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APPARATUS FOR CASTING GELATIN UPON A COOLED DRUM INCLUDING DRUM WARP COMPENSATING MEANS

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Fig. 1.

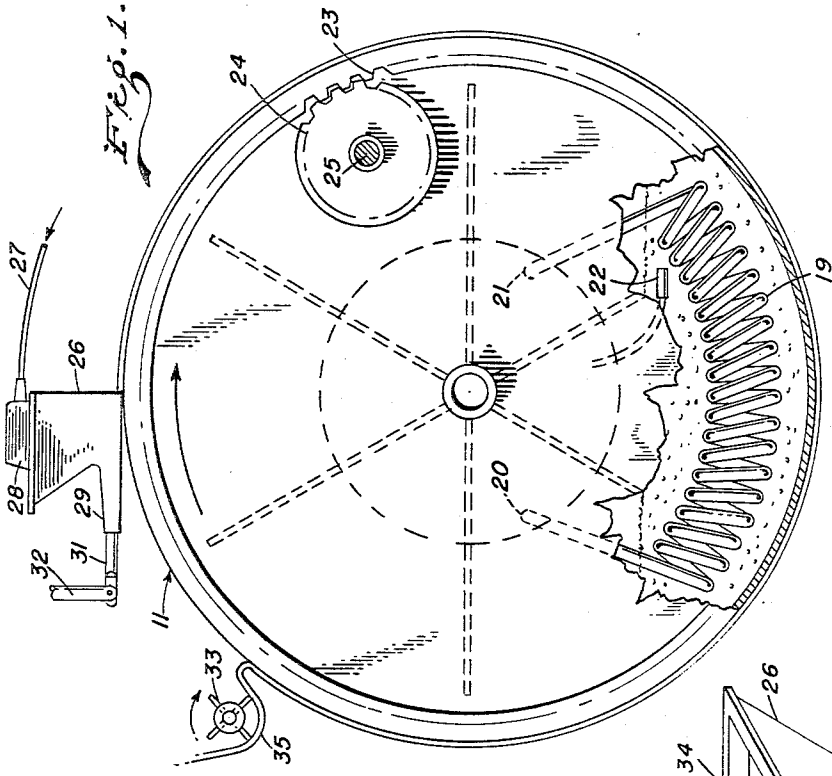


Fig. 3.

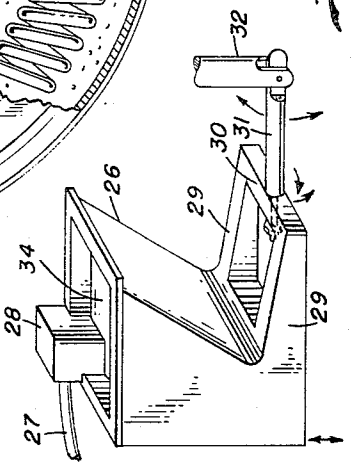
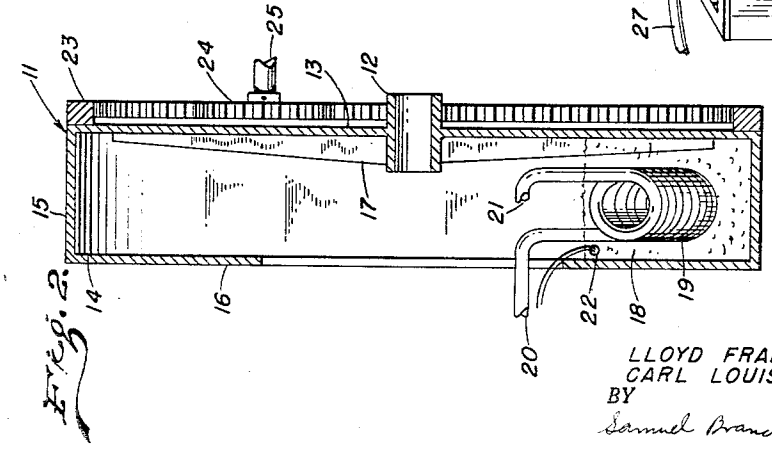


Fig. 2.



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APPARATUS FOR CASTING GELATIN UPON A COOLED DRUM INCLUDING DRUM WARP COMPENSATING MEANS

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Application June 13, 1955, Serial No. 515,008

2 Claims. (Cl. 18—15)

This invention relates to a machine for forming a soft plastic gelatin strip, particularly for the manufacture of soft gelatin capsules.

It is an object of our invention to provide a machine for uniformly and smoothly casting a gelatin strip on a cooled surface such that the strip is of uniform thickness, easily removed, and free from imperfections.

It is an object of our invention to provide a chatter-free drive for a gelatin casting drum.

It is a further object of our invention to provide a means for maintaining a desired temperature of the surface of a gelatin casting drum. Other objects and advantages will appear in connection with the following description.

Films and strips have been cast on the surfaces of cooled drums for a long time. Patent 521,945 to Cooper shows a concentric cylinder arrangement with a coolant, which may be liquid or gaseous, to cool the surface of a drum on which glue is cast, and discloses specifically the use of ice water as the coolant. More recent patents, such as the Kath patents, 2,292,760 and 2,345,674, disclose the use of water-cooled casting drums on which a gelatin composition is cast for the manufacture of capsules. Here, a liquid is fed into a drum and is permitted to overflow from the drum. U.S. Patent 2,643,416 to Moule discloses a hollow drum in which stationary cooling coils are located. Air is blown over the cooling coils and onto the back surface of the drum to provide temperature control. In other instances chilled air has been blown onto the front surface of the drum or the rear inner surface of the drum for temperature control.

Various temperatures have been recommended for the surface of the casting drum and for the coolant air. Patent 2,349,511 to Miller, calls for a sheet-forming surface at 90° F., a gelatin composition temperature of 140 to 160° F. and cooling the exposed side to a temperature of 45° F. to 65° F. while maintaining the surface contacting side of the sheet at 90° F. The Moule patent, 2,643,416, calls for the temperature of the casting drum to be between 40 and 60° F. and the gelatin composition to be within the temperature range of 130 to 145° F.

These various temperature ranges and conditions have been satisfactory under previously utilized conditions; however, we find that it is desirable to have a more effective method of cooling the surface of the drum than can be obtained by air to drum heat transfer such as disclosed by Moule, and yet it is desirable to avoid the difficulties encountered by having a liquid flow into the drum and flow out of the drum.

We have discovered that these difficulties can be avoided by using a drum in which a flange extends from the edges of the drum towards the center so that a continuous trough is formed at all times during the rotation of the drum about its horizontal axis. In this trough is placed a heat transferring liquid or coolant liquid. This liquid may be water or it may be water with an anti-freeze added, such as ethylene glycol, propylene glycol, alcohol, glycerin, a non-corrosive salt, etc. This liquid has a high heat transfer coefficient and a high heat capacity and thereby tends to maintain the temperature of the drum constant. Immersed in this body of coolant liquid is a stationary refrigerating coil. The refrigerating coil may have a low temperature brine run through it but more conveniently is designed so that a refrigerating fluid flows therethrough from a suitable compressor and condenser system. Such refrigerating systems are well known in the art and an ordinary household refrigerator system with a coil which is immersed in the cooling liquid may be used. The refrigerating fluid is conveniently a haloalkane such as dichlorodifluoromethane.

By such a system all of the problems associated with stuffing boxes and packing glands through a hollow cylinder are eliminated and at the same time the advantages which accrue from a liquid heat transfer from the interior surface of the drum is achieved.

Conveniently the drum is built with the mounting arms at one side so that the volume of the trough in which the cooling coil is located is thereby larger.

Using off-center arms tends to increase the difficulties with drum warping. Even with perfectly symmetrical drums the differences in temperature cause the surface of the drum to alter slightly and if the hopper is rigidly suspended from a stationary part of the machine and permitted to cast on the surface of a drum the thickness of the film cast may vary. The difficulties in this nature have been previously acknowledged, for instance, Patent 2,345,674, page 3, column 2, lines 3 to 18. The use of a hopper which rides on the surface of the drum accomplishes in part the function of permitting the hopper to ride up and down. However, the surface of the drum may not only vary diametrically but may also warp from side to side so that the casting hopper must not only raise and drop, but also must twist about an axis substantially parallel to a tangent to the casting drum at the line of casting. The necessity for rotation about this axis has not been previously recognized. The use of a hopper-suspension system such that the hopper can ride up and down while resting on the surface of the drum and rotate about a line parallel to a tangent to the casting drum at the point of casting permits a uniformity of casting which has not been previously achieved.

At times the casting drum exhibits a tendency to chatter if the drive system is near the center of the drum. With the use of worm gears which drive the axle on which the drum is mounted, such a chatter may occur. By using a drive near the periphery of the drum, as for example, an interior gear driving a ring gear, it is possible to achieve a smoothness in operation which minimizes chatter and the resultant minor imperfections in the surface of the gelatin strip.

The casting drum including the universally mounted hopper may be used in connection with conventional capsulating machines including particularly those disclosed in the Stirn, et al. Patents 2,663,128 and 2,697,317. The present casting drum and hopper are particularly useful with machines in which only a single casting drum is used.

In casting gelatin strip for encapsulation machines, it

is found that variations in the liquid gelatin composition require some variations in the casting conditions. For a gelatin composition which has approximately 40 to 50% of gelatin and 30 to 35% of water and 17 to 30% of a plasticizer such as particularly 48% gelatin, 34% water and 18% glycerin, a casting range for the composition of 100 to 130° F. or particularly 122° F., gives excellent results. In casting such a composition it is desirable that the casting surface, which may be the surface of the drum, have a temperature of between approximately 65 and 75° F. A temperature of about 71° F. and a casting speed of at least 5 feet per minute gives a very efficient operation.

More particularly, the present machine and its advantages are illustrated by the accompanying description and drawings of a particular embodiment thereof:

Figure 1 shows a side view of the casting drum from the drive side.

Figure 2 shows a sectional view of the casting drum.

Figure 3 shows a pictorial view of the hopper adapted for use with the present casting drum.

The casting drum **11** may be cast solid or built up. Conveniently it is built up from sheet materials. It includes a casting drum hub **12**, which may be journalled on a shaft or may be attached to a shaft which in turn is journalled and permitted to rotate. Attached to the casting drum hub is a casting drum back plate **13** which extends from the hub to the outer surface of the casting drum. Attached to this plate is the casting drum rim **14**, the outer surface of which forms the casting surface **15**. Adjacent the other side of the casting drum rim is an annular disk **16**. Conveniently, but not necessarily, support arms **17** extend between the casting drum hub and the casting drum back plate to stiffen and reinforce the plate and add rigidity to the drum. These support arms also act as agitators. The annular disk **16**, the casting drum rim **14**, and the casting drum back plate **13**, form a trough. The low portion of the thus formed trough is filled with the coolant liquid **18**. This liquid may conveniently be a mixture of water and ethylene glycol. Immersed in the coolant liquid is a refrigerant coil **19**. To this refrigerant coil are attached the refrigerant supply line **20** and the refrigerant discharge line **21**. Conveniently, a commercial refrigerant such as dichlordifluoromethane is supplied in at least a partially liquefied form through the supply line **20** and withdrawn in at least a partially gasified form through the discharge line **21**. The evaporation of the refrigerant furnishes the cooling effect required. A thermostat **22** is adjusted to control the refrigerating effect so as to maintain the coolant liquid at a desired temperature. The details of the refrigerating system are conventional and accordingly not shown.

To avoid chatter the drum is driven near its rim. This may be accomplished by mounting a ring gear **23** adjacent the periphery of the drum and driving the ring gear by a ring drive gear **24** which is mounted on and driven by a drive gear shaft **25**. Adjacent and above the casting drum is a gelatin hopper **26**. The gelatin hopper may be temperature controlled and may have a gelatin supply line **27** and a suitable gelatin level control **28** to insure that the gelatin level in the casting hopper is maintained at a uniform height and at a uniform temperature. The hopper has a casting orifice under its lower edge from which the gelatin composition **34** flows onto the casting drum to form the gelatin strip **35**. Unfortunately, it is mechanically impossible to build a casting drum which is absolutely accurate and the size of which does not change with temperature. Accordingly, the surface of the drum varies slightly and to use the surface of the drum as a casting surface, it is desirable that the hopper should ride on the surface of the drum uniformly and smoothly and at a constant distance from the drum. This is accomplished by attaching to the lower portion of the casting hopper, hopper brackets **29**. These hopper brackets may be integral or attached to the hopper. Between the hopper brackets is a cross bar **30**. The cross bar **30** is pivotably attached to a draw bar **31** so that the hopper may rotate about the axis of the draw bar. The axis of the draw bar is parallel to a line tangent to the center line of the surface of the casting drum. The draw bar, in turn, is supported by an anchor **32** which is attached to a stationary part of the machine. The anchor **32** pivotably supports the draw bar about an axis parallel to the axis of the casting wheel. By so supporting the hopper in what might be termed a universal fashion, the hopper can ride up and down to allow for diametral variations in the wheel and can rotate to allow for warp in the surface of the wheel and thereby the casting hopper rides smoothly and in fixed relationship to the casting surface.

The gelatin composition which hardens to form a gelatin strip is removed from the casting surface by a stripper paddle **33**. The detail of the stripper paddle and the subsequent use of the gelatin strip are disclosed in a patent of Stirn et al., 2,663,128.

Operation

34 parts of water and 18 parts of glycerin were mixed together, and heated to 190° F. 48 parts of bone gelatin were placed in a mixer, the mixer evacuated and heated to 140° F. and the mixture of water and glycerin added thereto with immediate vigorous stirring, while maintaining a sufficient vacuum to insure that any air released would be withdrawn. The temperature of the mixture was adjusted to 160 F. thereby forming a smooth uniform gelatin composition. The gelatin composition was passed from a storage tank through a supply line to the casting hopper and permitted to cool as it flowed therethrough so that the temperature of the gelatin in the casting hopper was 122° F. Two strips of gelatin 3 inches wide each and 0.03 inch thick were cast on the surface of the wheel at a casting speed of 16 feet per minute. The casting surface was maintained at a temperature of 71° F. by suitably adjusting the thermostat in the coolant liquid so that the heat losses and rate of heat transfer through the casting drum would give this uniform temperature. The coolant liquid was about 66° F. The casting drum itself was 4 feet in diameter. Room temperature air (70° *F.*) was blown across the strip to remove some moisture from the strip. The gelatin composition which was cast on the drum formed a uniform smooth even gelatin strip and was stripped from the casting surface.

It is convenient to use a current of air on the surface of the strip to assist in the evaporation of moisture therefrom, although this is not necessary, as ambient air will remove water at a satisfactory rate. The hardening of the gelatin composition to form a strip is due to the combined effects of chilling and evaporation of moisture.

The gelatin composition may have therein flavors, odors and dyes, if these are desired for esthetic reasons.

Having thus described in detail modifications thereof, as our invention, we claim:

1. An apparatus for casting gelatin strip for an encapsulation machine comprising a casting surface in the shape of the periphery of a cylinder, a journal means, connecting means between the casting surface and the journal means, means adjacent each side of the casting surface entering inwardly to form a liquid-tight trough, drive means to uniformly and continuously rotate the casting surface a coolant liquid which partially fills the low side of said trough, a stationary cooling coil immersed in said coolant liquid, and a casting drum warp compensating hopper support for a hopper which rides on the surface of the casting drum comprising an anchor, and a pivot fasting said hopper to said anchor which per-

mits said hopper to pivot about a line parallel to the axis of the casting drum, and also permits the hopper to rotate about a line parallel to a tangent to the center line of the surface of the casting drum, thereby causing the hopper to adapt itself to irregularities in the casting surface.

2. The casting apparatus of claim 1 in which the drive means to uniformly and continuously rotate the casting surface comprises an internally toothed ring gear adjacent to and fastened to the casting surface of the periphery of the cylinder and a drive gear for said ring gear.

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2,346,764	Kratz	Apr. 18, 1944
2,346,784	Pollack	Apr. 18, 1944
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2,643,416	Moule	June 30, 1953

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