting receptacle **27**, and to return the cold drainage liquid into the lower pan **14**.

Since ice cannot be frozen upon the tube sections **8** indefinitely, the briquettes **19** must be periodically harvested. The solid ice briquettes **19** can obviously be formed by admitting liquid refrigerant to the tube sections **8** through a lower conduit **20** and by delivering the spent gaseous refrigerant from these tube sections through an upper conduit **21** as in a direct expansion refrigeration system; while removal of the final briquettes **19** may be effected periodically by merely heating the tube sections **8** to defrost the same in any suitable manner. The term "defrost" as used herein, however, is intended to cover only partial melting of the concave surface portions of the ice pieces or briquettes **19** merely sufficient to release them from the external tube surfaces and fins **10, 11** as distinguished from complete melting of frost deposits as in ordinary refrigerating systems.

Now referring especially to FIG. 5 of the drawing, which discloses a diagram of one type of refrigeration system for exploiting the steps of the present improved method, this system comprises in general a compressor **30**, a condenser **31**, a high pressure receiver **32**, a low pressure accumulator receiver **33**, a refrigerant circulating pump **34**, a briquette producing unit **35**, and a plurality of valves and other accessories for effecting normal functioning of the system to produce and periodically remove the finished briquettes **19**. The main compressor **30** has an inlet line **36** which communicates with the upper interior of the accumulator receiver **33** past a solenoid actuated valve **2***a*, and the outlet line **37** of the compressor **30** communicates with the condenser **31** past a non-return valve **38**. The condenser **31** is adapted to deliver liquid refrigerant to the high pressure receiver **32** through a conduit **39**, and this receiver **32** has a liquid refrigerant discharge line **40** which is connected past a second solenoid actuated valve **1***a* with a float controlled valve **41** for normally maintaining the proper high level of liquid refrigerant within the low pressure receiver **33**. The liquid refrigerant circulating pump has its inlet line **42** connected to the lowermost portion of the receiver **33**, and its discharge line **43** communicable past a non-return valve **44** with the lower conduit **20** of the briquette producing unit **35**, and the conduit **20** is also connected with the delivery line **45** of the float valve **41**. The upper conduit **21** of the unit **35** communicates with the interior of the receiver **33** above the liquid level therein, and a float actuated switch **46** which is operable by the level of the refrigerant within this receiver **33** when lowered by the pump **34** controls the actuation of this pump during defrosting.

When the refrigeration system has been properly installed as shown in FIG. 5, its normal functioning is effected automatically as depicted in the diagram of FIG. 6 illustrating one operating cycle, and is as follows. During each briquette freezing period the circulating pump **34** feeds liquid refrigerant from the low pressure accumulator receiver **33** through the lower conduit **20** to the freezing coil of the unit **35** while water films or sprays are being cascaded over the tube sections **8** from the upper pan **12** through the orifices **13**. Any excess liquid refrigerant admitted to the freezing coil returns with the refrigerant vapor to the low pressure receiver **33** through the upper conduit **21**, and any such refrigerant required to make-up deficiency may be supplied to the conduit **20** past the float valve **41** while the solenoid valve **1***a* is open.

The pump-out period is an extension of the freezing period and is initiated by closing the solenoid valve **1***a* and by operating the circulatory pump **34** until low liquid level in the receiver **33** actuates the float switch **46**. The water suppply pump **18** is then stopped during the subcooling period, whereupon the defrosting period is effected by stopping the refrigerant circulatory pump **34**, by closing the solenoid valve **2***a* and by opening the solenoid valve **1***a* so as to cause liquid refrigerant from the high pressure receiver **32** to flow through the tubes **8** until the float actuated valve **41** closes. The water supply pump **18** may then be operated during the harvesting of the finished briquettes **19** which have been released from the coil by the defrosting operation and which are deposited by gravity upon the conveyor and are transferred thereby into the receptacle **25**, whereupon the cycle may be repeated to produce subsequent batches of briquettes **19**. It is to be noted that while the valves **1***a* and **2***a*, and the float switch have been described as being electrically operated in order to produce automatic functioning of the system, these valves and switches may also be manually actuated in order to carry on the several steps of the improved method, and other types of refrigeration systems may also be utilized for the commercial exploitation of the improved ice briquette production process.

From the foregoing detailed description it should be apparent that the present invention in fact provides an improved method of and apparatus for producing solid ice briquettes **19** of improved formation, both rapidly and effectively with simple equipment which may be furnished either as a complete unit or assembled in the field. The invention offers a number of major advantages over other ice briquette producing equipment and methods. The shape of the improved briquettes **19** provides large exposed surface area per unit of volume, thus promoting rapid melting of the pieces and resultant rapid cooling of the commodity to which the briquettes are applied. This crescent or C-shape of the briquettes **19** also eliminates large surface areas of contact between the adjoining pieces of ice when piled in bulk, thus making the briquettes easily separable after storage periods. The briquette forming apparatus is very simple and easy to construct in various sizes and capacities, and may be operated with simple refrigeration systems without utilizing scrapers or cutters for removing the ice from the freezing surfaces. The few moving parts of the system, namely the pump **18** and the conveyor are relatively available as standard equipment, and any repairs or maintenance which might become necessary can be made without great difficulty and at moderate cost. The improved unit is extremely compact, considering its capacity, and can be utilized to produce batches of solid ice briquettes **19** in rapid succession.

It should be understood that it is not desired to limit the invention to the exact steps of the method or to the precise construction of the apparatus herein specifically shown and described, for various modifications within the scope of the appended claims may occur to persons skilled in the art.

We claim:

1. In a machine for producing ice briquettes, a series of vertically superimposed but separated horizontal cylindrical tubes interconnected by longitudinal upright fins lying in the common plane of all of the axes of the tubes and by a succession of equally spaced upright transverse fins cooperating with the longitudinal fins to divide the external tube surfaces into approximately semi-circular areas, means for depositing successive films of water upon said tube surfaces, means for cooling said surfaces to simultaneously convert all of said films into solid crescent shaped briquettes segregated by said fins, and means for periodically heating said tube surfaces to defrost the tubes sufficiently to allow the finished briquettes to gravitate therefrom, said tubes being spaced closely

enough to each other to permit release of any ice build-up thereon during said defrosting operation.

2. In a machine for producing ice briquettes, a series of vertically superimposed but separated horizontal cylindrical tubes interconnected by longitudinal upright fins lying in the common plane of all of the axes of the tubes, means for depositing successive films of water upon said tube surfaces, means for cooling said surfaces to simultaneously convert all of said films into solid crescent shaped briquettes segregated by said fins, and means for periodically heating said tube surfaces to defrost the tubes sufficiently to allow the finished briquettes to gravitate therefrom, said tubes being spaced closely enough to each other to permit release of any ice build-up thereon during said defrosting operation.

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