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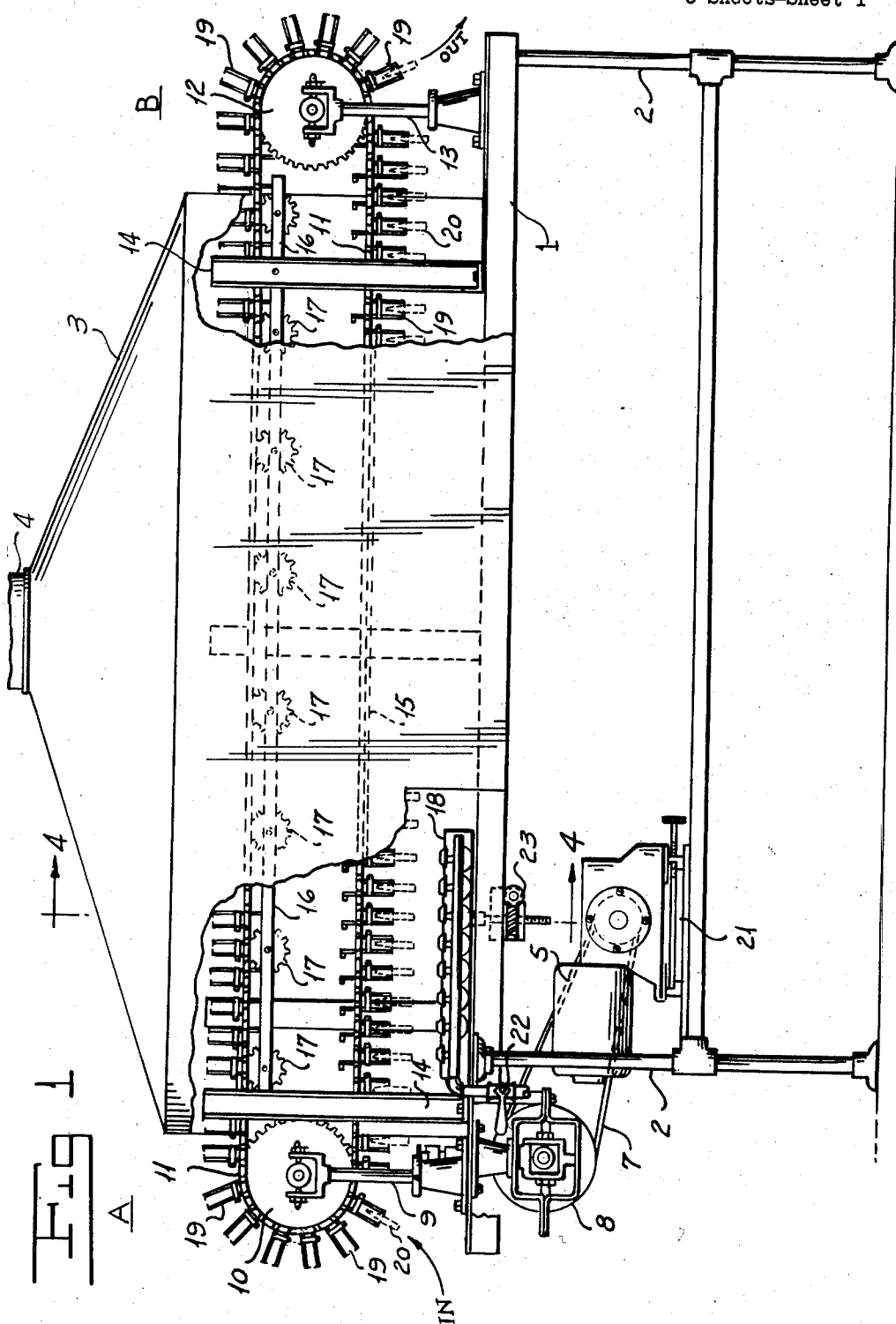
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AUTOMATIC AMPUL DRYING MACHINE

Filed Jan. 16, 1956

5 Sheets-Sheet 1



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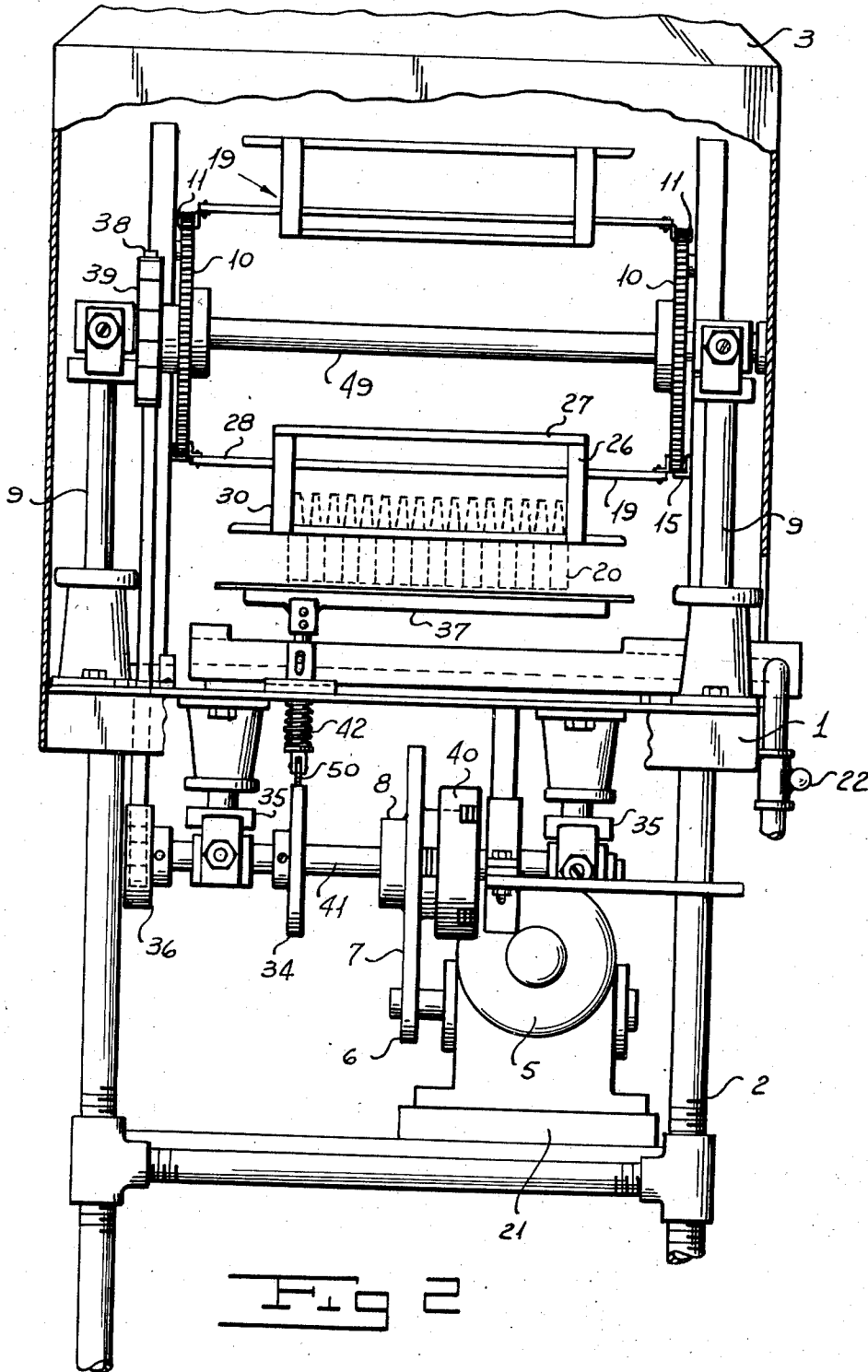
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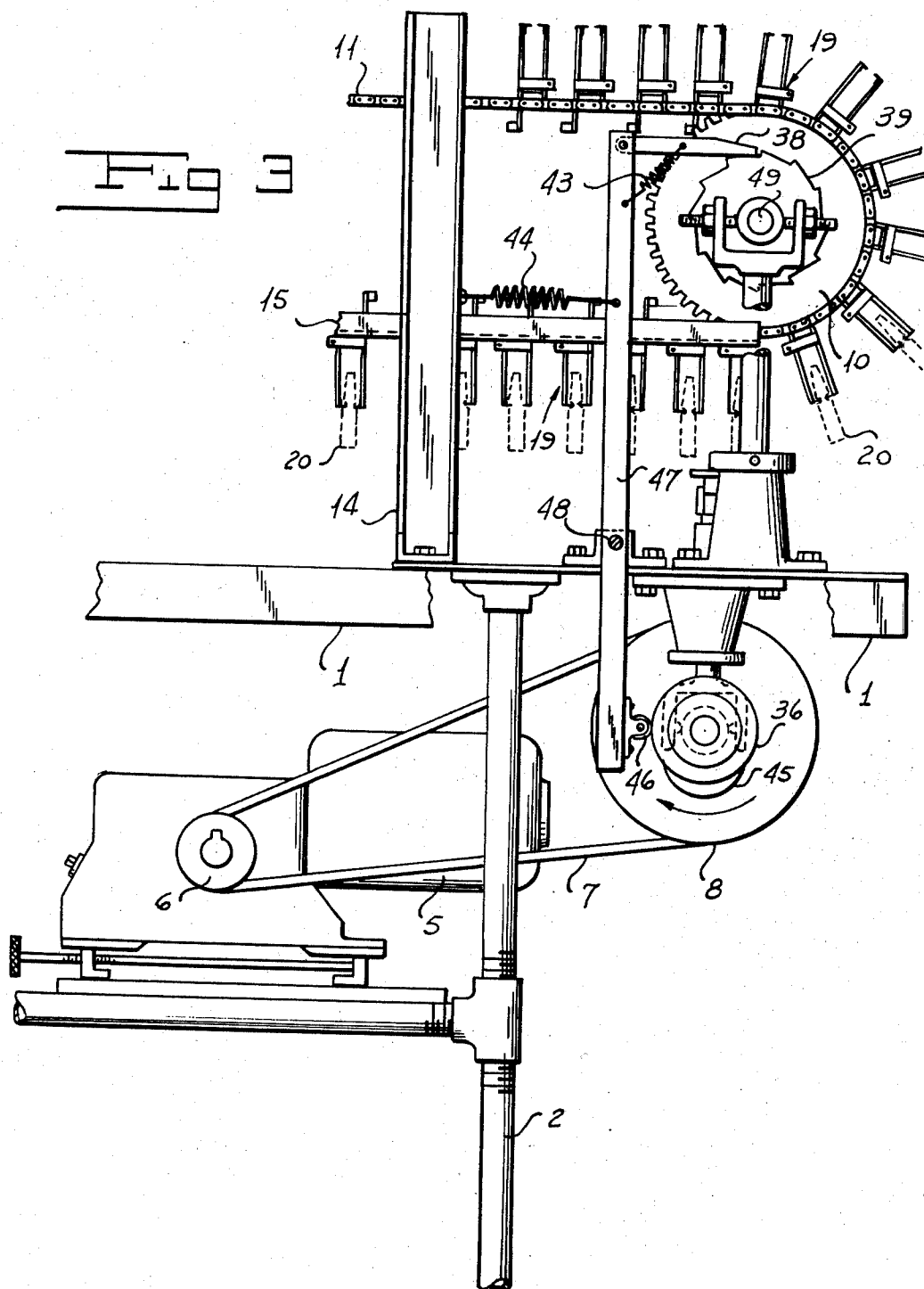
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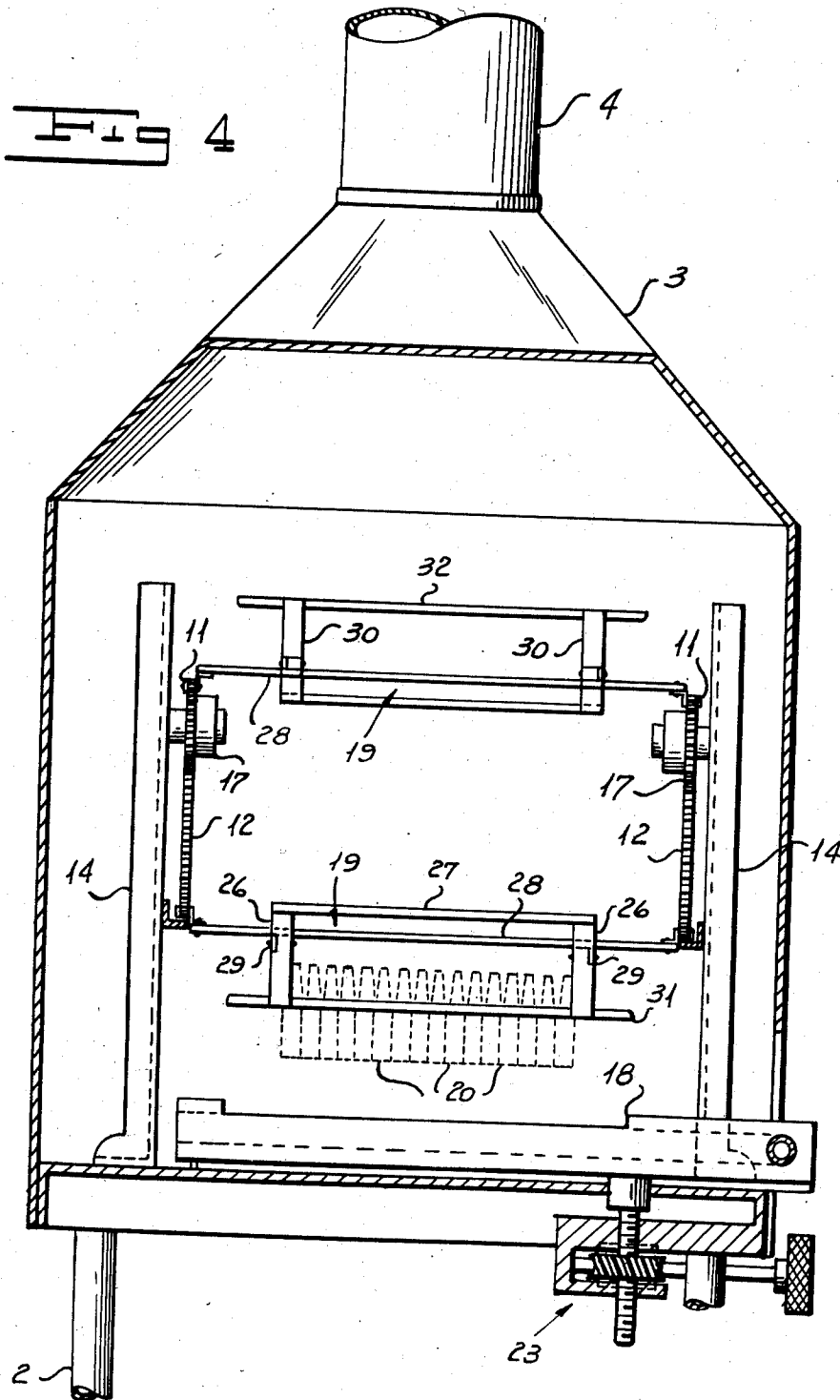
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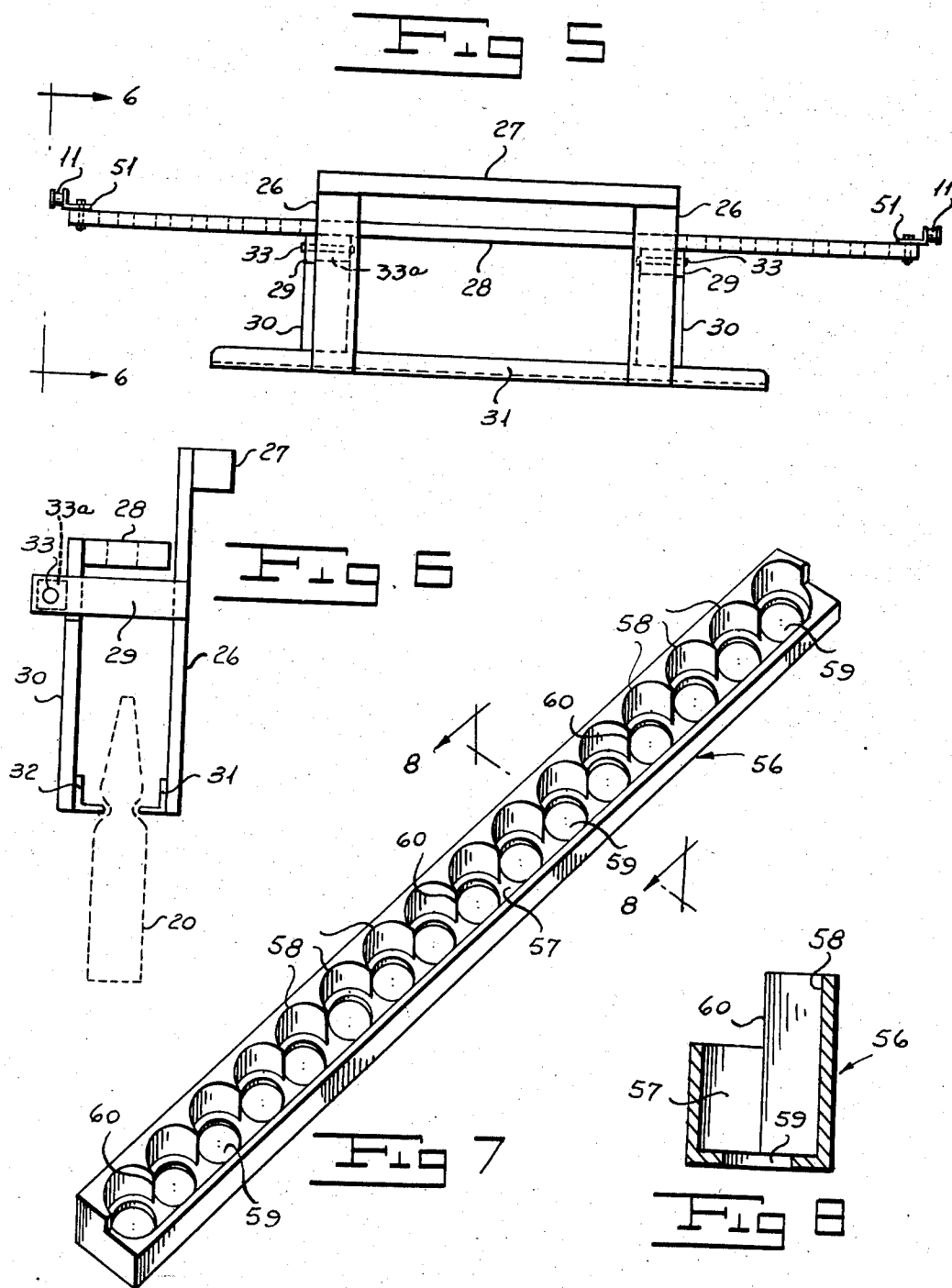
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AUTOMATIC AMPUL DRYING MACHINE

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5 Claims. (Cl. 263—8)

This invention relates to an automatic ampul drying machine. More particularly, the present invention relates to a drying machine wherein ampuls such as those used for medicinal substances may be quickly and efficiently dried and sterilized simultaneously by automatic means.

Therapeutic substances for intravenous and intramuscular administration are conventionally made up in dosage form in ampuls of various sizes. Sterility of the container and contents is imperative. The ampuls are conventionally first washed and then dried and sterilized prior to filling and sealing. Due to the irregular shape and varying size of the ampuls, it is difficult to handle the containers, particularly with the rapidity required in commercial operations and for maintaining sterility.

It is an object of this invention to provide an ampul drying machine wherein ampuls may be expeditiously dried and sterilized in a continuous, automatic manner.

It is also an object of this invention to construct an improved ampul carrier assembly for an ampul drying machine which is adjustable both for ampuls which vary in capacity and for ampuls which vary slightly from specifications.

It is a further object of this invention to construct an improved ampul carrier assembly for an ampul drying machine wherein a plurality of ampuls may be quickly and readily inserted and removed for a continuous operation.

It is also an object of this invention to provide an improved ampul handling or transfer device for handling a plurality of ampuls, particularly adapted for removing ampuls from the drying machine.

The continuous automatic ampul drying machine of this invention comprises an elongated framework which may be mounted on any support. At each side of the two ends of the frame, sprocket wheels are set in bearing posts. An endless roller chain extends along each side of the frame between two sprocket wheels. Attached to these roller chains at spaced intervals and extending transversely across the machine are a plurality of ampul carrier assemblies each adapted to transport a plurality of ampuls through the machine. A driving means, such as an electric motor mounted on a support below the frame, acts through a suitable indexing means such as a ratchet and pawl or Geneva mechanism and the sprocket wheels to advance the roller chains and the attached ampul carrier assemblies according to a pre-set timing arrangement. The sprocket wheels are rotated simultaneously through a part of a revolution by the driving means and in turn drive the roller chains so that the ampul carriers advance intermittently. The overall operation of the drying machine is, however, continuous.

Ampuls are inserted into a carrier assembly at the loading station of the machine preferably the end containing the driving mechanism, and are transported open end upward over a series of heating elements such as gas burners mounted on the framework adjacent to the loading station. The heat from the heating element vaporizes

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any residual water from the preceding washing operation and simultaneously sterilizes the ampul. As the ampuls are carried through the remaining length of the machine, they cool sufficiently for removal at the unloading station and for further handling.

Mounted on the frame is a hood which substantially completely encloses the area above the frame, except for openings providing access at either end for loading and unloading. The top of the hood is preferably pyramid-like in shape so as to collect hot gases or vapors rising within and to funnel the gases and vapors into a draw-off device such as a chimney.

A particular feature of this invention resides in the ampul carrier assembly which transports the ampuls through the drying operation. The carrier assembly comprises a rigid support bar attached at each end to the roller chains. Suspended from the support bar by rigid support means such as one or more fixed straps is a fixed carrier bar of L-shaped cross section. Attached to the support means by hinge means are second rigid support means such as one or more straps bearing on the lower end a companion carrier bar, also of L-shaped cross section, and at the upper end a counterweight, preferably in the form of an elongated bar. The second support means are movable, pivoting about the hinge means. The two carrier bars form an adjustable horizontal slot into which a row of ampuls is inserted and suspended from the carrier bars by means of the constrictions in the necks of the ampuls.

A second feature of this invention resides in an improved ampul handling or transfer device useful in handling a plurality of ampuls and particularly adapted for quickly and conveniently removing a plurality of ampuls from the drying machine, especially when fewer ampuls than full capacity are carried by the ampul carrier assembly. The ampul transfer device comprises an elongated bar having an L-shaped cross section and a hollowed base accepting the bodies of a plurality of ampuls. Partitioning means provide individual seats or pockets for the ampuls. The partitioning means comprises a series of vertical grooves and ridges along the back of the device, i. e. the vertical arm of the L. Ampuls seated in the pockets of the transfer device are maintained separate from each other. The L-shaped cross section and grooved back facilitate the seating of the ampuls in the device.

The accompanying drawings illustrate the construction and various features of the invention in detail.

Figure 1 is a right side elevation of the assembled ampul drying machine partly cut away to show the heating means and other details.

Figure 2 is a front elevation of the ampul drying machine showing the loading end of the device and details of the drive mechanism.

Figure 3 is a detail of the ratchet and pawl mechanism with the cam drive.

Figure 4 is a cross section on the line 4—4 of Figure 1.

Figure 5 shows a front view of the ampul carrier assembly.

Figure 6 is an end view of the ampul carrier assembly.

Figure 7 is a view in perspective of the ampul transfer device.

Figure 8 is a cross section of the ampul transfer device.

Referring to Figure 1, the loading station is designated A and the unloading station is designated B for convenience. Preferably the loading station is located at that end of the machine at which the drive mechanism is mounted. Frame 1 of the ampul drying machine is supported on legs 2. Suspended from the lower portion of legs 2 is a motor support 21 on which is mounted a conventional electric motor 5.

At opposite sides of loading station A of the ampul

drying machine, drive sprockets 10 are rigidly attached by shaft 49 which rotates in bearing posts 9 attached to frame 1. Idler sprockets 12 are similarly mounted at opposite sides of unloading station B on a shaft (not shown) in bearing posts 13 also attached to frame 1. At each side of the machine an endless roller chain 11 extends between a drive sprocket wheel and an idler sprocket wheel. Both roller chains operate together by virtue of the attachment of sprockets 10 to shaft 49.

At intervals along each side of frame 1 are vertical brackets 14 to which are attached, at approximately the mid-point along the height of the brackets, angle iron chain supports 15. The angle irons 15 provide support surfaces for the lower halves of the roller chains 11. Also attached to vertical brackets 14, near the top thereof, are roller chain sprocket supports 16. At intervals along supports 16 are sprocket wheels 17 which engage and support the top halves of the roller chains.

Ampul carrier assemblies 19 are suspended transversely between the roller chains 11 at spaced intervals by means of standard roller chain attachments. The ampul carrier assemblies are advanced by movement of the lower halves of the roller chains from the loading station to the unloading station and are then returned by the upper halves of the chains as shown in Figure 1. The ampul carriers advance through the machine in a series of short movements, each movement being followed by a period of rest; such movement being provided by a suitable indexing device such as a ratchet and pawl or Geneva mechanism.

Mounted on the frame 1 of the machine, immediately behind the bearing posts 9, is a heating device 18, preferably a series of adjustable gas burners, extending transversely across the frame. The heating elements may be elevated or lowered by worm 23 and are spaced so that each element is directly beneath a carrier assembly 19 during the period at which the carrier assemblies are at rest as discussed below.

Hood 3, attached to frame 1 or hung from above, covers the top and sides of the entire machine leaving access only to the loading and unloading stations as shown in Figure 1. Hood 3 connects with a draw-off device for heat and vapors such as chimney 4. The hood may be provided with removable side panels (not shown) for access to the interior of the device.

The front view of the ampul drying machine shown in Figure 2 discloses details of the driving mechanism, the ampul carrier assembly 19, a plurality of ampuls 20 in position over settling plate 37 and the activating mechanism for the settling plate. Motor 5 drives shaft 41 by means of belt 7 extending between pulleys 6 and 8. Clutch 40 permits the machine to be stopped without stopping the motor. Shaft 41 is supported by bearing assemblies 35. On shaft 41 are mounted cams 34 and 36. Cam 34 actuates ampul settling plate 37 through lifting rod 42 by means of roller 50. Cam 36 actuates ratchet and pawl mechanism 38—39. Cam 34 is designed so as to move settling plate 37 upward in momentary contact with the ampuls suspended in a stationary carrier assembly immediately above it. The settling plate exerts a slight upward force on each ampul so as to seat the carrier bars securely in the constrictions in the necks of the ampuls. Cam 36 is designed so that a forward motion is translated to pawl 38 against ratchet 39 sufficient to rotate sprocket wheels 10 through a part of a revolution.

Figure 3 shows in greater detail the ratchet and pawl mechanism which drives the roller chains through sprocket wheels 10. Ratchet 39 is mounted on shaft 49 which rigidly connects drive sprocket wheels 10 so that they rotate simultaneously when ratchet 39 moves. Cam follower 46 mounted on lever 47 rides on cam 36. Eccentric 45 on cam 36 exerts a backward force on follower 46 causing lever 47 to pivot about hinge 48. Ratchet 39

is engaged and rotates drive sprocket wheels 10 through part of a revolution thus providing a forward motion to the roller chains. When eccentric 45 moves beyond the follower, springs 43 and 44 return the pawl assembly to the rest position and the roller chains stop.

The ampul carrier assembly is shown in detail in Figures 5 and 6. Support bar 28 extends transversely across the machine and is attached at each end to the roller chain by means of standard chain attachments 51. Suspended from support bar 28 by one or more fixed straps 30 is an elongated, fixed carrier bar 32 of L-shaped cross section. These elements comprise the fixed side of the carrier assembly.

Attached to straps 30 by means of hinge block 33a, hinge pin 33 and hinge means 29 are one or more movable straps 26. Fixed to the lower ends of straps 26 is elongated companion carrier bar 31 which also has an L-shaped cross section and coacts with carrier bar 32 to form an adjustable, self compensating slot adapted to receive a plurality of ampuls. When a row of ampuls is inserted into the slot they are suspended from carrier bars 31 and 32 by the constrictions in the necks. Carrier bars 31 and 32 may be tapered at each end so as to facilitate loading and unloading. At the upper ends of the movable straps 26 is attached counterweight bar 27. The counterweight is designed so that the movable side tends to pivot about hinge pin 33 and close the slot formed between ampul carrier bars 31 and 32 when the ampul carrier assembly is in a substantially upright position. Elements 26, 27, 29 and 31 comprise the movable side of the carrier assembly.

In order to quickly and conveniently transfer a plurality of ampuls, ampul transfer device 56 is provided, as shown in Figures 7 and 8. Ampul transfer device 56 comprises an elongated bar having an L-shaped cross section. The base of the elongated bar, i. e. the base of the L, is hollowed so as to accept the bodies of a plurality of ampuls. The back, i. e. the vertical arm of the L, is partitioned so as to provide a plurality of pockets 57 each accepting and seating one ampul. The pockets are formed by a series of vertical grooves in the back of the device, each conforming to the general contours of the body of an ampul. When viewed from the front, the partitioning means appears as a series of alternate grooves 58 and ridges 60. The hollowed portion of the base of the L is deep enough to accept about one-half the body of an ampul. The back does not extend as high as the constriction in the neck. Each ampul transfer device is designed to accommodate ampuls of a given size, e. g. 1 cc., 2 cc., 5 cc., etc. Each transfer device may contain as many pockets as desired, but preferably the number of pockets equals the number of ampuls of a given size accepted by the ampul carrier assembly.

The ampul transfer device is adapted to readily remove the ampuls from the ampul carrier assembly when they reach and stop momentarily at the unloading station, particularly when less than a full load is borne by the carrier assembly. The L-shaped cross section facilitates seating of the ampul bodies in the transfer device during the brief period at which the mechanism is at rest. A hole smaller than the diameter of the body of the ampul may be provided in the base of each pocket if desired.

The automatic ampul drying machine operates as follows. Referring to Figure 1, an operator at loading station A prepares to insert into the horizontal slot of ampul carrier 19 a row of ampuls preferably by means of an ampul transfer device containing a plurality of ampuls. The loading position of the ampul carrier assembly is preferably at a 30° to 45° angle with the vertical as illustrated in Figure 1. When empty, the slot formed by the fixed and movable sides of the carrier is virtually closed. As the carrier stops at the loading

position, the ampuls, in an upright position, are urged

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from the side into the slot formed by carrier bars 31 and 32 until it has opened sufficiently for the constrictions in the necks of the ampuls to slide in and be grasped by carrier bars 31 and 32. By virtue of having one fixed side and one hinged side, the width of the slot automatically compensates itself for variations in the diameters of the constrictions and by virtue of the counterweight 27 the ampuls are prevented from sliding out of the slot. The ampuls are thus suspended from the ampul carrier assembly and the transfer device, if employed, is removed.

At the expiration of the preset pause in the movement of the ampul carrier assembly, the carrier moves forward one position. The loaded carrier 19 is at this time directly over settling plate 37 (shown in Figure 2) with the ampuls in a vertical position. As soon as the carrier comes to rest, the settling plate is activated upward so as to move the ampuls slightly in an upward direction permitting the carrier bars to be securely seated in the constrictions in the necks of the ampuls.

At the time the loaded carrier 19 moves forward to a position above settling plate 37, the succeeding empty carrier moves forward to the loading position. The next movement of the roller chains advances the loaded carrier forward from its position above the settling plate and the newly loaded carrier moves into that position. After several advances of the loaded carrier from the settling plate, the loaded ampul carrier arrives at a position over the first of the series of gas burners placed transversely across the frame. The ampuls suspended in the carrier pause over this first burner and then with each succeeding cycle of the timing mechanism advance and pause directly over each properly spaced burner. Sufficient burners are provided so as to produce adequate heat to both drive off any moisture contained in the washed ampuls and also to sterilize the ampuls. Each succeeding loaded ampul carrier follows the same sequence.

After passing the heating elements, each row of ampuls is carried forward by the ampul carriers with the same intermittent motion through the remaining length of the machine. This section of the machine is of sufficient length so as to permit the ampuls to cool enough to be handled at the unloading station.

The unloading position at station B is reached when the ampul carrier is at an angle of about 30° to 45° with the vertical as shown in Figure 1. As each ampul carrier arrives at the unloading station with its load of dry and sterile ampuls and pauses briefly, an operator removes the ampuls. This is accomplished expeditiously by seating a transfer device such as 56 over the bodies of the ampuls and sliding it laterally to remove them from the slot of carrier 19. The empty ampul carriers are carried back by the roller chain in an inverted position through the upper portion of the machine to return to position A for repetition of the process.

One complete cycle of the mechanism occurs with one revolution of shaft 41 and includes the period the carriers are at rest, begin to advance, complete their forward motion, and come to rest again. During each cycle the mechanism operates as follows. When the motor is started and the clutch is engaged, shaft 41 begins to rotate. Starting from the stationary position with everything at rest, the pawl is just about to push the indexing mechanism forward. Eccentric 45 on cam 36 is approaching follower 46. When eccentric 45 reaches the follower 46, it imparts the forward motion to the ratchet and pawl mechanism through lever 47 and indexes the sprockets and chains through one position. Eccentric 45 then moves beyond its follower, the indexing movement is finished and the carriers stop.

During this period the settling plate is in the downward or lower position and the eccentric on cam 34 approaches its follower. Immediately after the indexing movement has finished, the eccentric on cam 34 then

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raises the settling plate by means of lifting rod 42 to raise the ampuls slightly and securely seat them in the carrier. The eccentric on cam 34 then passes beyond its follower. As the period of rest is concluded, eccentric 45 again approaches follower 46 to initiate a new cycle. While the carriers are at rest several rows of ampuls are being heated by the gas burners and the operators at the loading and unloading stations carry out their respective functions.

The timing for each cycle may be varied to suit individual requirements. This is determined by the spacing of the carriers and by the speed of operation. A greater distance between ampul carrier assemblies tends to increase the time required for each cycle although this may be counterbalanced by higher speed operation of the motor. The indexing mechanism is designed to advance the carriers the same distance by which they are separated.

It has been found to be convenient to mount the respective carriers about two inches apart on the roller chain. The eccentric on cam 36 and the pawl and ratchet mechanism are then designed to rotate the drive sprocket wheels 10 through that portion of a revolution so as to advance the roller chain and the carrier assemblies the same distance during each cycle. The speed of operation may be varied by conventional means, e. g. by utilizing a variable pitch pulley on the motor and mounting the motor on a sliding base.

The heating elements 18 are preferably adjustable both as to position and as to the amount of heat supplied. The elements are mounted on the frame the same distance apart as the ampul carrier assemblies so that an element is properly located beneath a row of ampuls during the rest phase of the cycle.

The support bar 28 may contain a series of holes in order to aid in the dissipation of heat and to decrease the weight of the carrier assembly. The carrier assembly may be designed to accommodate any desired number of ampuls. A convenient length is one which accommodates 16 one cc., 16 two cc., or 9 five cc. ampuls. The counterweight 27 is a metal bar attached to movable straps 26 and is of sufficient weight to maintain the carrier bars securely in closed position when transporting its load of ampuls.

In general the overall length of the drying machine may vary widely but must be sufficient to provide adequate space for a plurality of heating elements, e. g., 6 to 10, for drying and sterilizing, as well as sufficient protected area to permit the ampuls to cool for further handling. A convenient length has been found to be about 12 to 15 feet but this of course may be varied to suit circumstances. If desired, a cooling means such as a stream of cool, sterile air may be introduced into the cooling area.

Other variations, readily apparent to one skilled in the art, are also within the scope of this invention.

We claim:

1. An automatic ampul drying machine which comprises an elongated frame mounted on supporting members, a drive shaft suspended from said frame and operatively connected to a driving means, two drive sprocket wheels mounted at opposite sides above a first end of said frame, two idler sprocket wheels mounted at opposite sides above the second end of said frame, an endless chain suspended between the driver and idler sprocket wheels at each side of the frame, an indexing mechanism connecting said drive shaft and said driver sprocket wheels adapted to rotate the driver sprocket wheels and advance the chains intermittently, a plurality of ampul carrier assemblies transversely suspended between the endless chains, each ampul carrier assembly comprising a support bar adapted to be attached by each end thereof to said endless chains, fixed support means suspended from said support bar, a carrier bar attached in a horizontal position to the end of said fixed support

means, movable support means attached to said fixed support means by hinge means, a movable companion carrier bar attached in a horizontal position to said movable support means, said movable carrier bar forming an adjustable slot together with said fixed carrier bar, and a counterweight attached to said movable support means in a position remote from the carrier bar and so aligned with respect to the hinge means as to close said slot while the carrier assembly is in ampul transporting position, and a heating device mounted on the frame of said machine.

2. An automatic ampul drying machine containing a drying section and a cooling section which comprises an elongated frame mounted on supporting members, a drive shaft suspended from said frame and operatively connected to a driving means, sprocket wheels mounted in bearing members at opposite sides of each end above said frame, the two sprocket wheels mounted at the driving end of the machine being rigidly connected by means of a shaft and comprising the driving sprocket wheels, the two sprocket wheels mounted at the opposite end of the machine comprising the idler sprocket wheels, an endless chain suspended between the driver and idler sprocket wheels at each side of the frame, a ratchet and pawl mechanism actuated by a cam on said drive shaft and adapted to rotate the driver sprockets intermittently thereby advancing the endless chain in a series of short forward motions with a pause between each advance, a plurality of ampul carrier assemblies transversely suspended between the endless chains, each ampul carrier assembly comprising a support bar adapted to be attached by each end thereof to said endless chains, fixed support means suspended from said support bar, a carrier bar attached in a horizontal position to the end of said fixed support means, movable support means attached to said fixed support means by hinge means, a movable companion carrier bar attached in a horizontal position to said movable support means, said movable carrier bar forming an adjustable slot together with said fixed carrier bar, and a counterweight attached to said movable support means in a position remote from the carrier bar and so aligned with respect to the hinge means as to close said slot while the carrier assembly is in ampul transporting position, a heating device mounted on said frame adjacent to the driving section, and a hood substantially covering said machine.

3. An automatic ampul drying machine containing a drying section and a cooling section which comprises an elongated frame mounted on supporting members, a drive shaft suspended from said frame and operatively connected to a driving means, sprocket wheels mounted in bearing members at opposite sides of each end above said frame, the two sprocket wheels mounted at the driving end of the machine being rigidly connected by means of a shaft and comprising the driving sprocket wheels, the two sprocket wheels mounted at the opposite ends of the machine comprising the idler sprocket wheels, a roller chain suspended between the driver sprocket wheel and the idler sprocket wheel at each side of the frame, support means for the roller chain along each side of the machine, a ratchet and pawl mechanism actuated by a cam on said drive shaft and adapted to rotate the driver sprocket wheels intermittently thereby advancing the roller chain in a series of short forward motions with a pause between each advance, a plurality of ampul carrier assemblies transversely suspended between the roller chains, each ampul carrier assembly comprising a support bar adapted to be attached at each end to said

roller chains, fixed straps suspended from said support bar, a carrier bar of L-shaped cross section affixed to the ends of said fixed straps in a horizontal position, movable straps attached to the fixed straps by hinge means located near the support bar, a movable companion carrier bar having an L-shaped cross section rigidly affixed in horizontal position to said movable straps, said movable and fixed carrier bars together forming an adjustable slot and cooperating to carry a plurality of ampuls by means of the constrictions in the necks thereof, and a counterweight attached to said movable straps at the ends remote from the movable carrier bar and so aligned with respect to the hinge means as to close said slot while the carrier assembly is in ampul transporting position, a settling plate actuated by a cam on the drive shaft during each period when the ampul carrier assemblies are at rest and adapted to force the ampuls in a slightly upward direction in the ampul carrier assembly stationary immediately above the settling plate, a plurality of gas burners mounted on said frame in the drying section of said machine and a hood substantially covering said machine.

4. In an ampul drying machine, an ampul carrier assembly which comprises a support bar adapted to be attached by each end to a conveying means, fixed support means suspended from said support bar, a carrier bar attached in a horizontal position to the end of said fixed support means, movable support means attached to said fixed support means by hinge means, a movable companion carrier bar attached in a horizontal position to said movable support means, said movable carrier bar forming an adjustable slot together with said fixed carrier bar, and a counterweight attached to said movable support means in a position remote from the carrier bar and so aligned with respect to the hinge means as to close said slot while the carrier assembly is in ampul transporting position.

5. In an ampul drying machine, an ampul carrier assembly which comprises a support bar adapted to be attached at each end to a roller chain, fixed straps suspended from said support bar, a carrier bar of L-shaped cross section affixed to the ends of said fixed straps in a horizontal position, movable straps attached to the fixed straps by hinge means located near the support bar, a movable companion carrier bar having an L-shaped cross section rigidly affixed in horizontal position to said movable straps, said movable and fixed carrier bars together forming an adjustable slot and cooperating to carry a plurality of ampuls by means of the constrictions in the necks thereof, and a rigid counterweight attached to said movable straps at the ends remote from the movable carrier bar and so aligned with respect to the hinge means as to close said slot while the carrier assembly is in ampul transporting position.

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