CAP FASTENING MACHINE

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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 co-pending application, Ramney 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 petroleum products, has been to carry out the weighing and filling operations automatically or semiautomatically, with or without a concomitant 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.

Hereinfore, 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 off reifier 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 medically. 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 Ramney 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 encountered in an automatic high speed capping operation of the character described is the fact that drums, as they come to a capping machine, are provided with different types of bungs which may require different types of chuck 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.

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 heretofore.

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 heretofore.

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 seating 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 compacting 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 compacting 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 compacting 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 compacting station.

Figure 15 is a view taken along the line 15—15 of Figure 1, showing the drum clamping means for clamping and holding the drum at the compacting 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 has been ejected from the compacting 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 compacting 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 compacting 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 compounding 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 compounding 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 orientation 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 compounding 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 27a slidable on such rods. A pusher arm or frame 28 is provided which is pivotally mounted on the slide member 27a at 28a. At its extreme 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 compounding 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 compounding 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 27a at 28a but for pivoting independently of the pusher frame 28. A cylinder 34 pivots the arm 33 at its extreme forward or left-hand 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 slidably mounted a plurality of fingers 41 each having laterally projecting ears 41a which normally rest upon the upper edges of the plates 40 and are held resiliently in contact therewith by tension springs 41b. 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 41a (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 41a 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 33a which is engageable with the lower end of a lever 42 pivoted on the frame of the machine at 42a, 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 27a is caused to move forward, from right to left as viewed in Figures 1 and 2. It will be apparent that, as the slide member 27a 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 27a is such that it will deposit the drum at the filling station at 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 33a 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 27a, 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 27a 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 Guerra 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 33a 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 rearward extension 33a 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 proper 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., Oakmont, 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 46a 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 intermingled.

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 51a, 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 49a. The upper tracks are provided with vertical flanges 52 over which lie the horizontal flanges 46a of the Rieke caps 46 and between which lie the Tri-Sure caps 47. In some cases, however, the cap rests on the chains 50 and the Rieke flange 46a 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 65a 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 65a to the left as viewed in Figure 3 and holds it and the escapement member 61 in the positions shown. At the appropriate instants 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 forcing the piston 65a 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 66 will push the piston 65c from right to left to the position shown in Figure 1, 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 60 to move forward 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 three bulk body portion 46b of a Rieke cap 46 will fit easily between the tracks but such that the gasket of the flange portion 46a 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 79a 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 76. The lower chute 76 is formed by two, spaced tracks or plates 80 which are spaced apart at 89a 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 47a 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 angular shoulder 88 and a socket 89, the shoulder 88 of the cup 81 being of greater diameter to receive the flange 46a 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 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 107a 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 Tri-Sure type of cap. A seal is provided at 109, the details of which are described in the said pending application Serial No. 317,856 and a seal is also provided at 109a 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 pending 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 129 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 122a and the sleeve 122 is in turn fixed slidably but nonrotatably to a hollow shaft 123 which constitutes an extension of the cap 108 and is sealed to the wall 84 of the drum. As will be seen, the central passage 103a 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 355a (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 rotate 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. These strokes 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 casing station.

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

Reverting 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 the cocked 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 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 overhand 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 139 and 139a. Also the appropriate shaft 128 is 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 respective cup 81 or 82. Suction applied through the line 347 with the air 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 casing station in the manner explained hereinafter.

A part of the control mechanism associated with and located at the casing 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, in turn, fixed to the lower end of a shaft 179. To the sleeve 178 there is also fixed a drum a eccentric lever 180 on the outer end of which is rotatably mounted a roller 181. The shaft 179 is jour- nalled 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 eccentric lever 180.

The eccentric lever 180 is normally held in the position illustrated in Figure 14 by the cylinder 175. When the casing 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 casing station. As a drum is pushed into the casing station, the eccentric 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 in its position as shown 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 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 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 again be operated 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, 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 character 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 the valve 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 drum of the cam, thereby moving 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. Hydrualic pressure then passes through the line 305 to the hydraulic pilot G of a valve 307. (See Figure 13.) This places the valve 307 in its hydraulic pilot position wherein it energizes lines 308 and 309. Compressed air from a suitable source (not shown) then passes through 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 hereinafore, causing it to slide down the appropriate chute 75 or 76. It will be assumed that a Rietke 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, thence the line of the hydraulic pilot of the valve 319. The operation 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 hereinafore 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 hereinafter 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 4 of a valve 329. The valve 329a is one side of a double purpose valve, the other side being indicated as 329b. The valve 329a functions with the "right hand" or "Rieke" side of the vacuum valve 329 with the left-hand" or "Tri-Sure" side of the system. When the valve 329a is placed in its air pilot 4 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 329a, thence to a line 338 to the hydraulic motor 121 of the Rieke mechanism. Spent hydraulic fluid drains through a line 339a 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 remain at a spindle 103 and the chuck 101 at a constant speed regardless of increasing torque caused by increasing tightness of the cup 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 103a 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.) This is to provide 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 103a 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 103a and the line 347, insufficient pressure is applied to the vacuum pilot of the valve 349 to permit it to rotate. 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 is required to set the seating 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. Accordingly that the chuck 101 immediately makes proper contact with the bung, its O-ring 109a (see Figure 8) will seal against the bung and a vacuum will be cre-
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 valve 359 to its spring position and in placing the valve 359a in its cam position. When the valve 359a 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 349, as illustrated. Thus compressed air is caused to pass from line 387 through valve 359a and line 358 to valve 349 (Figure 218). The valve 349 is 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 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 inoperative 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 327 (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 bung 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 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 opens 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 338 to that 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 ̇Ḣ, such valve being normally in its spring position, thereby communicating the line 411 with a line 413, thence through a branch line 413a with the air pilot of the trip valve 326. The resulting pressure pulse to the air pilot of the valve 326 recedes that valve and places it in the cam position shown in Figure 12, thereby shifting off the supply of air from the supply line 327 to the line 338. 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 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 356a, hence exhausts air pressure from the air pilot A of valve 329a. This resets valve 329a 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 353 is free to exhaust through line 351, valve 349, lines 348 and 328 and valve 326. With the valve 352 again 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 368a 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 359a (Figure 21A), lines 349, valve 328, valve 327 and valve 326. Valve 370 is, therefore, returned to its spring position, and in this position it communicates line 369 with a line 376b, which is also connected to the air pilot A3 of valve 377 (Figure 21B). Meanwhile, air pressure from the air pilot A3 of valve 377 is free to exhaust through line 376a, valve 370 and a line 414 to atmosphere. When the valve 377 is in its air pilot A3 position, it communicates air pressure line 376 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 lines 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 413a, as described above, to a line 4120, to the air pilot of valve 307 (Figure 21A), thereby placing the 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 piston case except for the brief interval of time when the bung is being ejected for a rapid return of this cylinder to its normal, spring position in readiness for ejectioning the capped drum from the capping station.

The return of cam bracket 153 to its central, neutral position, in the manner explained hereinafter, 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 into which it is placed by depression of a lever 419a which is shown in Figures 1 and 16. The lever 419a 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.

Freely in capping the bunging barrels of lubricating oil and other petroleum products, a stream 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 the 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 419a 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 A1 position during a previous part of the cycle of operation, i.e., while the valve 359 (Figure 21A) was in its spring position, manually communicating air pressure from the air pressure line 417 with a line 422 which contains a needle valve 422a and has a by-pass 422b containing a check valve 422c. The line 422 is also connected to the air pilot A1 of the valve 421. (Air pressure, meanwhile, has exhausted from air pilot A1 of valve 421 through a line 433, a valve 424 and an exhaust line 424a.) Hence air pressure in line 420 can pass through the valve 421 to line 423, thence to the air pilot A1 of a valve 424, thereby placing that valve in its air pilot A1 position. In this position the valve 424 communicates with 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 hereinafore.

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 A2 of the valve 421, and air pressure exhausts from air pilot A2 of valve 421 through line 422, by-pass 422b and check valve 422c (Figure 21B) and valve 359 to an exhaust line 417a (Figure 21A). The valve 421 is, therefore, placed in its air pilot A2 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 A1 of the valve 421 through the check valve 422c (Figure 21B) and valve 359 to an exhaust line 417a (Figure 21A). The valve 421 is, therefore, placed in its air pilot A2 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 A2 of the valve 421 (see Figures 1 and 16) it places the valve 419 in its cam position, in which line 418 is communicated with a line 435. Air pressure will then pass from the air pressure line 417 (Figure 21A) through the valve 424 (which is in its cam position), line 418 and valve 419 to line 435, thence to the air pilot A2 of valve 424, thereby placing that valve in its air pilot A2 position. When the valve 424 is in its air pilot A2 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 top 188 by reason of the torsion spring 187 (see Figure 13) and since that 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 dome 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 hereinafore. In this position the valve 366 communicates the air pressure lines 367 and 368a 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 441, 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 hereinafore. 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 such position, the valve 356 communicates an air pressure line 454 with a line 455, 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 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 349 (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 accomplish 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 valve 352 of pilot line 353. The valve 345 (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 422a 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 of valve 421, air pressure remaining in line 420 will pass through valve 421 (which would be in its air pilot A position) to line 423, hence to air pilot A of valve 424. To avoid this, the needle valve 422a is provided which causes a delay in actuation of the valve. The function of 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 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 drum is placed in the embrasure so that the drum filling 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 chucking 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 drum (Figure 21B) and 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 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 346 containing a check valve 346 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 368a 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 348, 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 381a. 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, for their "Cyclone Air Valve." This particular valve or others may be used for the purpose, and it comprises a housing or a 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 vacuum valve 496 is modified for purposes of the present invention as follows: A housing 498 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 chamber 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 508 will connect to atmosphere and the port 509 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 substantially identical. The same 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, a cap has been released from the cap conveyor, compressed air passes from line 327 through valve 326 to line 328, thence through a branch line 328a to the air pilot A1 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 escapper 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 "Tri-Sure" side.

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 escapper 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 346 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 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 such for spinning motion, a mechanism for making the engagement 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 a cyclic operation of movement wherein the chuck picks up and engages a threaded member at the pickup position, moves to the threading position, spins the threaded member and delivers it to a companion member at the threading position, and 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 cyclic motion wherein the chuck picks up and engages a threaded member at the pickup position, moves to the threading position, spins the threaded member and delivers it to a companion member at the threading position.
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23 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 threaded cap fitting said opening, said chuck being capable of spinning the screw cap, and for movement between a pickup position and said capping position, a cap holder at said pickup position, suction means operable to secure a cap to a 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 reapproaching 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 for actuating the chuck to move to the capping position when it engages a cap and forms an effective seal there-where, 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 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 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 there-where, 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 bung hole; and 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 rotational speed governed by the volume rate of flow through the motor, an 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 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 capping 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 a 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 chucks means operable to pick up each drum, and an 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 cap, and a plurality of inclined chutes, one for each drum means, selective with regard to the drum means to deliver each released cap to its corresponding chute.

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 drum conveyor comprising a common, overhead section operated by an endless conveyor for all caps, and an individual inclining chute for each drum means 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 pickup position, said cap conveyor comprising a common section for all caps and an individual section for each chuck, each individual section being selective with regard 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 pickup position, an escapement mechanism actuated by delivery of a drum to the capping station, said chuck conveyor comprising a common section for all caps and an individual section for each cap means, 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 pickup position, and chuck means operable to pick up the corresponding cap and to apply it to the bung hole of a drum, wherein the cap conveyor comprises 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 release means operable to pick up the chutes and associated delivery 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 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; an endless conveyor comprising an endless conveyor common to all caps and an individual type of cap and being adapted to receive empty drums or the like and fill each drum with a predetermined quantity of material; transfer means 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 pickup position; said capping apparatus comprising automatic chuck means operable with and capable of picking up the caps in sequence and transferring each engaged cap from a pickup point to said cap applying position, 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 drum conveyor for conveying caps to said pickup position, said conveyor including a gravity-operated section for each drum which is 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 pickup position; an escapement mechanism operable to release caps one at a time for delivery to said pickup point; and 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 operable to release a cap to cause said chuck to undergo its aforesaid cycle of operation.

16. 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 means 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 pickup position; said capping apparatus comprising automatic chuck means operable with and capable of picking up the caps in sequence and transferring each engaged cap from a pickup point to said cap applying position, 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 drum conveyor for conveying caps to said pickup position, 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.

17. 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-
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 control means actuated by delivery of a screw cap to said 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 operating 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 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 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 secure said operating means to the point of application of a screw cap to a bung hole, and control operating means actuated by torque of the chuck to actuate said operating means to release the cap and return to its starting position.

24. 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 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, 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 member 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.
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, a second, engaging position for 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 in a chuck engagement, 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, 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 for clamping 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 operable 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 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 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 with 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, a second signal means for initiating 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 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 and engaging, 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. A 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, barrel pre-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 the 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 includes a signal means for initiating such cycle of operation and means operated by delivery of a barrel to said capping station for actuating said barrel means.

36. A 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, barrel 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 the 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 includes a signal means for initiating such cycle of operation and means operated by delivery of a barrel to said capping station for actuating said barrel means.

37. In an automatic machine of the character described comprising a rotary tool mounted for spinning and engagement with a threaded member to spin the same and thereby thread it to a companion member, said tool being moveable between a pickup position for picking up a threaded member and a work position for applying the same to a companion member; said machine comprising a 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 for moving a normal closed position to an hydraulic pilot for moving the same to an 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; fluid pressure operated means for 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 pickup point, suction means associated with said pickup member to cause the same to pick up an article by suction and then undergoes its retractive movement; and hunting means whereby the 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 with and to form a seal with said 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 said 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 the 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 for application 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 aapping 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.

43. 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 for application 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 aapping 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 with 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 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 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 fluid pressure source and said pilot to delay operation of the pilot for a predetermined interval after contact of the pickup member with said article.

45. A capping mechanism comprising a chuck engageable with a cap screw 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 on an exhaust line and on the 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 to 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 value communicating with said motor to receive the back pressure thereof, said signal value 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.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Inventor</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,470,348</td>
<td>Clark</td>
<td>Oct. 9, 1923</td>
</tr>
<tr>
<td>1,748,961</td>
<td>Risser</td>
<td>Mar. 4, 1930</td>
</tr>
<tr>
<td>1,812,816</td>
<td>Weaver</td>
<td>June 30, 1931</td>
</tr>
<tr>
<td>1,848,827</td>
<td>Fink</td>
<td>Mar. 8, 1932</td>
</tr>
<tr>
<td>1,875,444</td>
<td>Hanna</td>
<td>Sept. 5, 1932</td>
</tr>
<tr>
<td>2,066,259</td>
<td>Everett</td>
<td>Dec. 29, 1936</td>
</tr>
<tr>
<td>2,145,820</td>
<td>Tucker</td>
<td>Jan. 31, 1939</td>
</tr>
<tr>
<td>2,147,099</td>
<td>Jones</td>
<td>Feb. 14, 1939</td>
</tr>
<tr>
<td>2,192,042</td>
<td>Hoffmann</td>
<td>Feb. 27, 1940</td>
</tr>
<tr>
<td>2,207,351</td>
<td>McLaughlin et al</td>
<td>July 9, 1940</td>
</tr>
<tr>
<td>2,252,201</td>
<td>Price</td>
<td>Aug. 12, 1941</td>
</tr>
<tr>
<td>2,384,399</td>
<td>Reynolds</td>
<td>Sept. 4, 1945</td>
</tr>
<tr>
<td>2,421,219</td>
<td>Price</td>
<td>May 27, 1947</td>
</tr>
<tr>
<td>2,523,968</td>
<td>Paulson</td>
<td>Sept. 26, 1950</td>
</tr>
<tr>
<td>2,570,351</td>
<td>Klessig</td>
<td>Oct. 9, 1951</td>
</tr>
<tr>
<td>2,596,408</td>
<td>Johnson et al.</td>
<td>May 5, 1952</td>
</tr>
<tr>
<td>2,610,779</td>
<td>House</td>
<td>Sept. 16, 1952</td>
</tr>
<tr>
<td>2,652,563</td>
<td>Pommeroy</td>
<td>Sept. 22, 1953</td>
</tr>
<tr>
<td>2,665,013</td>
<td>Socke</td>
<td>Jan. 5, 1954</td>
</tr>
<tr>
<td>2,681,758</td>
<td>Lipson</td>
<td>June 22, 1954</td>
</tr>
<tr>
<td>2,710,684</td>
<td>Hall</td>
<td>June 14, 1955</td>
</tr>
<tr>
<td>2,715,009</td>
<td>Beeley</td>
<td>Aug. 9, 1955</td>
</tr>
<tr>
<td>2,715,010</td>
<td>Reeves</td>
<td>Aug. 9, 1955</td>
</tr>
<tr>
<td>2,740,251</td>
<td>Anderson</td>
<td>Apr. 3, 1956</td>
</tr>
<tr>
<td>2,740,604</td>
<td>Swigart et al.</td>
<td>Apr. 3, 1956</td>
</tr>
</tbody>
</table>
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,983,089

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
USCOMM-DC