ABSTRACT

A detachable headset, for use with a closure sealing machine for securing a closure to a bottle, has a number of applying or sealing tools, usually in the form of rollers, arranged around its central axis. Each tool is moved inwardly to its operative position, wherein it engages a closure, by means of pressure fluid acting on a piston contained in a cylinder associated with the tool. Each tool may be mounted at one end of a pivoted actuating arm, the other end of which is engaged by the piston associated with the tool. In a preferred construction pressure fluid is led to the cylinders through the application head of the machine to which the headset is attached.

12 Claims, 6 Drawing Figures
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1

CLOSURE SEALING MACHINES

This invention relates to closure sealing machines of the type for sealing bottles and other containers by applying closures thereto, and is particularly concerned with the application of metal closures to bottles and other containers.

The invention principally relates to sealing machines of the type in which the applied closure is actuated by pressure applied to the closure in a direction generally opposed to the direction of closure, for deformy the skirt of the closure or for a thread rolling operation, for example, whilst pressure is applied to the top of the closure in an endwise direction, usually in a direction along the longitudinal axis of the container.

It is desirable, in machines of this type, for one basic model to be readily adaptable for use with a number of different forms of closure. It has therefore become customary to provide a series of interchangeable heads which comprise tools of a variety of forms according to the style of closure being sealed, and the present invention is concerned with heads for closure sealing machines.

Many closure sealing machines have provision for rotation of the tools employed around the closure during the closure sealing operation. Some heads embody tools which in addition to moving around the closure as the head rotates as a whole, also revolve simultaneously about their own axes of symmetry. These tools or so-called spinning rollers, which usually revolve solely by reason of frictional contact with the closure, thus perform an orbital motion around the closure.

A single head may perform more than one operation at the same time. For example, alternate tools arranged circumferentially around the head may perform deformation operations on two different zones of the closure. It should also be understood that heads are not restricted to use in deforming closures but may be used simply for such operations as tightening screw-on caps.

The heads are interchangeably mountable on the application head of the sealing machine and in most cases it is necessary for the head tools to derive at least their body rotational motion from power or drive means in the application head. The application head is also adapted for applying a regulated endwise pressure to the top of the closure being applied.

For large-scale operations, where several or many application heads are required in order to keep pace with production, it is convenient to arrange the application heads in a circle with each receiving their basic rotary motion from a central driving means. In such multi-head machines it is desirable that each application head and headset should be as compact as possible to reduce the overall size of the machine as determined by the diameter of the circle on which the application heads are arranged. Since the clearance which must be left between each application head is normally determined by the width of the head, it is evident that modifications to the construction of heads which result in a reduction of their size will have a considerable effect in reducing the overall size of multi-head machines.

According to the present invention there is provided a detachable head for an application head of a closure sealing machine, said head comprising a head block, a series of cylinders arranged around an axis of said block, a piston arranged in each cylinder, means whereby pressure fluid may be introduced into each of said cylinders to cause movement of the piston in one direction, means for returning the piston to its original position on release of said fluid pressure from said cylinder, a series of closure sealing or applying tools circumferentially spaced in relation to said axis and each mounted on said block so that it is capable of inward movement relative to said axis, each tool being associated with one piston and cylinder, and means for transmitting movement of each piston in its said one direction to its associated tool, whereby movement of said piston in said direction causes inward movement of said associated tool towards said axis.

The head may include an actuating arm arrangement for each cooperating piston and closure sealing or applying tool, and a pivot axis in said block for each actuating arm arrangement, whereby movement of said piston in said one direction is transmitted to the tool by means of an arm or arms of said arm arrangement pivotable about said pivot axis.

In one preferred arrangement there are four cylinders arranged around the head block and therefore four closure applying tools (usually rollers). This is in contrast to some conventional heads where there have been six tools. The number of cylinders required can however be varied by suitable choice of cylinder diameter; some appropriate alteration in working fluid pressure may also be required. The cylinders may be arranged in a plane or may be placed at vertically alternating levels to suit many combinations of cylinder number and diameter.

The present head is of particular use in the application of rolled-on and pilfer-proof closures. In this case the independent mounting of the tools, which take the form of freely rotatable rollers, is of importance since it allows the functions of thread rolling and skirt rolling, usually effected by different forms of rollers, alternately disposed around the closure, to be carried out independently of each other.

The use of independently mounted rollers allows full compensation of each roller in relation to the diameter of the closure being applied. The application of radial pressure to the skirt of the closure by the rollers is substantially constant since the pressure applied by the pistons is independent of the position of the piston in the cylinder. Thus the head is able to adjust itself to inequalities in the container without altering the degree of deformation of the closure.

The pressure exerted by the pistons can be varied by simple adjustment from a central point so that each roller can be finely controlled even whilst the machine is running should this prove necessary. In a multi-head machine each roller of each head may be controlled from a central point in this way. By contrast, the normal side pressure systems embodying springs and overstroke devices have to be adjusted individually for each of the roller arms of each head and such adjustment repeated for each head on each application head of a multi-head machine.

It has already been mentioned that in the application of certain closures the functions of thread rolling and skirt rolling may be carried out by different forms of rollers. It may be an advantage for machines adapted for the application of such closures to have separate fluid pressure lines so that the pistons and cylinders associated with one set of rollers may be controlled independently of the other set.
It has already been proposed in British Pat. specification No. 817,172 to provide a detachable headset for a closure sealing machine having a series of radially movable closure sealing or applying tool assemblies each comprising a slide and a tool (or holder carrying a tool) mounted on a slide. Radially inward movement of the slides is derived from pressure-applying means which receives its basic movement from means within the application head of the machine. Thus the head may include an elastic element which is expanded by air pressure conducted through passages in the head as described in British Pat. specification No. 817,171.

It is to be noted that one way in which the present invention differs from this previously described arrangement is that fluid pressure is introduced into the head set. The fluid is caused to act on piston and cylinder units whereby the skirt and thread rollers may be actuated through actuating arms. This arrangement is considered to be very reliable and more satisfactory for high speed operation. A further advantage is the compact head set assembly which the arrangement produces; as has already been noted this is especially important in the construction of multi-head closure machines.

The heads of this invention have the further advantages that they can be quickly and easily pre-set without reference to the sealing machine, they can be removed from the machine without interference with their setting and they can be stocked as ready-built units for rapid changeover. This last feature is of importance in obtaining maximum utilisation of sealing machine capacity.

The invention will now be further described by way of example only with reference to the accompanying drawings, in which:

FIGS. 1A and 1B are contiguous parts of a sectional elevation, generally on line D—D of FIG. 4 but with a skirt roller assembly and a thread roller assembly shown radially extended and in section, of an application head and a head set of a multi-head closure sealing machine,

FIG. 2 is a transverse sectional view of the head set on the line E—E of FIG. 1.

FIG. 3 is a plan view of the machine in the direction of the arrow B of FIG. 1, showing adjacent application heads,

FIG. 4 is a plan view of the head set in the direction of the arrow C of FIG. 1, and

FIG. 5 is a side elevation of the application head and head set of FIG. 1, with the head set shown separated from the application head.

Referring to FIGS. 1 and 5, there is shown an application head 1 of a multi-head closure sealing machine and a head set 2 connected to the lower end of the head 1. The neck of a bottle 3 is shown in engagement with the head set 2. The multi-head machine includes a rotatable turret assembly having a number of radially extending arms, one of which is shown at 101 in FIG. 3. The application heads are arranged on a circle centred on the axis of rotation of the turret assembly and are supported by longitudinal guides 102 mounted on the arms 101 and which cooperate with abutments 103 formed on the application head to allow vertical movement of the head for transmitting endwise pressure to the top of a closure being applied to the bottle 3.

At the upper end of the application head 1 is a head carrier 4 comprising an upstanding flange 5 and a casing 6. A bearing pin 7 is connected to the flange 5 and carries a cam follower 7A which is engaged with a cam block 107 formed in part of a fixed central support 100 around which the turret assembly revolves. Vertical motion is therefore imparted to each head as it revolves with the turret assembly. The cylindrical casing 6 defines a cylinder 8 within which moves a piston 9. An air supply duct 10 leads through the carrier 4 to the upper part of the cylinder 8. The piston 9 has a bowed head 11 and a sealing ring 12 arranged in a groove around its outer surface.

An upper pressure block 13 is bolted directly to the piston 9 and is surrounded at its upper end by a stepped annular disc 14 which is bolted to the lower end of the casing 6. The inner part of the disc 14 provides a lower stop for movement of the piston 9 in the cylinder 8. The pressure block 13 has a central blind bore 15 extending from its lower surface and a transverse air duct 16 communicating with the bore 15.

The end of a pressure block stem 17 which has a central axial passage 18 is received within the bore 19. A short transverse bore 19 in the stem 17 connects the passage 18 to the duct 16 in the block 13. The part of the stem 17 around the bore 19 is sealed in the bore 15 by sealing rings 20.

A flange 21 of the pressure block 13 is bolted to a short tubular section 22. The tubular section 22 has an inwardly directed flange 23 which closely surrounds a threaded portion 24 of the stem 17. Upper and lower lock-nuts 25, 26 are threaded on the portion 24 and lock onto the flange 23 to locate the pressure block stem 17 in relation to the tubular section 22. The section 22 is provided with an opening 27 through which access may be obtained to the lock-nuts 25, 26.

A generally tubular drive housing 28 is bolted to the lower end of the tubular section 22. Adjacent its ends the housing 28 supports upper and lower roller bearings 29, 30 within which is rotatably mounted a drive spindle 31 surrounding the pressure block stem 17. A gear member 31 is mounted around the drive spindle 31 and is drivenly connected thereto by means of a key 32. One side 33 of the drive housing 28 is cut-away so that a drive gear (indicated generally at 132) or the like may engage the gear member 32. The drive gear 132 is connected to the fixed support 100 and the gear member 32 is therefore rotated by virtue of the rotation of the head with the turret assembly.

Upper and lower spacers 34, 35 surrounding the drive spindle 31 locate the gear member 32 by abutment with the upper and lower bearings 29, 30 respectively. Axial location of the drive spindle 31 is provided by a pair of lock-nuts 36, 37, threaded on the upper end of the spindle 31 and which engage part of the bearing assembly 29, and a stepped part 38 of the spindle, which engages part of the bearing assembly 30. A bearing cap 39 is bolted to the lower end of the drive housing 28 and holds an oil seal 40 in engagement with the outer surface of the drive spindle 31.

The lower end of the drive spindle 31 is formed with a tapered part 41 adapted for non-rotatable engagement with an internally tapered boss 42 on the head set 2. The boss 42 is externally screw-threaded and is tightened into engagement with the spindle 31 by a head joint nut 43. The pressure stem 17 passes through the tapered part 41 and into a bore 44 in the head set 2.

The passage 18 through the stem 17 is blocked by a plug 45 near the joint between the head 1 and head set.
2 and four oblique ducts 46 lead to an annular recess in the tapered part 41 of the spindle 31 forming an air chamber 47. A seal 48 is mounted in the spindle 31 around the pressure stem 17 above the chamber 47. Four passages 49 lead from the air chamber 47 through the tapered part 41 and connect with passages 50 through the boss 42. A key 51 is mounted in the face of the tapered part 41 and engages in a keyway in boss 42 to hold passages 49 and 50 in register. A sealing ring 52 is mounted around the pressure stem 17 just below the boss 42.

The boss 42 forms part of a head block 53 on which the tools of the headset are mounted. A head cap 54 is bolted to the head block and surrounds the boss 42. The head block 53 is formed with four cylinders 55 (see also FIG. 2). Each of the passages 50 connects with a cylinder 55 for movement by air pressure of a piston 56 in the cylinder. The pistons 56 act directly on actuating arms 57 connected to actuating spindles 58 rotatably mounted in the block 53. Each arm 57 has an adjustable stop 59 which engages part of the block 53 to limit the extent by which the piston 56 can move in an outward direction. Torsion springs 60 are mounted around the spindle 58 and act between the arms 57 and part of the block 53 to return the pistons 56 to their inner positions when air pressure is removed from the cylinders 55.

At their lower ends two of the actuating spindles 58 are connected to thread roller arms 61 and two to skirt roller arms 62 (see also FIG. 4). Each thread roller arm 61 carries a thread roller 63 which is mounted on a shaft 64 rotatably mounted in a bearing sleeve 65 arranged in the arm 61 at a slight angle to the vertical. The thread roller 63 is axially movable in relation to the arm 61 and is biased upwardly by means of a compression spring 66 acting between the sleeve 65 and a flanged disc 67 engaging a shoulder 68 on the shaft 64. The springs 66 are fairly light so that relatively free axial movement of the rollers 63 is allowed. The rollers are therefore allowed to follow the thread on the bottle and the springs simply return the rollers to their initial position when the arms 62 are retracted.

Similarly the arms 62 carry skirt rollers 69 connected to shafts 70 which are rotatably mounted in bearing sleeves 71. The sleeves 71 are however mounted vertically in the arms 62. The shafts 70 are axially movable and are biased upwardly by compression springs 72 as before. In contrast to the springs 66, the springs 72 have a relatively high rating and are intended to provide resilience so that an acceptable turned-in closure skirt edge can be obtained even where there are vertical inequalities in the position of the corresponding skirt collar on the bottle. It should also be noted that the vertical position of each bearing sleeve 71 may be adjusted since it is received in a threaded bore in the arm 62. The position of the sleeve 71 in relation to the arm 62 is fixed by means of a grub screw 71a.

A lower pressure block 73 is connected by a screw-thread to the end of the pressure stem 17. A needle bearing 74 and bearing seal 75 are mounted between the pressure block 73 and the head block 53 around the end of the pressure stem 17.

The lower part of the pressure stem 17 is formed with a bore 76, slightly larger than the passage 18. The plug 45 is an interference fit within the bore 76. It will be realized that the lower pressure block may be of many different forms since its construction will be related to the size and type of closure to be applied. The pressure block 73 is adapted to reform the head of the closure and includes a head pressure member 79 which is slidably contained in the bore 76. A compression spring 80 is arranged between part of the block 73 and the pressure member 79 to bias the member 79 downwardly. Cross pins 81 pass into opposing sides of member 79 and act in slots 82 in the pressure block 73 to restrict vertical movement of the pressure member 79. A rod 78 is slidably mounted in bore 76 and a bore through pressure member 79 and a compression spring 77 arranged in bore 76 between the plug 45 and the upper end of rod 78 gives downward bias to the rod.

The head pressure applied to the top of a closure being applied by the pressure member 79 is transmitted through the upper pressure block 13, pressure stem 17 and lower pressure block 73. The upper pressure block 13 is connected to the piston 9 which is permanently in contact with air under pressure admitted to the cylinder 8 through the duct 10. The basic movement bringing the pressure member into contact with the bottle is derived from the movement of cam follower 7a in cam track 107, and before this mechanically controlled movement is completed head pressure is applied by virtue of the air pressure in cylinder 8 acting at all times on piston 11. Beyond this point the residual cam displacement merely causes differential movement of cylinder 8 relative to piston 11 and the resulting increase in pressure is negligible. The pressure is transmitted to the piston 9 by the air which acts as a cushion pre-loaded to impose a total load equivalent to the pressure multiplied by the effective piston area. It should be noted that once the cylinder 8 is charged with air at the required pressure no control cycle is needed, as it functions automatically and needs extra air only if leakage occurs. Upward movement of the application head on upward movement of the head carrier 5 is achieved by engagement of an inner part of the disc 14 with the bottom of the piston 9. The application of air pressure to the cylinder 8 is not directly related to the application of pressure to the roller arm cylinders. Thus reforming of the head of the closure can take place before any radial pressure is exerted on the closure skirt. Moreover, by contrast with other head pressure systems, the head pressure of each application head can be adjusted from a central point, even whilst the machine is in operation if necessary.

It has already been mentioned that with many headsets a bodily rotary movement is required. In the present case rotation of the head block 53 requires rotation of the rollers 63, 69 around the bottle 3. The rotation of the headset is achieved by virtue of its rigid keyed connection to the drive spindle 31 of the application head 1. The drive spindle 31 is driven by a gear member 32 engaged with a driven gear or belt. Both the pressure stem 17 and the drive housing 28 remain stationary. The gear member 32 is extended in an axial direction so as to remain in engagement with drive gear 132 (or equivalent means) during vertical movement of the application head.

As shown in FIG. 3, in a multi-head closure sealing machine adjacent application heads are arranged on a circle so that the gear member 32 of each may be engaged by one drive gear. This arrangement is also found to be convenient for incorporation of the machine into a production line.
Air for introduction to the cylinders 55 is initially passed through the duct 16 into the passage 18 in the pressure stem 17. From here it passes via the passage 46 to the annular chamber 47 in the rotating drive spindle 31. Each of the cylinders 55 is connected by separate passages 49, 50 to the chamber 47 for simultaneous operation of the pistons 56.

Air is introduced into the duct 16 of each application head by a flexible pipe leading from an air control valve carried by the turret adjacent the application head. Each air control valve receives air from a stationary central pipe through a rotary gland. The air control valve is typically removable so that flexible pipe can be connected to pressurised air from the central pipe or to atmosphere. As the application heads revolve around the fixed central support the air control valve can be operated by further cam means on the support and both the timing and duration of air supply to and from duct 16 may be controlled in this manner.

Various modifications are possible to this application head and headset described with reference to the drawings. For example, the headset may be arranged so that the skirt and/or thread roller arms pivot on a pin which is inclined to the vertical. In one possible construction the pivot pin is horizontal and the arms rock in a vertical plane, the rollers being carried on vertical spindles extending from one end of the arms.

An important refinement of the present apparatus is the separate control of fluid pressure delivered to the skirt and thread rollers. For this purpose separate passages to the respective cylinders in the headset are required. This may conveniently be arranged by having additional passages parallel to passages 16 and 18 and an additional annular chamber around the pressure stem 17 adjacent the chamber 47, together with suitable passages through the tapered part 41 of the application head and through the headset for connecting the supply to the appropriate cylinders.

I claim:

1. A closure sealing machine for securing a closure to a container comprising:
   an application head;
   a shaft, mounted for rotation in said application head, having a rotary drive coupling formation at one end;
   a headset, detachable as a unit from said application head, including a head block having a coupling formation adapted for attachment in a predetermined relative rotational position to said coupling formation on said shaft, said application head and said head block having respective fluid passageways which communicate with each other when said rotational formations are in said predetermined relative rotational position; said head block also having a series of cylinders arranged around the axis of rotation of said head block; a piston disposed in each cylinder; passage means leading from said fluid passageways in said coupling formations to said cylinders for introducing pressurized fluid into each of said cylinders to cause movement of each of said pistons in one direction; means for returning each of said pistons to its original position on release of the pressurized fluid from each of said cylinders; a series of closure sealing tools circumferentially spaced in relation to the axis of rotation of said head block, each of said tools being mounted on said block for inward movement relative to the axis of rotation and being associated with one piston and one cylinder; and means for coupling each of said pistons to its associated tool to transmit movement of said piston in said direction into inward movement of said associated tool toward the head block axis of rotation.

2. A closure sealing machine according to claim 1 further including an actuating arm arrangement for each cooperating piston and closure sealing tool, and a pivot axis in said head block for each actuating arm arrangement, whereby movement of said piston in said one direction is transmitted to the tool by means of said arm arrangement pivotal about said pivot axis.

3. A closure sealing machine according to claim 2 wherein said actuating arm arrangement for each cooperating piston and closure sealing tool includes a spindle rotatably mounted in said head block and constituting said pivot axis, an actuating arm connected to said spindle and in contact with said piston, and a further actuating arm connected to said spindle and carrying said tool associated with said piston.

4. A closure sealing machine according to claim 1 wherein each closure sealing tool is a rotatable roller member.

5. A closure sealing machine according to claim 4 further including a plurality of axially, reciprocally mounted rotatable shafts on each of which is mounted one of said roller members, and resilient biasing means whereby said shafts are capable of axial movement against said biasing means.

6. A closure sealing machine according to claim 5 wherein at least two of said shafts are mounted with their longitudinal axes parallel to said axis of rotation of said head block.

7. A closure sealing machine according to claim 5 wherein at least two of said shafts are mounted with their longitudinal axes at a slight angle to said axis of rotation of said head block.

8. A closure sealing machine according to claim 1 wherein there are four cylinders arranged at right angles around said axis of rotation of said head block.

9. A closure sealing machine according to claim 8 including four closure applying tools associated with said cylinders, said tools being arranged around said axis of rotation of said head block approximately 90° out of phase with respect to their respective cylinders.

10. A closure sealing machine according to claim 1 wherein said shaft and said head block have central bores disposed along the axis of rotation of said head block, and wherein said bores accommodate pressure stem projecting out of said application head.

11. A closure sealing machine according to claim 1 wherein said coupling formations comprise respectively a male conical seating surface and a complementary female conical seating surface and a key connection between said surfaces.

12. A closure sealing machine according to claim 1 wherein said series of closure sealing tools comprises at least two groups, said coupling formations having further intercommunicating fluid passageways for introducing pressurized fluid into the cylinders associated with the tools of said two groups through said fluid passageways and said further fluid passageways respectively.

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