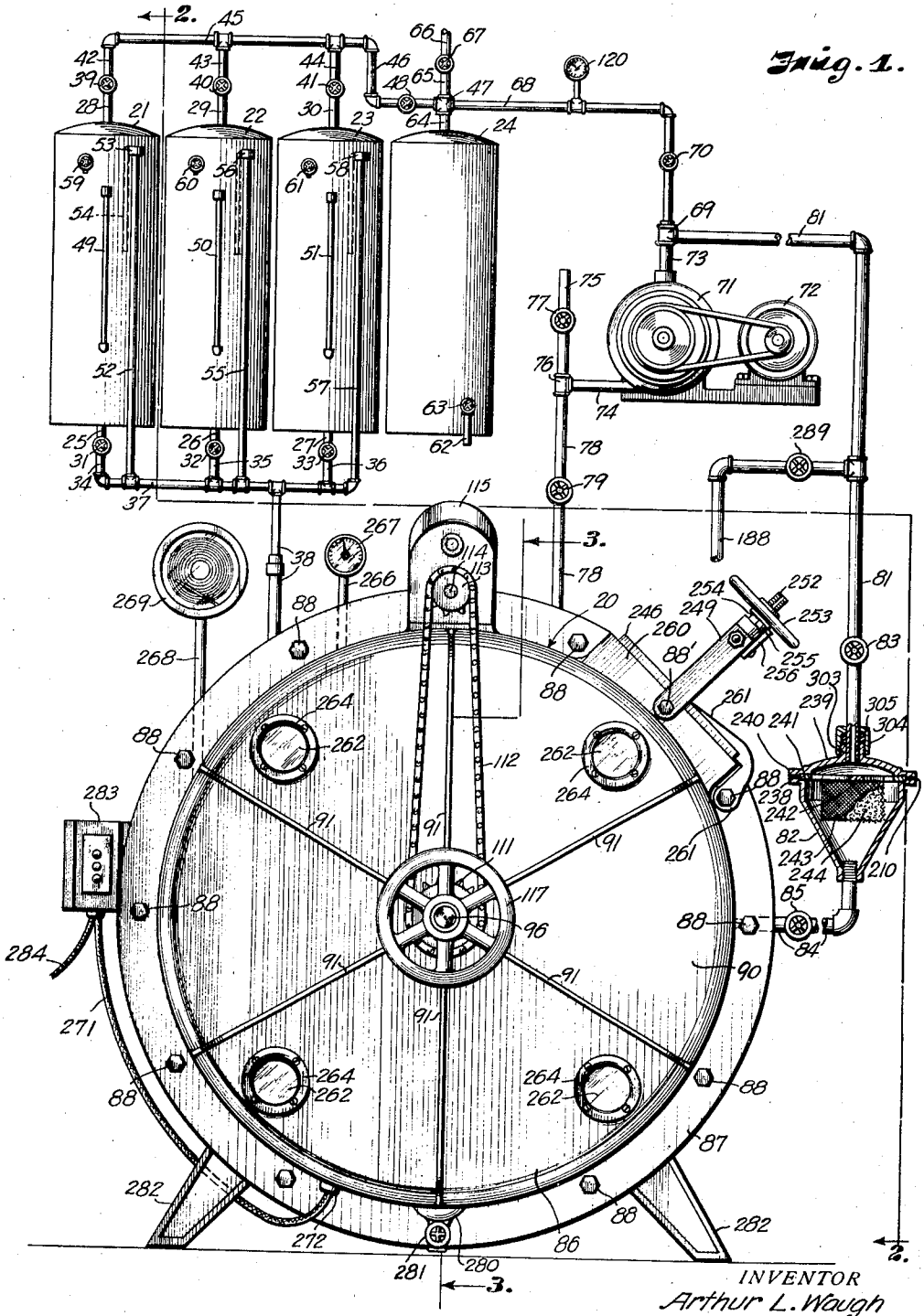
Dec. 21, 1937. A. L. WAUGH 2,102,868

LIGATURE TREATING APPARATUS

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Fig. 1.



Dec. 21, 1937. A. L. WAUGH 2,102,868

LIGATURE TREATING APPARATUS

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Fig. 9.

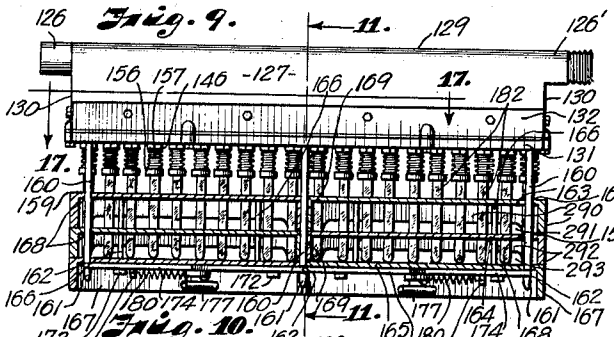


Fig. 10.

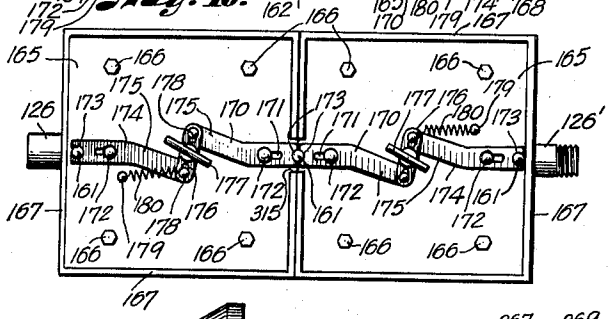
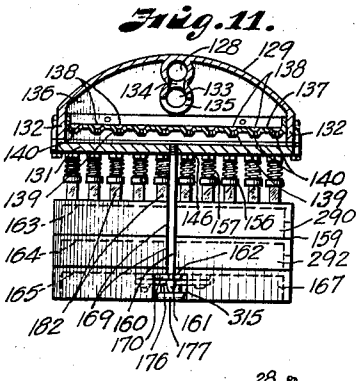


Fig. 11.



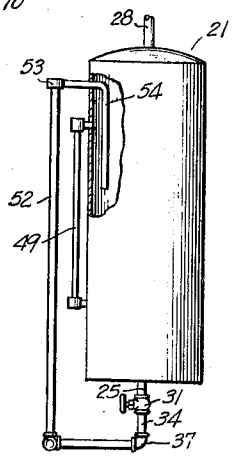
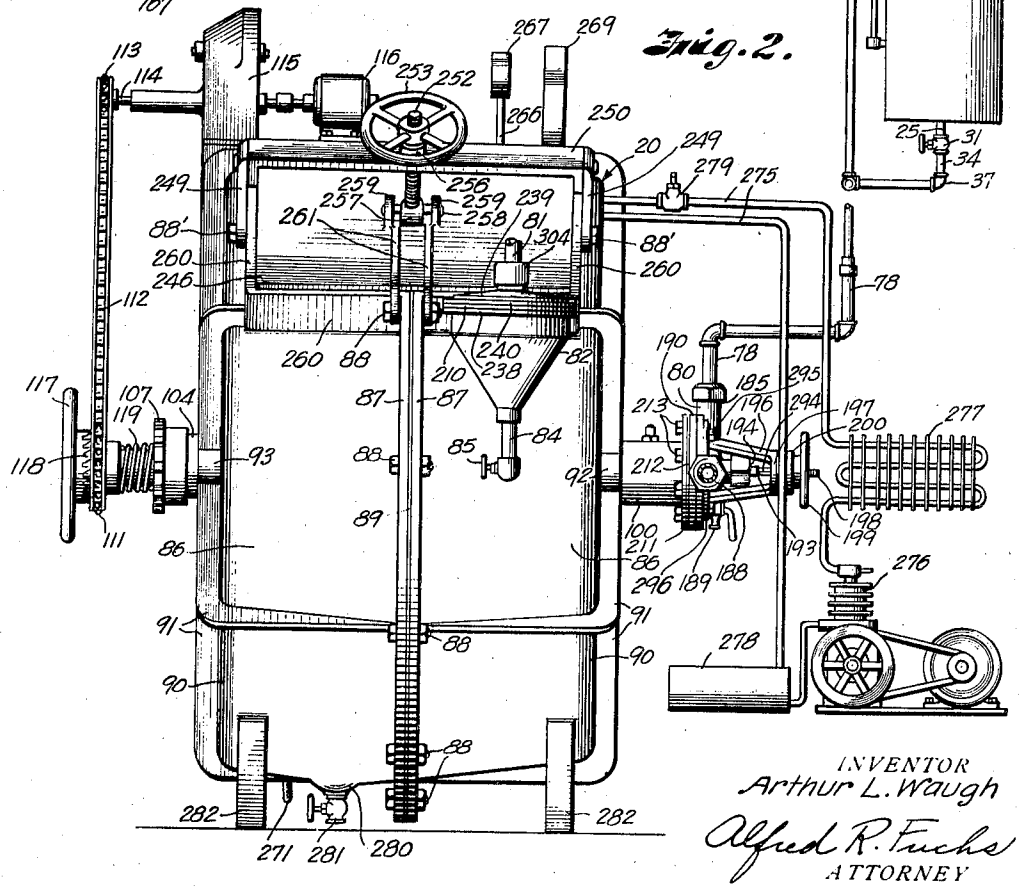


Fig. 2.



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Fig. 13.

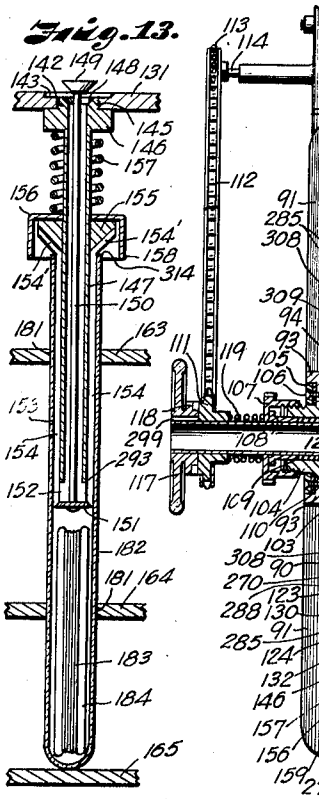


Fig. 3.

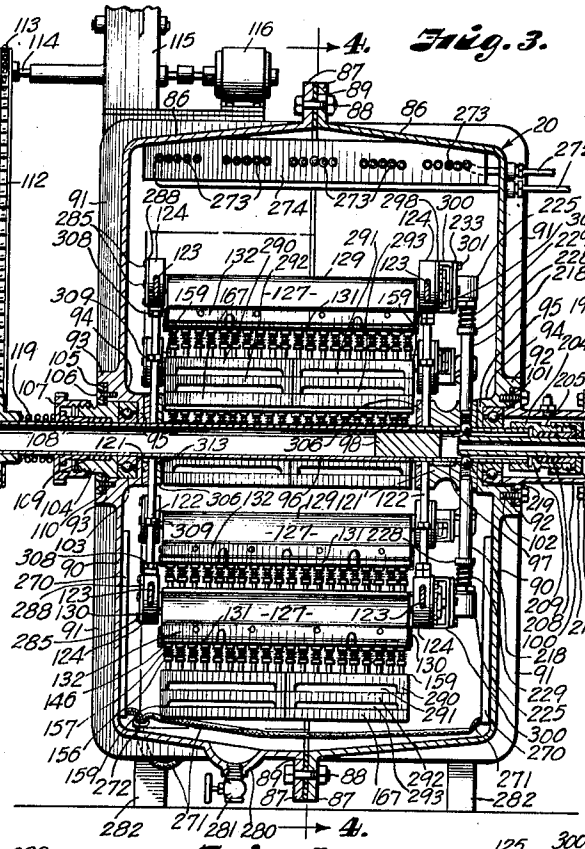


Fig. 14.

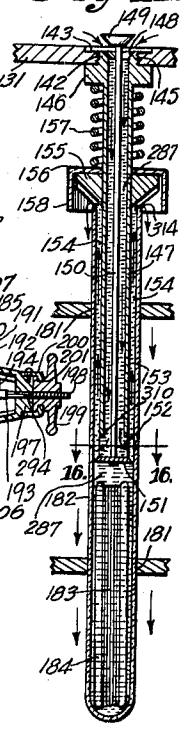


Fig. 5.

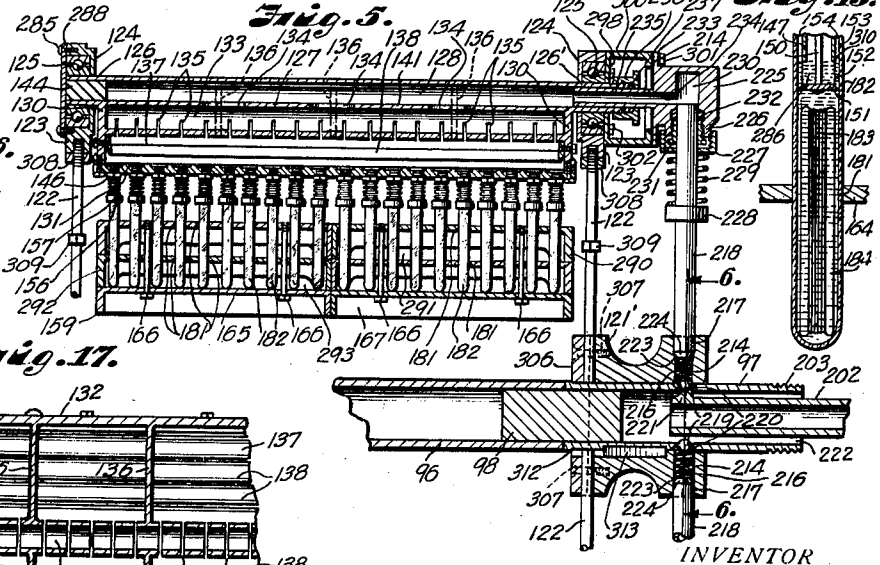


Fig. 15.

Fig. 16.

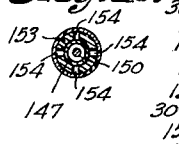
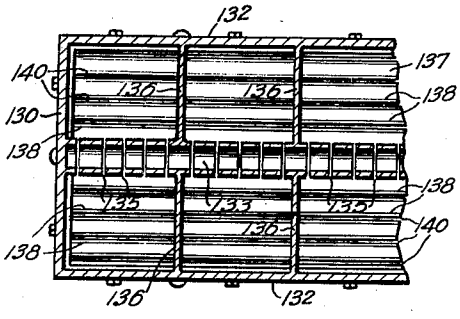


Fig. 17.



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LIGATURE TREATING APPARATUS

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Fig. 12.

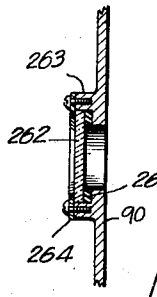


Fig. 4.

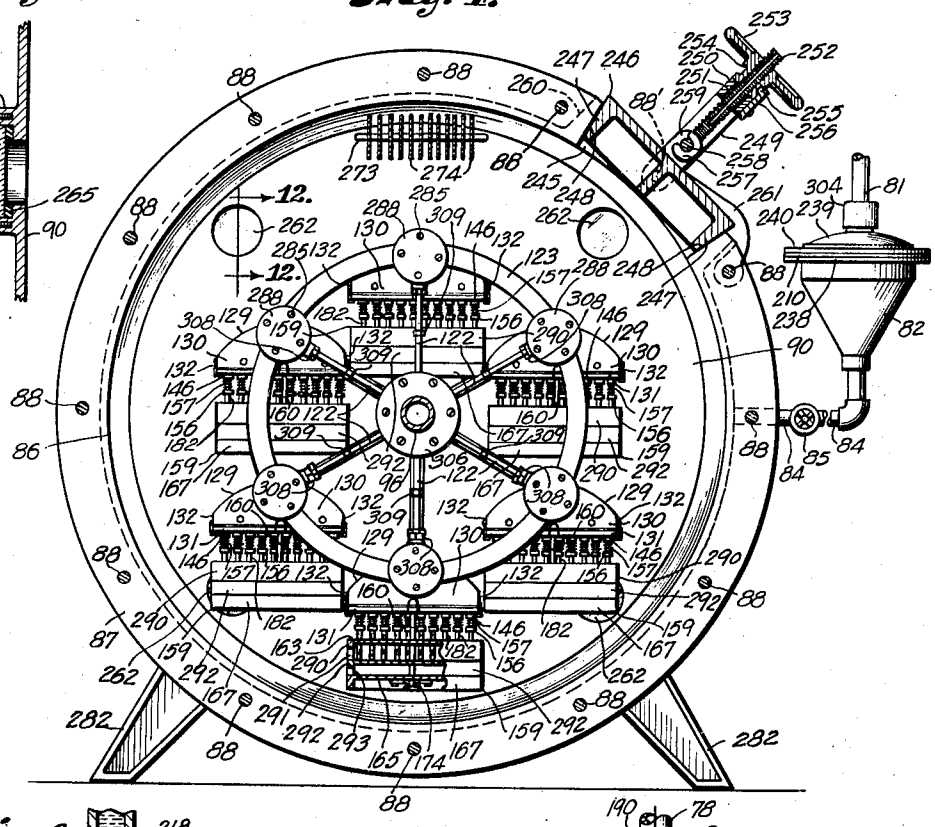


Fig. 6.

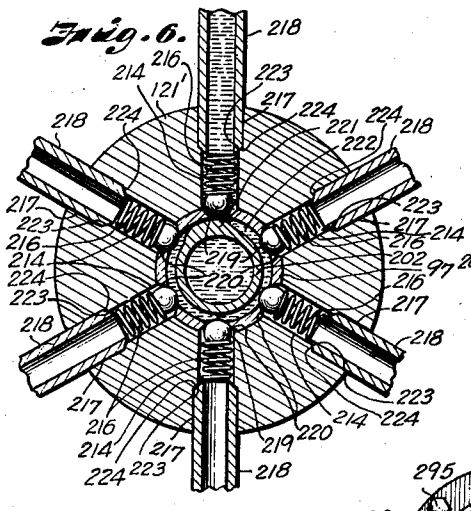


Fig. 7.

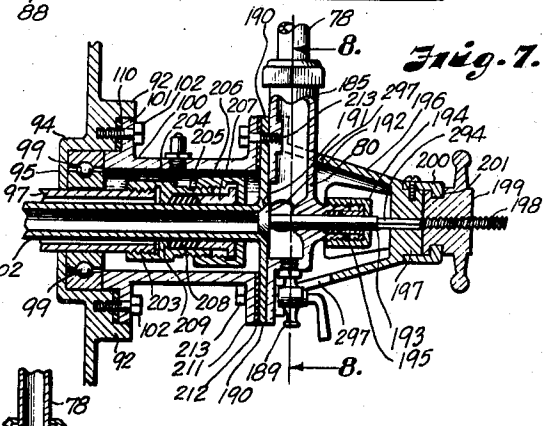
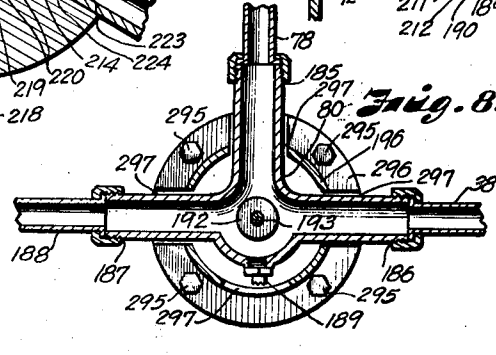


Fig. 8.



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UNITED STATES PATENT OFFICE

2,102,868

LIGATURE TREATING APPARATUS

Arthur L. Waugh, Chicago, Ill.

Application October 7, 1933, Serial No. 692,643

23 Claims. (Cl. 128—335.5)

My invention relates to ligature treating apparatus, and more particularly to apparatus for putting catgut or similar material into such condition that the same is sterile and is in such form that it can be used as a ligature or suture. The cord, usually known as catgut, and which, as is well known, is usually made from sheep casings, will hereafter be referred to as a ligature, although it is obvious that the cord thus produced can be used for other purposes than that of a ligature in the strictest sense, being in its more general characteristics, a sterile surgical cord.

It is a purpose of my invention to provide an apparatus for performing the various steps of sterilizing and otherwise treating a previously twisted ligature, that is so constructed and arranged as to eliminate handling of the catgut, or similar cord, during the treatment thereof and to prevent all contact of the ligature, such as catgut, with outside air, the apparatus being completely closed to the entrance of unsterile outside air during the process of treating the ligature.

It is more particularly a purpose of my invention to provide an apparatus for treating catgut, or similar ligatures, that will produce a product that will be much safer to use for surgical purposes than any that has been produced by previously known methods or apparatus. Particularly it is a purpose of the invention to avoid the handling of the ligature between the steps of extraction of the fat therefrom and the sterilization, by heat, of the same, and also between the steps of heat treating the same and placing the same in the sealed tubes or other containers in which the same are placed in a solution that keeps the same in a moist condition, and is intended to keep the same in a sterile condition. While various ways of handling the product during and between these various steps have been utilized by different manufacturers, even the best practice at the present time leaves the way always open for air infections before the tubes are partially filled with the solution in which the ligatures are kept in the tubes after sealing, and before the sealing of the tubes.

Some attempt at obtaining a more sterile condition of what are known as boilable tubes, has been attempted by giving the tubes a final treatment in a bath up to a temperature of 320 degrees Fahrenheit for a definite period of time. This, however, weakens the catgut, or other similar ligature, and makes it unsatisfactory for modern surgical use, unless the ligature to be treated is absolutely dry, or de-hydrated, at the time that this treatment takes place. It may be explained here that there are two kinds of ligatures on the market that are put up in sealed containers. One of these is known as boilable catgut, and the other as non-boilable catgut. The non-boilable catgut is put up in an alcoholic, or similar solvent, solution containing a germicide, and the solution itself in contact with the ligature, is intended to keep it sterile. The boilable catgut is put up in a hydrocarbon fluid, similar to that which is utilized for de-fatting the ligature, and this is not of high germicidal power. That is the form of catgut that is sometimes heat treated up to 320 degrees Fahrenheit before being sent from the place of manufacture.

One of the great difficulties encountered in the treatment of ligatures, is that it is difficult to get the same entirely dry, or de-hydrated, before applying heat thereto, for sterilization purposes. Room conditions vary so much in moisture on different days that the same results cannot be obtained from day to day. Drying ovens using air for drying are not satisfactory, for, while it may be possible to obtain complete de-hydration in the oven, the removal of the ligatures from the oven causes the ligatures to take up water from the air outside the dryer before the tubes can be filled with the necessary fluid for preserving the catgut, or other, ligatures in the sealed tubes.

More particularly it is a purpose of my invention to provide an apparatus that treats raw twisted catgut, or similar, ligatures, it being obvious that the same have been cleaned by the usual methods before being twisted, removes all of the fat therefrom, all of the water therefrom, sterilizes the ligatures and fills the tubes with the liquid that is to be contained in the tubes after sealing, to the desired level, all without exposing the ligatures to the outer air, the tubes, unsealed, being removed from the apparatus with the liquid completely covering the ligatures to prevent contact of air therewith, and the tubes are then immediately sealed and are ready for transportation to the place of using.

More particularly it is a purpose of my invention to provide a machine for treating ligatures, comprising a housing, which is provided with a filling opening, but is otherwise entirely closed, and is provided with a closure for the filling opening so that it can be completely closed to the entrance of outside air, which housing contains a rotatable means having a plurality of arms thereon radiating from the center of rotation, and provided with carriages for receiving tubes containing the ligatures that are to be treated, and these tubes are so mounted as to be associated with

suitable fluid feeding members mounted on the carriages and entering the tubes so as to be adapted to supply jets of liquid thereto, or to withdraw liquid therefrom, or supply air thereto or withdraw air therefrom, as may be desired. Communication with these feeding members is obtained from externally of the housing through a manifold that has a connection leading to a hollow tubular shaft on which the tubular radiating spoke-like members are mounted, that have the carriages mounted thereon. My improved apparatus further comprises means for supplying various fluids to the passages leading to the tubes mounted on the carriages and for receiving fluid therefrom, and also means for circulating air through the apparatus or for creating a partial vacuum within the apparatus.

It is a further purpose of the invention to provide means for automatically closing the jets, or feeding members, when no ligature tubes are mounted in cooperative relation thereto, and to provide valve mechanism for controlling the entrance or exit of fluid from the housing to the various containers located externally of the apparatus, and the vacuum pump, or other air circulating means, provided in association with the apparatus.

It is a further purpose of the invention to provide means for observing the action of the various steps of the process carried out by my apparatus from the exterior thereof, and to provide suitable means for heating the contents of the housing, which may be either electrical heating means or steam.

It is a further purpose of my invention to provide means for rotating the wheel-like member, comprising the arms and the carriages mounted within the housing, either by an electric motor or by hand, in such a manner that the hand drive will not in any way interfere with the operation of the motor drive, and vice versa.

Other objects and advantages of my invention will appear as the description of the drawings proceeds. I desire to have it understood, however, that I do not intend to limit myself to the particular details of structure shown or described, except as defined in the claims.

In the drawings:

Fig. 1 is a view in end elevation of my improved apparatus.

Fig. 2 is a view in side elevation thereof, portions thereof being broken away, the view being taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a vertical sectional view, taken substantially on the line 3—3 of Fig. 1, certain external appurtenances being omitted.

Fig. 4 is a vertical sectional view, taken substantially on the line 4—4 of Fig. 3.

Fig. 5 is a vertical longitudinal sectional view through one of the carriages and associated parts, the same being partly broken away, and the means for locking the trays to the carriage being omitted.

Fig. 6 is a section taken on the line 6—6 of Fig. 5, on a somewhat enlarged scale.

Fig. 7 is a fragmentary sectional view through the manifold leading to the interior of the housing, and one of the bearings for the shaft mounted in the housing, on an enlarged scale.

Fig. 8 is a section taken substantially on the line 8—8 of Fig. 7.

Fig. 9 is a view partly in side elevation and partly in vertical longitudinal section, of one of the carriages.

Fig. 10 is a bottom plan view of one of the carriages.

Fig. 11 is a section taken on the line 11—11 of Fig. 9.

Fig. 12 is a fragmentary enlarged sectional view, taken on the line 12—12 of Fig. 4.

Fig. 13 is a vertical sectional view through one of the tubes, showing the liquid conduit in association therewith, and fragmentary portions of the tube supporting means.

Fig. 14 is a similar view, showing the liquid overflowing the tube.

Fig. 15 is a fragmentary vertical sectional view of one of the tubes, showing the liquid retained in the tube after sealing, withdrawn to the level it will assume in the sealed tube.

Fig. 16 is a section taken on the line 16—16 of Fig. 14 and

Fig. 17 is a horizontal section taken substantially on the line 17—17 of Fig. 9, a portion of one of the partition members being broken away.

Referring in detail to the drawings, in Fig. 1 is shown my complete apparatus, comprising a housing 20, in which all of the operations of the apparatus are carried out on the ligatures. A plurality of tanks, indicated by the numerals 21, 22, 23, and 24 are utilized in association with the housing 20, and the tanks 21, 22, and 23 are provided for the storage of various liquids that are used in connection with the treatment of the ligatures by my improved apparatus. While it is obvious that any arrangement of the receptacles may be provided, and any desired liquid could be put in any one of these receptacles, it will be assumed for the purposes of this explanation, that the receptacle or tank 21 contains a liquid of a solvent character, preferably a hydrocarbon derivative, such as benzol. The tank 22 contains a different hydrocarbon liquid that is of a solvent character, and is utilized for a "tubing" fluid or a fluid contained in the tubes containing the ligatures after the same have been sealed.

The tank 23 preferably contains a liquid comprising a solvent, such as alcohol, and any germicide of any desired character, which will retain the ligatures in a sterile condition after the same have been treated by my improved apparatus. The tank 24 is utilized for the storage of air or other gases under atmospheric pressure, or is what might be termed a negative pressure reservoir. Conduits in the form of pipes 25, 26, and 27 extend from the bottoms of the tanks 21, 22, and 23, respectively, and conduits in the form of pipes 28, 29, and 30 extend upwardly from the tops of the tanks 21, 22, and 23, respectively.

Valves 31, 32, and 33 control the flow between branch pipes 34, 35, and 36, and the pipes 25, 26, and 27, which pipes 34, 35, and 36 lead to a conduit 37 connecting the same, which, in turn, connects with a conduit or pipe 38, which leads to the housing 20 in a manner to be described below. Valves 39, 40, and 41 are provided for establishing communication between the pipes 42, 43, and 44, and the pipes 28, 29, and 30, the pipes 42, 43, and 44 being connected with a conduit 45, which is connected with a pipe or conduit 46, which leads to a four-way connection 47, but which has a valve 48 interposed between said four-way connection and the pipe or conduit 45. The tanks 21, 22, and 23 are provided with gauge glasses 49, 50, and 51, respectively.

An inlet pipe 52 is provided, leading to the tank 21, through a check valve 53, which will open only upon upward flow of fluid through the pipe 52. A conduit 54 leads from the check valve to

the interior of the tank 21, (see Fig. 2). A similar inlet pipe 55 leads from the pipe 37 to the tank 22, through the check valve 56, and another similar pipe 57 leads from the pipe 37 through the check valve 58 to the tank 23. Each of the tanks has a valve controlled outlet to the outer air near the top thereof, these being indicated by the reference numerals 59, 60, and 61, respectively. The tank 24 is provided with an outlet to the outer air at 62 controlled by a valve 63.

From the four-way connection 47 a pipe 64 leads into the top of the tank 24, and a pipe 65 leads to a vent pipe 66, the communication with which is controlled by a valve 67. A pipe 68 leads to a T 69, a valve 70 being interposed in the conduit 68 between the four-way connection 47 and the T 69, and a pressure gauge 120 may be provided to indicate the pressure in the pipe or conduit 68. A blower 71 is provided, driven by a motor 72, which blower has its inlet end connected with the T 69 through a pipe 73, thus creating suction in the pipe 73 when in operation. A pipe 74 leads from the discharge end of the blower, and a vent 75 is provided, leading from the T 76 and controlled by a valve 77. A conduit 78 leads from the T 76 through the valve 79 to the intake manifold 80, (see Figs. 1 and 3). From the T 69 a pipe or conduit 81 extends to a drier 82, a valve 83 being interposed in the conduit 81 between the dryer 82 and the T 69, the opposite end of the dryer 82 being connected by means of a conduit 84 with the interior of the housing 20, a valve 85 being provided for controlling flow through the conduit 84, (see Figs. 1 and 2).

The housing 20 comprises a pair of substantially semi-cylindrical portions 86, which have flanges 87 for connecting the same by means of fastening elements, such as bolts 88, a gasket 89 being provided between the flanges 87 to provide a fluid-tight joint. Each of the members 86 is provided with a substantially vertical end wall 90, and has stiffening and reinforcing ribs 91 provided thereon. One of the end walls 90 is provided with an annular projection 92 thereon adjacent the center thereof, and the other end wall is provided with a similar annular projection 93 thereon, (see Fig. 3). Each of the end walls 90 is also provided with an inwardly offset annular portion 94, terminating in an annular flange 95, provided with a central opening therein, the portions 94 and 95 of said end walls 90 serving as receptacles for bearing members for a shaft, which will be described below.

A tubular shaft 96 is provided, extending into the housing 20, and a tubular shaft 97 extends from the inner end of the shaft 96, said shafts 97 and 96 being secured together to rotate in unison by means of a solid shaft portion 98, the shaft portions 96, 97, and 98 thus constituting a shaft, as a whole, which is partially tubular and partially solid, the interior of the tubular portion 96 not being in communication with the interior of the tubular portion 97. The tubular shaft portion 97 is mounted on ball bearings, indicated generally at 99, the same being provided with the usual ball races, and these being seated in the annular recess provided by the offset portions 94 and 95, and being held in position by engagement with the inner end of a tubular casing 100, which is secured by means of a flange 101, through which the securing elements 102 pass, to the thickened annular portion 92 on the housing 20, the details of this structure being shown in Fig. 7, the flange 101 seating in a recess in the annular portion 92, as will be evident from Fig. 7, a fluid-tight joint being provided between the members 100 and 92 by a packing 110 between the flange 101 and the annular portion 92. The hollow shaft 96 is provided with ball bearings, indicated generally at 103, which are provided with ball races mounted in the recess formed by the wall portions 95 and 94 in the other end wall 90, the ball races being held in position by means of a flanged collar 104, and a securing ring 105 held in position on the thickened portion 93 of the housing portion 86 by means of securing elements 106. The housing portions 86 are made from duplicate castings, so as to simplify the manufacture thereof as much as possible. The flanged collar 104 is one of the cooperating members of a stuffing box comprising the internally threaded flanged collar 107 that has screw-threaded engagement with the collar 104, and within which is mounted a slidable flanged member 108 that compresses the packing 109 between itself and the member 104, the member 104 being suitably recessed to slidably receive the member 108 and to receive the packing 109 in said recess. Thus a fluid-tight joint is provided between the shaft and the housing at this point, any suitable packing 110 being provided between the ring 105 and the annular shoulder on the member 93 to provide a fluid-tight joint between the housing and the stuffing box at this point.

Rotatably mounted on the hollow shaft portion 96 is a sprocket wheel 111, over which the sprocket chain 112 operates, which also operates over the sprocket wheel 113 provided on the shaft 114 of the reduction gearing 115, driven from the motor 116 by any suitable driving connection, the sprocket 111 thus rotating slowly as compared with the motor 116, and preferably rotating about once a minute, although a variation in this speed may be made if found to be desirable for purposes of carrying out the functions of my apparatus. A hand wheel 117 is keyed by a key 299 to the shaft 96, and a ratchet driving connection 118 is provided between the sprocket wheel 111 and the hand wheel 117, and thus between the sprocket wheel 111 and the shaft 96.

A coiled spring 119 is mounted between the flange on the stuffing box member 107 and the hub of the sprocket wheel 111 to hold the ratchet teeth normally in engagement, the teeth on the sprocket wheel 111 and on the hand wheel 117 being so directed that the perpendicular faces thereof will be in engagement when the motor is driving the shaft through the sprocket wheel 111 and the hand wheel 117. In case the motor is stopped, however, and it is desired to move the shaft 96 for purposes of rotating the parts carried by the shaft, the hand wheel 117 can be rotated without interference with the rotation thereof by the holding action of the reduction gear 115, due to the fact that the inclined faces of the ratchet teeth on the hand wheel 117 will slide over the inclined faces of the ratchet teeth on the sprocket wheel 111, compressing the spring 119 and permitting the shaft 96 to rotate without rotating the sprocket wheel 111, the chain 112, and the other parts associated therewith between the motor 116 and said sprocket wheel, (see Figs. 1 to 3).

Mounted within the housing 20 is a rotatable cage-like member mounted to rotate with the shaft, and comprising hub portions 121 and 121' fixed on the shaft, spoke-like members 122 ra-

diating therefrom, and annular rim portions 123 fixed on the outer ends of the spoke-like members 122. Each annular rim portion 123 is provided at spaced intervals around the periphery thereof, with enlargements 124 of an annular character, which serve as bearing receptacles for the ball bearings, indicated generally by the numeral 125.

Pivotally mounted on said rim portion and supported by the ball bearings 125, are the shaft portions 126 and 126' provide on a manifold 127, one of said shaft portions 126' being a tubular extension of the passage 128 in said manifold, whereas the other shaft portion 126 is provided with a plug 144 to seal the end of said passage leading to said shaft portion. Said manifold 127 comprises a housing having a top wall 129, end walls 130, side walls 132, and a bottom wall 131, (see Figs. 5 and 11), thus providing a box-like housing, into which the passage 128 extends. The member 127 is provided, not only with the upper passage 128, but with a lower passage 133, which is closed at the ends thereof, and which is connected with the passage 128 by openings 134 through the web portion 141, separating said passages in the member 127. The passage 133 is provided with a plurality of closely spaced transversely slotted outlets 135 leading into the chamber within the box-like member, and thus acting as a distributing means for the fluid entering through the passage 128 into said chamber within the box-like housing, creating a fan-like spray at each of said narrow slots or slits 135 when liquid passes outwardly through the same.

A transverse wall or partition 137 is provided in the housing below the bottom wall of the passage 133, said transverse wall or partition 137 being provided with a plurality of parallel grooves 138 running lengthwise of the member 137, and having inclined side walls, and with ribs 139 on the under face thereof opposite the grooves 138, said ribs being substantially V-shaped in cross section, but somewhat blunt or flattened at the apexes thereof, and having slots 140 running the full length of the ribs at their apexes (see Figs. 11 and 17).

The bottom wall 131 is provided with openings 145, there being a row of openings aligning with each slot 140, and there being as many openings in each row as there are slots 135 in the member 127. The openings 145 in the member 131 are in transverse alignment with the slots 135. The combined housing and manifold 127 is provided with a plurality of reinforcing webs 136 that connect the top and side walls of the housing and the tubular manifold within the housing, being preferably cast integral therewith.

Couplings 146 having threaded ends 142 are connected in fluid-tight relation in the threaded openings 145, said coupling members being formed on the ends of the tubes 147 and each have a seat 148 therein for a valve 149. The bottom 131 has a countersunk portion 143 surrounding each opening 145, to facilitate flow of liquid into said openings. The valve 149 has a stem 150, said valve stem being secured to a cross head 151 provided on a member 152, slidably mounted on said tube 147. The member 152 has the tubular portion 153 thereof slotted, as shown at 154, (see Figs. 13 and 16), and has a conical enlargement or head 155 formed at the end thereof opposite the head 151, the grooves 154' in the head 155 being continuations of the slots 154, and there being a flanged collar 156 interposed between a coiled compression spring 157 and the head 155, the flange thereon forming an annular skirting 158 surrounding the member 155 and serving as a deflector, to deflect liquid issuing from said slots 154' downwardly.

The combined housing and manifold comprises the upper portion of a carriage. Detachably mounted on the carriage are trays 159, there being two trays for each carriage. The bottom wall 131 of the housing has a plurality of rod-like members 160 depending therefrom, which each have a tapered head 161 on the lower end thereof, and an annular groove 162 spaced a short distance above the tapered head 161. The tray-like members have a pair of walls 163 and 164 spaced one above the other, and spaced from the bottom 165. Each tray-like member is preferably made up of three sections secured together by means of fastening elements, such as bolts 166. A flange 290 depends from all four margins of the wall 163 and this is cut away to provide elongated openings 291 therein to permit flow of liquid out of the tray-like members. A flange 292 cut away at 293 depends from the margins of the wall 164. The bottom 165 of each tray has a flange 167 depending therefrom, (see Figs. 10 and 11), to provide flanges on the trays, spacing the bottoms 165 thereof from any support upon which the same may be located.

Each tray is provided with aligning circular openings 168 therein for receiving one of the rod-like members 160, and with a semi-circular groove 169 for receiving a rod-like member 160. To assemble the tray-like members with the upper portion of the carriage, the trays are passed upwardly on the rods 160, and locking means is provided for holding the tray-like members in position on the rods after the rods have been passed through the same so that the heads 161 thereon are located below the bottoms 165 of the tray-like members. The locking means can be made in any desired manner, but, preferably, are provided with longitudinally slidable locking members 170, which are slotted at 171 to receive the guide pins 172, and which are provided with curved notches 173 in the ends thereof, providing a forked end on each locking member 170, passing around the rod-like members 160 at the grooved or reduced portion 162 thereof. Similar locking members 174 are also provided on each tray-like member, being made in substantially the same manner as described in connection with the locking members 170 and bearing the same reference numerals for the corresponding parts thereof. The flanges 167 are provided with openings 315 to accommodate the locking members 170.

The members 170 and 174 each have obliquely extending inner end portions 175, which are connected together by a link 176, the links 176 being connected with the obliquely extending ends 175 of the members 170 and 174 by a pin and slot connection. A finger piece 177 is provided on each link 176 for rotating the same, and coiled springs 180 are provided between one of the pins 178 of said pin and slot connections on each link and pins 179 fixed on the bottom 165. The springs 180 tend to hold the forked ends of the levers 170 and 174 in locking engagement with the members 160, but twisting of the finger piece 177 in a counterclockwise direction, as viewed in Fig. 10, will release said locking means. It will be obvious that after the trays 159 are pushed upwardly on the rods 160, the locking means will snap into locking position, and that there is no necessity of manipulating any locking means to place the

trays in position on the carriages, but that the locking means need only be manipulated to release the trays from the carriages.

The transverse partitions or walls 163 and 164 of the tray-like members, are provided with aligning openings 181, which receive the glass tubes 182, which serve as receptacles for the ligatures 183, the ligature 183 in Fig. 13 being shown as being wound on a spool-like member 184. The upper edges of the tubes 182 engage with the grooved conical faces of the members 155 when the bottoms of the tubes 182 engage the bottom 165 of the tray-like member. When the upper edges of the tubes 182 engage said members 155, the members 155 are caused to slide upwardly on the tubes 147 and carry the tubular portions 153 of the members 152 therewith, thus carrying the heads 151 along with the same, and also the valve rods 150, opening the valves 149. Thus the valves 149 will only be opened leading to such feed tubes 147 as have the tubes 182 associated therewith.

It will be obvious upon reference to Figs. 3 and 4 that there are a plurality of the carriages provided on the cage-like member previously described, and that means must be provided for supplying liquid or withdrawing liquid from the tubes 182 while the cage-like member is rotating in the housing 20. Said means comprises the intake manifold 80, which has the upstanding tubular connection 185 thereon connected with the conduit 78, (see Figs. 7 and 8), the laterally extending tubular connection 186 connected with the conduit or pipe 38, and the laterally extending tubular connection 187 connected with the pipe 188.

The manifold is also provided with a drain cock 189. Said manifold is secured to a flange 190, bolted on the casing 100, and said flange 190 has a valve seat 191 thereon for a valve 192, which has a stem 193 extending through a stuffing box 194 provided on the manifold 80, containing a packing 195. A valve casing is provided that has a tapering hollow body portion 196 terminating in a guide block 197 for the valve stem 193. The opening in the guide block 197 is preferably square and said valve stem has a squared portion 294 slidably mounted therein, said valve stem having also a threaded portion 198 thereon cooperating with a threaded hand wheel 199, which is mounted for rotation on the bearing member 197, but held against axial movement by means of the flanged split collar 200 entering the groove 201 on said member 199. It will be obvious that a twist of the member 199 will quickly open or close the valve 192. The hollow body portion 196 is detachably mounted on the flange 190 by means of fastening elements 295 passing through said flange 190 and the flange 296 on said body portion 196. Said body portion 196 has suitable openings 297 therein to accommodate the arms of the manifold 80, and the drain cock 189.

The flange 190 has a tubular extension 202, which is mounted co-axially with the tubular shaft portion 97 and extends well into the same. The tubular shaft portion 97 is provided with screw threads 203 on the end thereof that is mounted in said casing 100. A stuffing box comprising the collar 204 having threaded engagement with the screw threads 203, and having an externally threaded tubular extension 205, is provided on the shaft 97. The threaded tubular extension 205 engages with a flanged threaded collar 206, and has a slidable flanged member 207 mounted within the same to compress a packing 208 between said slidable member 207 and an inwardly directed flange 209 on the member 204. A fluid-tight joint is thus provided between the tubular member 202 and the shaft 97. A fluid-tight joint is provided between the flange 190 and a flange 211 provided on the casing 100 by means of a packing 212, the flanges 211 and 190 and manifold 80 being secured together by means of headed screw threaded fastening elements 213. The details of this structure are shown in Fig. 7.

Referring now to Fig. 5, it will be seen that the tubular member 202 extends within the shaft 97 a sufficient distance to reach inside the hub 121'. The hub 121' is provided with a plurality of passages 214 therein. The passages are further provided with enlarged portions 217, which receive the tubular conduits 218. Springs 216 seat against the ends of said portions 217 and bear against the ball valves 219, which engage with seats 220 on the tubular shaft 97, and a cam 221 is provided on the tubular member 202, (see Fig. 6), which is adapted to engage with each of the ball valves 219 as the tubular shaft 97 rotates around the tubular member 202, but only the uppermost one of the ball valves 219 will be opened thereby. Thus communication will be established through only one of the hollow tubular members 218, and the tubular member 202 at a time, communication being established between the member 202 and the tubular member 218 through the valve 219, due to the fact that an annular passage is provided at 222 between the members 97 and 202.

It will be noted that a beveled shoulder is provided at 223, against which the beveled end 224 of each tubular member 218 seats. Each of the tubular members 218 leads to a chambered inlet member 225, which is provided with a threaded tubular extension 226 directed toward a tubular member 218, said member 226 having an abutment nut 227 screw-threadedly engaging therewith so as to be adjustable thereon. Mounted between the nut 227 and a flange or annular abutment 228 on the tubular member 218, is a coiled compression spring 229. The member 225 is provided with a bore 230 therein of such size as to freely slidably receive the tubular member 218, and is of such extent that the member 218 can be removed from the opening receiving the same in the hub 121' by moving the same radially outwardly against the compression of the spring 229 into said bore 230. The nut 227 engages an external thread on the portion 226 of the member 225. A nut 231 engages an internal thread on said portion 226 and is slidable on said tube 218, but fits the same closely. Said nut is part of a stuffing box having a compressible packing 232 provided therein adapted to be compressed by means of said nut to seal the joint between the members 218 and 225, but permits sliding of the tube radially outwardly to disengage the same from the hub 121'. The spring 229 serves to force the member 218 into the hub portion so as to seat the end 224 of the tubular member 218 against the beveled seat 223, to provide a fluid-tight joint between said hub and said tubular member 218.

The member 225 is provided with a passage 234 therein connecting with the bore 230, which leads into the tubular extension 235 on said member 225, said tubular extension entering the tubular shaft portion 126', a fluid-tight joint being provided between the member 126' and the member

235 by means of a packing gland 236, having a compressible gasket 237 mounted between an inwardly directed flange on the same and the end of the shaft 126'. Thus when a tubular member 218 is in an upright position, or, with the carriage, to which the same leads, at or near the uppermost portion of its travel, the valve 219 leading to the same is opened by the cam 221 and communication is established between the manifold 80 and the tubes 182 mounted on the carriage through the feed tubes 147 whenever the valve 192 is opened. The member 225 has a flange 233 thereon which is secured to the flange 214 on the spider-like housing 300 by means of any suitable fastening elements, such as the screws 301, said housing having a flange 298 thereon for securing said housing 300 to the enlargement 124 on the rim 123, by means of screw threaded fastening elements 302. It will thus be evident that the tubular spoke-like member 218 can be removed, should this be found to be desirable, by pulling outwardly on the same so as to compress the spring 229, and the fastening elements 301 having been removed, the member 225 and the member 218 can be withdrawn as a unit by moving the member 225 in a lateral direction to disengage the tubular extension thereon from the interior of the shaft portion 126'.

Both the hub members 121 and 121' are provided with detachable collars 306, which are detachably secured to the hub members 121 and 121' by screw-threaded fastening elements 307. The collars 306 and the hub members are each provided with grooves, that are substantially semi-cylindrical, therein, which align so as to receive the inner ends of the spoke members 122. Thus when the collars 306 are clamped in position by means of fastening elements 307 the spokes will be fixed in position in the hub portions 121 and 121'. The rim portion 123 of each wheel-like member is provided with an internally threaded boss that receives the screw-threaded outer end of the spoke 122, and a locking nut 308 is provided on each spoke for locking the spoke in fixed position relative to the rim portion after the wheel is trued. Thus after the wheel has been trued by turning the solid spoke, the same having a polygonal portion 309 thereon at any desired point to facilitate turning thereof, the tubular members 218 are ready to be put in position. The hub portions 121 and 121' engage a slight shoulder 312 on the shafts 96 and 97, respectively, and are fastened on the shaft portions 96 and 97 so as to rotate therewith by means of a key 313.

The drier member 82 has a flange 238 on the body portion thereof and has a removable cap member 239, having a cooperating flange 240, and between said flanges is clamped the rim 241 of a spider-like supporting ring 242 for a wire basket 243 provided between the cover and said body portion, said wire basket containing calcium chloride 244, or similar de-hydrating means. A gasket 210 is provided between said cover and body portion, and said cover is slidably mounted on the pipe 81, having a threaded boss 303 thereon having an opening receiving said pipe. The packing nut 304 engages with the threads 303 and a compressible gasket 305 provides a fluid-tight joint between said pipe and cover. No fastening elements are necessary for securing the cover or cap member 239 to the body portion of the dryer 82, as the suction existing in the dryer will hold the cover member down against the body portion and seal the joint by means of the gasket 210.

The housing 20 is provided with a filling opening 245, which is provided with a closure member 246, said filling opening being sufficiently large that a tray can be readily passed through the same and placed in position on one of the carriages. While any desired fluid-tight closure can be provided, the closure member 246 is shown as being provided with beveled side and end walls 247, which cooperate with similar inclined walls 248 around the edges of the opening 245. Means is provided for clamping the cover member 246 removably in position, comprising a bail member 249, pivotally mounted on a pair of bolts 88', which engage suitable threaded openings in the reinforcing rib 260 provided around the edge of the opening 245 on the housing 20. The member 249 is provided with a cross bar 250, which is provided with an opening 251, through which a threaded member 252 extends, the opening in the member 250 being of such size that the threads on the member 252 can pass therethrough. A hand wheel 253 has screw threaded engagement with the threaded member 252, and has a grooved hub 254 thereon, with which a flange 255 on a bracket 256 on the member 250 engages. Thus the hand wheel 253 is held from movement axially of the opening 251 in the member 250, and rotation thereof in one direction will move the member 252 bodily away from the housing 20 and rotation of the member 253 in the opposite direction will move the member 252 bodily toward the housing 20.

The end of the member 252 remote from the hand wheel 253 is provided with a hook-like portion 257, which engages with a transverse bar 258, mounted between the ears 259 provided on the closure member 246. A pair of hinge members 261 is pivoted on one of the bolts 88, connecting the flanges 87, at one end thereof, and fixed to the door at the other end thereof. When it is desired to tighten the closure member 246 down within the opening 245, it is first swung into position by swinging the same around on the pivot 88 by means of the hinge bars 261. Then the hook-like member 257 on the screw member 252 is engaged with the rod 258, and the hand wheel 253 is rotated to force the screw 252 inwardly toward the housing 20, thus forcing the rod 258 and the cover 246 with the beveled faces 247 thereon, into tight engagement with the beveled faces 248 on the housing 20. When it is desired to release the cover member, the reverse operation takes place. The member 253 is manipulated to force the cover member outwardly, the pivotal mounting of the bail and the hook 257 on the rod 258, permitting such movement of the bail as will be necessary for the hinges 261 to function as the closure member 246 is forced outwardly from the opening by means of the screw 252, and when the same has been sufficiently far removed from the opening that it can be manipulated without the use of the hand wheel and screw threaded member 252, the hook 257 can be disengaged from the rod 258, and the cover 246 swung around by means of the hinges 261, by hand. The bail member and closure member can be moved into a position adjacent the housing where the same will be out of the way during the filling of the carriages or the removal of the trays from the carriages.

The housing is further preferably provided with a plurality of windows 262, which may be mounted in any desired manner to provide a fluid-tight joint between the windows and the housing, the windows being preferably so ar-

ranged that the operations being carried on within the housing can be observed therethrough, and suitable illuminating means may be provided exteriorly of the windows to illuminate the interior of the housing sufficiently for this purpose. The windows are shown as being seated within the annular flanges 263, and clamped in position by means of clamping rings 264, the fluid-tight joint between the end wall 90 of the housing and the window 262 being obtained by means of any suitable compressible gasket 265.

The housing can also be provided with a pipe 266 leading to a pressure gauge 267, and with a suitable conduit 268 leading to a recording thermometer 269, should this be desired. Means for both heating and cooling the interior of the housing is provided, the heating means being any suitable form of heating elements, either steam heated or electrically heated, but being shown as being electric heating elements 270, which are suitably insulated and housed, so as to prevent any contact with the solvent liquids utilized in the apparatus, which might be inflammable. Suitable insulated conductors 271 pass from the heating elements through an opening in the casing, which is provided with a suitable bushing 272 to make a fluid-tight joint, the heating elements being located at opposite ends of the housing adjacent the bottom thereof and extending upwardly along said ends any suitable distance. The cooling means is shown as comprising cooling coils 273 mounted adjacent the top of the housing 20, being supported by suitable fins 274, the refrigerant pipes 275 leading out through the housing through suitable packing glands to provide a liquid-tight joint between the conduits and said housing, refrigerating apparatus comprising the usual compressor 276, condenser 277 and refrigerant fluid storage receptacle 278, a valve 279 being provided to control the flow of fluid from the condenser 277 to the expansion coils within the housing.

The housing 20 is further provided with a suitable sump 280, by means of which the housing can be drained, a suitable drain valve 281 being provided in the bottom of said sump. The housing may, of course, be provided with any suitable support, the legs 282 being shown. The heating elements are controlled by means of a switch mounted in the control box 283 provided on the housing 20, the conductors 271 leading therefrom to the heating elements, and the conductors 284 leading therefrom to the motor 116.

The members 300 serve to hold the ball bearings 125 and the ball races in position in the members 124, with which these are associated. A plate 288 is fastened by means of screws 285, to the other members 124 opposite those carrying the members 225 to hold the ball bearings and ball races in place in the other member 124 of each pair of members 124 supporting a carriage.

In operation, the various carriages are filled with the tubes 182 by inserting the trays 159 into position in the carriages, a pair of trays being assembled with each carriage, this being preferably done by rotating the shaft by means of the hand wheel 117 until the carriages successively move into proper position for insertion of the trays through the filling opening 245. After all of the carriages have been filled with the tubes 182 containing the ligatures 183, which are made of twisted raw catgut, the closure member 246 is placed in position and clamped down tightly, and all the valves of the system are closed except the valve 79, the valve 83, the valve 85 and the valve 192. The vacuum pump 71 is then set in operation and air is discharged through the pipe 74, the pipe 78 and the manifold 80, through the valve 192 into the tube 202, from the tube 202 through one of the valves 219, into a tube 218, and from the tube 218 into the passage 128 in a carriage, through the opening 134, into the passage 133, then through the slots 135 into the space above the partition 137, through the slots 140 and through the openings 145 into the feeding tubes 147, through the open lower ends thereof into the slots 154, into engagement with the ligature 183, out through the grooves 154' in the conical portion 155, and into the space within the housing 20. Air is withdrawn from the housing 20 by the suction line of the pump through the conduit 84 into the dryer member 82, and to the pump through the conduit 81.

If desired, a slight vacuum may be created in the chamber 20 before circulating the air in the manner just described, by closing the valve 79, opening the valve 77 and operating the pump 71 until the desired amount of vacuum has been created. As the air is circulated in the manner described it will pass, successively, in contact with the calcium chloride in the wire cage 243 to extract the moisture from the air, through the vacuum pump and into engagement with the ligatures. The carriages in the meantime, are rotating slowly in the housing 20, and each valve 219 is opened as the carriage approaches the uppermost point of its movement, and will remain open for a predetermined period of time, depending on the shape of the cam 221. The extraction of the moisture from the ligatures is continued by this circulation of the air until all of the moisture has been removed therefrom, or the same have been completely de-hydrated. This is preferably done without the use of any heat, although, if found desirable, a predetermined temperature can be maintained in the housing 20 by operation of the electrical heating means, which may be thermostatically controlled to get a desired degree of heat for this purpose. After de-hydration has been completed, the valves 83 and 85 are closed, and with these valves closed, the cover 239 can be removed from the dryer and the calcium chloride can be removed from the wire basket 243, and dried or replaced by dry calcium chloride.

The pipe 188 is connected, by means of a T, with the conduit 81, and has a valve 289 interposed between the conduit 81 and the intake manifold 80. The valve 79 is now closed, the valve 77 is opened, and the valve 289 is opened, the valve 192 remaining open. The vacuum pump 71 is again operated to create suction in the line 81. A partial vacuum will thus be created within the casing 20. As soon as sufficient vacuum is created in the casing 20 for the purpose of withdrawing the liquid from the tank 24 and carrying it into the housing 20, the vacuum pump is shut off from the housing by closing the valve 289, the valve 70 being then opened, and the operation of the pump is continued to create a partial vacuum in the tank 24. As soon as the valve 289 is closed, the valve 31 is opened and the valve 59 is opened. The partial vacuum existing in the housing 20 will then draw the liquid through the intake manifold 80 and through the various passages to feed tubes 147, and into the ligature tubes 182, the liquid continuing to be drawn into the same until these overflow, the tubes of each carriage being filled as the carriage reaches the upper portion of its path of move-

ment in the housing. This is allowed to continue until sufficient liquid has been drawn into the housing that some of it will stand in the bottom thereof, up to a point to cover the top edges of the tubes **182** as they pass the bottom-most points of the movement with the carriages during their travel around the shaft.

The liquid in the tank **21** is preferably benzol, or a similar solvent, which dissolves the fat in the ligatures, this being much more easily done by the solvent when the same have been previously de-hydrated, than otherwise. A suitable temperature to hasten this action may be created by operating the heating elements **270**, which will be immersed in the liquid in the bottom of the housing **20**, and will thus cause the entire liquid in the housing, both that in the tubes **182** and that in the bottom of the housing, to be heated. The liquid will, as it enters the tubes through the feeding devices contained in the tubes, be sprayed against the ligatures by the jets created by these feeding devices. When the proper amount of solvent liquid has entered the housing **20**, the valve **192** is closed, this being done very quickly by a quick rotation of the hand wheel **199**. The operation of the vacuum pump **71** can now be stopped, as sufficient vacuum has been built up in the tank **24** for further operation of the apparatus.

The shaft is rotated at a relatively low speed, preferably, about one revolution a minute, during the carrying out of this de-fatting operation on the ligatures, and this is continued until the ligatures are entirely de-fatted. After this operation has been completed, the fluid that has accumulated at the bottom of the housing, may be drained off through the valve **281**, and this can then be distilled to separate the solvent from the fat. The valve **281** is then closed, the valve **31** having been previously closed, and the valve **192**, the valve **70** and the valves **83** and **85** are opened to create a suction in the housing **20**, any volatilized solvent being thus drawn into the tank **24**, and after condensation, it can be drained off through the valve **63** and the drain pipe **62**. As soon as suction is created in the housing **20**, the valve **31** is again opened, drawing clean solvent fluid into the tubes **182**, in the manner previously described, and this is allowed to continue until the tubes have overflowed for a considerable period of time, the clean fluid thus having entirely replaced the fluid that contains fat therein, and which has been dissolved from the ligatures. The valve **192** is thereupon closed.

The clean fluid that has been drawn into the housing is at this time being heated by the electric heating elements or other heating means provided in the housing, and this heating is continued so that the temperature is slowly being raised until it reaches a desired maximum. The heating elements are controlled by a thermo-electric regulator, which maintains the desired temperature, when reached, for a definite period, usually about two hours. At the end of this period, which is called the sterilization period, the operations on the ligatures are completed except for filling the tubes with what is commonly known as a tubing fluid, or the fluid in which the ligatures are kept while sealed in the tubes. During the entire time of heating the solvent fluid, the wheel-like cage with all the parts attached thereto, such as the carriages and trays mounted in the carriages, is turning about its axis slowly and thus the fluid at the bottom of the housing **20** is a bath for each of the tubes **182** as said tubes pass through the same at regular intervals, thus equalizing the temperature of the entire housing and of the ligatures and of the supporting members within the housing. After this sterilization process has been completed, the valve **85**, the valve **70** and the valve **31** are again closed, and the valve **281** is again opened to draw off the fluid that has collected in the bottom of the housing **20**, which, as previously stated, can be distilled to separate the solvent fluid from the fat.

After the valve **281** has been closed, the valves **85**, **83**, **70**, **61**, and **33** are opened, and the valve **192** is opened, and the suction in the tank **24** will draw the tubing fluid, which is usually a solvent, such as alcohol, and some germicidal agent in solution in said alcohol, from the tank **23** and fill it into the tubes **182**, displacing the benzol or similar de-fatting fluid that was previously contained therein, and this is continued while the tubes overflow. The valve **192** is then closed, the valves **85**, **61**, and **83** are closed, the valve **33** is closed, the valve **41** and the valve **48** are opened, and the valve **70** is closed. Suction will then be created in the tank **23** due to its being connected with the suction tank **24**, or if there is not sufficient suction remaining in the tank **24**, the valve **70** can be opened, as well as the valve **77**, and the pump **71** can be started. However, no matter in what way the suction is created in the tank **23**, this will cause a suction condition to exist in the conduit **57**, in the conduit **37**, the conduit **38**, and when the valve **192** is opened this suction created will withdraw fluid from the tubes **182** down to the point where the bottom ends **310** of the feed tubes **147** is reached by the level of the tubing liquid, which is indicated by the numeral **286** in Fig. 15. The ligature **183** is then completely immersed in the tubing fluid **286**. In Fig. 14 is illustrated the flow of the fluid when the tube **182** is being supplied with fluid from the feed tube **147** so as to overflow the same, the de-fatting liquid **287** being indicated in said tube as overflowing the top edge **314** of the tube **182**, and running down the sides thereof to collect in the bottom of the housing **20**. After the liquid in the tube **182** reaches the desired level, the valve **192** is closed, as is also the valve **33**, and the valve **41**, as well as the valve **48** and the valve **70**, if it has been opened, and the drain valve **281** is opened to withdraw any fluid that may have collected in the housing therefrom. The trays with the ligature receptacles **182**, now properly filled for sealing, are removed from the housing **20**, and the open ends **314** of the tubes are sealed hot or welded in a well known manner, the liquid **286** having protected the ligature from air infection during the time that this sealing operation is performed, heat having been applied to the ends **314** of the tubes, all micro-organisms are destroyed.

The method described above is that for treating ligatures in what are known as non-boilable tubes. The ligatures in the boilable tubes are processed in a similar manner, except that the liquid is used from the tank **22**, this being a solvent, usually a hydrocarbon, such as xylol, which is drawn into the tubes by creating a vacuum in the housing **20**, opening the valve **60**, opening the valve **32** and opening the valve **192** to draw the fluid into the tubes for de-fatting purposes and closing the valve **32** and the valve **60**, but opening the valves **40** and **48** to create a suction in the tank **22** to withdraw the fluid from the tubes up to the level at which it is to be maintained in the sealed tubes. The de-fatting fluid is used as a tubing fluid in this case, and the tubing and de-

fatting liquid is fed into the tubes after the defatting operation has taken place so as to overflow the same so as to get clean liquid in the tubes, and it is then withdrawn down to the proper level for use as a tubing fluid in the sealed tubes instead of being displaced by the tubing fluid in the tank **23**.

The valves may also be manipulated to draw liquid into the tanks **21**, **22**, and **23** from portable containers through the pipe **38**, manifold **80**, and pipe **78**, by providing a suitable connection from the container to the pipe **78** and opening the valves **39**, **40**, or **41**, as the case may be, and the valve **48**, to utilize the suction in the tank **24** to draw the liquid into the tank that is desired to be filled.

In order to inject the tubing fluid hereinbefore described as an alcoholic germicidal solution from the tank **23**, under proper conditions due to the fact that this solution contains a slight amount of water, and to prevent injury to the catgut, or other tissues, treated by my apparatus, which would be affected seriously if immersed in this solution above average room temperature, the cooling means comprising the cooling coils **273** is provided. Preferably, the compressor **276** is set into operation immediately following the period of sterilization and all the contents, including the glass tubes **182** containing the ligatures, are thereby sufficiently cooled promptly, rather than very slowly, as would be the case by cooling the same in contact with air at room temperature entering the housing. Thus, the speed of operation of the apparatus is markedly increased by provision of this cooling means, and the handling of the trays **159** is more quickly and readily accomplished.

It will be noted that the door opening in the housing is so located that the trays can be detached from the carriages and moved away from the carriages at an angle of substantially 45 degrees in a downward direction and then moved upwardly at an oblique angle through said opening, thus facilitating removal of the trays from and insertion of the trays into position in the housing.

What I claim is:

1. Apparatus of the character described comprising a housing closed to the outer air, means rotatable in said housing, and a plurality of carriers for ligature receptacles mounted on said rotatable means, said carriers comprising a detachable portion in which said receptacles are adapted to be mounted.

2. Apparatus of the character described comprising a housing closed to the outer air, means rotatable in said housing, and a plurality of carriers for ligature receptacles mounted on said rotatable means, said carriers comprising a detachable portion in which said receptacles are adapted to be mounted, and a portion pivotally carried by said rotatable means on which said detachable portion is mounted.

3. Apparatus of the character described comprising a housing closed to the outer air, means rotatable in said housing, and a plurality of carriers for ligature receptacles mounted on said rotatable means, said carriers comprising a detachable portion in which said receptacles are adapted to be mounted, and a portion pivotally carried by said rotatable means on which said detachable portion is mounted, said pivotally carried portion having a plurality of fluid conducting members carried thereby and adapted to each enter one of said receptacles.

4. Apparatus of the character described comprising a housing closed to the outer air, means rotatable in said housing, and a plurality of carriers for ligature receptacles mounted on said rotatable means, said carriers each having a plurality of fluid conducting members carried thereby, adapted to each enter one of said receptacles, and a valve for each conducting member having means engaged by the receptacle associated therewith to open said valve.

5. Apparatus of the character described comprising a housing closed to the outer air, means rotatable in said housing, about a substantially horizontal axis, a plurality of carriers for ligature receptacles mounted on said rotatable means, conduit means leading from externally of said housing to said carriers comprising feed tubes leading to each carrier, valve means controlling communication between said feed tubes and the conduit means leading to said feed tubes, and means for successively opening the valve means leading to said feed tubes as said carriers rotate about said axis.

6. Apparatus of the character described, comprising a housing closed to the outer air, a plurality of carriers for ligature receptacles in said housing, and means for withdrawing air from said housing, substantially isothermally dehydrating said air and returning said dehydrated air to said housing at substantially the same temperature at which the same was withdrawn.

7. Apparatus of the character described, comprising a housing closed to the outer air, conveying means within said housing, for ligature receptacles, means for selectively introducing one of a plurality of liquids into said receptacles, means for withdrawing liquid from said receptacles and means for creating a partial vacuum in said receptacles.

8. Ligature treating apparatus of the character described comprising a housing closed to the outer air, means rotatable on said housing on a horizontal axis, open receptacles mounted on said rotatable means, means for maintaining said receptacles with the open ends thereof upward during rotation of said rotatable means, and means for introducing liquid into the receptacles on said rotatable means from externally of said housing, during rotation of said rotatable means.

9. Apparatus of the character described comprising a housing closed to the outer air, means rotatable in said housing, receptacles mounted on said rotatable means, and means for withdrawing liquid from the receptacles on said rotatable means to a predetermined level during rotation thereof.

10. Apparatus of the character described comprising a housing closed to the outer air, ligature receptacle carrying means movably mounted in said housing, each of said means having means for holding a plurality of said receptacles in upright position, means for moving said carrying means alternately toward and away from the bottom of said housing, and means for introducing liquid into the receptacles on said carriers from externally of said housing while said carrying means is moving therein.

11. Apparatus of the character described, comprising a housing closed to the outer air, a plurality of carriers for ligature receptacles mounted for rotation about a horizontal axis in said housing, means for introducing liquid into said receptacles, suction means for withdrawing liquid from said receptacles and means for draining liquid from the bottom of said housing.

12. Apparatus of the character described, comprising a housing closed to the outer air, means for removably mounting a plurality of ligature receptacles in said housing, means for dehydrating the ligatures in said receptacles while in said housing, means for de-fatting the ligatures in said receptacles while in said housing and means for filling said receptacles with the fluid to be sealed in said receptacles while in said housing.

13. Ligature treating apparatus comprising a sterilizing chamber closed to the outer air, means for engaging liquid with ligatures in said chamber, means for increasing the temperature of said liquid, means for lowering the temperature of said liquid, and means for mounting said ligatures in said chamber comprising portable liquid holding means of a character to maintain said ligatures completely immersed in germicidal liquid upon withdrawal of said holding means from said chamber.

14. Ligature treating apparatus comprising a fluid tight housing providing a chamber closed to the outer air, a plurality of receptacles in said chamber, said receptacles being open to said chamber, means for introducing liquid into said receptacles while in said closed chamber and means for removing liquid from said receptacles to a predetermined level while in said closed chamber.

15. The method of making sterile ligature packages comprising sterilizing ligatures in transportable containers in a sterile atmosphere, and completely covering said ligatures with germicidal liquid while in said containers in said sterile atmosphere.

16. The method of making sterile ligature packages comprising heating ligatures in containers while immersed in a solvent liquid in a chamber sealed against entrance of outside air, replacing said solvent liquid in said containers with a germicidal liquid to completely immerse said ligatures in said germicidal liquid before admitting outside air to said chamber, removing said containers from said chamber, and closing each of said containers.

17. The method of making sterile ligature packages comprising heating ligatures in containers while immersed in a solvent liquid in a chamber sealed against entrance of outside air, cooling said liquid and said containers, replacing said solvent liquid in said containers with a germicidal liquid to completely immerse said ligatures in said germicidal liquid before admitting outside air to said chamber, removing said containers from said chamber, and closing each of said containers.

18. The method of treating ligatures, comprising enclosing the same in a chamber closed to the outer air, dehydrating said ligatures while enclosed in said chamber, defatting said ligatures while enclosed in said chamber, heat sterilizing said ligatures while enclosed in said chamber and covering said ligatures with a germicidal liquid while enclosed in said chamber.

19. Apparatus of the character described comprising a housing closed to the outer air, ligature receptacle carrying means movably mounted in said housing, means for holding said receptacles in upright position on said carrying means, said receptacles being open to receive liquid into the same, the lower portion of said housing comprising a liquid reservoir, and means for periodically immersing said receptacles in the liquid in said reservoir.

20. Apparatus of the character described comprising a housing closed to the outer air, ligature receptacle carrying means movably mounted in said housing, receptacles on said carrying means open to receive liquid into the same, the lower portion of said housing comprising a liquid reservoir, means for heating said liquid in said housing, means for immersing said receptacles in the liquid in said housing, and means for preventing the escape of ligatures from said receptacles during such immersion.

21. Apparatus of the character described comprising a housing closed to the outer air and carriers for ligature receptacles mounted in said housing, said carriers having means thereon entering said receptacles to hold the ligatures in said receptacles without closing said receptacles to entrance and discharge of liquid.

22. Apparatus of the character described, comprising a housing closed to the outer air, a plurality of carriers for ligature receptacles in said housing, ligature receptacles carried thereby, means for heat sterilizing said ligatures in said receptacles while in said closed housing and means for filling said receptacles with the fluid to be sealed in said receptacles while in said closed housing.

23. The method of sterilizing and sealing ligatures, which comprises filling portable containers containing ligatures with a sterilizing liquid, heating the liquid to effect sterilization of the ligatures, replacing said sterilizing liquid with a preserving liquid without bringing the ligatures into contact with air, and subsequently sealing the containers.

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