May 11, 1954 W. SCHOTT ET AL 2,677,942

COOLING MACHINE FOR OLEAGINOUS SUBSTANCES

Filed March 30, 1951

2 Sheets-Sheet 1

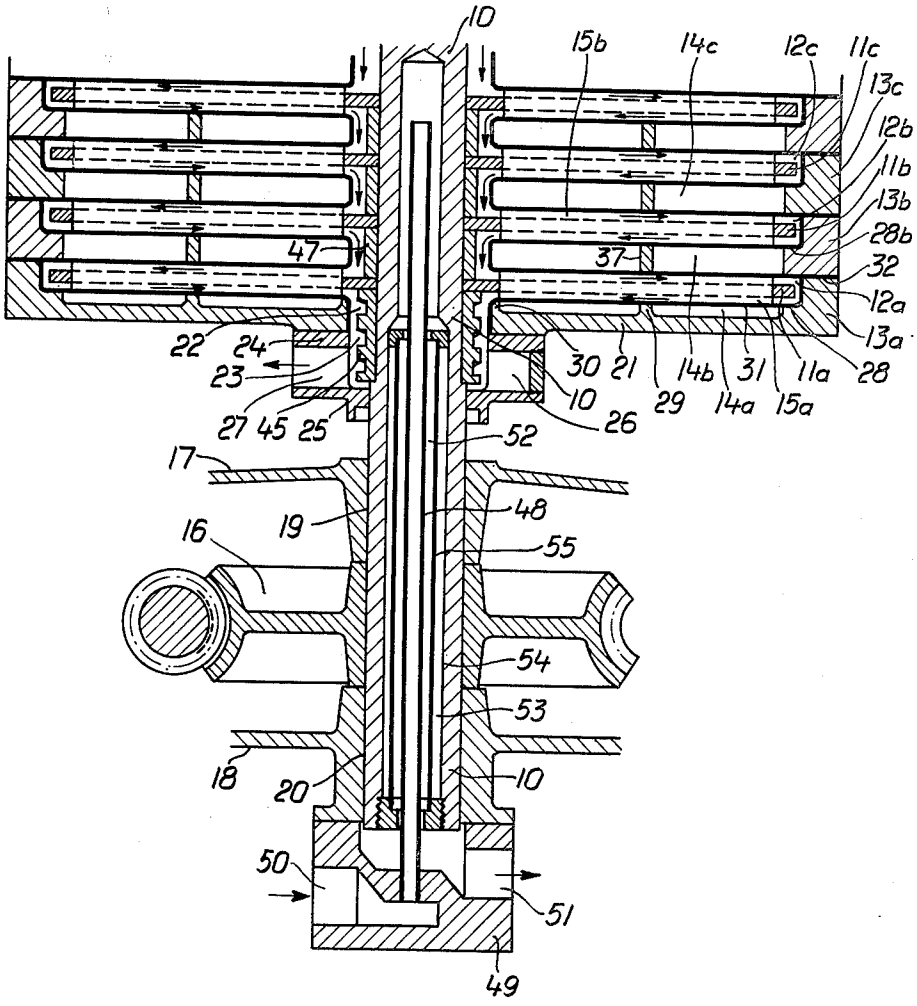

Fig. 1

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2 Sheets-Sheet 2

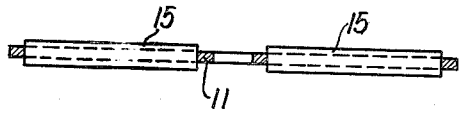

Fig. 3

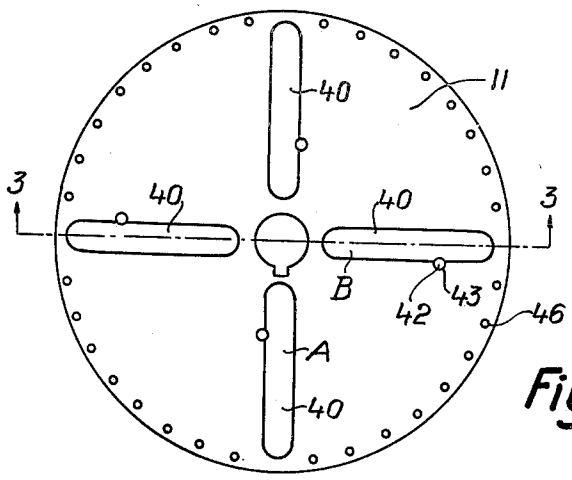

Fig. 2

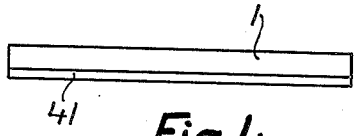

Fig. 4

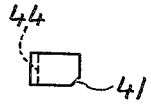

Fig. 5

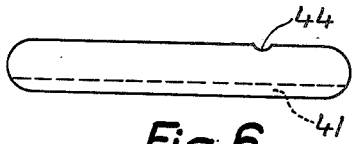

Fig. 6

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COOLING MACHINE FOR OLEAGINOUS SUBSTANCES

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6 Claims. (Cl. 62—114)

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This invention has to do with improvements in a rotary cooler for substances such as butter, grease, margarine and the like, in which the substance to be cooled is caused to flow in a relatively thin stream between closely spaced cooling surfaces with a rotary means acting in the space between cooling surfaces. Such coolers are known, employing conical chambers and rotating conical discs. The improvements relate in particular to coolers for plastic substances, where the cooling produces a less fluent condition and there is a tendency toward clogging of the flow passages.

The object of this invention is to provide a cooler that is simpler to manufacture and that is efficient both from the standpoint of performing the cooling and from the standpoint of avoiding clogging.

A preferred example of an embodiment of the invention is shown in the annexed drawings and is described below with reference thereto. In the drawings:

Figure 1 is a view in vertical section of the pertinent parts of a cooler embodying the invention, showing the driving mechanism and several cooling units acting in series; the top cover, inlet supply means and outer housings being omitted because not a part of the novel construction or necessary to an understanding of the improvement;

Figure 2 is a plan view of one of the novel rotating discs;

Figure 3 is a sectional view of the same disc, on the line 3—3 of Figure 2, but also showing the scraper elements in place in the slots in the disc;

Figure 4 is a view in elevation of a scraper element, looking at the side which is forward in the direction of rotation of the disc;

Figure 5 is an end view of the same; and

Figure 6 is a plan view of the same.

According to the invention, the cooling units of which there may be but one but usually there are several working in series, are of annular shape and planar; and afford closely spaced parallel planar walls which are suitably cooled. A plane disc is mounted to rotate in the cooling chamber thus formed between these cooling surfaces. There is an inlet and outlet for each cooling chamber, to permit continuous movement of

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the substance through each chamber, and preferably the inlet and outlet are centrally located around the driving spindle of the disc. The disc separates the inlet from the outlet and has an overflow clearance from the end wall of the annular cooling chamber at its outer rim so that the substance may flow to the underside of the disc after passing over its upper surface.

Preferably, the rotary disc is provided with scrapers to engage the cooling surfaces, and one improvement feature has to do with a form and arrangement of scrapers. The scrapers are located in radial slots in the disc and project on both sides of the disc toward the cooling surfaces. The arrangement is such as to cause certain scrapers to engage one of the parallel planar cooling surfaces while the others, alternately located, engage the other like cooling surface, the engagement being a forcible one which promotes effective clearing of the surfaces. This action is created by an inclined forward face on the scraper which is presented at one side of the disc so that a wedge action is induced by the resistance of the plastic substance to motion of the scraper through it.

Provision is made for use of identical scrapers, and for determining a unique fitting relation between such a scraper and each slot, this relation being reversed at alternate slots so that there is assurance of having the scrapers arranged to develop this forcible engagement with both cooling surfaces, some of the scrapers acting on one surface and the alternate ones acting on the other surface.

Improved means are provided also to prevent clogging at the outlet from a cooling chamber, comprising both a screw propulsion means at the final outlet and a means for interiorly heating the spindle of the machine in the region of the central outlets from the several cooling chambers, whereby to soften the outflowing material. In one form the spindle has interior passages for circulating a heating fluid to heat the spindle in the outlet region, and these passages are surrounded by thermal insulation in the region of the driving gear of the spindle to prevent the gear from being overheated.

The preferred form of machine used as an illustration has a vertical spindle 10 on the upper part of which are mounted a suitable number of

planar discs 11 (*a*, *b*, *c*, etc.) one above the other and separated from one another by sleeves. These discs turn respectively in a like series of cooling chambers 12 (*a*, *b*, *c*, etc.) formed by the fixed part of the structure. Speaking generally, this fixed structure comprises a series of suitably shaped annuli 13 to which are secured thin-walled horizontally disposed containers 14 for a cooling medium. The outer walls of these containers present parallel planar cooling surfaces which with the outer end-wall provided by the annulus 13 define the cooling chambers 12, in which the discs 11 turn. The discs carry scrapers 15 in radial slots, as described more fully below. At the lower part of the spindle 10 is a conventional worm-and-gear driving means 16 within a housing having upper and lower parts 17, 18 which include bearings 19, 20 for the spindle.

The substance to be cooled is fed in at the top and passes through the several cooling chambers in series. At each cooling chamber there is a central inlet and outlet separated by the rotary disc. The substance being cooled moves horizontally outward over the top of the disc where it is subject to the cooling action of the planar wall of the coolant container above, thence over the outer rim of the disc which is spaced from the end-wall of the chamber; and finally back to the central outlet through the space between the lower side of the disc and the planar wall of the coolant container beneath, which forms the lower wall of the cooling chamber. Final discharge is at the bottom of the series of units.

No novelty is presently asserted as to the details of construction of the fixed parts of the cooling units, and any suitable construction may be employed, including appropriate passages to introduce and to withdraw the cooling medium, continuously if desired, and to permit a flow of the cooling medium from one container to the next in series and through the individual containers. For the purpose of the present novelty, it is sufficient that the fixed parts of the structure provide one or more shallow annular cooling chambers defined by parallel plane surfaces which are cooled by a cooling medium flowing over or in any event in contact with their obverse surfaces, so that a transfer of heat may occur from the substance being cooled to the cooling medium through these planar bounding walls. Each cooling chamber must moreover be of such radial extent relative to the rotary discs that there is a clearance between the end wall of the chamber and the outer edge of the disc, to permit flow of the plastic substance over the rim of the disc to the space beneath the disc. Finally, there must be an inlet and outlet for each cooling chamber, preferably in the form of central openings around the spindle, one above and one below each disc. The plastic substance then flows down onto the disc at the center, moves radially outward on the upper side of the disc and over its rim, and finally radially inward on the lower side to the outlet. It is subjected to a cooling action in its passage in both directions.

For purposes of illustration, a particular preferred form of fixed structure is described. The lowermost annulus 13*a* has a web 21 extending to a circle close to the spindle 10, leaving a central outlet opening 22 in alignment with a like opening 23 in the upper wall 24 of a box 25 which forms an annular collecting chamber 26 with a side outlet 27 for continuous discharge of the cooled substance.

This lowermost annulus 13*a* has an annular step 28 at its inner side, and an upstanding annular rib 29 at a mid-point on the web 21, and an annular rib 30 at its inner rim. These ribs support a thin-walled member 31 which with the spaced web 21 forms the final container 14*a* for the cooling medium and also constitutes the lower planar cooling surface of the final cooling chamber 12*a*. This thin-walled member 31 overlies the side face of the inner rib 30, the step 28 and the top surface 32 of the annulus 13*a*, being secured in a way to prevent leakage at the joints.

The upper planar cooling surface of the lowermost cooling chamber 12*a* is formed by the lower wall of a further section 14*b* of the container for the cooling medium. This section 14*b* is made of thin-walled metal extending inwardly from the joint between annuli 13*a* and 13*b* to a circle near to but spaced from the spindle 10, then upwardly and back to the step 28*b* on annulus 13*b* and the joint between annuli 13*b* and 13*c*. The upper wall of this container section 14*b* forms the lower planar cooling surface of the next higher cooling chamber 12*b*. Being spaced from the spindle at its inner end, this section 14*b* defines the central inlet to the cooling chamber 12*a* and the central outlet from the next higher cooling chamber 12*b*. A ring 37 supports and spaces the planar walls of this container section 14*b*. Other cooling chambers are similarly provided by additional units similarly constructed. The uppermost unit (not shown) may be made the same as the lowermost unit 13*a*, but inverted.

Each horizontal planar disc 11 has a series of radially extending slots 40, here shown as four in number, which receive scrapers 15 as shown in Figures 3–6. Each scraper 15 is so shaped to have a free fit in the slot but is thicker vertically so as to extend above and below the disc. Its vertical dimension is slightly less than the spacing between the upper and lower horizontal cooling surfaces. At the forward face of each scraper, in the direction of rotation of the disc, is a camber 41 forming an inclined plane. When this camber is at the lower part of the forward face of the scraper, so as to present itself below the disc which carries it, the resistance of the plastic substance to motion of the scrapers creates a wedge action because of this inclined surface and forces the scraper upwardly into contact with the upper horizontal cooling wall. Conversely, when the camber is at the upper part of the forward face of the scraper, so as to present itself above the disc, the same action forces the scraper against the lower horizontal cooling wall. This forcible engagement assures a more effective scraping action on the wall toward which the scraper is forced, and thereby maintains a high rate of heat transfer.

The several scrapers 15 are so placed in their respective slots 40 that one presents its inclined face at the upper side above the disc and the next scraper presents it at the lower side, below the disc; and so on alternately in the series around the disc. Thus, half of the scrapers are forced against the upper cooling wall and half against the lower cooling wall of each cooling chamber.

To permit the use of identical scrapers in all of the slots, and at the same time to assure preservation of this alternate wedge action of the cambers or inclined forward surfaces, we provide an arrangement of interfitting or keying parts on one wall of the scraper and one wall of each slot. This may take various forms, but a convenient one employs a pin 42 inserted into a bore 43 in the disc, the circle of which bore ex-

tends into the slot. There is a complementary cut 44 in the side of the scraper, so that when the scraper is placed in the slot with its side cut 44 adjacent the bore 43 in the disc the pin 42 can be inserted to key the two together, without interfering with the freedom of the scraper to move up or down in the slot. The important thing is the relative location of this interfitting means in the different slots. This will be understood upon consideration of the two adjoining slots in Figure 2 which are marked A and B. Viewing each from its outer end, looking toward the center, it will be seen that the interfit at slot A is at the left and nearer the center, while at B it is at the left but nearer the outer end, and that in both it is spaced the same distance from the adjacent end of the slot. A scraper can be keyed in each slot in but one position, and in order to be keyed in slot B it must be turned upside down relative to its position in slot A, thereby presenting its wedge face at the opposite side of the disc.

To prevent clogging at the bottom outlet opening 22, we employ a worm 45 mounted to turn with the spindle 10 and so threaded as to force the plastic substance downwardly into the outlet box 25.

To lessen any tendency toward clogging at the outer rims of the discs, where the plastic substance overflows, we provide a series of holes 46 around the disc near its outer edge. To prevent clogging at the inner passages connecting each cooling chamber with the one beneath, where the cooled substance is less affected by the motion of the discs and scrapers and is in contact with the spacers 47 which separate the discs and surround the spindle 10, we make the spindle hollow, with a closed top, and we provide an open-ended pipe 48 extending up within the hollow part of the column to near its top. A bottom casting 49 has an inlet connection 50 for a heating fluid delivering to the central pipe 48 and a separate outlet connection 51, which communicates with the annular space 52 within the spindle and around the central pipe 48. This permits a continuous flow of a heating fluid, liquid or vapor, to heat the spindle and its surrounding sleeves; also to heat the worm 45 at the final outlet 23, 24.

A further provision, to protect the driving gear 16 from being overheated by this fluid, is an insulator consisting of a body of air 53 contained between the inner wall of an enlarged part 54 of the hollow spindle and a cylindrical partition 55 sealed at both ends to the spindle as shown.

Other heating means, such as an electrical resistance element, may be used to apply heat to the splindle in the region where it adjoins the inner flow passages forming the cooling chamber units, or at the final outlet of the lowermost chamber. Where a fluid heating medium is introduced at the bottom of the spindle, so as possibly to affect the part of the spindle near the driving gear, other forms of thermal insulation may be used to protect the driving gear from overheating.

In the foregoing, the improvements have been described in terms of a preferred machine having a vertical spindle, wherein the cooling surfaces and co-acting discs are horizontal. The improvements are not limited to that use but may be employed where the cooling surfaces and discs are vertical, but nevertheless are planar.

We claim:

1. In a cooling machine, means forming an annular cooling chamber having parallel closely spaced walls affording planar cooling surfaces, an inlet and outlet for said chamber, and a plane disc mounted to rotate between said cooling surfaces, said disc having at least two radial slots, scrapers projecting beyond the surfaces of the disc and movable freely in the slots in a direction normal to the disc, one scraper having an inclined forward face presented at one side of the disc and the other scraper having an inclined forward face presented at the other side of the disc, each inclined forward face being partly opposed to the adjacent planar cooling surface, whereby said scrapers are forced into engagement respectively with opposite cooling surfaces by a wedge action induced by passage of the scrapers through the substance being cooled.

2. In a cooling machine embodying the subject of claim 1, interfitting means in each scraper and slot determining a fitting relation in which the scraper may be placed in the slot, the interfitting means being reversely located in the two slots so that an identical scraper fitting in one presents its inclined face at one side of the disc and placed in the other presents said face at the other side of the disc.

3. In a cooling machine, means forming a cooling chamber having parallel spaced walls affording planar cooling surfaces, an inlet and an outlet for delivery of a substance to be cooled through said chamber, a plane disc parallel to but spaced from said cooling surfaces and mounted in the chamber to rotate between said cooling surfaces about an axis perpendicular to the disc, the disc having recesses, and scrapers disposed in said recesses and freely movable therein in a direction perpendicular to said planar cooling surfaces.

4. In a cooling machine, means forming an annular cooling chamber having parallel closely spaced walls affording planar cooling surfaces, a central inlet at one side of said chamber and a central outlet at the opposite side, a plane circular disc mounted to separate said inlet and outlet and to rotate between said planar cooling surfaces in spaced relation thereto, said disc having at its outer rim an overflow clearance from the outer wall of said chamber, whereby the disc divides the material flowing through said chamber into two layers contacting, respectively, the planar cooling surfaces and joined at said outer rim of the disc, said disc having at least two angularly spaced radial slots, and scrapers projecting beyond the disc surfaces on both sides of the disc and movable freely in the radial slots in a direction toward the planar cooling surfaces, one scraper having an inclined forward face presented at one side of the disc and the other having an inclined forward face presented at the other side of the disc, each inclined forward face being partly opposed to the adjacent planar cooling surface, whereby said scrapers are forced into engagement respectively with opposite cooling surfaces by a wedge action induced by passage of the scrapers through the substance being cooled.

5. In a cooling machine, means forming an annular cooling chamber having parallel closely spaced walls affording planar cooling surfaces, a central inlet at one side of said chamber and a central outlet at the opposite side, a plane circular disc mounted to separate said inlet and outlet and to rotate between said planar cooling surfaces in spaced relation thereto, said disc having at its outer rim an overflow clearance from the outer wall of said chamber, whereby the disc divides the material flowing through

said chamber into two layers contacting, respectively, the planar cooling surfaces and joined at said outer rim of the disc, and a screw propulsion element mounted in the outlet from the cooling chamber to rotate with said disc, and arranged as to direction of action to assist outflow of the substance being cooled.

6. In a cooling machine as defined in claim 5, a rotary spindle on which said disc is mounted, and means for heating the spindle interiorly in the region of said outlet and screw propulsion means.

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