May 9, 1961 D. H. REESE ET AL 2,983,089

CAP FASTENING MACHINE

Filed Aug. 25, 1955 10 Sheets-Sheet 1

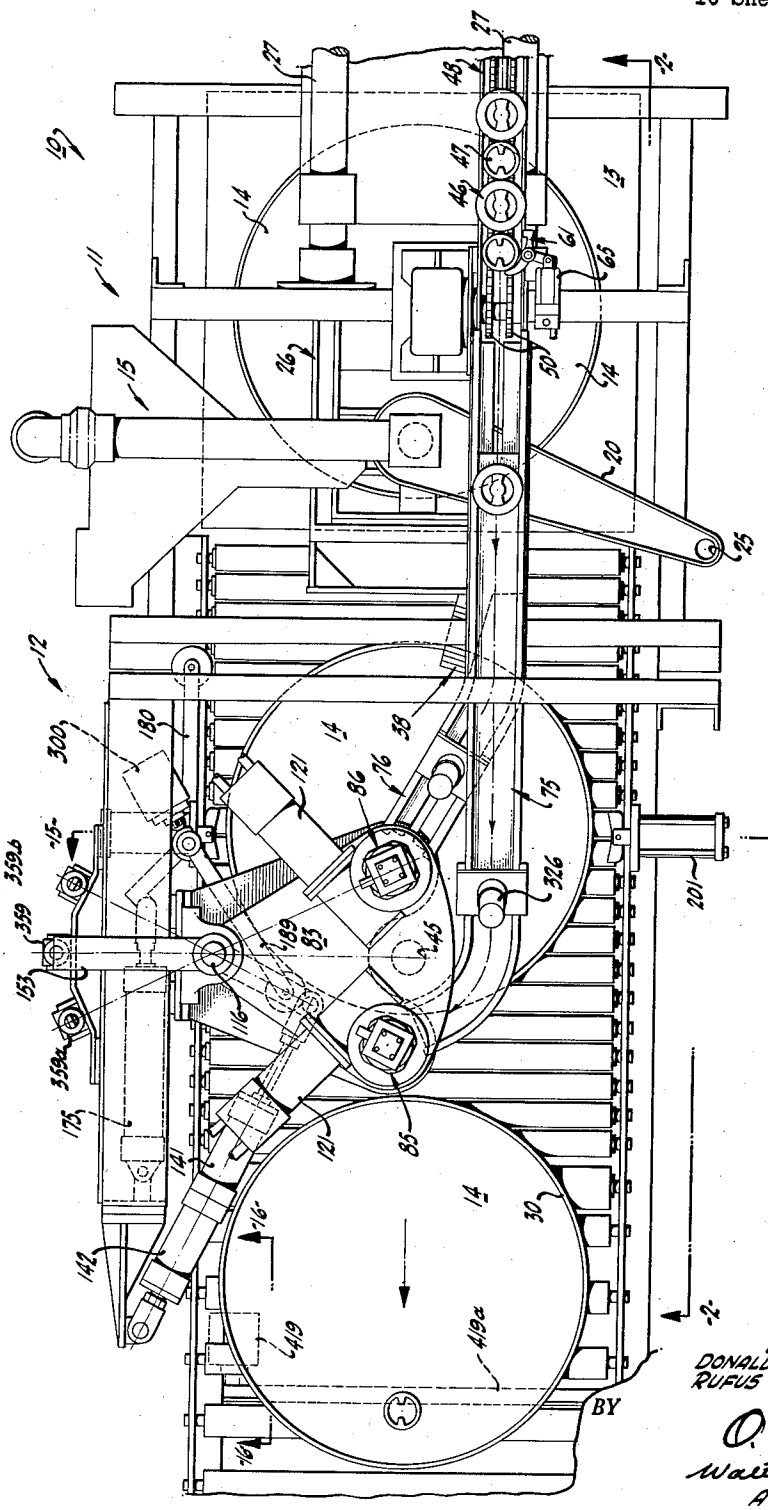

FIG-1

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CAP FASTENING MACHINE

Filed Aug. 25, 1955 10 Sheets-Sheet 2

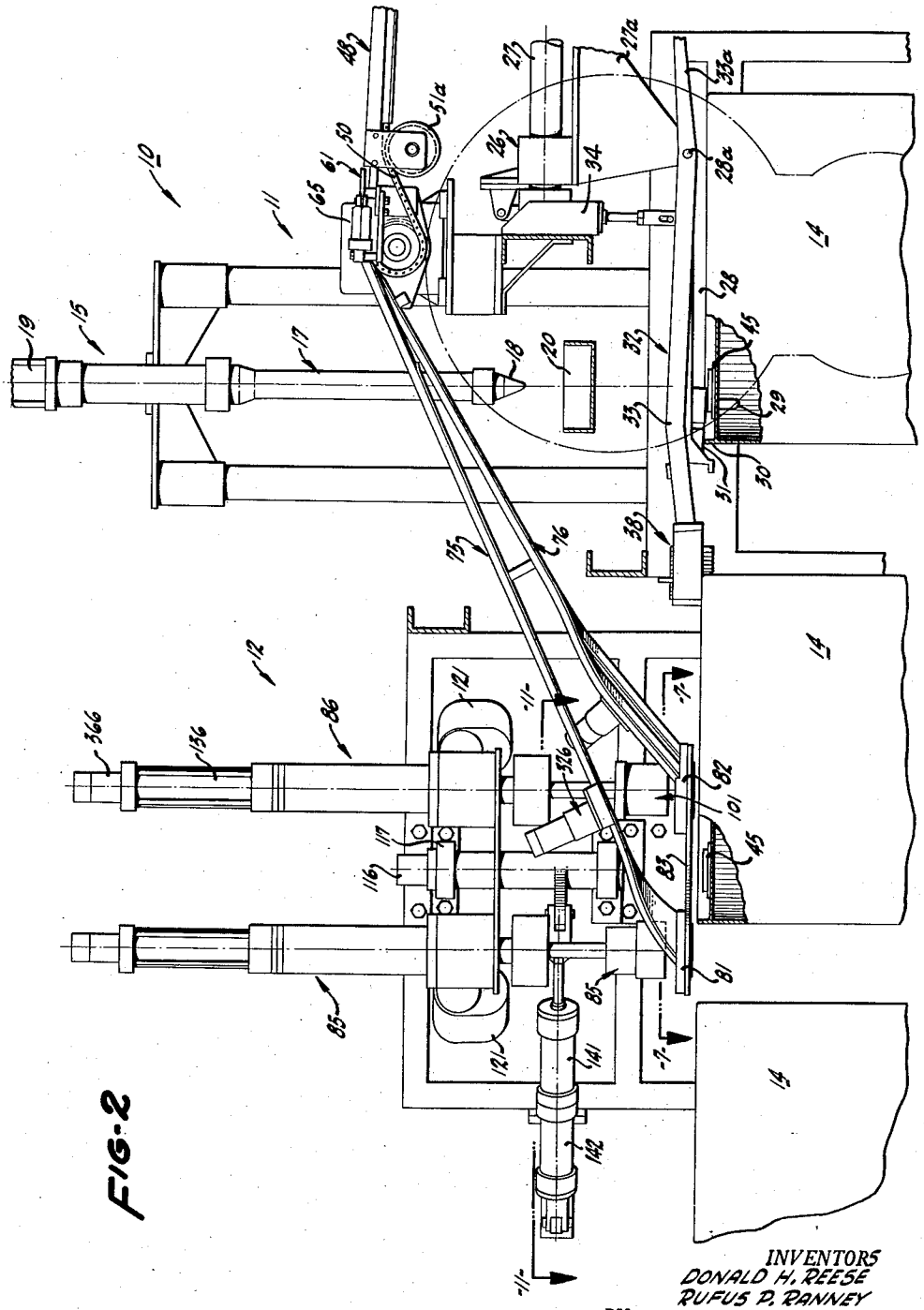

FIG-2

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CAP FASTENING MACHINE

Filed Aug. 25, 1955 10 Sheets-Sheet 3

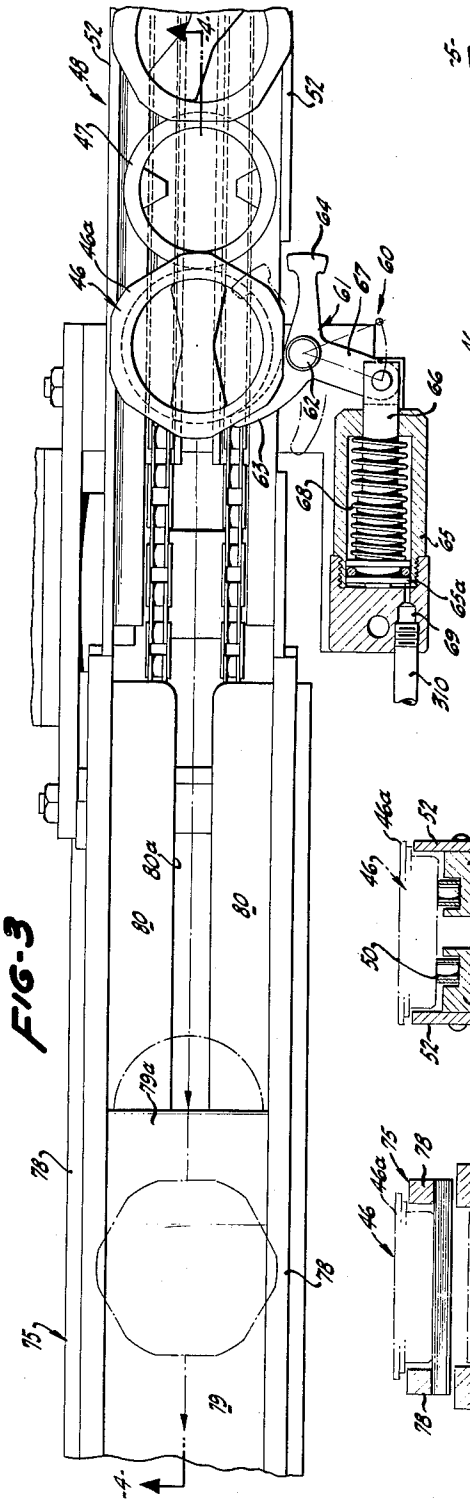

FIG-3

FIG-5

FIG-6

FIG-4

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CAP FASTENING MACHINE

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FIG-7

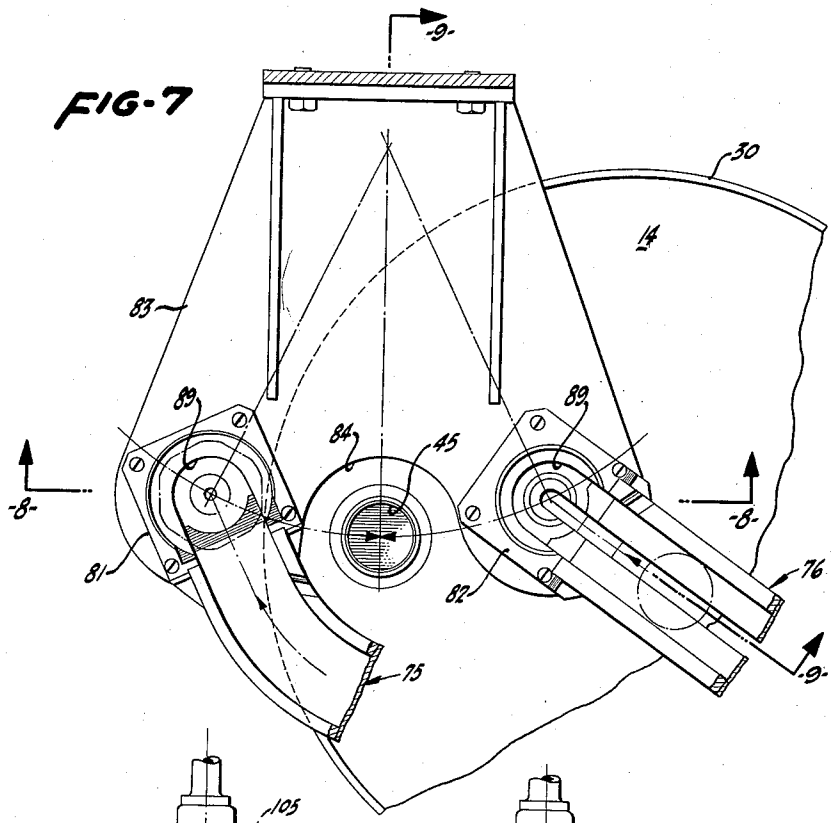
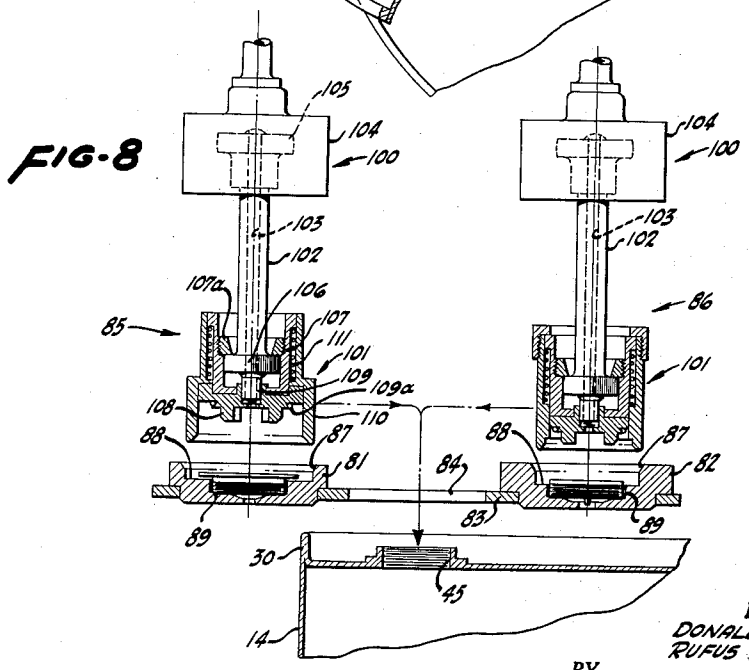


FIG-8



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CAP FASTENING MACHINE

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FIG-10

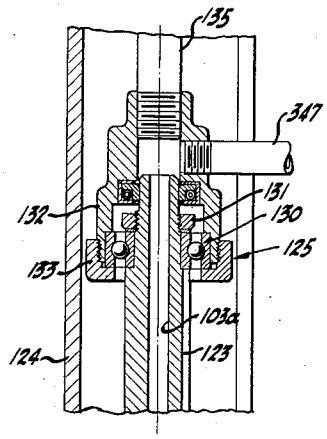

FIG-9

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CAP FASTENING MACHINE

Filed Aug. 25, 1955 10 Sheets-Sheet 6

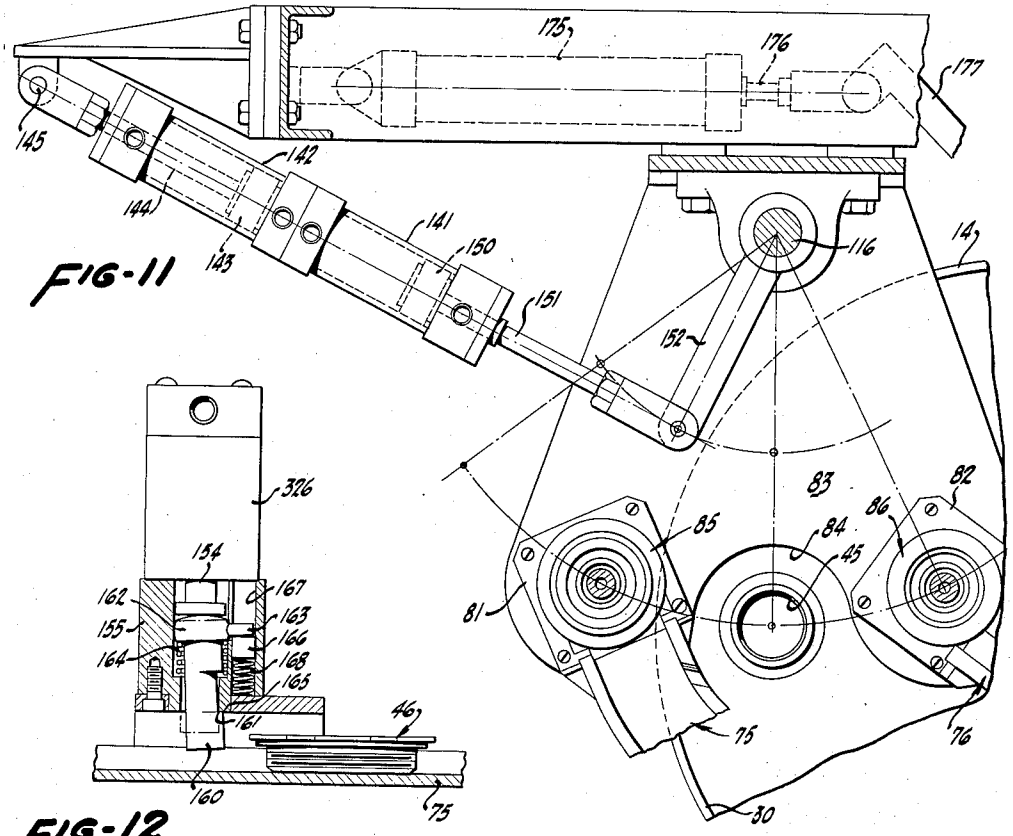

FIG-11

FIG-12

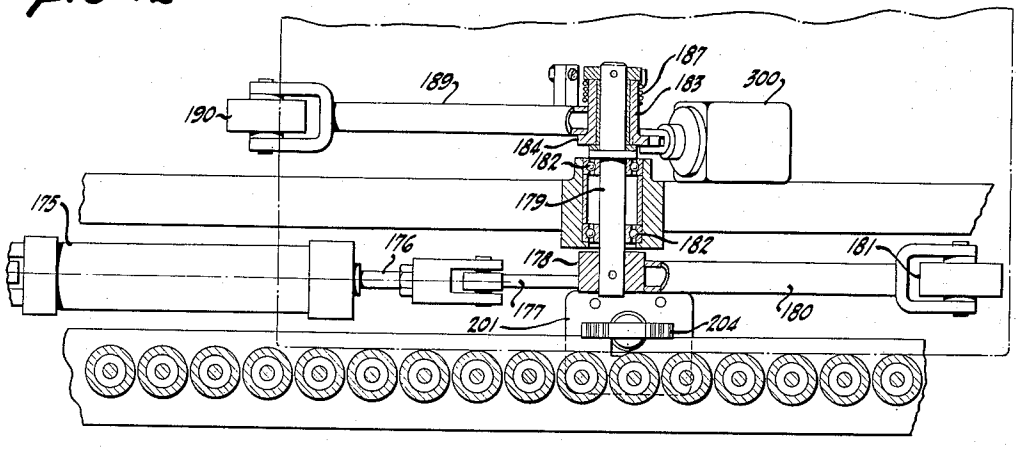

FIG-13

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CAP FASTENING MACHINE

Filed Aug. 25, 1955 10 Sheets-Sheet 7

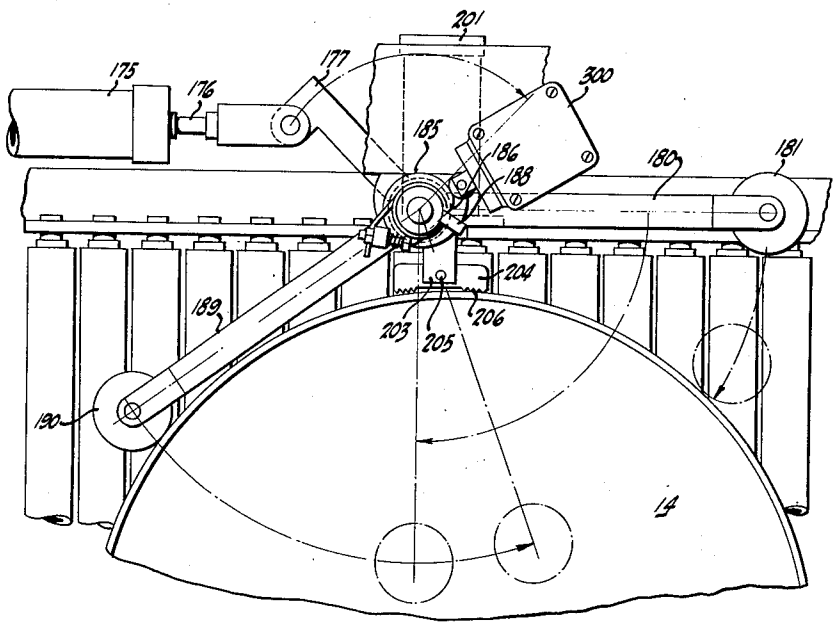

FIG-14

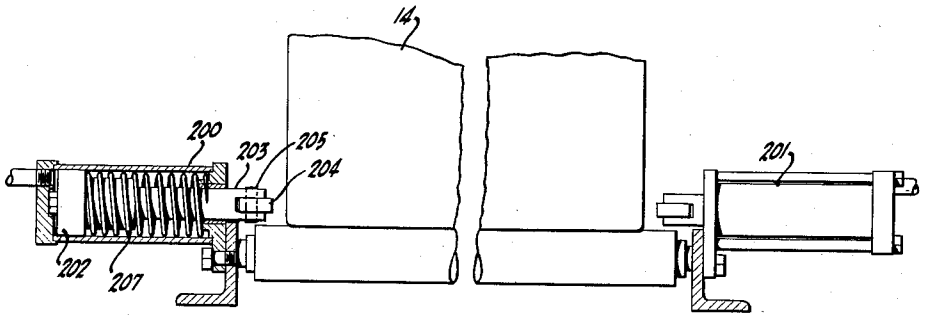

FIG-15

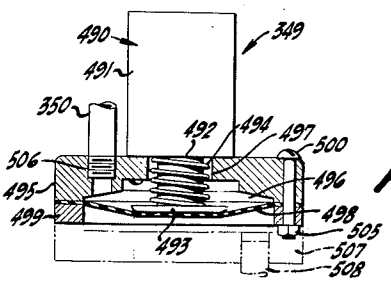

FIG-22

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CAP FASTENING MACHINE

Filed Aug. 25, 1955 10 Sheets-Sheet 8

FIG-16

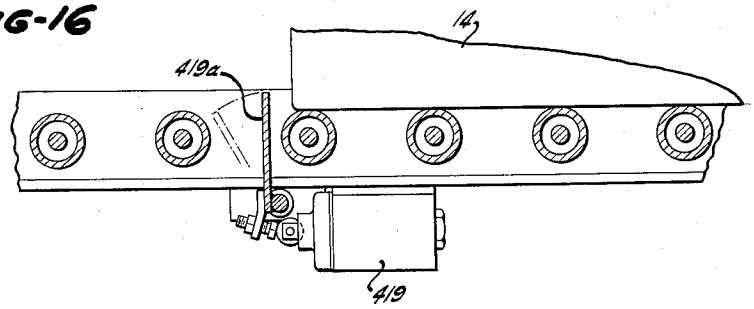
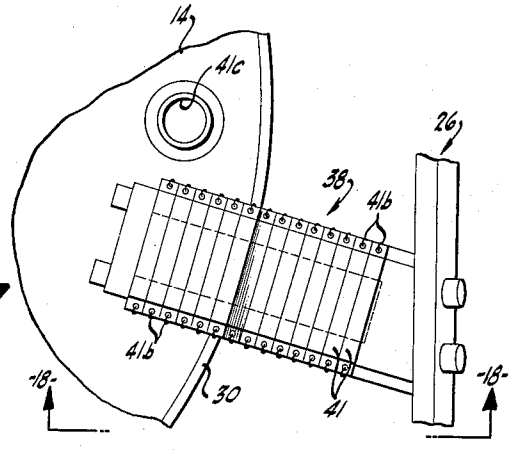


FIG-17



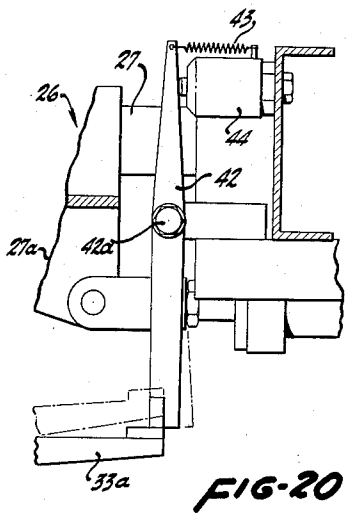


FIG-20

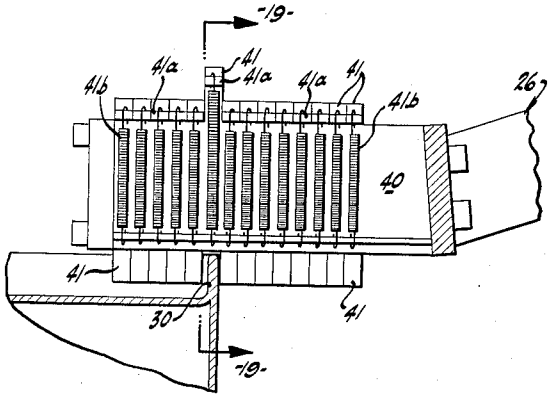


FIG-18

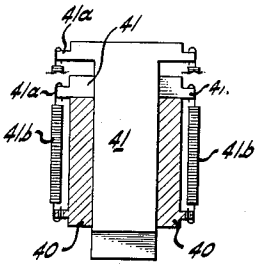


FIG-19

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CAP FASTENING MACHINE

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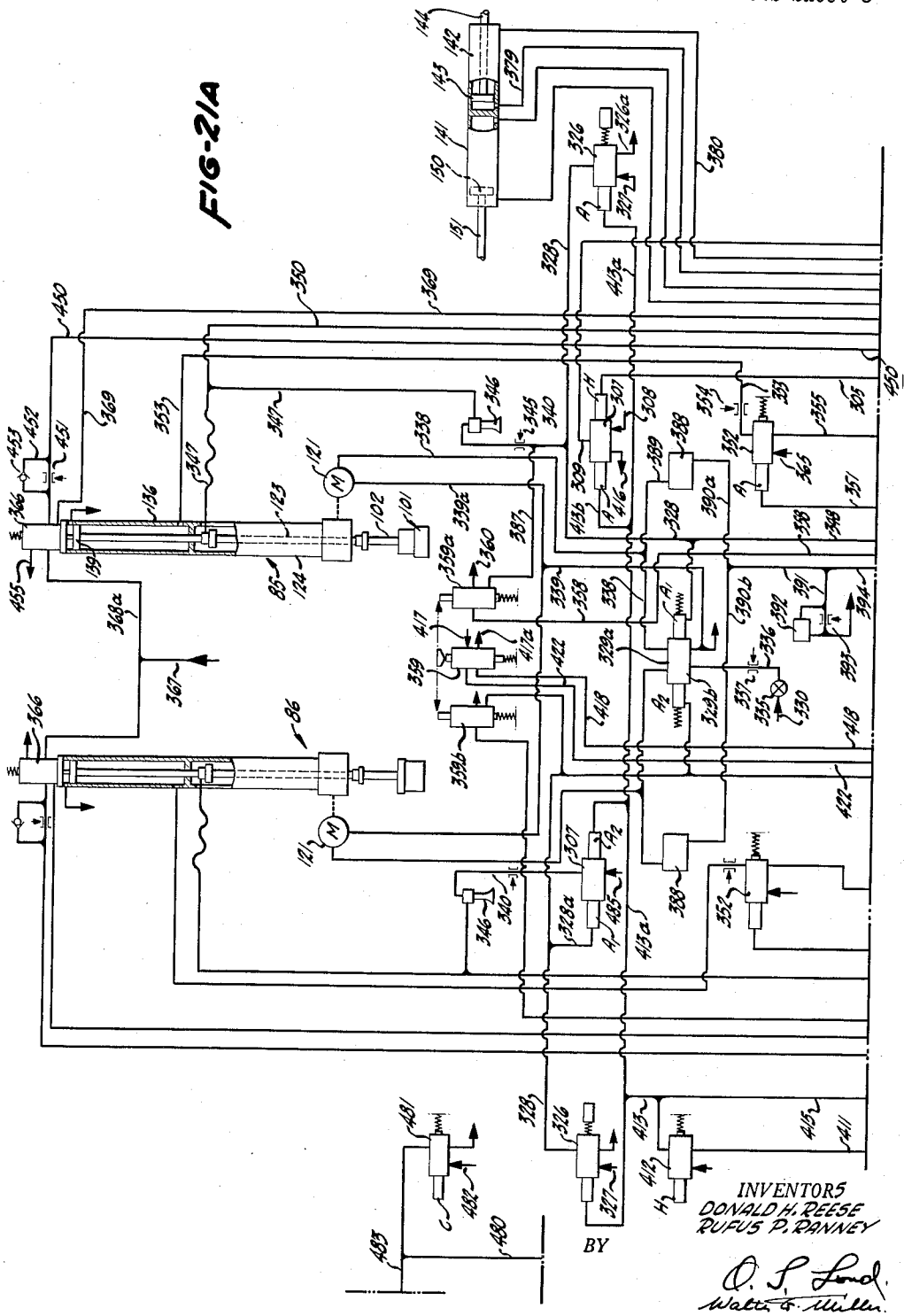
FIG-2/A



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CAP FASTENING MACHINE

Filed Aug. 25, 1955 10 Sheets-Sheet 10

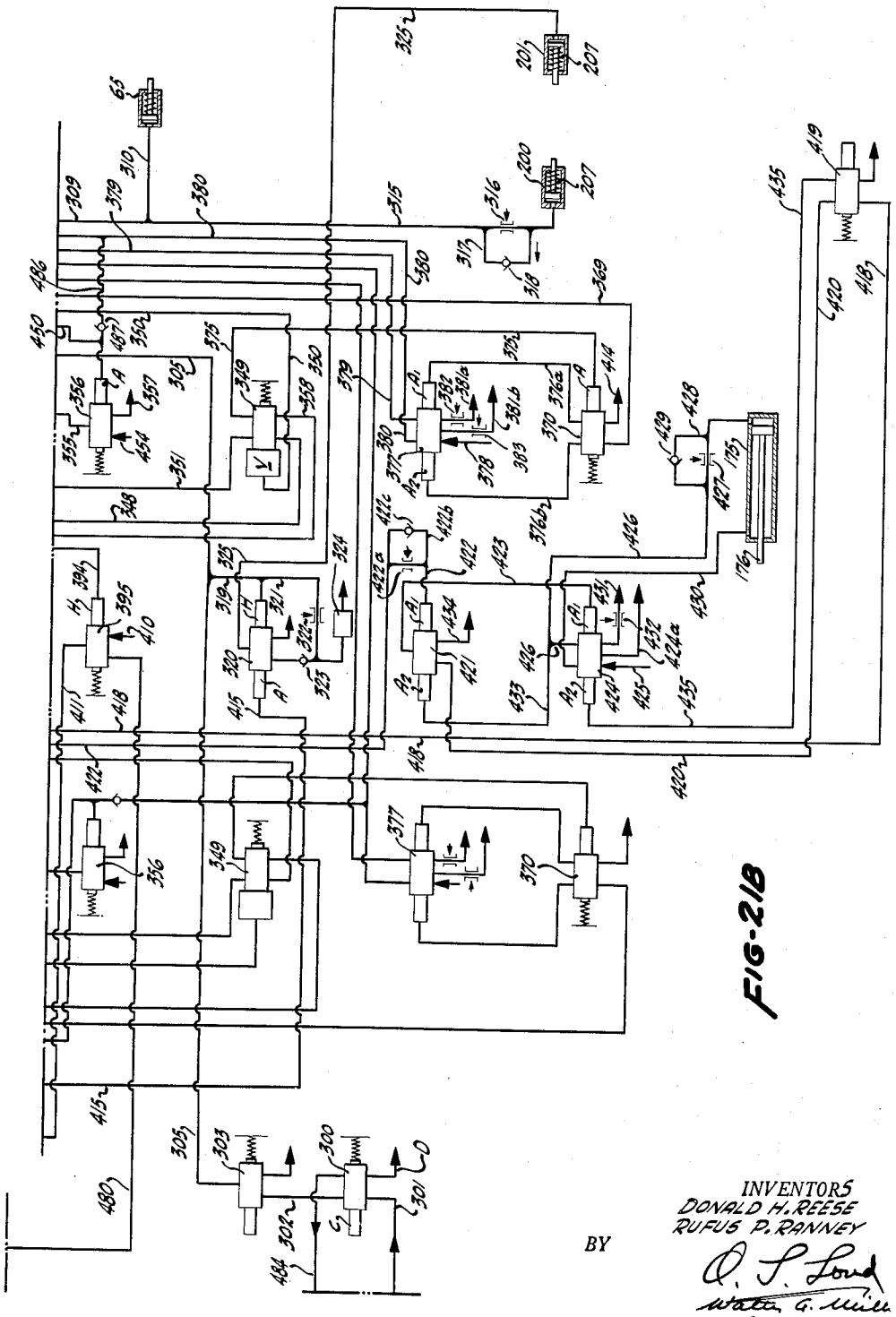

FIG-21B

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United States Patent Office 2,983,089 Patented May 9, 1961

2,983,089

CAP FASTENING MACHINE

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Filed Aug. 25, 1955, Ser. No. 530,492

49 Claims. (Cl. 53—72)

This invention relates to a machine for automatically applying caps or bungs to drums, barrels and other like containers.

More particularly this invention relates to a machine for automatically applying screw caps or bungs to steel drums in synchronism with an automatic filling machine wherein steel drums are supplied in rapid succession to a filling and weighing station with their bung holes in registry with a filling mechanism and at which each drum, in its turn, is filled to a predetermined net or gross weight, as desired, each filled drum then being transported to a capping station. The machine of the present invention has as an important object the application of screw caps or bungs to drums delivered to a capping station from an automatic filling machine of the character described.

The machine of the present invention has, as one of its principal objects, the provision of an automatic capping operation which is integrated and synchronized with an automatic filling operation such as described in Guerard et al. application Serial No. 307,554, filed September 2, 1952, entitled "Drum Filling Machine," now U.S. Patent No. 2,793,659. The machine of the present invention also preferably employs a vacuum-operated, flexible or universal type of chuck mechanism for picking up bungs or screw caps, aligning them properly with bung holes and then screwing the bungs or caps into the bung holes, such as described and claimed in another copending application, Ranney et al. Serial No. 317,856, filed October 31, 1952, entitled "Cap Fastener," now U.S. Patent No. 2,731,185.

Previous practice in connection with automatic and semiautomatic filling of containers such as steel drums, with products such as petroleum products, has been to carry out the weighing and filling operations automatically or semiautomatically, with or without a concommitant automatic orienting operation in which empty drums are received with their bung holes in random position and are automatically oriented to locate the bung hole of each drum in a predetermined position for registry with the filling mechanism. In such prior operations the final step of applying bungs or caps to the filling drums has been carried out manually with a torque wrench.

Heretofore, to our knowledge, this capping operation has not been carried out automatically, at least in connection with such containers as 55 gallon steel drums intended for petroleum products.

In connection with the high speed, automatic capping of steel drums filled with petroleum products, certain difficult problems are encountered which are not encountered to the same degree in many other types of capping operation. Thus, steel drums are sufficiently expensive that it is the custom for the purchaser to return them, obtaining a refund for the returned drums. Consequently, an oil refinery or other establishment carrying out large scale filling operations employs a great many used drums. Such drums are reconditioned; i.e., they are cleaned and repainted, and badly damaged drums are repaired mechanically. Nevertheless, it will be apparent that absolute uniformity of drums is impossible because of the variety of old drums used and because used and reconditioned drums have become damaged.

In Ranney et al. application Serial No. 317,856, referred to above, certain of the difficulties encountered in the capping of steel drums of this character are described. Thus, as pointed out in the description and as illustrated in the drawings of that application, the bung holes of steel drums will vary with respect to distance from the axis of the drum (such variation being referred to hereinafter as "horizontal deviation"), and it frequently happens that owing to imperfections in drums or to damage sustained by drums the bung holes do not lie in a horizontal plane (such departure from horizontal being referred to hereinafter as "vertical deviation").

It will, therefore, be apparent that a truly automatic capping mechanism must adjust itself automatically for horizontal and vertical deviations of the bung holes.

Yet another problem involved in an automatic, high speed capping operation of the character described is the fact that drums, as they come to a filling machine, are provided with different types of bungs which may require different types of chucks or wrench members for picking them up and manipulating them. Since drums as they come to a filling machine will usually have a random distribution of different types of bungs, it is apparent that a fully automatic capping machine must be able automatically to sense each type of bung and to provide the proper form of chuck.

Another problem encountered in an automatic filling and capping operation is the fact that, quite apart from structural differences as noted above, bungs are frequently painted the same color as the barrels (e.g., olive drab in the case of military supplies), and it is important that each bung be replaced in its corresponding barrel. This is especially troublesome when mixed orders are being filled.

Yet another and a very serious problem in an automatic filling and capping operation carried out at high speed of the order of, say, one 55 gallon drum each thirty seconds, is that all of the parts of the machine must be integrated with no station lagging behind any other. Also safety features should be incorporated in the machine such that if, for some reason, operation ceases or slows down in one part of the machine, operation of other parts of the machine will be adjusted appropriately and automatically.

It is an object of the present invention to provide an automatic capping machine having features which obviate some or all of the difficulties and problems mentioned hereinabove.

It is another object of the invention to provide an automatic capping machine which is adapted to high speed, automatic capping of steel drums with screw type bungs.

Another object is to provide an automatic capping machine of the character and for the purpose described which automatically adjusts itself for horizontal and vertical deviations of bung holes.

A further object is to provide an automatic capping machine which is selective with regard to the type of bung or cap and is able to receive filled drums or other containers with a random distribution of two or more types of bungs having structural differences and requiring different types of chuck.

Another object is to provide, in connection with an automatic capping machine, an automatic bung or cap delivery mechanism which is operable to replace each bung in its corresponding drum or barrel.

Yet another object is to provide an automatic capping machine which is operable at high speeds in conjunction with a high speed filling machine (with or without a

high speed orienting element) such as that described in Guerard et al. application Serial No. 307,554, mentioned hereinabove.

These and other objects of the invention will be apparent from the ensuing description and the appended claims.

One form of the invention is illustrated by way of example in the accompanying drawings, in which

Figure 1 is a top plan view of the machine of the present invention shown associated with an automatic filling and weighing mechanism.

Figure 2 is a view taken along the line 2—2 of Figure 1 showing a part of the machine of the invention in side elevation.

Figure 3 is a fragmentary top plan view showing the conveyor and escapement mechanism for conveying caps or bungs and releasing them one by one.

Figure 4 is a longitudinal section taken along the line 4—4 of Figure 3.

Figure 5 is a transverse section taken along the line 5—5 of Figure 4.

Figure 6 is a transverse section taken along the line 6—6 of Figure 4.

Figure 7 is a view taken along the line 7—7 of Figure 2 showing the capping station partly in section and partly in top plan view.

Figure 8 is a view taken along the line 8—8 of Figure 7.

Figure 9 is a staggered vertical section taken along the line 9—9 of Figure 7, showing in detail the operating mechanism for one of the capping chucks.

Figure 10 is a fragmentary sectional view taken along the line 10—10 of Figure 9 showing, on a larger scale than in Figure 9, the rotary seal for the chuck mechanism illustrated in Figure 9.

Figure 11 is a view taken along the line 11—11 of Figure 2, showing on a larger scale than that in Figure 2, another portion of the operating mechanism at the capping station.

Figure 12 is a view partly in side elevation and partly in vertical section of an automatic trip valve employed in the control circuit of the machine.

Figure 13 is a view partly in side elevation and partly in vertical section showing another portion of the operating mechanism at the capping station, more particularly the drum ejecting mechanism.

Figure 14 is a view as seen from above Figure 13, showing the drum ejecting mechanism with a drum in position at the capping station.

Figure 15 is a view taken along the line 15—15 of Figure 1, showing the drum clamping means for clamping and holding a drum at the capping station.

Figure 16 is a view taken along the line 16—16 of Figure 1, but on a larger scale than that in Figure 1, showing a control feature of the machine employed to suspend operation of the machine in the event that a filled drum that has been ejected from the capping station but has not proceeded forwardly to clear the way for the next drum.

Figure 17 is a fragmentary, top plan view of the drum gripping and pusher means employed to grip and push a filled drum from the filling station to the capping station.

Figure 18 is a side elevation of the same as seen along the line 18—18 of Figure 17.

Figure 19 is a transverse section along the line 19—19 of Figure 18.

Figure 20 is a fragmentary view showing a part of the mechanism employed to operate the gripping and pusher means shown in Figures 17 to 19.

Figure 21A is a diagrammatic illustration of a portion of the control circuit of the machine shown in Figures 1 to 20.

Figure 21B is a continuation of Figure 21A.

Figure 22 is a view, partly in side elevation and partly in vertical midsection, of a vacuum-operated pilot valve which is employed in the control circuit.

The mechanical features of the machine will first be described with reference to Figures 1 to 20.

Mechanical features

Referring now to the drawings and more particularly to Figures 1 and 2, the machine as a whole is generally designated by the reference numeral **10**. It comprises a filling and weighing station which is generally designated by the reference numeral **11** and a capping station which is generally designated by the reference numeral **12**. To the right of the filling station **11**, as viewed in Figure 1, there may be provided an orienting station such as that described and claimed in the aforesaid patent application, Guerard et al. Serial No. 307,554. At the filling station **11** there is provided a scale platform **13** which supports a drum **14**. A weighing mechanism such as that described in the aforesaid copending application Serial No. 307,554, may be provided to continuously record the net weight of the drum as it is filled, after having tared the empty drum.

Filling of the drum **14** or other container is accomplished by a filling mechanism which is generally designated by the reference numeral **15** and which may be of the type described in the said copending application Serial No. 307,554. Such filling mechanism, insofar as it is illustrated in Figures 1 and 2, comprises a lance **17** having a tip **18** which is extensible and retractable between an open position and a closed position, the closed position being shown in Figure 2. Details of such construction are described in the aforesaid application Serial No. 307,554. The filling lance **17** is operated by means of an hydraulic cylinder **19**. There is also illustrated in Figures 1 and 2, a drip pan **20** which pivots on a drain pipe **25**. The purpose of the drip pan **20** is to catch drippings from the lance **17** when the latter is retracted from a drum and the drip pan is swung underneath the lance **17**.

A pusher mechanism **26** is also provided for the purpose of propelling each empty, oriented drum from the orienting station (not shown) to the filling station, to the position shown in Figures 1 and 2. This pusher mechanism is substantially identical with that described in the aforesaid copending application Serial No. 307,554, but with certain modifications as hereinafter described. Briefly stated, the said pusher mechanism comprises a pair of spaced, parallel rods **27** fixed to the framework of the machine and a slide member **27***a* slideable on such rods. A pusher arm or frame **28** is provided which is pivotally mounted on the slide member **27***a* at **28***a*. At its forward, or left-hand end as viewed in Figure 2, the frame **28** is provided with a locating finger **29** pivotally mounted on the frame **28** in the manner described in the aforesaid co-pending application Serial No. 307,554. At its extreme forward or left-hand end, the frame **28** is provided with a roller **31** for rolling on the chime **30** of the drum **14**.

All the features of the pusher mechanism **26** thus far described are identical or substantially identical with those described in the aforesaid copending application Serial No. 307,554. However, the said pusher mechanism is further modified in a respect which will now be described.

A drum ejector means **32** is provided for ejecting filled barrels from the filling station in the form of an arm **33** pivotally mounted on the slide member **27***a* at **28***a* but for pivoting independently of the pusher frame **28**. A cylinder **34** pivots the arm **33** at its extreme forward or lefthand end as viewed in Figure 2, the arm **33** is provided with a gripping hand **38** having a pair of spaced plates **40** (see also Figures 17–19) between which are slideably mounted a plurality of fingers **41** each having laterally projecting ears **41***a* which normally rest upon the upper edges of the plates **40** and are held resiliently in contact therewith by tension springs **41***b*. As will be

seen from an inspection of Figures 2 and 17, the plates **40** and the fingers **41** are off center to clear the vent bung **41***a* (see Figures 1 and 17). As will be seen from an inspection of Figure 18 it is the purpose of the fingers **41** to grasp the chime **30** of a drum **14**. (The vent bung **41***a* is intended to be removed when the drum is emptied through the main bung hole, to allow entry of replacement air.)

Referring again to Figure 2 and also to Figure 20, the ejector arm **33** has a rearward extension **33***a* which is engageable with the lower end of a lever **42** pivoted on the frame of the machine at **42***a*, and which is normally held in the position illustrated in solid lines in Figure 20 by a spring **43** but which can be pivoted counterclockwise as viewed in Figure 20 by the piston of an hydraulic cylinder **44**.

Operation of the machine as thus far described and apart from the control mechanism is as follows:

When an empty drum has been oriented to locate its bung hole in a predetermined position at the orienting or bung locating station, the locating finger **29** will be located within the bung hole **45**. The slide member **27***a* is caused to move forwardly, from right to left as viewed in Figures 1 and 2. It will be apparent that, as the slide member **27***a* so moves, it will carry the empty, oriented drum with it, and it will also be apparent that the locating finger **29** will maintain the bung hole **45** in its predetermined oriented position. The stroke of the slide member **27***a* is such that it will deposit the drum at the filling station on the weighing platform **13** with the bung hole in registry with the filling lance **17**. While a drum is being oriented at the orienting station and a drum is being filled at the filling station **12**, the rearward extension **33***a* of the ejector arm **33** will be located beneath the lever **42**, hence the gripping hand **39** will be clear of the drum at the filling station and will not add weight to such drum. At the commencement of forward movement of the slide member **27***a*, cylinder **44** will operate to rock the lever **42** and disengage it from the ejector arm **33**, which will therefore drop by gravity and engage the fingers **40** with the chime **30** of the filled drum. Continued forward motion of the slide member **27***a* will cause the filled drum to be pushed forwardly to the capping station while an empty drum is deposited at the filling station.

After the empty drum has been deposited on the weighing platform, the following sequence of operations occurs as described in detail in the aforesaid Guerard et al. application Serial No. 307,554: The pusher frame **28** is raised by the cylinder **34** and is retracted to the locating station (the arm **33** being raised and retracted with the frame **28**); the empty weight or tare of the drum at the filling station is recorded; the lance **17** descends through the bung hole of the drum and opens up; filling commences, first at a very rapid rate with the lance wide open, then at a reduced rate with the lance partially closed; and then the lance **17** is closed and retracted from the drum.

While the pusher frame **28** and ejector arm **33** are being retracted, they are maintained in raised position, hence when the rearward extension **33***a* of ejector arm **33** reaches the end of its return stroke, it will underlie the lever **42**, which meanwhile will have returned to its normal spring position. Then the pusher frame **28** is lowered onto the next drum at the locating station, hence the extension **33***a* will contact the lever **42**, which will hold the gripper hand **39** in raised position to clear the drum at the filling station while it is being filled.

A means is also provided for conveying caps or bungs to the capping station in properly timed relation to the progress of drums through the machine. This means is illustrated in Figures 1 to 6 and is best shown in Figures 3 and 4.

Referring now to Figures 3 and 4, two types of cap or bung are there illustrated. One type is the "Rieke" cap which is manufactured by the Rieke Company, Auburn, Indiana, U.S.A., and is described in detail in the aforesaid copending application Serial No. 317,856. Another type is the "Tri-Sure" cap, which is manufactured by American Flange & Manufacturing Co., of New York, N.Y., and is also described in detail in the aforesaid Ranney et al. application Serial No. 317,856. Suffice it to say for purposes of the present description, that the "Rieke" cap shown at **46** in Figures 3 and 4 has a flange **46***a* which projects outwardly and the "Tri-Sure" cap shown at **47** does not have a corresponding flange and is of lesser overall diameter. Advantage is taken of these structural differences in the manner and for the purpose explained hereinafter.

A conveyor mechanism is provided for conveying caps or bungs such as those shown at **46** and **47**, such conveyor mechanism being generally designated by the reference numeral **48**. This conveyor mechanism extends rearwardly, or to the right as viewed in Figures 1 to 4 to some convenient point preceding the entire machine (including the locating station), so that an operator may from time to time pick off loose bungs from the drums as they are supplied to the machine, e.g., as the empty, unoriented drums travel by gravity down a slanting roller conveyor toward the machine. The rate of travel of drums through the machine is quite rapid, e.g., one 55 gallon drum each thirty seconds. However, ample time is provided for an operator to pick up loose caps or bungs from tops of drums prior to their delivery to the machine, it being necessary only that, from time to time, the operator walk along the gravity conveyor line, pick up bungs from a few dozen drums and deposit them on the conveyor mechanism **48** in the same order as they are picked up from the drums. This simple manual operation, if carried out to place the bungs or caps on the conveyor **48** in the same order as they arrive with the drums, is all that is required. The conveyor **48** will supply the bungs to the capping mechanism in this same order, such that bungs of different drums are not intermixed.

The bung conveyor mechanism **48** comprises spaced upper tracks **49** (see Figure 5) which receive and guide the upper reaches of endless chains **50** which engage sprockets **51** and idlers **51***a*, one such sprocket being driven so as to cause continuous movement of the chain, the upper reach thereof traveling from right to left as viewed in Figures 1 to 4. The lower reach of the chain is received in and guided by lower tracks **49***a*. The upper tracks are provided with vertical flanges **52** over which lie the horizontal flanges **46***a* of the Rieke caps **46** and between which lie the Tri-Sure caps **47**. In both cases, however, the cap rests on the chains **50** and the Rieke flange **46***a* clears the flanges **52**.

An escapement mechanism is provided which is shown in Figure 3 and is there designated generally by the reference numeral **60**. The escapement mechanism **60** comprises an escapement member **61** which is pivoted on the frame of the machine at **62** and which has a forward guard or keeper member **63** and a rearward guard and pusher member **64**. The escapement member **61** is operated by pneumatic means including an air cylinder **65** within which is reciprocable a piston **65***a* having a rod **66**, the outer or right-hand end of which, as viewed in Figure 3, is rotatably connected to a link **67** which is integral with the escapement member **61**. A spring **68** normally urges the piston **65***a* to the left as viewed in Figure 3 and holds it and the escapement member **61** in the positions shown. At the appropriate instant in the operation of the machine, i.e., when a filled drum at the filling station is ejected from the filling station and delivered to the capping station, compressed air is caused to enter the cylinder **65** through a line **310** and an inlet port **69**, thereby causing movement of the piston **65***a* from left to right as viewed in Figure 3, thereby rocking the escapement member **61** in counterclockwise direction. The pusher portion **64** of the escapement member **61** will push the leading cap **46** or **47**, as the case may be, off the chains **50** onto an inclined

chute which is described hereinafter. At the same time, the pusher member **64** acts as a guard to hold back the next succeeding cap or bung. Upon venting of the air pressure in the cylinder **65** at a later stage of operation, as described hereinafter, the spring **68** will push the piston **65***a* from right to left to the position shown in Figure 3 and will, therefore, rock the escapement member **61** in clockwise direction so as to be in the position shown in solid lines in Figure 3 and to allow the next succeeding cap or bung on the chains **50** to move forwardly to be held by the guard **63**.

Referring now to Figures 2, 3, 4 and 6, inclined chutes **75** and **76** are provided for guiding the released cap or bung to the capping station. As will be seen from an inspection of Figure 4, the chutes **75** and **76** coincide at their upper, right-hand ends adjacent the forward end of the conveyor **48**. The upper chute **75** is formed by spaced tracks **78** which are spaced apart a distance such that the threaded body portion **46***b* of a Rieke cap **46** will fit easily between the tracks but such that the gasket of the flange portion **46***a* will rest upon the upper edges of the tracks as illustrated in Figures 3, 4 and 6 and will slide down such tracks to the tongue **79***a* of a plate **79**. The cap **46** will then slide down the plate **79**. It will, therefore, be apparent that, as each Rieke cap **46** is released from the horizontal conveyor **48**, it will slide by gravity down the upper chute **75**. The lower chute **76** is formed by two, spaced tracks or plates **80** which are spaced apart at **80***a* a slight distance for a purpose explained hereinafter. The spacing of the upper tracks **78** is sufficient that a Tri-Sure cap **47** will fall between them into the lower chute **76**. It will, therefore, be apparent that each of the Tri-Sure caps, upon release from the conveyor **48**, will find its way to the lower chute **76** and slide down along it by gravity. The purpose of the spacing **80** between the plates **79** is to clear lugs **47***a* which are commonly formed on this type of cap.

Referring now to Figure 2, the upper and lower chutes **75** and **76** terminate at their lower ends, and selectively guide the caps or bungs to cups **81** and **82**, respectively. The cups **81** and **82** are supported by a fixed plate **83** which is supported by the frame of the machine. As is most clearly shown in Figures 7 and 8, the plate **83** has a central recess or socket **84** which is in registry with the bung hole **45** of a drum deposited at the capping station.

Two capping assemblies **85** and **86** are illustrated in Figure 8 which are identical with those described and claimed in the aforesaid Ranney et al. application Serial No. 317,856, to which reference may be made for details not described in their entirety in the present application. It will be understood, of course, that other types of cap fastening assemblies may be used. However, those illustrated are preferred.

Still referring to Figure 8, the two capping assemblies **85** and **86** are there shown which are in registry with the cups **81** and **82**, respectively. As will be seen each of the cups **81** and **82** has a flared portion **87**, an annular shoulder **88** and a socket **89**, the shoulder **88** of the cup **81** being of greater diameter to receive the flange **46***a* of a Rieke cap **46**.

Each of the capping assemblies **85** and **86** comprises an upper coupling **100**, a lower coupling assembly and chuck **101** and a spindle **102** formed with an axial suction passage **103**. The upper coupling **100** has a sleeve **104** and to the upper end of the spindle **102** is fixed a head **105** having a rounded periphery which is free to rotate about horizontal axes against the inner surface of the sleeve **104**. The lower coupling assembly **101** comprises a head **106** similar to the head **105** which also has a rounded periphery which is rotatable about horizontal axes against the inner surface of a sleeve **107**. A nut **107***a* holds the head **106** in place in the sleeve, and to the lower end of the sleeve **107** is fixed a wrench fitting **108** which engages a cap or bung. The fittings **108** of the two assemblies **85** and **86** are, of course, different to fit different types of cap. More specifically, the fitting **108** in the Rieke assembly **85** is intended to engage with, to fit and to serve as a wrench for rotating a Rieke type of cap and the fitting **108** in the right-hand assembly **86** is intended to engage with, to fit and to serve as a wrench for rotating a Tri-Sure type of cap. A seal is provided at **109**, the details of which are described in the said copending application Serial No. 317,856 and a seal is also provided at **109***a* for sealing against a cap or bung when it is engaged with the chuck. A socket **110** is also provided which is urged downwardly by a spring **111**.

As described in the aforesaid Ranney et al. application Serial No. 317,856, suction is applied through the passage **103** and the registering openings in the seal **109** and the fitting **108**, to pick up and hold a cap or bung. As also explained in the said copending application, the double universal joints provided by the coupling **100** and chuck **101**, automatically adjust the chuck for horizontal and/or vertical deviations of the bung holes of drums.

Referring now more particularly to Figures 9 and 10, each of the capping assemblies **85** and **86** (the assembly **86** being illustrated in Figure 9), is supported and operated by means which will now be described. The assembly **86** (likewise the assembly **85**) is supported by a bracket **115** which is fixed to and extends outwardly to the right as viewed in Figure 9, from a shaft **116** which is journaled in bearings **117** fixed to the frame of the machine. Just above the outer end of the bracket **115** and supported thereby is a housing **118** within which is disposed a worm wheel **119** meshing with a worm **120** driven by a shaft **120***a* which is driven by an hydraulic motor **121** (see Figures 1 and 2). The worm wheel **119** is fixed to a sleeve **122** which is journaled in bearings **122***a*, and the sleeve **122** is in turn fixed slideably but nonrotatably to a hollow shaft **123** which constitutes an extension of the spindle **102** and which is enclosed by a casing **124**. As is most clearly shown in Figure 10, a rotating seal is provided at **125**, such seal comprising a ballbearing **130**, the inner race of which is clamped to the hollow shaft **123** by means of a nut **131** and the outer race of which is clamped to a sleeve **132** by means of a nut **133**. As will be seen the central passage **103***a* of the shaft **123** communicates with a line **347** through which air is sucked by means described hereinafter. The upper end of the sleeve **132** is threaded to a piston rod **135** which extends upwardly into a cylinder **136** such cylinder having ports **353** and **353***a* (see Figure 9). To the upper end of the rod **135** is fixed a piston **139** which is reciprocable in the cylinder **136**, and the rod **135** has an extension **140** above the piston **139** which is intended to engage the plunger of a valve **366** for a purpose explained hereinafter.

Referring now more particularly to Figure 11, the shaft **116** is rotated to the left or to the right to register either of the chuck assemblies **101** with the bung hole of a drum, by means of a pair of pneumatic cylinders **141** and **142** which, as illustrated, are arranged end-to-end. A piston **143** is reciprocable in the cylinder **142** and has a rod **144** pivotally connected to the frame at **145**. The cylinder **141** has a piston **150** reciprocable therein to which is connected a rod **151** which is rotatably connected at its outer end, or to the right as viewed in Figure 11, to an arm or lever **152** which is fixed to the shaft **116**. It will be apparent that, when compressed air is supplied to the cylinder **141** to move its piston **150** from right to left as viewed in Figure 11, the arm **152** will be rotated in clockwise direction as viewed in Figure 11, thereby bringing the right-hand capping assembly **86** and its chuck assembly **101** (see Figure 8) into registry with the recess **84** in the plate **83** and with the bung hole **45** of a drum. It will also be apparent that, when the direction of travel

of the piston 150 is reversed, the arm 152 will be rotated in counterclockwise direction to return the right-hand chuck assembly 86 to the neutral position illustrated in Figures 8 and 11. It will also be apparent that, when compressed air is delivered to the cylinder 142 in a direction to move its piston 143 (i.e., relatively to the cylinder 142) to the right as viewed in Figure 11, that the arm 152 will be rotated in counterclockwise direction as viewed in Figure 11, thereby bringing the left-hand chuck assembly 85 into registry with the bung hole of a drum, and that when the piston 143 is moved (relatively to the cylinder 142) in the opposite direction, the chuck assembly 85 will be rotated back to its neutral position illustrated in Figures 8 and 11. Thes stroke of each of the pistons 143 and 150 is such as to bring the respective chuck assemblies 85 and 86 into precise registry with their corresponding cups 81 and 82, respectively, and into precise registry with the recess 84 and the bung hole 45 of a drum at the capping station.

Referring now more particularly to Figures 1 and 9, a cam arm 153 is provided which is fixed to and rotates with the shaft 116, the outer end of which (to the left as viewed in Figure 9) serves as a cam to actuate the plungers of three valves 359, 359*a* and 359*b*, in the manner and for the purpose described hereinafter.

As stated, bungs or caps 46 and 47 are released by the escapement mechanism 60 as described hereinabove and as illustrated in Figure 3. Each released cap slides downwardly along the proper chute 75 or 76, as explained hereinabove. As also explained, there are two capping assemblies 85 and 86 for the two different types of caps 46 and 47. It will be apparent that, for fully automatic operation, some means is required whereby the machine can sense the type of cap or bung which has last been released from the conveyor mechanism. A portion of such sensing means is illustrated in Figure 12 and will now be described.

Referring to Figure 12 a trip valve 326 is there shown which has a plunger 154 enclosed by a housing 155 which is fixed to the frame of the machine. A trip pin 160 is provided which is notched at 161 for a purpose explained hereinafter and which has a rounded head 162 which engages the plunger 154 of the valve. The head 162 is provided with a pin 163 which projects laterally therefrom. A spring 164 is compressed beneath the head 162 and, therefore, urges the plunger 160 upwardly and tends to lift the valve plunger 154. A cocking means is provided by reason of the notch 161 which is capable of engaging a shoulder 165 and is urged into such engaging action by a small piston 166 which is urged upwardly in a passage 167 by a spring 168. In operation, and apart from the control mechanism described hereinafter the valve and its cocking means are operated as follows:

The trip valve 326 is normally in the cocked position illustrated in Figure 12, i.e., with its plunger 154 in the down position and with the trip pin 160 in the cocked position shown. When a bung or cap such as that shown at 46 descends along the chute 75, it will strike the lower end of the pin 160 and will disengage the notch 161 from the shoulder 165. The spring 164 is then free to expand and, in expanding, it pushes the plunger 160 upwardly and causes retraction of the valve plunger 154. This results in setting the valve in its so-called "spring" position for a purpose which is explained hereinafter in connection with the control circuit. The valve will remain in this position until compressed air is delivered thereto in the manner explained hereinafter, thereby causing the plunger 154 to move downwardly against the force of the spring 164, carrying with it the plunger 160. When the latter has been pushed downwardly to the position illustrated in solid lines in Figure 12, with the notch 161 in registry with the shoulder 165, the cocking spring 168 and piston 166 will act against the pin 163 to pivot the plunger 160 to the inclined position shown in Figure 12 such that, when the compressed air is exhausted from the valve 326, the notch 161 will engage the shoulder 165. The valve operating mechanism will, therefore, remain in the cocked position illustrated until the next cap descends along the chute 75 and disengages the plunger 60. It will be understood, of course, that the chute 76 is provided with a similar valve 326.

In the operation of the capping station machine as thus far described, and apart from the control mechanism, bungs or caps are released from the overhead conveyor 48 by the escapement mechanism 60 in the manner described hereinabove, and each released cap or bung will slide down its appropriate chute 75 or 76 and will trigger or release the valve actuating mechanism illustrated in Figure 12, thereby placing the respective valve 326 in its spring position. This will result, through the control means described hereinafter, in a sequence of operations which include the following events:

Suction is applied to the line 347 (see Figures 9 and 10), thereby applying suction to the appropriate capping assembly 85 or 86 through its passages 103 and 103*a*. Also the appropriate shaft 120*a* will start rotating, thereby causing the corresponding spindle 102 and chuck 101 to commence rotating. Air pressure beneath the piston 139 in cylinder 136 is released through port 353, thereby causing the piston 139 and its associated chuck assembly 101 to drop by gravity into the appropriate cup 81 or 82. Suction applied through the line 347 will cause the chuck to hold the cap 46 or 47, as the case may be. Compressed air is then again delivered through the port 353 to the cylinder 136 beneath the piston 139, causing the latter to ascend, thereby lifting the chuck assembly 101 and the cap held by it. Next, the appropriate cylinder 141 or 142 is operated to rotate the appropriate capping assembly 85 or 86 (i.e., the assembly containing a cap or bung) into registry with the recess 84 in the plate 83 and with the bung hole 45 of the drum which, meanwhile, will have been delivered to the capping station in the manner explained hereinabove.

A part of the control mechanism associated with and located at the capping station is illustrated in Figures 13 and 14. Referring to these figures, there is shown a cylinder 175 having a rod 176 rotatably connected at its outer end to a lever 177, the other end of which is fixed to a sleeve 178 which is pinned to the lower end of a shaft 179. To the sleeve 178 there is also fixed a drum ejector lever 180 on the outer end of which is rotatably mounted a roller 181. The shaft 179 is journaled in ball bearings 182, and mounted on its upper end is a sleeve 183 which is free to rotate on the shaft 179. To the lower end of the sleeve 183 is fixed a cam 184 having a high dwell 185 and a low dwell 186, such cam serving to operate a valve 300 in the manner and for the purpose described hereinafter. A torsion spring 187 urges the sleeve 183 in counterclockwise direction as viewed in Figure 14, and a stop member 188 is provided to limit rotation of the sleeve 183. A cam lever 189 is fixed to the sleeve 183 and rotatably mounted on the outer end of the lever 189 is a roller 190. The stop member 188 also causes the cam lever 189 to rotate clockwise (as viewed in Figure 14) with the drum ejector lever 180.

The ejector lever 180 is normally held in the position illustrated in Figure 14 by the cylinder 175. When the capping station is unoccupied by a drum, the torsion spring 187 normally holds the cam lever 189 in the position shown in broken lines in Figure 14, i.e., lying athwart the path of travel of drums into the capping station. As a drum is pushed into the capping station, the ejector lever 180 will remain in the position illustrated in Figure 14 but the drum will rotate the cam lever 189 in clockwise direction, as viewed in Figure 14, to the position shown therein in solid lines. This will cause the high dwell 185 of the cam 184 to contact the plunger of the valve 300, which constitutes a signal in the manner and for the purpose described hereinafter

that the capping station is occupied by a drum. When a drum has been properly capped and the appropriate chuck assembly has been elevated and rotated back to the neutral position illustrated in Figures 8 and 9, the cylinder **175** is supplied with compressed air in such manner as to rotate the ejector lever **180** in clockwise direction, as viewed in Figure 14, from the position shown in solid lines therein to the position shown in broken lines, thereby ejecting a filled and capped drum from the capping station. By reason of the stop **188**, the cam lever **189** is prevented from rotating back to the transverse position illustrated in broken lines in Figure 14 until compressed air is supplied to the cylinder **175** to rotate the lever **180** back to the position shown in solid lines in Figure 14. Then the cam lever **188** rotates back by reason of the torsion spring **187**.

Referring now to Figures 14 and 15, and more particularly to Figure 15, there is provided certain clamping mechanism for firmly clamping both sides of a drum at the capping station and holding it in position during the capping operation in opposition to the torque produced by the capping operation. For this purpose two cylinders **200** and **201** are provided, the cylinder **201** being operated by hydraulic fluid and the cylinder **200** by compressed air. The construction of these two cylinders is otherwise identical. As shown, the cylinder **200** has a piston **202** reciprocable therein having a rod **203** to the outer end of which is attached a serrated clamping member **204** which is pivoted on the rod at **205** and has clamping jaws or teeth at **206**. An expansion spring **207** is provided which normally holds the rod in the retracted position illustrated.

In operation, at the appropriate instant after a drum has been located at the capping station, fluid is admitted first to the hydraulic cylinder **201** to cause its clamping member **204** to advance and contact but not to move the drum. Then the air cylinder **200** is operated to move its clamping member **204** toward the drum. The clamping member of the hydraulic cylinder **201** serves as a rigid stop because of incompressibility of the hydraulic fluid, and the air in the air cylinder **200** will compress when its clamping member **204** contacts the opposite side of the drum. Thus the drum is clamped firmly in position without disturbing its position. At a later instant in the cycle of operation, after a cap has been screwed into the drum, the pressure in cylinders **200** and **201** is relieved, the springs **207** will cause retraction of the clamping members and the drum is free to be ejected from the capping station.

At the conclusion of the capping operation and after the capped drum is unclamped, the cylinder **175** will operate to rotate the ejector lever **180** to eject the capped drum. Then the cylinder **175** will be operated in the reverse direction to rotate the lever **180** back to the position shown in Figure 14.

Control circuit

Referring now to Figures 21A and 21B, and from time to time to Figures 1 to 20, the control system of the machine described above and illustrated in Figures 1 to 20 operates as follows: In the control system which is illustrated in Figures 21A and 21B, certain standard equipment is employed, such as valves operated by spring pilots, hand pilots, cam pilots, hydraulic pilots and/or air pilots. These and other items of equipment are shown diagrammatically and they are for the most part of standard, purchased type and require no detailed description herein. One such valve is that shown at the lower left of Figure 21B and is indicated by the reference numeral **300**. A spring (unnumbered) is shown at the right and a cam is indicated by the letter C at the left, indicating that the valve **300** is spring operated, that it has a normal "spring" position and that it also assumes a "cam" position when the cam is operated. The valve **300** is also shown as being provided with a drain or exhaust line indicated by the reference character D, such characterization being omitted, however, in the case of other valves and being indicated by the same diagrammatic symbol. Referring now to Figures 13 and 14 the valve **300** is there shown and the cam **184** is the cam which operates the valve **300** to place it in its cam position. As will be seen, when a drum is pushed into place at the capping station it will rotate the cam lever **189** in clockwise direction as viewed in Figure 14, thereby causing the cam roller of the valve **300** to ride up onto the high dwell **185** of the cam, thereby placing the valve **300** in its cam position. Hydraulic fluid under pressure from a suitable source (not shown) therefore passes through a line **301** and the valve **300** to a line **302**, thence to a valve **303**. The valve **303**, like the valve **300**, is a spring operated valve having also a cam position. In its cam position the valve **303** communicates the line **302** with a line **305** but when in its spring position it does not permit such flow of pressure. The valve **303** is placed in its cam position when the pusher **26** (see Figure 2) is in its extreme forward position. Hydraulic pressure then passes through the line **305** to the hydraulic pilot H of a valve **307**. (See Figure 21A.) This places the valve **307** in its hydraulic pilot position wherein it communicates lines **308** and **309**. Compressed air from a suitable source (not shown) then passes from the line **308** through valve **307** to the line **309**, thence through a line **310** (Figure 21B) to the bung escapement cylinder **65** (see also Figure 3), and also through a line **315** containing a restriction **316** to the pneumatic barrel clamping cylinder **200** (see also Figure 15). The line **315** is also provided with a by-pass line **317** containing a check valve **318** so that pressure can pass through line **317** only in the direction indicated by the arrow, such by-pass and check valve serving a purpose explained hereinafter. By reason of the supply of pressure through line **310** to the bung escapement cylinder **65**, the latter will be actuated to release a bung or cap in the manner explained hereinabove, causing it to slide down the appropriate chute **75** or **76**. It will be assumed that a Rieke type of cap shown in Figures 3 and 4 at **46**, is released. Air pressure supplied in the manner described to the pneumatic drum clamping cylinder **200** will cause one of the drum clamping members **204** to move inwardly, thereby contacting the side of the drum. Meanwhile some of the hydraulic fluid passing through the line **305** will pass into a line **319** (Figure 21B), thence to the hydraulic pilot of a valve **320**, thereby placing that valve in its hydraulic pilot position. A portion of the hydraulic fluid will also pass through a line **321** containing a reducing valve **322** and a check valve **323**, to the valve **320**. When the valve **320** is in its hydraulic pilot position, the line **321** and a line **325** are connected, thereby communicating hydraulic pressure through the latter line to the hydraulic drum clamping cylinder **201** (see also Figure 15), thereby causing the opposite clamping member **204** to move forwardly to contact the opposite side of the drum. The purpose of the restriction **316** referred to hereinabove in connection with the pneumatic barrel clamping cylinder **200**, is to create a slight lag in the operation of that cylinder and its corresponding clamping member in relation to the hydraulically operated cylinder **201** and its respective clamping member. The hydraulic cylinder is operated at a relatively low pressure, e.g., 15 p.s.i. by reason of the reducing valve **322**, such pressure being sufficient to move the respective clamping member **204** quickly into contact with the drum **14** but insufficient to move the drum. The pneumatic cylinder **200** is operated at a higher pressure, e.g., 60 p.s.i., hence will clamp the drum firmly in position and will resist a high torque. The check valve **323** effectively closes the hydraulic cylinder **201**, which therefore acts as a rigid stop reacting against the pneumatic

cylinder **200**, and it does so slightly in advance of the pneumatic cylinder.

As explained hereinabove with reference to Figure 12, the release of a Rieke cap down its chute **75** will cause it to trip the corresponding valve **326** which is shown in Figure 12 and also in the control diagram, Figure 21A. This places the valve **326** in its spring position in which it communicates an air pressure line **327** with a line **328**. Air then passes through the line **328** to the air pilot A_1 of a valve **329***a*. The valve **329***a* is one side of a double purpose valve, the other side being indicated as **329***b*. The valve **329***a* functions with the "right hand" or "Rieke" side of the system, and the valve **329***b* with the left-hand" or "Tri-Sure" side of the system. When the valve **329***a* is placed in its air pilot A_1 position, hydraulic fluid under pressure from a suitable source (not shown) passes through a line **330** containing a stop valve **335** to a line **336** containing a compensated flow control valve **337**, to the valve **329***a*, thence to a line **338** to the hydraulic motor **121** of the Rieke mechanism **85**. Spent hydraulic fluid drains through a line **339***a* and a common line **339** to sump. The compensated flow control valve **337** is of a known construction and is of a type such that it passes fluid at a predetermined volume rate regardless of back pressure within suitable limits, such that the hydraulic motor **121** will rotate the spindle **103** and the chuck **101** at a constant speed regardless of increasing torque caused by increasing tightness of the cap in a bung hole, as explained in more detail hereinafter.

Meanwhile a portion of the air flowing through the line **328** is diverted through a line **340** containing a needle valve **345** to a venturi **346**, thereby creating suction in a line **347** connected to the venturi and to the passage **103***a* in the spindle **123** (see Figures 9 and 10). Air is also supplied through the line **328** and a line **348** to a valve **349**. (See Figure 21B.) The valve **349** is spring operated and has a normal spring position. It also has a vacuum pilot designated by the reference character "V." The construction of valve **349** is described in detail hereinafter with reference to Figure 22. It has a diaphragm which is controlled by the vacuum pilot and the spring. Suction is applied to the vacuum pilot through a line **350** and the line **347**, which is connected to the axial passage **103***a* of the spindle **123** and to the venturi **346**. (Figure 21A.) As long as air is being sucked up through the chuck **101** into the axial passage **103***a* and the line **347**, insufficient vacuum is applied to the vacuum pilot of the valve **349** to actuate it, hence that valve remains in its spring position. As long as the valve **349** remains in its spring position, it communicates the line **348** with a line **351** which is also connected to the air pilot of a valve **352**. (Figure 21A.) When the valve **352** is in its air pilot position it communicates a line **353** containing a restriction **354** with a line **355**. Referring to Figure 9 as well as to Figure 21A, it will be seen that the line **353** communicates with the chuck lifting cylinder **136** beneath the piston **139**. The line **355** connects the valve **352** with a valve **356** (Figure 21B) which, at this stage of operation, is in its normal, spring position thereby communicating the line **355** with an exhaust line **357** which is connected to atmosphere. It will, therefore, be apparent that air pressure in the chuck lifting cylinder **136** beneath the piston **139** is free to exhaust through line **353**, valve **352**, line **355**, valve **356** and line **357** to atmosphere. The release of pressure beneath the piston **139** as a result of this setting of the valves **352** and **356** permits the piston **139** to descend by gravity, but under control of valve **354**, thereby causing the chuck **101** to descend a short distance into its appropriate cup **81** (see Figure 9) to pick up a Rieke cap or bung **46**.

Assuming that the chuck **101** immediately makes proper contact with the bung, its O-ring **109***a* (see Figure 8) will seal against the bung and a vacuum will be created in the lines **347** and **350**, hence in the vacuum pilot of valve **349**. This will alter the valve **349**, placing it in what may be called its "vacuum pilot" position, thereby communicating the line **351** with a line **358** which is also connected to a valve **359***a* (Figure 21A). At this stage of operation, the valve **359***a* is in spring position as explained hereinafter. Therefore the valve **359***a* communicates the line **358** with an exhaust line **360** which is open to the atmosphere. (The valve **359***a* is one of three valves indicated as **359**, **359***a* and **359***b* which are shown in the control diagram and also in Figure 1. The valves **359***a*, **359** and **359***b* are normally in spring position but each is placed, at a suitable instant during the cycle of operation, in cam position by engagement with the cam bracket **153**, which is shown in Figures 1 and 9.) At the commencement of the capping cycle and at the stage of operation now under consideration the cam bracket **153** will be in the central "neutral" position illustrated in Figure 1, therefore in contact with the valve **359** and leaving the valve **359***a* (also the valve **359***b*) in spring position as explained above. It will, therefore, be apparent that with the valve **349** in its vacuum pilot position and the valve **359***a* in spring position, compressed air will exhaust from the air pilot of valve **352** to the atmosphere through line **351**, valve **349**, line **358**, valve **359***a* and line **360**. This will result in returning the valve **352** to its normal spring position in which it communicates an air pressure line **365** with the line **353**. Compressed air will then pass through the line **365**, the valve **352** and the line **353** to the cylinder **136** beneath its piston **139** and will raise the piston **139** to the up position illustrated in Figures 9 and 21A. This will result in raising the chuck **101** out of the cup **81**.

A valve **366** is provided which is located at the upper end of the cylinder **136** and which has a normal spring position, and also a cam position in which the valve is placed when the piston **139** is in the up position illustrated in Figures 9 and 21A. When the piston **139** returns in the manner just described to its up position, it therefore places the valve **366** in its cam position. In this position the valve **366** communicates a compressed air line **367** (which is common to both sides of the system) and a branch **368***a* with a line **369** which is also connected to a valve **370** (Figure 21B). The valve **370** has meanwhile been placed in its air pilot position as follows: Air from the line **348** passes through the valve **349** (which, as stated above, is in its vacuum pilot position) to a line **375** which is also connected to the air pilot of the valve **370**. When the valve **370** is in its air pilot position it communicates the line **369** with a line **376***a* which is also connected to the air pilot A_1 of a valve **377**. This places the valve **377** in its air pilot A_1 position wherein it communicates an air pressure line **378** with a line **379** which is also connected to the chuck pivoting cylinder **142**. The cylinder **142** is shown in the control circuit of Figure 21A and also in Figures 1 and 11. It will be seen that compressed air is communicated to the cylinder **142** in such manner as to move the cylinder **142** to the right. Air exhausts from the cylinder through a line **380** and the valve **377** to an exhaust line **381***a* which contains a needle valve **382** and which communicates with the atmosphere. Such movement of the cylinder **142** will rotate the Rieke capping mechanism **85** from the position shown in Figures 8 and 11, into registry with the bung hole **45** of a drum at the capping station.

Such movement of the capping mechanism will cause the cam bracket **153** (see Figures 1 and 9) to rotate from its central, neutral position shown in Figure 1 (in which it is in contact with the plunger of valve **359**) to a position in which it is in contact with the plunger of valve **359***a*. (In the control circuit of Figure 21A, the valves **359***a* and **359***b* and the chuck mechanisms **85** and **86** are transposed from their actual relative positions which are shown in Figure 1. This transposition is for the purpose of clarity, to maintain those elements of the circuit relat-

ing to one of the capping mechanisms on one side of the diagram and those relating to the other capping mechanism on the other side of the diagram. Those elements which are common to both sides are located in most cases centrally of the diagram.)

This movement of the cam bracket **153** results in returning the valve **359** to its spring position and in placing the valve **359***a* in its cam position. When the valve **359***a* is in its cam position it communicates a line **387** with the line **358**. The line **387** is supplied with compressed air from the line **340**, as illustrated. Thus compressed air is caused to pass from line **387** through valve **359***a* and line **358** to the valve **349** (Figure 21B). The valve **349** is still in its vacuum position by reason of the fact that a bung is in place in the chuck **110** and is sealed therein, thus creating a vacuum in the line **350**. Since the valve **349** is in its vacuum pilot position, the line **358** is in communication with the line **351**. Hence it will be apparent that air pressure will now be applied to the air pilot of the valve **352** (Figure 21A). The valve **352** is, therefore, placed in its air pilot position in which it communicates lines **353** and **355**. The valve **356**, to which the line **355** is connected, is still in its normal spring position, hence communicates line **355** with an exhaust line **357** which is connected to the atmosphere. Accordingly, pressure is exhausted from the chuck lifting cylinder **136** beneath the piston **139** through line **353**, restriction **354**, valve **352**, line **355**, valve **356** and line **357** to atmosphere. Accordingly, the piston **139** and with it the chuck **101** containing a bung, will drop to engage the cap with the bung hole of a drum at the capping station. As explained in detail in the aforesaid copending application Serial No. 317,856, by reason of the double universal joints in the capping mechanism the chuck **101** will automatically adjust itself for horizontal and vertical deviations of the bung hole. Meanwhile, the bung is held firmly in place, and in operative engagement with the chuck by the vacuum created by the venturi **346**. Also the chuck is spinning and will act as a wrench to thread the bung into a bung hole. When the bung has been properly aligned with the bung hole in the manner described herein and in greater detail in the aforesaid copending application Serial No. 317,856, it will be screwed into the bung hole. The flow control valve **337** (Figure 21A) referred to above will continue to deliver hydraulic fluid at the same volume rate to the hydraulic motor **121**; hence the chuck **101** will continue to spin at constant speed notwithstanding increasing torque and increasing back pressure on the line **338** as the bung tightens up in the bung hole. However, when a predetermined back pressure has been built up (i.e., when the bung has been screwed into its bung hole to a predetermined degree of tightness) rotation of the chuck **101** will be terminated in the manner now to be described.

For this purpose a sequence valve **388** is provided (Figure 21A) which is connected by a line **389** to the line **338** through which hydraulic fluid is supplied to operate the hydraulic motor **121**. The sequence valve **388** may be of standard, known construction and does not require detailed description herein. It exhausts through a line **390***a* and a common line **391** to an overload relief valve **392**. The line **391** has a restriction **393**, and it is connected (ahead of the restriction **393**) to a line **394** which is connected to the hydraulic pilot of a valve **395** (Figure 21B).

The sequence valve **388** is, in effect, a signal valve which is set to open at a predetermined pressure, e.g., 500–550 p.s.i. When the back pressure in line **338** reaches this predetermined value by reason of a predetermined torque (hence predetermined tightness of the cap in the bung hole), the valve **388** will open. Hydraulic fluid at this pressure will then flow through the line **391**. It is desirable to protect the hydraulic pilot of valve **395** against this high pressure; hence the overload relief valve **392** is provided which opens at, say 200–250 p.s.i. The purpose of the restriction **393** is to exhaust fluid under pressure from the hydraulic pilot of valve **395** at a controlled rate to allow a dwell of that valve in its hydraulic pilot position for a sufficient time, e.g., about two seconds. The purpose of the dwell is to insure resetting of the control system in the manner which will now be described.

When the reset valve **395** (Figure 21B) is placed in its hydraulic pilot position it communicates an air pressure line **410** with a line **411**. The line **411** is also connected to a hand valve **412** (Figure 21A) having a hand control H, such valve being normally in its spring position, thereby communicating the line **411** with a line **413**, thence through a branch line **413***a* with the air pilot of the trip valve **326**. The resulting pressure pulse to the air pilot of the valve **326** recocks that valve and places it in the cam position shown in Figure 12, thereby shutting off the supply of air from the supply line **327** to the line **328**. As a result of this closing of the valve **326** with respect to the line **328**, suction in the lines **347** and **350** will be terminated. Vacuum is, therefore, broken and the chuck **110** is caused to release the bung or cap, which meanwhile has been screwed into its bung hole. Also the valve **349** (Figure 21B) is caused to return to its normal, spring position because no vacuum is applied. Moreover, line **328** (Figure 21A) exhausts through trip valve **326** to exhaust line **326***a*, hence exhausts air pressure from the air pilot A_1 of valve **329***a*. This resets valve **329***a* and shuts off hydraulic pressure to hydraulic motor **121** and stops that motor. The valve **352** (Figure 21A) also returns to its normal, spring position because no air is supplied through lines **328** and **348** and because the pressure in the air pilot of valve **352** is free to exhaust through line **351**, valve **349**, lines **348** and **328** and valve **326**. With the valve **352** aagin in its spring position, air will pass from the air supply line **365** through valve **352** to line **353**, thence to the chuck lifting cylinder **136** beneath the piston **139**, resulting in the lifting of the piston **139** and of the chuck **110**. When the piston **139** reaches its up position illustrated in Figures 9 and 21A, the valve **366** will again be placed in its cam position. When the valve **366** is in its cam position it communicates lines **368***a* and **369**, thereby supplying air to the valve **370**. (Figure 21B.) Meanwhile, compressed air has exhausted from the air pilot of valve **370** through line **375**, valve **349**, line **358**, valve **359***a* (Figure 21A), lines **387**, **340** and **328** and valve **326**. Valve **370** is, therefore, returned to its spring position, and in this position it communicates line **369** with a line **376***b*, which is also connected to the air pilot A_2 of valve **377** (Figure 21B). Meanwhile air pressure from the air pilot A_1 of valve **377** is free to exhaust through line **376***a*, valve **370** and a line **414** to atmosphere. When the valve **377** is in its air pilot A_2 position, it communicates air pressure line **378** with line **380**, thence with the chuck pivoting cylinder **142** (Figure 21A) in such manner as to move the cylinder to the left. This pivots the chuck mechanism **85** and returns it to its central, neutral position illustrated in Figures 2 and 8.

Air from air pressure line **410** (Figure 21B) also passes through valve **395**, line **411** and hand valve **412** (Figure 21A), as described above, to a line **415**, thence to the air pilot of valve **320**, (Figure 21B) which is therefore placed in its air pilot position. Consequently hydraulic fluid is allowed to exhaust from the hydraulic barrel clamping cylinder **201** through line **325** and valve **320** to sump. The spring **207** in cylinder **201** will, therefore, retract the respective clamping member **204**. Air also passes from the same source **410** through valve **395**, line **411**, hand valve **412**, line **413** and branch line **413***a*, as described above, to a line **413***b*, to the air pilot of valve **307** (Figure 21A), thereby placing that valve in its air pilot position. When the valve **307** is in its air pilot position it communicates the line **309** with an exhaust line **416**. As a consequence, compressed air is exhausted

from the bung escapement cylinder 65 (Figure 21B) through lines 310 and 309, valve 307 and line 416, and from the pneumatic barrel clamping cylinder 200 through the by-pass line 317, its check valve 318, line 315, line 309, valve 307 and exhaust line 416. The purpose of the by-pass line 317 is to allow very rapid exhausting of pressure from the pneumatic cylinder 200 for a rapid return of this cylinder to its normal, spring position in readiness for ejecting the capped drum from the capping station.

The return of cam bracket 153 to its central, neutral position, in the manner explained hereinabove, results in placing the valve 359 (Figure 21A) in its cam position. When in its cam position the valve 359 communicates an air pressure line 417 with a line 418. Consequently compressed air passes through the route indicated to a valve 419 (Figure 21B). The latter valve is also illustrated in Figures 1 and 16. It is normally in its spring position but it also has a cam position in which it is placed by depression of a lever 419*a* which is shown in Figures 1 and 16. The lever 419*a* is depressed only when a drum is located in the position shown in the extreme left of Figure 1, i.e., just beyond the capping station.

Frequently in capping or bunging barrels of lubricating oil and other petroleum products, a seal is applied to each bung after it has been screwed into a bung hole. This is done to comply with consumers' requirements or as a matter of business policy, to indicate that each barrel has not been opened and that the contents have not been disturbed. At the present time it is contemplated that such sealing operation will be performed manually by an operator. Filled drums are blocked down the line some distance and from time to time the operator will apply seals to the filled drums that have accumulated. Because of preoccupation with other duties, the operator may allow too many filled drums to accumulate, and a drum may be located at the position indicated at the extreme left of Figure 1. When in this position the lever 419*a* will be depressed and, as a consequence, the valve 419 will be in its cam position. When the valve 419 is in its cam position air pressure in line 418 cannot pass through the valve 419 to line 420. As will be apparent from the description hereinafter, this condition will stop further operation of the machine until the space adjacent the capping station is cleared.

Assuming that this area is free and clear, as is normally the case except for the brief interval of time while a drum is passing over the lever 419a, the valve 419 will be in its spring position and, when in this position, it will communicate the line 418 with a line 420 which is also connected to a valve 421. The valve 421 meanwhile has been placed in its air pilot A_1 position during a previous part of the cycle of operation, i.e., while the valve 359 (Figure 21A) was in its spring position, hence communicating air pressure from the air pressure line 417 with a line 422 which contains a needle valve 422*a* and has a by-pass 422*b* containing a check valve 422*c*. The line 422 is also connected to the air pilot A_1 of the valve 421. (Air pressure, meanwhile, has exhausted from air pilot A_2 of valve 421 through a line 433, a valve 424 and an exhaust line 424*a*.) Hence air pressure in line 420 can pass through the valve 421 to a line 423, thence to the air pilot A_1 of a valve 424, thereby placing that valve in its air pilot A_1 position. In this position the valve 424 communicates an air pressure line 425 with a line 426 containing a restriction 427 and having a by-pass 428 containing a check valve 429. The line 426 is also connected at one end of the drum ejecting cylinder 175, to the right of the piston thereof as viewed in Figure 21B. The cylinder 175 is, therefore, operated to eject the drum in the manner described hereinabove. Air exhausts from the other end of the cylinder 175 through a line 430 and the valve 424 to an air exhaust line 431 containing a restriction 432 and which communicates with the atmosphere. Air also passes through a line 433 branching from the line 426 to the air pilot A_2 of the valve 421, and air pressure exhausts from air pilot A_1 of valve 421 through line 422, by-pass 422*b* and check valve 422*c* (Figure 21B) and valve 359 to an exhaust line 417*a* (Figure 21A). The valve 421 is, therefore, placed in its air pilot A_2 position, and in this position it communicates the line 423 with an air exhaust line 434 which communicates with the atmosphere, thereby exhausting air pressure from the air pilot A_1 of the valve 424. When the ejected drum contacts the lever 419*a* (see Figures 1 and 16) it places the valve 419 in its cam position, in which the line 418 is communicated with a line 435. Air pressure will then pass from the air pressure line 417 (Figure 21A) through the valve 359 (which is in its cam position), line 418 and valve 419 to line 435, thence to the air pilot A_2 of valve 424, thereby placing that valve in its air pilot A_2 position. When the valve 424 is in its air pilot A_2 position it communicates the air pressure line 425 with the line 430, which is also connected to the drum ejecting cylinder 175 to the left of the piston thereof. This will result in moving the piston to the right as viewed in Figure 21B, hence will rotate the drum ejecting lever 180 counterclockwise to the position shown in Figures 1 and 14. The cam lever 189 will also rotate with the stop 188 by reason of the torsion spring 187 (see Figure 13) and since no drum is at the capping station the cam arm 189 will be free to rotate to the position shown in broken lines in Figure 14. The cam lever 189 will, therefore, cause the low dwell 186 of the cam 184 to register with the plunger of the valve 300, thereby returning that valve to its spring position.

This completes a cycle of operation and the machine is now in readiness to receive the next filled, weighed drum and to commence a new cycle.

In the operation described it has been assumed that the chuck 101 picked up a bung and formed a vacuum on its first pass. It may, however, happen that imperfect contact is made with the bung because of lack of proper engagement of the driving lugs on the bung and the wrench fittings 108. A vacuum, therefore, fails to form. In such event a means is provided to raise the chuck and lower it again, and to repeat this "hunting" operation, if necessary, until the chuck makes proper contact with a bung and forms a vacuum. Such means is incorporated in the control circuit illustrated and described above and will now be described in detail.

A line 450 is provided which is connected at one end to the valve 366 (Figure 21A) and at its other end to the air pilot of the valve 356 (Figure 21B). The line 450 contains a needle valve 451 and is provided with a by-pass 452 containing a check valve 453.

When the piston 139 descends in the chuck lifting cylinder 136 at the commencement of a cycle of operation, the valve 366 is returned to its normal spring position as explained hereinabove. In this position the valve 366 communicates the air pressure lines 367 and 368*a* with the line 450 so that compressed air can reach the air pilot of the valve 356. However, the rate at which air pressure is supplied to this air pilot is controlled by the setting of the needle valve 451, which is purposely set so that it will actuate the air pilot of the valve 356 only after the lapse of a predetermined time, of the order of 3 to 5 seconds. Meanwhile the chuck 101 will have descended and made a pass at the bung in the cup 81 and, if the cap or bung seats properly in the chuck and a vacuum is created, normal operation will proceed as described hereinabove. If, however, a cap or bung is not picked up and a vacuum is not formed within such predetermined time, then sufficient air pressure will have been delivered to the air pilot of the valve 356 to actuate the same, thereby placing the valve 356 (Figure 21B) in its air pilot position. In this position, the valve 356 communicates an air pressure line 454 with a line 355, thereby supplying air under pressure to that line. Meanwhile, the valve 349 (Figure 21B) is still in its normal spring

position because insufficient vacuum has been created in the vacuum pilot V of the valve **349**. In this position the valve **349** communicates line **348** with line **351**, which places the valve **352** in its air pilot position. In this position, the valve **352** communicates lines **355** and **353**. It will, therefore, be apparent that, when the condition described above exists, i.e., when the chuck **101** has dropped but has not picked up a bung and formed a vacuum within a predetermined interval of time, air will pass into the cylinder **136** beneath the piston **139** through line **454**, valve **356**, line **355**, valve **352** and line **353**. The piston **139** will, therefore, lift and will lift the chuck **110**.

When the piston **139** reaches its top position, it will place the valve **366** again in its cam position, which will exhaust compressed air from the air pilot of the valve **356** through the line **450**, the by-pass **452**, check valve **453**, valve **366** and an air exhaust line **455**. The valve **356** will, therefore, return to its normal spring position, and will communicate the line **355** with the air exhaust line **357**. The valve **352** meanwhile is still in its air pilot position, hence communicates line **353** with line **355**. It will, therefore, be apparent that pressure will be exhausted from the cylinder **136** beneath the piston **139** through line **353**, valve **352**, line **355**, valve **356** and line **357** to atmosphere. Accordingly, the piston **139**, and with it the chuck **110**, will drop again, thereby making a second pass at the bung in the cup **82**.

This procedure will repeat itself indefinitely until the chuck has picked up a bung and has formed a vacuum. It will, therefore, be apparent that an effective bunting operation is provided whereby effective operation of the machine is insured.

In the description of the control circuit hereinabove, a number of needle valves and the like are referred to and are shown in Figures 21A and 21B; e.g., the needle valve **345** (Figure 21A) in line **340** leading to the venturi **346** and the needle valve **354** (Figure 21A) in the line **353** connected to pilot valve **352**. The purpose of some of these needle valves, etc. will be apparent. In general they are intended to control speed of operation of various components of the machine and are adjustable to synchronize the various operations of the machine. The following detailed description of the functions of several of these valves will suffice as an explanation.

The needle valve **345** (Figure 21A) controls the air pressure to venturi **346**, hence controls the degree of suction or vacuum in lines **347** and **350**, hence in chuck **101** and the vacuum pilot of pilot valve **349**. The valve **354** (Figure 21A) controls the rate of supply of air pressure to and exhaust of air pressure from the chuck lifting cylinder **136** beneath piston **139**; hence it controls the speed of operation of that piston **139**.

The function of the needle valve **422***a* in line **422** (Figure 21B) is more complex. When the valve **359** returns to its spring position (i.e., when the cam bracket **153**, see Figures 1 and 9, is pivoted to one side), compressed air exhausts through line **418**, valve **359** and line **417***a*. However, because of its compressibility, air pressure remains in line **420** (Figure 21B) for a brief interval of time. If compressed air is delivered immediately from air pressure line **417** through valve **359** and line **422** to air pilot A_1 of valve **421**, air pressure remaining in line **420** will pass through valve **421** (which would be in its air pilot A_1 position) to line **423**, thence to air pilot A_1 of valve **424**. To avoid this, the needle valve **422***a* is provided which causes a delay in actuation of the A_1 pilot of valve **421** until pressure has exhausted from line **420**.

The function of the needle valve **322** (Figure 21B) is to reduce the hydraulic pressure supplied through pilot valve **320** and line **325** to the hydraulic drum clamping cylinder **201**. Pressure for operating that cylinder need not and should not be as high as the pressure in line **305**. The function of needle valve **427** is to control the exhaust of air pressure from drum ejecting cylinder **175** (Figure 21B) through line **426**, etc., hence to control the speed of operation of that cylinder in one direction. The needle valves **382** and **383** (Figure 21B) control the rate of exhaust, hence the rate of operation of the chuck pivoting cylinder **142**. We have found that, with air cylinders such as the cylinders **175** and **142**, smoother operation is obtained by placing such control valves on the outlet side rather than the inlet side of the cylinder.

Among other features of the machine which are illustrated in the drawings but are not described hereinabove, there may be mentioned the following:

Referring to Figures 21A and 21B, it will be seen that a line **480** is connected to valve **395**. This line, which is continued in Figure 21A, is also connected to a valve **481** which is supplied with compressed air by a line **482**. The line **480** also branches at **483**, the branch **483** being connected to the control circuit of the drum filling mechanism. The valve **481** is normally in its spring position wherein the air pressure line **482** is not connected to the line **480**. However, the valve **481** is placed in its cam position when a door (not shown) in the enclosure (not shown) of the capping mechanism is opened. When the valve **481** is thus placed in its cam position, air pressure passes from line **482** through valve **481** to line **480**, thence to valve **395** (Figure 21B), which is normally in its spring position. Hence air pressure passes from line **480** through valve **395** to line **411**. Air pressure thus delivered to line **411** will stop the capping mechanism, as will be apparent. Thus, it will recock the trip valve **326**, hence shut off air pressure to line **328** (Figure 21A), etc. Air pressure delivered through branch line **483** will also stop the filling mechanism.

It will, therefore, be apparent that the door operated valve **481** serves as a safety feature to stop the machine whenever an access door is opened, e.g., for inspection, adjustment or repairs.

A line **484** is connected to the valve **300** (Figure 21B). As explained hereinabove, the valve **300** is placed in its cam position when a drum is delivered to the capping station, thereby communicating hydraulic pressure line **301** with line **302** and starting a cycle of operation. When the capping station is empty, the valve **300** is in its spring position, and in that position it communicates pressure line **301** with the line **484**. Pressure in line **484** is a signal to the filling mechanism that the capping station is empty, hence in readiness to receive another filled (but uncapped) drum. The valve **300**, in fact, takes the place of the valve 341 shown in Figure 25 of Guerard et al. Serial No. 307,554. That valve provided a downstream signal to indicate whether the space adjacent and downstream from the filling station is clear. The addition of the capping mechanism of the present invention requires that the corresponding valve be moved farther downstream.

Referring to the Rieke chuck pivoting cylinder **142** in Figure 21A, its piston **143** is there shown in its "neutral" position, i.e., holding the Rieke chuck **101** (see Figures 8 and 11) in registry with the Rieke cap **81**. The piston **143** is held in this "neutral" position (until the appropriate signal, as explained hereinabove) in the following manner. The valve **377** (Figure 21B) is as yet in its air pilot A_2 position, hence communicates air pressure line **378** with line **380**, thence with cylinder **142** in such manner as to hold the piston **143** in neutral position.

A line **486** containing a check valve **487** is shown in Figure 21B connecting lines **450** and **380**. The purpose of this connection is as follows: When the chuck **101** has picked up a cap or bung, then lifted and pivoted into registry with the bung hole of the drum and then descended and commenced to screw the cap into the bung hole, it is necessary to prevent the chuck from lifting again until the capping operation has been completed. However, when the chuck **101** is in its down

position, the valve 366 (Figure 21A) will be in its spring position, and in that position it will communicate air pressure lines 367 and 368*a* with line 450, which in turn connects to the air pilot of valve 356. If valve 356 is placed in its air pilot position it will supply pressure from air pressure line 454 to line 355, thence through line 355, valve 352 and line 353 to chuck lifting cylinder 136, and will cause the piston 139 and chuck 101 to lift. However, at this stage of operation, the line 380 vents to atmosphere through valve 377 and line 381*a*. Accordingly, air pressure will bleed from line 450 through check valve 487, line 486, line 380, etc. It will be apparent, therefore, that during this stage of operation, valve 356 is maintained in its spring position, hence does not cause the chuck 101 to lift. During that stage of operation when it is required to actuate the air pilot of valve 356, the check valve 487 is closed by a higher pressure in line 380.

The vacuum pilot valve 349 is shown diagrammatically in Figure 21B. It is shown in greater detail in Figure 22. Referring now to Figure 22, the valve 349 comprises a component 490 which is itself a valve of known design. For example, the valve 490 may be a commercially available valve known as a Beckett-Harcum valve manufactured by the Beckett-Harcum Co. of Wilmington, Ohio, and called the "Hi-Cyclic Air Valve." This particular valve or others may be used for the purpose, and it comprises a housing or valve body 491 having suitable ports (not shown) which connect with the lines 348, 358, 351 and 375 shown in Figure 21B. The housing contains suitable means (not shown) to interconnect the various ports, such means being operated by a plunger 492 formed with a button 493 at its outer end. A spring 494 (which is shown diagrammatically and is unnumbered in Figure 21B) is provided which normally maintains the plunger 492 in extended position.

The foregoing valve 490 is modified for purposes of the present invention as follows: A housing 495 is provided which is formed with a chamber 496 and is drilled through at 497 to receive the plunger 492. A diaphragm 498 is bolted to the housing 495 by a ring 499, bolts 500 and nuts 505. The housing is tapped and threaded at 506, to provide a port which is connected to the line 350 (Figure 21B).

It will be apparent that, when the port 506 is open to atmospheric pressure, the component valve 490 will be in its spring position. It will also be apparent that, when a sufficient degree of suction is pulled on the chamber 496 through port 506, the pressure differential between atmospheric pressure on the outside of diaphragm 498 and the low pressure in chamber 496 will move the diaphragm 498 and plunger 492 against the spring 494 and will place the valve 490 in its vacuum pilot position.

The valve assembly 349 can be modified to convert it to a low-pressure-operated valve, by adding a cover as shown in dotted lines at 507, such cover having a port at 508. The port 506 will connect to atmosphere and the port 508 to a source of low pressure fluctuating between, say, atmospheric pressure and 3 p.s.i. above atmospheric. When the pressure communicated to chamber 496 through port 508 reaches a predetermined value, e.g., 3 p.s.i., it will actuate the valve to place it in its air pilot position.

Operation of the machine of the present invention has been described with reference to the "Rieke" side of the system. It will be apparent that operation of the "Tri-Sure" side is virtually identical. Like reference numerals are used for like parts of the "Tri-Sure" side of the system.

One difference worthy of note is with respect to the trip valves 326 and valves 307 (Figure 21A). As explained hereinabove, when the "Rieke" trip valve 326 is tripped by a Rieke cap which has been released from the cap conveyor, compressed air passes from line 327 through valve 326 to line 328, thence through a branch line 340 to venturi 326. On the "Tri-Sure" side of the system, when a "Tri-Sure" cap trips the corresponding trip valve 326 (which is shown on the left-hand side of Figure 21A), compressed air passes from line 327 through valve 326 to line 328, thence through a branch line 328*a* to the air pilot A_1 of valve 307 on the Tri-Sure side. Meanwhile, hydraulic pressure will have placed the valve 307 on the "Rieke" side in its hydraulic pilot position to operate the bung escapement cylinder 65 and pneumatic drum clamping cylinder 200 in the manner described hereinabove. (These elements—cylinders 65 and 200—both of which are shown in Figure 21B, are common to both sides of the system and are actuated independently of and ahead of the trip valves 326.) It will be seen that the valve 307 (Figure 21A) on the "Tri-Sure" side serves to connect an air pressure line 485 with the line 340 which is connected to the corresponding venturi 346. The line 485 is in turn connected to a source of higher air pressure than the line 327 on the "Rieke" side. Therefore, the venturi 346 on the "Tri-Sure" side is operated at a higher velocity and a greater suction is pulled in the "Tri-Sure" chuck 101.

The purpose of this greater suction is as follows: A certain proportion of "Tri-Sure" caps are pierced to provide two small holes for attachment of a sealing wire. These holes leak and tend to break the suction. Hence, a greater suction is provided in the manner described.

It will, therefore, be apparent that the valve 307 on the Rieke side serves both sides of the system and its function is to operate the bung escapement cylinder 65 and the pneumatic clamping cylinder 200; that the trip valve 326 on the "Rieke" side serves the purpose, among others, of operating the corresponding venturi; and that the valve 307 on the "Tri-Sure" side serves the purpose of operating its corresponding venturi 346.

It will, therefore, be apparent that a machine has been provided which is capable of applying screw caps or bungs automatically to steel drums, barrels and the like, such operation being carried out at high speed. The machine is integrated and synchronized with a filling machine; it is capable of applying different types of caps or bungs to drums; and it applies the proper cap or bung to each of the drums. The machines incorporate numerous safety and interlock features which render its operation safe and dependable as well as speedy and automatic.

We claim:

1. A machine of the character described comprising a chuck for picking up, engaging and spinning a threaded member such as a screw cap, means mounting said chuck for such spinning motion and for movement between a pickup position and a threading position, and operating means actuated automatically by delivery of a drum to said threading position and by delivery of a screw cap to said pickup position for causing the chuck to undergo automatically a cycle of operation wherein the chuck picks up and engages a threaded member at the pickup position, moves to the threading position, spins the threaded member and threads it to a companion member at the threading position, disengages the threaded member when a given degree of tightness is achieved and returns to the pickup position.

2. A machine of the character described comprising a chuck for picking up, engaging and spinning a threaded member such as a screw cap, means mounting said chuck means for such spinning motion and for movement between a pickup position and a threading position, suction means for securing a screw cap to said chuck, and operating means actuated automatically by delivery of a drum to said threading position and by delivery of a screw cap to said pickup position for causing the suction means to operate and the chuck to undergo automatically a cycle of operation wherein the chuck picks up and engages a threaded member at the pickup position, moves to the threading position, spins the threaded member and threads it to a companion member at the threading posi-

tion, disengages the threaded member when a given degree of tightness is achieved and returns to the pickup position.

3. Automatic capping mechanism comprising a drum support for supporting a drum with its threaded opening at a capping position, a chuck engageable with a screw cap fitting said opening, said chuck being capable of spinning the screw cap, said chuck being mounted for such spinning motion and for movement between a pick-up position and said capping position, a cap holder at said pickup position, suction means operable to secure a cap to said chuck, means for automatically spinning said chuck, means for automatically moving said chuck between said capping and pickup positions, and torque responsive means for disengaging the chuck from a cap that has been screwed to a threaded opening to a predetermined degree of tightness.

4. Automatic capping mechanism comprising a cap holder for holding a screw cap, a chuck engageable with such screw cap to spin the cap and thread it to a threaded bung hole, sealing means associated with the chuck to seal against a cap which is properly engaged with the chuck, suction means communicating suction to the chuck to cause the chuck to hold a cap by suction for transport to a capping position, means mounting the chuck for spinning and for movement between said cap holder and said capping position, means automatically causing a cycle of operation wherein the chuck moves to the cap holder when a cap is received by the holder, commences its spinning motion, forms a seal with the cap and moves to the capping position, and means operable when an imperfect seal is formed for automatically and repeatedly retracting the chuck from and re-approaching the cap holder until a proper seal is effected.

5. Automatic capping mechanism comprising a cap holder for holding a screw cap, a chuck engageable with such screw cap to spin the cap and thread it to a threaded bung hole, sealing means associated with the chuck to seal against a cap which is properly engaged with the chuck, suction means communicating suction to the chuck to cause the chuck to hold a cap by suction for transport to a capping position, means mounting the chuck for spinning and for movement between said cap holder and said capping position, means actuated by the delivery of a cap to said cap holder for causing the chuck to automatically commence spinning and move into engagement with a cap in the cap holder and for causing said suction means to commence operation, suction responsive means causing the chuck to move to the capping position when it engages a cap and forms an effective seal therewith, and means operable when the chuck fails to form an effective seal for automatically and repeatedly retracting the chuck from and reapproaching the cap holder until a proper seal is effected.

6. Automatic capping mechanism comprising a chuck engageable with a screw cap to spin the same and having sealing means for sealing against such cap, and suction means operable to secure such cap to the chuck; said chuck being mounted for spinning to screw a cap to a threaded bung hole and being movable between a pickup position for picking up a cap and a capping position for screwing the cap to a bung hole; means actuated by delivery of a cap to said capping position to initiate a cycle of operation wherein the chuck moves to the pickup position to pick up a cap by suction, and then moves to the capping position to screw a cap into a bung hole; and hunting means operable, when the chuck fails to form a seal with a cap, to retract and then return the chuck to its pickup position, and to repeat such retractive-return movement until a seal is formed.

7. Automatic capping mechanism comprising a chuck engageable with a screw cap to spin the same, a tubular spindle for spinning the chuck and applying suction thereto, sealing means for sealing against a cap held by the chuck, and means for applying suction to said spindle; said chuck being mounted for spinning to screw a cap to a threaded bung hole and being movable between a pickup position for picking up a cap and a capping position for screwing the cap to a bung hole; means actuated by the delivery of a cap to said capping position to initiate a cycle of operation wherein the chuck commences spinning, suction is applied, the chuck moves to the pickup position to pick up a cap by suction, then moves to the capping position to screw a cap to a bung hole, and then releases the cap and returns to the pickup position; and hunting means operable, when the chuck fails to form a seal with a cap, to retract and then return the chuck to its pickup position, and to repeat such retractive-return movement until a seal is formed.

8. Automatic capping mechanism comprising a chuck engageable with a screw cap for spinning the same, a tubular spindle for spinning the chuck and for applying suction thereto, sealing means on said chuck for sealing against a cap; means mounting said chuck for spinning and to move between a pickup position for picking up a cap and a capping position for screwing the cap to a bung hole; means for spinning the chuck, means for applying suction through the spindle, means for moving the chuck between said pickup and capping positions; and means actuated by delivery of a cap to said capping position to initiate a cycle of operation wherein suction commences and the chuck commences spinning and moves to the pickup position to pick up a cap by suction, then moves to the capping position to screw a cap to a bung hole then returns to the capping position; and hunting means operable, when the chuck fails to form a seal with a cap, to retract and then return the chuck to its pickup position, and to repeat such retractive-return movement until a seal is formed.

9. A capping machine of the character described comprising a chuck engageable with a screw cap for spinning the cap and screwing it to a threaded bung hole, an hydraulic motor for rotating the chuck at a rotary speed governed by the volume rate of flow through the motor, adjustable valve means supplying hydraulic fluid to the motor at a constant volume rate, and an overload relief means for by-passing the hydraulic motor and terminating the capping operation when the back pressure created by the torque of the chuck reaches a predetermined value.

10. A capping machine comprising a cap holder for holding a screw cap at a pickup point, a drum holder for holding a drum at a capping station with its bung hole at a capping point, a chuck engageable with a cap and capable of spinning such cap and applying it to said bung hole, means for automatically moving said chuck from the pickup point to the capping point, an hydraulic motor for automatically spinning the chuck, a source of hydraulic pressure, a first, volume control valve and a second, signal valve interposed between said source and said motor; said volume control valve serving to supply hydraulic fluid to the motor at a constant volume rate to operate the motor at a constant speed; said signal valve having a normal closed position and an open position, a signal operated pilot for moving the signal valve to its open position and means for so operating the pilot which is actuated by the delivery of a cap to said cap holder; said machine also comprising overload relief means for by-passing the hydraulic motor and terminating the capping operation when the back pressure created by the torque of the chuck reaches a predetermined value.

11. A capping machine comprising means for automatically conveying drums or the like to a capping station, a cap conveyor including an escapement mechanism for conveying caps to a pickup station, chuck means for picking up each cap at the pickup station and applying it to a drum at the capping station, a first automatic control means operable to actuate the escapement mechanism to release a cap when a drum is delivered to the

capping station, and a second automatic control means operable to actuate said chuck when a released cap has been delivered to the pickup station.

12. A capping machine comprising means for automatically conveying drums or the like to a capping station, a cap conveyor including an escapement mechanism for conveying caps to a pickup station, chuck means for picking up each cap at the pickup station and applying it to a drum at the capping station, said chuck having a cycle of operation wherein it picks up a cap at the pickup station, commences spinning, moves to the capping station, applies a cap to drum, then returns to the pickup station, a first automatic control means operable to actuate the escapement mechanism to release a cap when a drum is delivered to the pickup station, and a second automatic control means operable to start the cycle of operation of the chuck when a released cap has been delivered to the pickup station.

13. An automatic capping machine comprising a drum conveyor for conveying drums in sequence to a capping station, a plurality of chuck means each of which is operable automatically to apply a specific type of cap to drums at the capping station, an overhead endless cap conveyor for conveying all caps in like sequence to a release point, an escapement mechanism actuated by delivery of a drum to the capping station to release a single cap from the overhead conveyor at said release point, and a plurality of inclined chutes, one for each chuck means, selective with regard to the caps to deliver each released cap to its corresponding chuck.

14. Automatic capping mechanism for applying assorted caps to drums, comprising a plurality of chucks located at a capping station, each chuck corresponding to a specific type of cap and being adapted to engage and pick up the corresponding cap and to apply it to the bung hole of a drum, said chucks being normally located with each chuck at a cap pickup position; a cap conveyor comprising a common section for all caps and an individual section for each chuck, each individual section being selective with respect to a given type of cap and terminating at the corresponding cap pickup position, a drum conveyor for conveying drums to said capping station with the bung hole of each drum at a cap applying position, escapement means controlling the release of caps from said common section to said individual sections, means actuated by delivery of a drum to the capping station to actuate the escapement mechanism to release a cap, sensing means associated with each individual section and actuated by delivery of a cap to such section, and chuck operating means actuated by such sensing means to cause the respective chuck to undergo a cycle operation wherein a cap is picked up at the corresponding cap pickup position, engaged by the chuck, transferred to the cap applying position and applied to the bung hole of a drum, and wherein the chuck is then disengaged from the cap and restored to its normal location.

15. Automatic capping mechanism for applying assorted caps to drums, comprising a plurality of chucks located at a capping station, each chuck corresponding to a specific type of cap and being adapted to engage and pick up the corresponding cap and to apply it to the bung hole of a drum, said chucks being normally located with each chuck at a cap pickup position; a cap conveyor comprising an endless conveyor common to all caps and an individual gravity-operated section for each chuck which is selective with respect to a specific type of cap and terminating at the corresponding cap pickup position; a drum conveyor for conveying drums to said capping station with the bung hole of each drum at the cap applying position; escapement means controlling the release of caps from said endless conveyor to said individual sections; means actuated by delivery of a drum to the capping station to actuate the escapement mechanism to release a cap; sensing means for each of said individual sections actuated by delivery of a cap by such section; and chuck operating means actuated by such sensing means to cause the respective chuck to undergo a cycle of operation wherein a cap is picked up at the corresponding cap pickup position, engaged by the chuck, transferred to the cap applying position and applied to the bung hole of a drum, and wherein the chuck is then disengaged from the cap and restored to its normal position; said chuck operating means including also suction means for securing a cap to the chuck, and means for releasing a cap when it has been applied with a predetermined degree of tightness.

16. Automatic capping mechanism for applying assorted caps to drums comprising a plurality of chucks located at a capping station, each chuck corresponding to a specific type of cap and being adapted to engage and pick up the corresponding cap and to apply it to the bung hole of a drum, said chucks being normally located with each chuck at a cap receiving position; a cap conveyor comprising a common, overhead section operated by an endless conveyor for all caps, and an individual inclined chute for each chuck selective with respect to a specific type of cap and terminating at the corresponding cap receiving position; a drum conveyor for conveying drums to said capping station with the bung hole of each drum at a cap applying position; escapement means controlling the release of caps from said endless conveyor to said individual chutes; means actuated by delivery of a drum to the capping station to actuate the escapement mechanisms to release a cap; sensing means for each individual chute actuated by movement of a cap along the chute; and chuck operating means actuated by such sensing means to cause the respective chuck to undergo a cycle of operation whereby a cap is picked up at the respective cap pickup position, engaged by the chuck, transferred to the cap applying position and applied to the bung hole of a drum, and whereby the chuck is then disengaged from the cap and restored to its normal location.

17. Conveyor means of the character described comprising a continuous conveyor operable to convey screw caps or the like continuously to a release point, an escapement mechanism at said release point operable to release the adjacent screw cap and to hold back the next cap until the next cycle of operation, and a pair of chutes for supplying released caps to two distinct pick-up points, said chutes being selective with regard to the caps to direct one type of cap to one pickup point and another type of cap to the other pickup point.

18. In combination, automatic filling apparatus and automatic capping apparatus, said filling apparatus being adapted to receive empty drums or the like and fill each drum with a predetermined quantity of material; transfer mechanism for automatically transferring each filled drum from the filling apparatus to the capping apparatus with the bung hole of the drum located at a cap applying point; said capping apparatus comprising automatic chuck means engageable with and capable of picking up the caps in sequence and transferring each engaged cap from a pickup point to said cap applying point, and capable of applying such cap to the bung hole of a drum and of disengaging the cap once it has been applied, and returning to said pickup point; a cap conveyor for conveying caps to said pickup point; said conveyor including an escapement mechanism operable to release caps one at a time for delivery to said pickup point, control means actuated by delivery of a drum to said capping apparatus and operable to actuate said escapement mechanism to release a cap; and control means actuated by release of a cap to cause said chuck to undergo its aforesaid cycle of operation.

19. In combination, automatic filling apparatus and automatic capping apparatus, said filling apparatus being adapted to receive empty drums or the like and fill each drum with a predetermined quantity of material; trans-

fer mechanism for automatically transferring each filled drum from the filling apparatus to the capping apparatus with the bung hole of the drum located at a cap applying point; said capping apparatus comprising chuck means engageable with and capable of picking up the caps in sequence and transferring each engaged cap from a pick-up point to said cap applying point, and capable of applying such cap to the bung hole of a drum and of disengaging the cap once it has been applied, and returning to said pickup point; a cap conveyor for conveying caps to said pickup point, said conveyor including an escapement mechanism operable to release caps one at a time for delivery to said pickup point, control means actuated by delivery of a drum to said capping station operable to actuate said escapement mechanism to release a cap; control means actuated by release of a cap to cause said chuck to pick up the released cap, move to the cap applying point and apply the cap to the drum at the cap applying point; and control means actuated by the torque of the cap applying operation, to terminate such operation, release the applied cap and cause the chuck means to return to its pickup point.

20. In combination, automatic filling apparatus and automatic capping apparatus, said filling apparatus being adapted to receive empty drums or the like and fill each drum with a predetermined quantity of material; transfer mechanism for automatically transferring each filled drum from the filling apparatus to the capping apparatus with the bung hole of the drum located at a cap applying point; said capping apparatus comprising a plurality of chuck means for different types of cap, each such chuck means being engageable with and capable of picking up the corresponding type of cap and transferring each engaged cap from a pickup point to said cap applying point, and capable of applying such cap to the bung hole of a drum, and of disengaging the cap once it has been applied and returning it to said pickup point; a cap conveyor for conveying caps to said pickup point, said conveyor having a common section for all caps and an individual section for each type of cap, each individual section being selective with respect to a specific type of cap and terminating at a cap pickup point in registry with the corresponding chuck; an escapement mechanism operable to release caps one at a time from said common section to the corresponding individual section for delivery to the corresponding pickup point; control means actuated by delivery of a drum to said capping apparatus operable to actuate said escapement mechanism to release a cap and control means actuated by release of a cap to cause said chuck to undergo its aforesaid cycle of operation.

21. A capping mechanism of the character described comprising a rotary chuck engageable with a threaded member such as a screw cap and capable, when so engaged, of spinning the threaded member and threading it to a companion member, means mounting said chuck for said spinning motion and also for lateral movement to transfer a threaded member from a pickup point to an application point, suction means for securing such threaded member to the chuck, reciprocating means for raising and lowering the chuck to and from engagement with a threaded member, means for moving the chuck laterally, means for spinning the chuck, operating means operable to cause the chuck to undergo a cycle of operation in which the chuck is lowered into engagement with a threaded memebr at said pickup point, suction is applied to secure the threaded member to the chuck, the chuck is raised, then moved laterally to said application point and lowered to engage the threaded member with its companion member, the chuck is caused to spin and thereby apply the threaded member to its companion member, and the chuck is then caused to disengage the threaded member and return to its starting position, and control means actuated by delivery of a threaded member to said pick up point to actuate said operating means.

22. A capping mechanism of the character described comprising a rotary chuck engageable with a screw cap and capable, when so engaged, of spinning the screw cap and threading it to a bung hole, means mounting said chuck for said spinning motion and also for lateral movement to transfer a screw cap from a pickup point to an application point, suction means for securing such screw cap to the chuck, reciprocating means for raising and lowering the chuck to and from engagement with a screw cap, means for moving the chuck laterally, means for spinning the chuck, operating means operable to cause the chuck to undergo a cycle of operation in which the chuck is lowered into engagement with a screw cap at said pickup point, suction is applied to secure the threaded member to the chuck, the chuck is raised, then moved laterally to said application point and lowered to engage the screw cap with its bung hole, the chuck is caused to spin and thereby apply the screw cap to its bung hole, and the chuck is then caused to disengage the threaded member and return to its starting position, control means actuated by delivery of a screw cap to said pickup point to actuate said operating means to the point of application of a screw cap to a bung hole, and control means actuated by torque of the chuck to actuate said operating means to release the cap and return to its starting position.

23. A capping mechanism of the character described comprising a chuck engageable with a screw cap and capable, when so engaged, of spinning the screw cap and threading it to a bung hole, means mounting said chuck for said spinning motion and also for lateral movement to transfer a screw cap from a pickup point to an application point, suction means for securing such threaded member to the chuck, reciprocating means for raising and lowering the chuck to and from engagement with a screw cap, means for moving the chuck laterally, an hydraulic motor for spinning the chuck, operating means operable to cause the chuck to undergo a cycle of operation in which the chuck is lowered into engagement with a screw cap at said pickup point, suction is applied to secure the threaded member to the chuck, the chuck is raised, then moved laterally to said application point and lowered to engage the screw cap with its bung hole, the chuck is caused to spin and thereby apply the screw cap to its bung hole, and then disengage the screw cap and return to its starting position, control means actuated by delivery of a screw cap to said pickup point to actuate said operating means to commence the cycle of operation including spinning of the chuck and picking up a screw cap, control means actuated by suction and operable, when the chuck has formed a seal with a screw cap, to move the chuck to said application point, supply valve means supplying hydraulic fluid to said motor to operate the same at a constant rotary speed, a by-pass valve operating to by-pass said motor when a predetermined back pressure is created by the torque of the rotating screw cap, and control means actuated by the by-passing of said motor to complete the cycle of operation.

24. A chuck mechanism of the character described comprising a chuck having a fitting to engage and spin a threaded member such as a screw cap, a tubular spindle for said chuck, means for applying suction through the spindle to the chuck, double universal connections allowing freedom of movement of the chuck relatively to the normal spindle axis in a horizontal plane and in a vertical plane, means for rotating the spindle, means for moving the spindle axially, and means mounting the spindle for lateral movement.

25. A chuck mechanism of the character described comprising a stationary frame, a chuck pivotally mounted on the frame for pivoting between a first, receiving position for engaging and picking up a screw cap or the like and a second, applying position for applying the engaged screw cap to a threaded bung hole, a hollow spindle for said chuck, means mounting said spindle for rotation

about its axis and also for axial movement, means for spinning the spindle, fluid pressure operated means for moving the spindle axially and suction applying means for applying suction through the spindle to enable the chuck to pick up and secure a screw cap at a pickup position and transfer the same to the applying position.

26. A chuck mechanism of the character described comprising a stationary frame, a chuck pivotally mounted on the frame for pivoting between a first, receiving position for engaging and picking up a screw cap or the like and a second, applying position for applying the engaged screw cap to a threaded bung hole, a hollow spindle for said chuck, means mounting said spindle for rotation about its axis and also for axial movement, an hydraulic motor for spinning the spindle, a supply valve supplying hydraulic fluid to the motor at a constant volume rate, a by-pass valve for by-passing the motor when a predetermined back pressure is created by the torque of the spindle, fluid pressure operated means for moving the spindle axially, and suction applying means for applying suction through the spindle to enable the chuck to pick up and secure a screw cap at a pickup position and transfer the same to the applying position.

27. A capping mechanism comprising a chuck engageable with a screw cap for spinning the cap to thread it to a bung hole, a hollow spindle, means for applying suction through the spindle, to the chuck to secure a cap to the chuck by suction, universal joint connections permitting limited freedom of movement of the chuck relatively to the normal axis of the spindle in a horizontal plane and in a vertical plane, an hydraulic motor and means connecting the motor to the spindle to rotate the latter, valve means for rotating the hydraulic motor at constant speed until a predetermined back pressure is created by the torque of the spindle, means mounting the spindle for axial movement and for lateral movement, fluid pressure means for imparting axial movement to the spindle and fluid pressure means for imparting lateral movement to the spindle.

28. Drum clamping means comprising a base for supporting a drum, clamping members arranged on opposite sides of the base to clamp opposite sides of a drum, each said clamping member being capable of inward and outward movement to and from a clamping position, respectively, pneumatic means for operating one of said members and hydraulic means for operating the other of said members.

29. Drum clamping means comprising a base for supporting a drum, clamping members arranged on opposite sides of the base to clamp opposite sides of a drum, each said clamping member being capable of inward and outward movement to and from a clamping position, respectively, pneumatic means for operating one of said members and hydraulic means for operating the other of said members, and means for delaying action of the pneumatic means relatively to the hydraulic means whereby the hydraulically operated clamping member undergoes its inward stroke in advance of the pneumatically operated clamping member to serve as a rigid stop.

30. In apparatus of the character described comprising a drum support at a capping station, means for automatically delivering drums to said station in sequence with the bung hole in a predetermined position, rotary means for applying a screw cap to the bung hole of the drum at said station, and drum clamping means to hold the drum at said station with the bung hole thereof at said predetermined position against the torque created by said rotary means, said clamping means comprising an hydraulically operated clamping member and a pneumatically operated clamping member, on opposite sides of the drum, a control circuit for operating the same including a source of hydraulic pressure to operate the hydraulic clamping member at a pressure sufficient to cause such clamping member to contact the drum but insufficient to displace the drum laterally, a check valve preventing back flow of hydraulic fluid, a source of pneumatic pressure of sufficient magnitude to prevent rotary displacement of the drum, and delay means to delay operation of the pneumatic clamping member until the hydraulic clamping member has contacted the drum.

31. Automatic barrel capping apparatus comprising a barrel support for supporting a barrel at a capping station, barrel supply means for supplying barrels automatically and in sequence to said station, cap supply means for supplying caps in similar sequence to said station, cap applying means for automatically applying each cap supplied to said station to a barrel at said station, operating means for operating said cap applying means and actuated when a barrel and a cap are at said station, and barrel ejection means operble automatically to eject each barrel at the conclusion of the capping operation, said barrel ejection means being actuated by said cap applying means when a cap has been applied with a predetermined degree of tightness.

32. Automatic barrel capping apparatus comprising a barrel support for supporting a barrel at a capping station, barrel supply means for supplying barrels automatically and in sequence to said station, cap supply means for supplying caps in similar sequence to said station, cap applying means for automatically spinning each cap supplied to said station to apply the same to a barrel at said station, operating means for operating said cap applying means and actuated when a barrel and a cap are at said station, and barrel ejection means operable automatically to eject each barrel at the conclusion of the capping operation, said barrel ejection means comprising a barrel ejector arm, fluid pressure means for operating said arm, and means actuated by the torque of said cap applying means for actuating said fluid pressure means when a cap has been applied to a predetermined degree of tightness.

33. In automatic apparatus of the character described comprising an operating station and mechanism for automatically manipulating a barrel or the like at said station, said mechanism having a cycle of operation wherein it starts at a rest position, performs said manipulation, and returns to said rest position, the improvement which comprises a pivoted barrel ejector and automatic means for pivoting the barrel ejector from a normal position clear of said station to eject a barrel from the station and to pivot the ejector back to its normal position, a first signal means actuated by the conclusion of the said manipulating operation to actuate said automatic pivoting means, a second signal means operable to initiate said cycle of operation, and a pivoted signal actuator which pivots with said barrel ejector during ejection of a barrel but returns after such ejection to a rest position and which, in so doing, actuates said second signal means.

34. Barrel capping apparatus comprising a barrel support at a capping station, barrel clamping means to clamp a barrel at said station to prevent rotation of the barrel during the capping operation, barrel supply means for supplying barrels in sequence to said capping station, cap supply means for supplying caps in like sequence to a pickup point at said station, a chuck for engaging and spinning such cap, means mounting said chuck for spinning movement and for lateral movement between said pickup point and a capping point for applying the cap to a bung hole of a barrel at said station, means for spinning said chuck, means for effecting said lateral movement of the chuck, and means for ejecting a capped barrel from said station; said apparatus also comprising motive means for accomplishing the said operations and control means operable to effect automatically and repeatedly a cycle in which the barrel supply means supplies a barrel to said station, the barrel clamping means clamps such barrel, the cap supply means supplies a cap to said pickup point, the

chuck moves from a rest position, picks up such cap, moves to said applying point, spins and applies the cap to the barrel, the chuck then releases the cap when a predetermined tightness has been achieved, and returns to its rest position, and the barrel ejecting means moves from a rest position, ejects the capped barrel and then returns to its rest position.

35. Barrel capping apparatus comprising a barrel support at a capping station, barrel clamping means to clamp a barrel at said station to prevent rotation of the barrel during the capping operation, barrel supply means for supplying barrels in sequence to said capping station, cap supply means for supplying caps in like sequence to a pickup point at said station, a chuck for engaging and spinning such cap, means mounting said chuck for spinning movement and for lateral movement between said pickup point and a capping point for applying the cap to the bung hole of a barrel at said station, means for spinning said chuck, means for effecting said lateral movement of the chuck, and means for ejecting a capped barrel from said station; said apparatus comprising motive means for accomplishing the said operations and control means operable to carry out automatically and repeatedly a cycle in which the barrel supply means supplies a barrel to said station, the barrel clamping means clamps such barrel, the cap supply means supplies a cap to said pickup point, the chuck moves from a rest position, picks up such cap, moves to said applying point, spins and applies the cap to the barrel, the chuck then releases the cap when a predetermined tightness has been achieved and moves back to its rest position, and the barrel ejecting means moves from a rest position, ejects the capped barrel and then returns to its rest position; said control means including a signal means for initiating such cycle of operation and means operated by delivery of a barrel to said capping station for actuating said signal means.

36. Barrel capping apparatus comprising a barrel support at a capping station, barrel clamping means to clamp a barrel at said station to prevent rotation of the barrel during the capping operation, barrel supply means for supplying barrels in sequence to said capping station, cap supply means for supplying caps in like sequence to a pickup point at said station, a chuck for engaging and spinning such cap, means mounting said chuck for spinning movement and for lateral movement between said pickup point and a capping point for applying the cap to the bung hole of a barrel at said station, means for spinning said chuck, means for effecting said lateral movement of the chuck, and means for ejecting a capped barrel from said station; said apparatus comprising motive means for accomplishing the said operation and control means operable to carry out automatically and repeatedly a cycle in which the barrel supply means supplies a barrel to said station, the barrel clamping means clamps such barrel, the cap supply means supplies a cap to said pickup point, the chuck moves from a rest position, picks up such cap, moves to said applying point, spins and applies the cap to the barrel, the chuck then releases the cap when a predetermined tightness has been achieved and moves back to its rest position, and the barrel ejecting means moves from a rest position, ejects the capped barrel and then returns to its rest position; said control means including a signal means for initiating such cycle of operation, and means operated by delivery of a barrel to said capping station for actuating said signal means; said control means also including a second signal means for causing ejection of a capped barrel and return of the machine to its initial state of readiness for the next cycle, said second signal means being actuated by the torque of said chuck.

37. In an automatic machine of the character described comprising a rotary tool mounted for spinning and engageable with a threaded member to spin the same and thereby thread it to a companion member, said tool being movable between a pickup position for picking up a threaded member and a work position for applying the same to such companion member; said machine also comprising an hydraulic motor for spinning said tool and an automatic control circuit operable to carry out a cycle of operation wherein said tool picks up and engages a threaded member at said pickup position, moves to said work position, spins, applies the threaded member to a companion member at said work position, ceases spinning and returns to said pickup position; said automatic control circuit comprising a supply valve for supplying hydraulic pressure to said motor, a normally closed sequence valve set to open at a predetermined pressure corresponding to the back pressure of said motor when operating at a predetermined torque, said sequence valve being so connected to the supply of hydraulic pressure to said motor as to vent pressure therefrom, a normally closed overload relief valve in series with and on the outlet side of said sequence valve and set to open at a lower pressure than said predetermined pressure, said relief valve including also a restriction to bleed pressure gradually, and a reset valve having a normal closed position and an hydraulic pilot for moving the same to open position, said hydraulic pilot being connected to the outlet of said sequence valve in parallel to said relief valve, and means actuated by said reset valve when placed in hydraulic pilot position for resetting the control circuit to close said supply valve, and return said tool to its pickup position.

38. In a machine of the character described comprising a rotary tool mounted for spinning and for movement between a pickup position and a work position, such tool being engageable with a threaded member to spin the same and thereby thread it to a companion member, an hydraulic motor for spinning said tool, means for automatically supplying threaded members in sequence to said pickup position, means for automatically supplying companion members in sequence to said work position, a control circuit for causing said machine to undergo a cycle of operation wherein a threaded member is supplied to said pickup position, a companion member is supplied to said work position, said tool moves from a starting position to said pickup position, picks up a threaded member, moves to said work position, spins and applies said threaded member to the companion member; said control system including normally closed pressure relief means adjusted to vent hydraulic fluid supplied to said motor when the torque of said tool creates a predetermined back pressure, bleed means to bleed the vented fluid gradually, and a normally closed, hydraulic pilot-operated reset valve so situated as to reset the control system and cause said motor to cease operating and to cause said tool to return to its starting position; the hydraulic pilot of said reset valve being actuated by hydraulic fluid vented by said pressure relief means; said bleed being adjusted to delay the dumping of hydraulic pressure to maintain the reset valve in its open position for a time sufficient to reset the control system.

39. A machine of the character described comprising a stationary frame, a pair of chucks engageable and operable with two different types of screw cap or the like, a pair of cap holders, chuck mounting means for pivoting the chucks together about a single pivot axis between a first position wherein the chucks are in registry with their respective cap holders, a second position wherein one of the chucks is at a work station and a third position wherein the other chuck is at said work station; and fluid pressure operated means for so pivoting said chucks, comprising a pair of cylinders arranged end to end and a rod and piston for each cylinder, one such rod being connected to said stationary frame, the other rod being connected to said chuck mounting means; the stroke of each piston being such as to pivot its corresponding chuck

between said work station and the corresponding cup holder.

40. A device of the character described comprising a pickup member for picking up a loose article at a pickup point, means mounting said pickup member for advance movement to and retractive movement from said pick-up point, suction means associated with said pickup member to cause the same to pick up an article by suction, motive means for causing such movement in a normal cycle wherein the pickup member undergoes its advance movement, picks up an article by suction and then undergoes its retractive movement; and hunting means whereby said pickup member is caused to retract and advance, and to repeat such retractive-advance movement whenever the pickup member fails to form a seal with an article, said hunting means comprising a signal source, a pilot valve having a normal position and also a pilot position wherein it initiates such hunting movement, and connecting means interconnecting said signal source and said pilot valve to place said valve in its pilot position, said connecting means including also a delay element which delays transmission of said signal for a predetermined period of time.

41. A device of the character described comprising a chuck adapted to engage and form a seal with a loose article at a pickup point, means mounting said chuck for advance movement to and retractive movement from said pickup point, suction means associated with said pickup member to cause the same to form a vacuum seal with and to pickup an article by suction, motive means for causing such movement in a normal cycle wherein the chuck undergoes its advance movement, forms a vacuum seal with and picks up an article by suction and then undergoes its retractive movement; and hunting means whereby said chuck is caused to retract and advance, and to repeat such retractive-advance movement whenever the chuck fails to form a vacuum seal with an article, said hunting means comprising a signal source, a pilot valve having a normal position and also a pilot position wherein it initiates such hunting movement, and connecting means interconnecting said signal source and said pilot valve to place said valve in its pilot position, said connecting means including also a delay element which delays transmission of said signal for a predetermined period of time after said chuck has made initial contact with an article at said pickup point.

42. In a machine of the character described comprising a chuck engageable with a cap screw or the like to form a vacuum seal with and to pick up and spin the cap, a cap holder for holding a cap at a pickup point, suction means associated with said chuck to apply suction to a cap to form a vacuum seal when the chuck is properly engaged with the cap and to hold such a cap to the chuck by vacuum; main operating means for imparting a normal operating cycle to said chuck wherein the chuck is moved from a rest position to said pickup point, is caused to spin, is moved to a capping point for application of the cap to a drum or the like and is returned to its rest position; and auxiliary operating means for imparting a secondary cycle to said chuck wherein the chuck oscillates between said rest position and pickup point; said auxiliary operating means comprising a fluid pressure operated motive member for so oscillating said chuck, a source of fluid pressure for operating the motive member, a switching valve which operates automatically to move said motive member in one direction when the chuck is at its rest position and in the opposite direction when the chuck is at said pickup point, thereby causing repeated oscillation of the chuck, and delay means interposed between the source of fluid pressure and the motive member to start said auxiliary cycle only when the chuck fails to form a vacuum seal with a cap within a predetermined period of time after contact with the cap.

43. In a machine of the character described comprising a chuck engageable with a screw cap or the like to form a vacuum seal with and to pick up and spin the cap, a cap holder for holding a cap at a pickup point, suction means associated with said chuck to apply suction to a cap, to form a vacuum seal when the chuck is properly engaged with the cap and to hold a cap to the chuck by vacuum; and main operating means for imparting a normal operating cycle to said chuck wherein the chuck is moved from a rest position to said pickup point, is caused to spin, is moved to a capping point for application of the cap to a drum or the like and is returned to its rest position, said main operating means including a vacuum operated control means actuated by said vacuum seal and serving, when such vacuum seal is formed, to continue the normal cycle of operation; and auxiliary operating means for imparting a secondary cycle to said chuck wherein the chuck oscillates between said rest position and pickup point; said auxiliary operating means comprising a fluid pressure operated motive member for oscillating said chuck, a source of fluid pressure for operating the motive member, a switching valve which operates automatically to move said motive member in one direction when the chuck is at its rest position and in the opposite direction when the chuck is at said pickup point, thereby causing repeated oscillation of the chuck, and delay means interposed between the source of fluid pressure and the motive member to start said auxiliary cycle only when the chuck fails to form a vacuum seal with a cap within a predetermined period of time after contact with the cap.

44. A pickup mechanism comprising a pickup member engageable with a loose article located at a pickup point and forming a vacuum seal therewith when properly engaged, suction means associated wth said pickup member to form such vacuum and to secure such article to the pickup member by vacuum, a cylinder and a piston therein and means connecting the piston to the pickup member to move the same by gravity from an elevated rest position to said pickup point and by fluid pressure from said pickup point to said rest position; operating means for imparting a normal cycle of operation to said pickup member when the same has formed a vacuum seal with an article; control means for initiating operation of said operating means, said control means being actuated by said vacuum seal; and hunting means for oscillating said pickup member between said rest position and pickup point in the event that a vacuum seal fails to form, said hunting means comprising a fluid pressure-activated pilot valve having a normal position and a pilot position, a first fluid pressure source connected to said cylinder beneath said piston through said pilot valve when such valve is in its pilot position, a pressure outlet line for said cylinder through said pilot valve when such valve is in its normal position, a switching valve connected on one side to a second fluid pressure source and to an exhaust line and on its other side to the pilot of said pilot valve, said switching valve operating to connect said second fluid pressure source with said pilot, and said pilot with said exhaust line when said pickup member is at said pickup point and at said rest position, respectively, and a delay element in the connection between said second pressure source and said pilot to delay operation of the pilot for a predetermined interval of time after contact of the pickup member with said article.

45. A capping mechanism comprising a chuck engageable with a screw cap located at a pickup point and forming a vacuum seal therewith when properly engaged, suction means associated with said chuck to form such a vacuum and to secure such cap to the chuck by vacuum, a cylinder and a piston therein and means connecting the piston to the chuck to move the same by gravity from an elevated rest position to said pickup point and by fluid pressure from said pickup point to said rest position; operating means for imparting a normal cycle of operation to said chuck when the same has formed a vacuum seal with an article; control means for initiating

operation of said operating means, said control means being actuated by said vacuum seal; and hunting means for oscillating said chuck between said rest position and pickup point in the event that a vacuum seal fails to form, said hunting means comprising a fluid pressure-actuated pilot valve having a normal position and a pilot position, a first fluid pressure source connected to said cylinder beneath said piston through said pilot valve when such valve is in its pilot position, a pressure outlet line for said cylinder through said pilot valve when such valve is in its normal position, a switching valve connected on one side to a second fluid pressure source and to an exhaust line and on its other side to the pilot of said pilot valve, said switching valve operating to connect said second fluid pressure source with said pilot, and said pilot with said exhaust line when said pickup member is at said pickup point and at said rest position, respectively, and a delay element in the connection between said second pressure source and said pilot to delay operation of the pilot for a predetermined interval of time after contact of the pickup member with said article.

46. In an automatic drum filling and capping machine comprising an automatic drum filling element, an automatic drum capping element and a drum conveyor for supporting drums and conveying the same to said filling element and thence to said capping element, the improvement which comprises an overhead cap conveyor upon which drum caps may be placed in the same sequence as the drums from which they are removed and by means of which the caps are conveyed in the same sequence to a release point, said overhead cap conveyor being located above said drum conveyor, extending along the drum conveyor and being accessible to a human operator standing alongside a row of drums on the drum conveyor, an escapement mechanism actuated by delivery of a drum to said capping element to release the corresponding cap from said overhead conveyor and a passage for guiding the released cap to the capping element for application to said drum.

47. Drum clamping means comprising a base for supporting a drum, clamping members arranged on opposite sides of the base to clamp opposite sides of a drum, each said clamping member being capable of inward and outward movement to and from a clamping position, respectively, and means for operating said clamping members, said operating means functioning to advance one of the clamping members to a predetermined position to act as a back stop and positioning member and subsequently to advance the other clamping member.

48. Drum clamping means comprising a base for supporting a drum, a first clamping member and a second clamping member arranged on opposite sides of the base to clamp opposite sides of a drum, each said clamping member being capable of forward and retractive movements to and from a clamping position, respectively, a first operating means for operating said first clamping member, said first means operating to move the first clamping member forwardly to a fixed position and to hold the same rigidly in such position, and a second operating means for operating the second clamping member, said second means operating to move the second clamping member forwardly after forward movement of the first member and exerting a resilient clamping force on a barrel.

49. In a machine of the character described comprising a rotary tool engageable with a threaded member to thread the same to a companion member, the improvement which comprises a source of fluid pressure, a fluid pressure operated motor for operating said tool, said motor operating at a rotary speed governed by the volume rate of flow through the motor, a first, volume control valve interposed between said source and said motor to supply fluid to the motor at a constant volume rate to operate the motor at a constant speed; a second, control valve also interposed between said source and said motor, said control valve having an open position which allows flow of fluid from the source to the motor and a closed position which precludes such flow; a third, signal valve communicating with said motor to receive the back pressure thereof, said signal valve being normally closed but opening in response to a predetermined back pressure from the motor; and means operatively connecting said signal valve with said control valve whereby, when said signal valve opens, said control valve is caused to close, thereby stopping the motor when the torque applied to said tool creates a predetermined back pressure.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,983,089 May 9, 1961

Donald H. Reese et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 68, for "33 at" read -- 33. At --; column 9, line 14, for "Thes" read -- The --; line 31, for "caps" read -- cap --; column 13, line 14, for "the left-hand" or" read -- the "left-hand" or --; column 16, line 35, for "aagin" read -- again --; column 19, line 31, for "bunting" read -- hunting --; column 27, line 66, for "memebr" read -- member --; column 30, line 15, for "operble" read -- operable --; column 33, line 30, for "pickup" read -- pick up --.

Signed and sealed this 31st day of October 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

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