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PROCESS AND APPARATUS FOR SATURATING FRUIT
JUICES AND OTHER LIQUIDS WITH GAS
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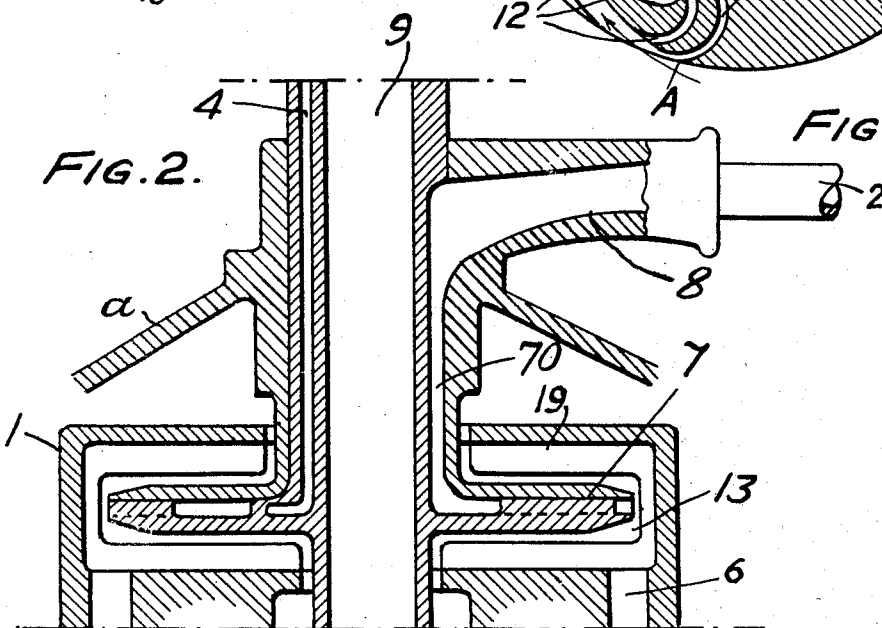
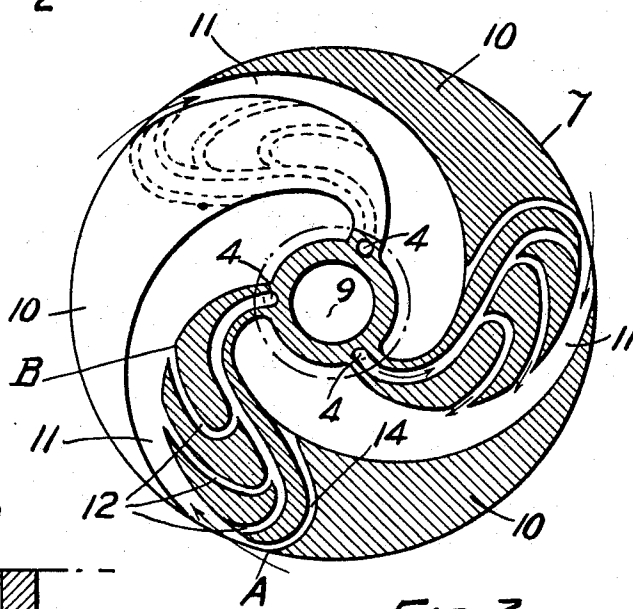
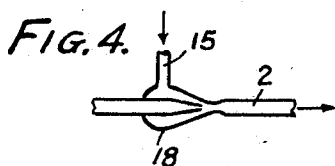
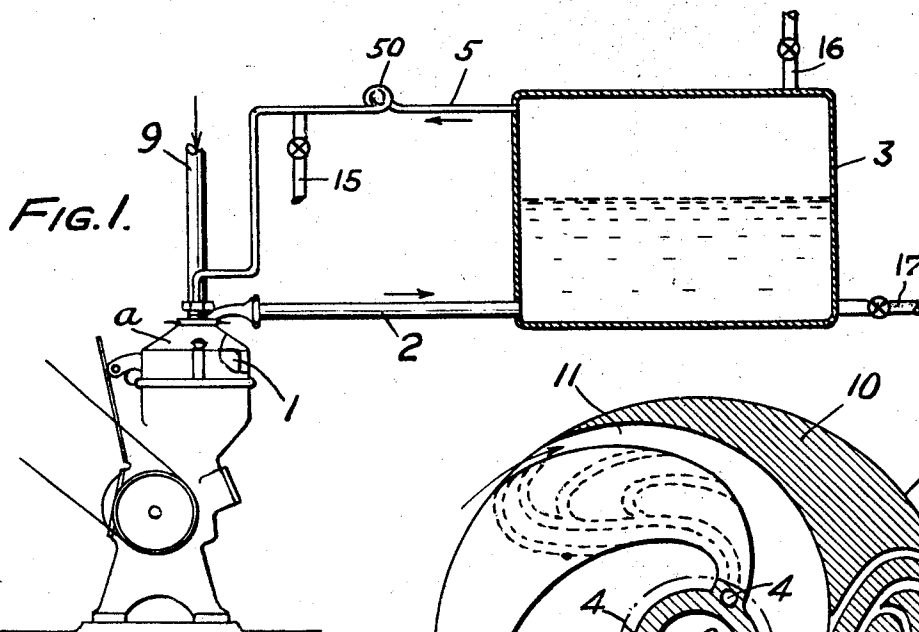


FIG. 3.

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PROCESS AND APPARATUS FOR SATURATING FRUIT JUICES AND OTHER LIQUIDS WITH GAS

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13 Claims. (Cl. 261-76)

It is known to use centrifugal separators for purifying fruit juices in connection with their storage, under a pressure exerted by carbonic acid gas. The juice which has been purified in the centrifuge is forced into a tank filled with, for instance, carbonic acid gas under a pressure of 6 to 8 atmospheres. The juice may be pumped into the tank either by a pumping device built with the centrifuge or by an individual pump. For obtaining a quick saturation of the juice with carbonic acid gas, an injector apparatus is generally provided in the pipe line, between the pump and the tank, thru which the liquid passes and which sucks carbonic acid gas from the tank. The injector apparatus is of such construction that a very fine distribution of the carbonic acid gas in the fruit juice is insured.

The object of the present invention is to provide a process and apparatus whereby, if the centrifuge is equipped with the paring device for the liquid discharged from the centrifugal bowl, such paring device may be made to function efficiently to effect thorough mixing of the gas with the liquid.

In case the centrifuge is provided with a paring device for the liquid, it is possible to work without the special pumping device above mentioned. A paring device generally consists of a stationary disc or tube-shaped member into which the rapidly rotating liquid flows from the separating chamber of the centrifugal bowl. In the paring device part of the kinetic energy of the liquid is converted into pressure energy, which conversion, however, involves heavy losses partly caused by eddies. This fact has been of material importance in contriving the present invention.

It is important, in order to accomplish the purpose of the invention, that the discharge channels of the paring device, into the outer ends of which the liquid flows at high velocity, shall be sharply curved. The static partial vacuum which occurs in these channels (a vacuum in relation to the static pressure in the discharge pipe and the storage tank) is utilized for sucking the required amount of gas to the paring device. As above stated, the shape of the channels is very important, because the static vacuum depends on the height of the dynamic pressure and the radius of deflection of the boundary surfaces of the channels. A considerable static vacuum is obtained at the convex surface in relation to the average static pressure in the channel and particularly in relation to the static pressure at the concave surface of the channel.

If the difference of pressure obtained in this way does not enable the mixture of enough gas with the liquid, a higher pressure than that present in the tank must be applied to the gas. The required pressure may, for instance, be generated by a pump arranged between the storage tank and the centrifuge.

The present invention is characterized by the fact that gas is fed into the paring device at suitable points and is finely mixed with the liquid.

The drawing illustrates an apparatus, comprising a tank, centrifuge and paring device and including also, in combination therewith, novel structural features by means of which our improved process may be practiced.

Fig. 1 is an elevational view of the entire apparatus.

Fig. 2 is an enlarged vertical sectional view of the upper part of a centrifuge and the paring device.

Fig. 3 is a view, partly in horizontal section, of the paring device.

Fig. 4 is a detail view of a supplemental gas-feeding device.

The purifying centrifuge comprises a rotatable bowl 1 having a feed tube 9. The bowl is enclosed in a stationary frame *a*. The bowl encloses a purifying chamber (not shown) and above it a paring chamber 13. The purified liquid is discharged from the separating chamber, through the stationary paring device 7 into a discharge 8 and thence, through a pipe line 2, into a storage tank 3. From the upper part of the tank a pipe line 5 and branches 4 extend to the centrifuge (as hereinafter more particularly described). In the pipe 5 may be a pump 50 of any suitable type, for example, a centrifugal fan. The use of a pump is of advantage, but is not in many cases necessary to the operativeness of the apparatus or the practice of the process.

The inner zone of the purifying chamber of the bowl communicates with the paring chamber 13 through a passage 6. Wings 19, attached to the bottom, top and peripheral walls of chamber 13, maintain the rotation of liquid in the chamber. The stationary parer 7 is preferably disc-shaped, as shown in Fig. 3, and comprises spaced apart wings 10 forming channels 11 which are sharply curved and increase in width from their peripheral admission ends to their outlet ends, the latter communicating with an annular passage 10 surrounding the feed tube 9 and communicating, through the discharge 8, with the pipe line 2.

In each of channels 11 there are points, such as A and B, in the zone of the convex surface, at which, as above described, the pressure is substantially lower than in the discharge pipe.

5 In our invention the gas pipes 4, connected with the gas pipe line 5, communicate with a system of channels 12 at points along the convex surface of the channels 11, whereby gas is admixed with the liquid, and, owing to the strong
10 currents, is finely distributed therein. By means of the pumping device 50, it is possible, and in some cases is necessary, to increase the ejector action of the liquid by increasing the pressure on the gas. Gas may be supplied to the tank 3
15 through a valve-controlled pipe 16 and treated liquid may be removed through a valve-controlled pipe 17.

In some cases it may be advantageous to saturate the liquid with gas by degrees or steps; that is, liquid saturated with gas is made to suck up a further quantity of gas at another point of the paring device or in the liquid flow pipe line 2. This may be brought about, as shown in Fig. 3, by conducting back liquid saturated with gas
25 from one paring channel into the adjacent one thru a special overflow channel 14. It is also possible to build a liquid injector in the pipe 2 by which further amounts of gas are forced into the liquid, as illustrated in Fig. 4, in which 15 is a valve-controlled gas pipe connecting gas pipe 5
30 and pipe 2 and 18 is the injector.

While the means above described is especially efficient for carrying out our improved process, the practice of the process is not dependent
35 thereon and is capable of being practiced by other means.

While the described use of the invention is the saturation of fruit juices with carbonic acid gas, the invention is applicable to the charging, to
40 any degree of saturation, of any liquid with any gas.

What we claim and desire to protect by Letters Patent is:

1. The process of saturating with gas liquid
45 from a flowing body of liquid rotating at high speed which comprises conveying said liquid toward a locus of liquid reception through a stationary curved closed passage extending from within the body of rotating liquid inward toward
50 its axis of rotation, wherein, due to centrifugal force, the liquid tends to leave one side of the passage and a zone of reduced pressure is created along that side, and admitting gas under pressure to the reduced pressure side of the stream
55 of liquid flowing through said passage.

2. The process of saturating with gas liquid from a flowing body of liquid rotating at high speed which comprises conveying said liquid toward a locus of liquid reception through a stationary curved closed passage extending from within the body of liquid inward toward the axis of rotation, and admitting gas under pressure to the concave side of said stream as it flows through said curved passage.

3. The process of saturating with gas liquid from a flowing body of liquid rotating at high speed which comprises conveying said liquid toward a locus of liquid reception and gas under pressure through a stationary curved closed
60 passage extending from within the body of rotating liquid inward to its axis of rotation, wherein, due to the centrifugal force, the liquid tends to leave one side of the passage and a zone of reduced pressure is created along that side,
65 and admitting gas from said locus to the reduced

pressure side of the stream of liquid flowing through said passage.

4. The process set forth in claim 3 which comprises also imparting a higher pressure to the gas in the course of its flow from said locus in
5 said passage.

5. The process set forth in claim 1 in which said gas is admitted to said reduced pressure side of the stream of liquid at a number of points along said stream.

6. The process of saturating with gas liquid from a flowing body of liquid rotating at high speed which comprises conveying said liquid toward a locus of liquid reception through stationary curved closed passages extending from
15 within the body of rotating liquid inward toward the axis of rotation, admitting gas under pressure to the low pressure side of the stream of liquid flowing through said passages, and conveying gas-impregnated liquid from the high
20 pressure side of one passage into the low pressure side of another passage to effect in the latter a higher degree of saturation of the liquid therein.

7. A stationary paring disc for removing liquids
25 from a centrifuge, having a sharply curved passage extending from the periphery of the disc toward its center, whereby liquid flowing there-through has its direction so rapidly changed that centrifugal force causes a tendency to leave the
30 convex wall of the passage and produces a relatively low pressure along said wall, and means providing gas admission ports opening only along said convex wall.

8. A stationary paring disc for removing liquids
35 from a centrifuge, having sharply curved passages extending from their peripheries toward their centers, whereby liquid moving there-through is acted upon by centrifugal force to cause a relatively high pressure along their concave walls and a relatively low pressure along their convex walls; means for admission of gas to the passages and channels each communicating at one end with a port in the concave wall of one passage and at the other end with a port
45 in the convex wall of another passage.

9. A stationary paring disc for removing liquids from a centrifuge, having sharply curved passages extending from their peripheries toward their centers, whereby liquid moving there-through is acted upon by centrifugal force to cause a relatively high pressure along their concave walls and a relatively low pressure along their convex walls; gas admission means and ports along the convex wall of each passage communicating with the gas admission means, and channels each opening at one end into the concave wall of one passage and at the other end into the convex wall of another passage.

10. In a liquid purifying apparatus comprising
60 a centrifuge, a stationary paring disc having sharply curved passages extending from its periphery toward its center, an outflow pipe through which the purified liquid is discharged to the tank and means to admit gas to the tank,
65 the improvement for effecting thorough mixing of the gas with the centrifuged liquid which comprises channels communicating with said tank and with said passages along their convex sides, whereat, due to the centrifugal force of the liquid entering the channel, the pressure is substantially less than the pressure along their concave sides and the gas is therefore sucked into the passages while the liquid is flowing there-through.

11. In a liquid purifying apparatus comprising a centrifuge, a stationary paring disc having sharply curved passages extending from its periphery toward its center, an outflow pipe through which the purified liquid is discharged to the tank and means to admit gas to the tank, the improvement for effecting thorough mixing of the gas with the centrifuged liquid which comprises channels communicating with said tank and with said passages along their convex sides, and other channels each opening at opposite ends into the concave wall of one passage and the convex wall of another passage.

12. The process of saturating liquid with gas which comprises pumping said liquid from an annular body of liquid in closed streams in sharply curved directions inwardly toward a common center to thereby create a pressure along

the concave sides of the streams substantially less than that along the convex sides of the streams, and admitting gas at points along only the concave sides of the streams.

13. The process of saturating liquid with gas which comprises pumping said liquid from an annular body of liquid in closed streams in sharply curved directions inwardly toward a common center to thereby create a pressure along the concave sides of the streams substantially less than that along the convex sides of the streams, admitting gas along the concave sides of the streams and conveying liquid from the convex side of one stream to the concave side of another stream.

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