

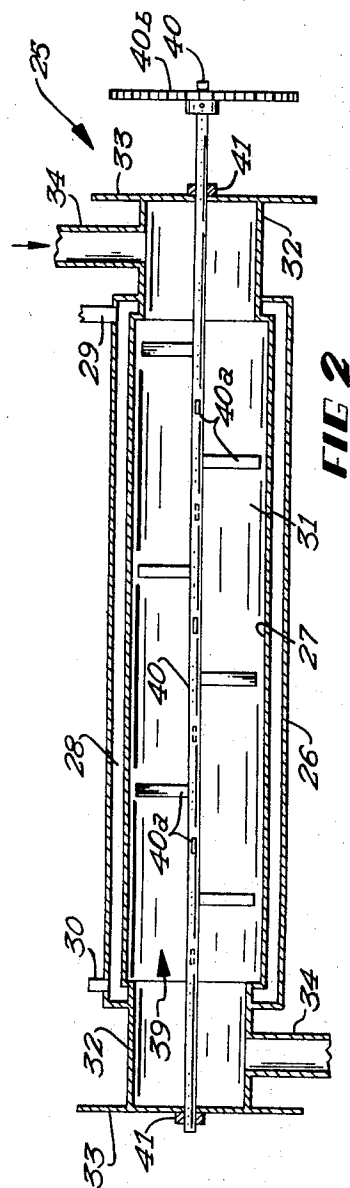
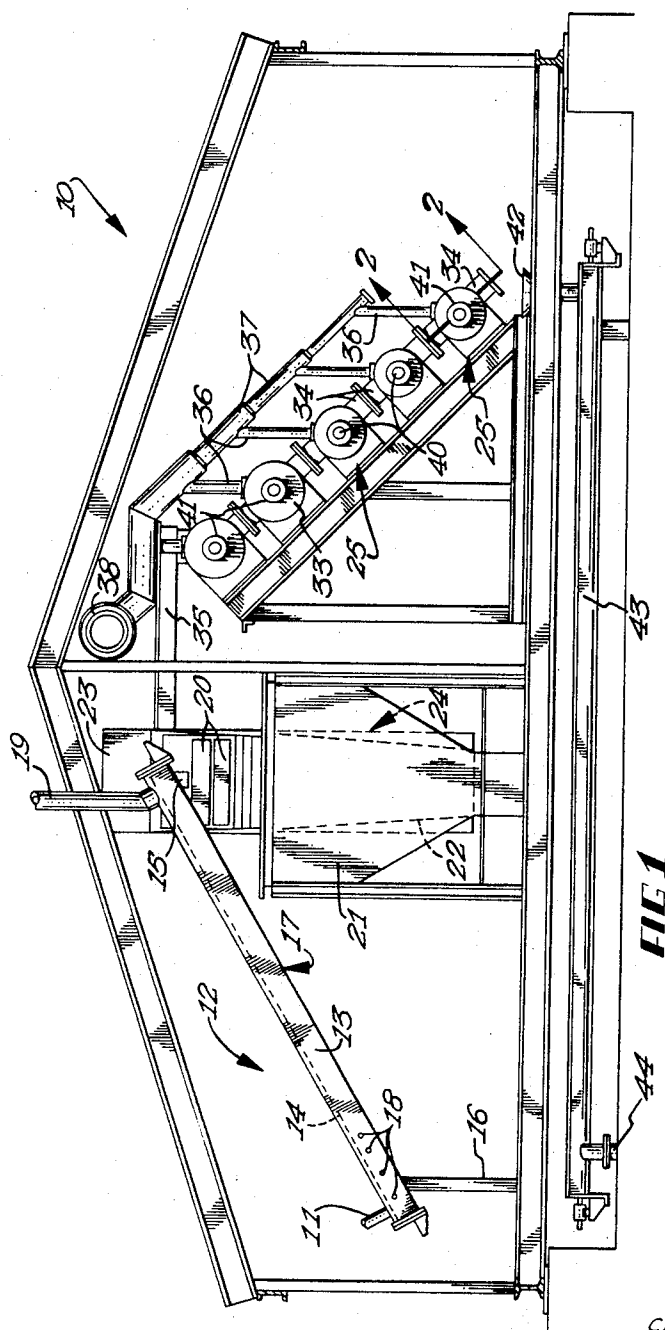
March 4, 1969

C. D. MACY ET AL

3,431,118

PROCESS AND APPARATUS FOR COAGULATING AND DRYING BLOOD

Filed March 12, 1964



INVENTORS
CHRISTIAN D. MACY, DECEASED, BY
LAURA G. MACY, ADMINISTRATRIX,
HAROLD B. BUTLER
BY *Williamson & Palmatier*
ATTORNEYS

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PROCESS AND APPARATUS FOR COAGULATING AND DRYING BLOOD

Christian D. Macy, deceased, late of Austin, Minn., by
Laura G. Macy, special administratrix, Austin, Minn.,
and Harold B. Butler, Austin, Minn., assignors to Geo.
A. Hormel & Company, Austin, Minn., a corporation
of Delaware

Filed Mar. 12, 1964, Ser. No. 351,570

U.S. Cl. 99—199

4 Claims

Int. Cl. B01d 1/02; A23j 1/06

ABSTRACT OF THE DISCLOSURE

The continuous drying of animal blood by passing blood through an upwardly inclined coagulation chamber and injecting steam at the lower end of the chamber to coagulate the blood. The coagulated blood passes out of the chamber on to an evaporation screen to separate the liquid residue from the semi-solid blood particles. The particles pass through a plurality of vertically spaced-apart elongate heating chambers to progressively dry the blood. The particles are impinged against the heating surfaces of each heating chamber while they are allowed to flow slowly through each chamber and to overflow by action of gravity into the next adjacent chamber primarily in response to the influx of additional particles.

This invention relates to a continuous, high capacity process and apparatus for use in effectively drying animal blood.

During the various slaughtering operations in meat packing plants and slaughter houses, the slaughtered animals are bled thus resulting in vast accumulations of blood. Because of the high sanitary requirements and other prevailing work conditions, this blood must be treated or otherwise disposed of. It has been that since the blood does contain high concentrations of protein, it is desirable to collect and stabilize the blood into a stable product. This has been done through a drying process although heretofore, no commercially feasible high capacity continuous blood drying processes have been provided. The conventional way of treating or drying blood has been through batch type drying operations, which operations have been found highly unsatisfactory since this batch type approach cannot be co-ordinated effectively with the high capacity slaughtering operations.

It is therefore an object of this invention to provide a continuous process and apparatus for drying blood which is collected as a result of the slaughtering operations and wherein blood is first coagulated into semi-solid blood particles in a liquid residue and these blood particles are thereafter continuously introduced and passed through a plurality of heating chamber structures to cause removal of the moisture from the semi-solid blood particles.

Another object of this invention is to provide a novel continuous high capacity process and apparatus for use in drying animal blood wherein the animal blood is continuously delivered to and moved through a coagulation chamber, live steam being introduced directly into the liquid blood as this blood is moved through the coagulation chamber to thereby cause coagulation of the blood into semi-solid particles in a liquid residue, and in which the mixture of coagulated semi-solid blood particles in liquid residue are physically separated through the medium of vibrating screen mechanism, the semi-solid blood particles being sequentially passed through a series of interconnected heating zones or chambers to substantially remove the moisture from the blood, whereby the blood is rendered stable for subsequent use.

Another object of this invention is to provide a high capacity continuous blood drying process and apparatus of the class described wherein the moisture-containing air within the heating chamber structures is constantly exhausted to thereby increase the rate at which the moisture is removed from the particles of blood.

These and other objects and advantages of the invention will more fully appear from the following description made in connection with the accompanying drawing wherein like character references refer to the same or similar parts throughout the several views, and in which:

FIG. 1 is a diagrammatic side elevational view illustrating the novel apparatus for carrying out the process, and in which certain parts thereof are broken away for clarity; and

FIG. 2 is a cross sectional view on an enlarged scale of one of the heating chamber structures.

Referring now to the drawing and more specifically to FIG. 1 it will be seen that one embodiment of the apparatus, designated generally by the reference numeral 10, is there shown. This apparatus 10 includes an inlet conduit 11 which has one end connected to the surge tank (not shown) and has the other end connected to a blood coagulating mechanism 12. It will be appreciated that blood may be continuously supplied to the blood coagulating mechanism 12 through the conduit 11 and that during the normal slaughtering operation, blood will be continuously delivered to the surge tank. The blood delivered to the blood coagulating mechanism 12 will be in the liquid condition and it will be seen that the blood coagulating mechanism includes an elongate, generally tubular hollow housing structure 13 defining a coagulation chamber 14 therewithin. The housing structure 13 is provided with an inlet adjacent one end thereof which intercommunicates the discharge end of the inlet conduit 11 with the coagulation chamber 14. The housing structure 13 is also provided at its other end with an outlet 15 through which the blood material is discharged from the coagulation chamber 14. It will be noted that the housing structure 13 is inclined upwardly so that the outlet 15 is disposed at a higher elevation than the inlet, the housing being supported in this inclined position by suitable support means such as the supports 16.

The blood introduced into the housing structure 13 is in a liquid condition and the blood is moved continuously axially through the coagulation chamber 14 towards the outlet by means of a suitable driven auger mechanism 17 which extends through the housing structure 13. Although not shown in the drawing, the auger mechanism 17 is provided with suitable drive means for revolving the auger mechanism. The liquid blood is effectively coagulated as it is moved through the coagulation chamber 14 and this coagulation is accomplished by introducing live steam directly into the coagulation chamber.

To this end, it will be seen that a plurality of steam inlet conduits 18 are provided each of which has one end thereof connected to the housing structure 13 in communicating relation with the coagulation chamber 14 thereof, and each steam inlet conduit 18 also having the other end thereof connected to a source of steam under pressure. It will be noted that the steam conduits 18 discharge steam into the coagulation chamber 14 adjacent the inlet end of the housing structure so that the temperature of the liquid blood is quickly raised by the admixture of steam and blood.

The introduction of steam into the continuously moving stream of blood raises the temperature of the blood to approximately 200° F. which causes coagulation of the blood into gelatinous like clumps. During this coagulation of the blood, a protein-containing liquid residue is also produced and this mixture of generally semi-solid clumps or

particles of coagulated blood in liquid residue are continuously moved upwardly at a predetermined deliberate rate. It will be appreciated that by including the housing structure 13 upwardly, rather than horizontally or at a declined position, the normal action of gravity will tend to urge the blood downwardly or rearwardly against the action of the auger mechanism 17. Therefore the overall resultant effect of the use of an upwardly inclined housing structure is that the liquid blood is subjected for a longer period of time and in a more deliberate manner to the action of the steam. Thus by having a housing structure of predetermined length and cross sectional size, and by operating the auger mechanism 17 at a predetermined speed, substantially all of the blood introduced into the coagulation chamber 14 will be coagulated as the blood reaches the outlet 15. The remaining liquid residue which contains some blood and other proteinaceous material, is collected and treated in a manner to appear more clearly hereinbelow.

During the coagulation operation within the housing structure 13, it is necessary to remove the excess steam from the coagulation chamber 14. A stack member or conduit 19 has one end thereof connected to the housing structure 13 in communicating relation with the coagulation chamber 14 adjacent the discharge end thereof, as best seen in FIG. 1. The other end of this discharge conduit or stack member communicates with the exterior to thereby permit the excess steam to be constantly removed from the housing structure 13.

Means are provided for separating the coagulated clumps of blood from the liquid residue and to this end it will be seen that a pair of superimposed vibrator screen mechanisms 20 are provided in close proximity to and below the outlet 15 of the housing structure 13. These vibrator screen mechanisms 20 are of conventional construction and are provided with suitable vibrating or reciprocating drive means to drive the same. It will be seen that the outlet 15 of the housing structure 13 delivers the mixture of coagulated blood material and liquid residue directly upon the uppermost of the vibrator screen mechanism 20, the lower screen mechanism being positioned directly below and spaced from the upper screen mechanism. It is preferred that the perforations in the upper screen mechanism be slightly larger than the perforations in the lower screen mechanism and the two screen mechanisms will discharge the semi-solid clumps or particles of coagulated blood from the peripheral edges thereof into a hopper type receiver 21. The protein-containing liquids will pass through the perforations in the screen mechanism 20 and will pass through a generally vertically disposed chute or conduit 22 which extends through the hopper 21 and which communicates at its lower end with suitable conduit means for directing the liquids to an evaporator device wherein the liquids are evaporated and the remaining residue which contains a relatively high amount of protein is thereafter collected.

The coagulated blood material which falls within the hopper 21 is delivered to a collection hopper 23 by means of a steeply inclined conveyor mechanism 24 as best seen in FIG. 1. The particles of blood which have been collected in the collection hopper 23 are thereafter delivered to a plurality of heating devices or heating chamber structures 25 whereby these clumps or particles of coagulated blood are completely dried. It will be noted in the embodiment shown that five such heating devices or heating chamber structures 25 are provided, the uppermost pair being slightly larger in cross sectional size than the lower three chamber structures. These heating chamber structures are otherwise substantially identical in construction other than their cross sectional size and each includes, as best seen in FIG. 2, an outer cylindrical wall 26 and an inner cylindrical wall 27 spaced from each other and defining a cylindrical volumetric space therebetween which constitutes a steam chamber 28. This steam chamber is connected by a suitable conduit means 29 to

a source of steam under pressure. Each heating chamber structure is also provided with a suitable valve type vent means 30 to permit bleeding of aid from the associated steam chamber 28 and to thereby permit uniform heating of the steam chamber.

The interior of each heating chamber structure defines a generally cylindrically shaped heating chamber or zone 31 which extends completely through each heating chamber structure. The end portions 32 of each heating chamber structure is of reduced single wall construction and these end portions are connected to end walls 33 so that each heating chamber structure is closed to the exterior. It will be seen that adjacent heating chamber structures are connected in communicating relation with each other by interconnecting conduits or ducts 34, the latter communicating with the interior of the reduced end portions 32 of the adjacent heating chamber structures.

It will also be noted that the interconnecting conduits are staggered so that one conduit 34 receives the material from the heating chamber structure at one end thereof and serves to introduce this discharged material into the adjacent end of the next adjacent heating chamber structure. The uppermost of the conduits 34 intercommunicates the uppermost heating chamber structure with a conveyor mechanism 35 which delivers the coagulated blood material from the collection hopper 23. It will therefore be seen that the coagulated blood material is introduced into the uppermost heating chamber structure 25 at one end thereof and is discharged at the opposite end thereof while the material discharged from this uppermost heating chamber structure is introduced into the next adjacent heating chamber structure to be moved or conveyed axially therethrough. Thus it will be seen that the blood material is moved through the heating chamber structures 25 in a tortuous course.

Exhaust means are provided for continuously exhausting the air within each heating chamber structure to thereby remove moisture entrained in the air. It will be appreciated that the coagulated blood during the drying operation will result in a predetermined amount of free moisture or water being volatilized or vaporized and in order to obtain a more efficient heating operation, it is desirable to remove this volatilized or vaporized moisture. Each heating chamber structure has an elongate exhaust duct 36 connected in communicating relation to the reduced end thereof located at the right. It will be seen that these exhaust ducts are disposed in substantially vertically extending relation. The upper end of each of these exhaust ducts or conduits 36 is connected in communicating relation into an elongate main exhaust conduit 37 which, as seen, is of increasing diametrical size as it extends upwardly. This main conduit 37 is connected to an exhaust vent mechanism so that moisture which is entrained in the air passing through the heating chamber structures is constantly and simultaneously removed from all of the heating chamber structures. It is pointed out that the greater amount of moisture will be removed from the uppermost of the heating chamber structures since the coagulated blood material is progressively dried as it passes through the heating chamber structures.

Means are provided for agitating the coagulated blood material to be dried as this blood material is moved through the heating chamber structures and this agitating means also serves to move the blood material into intimate contacting relation with the inner surface of the inner cylindrical wall 27. This agitating mechanism for each heating chamber structure, designated generally by the reference numeral 39, includes an elongate shaft 40 extending through the associated heating chamber structure and having its respective ends projecting through the associated end walls and journaled in suitable bearings 41.

The shaft 40 is provided with a plurality of paddle elements 40a affixed thereto and projecting radially therefrom, as best seen in FIG. 2. These paddle elements 40a are arranged in staggered relation around the shaft 40 and

serve primarily as pointed out above to move the material into contacting relation with the inner surface of the heating chamber structures. It is also pointed out that each paddle element 40a is disposed in a plane arranged substantially radially with respect to the general longitudinal axial center of the shaft 33. By maintaining constant agitation of the material while in the respective heating chamber structures, the downward action of the accumulating material overflows from each heating chamber structure into the next adjacent heating chamber structure.

It will be seen that one end of the shaft 40 of each of the agitating mechanisms 39 projects axially beyond one of the end walls 33 and is provided with a sprocket 40b which is keyed thereto for rotation therewith. This sprocket is engaged by an endless drive chain, although not shown in the drawing, and the drive chain will be driven by a drive sprocket connected to a suitable source of power such as an electric motor or the like.

As the material is introduced into the uppermost heating chamber structure, the coagulated blood clumps or particles will have a temperature of approximately 200° F. The inner surfaces of the heating chamber structures will have a temperature approximating 300° F., thus permitting any free water in the coagulated blood to quickly vaporize within the heating chamber or zone 31 without the necessity of introducing or providing a pressure condition. Thus as the amount of free water in the coagulated blood material decreases, the necessary steam pressure required to heat the inner wall surface of the heating chamber structure will be accordingly reduced. The exhaust fan mechanism constantly exhausts air through each heating chamber structure so that the air entrained moisture will be quickly removed and the heating operation expedited.

The dried blood is discharged from the lowermost of the heating chamber structures 25 into a funnel-shaped cyclone dust collector structure 42 which permits collection of the fine particles of dried blood. To this end, it is pointed out that the blood will be in a substantially dried powdered form as it is discharged from the lowermost of the heating chamber structures 25 and will have a temperature of approximately 210° F. As pointed out above, the temperature of the inner wall surfaces of the heating chamber structures is approximately 300° F. and approximately 80 lbs. of steam is supplied to the steam chamber 28 of each heating chamber structure. Since the moisture content of the coagulated blood will progressively reduce as the blood is passed through each succeeding heating chamber structure, the heat exchange action will be lessened and accordingly the steam pressure needed for heating the lower pair of heating chamber structures will be lessened.

The powdered dried blood is then delivered to a collection conveyor mechanism 43 which communicates with the cyclone type dust collector structure 42 and this dried blood material is discharged through a discharge conduit 44 into a suitable collection hopper or other receptacle wherein the dried blood material may thereafter be suitably packed in bags or other containers. This dried blood contains a relatively high amount of protein and has been found to be very desirable as a constituent to animal feed mixes. It has been found to be a good feed supplement material for poultry feed mixes with especially good results as an additive to turkey feed mixes. This dried blood is also a highly desirable additive to the conventional packing or slaughter house tankage since the general protein content of such tankage is only approximately 40% and it is desirable to have the tankage contain approximately 60%. The residues from the protein-containing waters which are separated after the coagulation step are also highly desirable for use in the tankage since these residues also contain a relatively high amount of protein.

From the foregoing it will be seen that we have provided a novel process and apparatus for continuously

drying animal blood which results from the normal slaughtering operations in packing houses or slaughter houses. Our blood drying process and apparatus is not only capable of continuous operation, but is also capable of efficiently and continuously handling those volumes of blood produced from a high capacity slaughtering system whereby this system is especially adaptable for high capacity slaughtering operations.

It will also be seen from the preceding paragraphs that our novel process and apparatus first treats the liquid blood to coagulate the same for a more efficient and effective handling during the drying operation, and separates the coagulated blood from the liquid residue thereby resulting in very little waste, if any, of any of the protein-containing materials.

Thus it will be seen that we have provided a novel and continuous process and apparatus for drying blood which functions in a more efficient manner than any heretofore known comparable process or apparatus.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of our invention.

What is claimed is:

1. A continuous process for drying animal blood consisting in

passing liquid blood in an upwardly inclined direction through a coagulation chamber,

introducing steam into the liquid blood as the blood is moved in the upwardly inclined direction through the coagulation chamber to raise the temperature of the liquid blood to approximately 200° F. and for a period of time to cause coagulation of the blood into semi-solid particles and a liquid residue, discharging the mixture of coagulated semi-solid blood particles and liquid residue from the coagulation chamber directly upon a perforate surface to physically separate the semi-solid particles from the liquid residue,

sequentially passing the semi-solid particles of blood through a series of substantially exteriorly closed vertically spaced apart horizontally arranged interconnected chambers disposed in side-by-side relation and each presenting heating surfaces, each chamber having an inlet at one end thereof and an outlet at the other end thereof, the outlet of one chamber communicating with the inlet of an adjacent chamber,

continuously impinging the semi-solid particles of blood against the heating surface of each heating chamber to increase the temperature of the blood to approximately 210° F. while the particles of blood are allowed to flow slowly through each chamber and to overflow by action of gravity into the next adjacent chamber primarily in response to the influx of additional blood being fed into each chamber to thereby dry and remove the moisture from said particles.

2. The process as defined in claim 1 wherein steam is directed into the liquid blood adjacent the zone of introduction of the blood into the upwardly inclined coagulation chamber.

3. Apparatus for use in drying animal blood, said apparatus comprising

an elongate, generally tubular housing structure defining a coagulation chamber therewithin and having an inlet communicating with said coagulation chamber and through which liquid blood is introduced into the latter, said housing structure having an outlet communicating with said coagulation chamber and being inclined upwardly from said inlet towards said outlet,

conveyor means within said housing for moving said blood through said coagulation chamber from said inlet towards said outlet,

means, connected to a source of steam under pressure and communicating with said coagulation chamber for introducing steam directly into the coagulation chamber to heat the liquid blood to approximately 200° F. and to cause coagulation of the liquid blood into semi-solid particles and a liquid residue as the blood is moved from said inlet toward said outlet, vibrating screen mechanism adjacent said outlet for receiving the mixture of coagulated semi-solid blood particles and liquid residue from said outlet and for separating the semi-solid particles from the liquid residue,

a plurality of elongate vertically spaced apart horizontally oriented heating chamber structures arranged in side-by-side relation and each defining an exteriorly closed heating chamber therewithin and each heating chamber presenting a heating surface, each heating chamber structure having an inlet at one end thereof and an outlet at the other end thereof,

means interconnecting the outlet of one of said heating chamber structures in communicating relation with the inlet of an adjacent chamber structure whereby the semi-solid particles of the blood to be dried during the drying operation is passed sequentially in a predetermined direction through said heating chamber structures,

a receptacle structure for receiving said semi-solid particles of blood from said screen mechanism,

means for delivering said semi-solid particles of blood from said receptacle structure to the uppermost of said heating chamber structures,

means for heating the surface of each heating chamber structure to a predetermined temperature,

mechanism within each of said heating chamber structures operable to impinge the semi-solid particles of blood against the heating surface of each of said heating chambers as the particles are caused to be moved through each chamber and to overflow by action of gravity into the next adjacent chamber primarily in response to the influx of additional particles of blood being fed into each chamber whereby to heat and dry said particles of blood.

4. The apparatus as defined in claim 3 wherein said impinging mechanism within each chamber comprises and elongate shaft and a plurality of longitudinally spaced apart paddles affixed to said shaft and extending radially therefrom.

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A. LOUIS MONACELL, *Primary Examiner.*

H. H. KLARE III, *Assistant Examiner.*

U.S. Cl. X.R.

34—166, 180; 99—21; 159—11