Nov. 14, 1950 F. J. COZZOLI 2,530,230

COMBINED FILLING AND SEALING MACHINE

Filed July 24, 1948 7 Sheets-Sheet 1

FIG. 1.

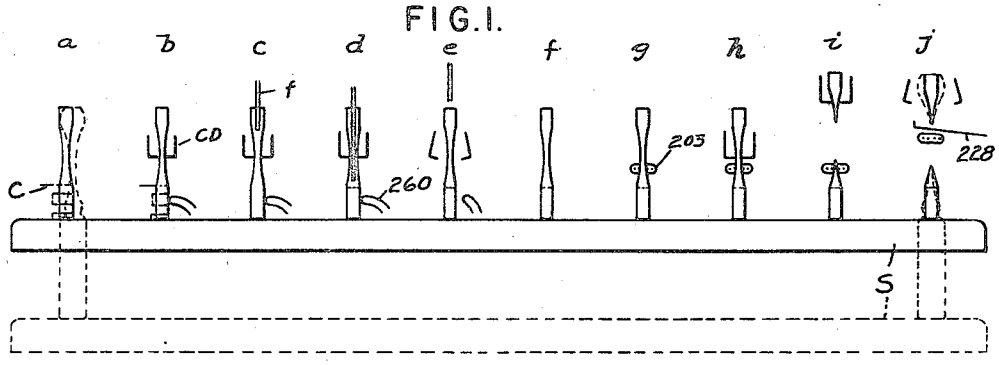
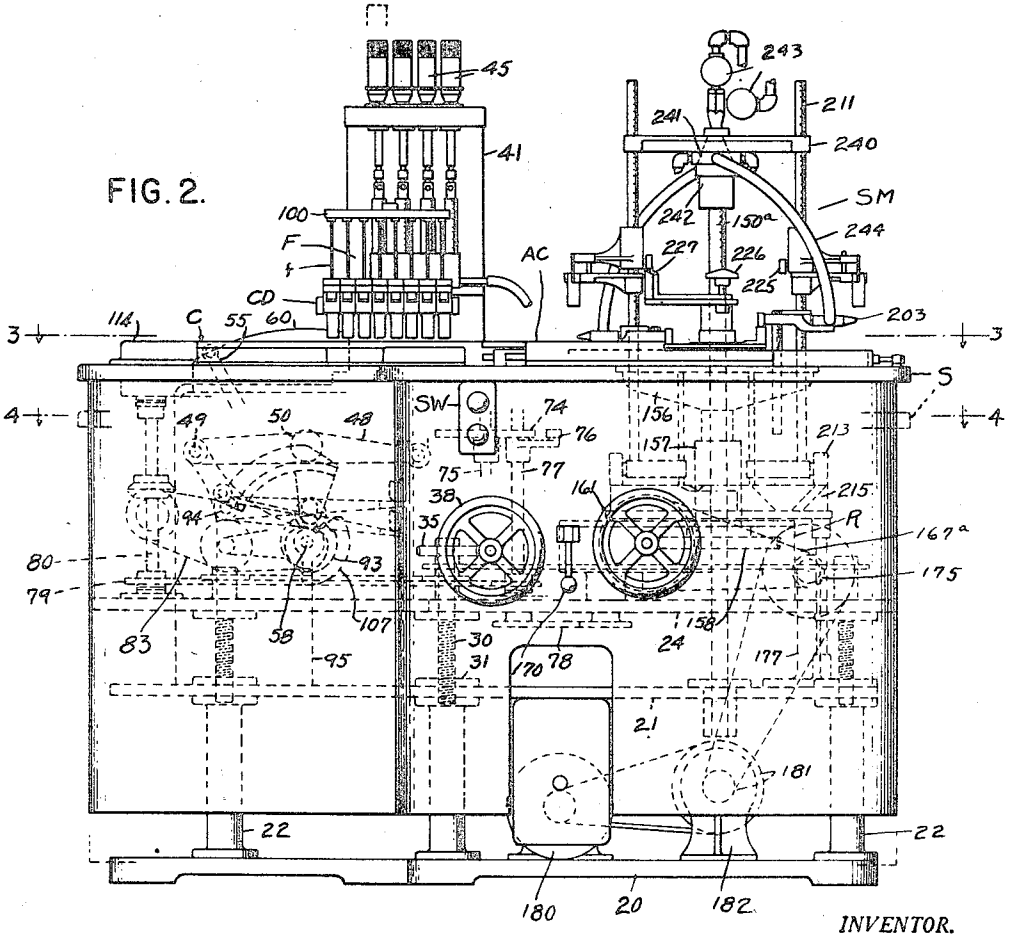


FIG. 2.



INVENTOR.

Frank J. Cozzoli

BY

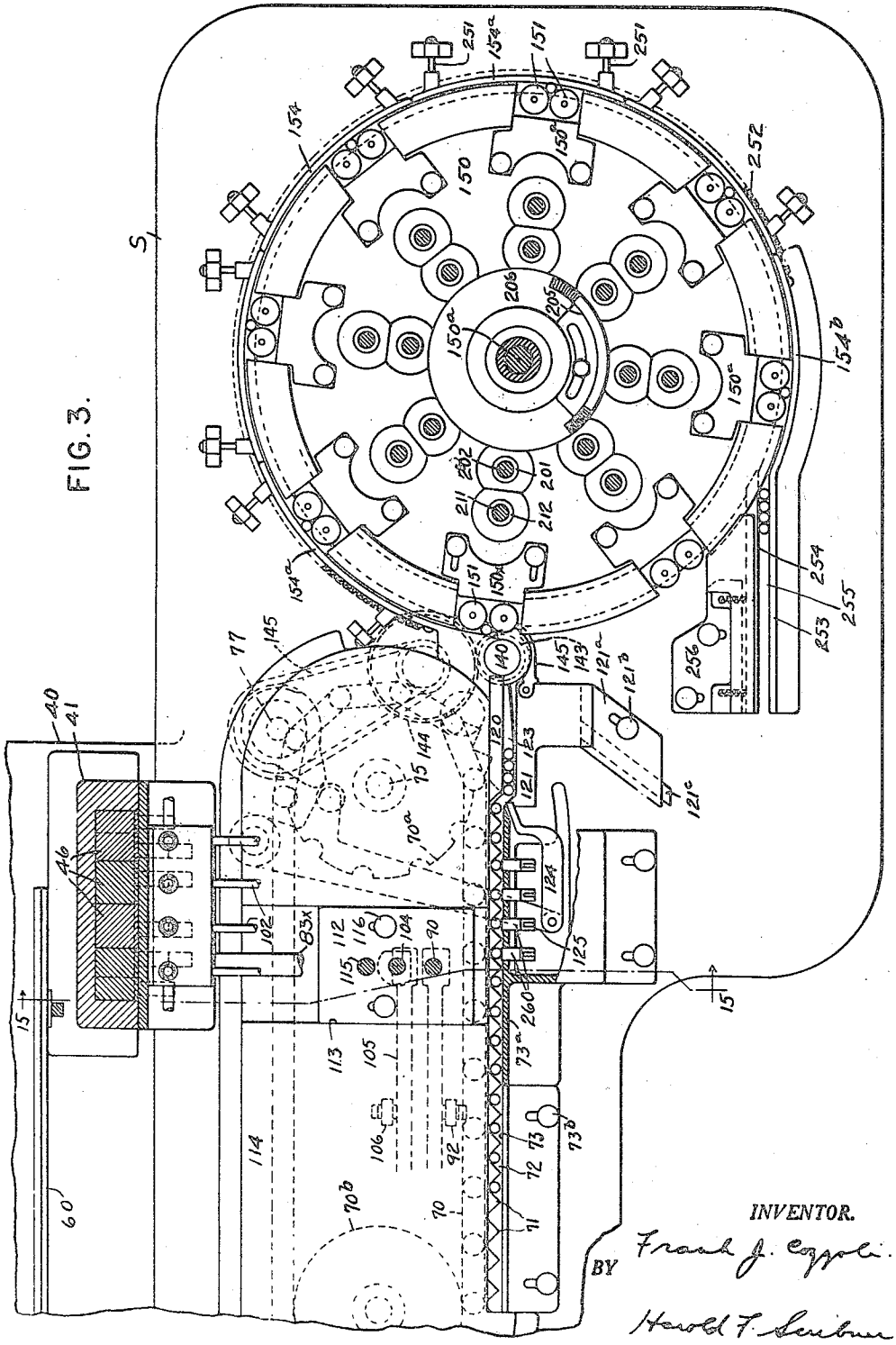
Harold F. Leibman

Nov. 14, 1950 F. J. COZZOLI 2,530,230

COMBINED FILLING AND SEALING MACHINE

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FIG. 3.

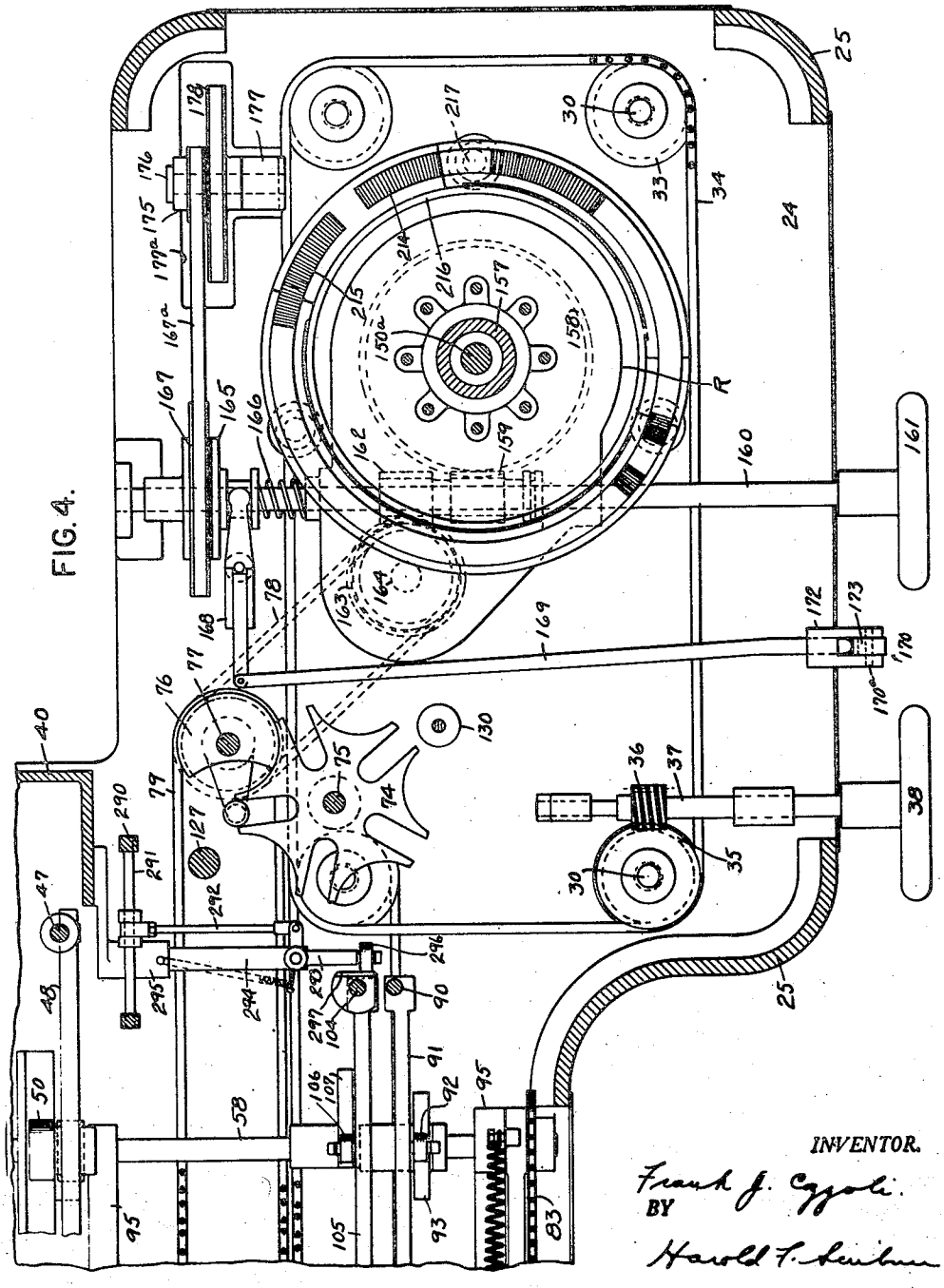


Nov. 14, 1950 F. J. COZZOLI 2,530,230

COMBINED FILLING AND SEALING MACHINE

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FIG. 4.



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Nov. 14, 1950 F. J. COZZOLI 2,530,230

COMBINED FILLING AND SEALING MACHINE

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FIG.6.

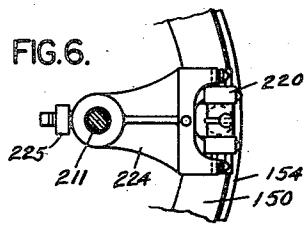


FIG.5.

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Nov. 14, 1950 F. J. COZZOLI 2,530,230

COMBINED FILLING AND SEALING MACHINE

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FIG.8.

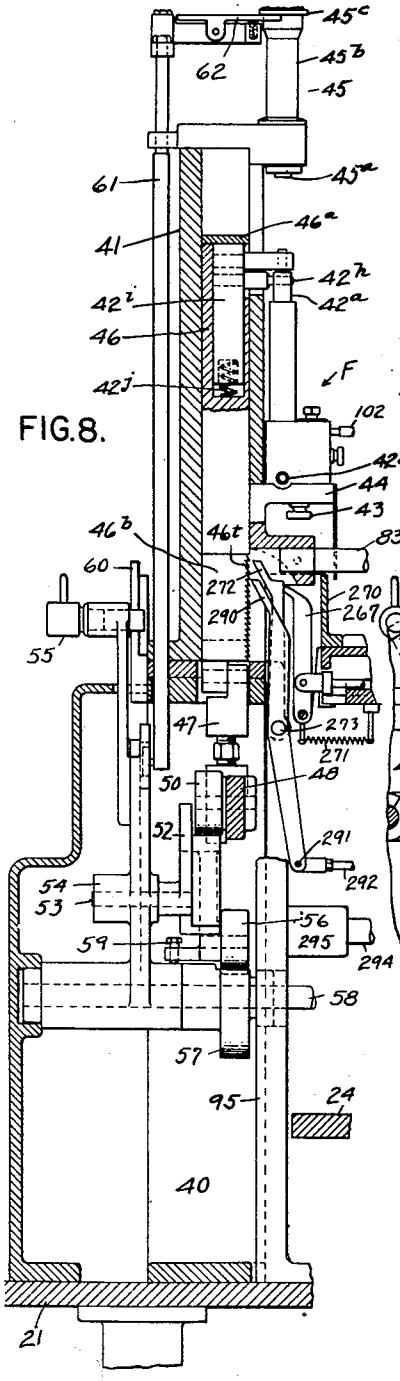


FIG.9.

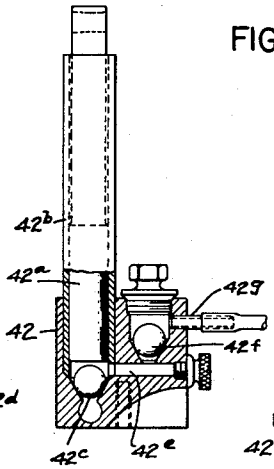
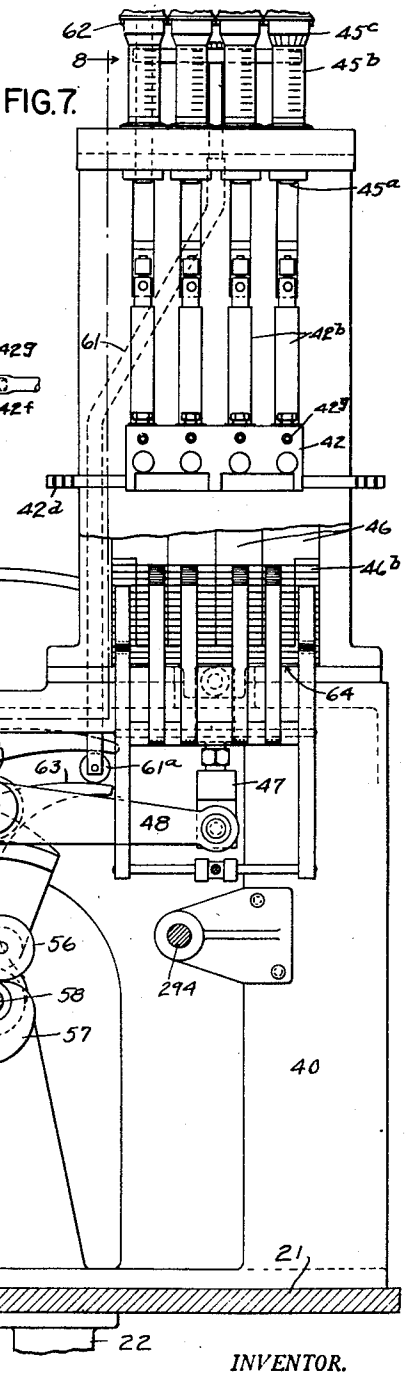


FIG.7.



INVENTOR.

BY Frank J. Cozzoli

Harold F. Seibert

Nov. 14, 1950 F. J. COZZOLI 2,530,230

COMBINED FILLING AND SEALING MACHINE

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FIG.11.

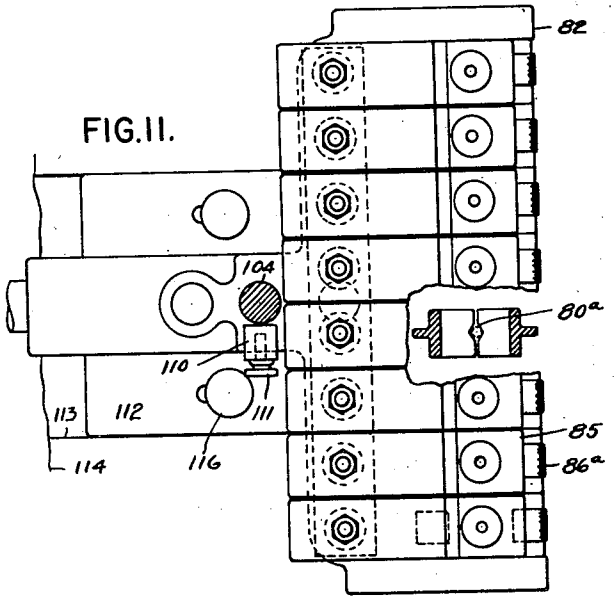


FIG.14.

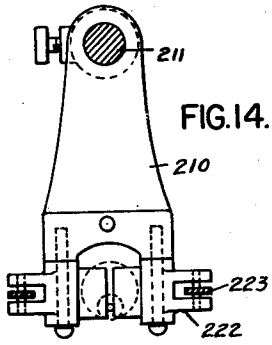


FIG.13.

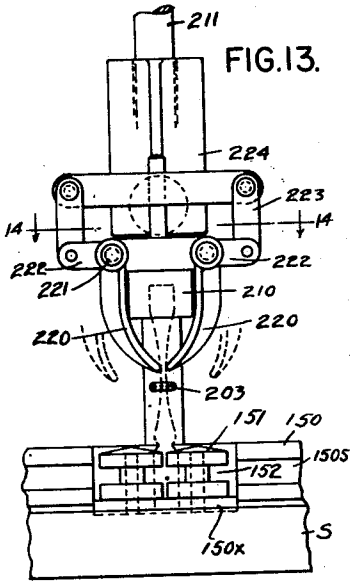
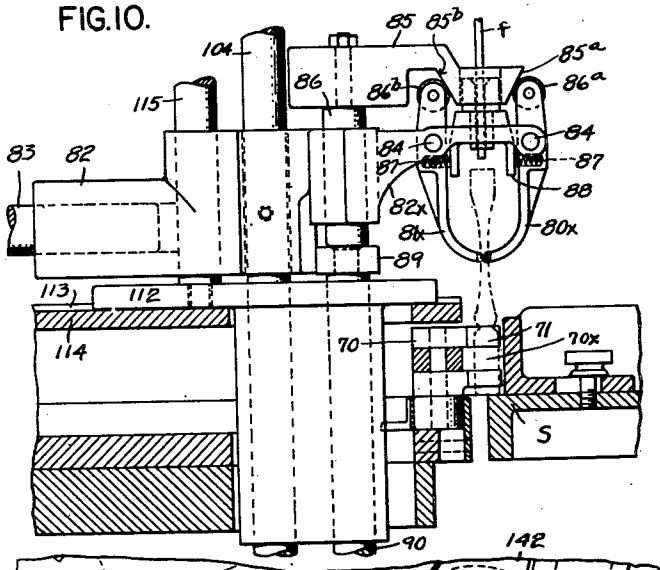


FIG.10.



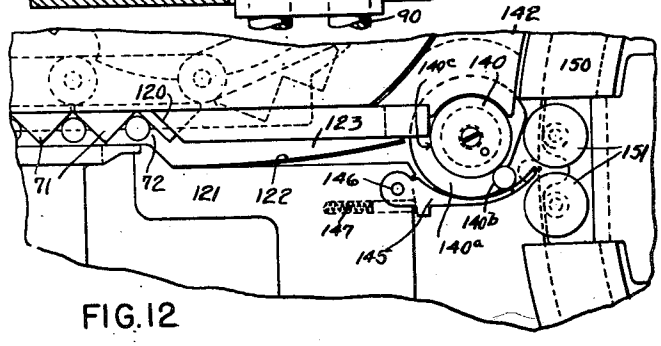


FIG.12

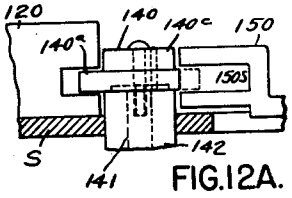


FIG.12A.

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Nov. 14, 1950 F. J. COZZOLI 2,530,230

COMBINED FILLING AND SEALING MACHINE

Filed July 24, 1948 7 Sheets-Sheet 7

FIG.17.

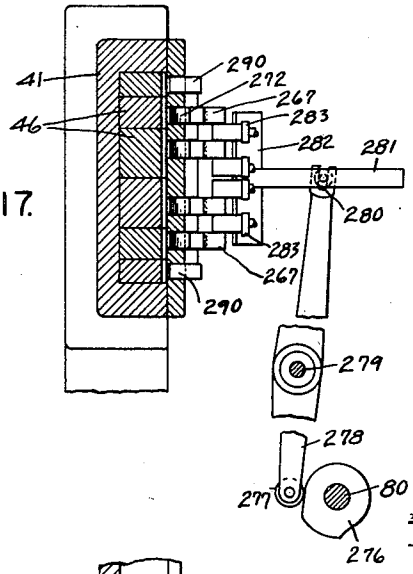


FIG.18.

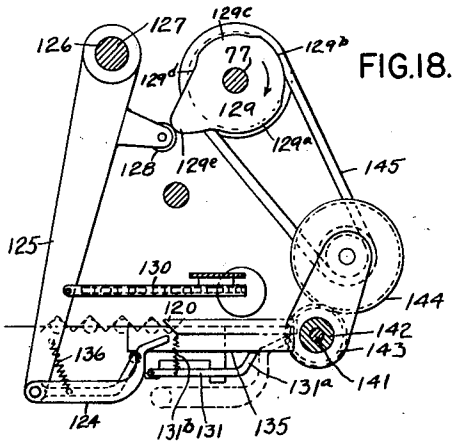


FIG.19.

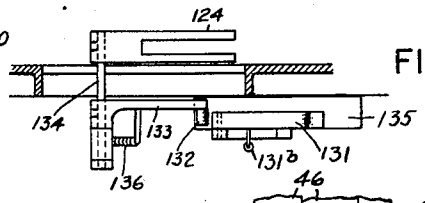


FIG.16.

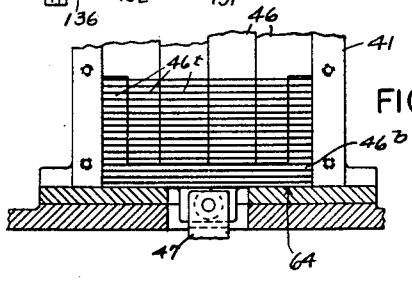


FIG.15.

INVENTOR.

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Harold F. Seidman

Patented Nov. 14, 1950 2,530,230

UNITED STATES PATENT OFFICE

2,530,230

COMBINED FILLING AND SEALING MACHINE

Frank J. Cozzoli, Plainfield, N. J.

Application July 24, 1948, Serial No. 40,488

26 Claims. (Cl. 226—19)

1

The present invention relates to the pharmaceutical industry and is concerned more particularly with improvements in the art of filling and sealing glass tubes and ampoules.

A primary aim of the invention is to effect the filling and sealing of containers rapidly and efficiently in an automatic manner and without aid of the attendant other than that of loading the machine with the empty tubes or ampoules that are to be filled and sealed.

Another aim of the invention is to effect the simultaneous filling of a plurality of tubes and transfer of the filled tubes from the filling units to the sealing units automatically whereby to avoid not only manual handling and consequent delays and problems incident to storing open containers containing a medicinal preparation, but also to reduce to a minimum the possibility of fouling or contaminating the medicinal preparation by such manual handling.

Another aim of the invention is to effect the filling of a group of containers simultaneously and separately to measure the quantity delivered into each of the containers of the group independently and with high degree of precision.

A further aim of the invention is to provide an automatic multiple filling machine with means automatically operative to suspend the operation of one or more of the filling heads in the event that one or more of the unfilled containers fail to be in filling position relative to the filling spouts, to the end of conserving the medicinal preparation and avoiding discharge thereof into the blank container holder or over the machine parts. By way of further refinement the invention also aims to provide a multiple filler of this character with additional means operative to suspend the action of the filling units in the event one or more of the filling needles and unfilled containers fail properly to be brought into registry in the manner required for the filling thereof, without suspending the operation of the container sealing means or delaying the sealing of previously filled containers.

Still a further aim of the invention is to provide in an automatic filling and sealing machine a means for adapting the filling and sealing elements to any of a range of lengths of tubes, and to effect the adaptation in manner whereby an adjustment for tube length automatically results in an adjustment to the filling as well as the sealing mechanisms so as to insure proper cooperative relations of the elements of the several coacting mechanisms at all times.

Another objective of the invention is to provide an automatic filling and sealing machine that requires but one attendant whose only duty is to place empty tubes or ampoules in the receptacles provided on the machine.

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Still another aim of the invention is the construction of a combination filling and sealing machine that may quickly and easily be cleaned, more especially those parts of the mechanisms that are contacted by the preparation to be packaged, to the end that the machine may be used to fill and seal ampoules with a selected preparation and on completion of the run, quickly conditioned for a run of another preparation in the same or another size of ampoule.

In the packaging of pharmaceutical preparations in glass tubes or ampoules the danger of breakage is ever present. Breakage of tubes and the consequent spilling of the packaged preparation is not only wasteful and expensive, but the spilling of the preparation and the scattering of broken glass is a hazardous condition which the present invention undertakes to eliminate.

In carrying forward the aims of this invention advantage is taken of the fact that, in the case of ampoules, the point of sealing off of the narrow stem bears a substantially constant relation to the zone of constriction of the body part of the ampoule. In the average case, the sealing off point is about one inch above the constricted throat of the ampoule, and variations in capacity of the ampoule are made in the length and in the diameter of the body part. In order to fill an ampoule, the end of the filling needle must be inserted into the stem and project into the body part a short distance, at least, past the constricted throat. The ampoule having the longest stem, therefore, establishes the length of the filling needle.

In accordance with this invention, it is proposed to provide a single combination support and runway for the ampoules for both the filling and the sealing mechanisms and to arrange the support so that it may be vertically adjusted to the level required for the different length ampoules. The arrangement is such that the ampoules to be filled and sealed are placed in carriers and moved along the support to the filling mechanisms and thereafter transferred to the sealing mechanisms, and all the while being supported by and upon the vertically adjustable track or runway.

Cooperatively related, are ampoule centering mechanisms that center each ampoule with respect to an associated filling needle; the filling needles and their actuating means that causes a

group of needles to enter and leave the necks of a group of ampoules; detecting means that are sensitive to the absence of a container and suspends filling action of that particular filling head, and additional detecting means that responds to suspend the filling operation if the needles fail to enter the tubes; the mechanisms automatically operative to transfer filled ampoules from the group filling mechanisms to the successively operated sealing mechanisms; and the ampoule sealing mechanism which includes heat applying means, ampoule rotating means and ampoule stretching and drawing off means.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure and, in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:

Figure 1 of the drawings is a diagrammatic representation of the successive operations automatically performed by a machine constructed in accordance with this invention.

Fig. 2 is a front elevation of a combination filling and sealing machine embodying principles of this invention.

Fig. 3 is a top view on a larger scale, of portions of the table of the machine of Fig. 2, taken substantially along lines 3—3 of Fig. 2.

Fig. 4 is a horizontal sectional view, on an enlarged scale, taken substantially along line 4—4 of Fig. 2, illustrating portions of the main drive mechanisms.

Fig. 5 is an enlarged end view of the upper portions of the machine of Fig. 1, with certain parts broken away and illustrated in sectional planes to show the structure and relation.

Fig. 6 is a detail plan view of a gripper mechanism of one of the sealing units.

Fig. 7 is a vertical view of the filling unit actuating mechanisms taken substantially along line 7—7 of Fig. 5.

Fig. 8 is a vertical sectional view of the filling mechanisms taken substantially along line 8—8 of Fig. 7.

Fig. 9 is an enlarged vertical sectional view through one of the filling units of the machine.

Fig. 10 is a vertical sectional view, on an enlarged scale, of an ampoule and needle centering mechanism.

Fig. 11 is a top view of the centering mechanism, with portions broken away better to illustrate the construction.

Fig. 12 is an enlarged plan view of an ampoule accumulator and transfer device designed to receive ampoules in groups and to transfer them individually and successively to the sealing mechanisms. Fig. 12*a* is a detail view of a transfer cam.

Fig. 13 is a constructive view of portions of one of the tube sealing assemblies and Fig. 14 is a horizontal view taken along line 14—14 of the gripper illustrated in Fig. 13.

Fig. 15 is a vertical sectional view taken substantially along line 15—15 of Fig. 3 showing more clearly a means for detecting a blank in the tube conveyor and means responsive thereto to suspend the filling operation.

Fig. 16 is a front view of the column with the unit shelf removed to illustrate the lower portions of the filling unit actuating slides.

Fig. 17 is a constructive sectional view of a slide-latch retract mechanism, taken substantially along line 17—17 of Fig. 15.

Fig. 18 is a constructive plan view of the tube transfer actuating means, and Fig. 19 is an elevational view of the tube advancing finger and its underlying switching mechanism.

Referring more particularly to Fig. 2, the invention is disclosed in connection with a machine setup for the automatic filling and sealing of ampoules and which includes a plurality of interrelated and correlated mechanisms comprising, in general, an ampoule support S, a conveyor means C, a centering device CD, filling assemblies F, an accumulator and transfer device AC, and a rotary type sealing machine SM which embodies a plurality of tube sealing assemblies. These mechanisms will be explained more in detail later. In the interests of clarity it may be well first to explain the filling and sealing cycle represented diagrammatically by Fig. 1. In this diagram *a* represents a loading station at which the attendant places ampoules in openings provided in an intermittently movable conveyor C. The ampoules rest upon the support S. The conveyor moves the ampoules in groups to a position beneath filling needles F at which station the centering mechanism CD operates to center each ampoule with its associated filling needle, illustration *b*. The ampoules are next telescoped with the needles, illustration *c*, and a predetermined quantity of the preparation is discharged into each, illustration *d*. After filling, the needles are withdrawn and the centering mechanisms release the ampoules, illustration *e*. At illustration *f* the ampoule is represented as being discharged from the conveyor and being transferred to the sealing mechanisms. At *g* the ampoule is in position before a burner; position *h* indicates the heated ampoule being gripped by a gripper preparatory to being drawn. Illustration *i*, represents the ampoule in severed condition and the heat applied to the tip of the body part to finish the seal. Illustration *j* represents the filled ampoule in sealed condition, wherein the burner has been moved away, and the gripper has discharged the drawn off waste end into a discharge chute. These processing operations are carried in timed relation, with processes *a*, *b*, *c*, *d*, and *e* being performed simultaneously on groups of ampoules, and processes *f*, *g*, *h*, *i*, and *j* being carried on individually and successively. When larger ampoules are to be filled and sealed, the supporting platform S is lowered relative to the centering mechanisms, filling mechanisms, burner and gripper mechanisms, whereby to place the constricted portion of the ampoule in the same relative relation to the named mechanisms that the smaller ampoules occupied. The dotted line position of the support S shown in Fig. 1, illustrates the position for a larger ampoule.

From the foregoing it will be perceived that certain of the mechanisms are fixed in space and are caused to perform their respective functions, whereas certain other cooperating mechanisms are movable and may be set to occupy different positions in space and in each position of adjustment they are caused to perform their respective functions in timed relation with the relatively fixed mechanisms.

Fig. 2 illustrates a preferred design of structure wherewith the above explained filling and sealing

processes may be performed and also how the fixed and movable mechanisms for carrying out the various processing operations may be correlated and propelled from a common source.

In this embodiment of the invention, the machine is disclosed as having a base unit comprising essentially, a lower platform **20**, an upper platform **21**, rigidly connected by a plurality of columns **22**. The base unit supports a table unit comprising an ampoule supporting top S, a lower shelf **24**, both rigidly connected together as by means of risers **25** (see Figs. 4 and 5). The members S, **24**, and **25** together form a sturdy box-like table unit that is supported upon the base unit by means of a plurality of synchronized elevating jacks. Each jack comprises a revolvable threaded screw **30** journaled in the table unit and a cooperating threaded nut **31** fixed to the shelf **21** of the base unit. For convenience the jacks are positioned in concentric relation with preferably hollow supports **22** so that the screws may pass into the interior thereof and thereby provided with a certain degree of protection. The upper portion of each screw is rotatably but non-translatably journaled in bearings provided by the lower shelf **24** of the table unit and has fixedly mounted thereon a chain sprocket **33**. An endless chain **34** passes around and operatively engages each sprocket so that all jack screws move in unison. To rotate the jack screws, one screw is provided with a worm wheel gear **35** that is meshed by a worm **36**. The worm **36** is secured to a shaft **37** that extends to the front of the machine and carries a hand wheel **38**. When the hand wheel is manipulated the jack screws are revolved and the entire table structure is caused to be moved up or down according to the direction the hand wheel is operated.

Filling units

As illustrated most clearly in Figs. 3, 5, and 8, a portion of the base unit is caused to extend beyond the rear edge of the movable table structure and supports a filling machine transmission housing **40** and a filling machine column **41**. A multiple charge filling unit indicated generally at F is removably secured, as by screw means **43**, to a shelf **44** mounted to the front face of the column **41**. With reference more particularly to Figs. 7, 8, and 9, the filling unit F comprises a body member **42** which is bored and reamed to accommodate four independent measuring pumps. Fig. 9 is a sectional view of one of the pumps and which comprises a piston **42***a*, a cylinder **42***b*, intake valve **42***c*, intake port **42***d*, delivery port **42***e*, delivery valve **42***f*, and delivery nipple **42***g*. These elements lie in a single plane, and four such groups are contained in the body **42** in spaced apart relation as shown in Fig. 7. As the piston **42***a* is moved upwardly the liquid (from a source not shown) is caused to enter the measuring cylinder **42***b* through the port **42***d*, past intake valve **42***c*. Delivery valve **42***f* moves to closed position on the intake stroke. Precision control of quantity of preparation that enters the pump cylinder is determined by positively limiting the travel of the piston and this is controlled in the present instance by micrometer abutment means **45**, cooperatively related and individual to each pump unit. Briefly, the micrometer comprises a threaded spindle **45***a*, an internally threaded and exteriorly graduated barrel **45***b*, and a graduated sleeve **45***c*. The sleeve is secured to the spindle and its angular as well as its axial position on the barrel, as shown by the calibrations, fixes the limit of piston travel and so determines the pump displacement.

The pistons of the four pump units are conjointly operated by means of weighted slides **46** and a variable stroke producing system of levers and cams contained in the transmission housing **40**. A variable stroke mechanism similar to the one incorporated in the present machine is disclosed and explained in more detail in my copending application Serial #648,723, filed Feb. 19, 1946, now Patent No. 2,492,555 of Dec. 27, 1949, but as the present mechanism differs in important respects from the disclosure of that application, it will be described briefly herein. Each of the four pistons **42***a* of the multiple filling unit hangs upon a pin **42***h* projecting from a plunger **42***i* slidably mounted in the associated slide **46**. A spring **42***j* in each plunger bore normally urges the associated plunger **42***i* against a cap **46***a* that is fastened to its slide **46**. The lower ends of the four slides normally rest upon a yoke member **46***b* which in turn is connected by a connecting rod **47** to the free end of a pivoted lever **48**. The lever **48** is pivoted as at **49** to a fixed part **95** of the base frame and carries intermediate its ends a roller **50**. The roller **50** normally tracks a curved surface **51** formed upon an oscillatory and circumferentially movable lever **52**. One end of the lever **52** is pivoted at **53** to an angularly movable support **54** to which an operating handle and clamp **55** is secured. The free end of the lever **52** carries a roller **56** that is engaged by a somewhat heart shaped cam **57** mounted upon a cam shaft **58**. As the cam **57** revolves, the roller **56** is caused to rise and fall and to transmit that motion to the lever **48** to a varying degree depending upon the effective length lever arm of the surface **51** with relation to roller **50**. For example in the position illustrated in Fig. 7, a maximum stroke will be imparted to the slide **46**; but if the pivot **53** is swung clockwise into substantial coincidence with the center of the roll **50**, the rocking of lever **52** induced by the cam **57** will have no effect upon the roller **50** and the stroke of the slide will be zero. A stop **59** (Fig. 8) is provided on the lever **52** to limit the inward movement thereof to a position whereat the track portion **51** constitutes a portion of a cylinder. When so limited the slides **46** and yoke **46***b* will fall, by gravity to a definite point on each stroke and all variations in pump piston stroke are caused to occur at the upper end of slide movement, in accordance with the angular position of pivot point **53** of the lever **52**. The latter adjustment is effected by unclamping the handle **55** from the segment plate **60**, swinging the handle and bracket **54** over, and reclamping. Inasmuch as the micrometer abutments **45***a* positively limit the piston travel, they are to be first adjusted to the displacement capacity required and then the adjustment made the slide stroke by handle **55**, if the adjustment is to increase displacement; whereas if the adjustment is to decrease displacement, the handle **55** is first to be adjusted and then the micrometers **45**. To insure this sequence of operation an interlock is provided in the form of a rod **61** which has four yieldable extensions **62** at its upper end each of which engages the underside of a flange formed upon each micrometer sleeve. The lower end of the rod **61** is provided with a roller **61***a* that tracks a specially contoured cam surface **63** formed upon the adjustable bracket **54**. The curvature of the surface **63** is such that as the bracket is angu-

larly adjusted toward the maximum slide movement the interlock rod moves upwards, and as the bracket **54** is moved toward zero displacement the interlock rod moves downwards. The cam **63** is so contoured that the increment of interlock rod movement caused thereby is substantially in proportion to the increment of piston movement for the various displacement settings. The cam **57** and lever mechanisms **52**, **48**, etc. function to elevate the slides and move the several pistons of the filling unit on their intake stroke, and the overtravel of the slides relative to piston movement is absorbed by the springs **42***j* associated with each piston plunger **42***i*. The down travel of the slides and pistons is effected by gravity. However, if the slides and pistons are caused to descend at the rate prescribed by the contour of the cam **57**, the pistons will end their downward travel at a progressively diminishing rate, so much so that the liquid being expelled moves at a very slow rate at the end. This action tends to cause a drop to adhere to the filling needles *f* which is a detriment and impairs sealing because of the wetting the stems of the ampoules. To overcome the drop formation it is proposed to allow the slides to fall of their own weight and to stop their travel suddenly as by having them come to rest upon the fixed abutment provided by the yoke **46***b*, which in turn is stopped by the ledge **64**. The ledge **64** not only relieves the cam mechanism of the load of overcoming slide inertia, but has the effect of stopping piston travel suddenly, and the flow through the filling needles *f* is cut off suddenly, so suddenly, in fact, that no drops adhere to the ends thereof.

Tube conveyor mechanism

The mechanism for bringing the tubes into filling position relative to the filling needles is disclosed more clearly in Figs. 2, 3, 4, 5, and 10, and comprises essentially an endless chain of links **70** that track driving and driven wheels **70***a* and **70***b* journaled in bearings provided in the movable frame **24**, **25**, S, etc. Each of the links **70** is formed with two outwardly directed V-shaped projections **71** that together form an intervening V-shaped cavity **72** and half cavities at each end. The half cavities of adjacent and aligned links also form a V-shaped cavity **72**. In the present embodiment, if the link pitch be taken as 2", the V-shaped cavities **72** will have a pitch of one inch. As illustrated in Fig. 3, only one of the straight runs of the conveyor is utilized to transport the tubes and this run is faced by a laterally adjustable wall **73** which together with the walls of the V-shaped cavities in the conveyor form, in effect, three-sided openings adapted to receive the tubes and to support them in an upright position. The "receptacles" so formed are composed in part by movable members **70** and in part by stationary walls **73** and S, the latter member being the table top which underlies the tubes and forms a track along which they are moved (see Figs. 5, 10 and 15). The conveyor is indexed intermittently by a Geneva mechanism designed to move the conveyor chain a distance of two links or four tubes on each index cycle. Fig. 4 illustrates the mechanisms which includes a Geneva star wheel **74** secured to the conveyor chain drive shaft **75**, a Geneva crank and locking segment **76** that is mounted upon a continuously rotating shaft **77**. The shaft **77** is designed to receive power from a speed reducing mechanism R carried by the adjustable shelf **24** (Figs. 1 and 4), through the medium of chain and sprocket elements indicated generally as **78**. The shaft **77** also drives the filling unit actuating cam shaft by means of a chain and sprocket drive **79** to vertical shaft **80**, bevel gear drive **81** to a cross shaft **82**, and chain and sprocket drive **83** to the cam shaft **58** on which the actuating cam **57** is secured. By so connecting the filling unit drive with the conveyor drive, the two cooperating trains are caused to be driven in proper phase relation, i. e. the filling units operate through one complete filling cycle for each indexing movement (four tubes) of the conveyor.

The stationary wall **73**, as hereinafter mentioned is laterally adjustable and normally is held in fixed position by thumb screws **73***b*. When larger diametered tubes are to be filled, the wall **77***b* is adjusted outwardly thereby to increase the capacity of the V-notches formed by the conveyor chain links. This adjustment is made for tube diameter and does not change tube pitch or spacing. Similar adjustments are made to other wall forming elements of the tube supports throughout the travel of tubes undergoing processing, and will be explained later.

The unfilled tubes are placed into the cavities in the conveyor during the periods of rest thereof. Thereafter they are indexed to a position underlying the tube centering means and the filling needles.

Tube centering means, Figs. 5, 10, and 11

After the tubes (or ampoules) leave the loading station they are brought to rest between pairs of neck centering jaws **80**, **81** and in registry with the filling needles *f*. The function of the centering jaws is to position the top of each individual ampoule in concentric relation with the filling needle. This is an important feature due to the fact that the stems of ampoules rarely are straight and the allowable tolerance between needle size and ampoule stem size is too small to allow for any appreciable variation. As illustrated in the drawings the centering device comprises a pair of centering jaws, individually operable, for each ampoule, and each pair of jaws respond, in accordance with the diameter of the ampoule then in position, to center it with the associated filling needle. With reference to Figs. 10 and 11, the centering jaws **80***x*, **81***x* in the instant embodiment, are arranged in a single bank totalling eight pairs, and are supported by a relatively fixed bracket **82***x* that is slidably mounted upon a shaft **83***x* projecting from the filling machine column **41**. The centering jaws are two-ended and pivotally mounted on rods **84**. Each jaw is formed with an inwardly curved ampoule engaging portion that is further formed with a centrally located V-shaped notch **80***a* (Fig. 11.) The pairs of jaws are spring pressed to open position as the ampoules are indexed into position, after which the jaws close with the stems of the ampoules in opposed V notches of the respective pairs of jaws. The closing of the jaws is occasioned by a weighted member **85** associated with each pair of jaws. Each of the members **85** is mounted upon a shaft **86** which is adapted for vertical movement in bearings provided in the bracket **82***x*. The weighted members extend forward and each is formed with two faces **85***a* and **85***b* positioned as to cooperate with rolls **86***a* and **86***b* carried at the opposite ends of the jaw members **80***x*, **81***x*. The lower ends of the jaws **80** and **81** are normally

spring pressed apart by means of compression springs 87 contained in recesses provided in the respective members. The other ends of the springs abut against the sides of the channel shaped member 88 carried by the bracket 82x. When the weight 85 is elevated the rolls 86a and 86b move toward each other and the ampoule centering portions of the jaws 80x, 81x move away from each other, thereby releasing the ampoules and affording a clear channel through which they may pass. Each of the weights 85 is provided with its own stem 86 which normally rests upon a vertically movable cross head 89 that is mounted upon a rod 90. The rod 90 extends through the table top and its lower end rests upon the free end of a cam operated lever 91. The lever 91 is pivoted at its other end on a cross shaft 94 that is supported by front and rear bracket members 95 rising from the shelf 21. The lever 91 carries a roller 92 positioned to track a cam 93 mounted on the cam shaft 58. The cam shaft 58 accordingly operates the filling units as hereinbefore explained, and also operates the ampoule centering jaws in timed relation. The cam 93 is contoured to provide a high portion (which lifts lever 91, bar 90, crosshead 89, and weights 85) and a low portion (which permits those elements to lower). However by means of the independency of the weights and pairs of jaws 80x, 81x, each centering assembly functions (in a closing direction) independently of the others, and therefore each ampoule is properly centered notwithstanding variations in size of adjacent ampoules.

With reference to Figs. 2 and 11, eight such centering assemblies have been illustrated, the first four of which are adapted to center ampoules with relation to four filling needles *f* which if desired may be connected to a gas injection apparatus (not shown) and the second four with filling needles *f* that are connected to receive measured quantities of preparation from the filling units F.

The filling needles *f* are carried by a vertically movable crosshead member 100 that extends over and is aligned with the V pockets in the conveyor chain. Crosshead 100 is drilled and tapped to receive the hub end of the tubular needles *f* and the communicating hose nipples 101. Hose connections 102 connect the filling needles with the respective filling units F as will be understood. The needle bar 100 is mounted to a second bar 103 that is secured to a vertically movable rod 104. The rod extends below the table top and normally rests upon the free end of a lever 105. Lever 105 is also pivoted on the aforementioned shaft 94 and carries a roller 106 positioned to track a needle raising and lowering cam 107. The cam 107 is also mounted upon the cam shaft 58 and accordingly actuates the filling needles in timed relation with the operation of the filling units and the ampoule centering devices. The cam 107 is formed with high and low portions adapted to raise and lower the needle bar 100 so as to cause the needles *f* to enter, hold, and leave the ampoules between periods of movement of the ampoule conveyor. As will be seen from the drawings the needle bar is lifted by the cam 107 and is permitted to descend by gravity, and the extent of its descent is adjustably controlled by a manually adjusted stop 110. The stop 110 may be of any suitable form and is herein disclosed as a slotted bar having an inturned end adapted to form an abutment against which the bar 103 may stop. The abutment bar 110 is adapted to be clamped to the bracket 82x by a collar screw 111.

Normally the supporting bracket 82 occupies a fixed position such that the centers of the ampoule centering jaws are in alignment with the axial centers of the ampoules. When larger or smaller diametered ampoules are to be filled, the axial centers thereof move out or in as the case may be, and the centering devices, filling needles, and their actuating means must move out or in accordingly. To accomplish that end the supporting bracket 82x is arranged for sliding movement, out or in, on its support 83x. Actuating rods 90 and 104 are guided in a bushing plate 112 whose marginal edges are fitted to guideways 113 formed in the upper surface of the conveyor chain cover 114. A post 115 rising from the bushing plate 112 is telescoped by the bracket 82 and functions to lock bracket 82x and bushing plate 112 against relative shifting and yet affords convenient means permitting those two members to move toward and away from each other in accordance with the raising and lowering movement of the table S, when resetting the machine for a different length tube or ampoule. Bushing plate 112 is adjustably secured to the conveyor cover 114 by means of collar screw and slot devices 116. The conveyor cover is, of course, secured to the table top S by suitable screws.

Container transfer mechanism

The conveyor is indexed intermittently by the mechanisms previously explained, and between indexings the ampoules are centered, the needles enter the necks thereof, a predetermined quantity of liquid is injected therein, the needles leave the tubes and the centering jaws open. The next indexing movement moves the filled tubes in groups of four into an accumulating mechanism AC wherein they are thereafter transferred and placed singly upon the carrier of a sealing machine.

The accumulator and transfer mechanism is illustrated more clearly in Figs. 3, 12, 18, and 19 and comprises a tongue element 120 formed with a beveled end that projects into a slot 70x formed in the side of each of the conveyor links. The leading edge of the tongue is inclined away from the conveyor links and functions to cam the filled tubes out of the V-notches as the conveyor indexes (Fig. 12). At this delivery region of the conveyor, the ampoule retaining outer wall is formed by an independently laterally adjustable guide fence 121 whose ampoule engaging face is preferably equipped with a leaf spring 122. The spring 122 functions to apply pressure on the leading ampoule as it is delivered from the conveyor and keeps it and those following standing upright in the channel 123 formed between the faces of the tongue 120 and fence member 121. Fig. 3 illustrates a group of four filled and delivered ampoules standing in the channel at the time the conveyor indexing stops. Immediately thereafter the four ampoules are advanced along the channel toward the sealing machine by a cam operated pusher 124. The pusher 124 is a bifurcated arm which straddles the fence member 121 and is mounted upon the free end of a lever 125. Lever 125 underlies the table and is pivotally supported, as at 126, to a supporting post 127 that extends between the top S and the shelf 24. A roller 128 carried by the lever 125 is positioned to be engaged by a continuously rotating cam 129 mounted upon the shaft 77. The cam 129 is formed with a high portion 129e

and a series of successively decreasing low portions 129a, b, c, and d. The lever 125 is urged in a clockwise direction (Fig. 18) by the cam, and in a counter-clockwise direction by means of a chain and weight device 130, the pull of which is calibrated to exert force sufficient to move the ampoules along the channel without crushing effects. With the parts in the position illustrated in Figs. 3 and 18 a further movement of the cam 129 in the direction of the arrow permits the lever 125, and its pusher fork to engage and advance the tubes along the channel 123. The advancing movement stops momentarily while the roller tracks portion 129a of the cam, then continues and again is stopped by portion 129b. This intermittent ampoule pushing action continues as portions 129c and 129d are reached, after which the lever is retracted by the high portion 129e of the cam. The purpose of the intermittent pushing action is to provide the necessary time, without excessive pressure to transfer the tubes one by one to the sealing machine. As the pusher member is retracted, four additional tubes will be entering the channel from the conveyor, and so that the pusher does not strike them on its retracting movement a switching pawl 131 underlying the table functions to swing the pusher arm outward until its end has passed the last ampoule. The pawl 131 is arranged to allow the passing of a roller 132 behind it (Fig. 19) when the pusher moves to the right, and in front of it when the pusher moves towards the left. The roller 132 is carried by a lever 133 fast upon the pusher shaft 134, and is adapted normally to track a straight edge track 135 mounted under the table S. A tension spring 136 normally maintains that relation. As the roller moves along the track 135 it engages and lifts the curved end 131a of the pawl 131 and the latter snaps behind it under the action of another tension spring 131b. On the return movement of the pusher the roller 132 is caused to engage the outer side of the pawl and causes the arms 133 and 124 to swing outward, both arms being fast on the shaft 134.

Fig. 12 illustrates a preferred form of accumulator-to-sealer transfer mechanism. This mechanism includes a continuously driven disc element 140 which is removably mounted upon a shaft 141. The shaft 141 is journaled in a bearing member 142 and carries a spur gear 143 at its lower end. Gear 143 is constantly meshed by another gear 144 which in turn is driven by a chain and sprocket drive 145 from the aforementioned shaft 77. The sprocket and gear ratios are such as to give four revolutions to the disc 140 for each one revolution of the shaft 77. Each revolution of shaft 77 through the crank and Geneva mechanism 74, 76, brings four filled tubes into the channel 123, and to remove them singly, four turns of the disc 140 in the same time interval are required.

The disc 140 is adapted for interchange with others of different sizes and comprises a member having a medial peripheral flange 140a which is notched out as at 140b to form a hook portion adapted to engage with the tubes. The flange 140a revolves in a slot formed in the bearing member 142 and in the tongue member 120 and engages the sides of successive tubes standing in the channel 123 medially of their ends. The pusher arm member 124 advances the tubes along the channel 123 until the leading tube is resting against the hub 140c of the disc 140. As the disc turns, the hooked portion 140b engages the back of the tube and propels it laterally out of the channel 123. A spring tensioned circular guard 145 positioned outside the disc 140 forms a retaining wall and keeps the tube standing upright. The guard 145 is pivoted at 146 to the fence member 121, and a spring 147 housed in the fence tensions the guard toward the disc 140, so that the ampoule is not only confined to an arcuate path in an upright position but with such yielding pressure as to compensate automatically for variations in ampoule diameter. When the machine is readjusted for tubes of a different diameter, the fence 121 and its curved shoe 145, is adjusted outwardly (or inwardly) as needed, by loosening a collar screw 121b and adjusting the fence base 121a along guides 121c formed in the table top (Fig. 3).

Sealing machine

Each ampoule on completion of its travel or sweep along the inside of the curved guard 145 is delivered to and received by a traveling tube support of the sealing machine. The sealing machine comprises a rotary table 150 to which a series of equally spaced pairs of rollers 151 are mounted near its periphery on adjustable pads 150x. The rollers of each pair are in double tiers so as to form an annular groove or space 152 within which the hooked flange of the disc 140 may periodically dive. A guard ring 154, made up of fixed and yielding sections 154a, 154b respectively, extends around the table 150 and forms a relatively stationary outer wall to the V-shaped pocket formed by the outer portions of each of the pairs of rolls 150. The rolls 150 are mounted for free rotation on radially adjustable supports 150x, as disclosed more clearly in my copending application Serial No. 755,932 filed June 20, 1947, now Patent 2,500,522 of March 14, 1950. In certain respects the sealing machine herein disclosed is similar to the machine of the said application, but as there are critical differences, such parts that are of particular significance in the present invention, will be explained in detail.

The rotary table 150 is mounted on a carrier 156 which depends and is keyed or otherwise secured to a hub extension 157 of a worm wheel gear 158 journaled in bearings provided in the reduction housing R. Reduction housing R is secured to the movable shelf 24 and raises and lowers therewith. Power to rotate the worm wheel gear 158 is received from a worm 159 mounted upon a cross shaft 160. Shaft 160 extends to the front of the machine and carries a handwheel 161 by which the machine may be turned over by hand. The shaft 160 also carries a second worm gear 162 that meshes with a gear 163 mounted on a stub shaft 164. This shaft 164 extends to the under side of the shelf 24 and has pinned thereto one of the chain sprockets of the drive 78 over to the Geneva crank shaft 77. Rotation of the sealing machine table is by the foregoing mechanisms maintained in proper phase relation with the conveyor indexing means, filling means, and with the tube transfer mechanisms.

The main drive shaft 160 extends further rearward and has keyed thereto a clutch disc 165. A spring 166 normally urges the disc 165 into driving relation with a driving pulley 167 carried loose on the shaft 160. A clutch operating lever 168 is pivoted intermediate its ends to the shelf plate 24, and one end of the lever forks a groove formed in the clutch disc 165. The other end is

connected by means of a bar 169 to a operating handle 170 located at the front of the machine. The handle 170 is pivoted in a fixed bracket 172 and is formed with a eccentric portion 173 adapted to abut the end of the bar 169. By moving the handle about its pivot 170a the bar 169 is caused to move endwise and brings about the actuation of the power clutch. Rotary motion of the sealing machine table and of the conveyor, filling, and transfer mechanisms by power is thus brought under convenient control of the operator.

As indicated in Figs. 2 and 4, the clutch pulley 167 is driven by belt 167a from a pulley 175 mounted upon a jack shaft 176 which in turn is mounted in a supporting bracket 177. The bracket 177 is secured to the fixed shelf 21. Pulley 175 is fixed to a pulley 178 that receives power from a motor 180 mounted to the base 20 after an appropriate speed reduction conveniently afforded by the pulleys 181 of an air pump 182. The air pump 182 furnishes supplementary air for combustion to the burners of the sealing machine in known manner. A motor control switch SW at the front of the machine is provided to control the operation of the motor.

As before indicated the jack shaft bracket 177 is mounted to the fixed shelf 21 and extends through a slot 177a formed in the movable shelf 24 whereby to position the axis of shaft 176 substantially in horizontal alignment with the main shaft 160 that it drives. The shaft 160 moves vertically with the table S and shelf 24 but the V belt drive 167a between pulleys 167 and 175 is maintained effective and is self accommodating to the slight change in center distance incident to the vertical movement of the table S relative to the jack shaft 176.

Burners

Figs. 2, 3, 4, and 5, illustrate more clearly the sealing machine burners, upper grippers, and their actuating means. There are eight burners and gripper assemblies in the machine of this invention and as all are alike a brief description of one will, it is believed, suffice.

Each burner comprises a bracket 200 mounted on a guide post 202 that is vertically movable in a bearing 201 carried by the rotary table 150. The outer portion of the bracket 200 provides a shelf for adjustably supporting one or more burner heads 203. The inner portion of the bracket carries a roller 204 positioned to track a normally fixed burner raising and lowering cam 205. The cam 205 is angularly adjustable on a shelf 206 so that the heating period on a run of tubes may be varied.

Upper grippers

Aligned with each burner 203 and pair of roll supports 151, is a gripper assembly operable to grip the waste end of a tube and to draw it off at the proper time in the sealing operation. Each gripper assembly (of which there are also eight) comprises a bracket 210 adjustably secured to a vertically movable rod 211. Each rod is guided in a bushing 212 in the rotary table 150 and carries a roller 213 at its lower end., The roller 213 is positioned to track circular gripper raising and lowering cams 214, 215 that are mounted in a supporting ring 216 which in turn is suspended from the fixed shelf 21 by means of a plurality of posts 217. The posts extend through openings 218 provided in the movable shelf 24. The stationary raising and lowering cams, operate it will be seen, to raise and lower the grippers in succession, each through a fixed distance. I have found 1½ inches of gripper lift to be adequate for the drawing off operation on any of a wide range of tubes, presupposing of course, that the tubes are sufficiently heated and the glass softened to the required extent before stretching occurs.

Referring more particularly to Figs. 5, 6, 13, 14, each of the gripper supports 210 has a pair of inwardly directed gripper jaws 220 pivoted as at 221 to the outer end thereof and at opposite sides of a medial line. Each jaw is also formed with a laterally extending arm 222 that is connected by a link 223 to the outer end of a weighted actuator 224. The actuators are mounted for vertical movement on rods 211 and carry at their inner sides rollers 225 designed to engage fixed arcuate cams 226 and 227 in the course of their orbital travel with the table 150 around a central fixed post 150a. Cam 226 is a waste release cam having inclined leading and trailing sides. As the gripper roll 225 engages the cam, it is elevated relative to the gripper rod 211 and the support 210, which relative movement through the link connections 223 with the gripper jaws 220, open the gripper jaws 220 (dotted line position Fig. 13) and the drawn off waste end of the container is released. At that region of the orbital travel of the gripper a chute 228 (Fig. 1) is provided to catch the waste tip and conduct it away from the machine.

Further rotary motion of the table 150 brings each gripper assembly to the ampoule receiving station (Fig. 3). During this portion of the travel, the gripper assemblies remain in elevated position by reason of gripper rod rolls 213 continuing to track the "high" portion of the cams 214 and 215. The ampoule or tube being delivered into the V-notch between table rollers 151 enters the pocket freely and is at once carried along with the table. After a reasonable period of tube heating by the related burner 203 the gripper rod roller rides down the cam 215 (Fig. 4). This lowering action of the rod lowers the gripper weight 224 until its roller 225 rests upon the fixed cam 227. Further lowering of the rod 211 relative to the weight 224 again effects an opening of the gripper jaws. Cam 227 is formed on its trailing side with a descending portion that substantially corresponds in shape with cam 215 but is "late" in its effect upon the weight 224 so that the gripper assembly continues its descent with the jaws open to receive the upper end of the ampoule. Further rotation of the table brings the gripper weight roll 225 to a position where it falls off cam 227 and the weight 224 thereupon drops. Dropping of the weight 224 with gripper parts 211, 210 stationary effects the reverse action on the jaw members 220 and they close on the tube. This closing is caused to occur preferably at or about the time the gripper roll 213 reaches elevating cam 214, after which, the gripper assembly is caused to elevate and draw off the waste end of the tube.

With reference more particularly to Figs. 5, 6, 13 and 14, it will be observed that the gripper jaws are relatively wide with straight tube engaging ends, and are so positioned that their parallel ends lie in planes radial of the carrier 150. Such radial disposition of the jaws conforms with the radial adjustability of the table rollers 151 so that as the V-notch of the rollers is moved inwardly, to accommodate a larger diametered tube (dotted lines Figs. 6 and 14) the upper end of the tube or ampoule will always be within the width of the gripper jaws and be gripped thereby. A

gripper so constructed is self-adjusting not only with respect to diameter of the tube but also with respect to the axial location of the tube in the supporting receptacle.

The gripper rods 211 are maintained in vertical parallelism at their upper ends by a spider-like bushing member 240 that is fastened to a gas distributing valve head 241. The valve head 241 centers on a cone 242 normally fixed but angularly adjustable on the central post 150a. Gas and air enter the top of the cone through valves 243 and as the head 241 revolves thereabout the fuel is directed in increased and decreased amounts to the respective burner heads 203 through separate tubes 244. This gas distributing valve functions to increase the intensity of the burner flame during the heating and softening period of the tube travel and to decrease the flame on completion of the sealing operation, in a manner similar to that set forth in my prior Patent #2,379,343. Gripper rods 211, which extend through the table 150 and rotate therewith serve to drive the spider 240, and the spider in turn drives the valve head 241. Supplementary supporting and spider drive rods may be provided if desired.

In the sealing operations heretofore mentioned the timing of the actions of the burners, burner flames, gripper opening, closing, drawing, and releasing actions and their phase relation with other coordinating elements are determined by the various cams and once their relative positions are properly set to suit the nature of the seal desired they remain fixed, and the only adjustment ordinarily necessary to effect seals on a selected run of ampoules is that of flame intensity or temperature, the time factor (period of travel of the tube in the flame) remains unaltered.

Delivery

As the tubes are carried around by the table 150 their outer peripheries are in engagement with the spring tensioned sectional rim 154. The latter is made up of a series of arcuate sections 154a each guided by limiting pins 251 and each pressed toward the table by a garter spring 252. The delivery region is located approximately 300 degrees away from the receiving station, and at this region the table is bounded by a fixed rim section 154b that extends longitudinally away from the rotary table. Opposite the straight portion 253 of rim member 154b a delivery tongue element 254 is positioned. The inner end of the tongue is narrowed down to fit within an annular slot 150s in the table 150, and also within the annular slot in the rolls 151, and functions as a slanted wall lying in the path of travel of the tubes. When the tubes reach the tongue they are cammed out of the V between the rolls 151, and are left standing upright in the channel 255 formed between the members 253 and 254. The tongue member 254 is yieldingly supported in a base plate 256 and the latter is adjustably mounted to the table top. When the larger tubes are to be sealed the base is adjusted laterally so as to widen the receiving channel 255.

It will be observed that the table top S underlies the tubes at the loading station (Fig. 3), at the gassing and filling stations (Fig. 10), at the transfer station (Fig. 12), all around the sealing machine table 150, and also at the delivery region, and forms a continuous track on which the bottoms of the ampoules or tubes rest throughout the course of their travel. And the raising or lowering of the table is but a single adjustment that adapts all of the filling and sealing instrumentalities at once to a different length of tube.

Blank detecting mechanism

Another important feature of the invention resides in the provision of means operative to detect the presence or absence of a tube in the conveyor and to control the action of the related filling head in accordance. A preferred mechanism for accomplishing that purpose is disclosed more particularly in Fig. 15 and includes a series of U-shaped fingers 260, each of which has one leg pivotally mounted as at 261 at the underside of the table S to a depending portion of a combined guide fence and finger housing 73a. One of the fingers is aligned with each tube receiving notch of the conveyor when the latter is in a position of rest under the filling needles. The presence of a tube in the conveyor limits the movement of the free end of the U-shaped finger. Each finger is connected at the region of its bend to a link 262 and the latter is also connected to one arm of a bell crank lever 263. Link 262 is arranged to extend substantially vertically so that the lateral movement of the guide fence and finger carrier 73a in changing over to a different diametered tube, has little effect upon the position or operation of the free end of the fingers 260. Bell crank 263 is fixedly pivoted as at 264 to a table mounted bracket 265, and its other end is pivoted to the end of a rod 266 that extends across the machine toward the filling unit column. At the column end of the rod 266 a pusher pawl 267 is connected. The pawl 267 is pivoted as at 268 on a shaft that is supported in arms 269. Arms 269 depend from and are part of a guard member 270. A pull spring 271 connected with the pawl 267 and a stationary part of the table S is tensioned normally to swing the upper end of the pawl 267 and also the detector finger 260 counterclockwise (as viewed in Fig. 15). If a tube is present in the conveyor chain before the finger 260, movement of the finger and pawl does not occur, but in the absence of a tube, the force of spring 271 causes the pawl to swing and the finger 260 to dive into the empty tube notch in the conveyor.

As illustrated in Figs. 8, 15, and 16, the face of each of the filling unit slides 46 and their common yoke 46b is formed with a series of transversely extending rack teeth 46t spaced so as to be cooperatively related with slide holding pawls 272. One pawl 272 is associated with each of the slides 46, and all of the pawls are pivoted at their lower ends at 273 to an L-shaped bracket 274 that is supported upon the housing 40 under column 41. The rear side 272a of each pawl is machined so as to lie in a vertical plane when the rack engaging end of the pawl is disengaged and standing clear of the rack teeth, for the reason that the pawl 272 is fixed in space and the pusher pawl is vertically movable with the up and down movement of the table S. In all positions of the table the pusher pawl will have its effect upon the associated slide locking pawl. The locking pawls are normally urged out of engagement with the rack teeth 46t by means of compression springs 275 pocketed behind each.

The detector fingers are withdrawn from the notches in the conveyor immediately prior to an indexing movement thereof by means of a cam 276 secured to the bevel pinion shaft 80 (Figs.

5 and 17). The cam is formed with concentric high and low portions that are tracked by a roller 277 mounted on a lever 278. Lever 278 is pivoted at 279 to the under side of the table S and its free end is forked as at 280 and is operatively connected to a hooked slide bar 281. One end of the bar 281 carries an angle piece 282 whose upstanding edge engages collars 283 on the rods 266. Bevel gear shaft 80 is chain driven from the Geneva crank shaft 77 which indexes the conveyor and hence moves in timed relation therewith. And by correctly positioning the detector finger withdrawal cam 276 on the shaft 80, the slide bar 281 may be caused to retract and simultaneously retract the four rods 266. Each rod 266 connects with a separate detector finger and all four fingers are moved away from the V-notches in the conveyor prior to indexing thereof. When indexing of the conveyor is completed the cam 276 will have turned to present a low portion to the roller 278 and the detector rods are free to advance under the action of their respective springs 271. If all of the conveyor cavities are filled with tubes, the detector fingers are held out by the tubes themselves, but if any conveyor cavity is not filled by a tube, the detector finger related thereto moves in. Through the linkages 262, 263, and 266, the pusher pawl is caused to move against locking pawl 272 and the latter is pressed into the rack 46*t* on the filling unit slide. In the instant embodiment there are four filling unit slides each with its own latching and tube detecting connections, and each filling unit is caused to suspend its filling operation quite independently of the others. So irrespective of the number of blank cavities appearing under the filling needles, only those containing tubes will be filled and the remaining filling units held out of operation until the next cycle. In the embodiment shown, the filling units F operate to take in a measured quantity of preparation on an upstroke of the slides 46 and to discharge that quantity into the tubes on a down stroke of the slides, and the conveyor and slide actions are so coordinated that indexing of the tubes is completed just prior to completion of slide movement in a pump intake direction. Accordingly, if a blank space occurs in the conveyor under a needle, the related detector finger functions to operate the pusher pawl 267 and locking pawl 272 whereby the affected filling unit slide is held in its "up" position for the remainder of the cycle, and no discharge from that particular filling unit and needle occurs.

Needle block safety

Occasionally in a run of ampoules or tubes a few will be found to be badly bent but which will, nevertheless, be placed unnoticed in the conveyor notches. In the case of a badly deformed tube or ampoule the jaws of the centering device CD may be unable to pull the neck of the ampoule into concentric relation with the axis of the filling needle. Also, an ampoule may be encountered having an unusually small opening in its stem. In either case, the descent of one or more of the filling needles may be blocked and the preparation discharged promiscuously. To avoid such action and waste the present invention proposes means for suspending pump discharge in the event the needles fail to enter the containers. Figs. 4, 8, and 15, illustrate a preferred form of means for this purpose which comprises devices responsive to the vertical motion of the needle bar 104 and connected to actuate a slide lock.

The slide yoke member 46*b* is formed with rack teeth 46*t* across its front face (Fig. 16) which are adapted when necessary to be engaged by a pair of pawls 290. Pawls 290 are pivoted intermediate their ends to the shaft 273 outside of the four slide pawls 272. The lower ends of the pawls 290 are connected together by a cross bar 291 which in turn is medially connected with an actuating rod 292. Rod 292 extends forward and is pivoted to one end of a bell crank lever 293 that is pivotally supported on a bar 294 projecting from a bracket 295 on the stationary housing 40. The other arm of lever 293 carries a roller 296 positioned so as to be engaged and rocked laterally by a cam 297 mounted upon the needle actuating shaft 104. In the position of the parts illustrated in Figs. 4 and 15 the needle actuating shaft is in its downward position and the cam 297 thereon has moved the bell crank lever 293 in a counter-clockwise direction (Fig. 4). When so actuated the connection 292 functions to rock the pawl 290 clockwise (Fig. 15) and its upper end is moved clear of the rack teeth 46*t* on the yoke member 46*b*. As the needle actuating shaft is elevated to its upper position the cam 297 moves beyond the roller 296 and the latter swings partially under the cam. This movement of roller 297 effects the opposite action of the latching pawl 290 and the later moves in and engages with the rack teeth 46*t*. This engagement is not positive but under the control of a tension spring 298 connected between bell-crank lever 293 and the fixed bracket 295, so that upward movement of the slides and slide yoke is not hindered. It will be recognized that if for some reason, as for example, a defective tube in the conveyor, one or more of the filling needles have their descent obstructed, the needle bar 104 will not be lowered, and accordingly the cam 297 will not actuate the roller 296 and the locking pawls 290 will remain inter-locked with the rack teeth 46*t* of the yoke 46*b* and none of the slides 46 will move downward on their discharge strokes. By so holding the slides up, no harm is done to the slide actuating mechanism because lever 48 and its roll 50 merely are hung up and suspended and the cam shoe 52 falls away. Thus the filling action stops automatically when necessary but the transferring of filled tubes and the sealing operations on the filled tubes continue. On the next conveyor index movement the defective tube or tubes are passed along unfilled, and needle lowering cycle, filling cycle, etc. are automatically re-instituted where they left off on the preceding cycle. Assuming, of course, that the next bank of tubes positioned under the needles contain no deformities as to interfere with needle lowering.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various utilizations by retaining one or more of the features that, from the standpoint of the prior art, fairly constitute essential characteristics of either the generic or specific aspects of this invention and, therefore, such adaptations should be, and are intended to be, comprehended within the meaning and range of equivalency of the following claims.

Having thus revealed this invention, I claim as new and desire to secure the following combina-

tions and elements, or equivalents thereof, by Letters Patent of the United States:

1. A combined tube filling and sealing machine having tube filling means and relatively movable tube sealing means combining a tube support common to said filling means and to said sealing means, means operative to move a tube along said support to a tube filling station and to hold a tube at said station during the filling operation, means operative to move the tube further along said support away from said filling station and into tube sealing relation with said relatively movable tube sealing means, said sealing means including a movable burner, means operative to move the tube along said support in phase relation with said movable burner for a sufficient period of time to effect sealing of the tube, and means thereafter operative to move the tube along said support away from the burner at the completion of the formation of the seal.

2. The combination set forth in claim 1 in which said tube support is mounted for vertical movement relative to the tube filling and tube sealing means, and means operative to adjust said support vertically whereby to adapt same to a tube of a given length.

3. A tube filling and sealing machine combining a main frame unit, an auxiliary frame unit mounted thereto for vertical movement, relatively stationary tube filling and tube sealing means supported by said main frame, means operative to move a tube in upstanding position along said auxiliary frame unit from a loading station to a filling station before said filling means, thence into sealing relation with the sealing means, and thence to a tube delivery station, and means for adjusting said auxiliary support along which the tube is moved relative to said tube filling and tube sealing means whereby to adjust the machine to a selected length of tube to be filled and sealed.

4. A machine of the character described combining means to fill a tube, power means operatively connected to said filling means for effecting cyclic actuation thereof, tube transporting means for supporting tubes to be filled and operative to move the tubes from a loading station cyclically to a position in filling relation with said filling means, power means for actuating said transporting means in phase relation with the operation of said filling means, and blank detecting means cooperatively associated with said transporting means and with said filling means operative to detect a blank in said transporting means and to effect suspension of the actuation of said filling means in the absence of a tube from the transporting means.

5. A machine for filling and sealing tubes combining means to fill a tube, power means operatively connected to said filling means and with said sealing means for actuating same in phase relation, tube transporting means for supporting tubes to be filled and operative to move the tubes from a loading station cyclically to a position in filling relation with said filling means and thereafter to a position in sealing relation with the sealing means, power means for actuating said transporting means in phase relation with the operation of said filling and sealing means, and blank detecting means cooperatively associated with said transporting means and with said filling means operative to effect suspension of the actuation of said filling means when the supporting means is unfilled with a tube and to continue said sealing means in operation to effect sealing of the previously filled tube.

6. A combined tube filling and tube sealing machine comprising a fixed support, tube filling means supported by said fixed support, tube sealing means including a burner also supported by said fixed support, a vertically movable tube-support mounted to said fixed support and normally occupying a position cooperatively related to said fixed filling and sealing means, means to move a tube along said movable support into filling position relative to said filling means and thereafter into tube sealing position relative to said sealing means, and means for adjusting the location and said movable tube support relative to said filling and sealing means to position the open end of a tube of a selected length in proper relation simultaneously with said tube filling and tube sealing means.

7. A machine for filling tubes or ampoules or like containers in groups with a preparation combining a plurality of filling units, means normally effective to actuate said units in unison, means for transporting a group of tubes from a loading station to a position in filling relation with said filling units, said transporting means being operative to position one container of the group into filling relation with each of the filling units, means normally effective in the absence of containers on said transporting means to suspend operation of said filling units, and means individually responsive to the presence of containers in filling relation with the respective filling units to render the respective filling units effective to fill those containers.

8. A machine for filling tubes or ampoules or like containers in groups with a preparation combining a plurality of filling units, means normally effective to operate said units in unison whereby normally to effect simultaneous filling of a group of containers placed in filling relation therewith, means for transporting tubes to be filled in groups from a loading station to a position in filling relation with said filling units, said supporting means being operative to position one container of the group into filling relation with one of the filling units, means sensitive to the presence of containers on said transporting means to render operation of said filling units effective, and additional means responsive to the presence of a defective container in filling relation with the filling units to render the operation of the filling units ineffective.

9. The combination set forth in claim 8 wherein said means sensitive to the presence of containers is constructed and arranged to suspend the filling operation of one or more of said filling units in the event that one or more tubes are absent from the transporting means.

10. A tube filling machine comprising tube filling means including a filling needle normally operative to deliver a quantity of the preparation to be packaged into the tube to be filled, tube holding means for supporting the lower end of a tube and for positioning the said lower end in registry with said filling needle, additional means aligned with said tube holding means and operative on said tube to position the upper end thereof in registry with the said filling needle, means for adjusting said tube holding means relative to the said additional means whereby to accommodate a tube of a specified length in the machine, means connected to operate said filling means, and means in part movable with and operative in all positions of adjustment of said supporting means and responsive to the presence of

a tube therein to render the operation of said filling means effective.

11. The combination set forth in claim 10 including means operative normally to effect a telescoping of the tube and filling needle prior to the filling operation, and additional means operative on failure of the tube and needle to telescope one another to suspend the action of said filling means.

12. A machine for filling a multiplicity of tubes simultaneously with a preparation combining tube filling means embodying a series of filling spouts adapted normally to be projected into and withdrawn from the tubes in the course of the filling operation, means for positioning a group of containers to be filled in filling relation with said spouts, and means operative on failure of one or more of said spouts to enter its associated tube to render said filling means ineffective.

13. A machine for filling tubes with a preparation combining a tube filling means embodying a filling spout adapted normally to be projected into and withdrawn from the tube in the course of the filling operation, means normally operative to actuate said filling spout, means for positioning a container to be filled in filling relation with said spout, means common to said filling spout actuating means and to said container positioning means to actuate said two means in phase relation, means responsive to the presence of a tube in filling relation with the said spout for rendering said filling means effective, and additional means operative thereafter and on failure of said spout to enter the said tube to render said filling means ineffective.

14. A container filling and sealing machine combining a stationary filling unit, conveyor means adapted to transport a tube to be filled into filling position relative to said filling unit and thereafter to a position away from the filling unit, means including a tongue member operative to remove the filled tube from the conveyor subsequent to the filling thereof; tube sealing means including a tube support, and a burner cooperatively associated therewith, and means adjacent said tongue member constructed and arranged to transfer the filled tube to the tube support of the sealing means in cooperative relation with the sealing machine burner for sealing, and means adjacent the sealing machine constructed and arranged to remove the tube from the support of the sealing machine after completing the sealing thereof.

15. A combined tube filling and sealing machine comprising means to support a tube to be filled and sealed, said means including in part laterally movable walled elements positioned as to form an open-sided notch, and in part a relatively stationary wall element constructed and related to said laterally movable walled elements as to form a third wall to said notch, and in part a second relatively stationary element constructed and related to the aforesaid elements as to form a bottom to said walled notch, relatively stationary tube filling means aligned with said tube supporting means, tube sealing means aligned with said tube supporting means, and means to actuate said tube supporting means whereby to transport a tube to be filled along said second mentioned stationary element from a loading station to a position in registry with said filling means and thereafter to a position in registry with said sealing means.

16. The combination set forth in claim 15 including means mounting said means to support a tube for adjustment bodily in a direction transverse the path of lateral movement of said laterally movable elements, and means operably connected with said means to support a tube to effect an adjustment thereof in said transverse direction.

17. The combination set forth in claim 15 in which the means to support a tube is constructed and adapted for intermittent movement with respect to said tube filling means.

18. The combination set forth in claim 15 in which said sealing means is constructed for continuous movement relative to said filling means and in which said tube supporting means is constructed and adapted for intermittent movement with respect to said filling means and for continuous movement in phase with said sealing means.

19. A combined tube filling and sealing machine embodying stationary tube filling means and relatively movable tube sealing means combining, a tube track, means operative to move a tube along said track to a tube filling station and to hold a tube at said station during the filling operation, means operative to further move the tube along said track into tube sealing relation with said movable tube sealing means, and means operative to move the tube along said track in phase relation with the tube sealing means for a sufficient period of time to effect sealing of the tube.

20. The combination set forth in claim 19 in which said tube track is mounted for vertical movement relative to the said tube filling and tube sealing means, and means to adjust said track whereby to adapt the machine to a tube of a given length.

21. The combination set forth in claim 19 in which the said means operative to move a tube along the track is constructed and adapted for intermittent movement with respect to said tube filling means and for continuous movement in phase with said sealing means, and means interposed between said filling means and said sealing means for receiving the filled tubes intermittently and for transferring the filled tubes singly and successively to the said sealing means.

22. A tube filling and sealing apparatus combining a plurality of tube filling units arranged to deliver fluid into tubes to be filled and operative normally in unison, tube conveyor means juxtaposed to said filling units, means for actuating said conveyor means intermittently whereby to move a group of tubes from a loading station to positions in operative filling relation with said filling units and for holding the tubes in said positions until filled and thereafter to a position away from said filling units, receiving means for the filled tubes operative to remove the tubes in groups from the conveyor, movable tube sealing means adjacent said receiving means, including individual tube supports and a tube heater associated with each support, and means operative to transfer the tubes from said group receiving means to the supports of said sealing means singly and in succession, means for actuating the said filling units intermittently and said movable sealing means continuously in phase relation with the movement of said conveyor and said means operative to transfer tubes.

23. A tube filling and sealing apparatus combining a plurality of tube filling units embodying discharge spouts arranged to deliver fluid into tubes to be filled and operative normally in unison, tube conveyor means juxtaposed to the dis-

charge spouts of said filling units, means for actuating said conveyor means intermittently whereby to move a group of tubes from a loading station to positions in operative filling relation with said discharge spouts and for holding the tubes in said positions until filled and thereafter to a position away from said spouts, tube centering means at said filling station operative intermittently to center the open ends of the respective tubes with the respective discharge spouts of said filling units, and means responsive to the presence of tubes in filling relation with said spouts operative to render the respective filling units effective, and additional means operative on the failure of one or more tubes to center with its associated spout to render said filling units ineffective.

24. A combined tube filling and sealing machine including in combination a first tube carrier, a second tube carrier, means for actuating said first carrier intermittently, means for actuating said second carrier continuously, tube supports in each of said carriers, and transfer means interposed between the two carriers operative to effect transfer of tubes from one of the carriers to the other.

25. The combination set forth in claim 24 in which the transfer means is constructed to receive tubes in groups of two or more and to release the tubes singly and in succession to the other carrier.

26. The method of filling glass tubes in groups and heat sealing the tubes individually which comprises placing the tubes to be filled on a track in uniformally spaced relation, indexing the tubes along the track a distance equalling the spacing of a group of two or more tubes to position whereat the individual tubes of the group are brought into registry with individual spouts of a group of two or more similarly spaced filling spouts and holding the group of tubes in said position until they are filled, moving the filled tubes as a group along the track away from the group of filling spouts to a station adjacent tube sealing means and simultaneously presenting a succeeding group of empty tubes to the spouts, then moving the filled tubes continuously along the track individually and in succession and heat sealing the open end of each tube of the group within the time period allotted for the filling and indexing cycle.

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