Nov. 2, 1965 V. R. SHELLMAN ETAL 3,214,831

PIPETTE DE-STUFFER

Filed Nov. 12, 1963 3 Sheets-Sheet 1

Fig. 1

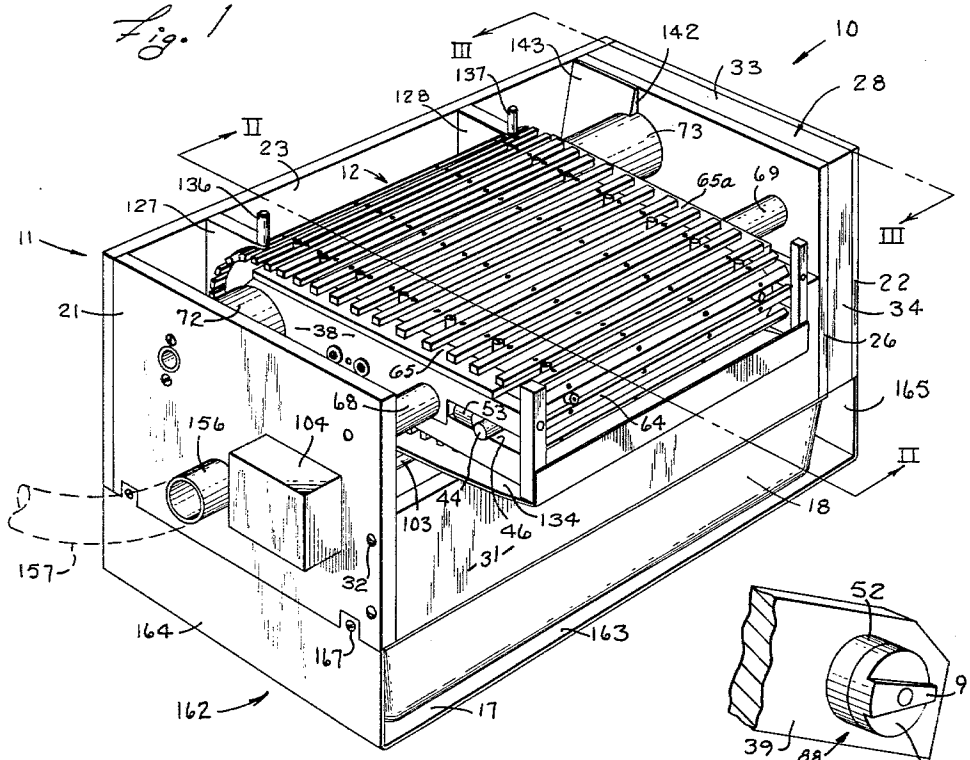

Fig. 11

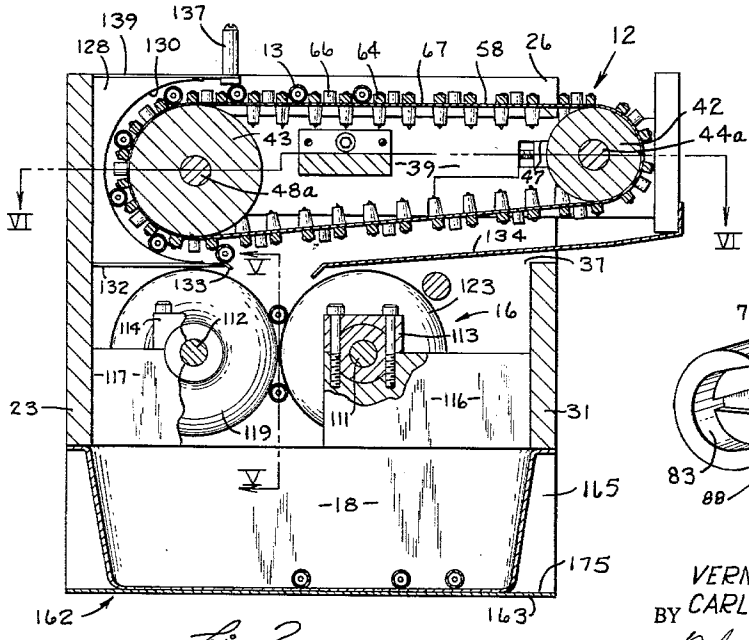

Fig. 2

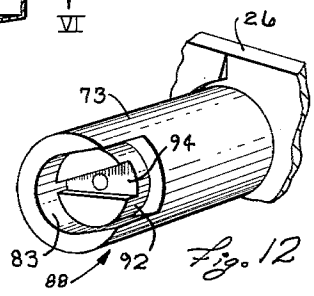

Fig. 12

INVENTORS
VERNELL R. SHELLMAN
BY CARL J. VELEY
Robert C. Woodbams
ATTORNEY

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PIPETTE DE-STUFFER

Filed Nov. 12, 1963 3 Sheets-Sheet 2

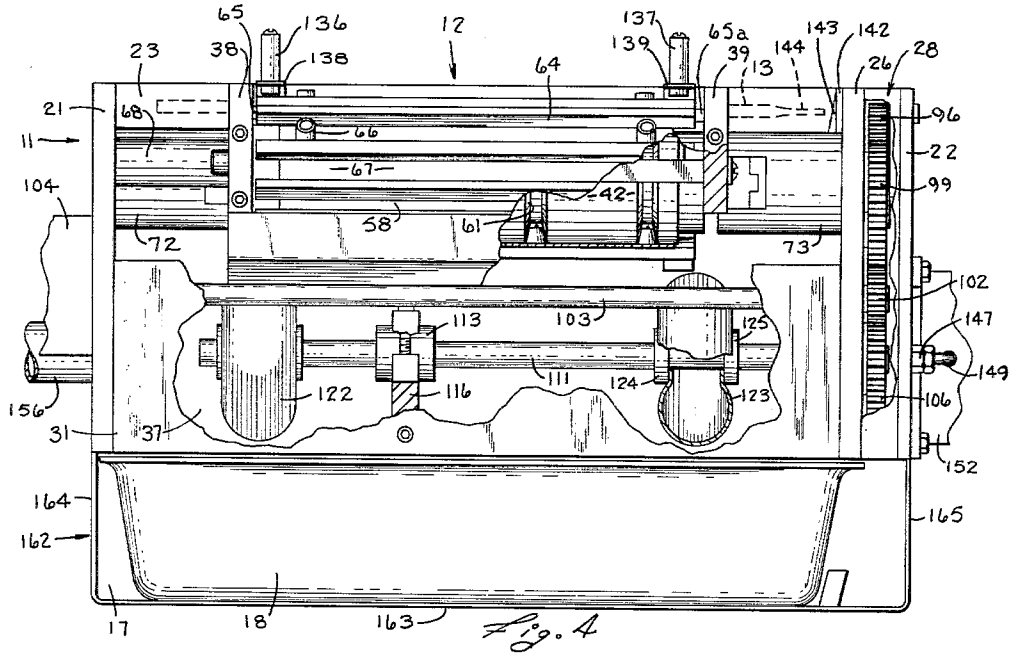

Fig. 4

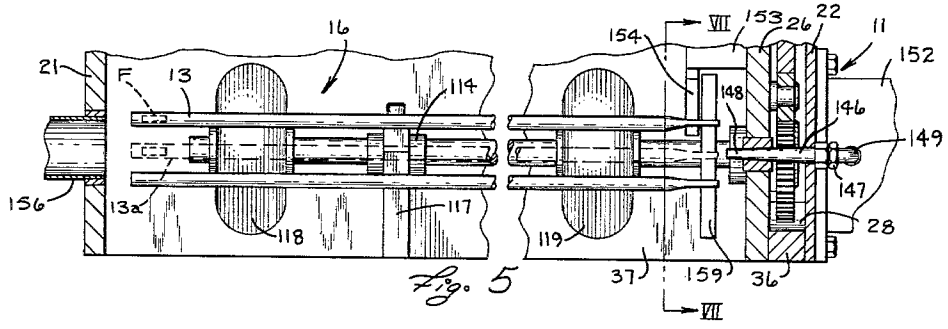

Fig. 5

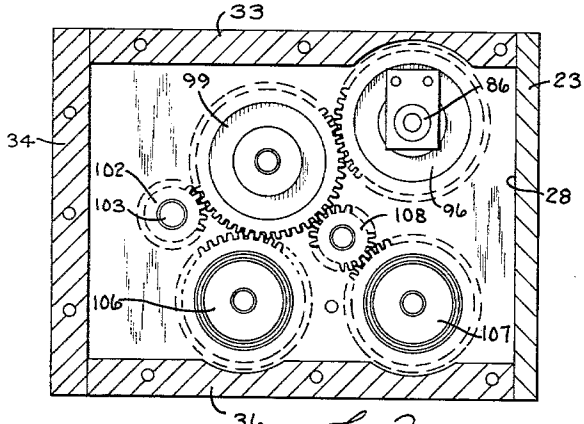

Fig. 3

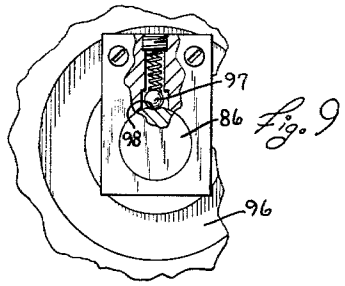

Fig. 9

INVENTORS
VERNELL R. SHELLMAN
BY CARL J. VELEY
Robert E. Woodhams
ATTORNEY

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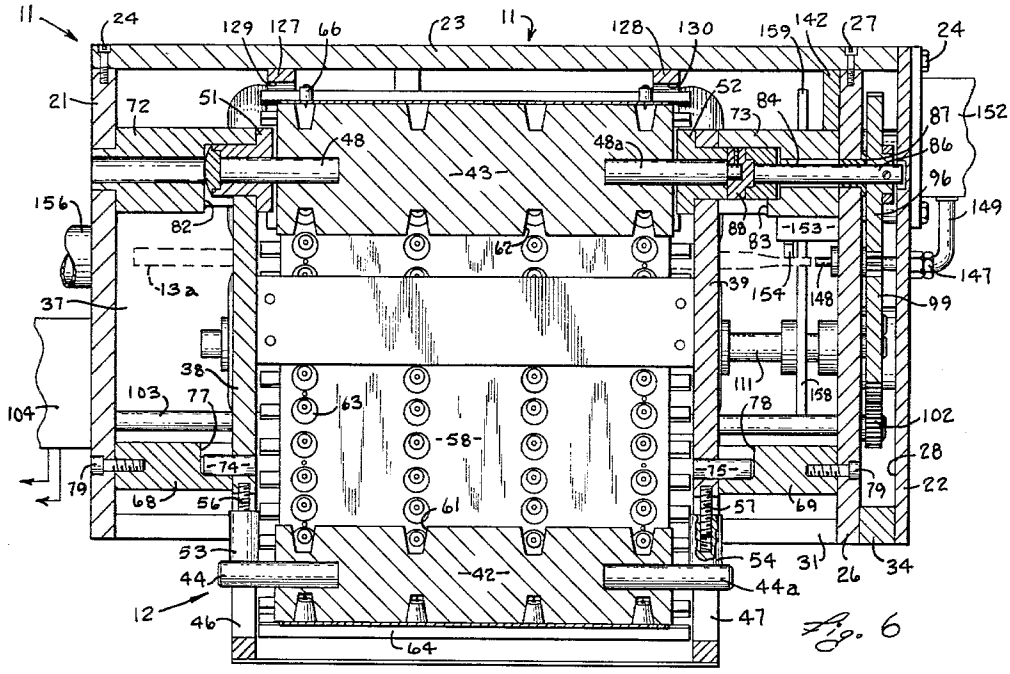

Fig. 6

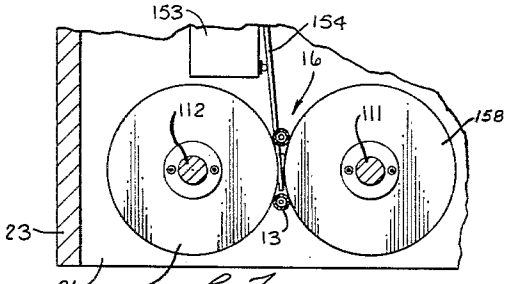

Fig. 7

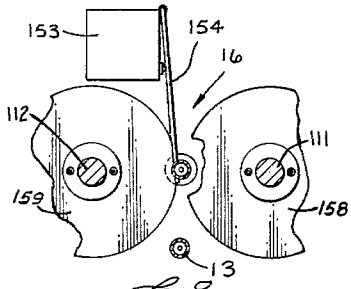

Fig. 8

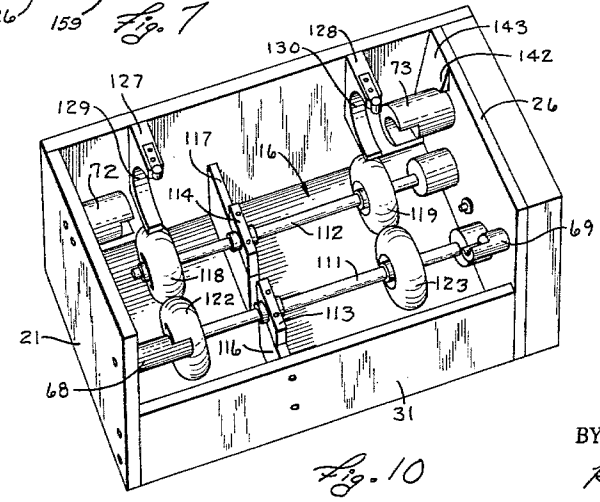

Fig. 10

INVENTORS
VERNELL R. SHELLMAN
BY CARL J. VELEY
Robert C. Woodhams
ATTORNEY

United States Patent Office 3,214,831 Patented Nov. 2, 1965

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PIPETTE DE-STUFFER

Vernell R. Shellman, Kalamazoo, and Carl J. Veley, Richland, Mich., assignors to The Upjohn Company, Kalamazoo, Mich., a corporation of Delaware

Filed Nov. 12, 1963, Ser. No. 322,890
10 Claims. (Cl. 29—427)

This invention relates in general to a machine for removing a removable obstruction from within an elongated tube and, more particularly, to a machine for removing the filter plug from within each mouthpiece end of a plurality of pipettes each having a restricted orifice at the other end thereof.

It is well known that large quantities of pipettes are used in certain fields, particularly by chemists, biologists, chemical engineers and their laboratory assistants, in conducting tests, in carrying out research and development projects and sometimes in production work. For example, large quantities of pipettes are used to conduct experiments during the development and testing of medicines and other pharmaceuticals. Obviously, the instruments used in conducting tests with medicines and similar products must be completely sanitary and often sterile. Thus, each pipette must be thoroughly cleaned after each use if it is to be reused.

Where large numbers of pipettes are used by a single entity or by a related group of entitles, such as a large research complex, it is not uncommon to have a separate but associated department for cleaning pipettes and other similar instruments which are used in all of the various research departments of the complex.

It is customary to stuff the mouthpiece end of each clean pipette with a filter material, such as a cotton plug, to protect the research worker who uses the pipette and to minimize contamination of the interior of the pipette. That is, the cotton filter placed in the mouthpiece end of the pipette minimizes the chance that the material in the pipette will be drawn into the mouth of the worker who is operating the pipette. Moreover, and at the same time, the cotton filter minimizes the chance of contaminating the chemical which is drawn into and expelled from the pipette by the research worker.

A machine for stuffing a cotton filter plug into a pipette has been developed and is disclosed in patent application Serial No. 141,840, which is assigned to the assignee of this application. However, insofar as I am aware, no machine has been developed for the purpose of automatically removing the filter plug from each of the pipettes after the pipettes have been used.

The removal of the cotton or other filter plugs from pipettes, after they have been used, has been troublesome and time-consuming. Previously, the filter plug has been removed either by an instrument, which is inserted into the pipette, or by directing a stream of fluid under considerable pressure into one end of the pipette so that the plug is discharged thereby from the other end of the pipette. To the extent that this latter procedure is presently in use, it is conducted manually on a one-at-a-time basis. That is, each pipette must be manually engaged and placed in position with respect to the stream of pressure fluid so that the discharge of the filter plug therefrom can be effected in a controlled manner. This procedure has become tedious, often messy, and also increasingly costly.

Accordingly, a primary object of this invention has been the provision of a machine for automatically removing from an elongated tube a removable obstruction therein.

A further object of this invention has been the provision of a machine, as aforesaid, for automatically and quickly removing a filter plug from the mouthpiece end

of a plurality of pipettes without creating a messy condition.

A further object of this invention is to provide greater safety for the operating personnel by enclosing the plug removing operation so that the personnel are protected from injury by a weakened pipette which may explode when the pressure fluid is applied to the pipette to remove the plug.

A further object of this invention has been the provision of a machine, as aforesaid, which is capable of handling at the same time a plurality of pipettes of various cross sectional dimensions, which is relatively small and compact in size, which can be operated easily by any person capable of removing the filter plugs from pipettes according to existing procedures for this purpose, and which is completely automatic in its operation after the pipettes have been placed therein.

A further object of this invention has been the provision of a machine, as aforesaid, which is relatively inexpensive to produce, which is extremely inexpensive to operate, which is assembled from components that can be quickly and easily separated from each other for the purpose of cleaning the machine, and which requires little or no maintenance.

Other objects and purposes of this invention will become apparent to persons familiar with this type of equipment upon reading the following descriptive material and examining the accompanying drawings, in which:

FIGURE 1 is a perspective view of a machine embodying the invention.

FIGURE 2 is a sectional view taken along the line II—II in FIGURE 1.

FIGURE 3 is a sectional view taken along the line III—III in FIGURE 1.

FIGURE 4 is a broken, front elevational view of said machine.

FIGURE 5 is a sectional view taken along the line V—V in FIGURE 2.

FIGURE 6 is a sectional view taken along the line VI—VI in FIGURE 2.

FIGURE 7 is a sectional view taken along the line VII—VII in FIGURE 5.

FIGURE 8 is a fragment of FIGURE 7 showing a portion thereof in a different position of operation.

FIGURE 9 is an enlarged, broken fragment of FIGURE 3.

FIGURE 10 is a perspective view of the frame structure of the machine with the conveyor unit and the subframe removed.

FIGURE 11 is a perspective fragment of the conveyor unit showing the driven half of the coupling connected to the conveyor.

FIGURE 12 is a broken perspective fragment of the frame structure of the machine disclosing the driving half of the coupling which is connected to the conveyor.

For the purpose of convenience in description, the terms "upper," "lower" and words of similar import will have reference to the machine of the invention as appearing in FIGURES 1 and 2. The terms "front," "rear" and words of similar import will have reference to the right and left sides, respectively, of the machine as appearing in FIGURE 2. The terms "inner," "outer" and derivatives thereof will have reference to the geometric center of said machine and parts thereof.

General description

The objects and purposes of the invention, including those set forth above, have been met by providing a machine having a removable conveyor unit by which a plurality of pipettes, for example, having various diameters can be held in parallel spaced relationship and continuously advanced along a path toward a position at which the

filter plug in each pipette is removed therefrom. A positioning mechansim within the machine receives the pipettes from said conveyor unit and moves them, one at a time, into and out of the discharge position.

Guide means directs a stream of fluid under pressure into the machine so that the stream can enter the constricted end of a pipette in said discharge position, and thereby eject the filter plug from the mouthpiece end of said pipette. The flow of pressure fluid through the guide means is controlled by a device responsive to the movement of the pipette into and out of the discharge position. Drive mechanism simultaneously operates the conveyor and the positioning mechanism in predetermined and cooperating relationship.

Detailed construction

The machine **10** (FIGURES 1 and 4), which illustrates a preferred embodiment of this invention, is comprised of a frame structure **11** which removably supports a conveyor unit **12** for receiving a plurality of elongated tubes, such as the pipettes **13**, and for advancing them in uniform spaced relationship toward a discharge position **13***a* (FIGURE 5). The filter plugs F in the ends of pipettes **13** may be formed of cotton roving. A positioning mechanism **16**, also mounted upon and within the frame structure **11**, receives the pipettes **13**, one at a time, from the conveyor unit **12** and moves them through said discharge position **13***a*. The frame structure **11** includes a compartment **17** (FIGURES 1 and 4).

The frame structure **10** (FIGURES 1 and 4), which is preferably substantially rectangular, includes a pair of parallel side walls **21** and **22**, which are connected near one edge of each to the opposite ends of the rear wall **23** by the screws **24** (FIGURE 6). A partition **26**, which is preferably of about the same size and shape as the left side wall **22**, is secured along one edge thereof to the rear wall **23** by means of the screws **27** so that said partition is near to, spaced from and parallel with said right side wall **22** to define therebetween a gear box **28**.

The front edge portions of the partition **26** and the left side wall **21** are secured to opposite ends of a front wall **31** by the screws **32**. Said front wall **31** extends from the lower edges of the left side wall **21** and partition **26** upwardly about half way toward the upper edges of said partition and side wall.

The gear box **28** has a top wall **33**, front wall **34** and bottom wall **36** (FIGURE 3), which extend between the partition **26** and the right side wall **22**. The rear wall of the gear box is provided by the rightward end of the rear wall **23** of the frame structure. The right side wall **22** is mounted upon the top wall **33**, front wall **34** and bottom wall **36** of the gear box **28** so that the right side wall can be removed easily and quickly to examine the contents of the gear box **28**. The front wall **31**, the left side wall **21**, the partition **26** and the portion of the rear wall **23** extending between the side wall **21** and the partition **26** define the pipette handling compartment **37**, which is open at the upper and lower ends thereof, in this particular embodiment. The various parts of the frame structure **11** and conveyor **12**, except the belt **58**, are preferably fabricated from metal, such as stainless steel and/or aluminum.

The conveyor unit **12** (FIGURES 1 and 2) is disposed within the upper portion of the handling compartment **37** so that said conveyor extends from adjacent the rear wall **23** over, and frontwardly of, the front wall **31**. The frontward extension of said conveyor **12** can be varied to increase or decrease the pipette holding capacity of the conveyor. The conveyor **12** includes a pair of substantially parallel and coextensive side plates **38** and **39** upon and between which the front roller **42** and rear roller **43** are rotatably supported in spaced parallel relationship. The front roller **42** has stub shafts **44** and **44***a*, which are rotatably and adjustably supported in the horizontal slots **46** and **47**, respectively, in the front ends of the side plates **38** and **39**, respectively. The rear roller **43** has stub shafts **48** and **48***a* which are rotatably supported in the bearings **51** and **52**, respectively, which are mounted in the rearward ends of the side plates **38** and **39**, respectively.

A pair of cylindrical adjustment blocks **53** and **54** (FIGURE 6) are held in the slots **46** and **47**, respectively, by the screws **56** and **57** on the rearward side of, and for engagement with, the stub shafts **44** and **44***a*. By appropriate rotation of the blocks **53** and **54**, the roller **42** can be moved horizontally with respect to the roller **43**, whereby the tension on the conveyor belt **58**, which encircles said rollers, can be varied.

The rollers **42** and **43** (FIGURE 6) have a plurality of similar and radially aligned grooves **61** and **62**, respectively, for receiving rows of guide elements **63** which are mounted along the inner surface of the belt **58** for positively preventing movement of the belt axially of said rollers during the movement of the belt around said rollers. A plurality of elongated spacing elements **64**, such as stainless steel or plastic bars, are secured upon the outer surface of the belt **58** in spaced and parallel relationship. Bridge members **66** may be secured to the upper surface of the belt between selected ones of said spacing elements **64** to control the spacing and number of grooves **67** defined by said spacing elements **64** into which the pipettes **13** may be received. The width of each groove **67** is sufficient to accommodate pipettes of various sizes within a reasonable range. The belt **58** may be fabricated from a flexible and somewhat resilient sheet material, such as plastic or a resin impregnated cloth.

It will be seen that the rows of elements **63** could be replaced by spaced, parallel ridges, which are integral with the inner surface of, and project inwardly from the belt **58**. Likewise, the spacing elements **64** and bridge members **66** could be integral, outward projections on said belt **58**.

A pair of guide strips **65** and **65***a* (FIGURES 1 and 4) are mounted respectively upon the upper edges of the side plates **38** and **39** for supporting and guiding the lateral edges of the upper reach of the belt **58**.

Two pair of similar, coaxial support posts **68**, **69** and **72**, **73** (FIGURE 6) are mounted upon and substantially between the left side wall **21** and partition **26** for the purpose of removably supporting the conveyor unit **12**. A pair of substantially coaxial support pins **74** and **75** are secured to and extend in opposite directions away from the side plates **38** and **39**, respectively, near to but spaced from the front ends thereof. The front support posts **68** and **69** are rigidly secured to the side wall **21** and the partition **26**, respectively, by the screws **79**. The adjacent ends of the front support posts **68** and **69** have notches **77** and **78**, respectively, which open inwardly, rearwardly and upwardly for reception and removable support of the support pins **74** and **75**, respectively, to support the front end of the conveyor unit **12**.

The adjacent ends of the rear support posts **72** and **73** have slots **82** and **83** (FIGURE 6) which open inwardly and frontwardly. The bearings **51** and **52** project through and beyond the outer surfaces of the side plates **38** and **39**, respectively, for snug slidable reception into the slots **82** and **83**, respectively.

The support post **73** (FIGURE 12) has a central shaft opening **84** (FIGURE 6) which communicates between the slot **83** and the interior of the gear box **28**. A shaft **86** is coaxially held within the shaft opening **84** by a bearing **87** so that the shaft **86** extends between the gear box **28** and the slot **83**. A coupling **88** is secured to and connected between the inner end of the shaft **86** and the outer end of the shaft **48***a* which extends into the slot **83** beyond the end of the bearing **52**.

The coupling **88**, which includes a driven part **89** (FIGURE 11) and driving part **92** (FIGURE 12) is rotatably disposed within the slot **83** (FIGURE 6) when the conveyor unit **12** is in its operating position. The driven part **89** of said coupling has a wedge-shaped pro-

jection **93** on its outer axial end, and the driving part **92** has a diametrically tapered slot **94** into which the projection **93** can be slidably and snugly received for effecting a sliding connection between the driven and driving parts.

A conveyor driving gear **96** (FIGURE 3) is supported upon the outer end of the shaft **86**. A spring-backed ball **97** (FIGURE 9) is supported upon the gear **96** for reception into a recess **98** in the shaft **86** for the purpose of effecting a quick release connection between the gear **96** and the shaft **86**. The conveyor driving gear **96** (FIGURE 3) is engaged and driven through an idler gear **99** which is in turn engaged and driven by the drive gear **102**, both of which are disposed within the gear box **28**. The idler gear **99** is rotatably supported upon the partition **26**, and the drive gear **102** is connected to one end of the drive shaft **103** which extends completely through the handling compartment **37** where it is connected at its other end to the drive motor **104**, which is supported upon the side wall **21**.

A pair of positioning gears **106** and **107** are rotatably supported within the gear box **28** approximately directly below the large idler gear **99** and the conveyor gear **96**, respectively. The said positioning gear **106** is engaged and driven by the large idler gear **99**. A small, reverse idler gear **108** is rotatably supported within the gear box **28** between the large idler **99** and the positioning gear **107** so that it is engaged with both gears. Thus, rotation of the idler gear **99** causes the positioning gears **106** and **107** to rotate in opposite rotational directions.

The gears **106** and **107** are mounted upon corresponding ends of the spaced and parallel positioning shafts **111** and **112** (FIGURES 2 and 10), which extend into and substantially through the handling compartment **37**. The positioning shafts **111** and **112** are supported within the handling compartment **37** by bearings **113** and **114** which are supported upon the front wall **31** and rear wall **23** by the bearing supports **116** and **117**, respectively.

A pair of similar, resiliently flexible wheels **118** and **119** (FIGURES 5 and 10) are coaxially mounted upon the rear positioning shaft **112** on opposite sides of the bearing support **117**. A pair of wheels **122** and **123** (FIGURES 4 and 10), which are preferably similar to the wheels **118** and **119**, are mounted upon and rotatable with the front positioning shaft **111** so that said wheels **122** and **123** are adjacent to and radially aligned with the wheels **118** and **119**, respectively. In this particular embodiment, the wheels **118** and **119** and **122** and **123** are fabricated from resiliently flexible sheet material, such as rubber or plastic, which is shaped to form a hollow, self-supporting annulus, like a tire. Each of the wheels is held in position upon its corresponding shaft by a pair of set collars **124** and **125**, removably secured to said shaft on opposite sides of each wheel.

In this particular embodiment, all four of the wheels **118**, **119**, **122** and **123**, are substantially identical and are spaced downwardly from the lowermost point of the conveyor belt **58** a distance somewhat greater than the diameter of the largest pipette **13** which can be handled by the conveyor unit **12**.

A pair of fixed guides **127** and **128** (FIGURES 1 and 6) are mounted upon the rear wall **23** adjacent the upper edge thereof and adjacent the opposite lateral edges of the belt **58**. Said guides **127** and **128** (FIGURE 10) have semicircular recesses **129** and **130** in their frontward faces which are concentric with the axis of the rear roller **43** (FIGURE 2) and shaped from the outer surface of said belt **58** a distance slightly greater than the largest pipette **13** which the belt **58** is capable of handling. The lower extremities of the recesses **129** and **130** are preferably disposed directly above and a slight distance from the upper portions of the rear wheels **118** and **119**. The gearing in the gear box **28** is arranged so that the wheels **118** and **119**, as appearing in FIGURE 2 rotate in a clockwise direction, and the wheels **122** and **123** rotate in a counterclockwise direction.

A guide plate **132** (FIGURE 2), which is secured to the lower edges of the guides **127** and **128**, extends from the rear wall **23** to a line forwardly of the guides **127** and **128**. Said guide plate **132** has a downwardly extending flange **133** along its frontward edge to guide the movement of pipettes by the conveyor belt **58** from said plate **132** into the positioning mechanism **16**. This arrangement tends to insure movement of the pipettes from the conveyor unit **12** into the nip of the wheels **118**, **119**, **122** and **123** in a position, as shown in FIGURES 2 and 5, which is parallel with the axes of said wheels.

A splash plate **134** (FIGURE 2) is mounted at its frontward end upon the front ends of the side plates **38** and **39** from which it extends rearwardly beneath the conveyor belt **58**, over the top of the front wall **31** and to a line above and close to the rearward sides of the wheels **122** and **123**.

The rearward edge of the splash plate **134** is also flanged downwardly.

A pair of stops **136** and **137** (FIGURE 1) are supported upon and forwardly of the guides **127** and **128** by means of the resilient elements **138** and **139** to obstruct the rearward movement of any pipettes which are not properly in a groove **67**. A wedge **142** is mounted upon the partition **26** between the rear wall **23** and the rearward roller **43** so that its exposed surface **143** diverges downwardly with respect to the adjacent surface of the partition **26**. The wedge **142** (FIGURE 4) is located so that the constricted end **144** of a pipette **13**, which is too close to the partition **26**, engages said surface **143** and moves such pipette a predetermined distance away from the partition **26**, for reasons appearing hereinafter.

As shown in FIGURE 5, a nozzle **146** extends through the side wall **22**, the gear box **28** and into the handling compartment **37** so that it is substantially coaxial with a pipette **13** held in the discharge position **13***a* by the wheels **118**, **119**, **122** and **123**, which are part of the positioning mechanism **16**. The nozzle **146** is mounted upon and held with respect to the frame structure **11** in a conventional manner. The discharge or inner end **148** of the nozzle **146** is spaced from the inner surface of the partition **26** a distance slightly less than the maximum thickness of the wedge **142** to prevent interference between the constricted ends **144** of the pipettes **13** and the inner end **148** of the nozzle **146**. The outer end of the nozzle **146** is connected by the coupling **147** to a pipe **149** which is connected to a substantially conventional solenoid valve **152**, which is in turn connected to a source of pressure fluid, not shown, such as compressed air.

A switch **153** (FIGURES 5 and 6) is mounted upon the partition **26** within the handling compartment **37** so that its actuator **154** extends downwardly adjacent the constricted end **144** of a pipette **13** being held by the positioning mechanism **16**. Said switch actuator **154** is engaged by each pipette, as it is moved downwardly by said position mechanism **16**, so that the switch **153** is closed by a pipette **13** disposed in the discharge position **13***a* (FIGURE 5). Closing of the switch **153** operates the solenoid valve **152** whereby pressure fluid is discharged through the nozzle **146** into the constricted end **144** of the pipette in the discharge position **13***a*. The pressure fluid drives the filter plug F out of the pipette through the mouthpiece end thereof. As soon as the pipette is moved out of the discharge position **13***a*, it becomes disengaged from the switch actuator **154**, whereby the switch **153** is opened and the flow of pressure fluid through the nozzle **146** is terminated by the solenoid valve **152**.

An exhaust pipe **156** is connected to and extends through the left side wall **21** (FIGURES 1 and 5) in a position substantially coaxial with the nozzle **146** and a

pipette in the discharge position 13*a* (FIGURE 5). The pipe **156** may be connected to a vacuum source, not shown, by means including the hose **157** (FIGURE 1). Thus, a plug F discharged by the pressure fluid from a pipette in the position 13*a* will ordinarily be directed into the pipe **156** and thereafter drawn away from the machine **10** by a pressure which is substantially less than ambient pressure.

A pair of guide disks **158** and **159** (FIGURES 6, 7 and 8) are mounted upon the positioning shafts **111** and **112**, respectively, near the partition **26** so that they engage and guide the constricted end **144** of each pipette **13** accurately into the discharge position 13*a* (FIGURE 5). The guide disks **158** and **159** are preferably fabricated from a resiliently flexible material, such as rubber, which is somewhat stiffer than the material contained in the wheels **118** and **119**, for example. Thus, the peripheral surfaces of the guide disks **158** and **159** which can be depressed by the pipettes **13** without breaking same, cause the ends **144** of said pipettes to move into and out of the desired position of alignment with the nozzle **146** as the pipettes **13** move through the discharge position 13*a*. Accordingly, the plug F will be discharged from each pipette, even though the pipette is moved through the discharge position 13*a* without being precisely coaxial with the nozzle **146**.

In this particular embodiment, the receptacle **18** is disposed in the lower compartment **17**, which is defined by a substantially channel-shaped subframe **162** (FIGURE 1) having a bottom plate **163** and a pair of side plates **164** and **165** which extend upwardly from said bottom plate and are secured to the side walls **21** and **22**, respectively, of the frame structure **11** by means of screws, such as those appearing at **167**. The receptacle **18** extends completely under the handling compartment **37** so that it not only receives all of the pipettes **13** which have passed through the discharge position 13*a*, but also receives any moisture which drops from the pipettes as they are moved by the conveyor **12** and the positioning mechanism **16**. The receptacle **18** can be slidably moved into and out of its position (FIGURES 2 and 4) in the compartment **17**.

Operation

The machine **10** is prepared for operation by placing a receptacle **18** within the lower compartment **17**, by connecting the solenoid valve **152** (FIGURE 5) to a suitable source of pressure fluid and by connecting the exhaust nipple **156** to a suitable source of suction pressure. The solenoid valve **152** may be electrically connected to the same source of electrical energy supplied to the drive motor **104**. A plurality of pipettes **13** is now placed upon the upper reach of the belt **58** and preferably within the grooves **67**. It is immaterial if one or more of the grooves **67** remain unfilled.

The belt **58** is moved by the gears in the gear box **28** at a relatively slow rate, such as about five to ten feet per minute. The pipettes are moved rearwardly by the belt **58**, then downwardly along the recessed surfaces **129** and **130** of the guides **127** and **128**, respectively, and thence frontwardly along the guide plate **132** until they pass over the flanged, front edge **133** of said plate **132**. The stops **136** and **137** obstruct the rearward movement of any pipette which is not properly within a groove **67**. The wedge **142** will engage any pipette which is too close to the partition **26** and move it leftwardly, as appearing in FIGURE 4.

If a pipette should become jammed in the guides **127** and **128**, for example, or if the normal movement of the belt **58** should in any other way be obstructed, the spring-backed ball **97** (FIGURE 9) will be urged out of the recess **98**. Thus, the gear **96** can rotate within the gear box **28** without rotating the shaft **103** and, therefore, without damaging the conveyor unit **12** or a pipette **13**.

Each pipette **13** is moved, one at a time, from the guide plate **132** into the nip between the wheels **118**, **119**, **122** and **123**, which then move each pipette **13** downwardly through the discharge position 13*a* (FIGURES 5 and 8) and into the receptacle **18**.

As shown in FIGURES 7 and 8, the switch actuator **154** is caused by the pipette **13** to close the switch **153** just before the pipette **13** arrives into the discharge position 13*a*. Said pipette **13** becomes disengaged from the switch actuator **154**, whereby the switch **153** is permitted to reopen shortly after the pipette moves away from the discharge position 13*a*.

As stated previously, closure of the switch **153** operates the solenoid valve **152** whereby pressure fluid is discharged at a high velocity through the nozzle **146** and into and through the pipette **13** in the discharge position 13*a*, whereby the filter plug F is discharged therefrom into the exhaust pipe **156**.

The foregoing operation may be continued indefinitely, it being necessary only to supply pipettes to the conveyor unit **12** and occasionally empty them from the receptacle **18**.

Although a particular preferred embodiment of the invention has been disclosed herein, it will be understood that variations or modifications of such disclosure, which come within the scope of the appended claims, are fully contemplated.

What is claimed is:

1. A machine for removing a removable obstruction from within an open ended tube, comprising:

a frame structure;

conveyor means mounted upon said frame structure for moving said tube into and out of a position for discharging the obstruction therefrom;

pressure fluid guide means mounted adjacent to said conveyor means and being located close to an end of a tube at said position, said guide means having a discharge opening which opens toward said position in a direction transverse to the direction of movement of the conveyor means, said discharge opening being aligned and substantially parallel with the lengthwise axis of a tube supported on said conveyor means at said position, and means connecting said guide means to a source of pressure fluid whereby a stream of pressure fluid can be directed lengthwise into and through a tube when it is in said position; and

control means responsive to movement of said tube into and out of said position for starting and stopping the flow of pressure fluid through said nozzle means.

2. A machine for removing a removable obstruction from within an open ended tube, comprising:

a frame structure;

conveyor means mounted upon said frame structure for receiving said tube and moving same into and out of a position for discharging the obstruction therefrom, said conveyor means including movable positioning means for firmly engaging a tube at said position and temporarily holding said tube in said position;

nozzle means mounted on said frame structure adjacent to said conveyor means in alignment with said position and extending close to an end of a tube at said position, said nozzle means having a discharge opening which opens toward said position in a direction transverse to the direction of movement of the conveyor means and substantially parallel with the lengthwise axis of a tube supported thereon at said position, and means connecting said nozzle means to a source of pressure fluid whereby a stream of pressure fluid can be directed lengthwise into and through a tube when it is in said position; and

control means responsive to movement of said tube into and out of said position for starting and stopping the flow of pressure fluid through said guide means.

3. A machine for removing a removable filter plug from within a pipette having a constriction at one end thereof, the combination comprising:

a frame structure;

conveyor means mounted upon said frame structure for receiving a plurality of pipettes and moving same in a direction transverse to the lengthwise axis thereof toward a position for discharging the plug therefrom;

movable positioning means for receiving said pipettes from said conveyor means and moving said pipettes in a direction transverse to the lengthwise axis thereof one at a time into and out of said position, said positioning means including means for holding said pipettes against movement while they are in said position;

nozzle means mounted on said frame structure adjacent to said positioning means in alignment with said position and extending close to an end of a pipette at said position, said nozzle means having a discharge opening which opens toward said position in a direction transverse to the direction of movement of the positioning means and substantially parallel with the lengthwise axis of a pipette supported thereon at said position, and means connecting said nozzle means to a source of pressure fluid whereby a stream of pressure fluid can be directed lengthwise into and through a pipette when it is in said position.

4. A machine for removing a removable filter plug from within a pipette having a constriction at one end thereof, the combination comprising:

a frame structure;

conveyor means mounted upon said frame structure for receiving a plurality of pipettes and moving same in a direction transverse to the lengthwise axis thereof toward a position for discharging the plug therefrom;

a pair of movable positioning means disposed adjacent to and facing each other for receiving and gripping therebetween pipettes from said conveyor means and moving said pipettes in a direction transverse to the lengthwise axis thereof one at a time into and out of said position, said positioning means holding said pipettes against movement with respect to said positioning means while they are in said position;

nozzle means mounted on said frame structure adjacent to said positioning means in alignment with said position and extending close to an end of a pipette at said position, said nozzle means having a discharge end opening which opens toward said position in a direction transverse to the direction of movement of the positioning means and substantially parallel with the lengthwise axis of a pipette supported thereon at said position, and means connecting said nozzle means to a source of pressure fluid whereby a stream of pressure fluid can be directed lengthwise into and through a pipette when it is in said position; and

control means responsive to movement of each pipette by said positioning means into said position for initiating the flow of pressure fluid through said nozzle means, said control means being responsive to movement of each pipette out of said position for terminating the flow of pressure fluid through said nozzle means.

5. A machine for removing removable filter plugs from within the mouthpiece end of a plurality of pipettes having constricted orifices at their other ends, comprising:

a substantially rectangular frame structure having a pair of spaced and parallel side walls;

an endless conveyor having substantially horizontal upper and lower reaches mounted upon and between said side walls for movement lengthwise thereof, said conveyor having a plurality of elements projecting from the outer surface thereof and defining a plurality of spaced and parallel grooves extending transversely of the direction of said movement for receiving said pipettes therein;

positioning means supported within and upon said frame structure beneath said lower reach for receiving said pipettes from said conveyor and moving said pipettes one at a time in uniform intervals into and out of a position substantially perpendicular to said side walls for discharging the filter means through the mouthpiece end thereof;

nozzle means mounted in the side wall adjacent the constricted ends of said pipettes and connectible to said source of pressure fluid for directing said pressure fluid into the constricted end of a pipette in said position, whereby the filter plug is ejected by the pressure fluid from the pipette through the mouthpiece end thereof;

control means operable by each pipette as it moves into said position for initiating the flow of pressure fluid through said nozzle means, and operable by said pipette as said pipette is moved out of said position and for terminating the flow of pressure fluid through said nozzle means; and

drive means mounted upon said frame structure and connected to said conveyor and said positioning means for actuating same.

6. A method for removing filter plugs from within the mouthpiece end of a plurality of pipettes each having a constriction at the other end thereof, the steps comprising:

placing a plurality of the pipettes in parallel, uniformly spaced positions defining a substantially horizontal plane with the constricted ends thereof extending in the same direction;

moving the constricted ends of said pipettes into lateral alignment with each other;

advancing said pipettes at a uniform speed along a path substantially perpendicular to said pipettes toward a discharge position;

moving said pipettes one at a time and at uniform intervals away from said path and into said discharge position;

directing a stream of pressure fluid into the constricted end of each pipette and lengthwise thereof while the pipette is in said position, so that the filter plug is ejected therefrom; and

moving each said pipette out of said position and into a collecting zone.

7. A machine for removing a removable filter plug from within a pipette, comprising:

a pair of rotatable, substantially parallel and horizontal shafts;

wheel means mounted on each of said shafts for rotation therewith, the wheel means on the respective shafts being radially aligned with each other and positioned so that the peripheral surfaces of said wheel means are movable substantially into contact with each other at a zone between said shafts, said peripheral surfaces being resilient whereby pipettes can be placed in the gap between said peripheral surfaces above said zone and then can be engaged thereby and moved downwardly through said zone and then drop downwardly away from said wheel means; and

fluid supply means mounted adjacent corresponding one ends of said shafts, said fluid supply means having a discharge opening axially aligned with and facing said zone for supplying a pressure fluid to one end of a pipette located in said zone for displacing the filter plug therefrom.

8. A machine according to claim 7, including conveyor means disposed above said shafts for supplying pipettes one at a time to said gap.

9. A machine for removing a removable filter plug from within a pipette, comprising:

a frame structure;

conveyor means mounted upon said frame structure,

said conveyor including means for supporting individual pipettes at spaced-apart points therealong for moving same in a direction transverse to the lengthwise axis thereof;

a pair of endless movable positioning elements disposed directly below said conveyor means, said positioning elements being disposed adjacent to each other and having downwardly movable surface portions facing each other, said surface portions being arranged to define an upwardly opening gap facing said conveyor whereby said pipettes can be dropped from said conveyor into said gap, said surface portions being disposed closer to each other at a zone below said gap to grip the pipettes therebetween and hold same against movement with respect to said positioning elements, said positioning elements then extending away from each other below said zone, then upwardly and thence back toward said gap;

nozzle means mounted on said frame structure adjacent one horizontal end of said zone, said nozzle means having a discharge opening extending between and transverse to the direction of movement of said positioning elements and substantially parallel with the lengthwise axis of a pipette disposed in said zone,

and means connecting said nozzle means to a source of pressure fluid whereby the pressure fluid can be directed lengthwise into and through a pipette when it is in said zone.

10. A machine according to claim **9**, in which said conveyor means is an endless, substantially horizontally disposed, pulley-supported belt conveyor having upper and lower reaches and having upstanding elements thereon for engaging the pipettes and moving them with said conveyor, the lower reach of said conveyor extending across the upper end of said gap and arcuate wall means extending part way around one of the pulleys and thence substantially to said gap whereby the pipettes move along said wall means and are deposited into said gap.

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WHITMORE A. WILTZ, *Primary Examiner.*

THOMAS H. EAGER, *Examiner.*