Sept. 1, 1970 V. E. SWANSON 3,526,470

CIRCULATING PUMPS

Filed Sept. 11, 1968 4 Sheets-Sheet 1

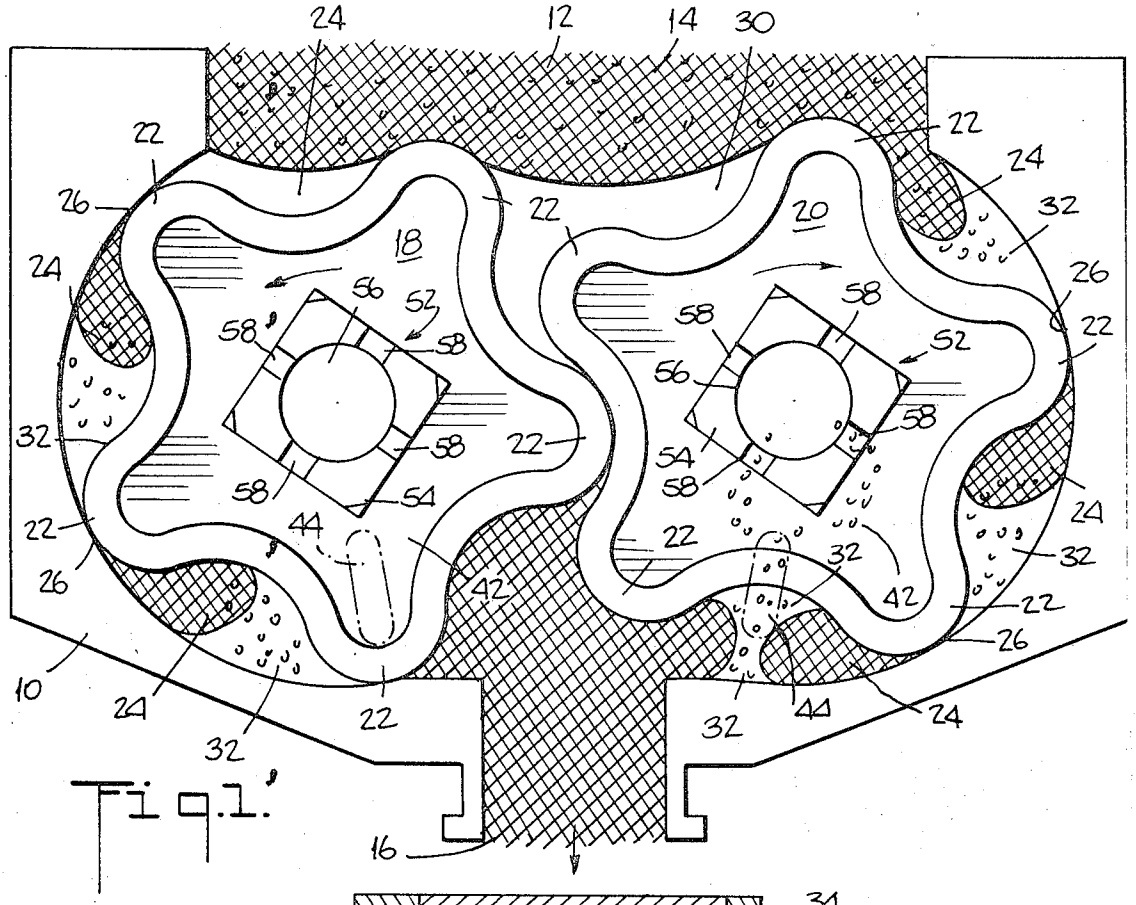

Fig. 1.

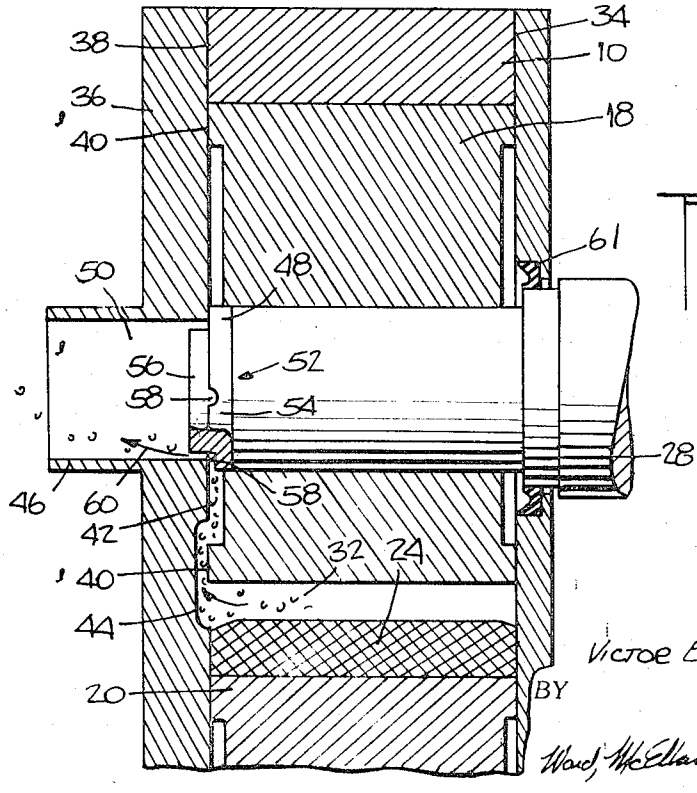

Fig. 2.

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CIRCULATING PUMPS

Filed Sept. 11, 1968 4 Sheets-Sheet 2

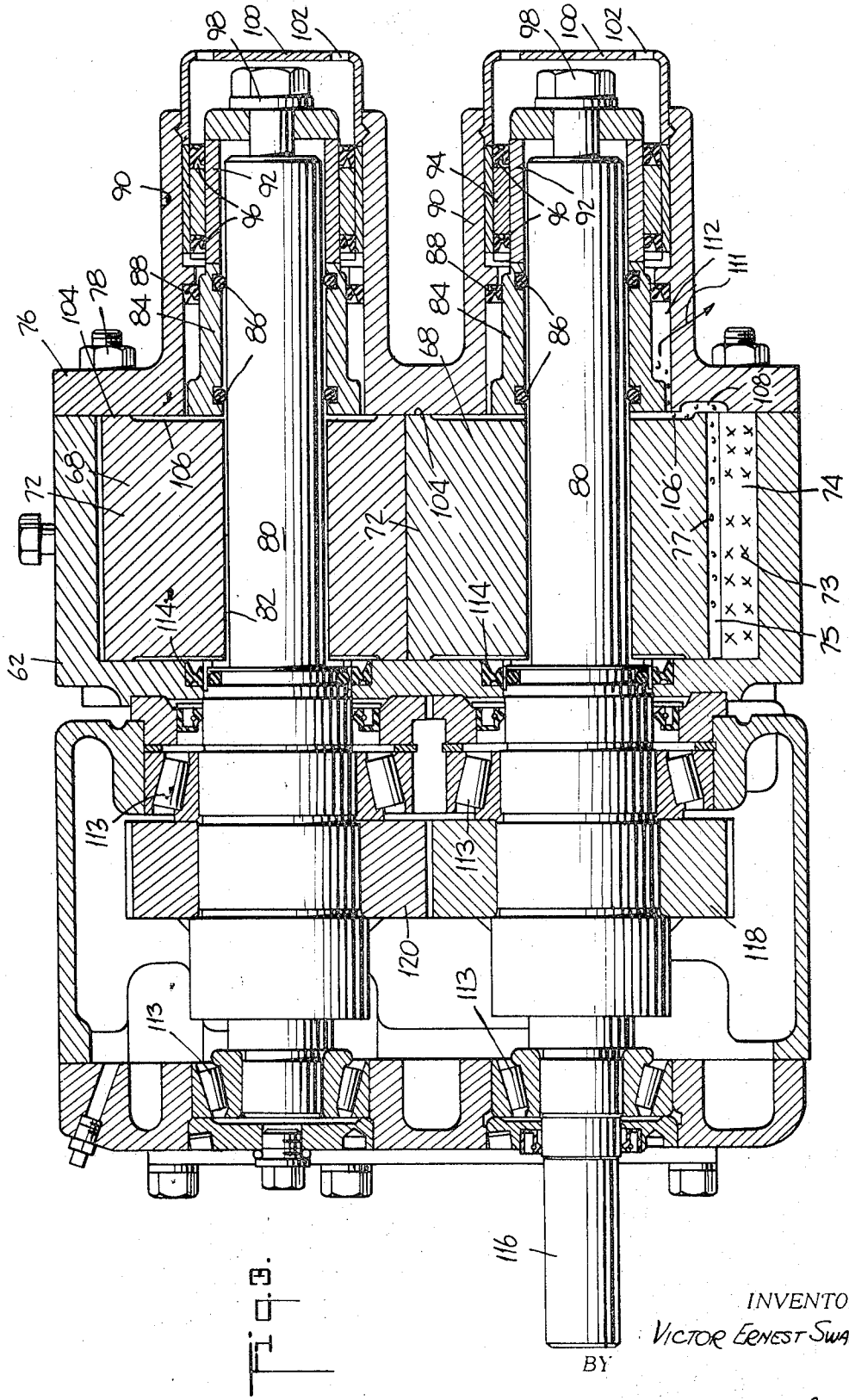

Fig. 3.

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CIRCULATING PUMPS

Filed Sept. 11, 1968 4 Sheets-Sheet 3

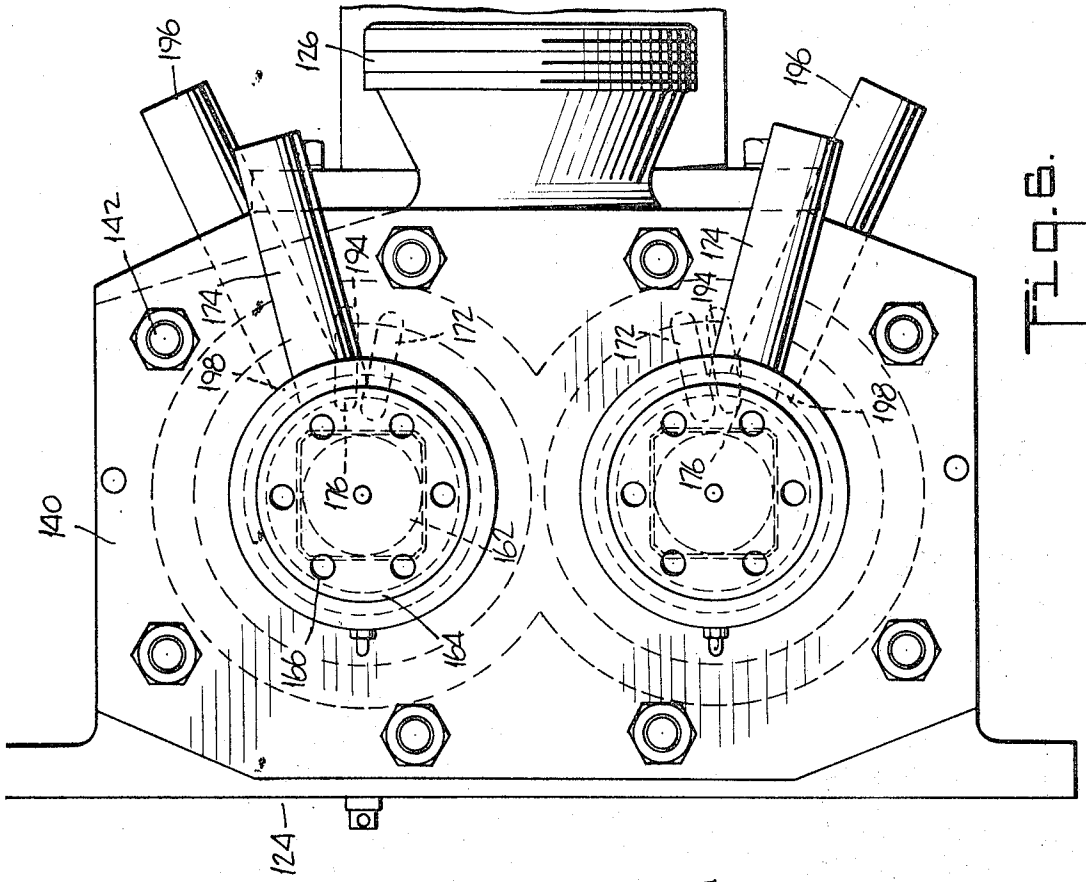

Fig. 6.

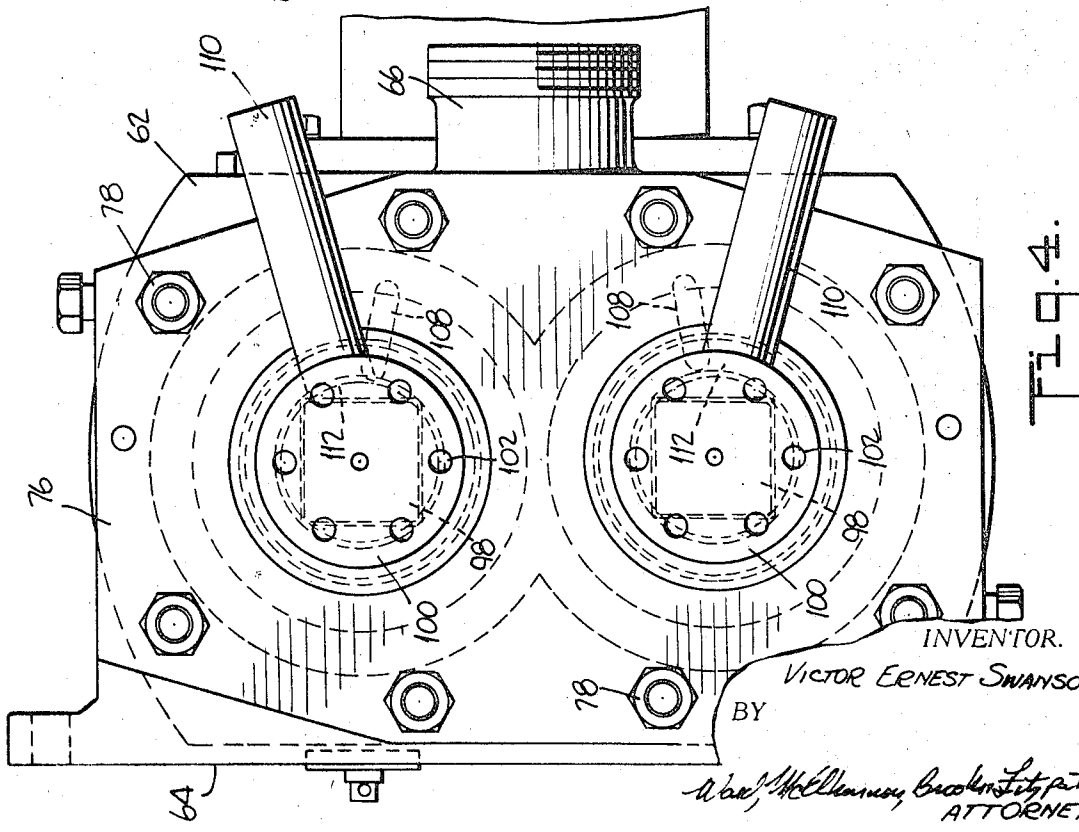

Fig. 4.

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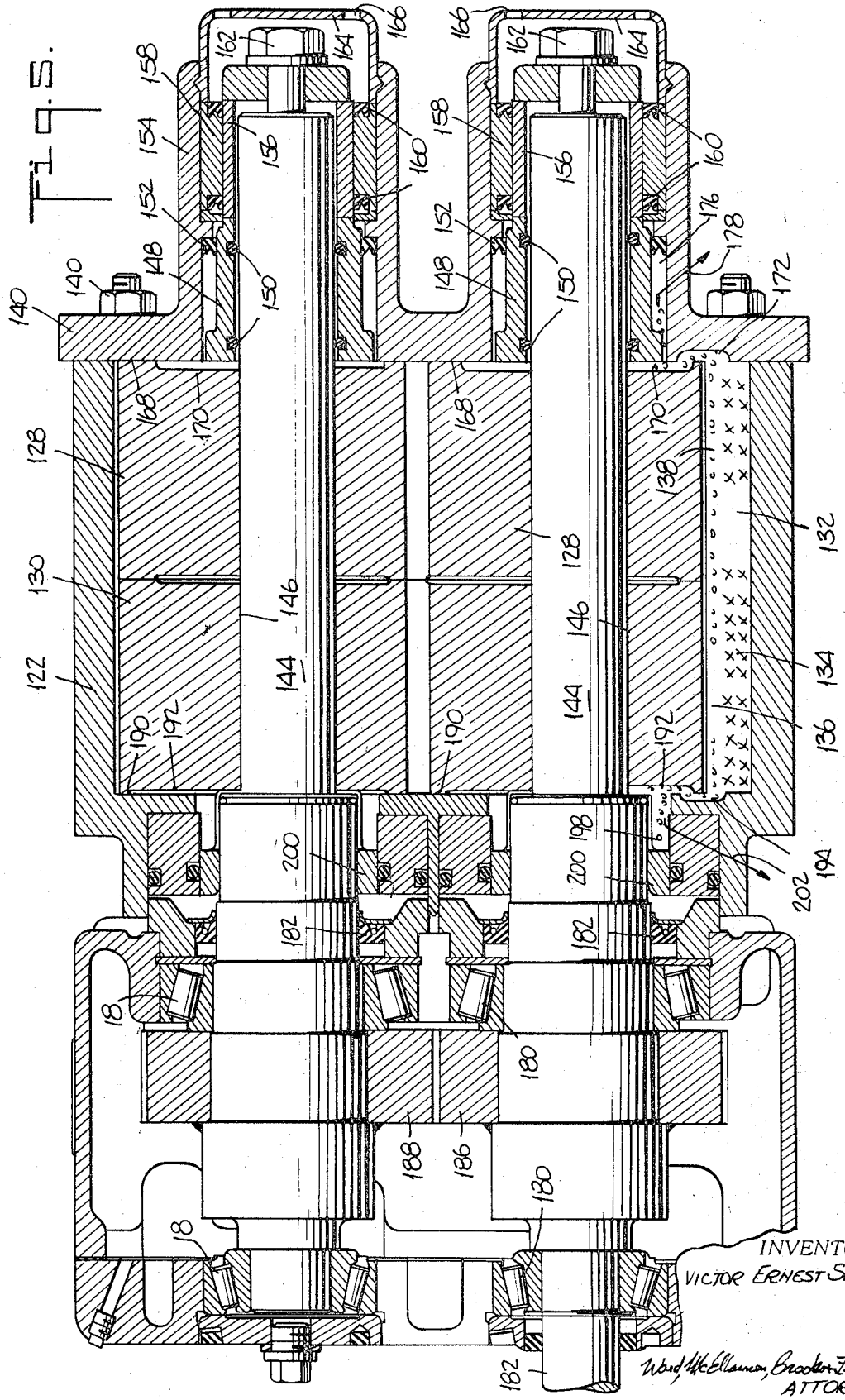
CIRCULATING PUMPS

Filed Sept. 11, 1968 4 Sheets-Sheet 4

Fig. 5.



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3,526,470

CIRCULATING PUMPS

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Int. Cl. F04c 1/08
U.S. Cl. 418—15 8 Claims

ABSTRACT OF THE DISCLOSURE

A pump for circulating a viscous liquid product and simultaneously removing gas from the product being pumped including a pair of rotors mounted in a pump body. The rotors are provided with lobes and rotor pockets therebetween, and the rotors are rotated at a speed sufficient to create a reduced pressure area in the pump inlet to draw in the product and partially fill the rotor pocket, leaving an unfilled space in the rotor pocket. The unfilled space, being under reduced pressure, receives gas from the product while the lobes serve to increase the pressure of the product in the rotor pocket as it is propelled towards the outlet. Venting means are provided adjacent the outlet to permit the escape of gas from the unfilled space in the rotor pocket.

This invention has to do with pumps for circulating a viscous liquid product, and more particularly to pumps which in addition serve to remove gases from the product being pumped.

A pump constructed in accordance with the concept of this invention is particularly adapted, among other possible applications, for use in removing generated or trapped gases from food products. The liquids handled by this pump generally have a high viscosity rating which ranges up to only sufficient fluidity to be drawn into the entrance of the pump. For example, in bakeries bread and/or bun dough is handled at different points of processing. In meat plants the various meat emulsions, similar to hamburger, used in making wieners, sausages, etc., are processed through the degasser pump. While the illustrated usage of the degasser pump has been applied to the food industry, the principle may be used on any product requiring degassing which is compatible with the materials of the pump construction.

In the past commercial pumping apparatus has been employed for circulating these products. Such apparatus is disclosed in the A. H. Wakeman Pat. No. 2,848,952 dated Aug. 26, 1958. The present invention concerns improvements upon the features of such apparatus.

Summarizing briefly, this invention provides a new and improved pump for circulating a viscous liquid product which includes a pump body with a rotor mounted therein, the pump body having the usual inlet port and outlet port. The rotor is provided with lobes and rotor pockets therebetween, and means are provided for rotating the rotor at a speed which is sufficient to create a vacuum or reduced pressure area in the inlet area of the pump. This vacuum draws the product into and partially fills the rotor pockets, and allows the gases to escape from the product into the unfilled space in the rotor pocket. The speed of rotation of the rotor must be great enough to only partially fill the rotor pocket, and this minimum speed will vary depending upon the viscosity of the product. An increase in speed increases the vacuum, and hence the amount of gas removed. When the speed is decreased to the extent that the rotor pocket is completely filled with product, the elimination of the gas will stop. The lobes of the rotors serve to increase the pressure of the product as well as the gas in the rotor pocket, as they

are propelled from the inlet port to the outlet port. As the product in the rotor pocket approaches the outlet port, the gas in the unfilled area is compressed and vented through venting means disposed adjacent said outlet port. In one form of the invention the venting means comprises a cover for the pump body, a rotor having an end face with a relieved area adjacent the cover and the cover having vent grooves to permit the gas to escape from the unfilled space in the rotor pocket to the relieved area. Thence, the gas escapes from the relieved area through a vent tube.

In another form of my invention, there is provided a vent plug mounted in the relieved area adjacent the vent tube for restricting the product flow, but allowing gas to escape to the vent tube.

In addition, according to another form of my invention, the rotor is driven by a drive shaft having one end mounted on the pump body and the other end mounted on the cover. In addition to the first end face adjacent the cover, described hereinbefore, there is a second end face on the opposite side of the rotor which also has a relieved area. The pump body adjacent the second end face is provided with grooves to permit the gas to escape from the unfilled space in the rotor pocket to the relieved area of the second end face. A second vent tube is mounted on the pump body adjacent the relieved area of the second end face for allowing the gases to escape from the relieved area of the second end face to the vent tube.

Under some conditions, a small amount of product may be vented with the gases. If it is desired to retrieve this product means, well-known in the art, may be attached to the vent tube to recirculate the product to the feed hopper.

There has thus been outlined rather broadly the more important features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception on which this disclosure is based may readily be utilized as the basis for the designing of other structures for carrying out the several purposes of the invention. It is important, therefore, that the claims be regarded as including such equivalent constructions as do not depart from the spirit and scope of the invention.

Several embodiments of the invention have been chosen for purposes of illustration and description, and are shown in the accompanying drawings, forming a part of the specification, wherein:

FIG. 1 is a transverse sectional view of the pump, partially broken away to reveal the interaction of the rotors and pump body on the product being circulated;

FIG. 2 is a fragmentary, medial, longitudinal sectional view of the pump of FIG. 1 showing the details of the venting arrangement;

FIG. 3 is a longitudinal sectional view of another embodiment of a pump constructed in accordance with the concept of this invention;

FIG. 4 is an end elevation of the embodiment of FIG. 3;

FIG. 5 is a longitudinal sectional view of still another embodiment of the invention; and

FIG. 6 is an end elevation view of the embodiment of FIG. 5.

In the embodiment of the invention illustrated in FIGS. 1 and 2, there is provided a pump body **10** having an inlet port **12** through which the product **14** enters the pump from a hopper or other feed source (not shown), and an outlet port **16** through which the product leaves the pump at a relatively higher pressure.

A pair of rotors **18** and **20** is mounted within the pump body **10**. Each of the rotors has a peripheral configuration formed by a non-uniform radius about the rotary axis of the rotor forming a plurality of spaced lobes **22** with rotor pockets **24** therebetween. The lobes **22** are in slidable contact with the pump body **10** as at **26** to impel the product **14** from the inlet port **12** to the outlet port **16**.

Means such as drive shaft **28**, FIG. 2, are provided for rotating the rotors at a speed sufficient to create a vacuum in the area **30** of the inlet port **12** to draw the product **14** into and partially fill the rotor pockets **24**. The unfilled space **32** in the rotor pocket **24** is under reduced pressure or vacuum for receiving gases from the product.

The pump body **10** may be fabricated in one section or in two sections fixedly interconnected as along interface **34**, FIG. 2. A cover **36** is mounted on the pump body **10**, as at **38**. Each of the rotors is provided with a first end face **40** adjacent the cover, and each end face is provided with a relieved area **42**. Vent grooves **44** in the cover **36** permit the gas to escape from the unfilled space **32** in the rotor pocket **24** to the relieved area **42** in the rotor face **40**. It will be appreciated that the vent grooves **44** are positioned to permit the maximum gas discharge with minimum product loss. As best seen in FIG. 1, the lobes **22** are arranged to pass over the vent grooves **44** in the cover to intermittently terminate the venting of the gases. A vent tube **46**, FIG. 2, is mounted on the cover **36** for each rotor (one being shown).

As best seen in FIG. 2 the drive shaft **28** is provided with a free space **48** adjacent the end thereof. In addition, the cover **36** is provided with a clearance aperture **50** adjacent the drive shaft. A vent plug indicated generally at **52** is mounted on the end of the drive shaft **28**, extending into the clearance aperture **50** adjacent vent tube **46**. The vent plug has a square portion **54** which is mounted on the drive shaft **28** and a round portion **56** which extends into the clearance aperture **50**. The shoulder area of the vent plug between the square portion **54** and the round portion **56** contains grooves **58** for permitting the gases from the product to pass from the relieved area **42** of the rotor through the clearance area of the round section to the vent tube **46**, as indicated by arrow **60** in FIG. 2.

Sealing means such as an annular sealing piece **61** (FIG. 2) is interposed between the pump body **10** and the drive shaft **28** to prevent the liquid product from leaking along the shaft.

In the embodiment of the invention illustrated in FIGS. 3 and 4, there is a pump body **62** having an inlet port **64** (FIG. 4) through which the product enters the pump, and an outlet port **66** (FIG. 4) through which the product leaves the pump at a higher relative pressure. A pair of rotors **68** (FIG. 3) is mounted in the pump body **62**. Each of the rotors has a peripheral configuration formed by a non-uniform radius about the rotary axis of the rotor forming a plurality of spaced lobes **72** with rotor pockets **74** therebetween. The lobes **72** and rotor pockets **74** are constructed and function in a manner similar to that described hereinbefore in connection with lobes **22** and rotor pockets **24** in the embodiment of FIGS. 1 and 2. As pointed out hereinbefore in connection with the embodiment of FIGS. 1 and 2, the rotors are rotated at a speed sufficient to create a vacuum in the area of the inlet port to draw the product **73** into and partially fill the rotor pockets, the unfilled space **75** in the rotor pocket being under reduced pressure for receiving gases **77** from the product, and the lobes of one rotor contacting the lobes of the other rotor and the pump body when the rotors are rotated to effectively impel the product from the inlet port to the outlet port.

A cover **76** is mounted on the pump body **62**, as by means of nut and bolt assemblies **78**. The rotors **68** are driven by means of drive shafts **80** keyed thereto as at **82**. These shafts extend beyond the rotors and carry inner sleeves **84** having O-rings **86** to prevent leakage along

the shaft. Sealing means, such as annular sealing pieces **88**, are interposed between the inner sleeve **84** and an outwardly projecting flange portion **90** of the cover **76**. An outer sleeve **92** is mounted on the shaft **80** and serves to receive bearing assembly **94** which incorporates seals **96**. An end bolt assembly **98** serves to retain sleeves **84** and **92** in position, and a cap **100** with apertures **102** prevents dirt or other foreign matter from entering the pump.

As best seen in FIG. 3, each of the rotors **68** is provided with a first end face **104** adjacent the cover **76**, and each end face is provided with a relieved area **106**. Vent grooves **108** in the cover **76** permit the gas **77** to escape from the unfilled space **75** in the rotor pocket **74** to the relieved area **106** in the rotor face **104**. It will be appreciated that the vent grooves **108** are positioned to permit the maximum gas discharge with minimum product loss. The lobes **72** are arranged to pass over the venting grooves **108** in the cover to intermittently terminate the venting of the gas **108**. A vent tube **110**, FIG. 4, is mounted on the cover **76** for each rotor **68**, and is open to the clearance area **112** between the sleeve **84** and the cover **76** so that the gas passes from the relieved area **106** to the clearance area **112** to the vent tube **110**. That is, the gas passes from the clearance area **112** to the vent tube **110**, as indicated by the arrow **111** in FIG. 3. It is noted that the restriction between the sleeves **84** and the cover **76** in FIG. 3 is similar to the restriction built into the vent plug **52** in FIG. 2.

Bearings **113** are mounted on the pump body **62**, as best seen in FIG. 3, for supporting the other end of the drive shafts **80**. Sealing means, such as annular sealing pieces **114**, are interposed between the pump body **62** and the shafts **80** to prevent leakage of the liquid product.

One of the drive shafts is provided with an extension **116** to which an electric motor or other driving means is connected in a manner well-known in the art. The shaft with the extension is provided with a drive gear **118** and the other shaft is provided with a mating driven gear **120** to effect simultaneous rotation of the rotors **68**.

In the embodiment of the invention illustrated in FIGS. 5 and 6, there is a pump body **122** having an inlet port **124** (FIG. 6) through which the product enters the pump, and an outlet port **126** (FIG. 6) through which the product leaves the pump at a higher relative pressure. A pair of rotors **128** (FIG. 5) is mounted in the pump body **122**. Each of the rotors has a peripheral configuration formed by a non-uniform radius about the rotary axis of the rotor forming a plurality of spaced lobes **130** with rotor pockets **132** therebetween. The lobes **130** and the rotor pockets **132** are constructed and function in a manner similar to that described heretofore in connection with lobes **22** and **72** and rotor pockets **24** and **74** in the embodiment of FIGS. 1 and 2, and FIGS. 3 and 4. As pointed out hereinbefore in connection with the other embodiments, the rotors are rotated at a speed sufficient to create a vacuum in the area of the inlet port to draw the product **134** (FIG. 5) into and partially fill the rotor pockets **132**, the unfilled space **136** in the rotor pocket being under reduced pressure for receiving gas **138** from the product **134**, and the lobes of one rotor contacting the lobes of the other rotor and the pump body when the rotors are rotated to effectively impel the product from the inlet port to the outlet port.

A cover **140** is mounted on the pump body **122**, as by means of nut and bolt assemblies **142** provided for the purpose. The rotors **128** are driven as by means of drive shafts **144** keyed thereto, as at **146**. The shafts extend beyond the rotor and carry inner sleeves **148** having O-rings **150** to prevent leakage along the shaft. Sealing means, such as annular sealing pieces **152**, are interposed between the inner sleeve **148** and an outwardly projecting flange portion **154** of the cover **140**. An outer sleeve **156** is mounted on the shaft **144** and serves to receive bearing assembly **158** which incorporates seals **160**. An end bolt assembly **162** serves to retain sleeves **148** and **156** in position, and a cap **164** with apertures **166** pre-

vents dust or other foreign matter from entering the pump.

As best seen in FIG. 5, each of the rotors **128** is provided with a first end face **168** adjacent cover **140**, and each end face has a relieved area **170**. Vent grooves **172** in the cover **140** permit the gas **138** to escape from the unfilled space **136** in the rotor pocket **132** to the relieved area **170** in the rotor face **168**. It will be appreciated that the vent grooves **172** are positioned to permit the maximum gas discharge with minimum product loss. The lobes **130** are arranged to pass over the vent grooves **172** in the cover **140** to intermittently terminate the venting of the gas **108**. Mounted on the cover **140** for each rotor **128** is a vent tube **174** (FIG. 6) which is open to the clearance area **176** between the sleeve **148** and the cover **140** so that the gas passes from the relieved area **170** to the clearance area **176** to the vent tube **174**. That is, the gas passes from the clearance area **176** to the vent tube **174**, as indicated by the arrow **178** in FIG. 5.

Bearings **180** are mounted on the pump body **122**, as best seen in FIG. 5, for supporting the other end of the drive shafts **144**. Sealing means, such as annular sealing pieces **182**, are interposed between the pump body and the shafts **144** to prevent leakage of the liquid product along the shafts toward the bearings.

One of the drive shafts is provided with an extension **184** to which an electric motor or other driving means is connected. The shaft with the extension is provided with a drive gear **186**, and the other shaft is provided with a mating driven gear **188** to effect simultaneous rotation of the two rotors.

As best seen in FIG. 5, each of the rotors **128** is provided with a second end face **190** on the opposite side of the rotor with respect to the first end face **168**. The second end face has a relieved area **192**, and the pump body adjacent the second end face is provided with second vent grooves **194** to permit the gas **138** to escape from the unfilled space **136** to the relieved area **192** of the second end face. It will be appreciated that the vent grooves **194** are positioned to permit the maximum gas discharge with minimum product loss. The lobes **130** are arranged to pass over the second vent grooves **194** in the pump body to intermittently terminate the venting of the gases. A vent tube **196** (FIG. 6) is mounted on the pump body **122** for each rotor **128**. The vent tube is open to the clearance area **198** formed between a sleeve **200**, the pump body and the shaft **144**, the sleeve **200** being mounted for rotation on shaft **144**. The gas passes from the clearance area **198** to the vent tube **196**, as indicated by the arrow **202** in FIG. 3.

It will thus be seen that the present invention does indeed provide an improved pump for circulating a liquid product which in addition serves to remove gases from the product being pumped, and which is superior in simplicity, economy and efficiency as compared to prior art such devices, thereby ensuring a fineness in texture and smoothness in external appearance, and in addition providing more accurate weight control and an increase in shelf life of the product so circulated.

Although certain particular embodiments of the invention are herein disclosed for purposes of explanation, various modifications thereof, after study of this specification, will be apparent to those skilled in the art to which the invention pertains, and reference should accordingly be had to the appended claims in determining the scope of the invention.

What is claimed and desired to be secured by letters patent is:

1. A pump for circulating a liquid product comprising a pump body, a rotor mounted within said pump body, said pump body having an inlet and an outlet port, said rotor having a plurality of spaced lobes and rotor pockets therebetween, the size and dimension of said inlet and the size and dimension of said rotor pockets and the speed of rotation of said rotor being correlated to create reduced pressure in the area of the inlet port to draw said product into and partially fill said rotor pockets leaving an unfilled space in the rotor pocket, the unfilled space being under reduced pressure for receiving gases from the product when said pump is in operation, said lobes serving to increase the pressure of the product and the gases in the rotor pocket as they are propelled from said inlet port to said outlet port, venting means disposed adjacent but not in fluid flow communication with said outlet port to permit the escape of gas from said unfilled space in the rotor pocket.

2. A pump for circulating a liquid product according to claim **1** wherein said venting means comprises a cover for said pump body, said rotor having a first end face adjacent said cover, said end face having a relieved area, said cover having vent grooves to permit said gas to escape from said unfilled spaces in the rotor pocket to said relieved area, said lobes being arranged to pass over said vent grooves in the cover to intermittently terminate the venting of said gases, a vent tube mounted on said cover for allowing said gases to escape from said relieved area.

3. A pump for circulating a liquid product comprising a pump body, a rotor mounted within said pump body, said pump body having an inlet and an outlet port, said rotor having a plurality of spaced lobes and rotor pockets therebetween, means for rotating said rotor at a speed sufficient to create reduced pressure in the area of the inlet port to draw said product into and partially fill said rotor pockets leaving an unfilled space in the rotor pocket, the unfilled space being under reduced pressure for receiving gases from the product when said pump is in operation, said lobes serving to increase the pressure of the product and the gases in the rotor pocket as they are propelled from said inlet port to said outlet port, venting means disposed adjacent said outlet port to permit the escape of gas from said unfilled space in the rotor pocket, said venting means comprising a cover for said pump body, said rotor having a first end face adjacent said cover, said end face having a relieved area, said cover having vent grooves to permit said gas to escape from said unfilled spaces in the rotor pocket to said relieved area, said lobes being arranged to pass over said vent grooves in the cover to intermittently terminate the venting of said gases, a vent tube mounted on said cover for allowing said gases to escape from said relieved area, and a vent plug mounted in said relieved area adjacent said vent tube for restricting product flow but allowing gases to escape to said vent tube.

4. A pump for circulating a liquid product according to claim **3** wherein said means for rotating said rotor comprises a drive shaft for said rotor, and wherein said rotor has a free space adjacent the end of the drive shaft, said cover being provided with a clearance aperture adjacent said drive shaft, said vent plug having a square portion mounted on the end of the drive shaft, said plug having a round portion extending into said clearance aperture, the shoulder area of the plug between said square portion and the round portion containing grooves for permitting the gases from the product to pass from the relieved area of the rotor through the clearance area of the round section to said vent tube in the cover.

5. A pump for circulating a liquid product according to claim **2** wherein said rotor is driven by a drive shaft, bearing means mounted on said pump body on one side of said rotor for supporting one end of said shaft and bearing means mounted on said cover on the other side of said rotor for supporting the other end of said shaft.

6. A pump for circulating a liquid product according to claim **5** wherein said rotor has a second end face on the opposite side of said rotor with respect to said first end face, said second end face having a relieved area, said pump body adjacent said second end face having vent grooves to permit said gas to escape from said unfilled space to the relieved area of said second end face, said

lobes being arranged to pass over the second vent grooves in the pump body to intermittently terminate the venting of said gases, a second vent tube mounted on said pump body adjacent said relieved area of said second end face for allowing the gases to escape from the relieved area of the second end face to said second vent tube.

7. A pump for circulating a liquid product comprising a pump body, a pair of rotors mounted within said pump body, said pump body having an inlet port through which said product enters said pump and an outlet port through which said product leaves said pump at a higher relative pressure, each of said rotors having a peripheral configuration formed by a non-uniform radius about the rotary axis of said rotor forming a plurality of spaced lobes with rotor pockets therebetween, means for rotating said rotors at a speed sufficient to create a vacuum in the area of the inlet port to draw said product into and partially fill said rotor pockets leaving an unfilled space in the rotor pocket, the unfilled space being under reduced pressure for receiving gases from the product, the lobes of one rotor contacting the lobes of the other rotor and the pump body when said rotors rotate to effectively impel the product from the inlet port to the outlet port, a cover for said pump body, each of said rotors having a first end face in substantially continuous sliding engagement with the adjacent cover, said end face having a relieved area, said cover having vent grooves to permit said gas to escape from said unfilled space in the rotor pocket to said relieved area, said lobes being arranged to pass over said vent groves in the cover to intermittently terminate the venting of said gases, a vent tube mounted on said cover for each rotor vent plugs mounted in said relieved areas adjacent said vent tubes for restricting product flow but allowing gases to escape to said vent tubes, respectively.

8. A pump for circulating a liquid product comprising a pump body, a pair of rotors mounted within said pump body, said pump body having an inlet port through which said product enters said pump and an outlet port through which said product leaves said pump at a higher relative pressure, each of said rotors having a peripheral configuration formed by a non-uniform radius about the rotary axis of said rotor forming a plurality of spaced lobes with rotor pockets therebetween, means for rotating said rotors at a speed sufficient to create a vacuum in the area of the inlet port to draw said product into and partially fill said rotor pockets leaving

an unfilled space in the rotor pocket, the unfilled space being under reduced pressure for receiving gases from the product, the lobes of one rotor contacting the lobes of the other rotor and the pump body when said rotors are rotated to effectively impel the product from the inlet port to the outlet port, a cover for said pump body, a drive shaft for each rotor, bearing means mounted on said pump body on one side of said rotor for supporting one end of the shaft and bearing means mounted on said cover on the other side of said rotor for supporting the other end of said shaft, each of said rotors having a first end face adjacent said cover, said end face having a relieved area, said cover having venting grooves to permit said gas to escape from said unfilled space to said relieved area, said shaft having a sleeve arranged to cooperate with said cover to form a clearance area in fluid flow communication with said relieved area, a venting tube mounted on said cover for allowing said gas to escape from said clearance area, each of said rotors having a second end face on the opposite side of said rotor with respect to said first end face, said second end face having a second relieved area, said pump body adjacent said second end face having second vent grooves to permit said gas to escape from said unfilled space to said second relieved area, said shaft having a sleeve arranged to cooperate with said pump body and said shaft to form a second clearance area in fluid flow communication with said second relieved area, a second vent tube mounted on said pump body for allowing said gas to escape from said second clearance area.

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U.S. Cl. X.R.

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