A plurality of crimping jaws arranged in a circle are moved inward and constrictively against the outer peripheral skirt of a lid fitted onto a can temporarily stopped on a conveyor by two stop arms of a positioning mechanism thereby to bend and crimp the skirt of the lid around and under a bead formed around the outer part of the rim of the can and thereby to secure and seal the lid tightly against the can. The stop arms, which are swingable about respective vertical axes on opposite sides of the conveyor, arrest a can when they are in closed state in which they are directed convergently in the downstream direction and release a can by swinging laterally and clear of the conveyor.

3 Claims, 14 Drawing Figures
FIG. 7
APPROATUS FOR AUTOMATICALLY CRIMP CROWNING LIDS ON CANS

BACKGROUND OF THE INVENTION

This invention relates generally to metallic containers and more particularly to apparatus for automatically carrying out a series of operations for crimp crowning or fastening lid structures to cap and seal the open ends of respective cylindrical can structures.

It has been conventionally customary to use can structures, principally, in large quantities for packaging commodities of fluid or pasty nature such as paints, coating materials, lubricating oils, and greases. Of the various shapes of can structures which are available, the cylindrical cans have been particularly popular for the reason that they have features such as convenience and cleanliness which enhance the merchandising value of the commodities.

A representative form of these cylindrical can containers (hereinafter referred to as "cans") is the pull can of a construction wherein the entire top end of the can is openable by removing a lid extending thereover. This invention contemplates the provision of an apparatus whereby a chain of operational steps for crimp crowning lids onto respective pull cans is automatically carried out.

As conducive to a full understanding of this invention, the following description of a pull can, its lid, and problems related thereto is first set forth.

The pull can P comprises a can body A and a lid B and has a construction as illustrated in FIGS. 1 and 2 of the accompanying drawings. The can body A is fabricated of a material such as an aluminum (alloy) sheet or a thin steel sheet into a cylindrical vessel with a closed bottom and open top and is provided with a bead 1 around the outer periphery of its upper rim formed by curling the upper rim outward into a tubular molding of substantially circular cross section.

The lid B of substantially disk shape has a circular wall part 2 and an annular trough part 3 formed around the outer periphery of the wall part 2 contiguous thereto, the entire lid B being formed from a single piece of a sheet material. The annular trough part 3 projects upward from the wall part 2, which therefore is depressed or recessed downward relative to the top part of the trough part 3. The trough part 3 has a substantially semicircular cross section which is open at the bottom to fit onto the bead 1 of the can body A and accommodates therewithin an elastic packing 5 made of material such as a synthetic resin or rubber. The outer part of the trough part 3 extends downward as a skirt, which is scalloped or serrated, whereby a plurality of tongue-like tabs 4 of equal width are formed with equal spacing in the circumferential direction.

After a prescribed commodity has been charged into the can body A during a packaging (canning) process, the lid B is crimp crowned onto the can body A. In this operation, the lid B is placed on the can body A so that the annular trough part 3, with the packing 5 accommodated therein, fits onto the bead 1 at the upper rim of the can body A. Then, as indicated in FIG. 2, the tabs 4 of the lid B are crimp bent inward in a manner whereby the root parts of the tabs 4 are wrapped around and engaged with the outer part of the bead 1 of the can body A thereby to fasten the lid B securely onto the can body A.

The lid B is thus securely fastened to the can body A, and, at the same time, the elastic packing 5 within the trough part 3 of the lid B is firmly pressed against the entire upper part of the rim 1 of the can body thereby to effect hermetical sealing of the can and prevent leakage of the can contents to the outside. Positively sealed packaging is thereby achieved.

However, for pull can sealing work as practiced heretofore, use has been made of machines of the type wherein there are provided crimping jaws arranged in a circle and connected to the lower ends of actuating rods arranged radially somewhat in a conical shape and adapted to carry out crimping action, and, by lifting by machine power or by human power the inner central part of the vertex of the conical assembly of the actuating rods, the crimping jaws are caused to undergo crimping action inward toward the center, whereby the tongue-like tabs 4 around the outer periphery of the lid B placed on top of the can body A are bent inward and thus forced into engagement with the rim 1 of the can body A.

This crimping and crimping action by the actuation of the radially arranged actuating rods has been accomplished by means of a power cylinder operated by a pressurized fluid such as air in the case of machine power. While this practice effects a saving in labor in the lid crowning process step, it has tended to increase the size and cost of the apparatus itself. Moreover, this step requires only the press of pressing and bending the tabs 4 of the lid B, and there have been no proposals in the prior art, as far as we are aware, for apparatus in which the step of receiving each can body A into the section for lid crowning and the step of positioning each can body A for the lid crowning process are synchronized and automated when carried out as a flowing line process steps, and the entire series of process steps for the securing each lid B onto its can body A, such as the delivery outward of the each can body A with its lid B crowned thereon, is automated and accomplished with relatively small-size apparatus.

SUMMARY OF THE INVENTION

It is an object of this invention to provide apparatus for automatically and continuously carrying out a series of operational steps for crimp crowning lids onto the open ends of respective can body structures thereby to cap and seal the same in which the above described difficulties encountered in the prior art are overcome.

Another object of the invention is to provide apparatus as stated above in which the required human labor and supervision are substantially reduced.

Another object of the invention is to provide apparatus of the above stated character which is relatively small size and relatively simple construction.

Still another object of the invention is to provide apparatus as stated above in which the crimp crowning action is carried out accurately and positively thereby to obtain fluid-tight sealing between each lid and its can body.

A further object of the invention is to provide apparatus as stated above in which there are provided means for accurately positioning each can body for the crimp crowning step and means for detaining a succeeding can body in standby state until completion of the crimp crowning step for the preceding can body.

According to this invention, briefly summarized, there is provided apparatus for automatically crimp
crowning lids on cans which comprises: a can conveying mechanism having a traveling surface for conveying thereon cans with respective lids fitted thereon in a downstream direction; a lid crimping mechanism having a plurality of crimping jaws arranged in a circle and adapted to press inward against the outer periphery of each lid thus fitted thereby to crimp crown and fasten the lid onto the respective can; a conveying control mechanism comprising positioning means and standby detention means for controlling the movement of the cans conveyed on the traveling surface; and an automatic control system for controlling the above mentioned mechanisms thereby to accomplish automatic and continuous crimp crowning of lids on cans.

The nature, principles, and utility of this invention will be more clearly apparent from the following detailed description with respect to a preferred embodiment of the invention when read in conjunction with the accompanying drawings briefly described below, throughout which like parts are designated by like reference numerals and characters.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is an elevation, with parts cut away and some parts shown in section, illustrating one example of a cylindric can (i.e., pail can) and its corresponding lid, which is shown in exploded state prior to fitting onto and crimp fastening to the can body and can be thus crimp fastened by the apparatus according to the invention;

FIG. 2 is a similar elevation, with parts cut away and some parts shown in section, showing the same can with the lid crimp fastened thereto;

FIG. 3 is an elevation, as viewed downstream from the upstream end of the work flow, of one example of the apparatus for crimp crowning cans according to this invention;

FIG. 4 is a left side elevation (as viewed from the left in FIG. 3) of the same apparatus;

FIG. 5 is a right side elevation (as viewed from the right in FIG. 3) of the same apparatus;

FIG. 6 is a plan view of the same apparatus;

FIG. 7 is an elevation, as viewed upstream from the downstream end of the work flow, of the same apparatus;

FIG. 8 is an elevational view taken along the plane indicated by line VIII—VIII in FIG. 6 as viewed in the arrow direction;

FIG. 9 is a plan view of an automatic positioning mechanism in the same apparatus;

FIG. 10 is a relatively enlarged elevation as viewed upstream from the downstream end, with parts cut away and parts shown in section, showing a crowning mechanism in the same apparatus;

FIG. 11 is a plan view of an essential part of the crowning apparatus shown in FIG. 10; and

FIGS. 12, 13, and 14 are enlarged elevations, partly in vertical section, indicating progressive steps in the crowning action of essential parts in the above mentioned crowning mechanism.

Throughout this disclosure, the terms “upstream” and “downstream” designate directions and end parts of the apparatus as considered with respect to the direction of travel of the can bodies thereon. Directional designations “left” and “right” refer respectively to lateral sides of the apparatus as viewed from the upstream end toward the downstream end.

DETAILED DESCRIPTION

As shown in FIGS. 3 through 8, the apparatus illustrated therein has a machine frame 6 extending longitudinally in the direction of work flow. This frame 6 near its upstream and downstream ends rotatably supports two transverse rotating shafts 7a and 7, which respectively support sprocket wheels 8a, 8a and 8, 8 fixed to the left and right ends thereof. Two endless chains 9, 9 are respectively passed around and supported by the left and right side pair of sprockets 8a and 8. A plurality of conveyor belt slats 10 are disposed transversely across from one chain 9 to the other chain 9 in mutually parallel arrangement with small spacing gaps between adjacent slats.

The rotating shaft 7 on the downstream end extends laterally to the left side and is driven at its end on this side by power transmitted by way of sprockets 12, 12 and an endless chain 13 from a geared motor 11 mounted on a lower downstream part of the frame 6. Thus, the sprockets 8, 8, the chains 9, 9, and the sprockets 8a, 8a are driven, whereby the conveyor belt slats are moved.

Above and along the opposite lateral edges of the upper span of the conveyor belt, there are provided guide rails 14, 14 in mutually-opposed horizontal state with a transverse spacing distance 5 therebetween and with a small gap between these rails and the upper surface of the conveyor belt slats 10 riding on the endless chains 9, 9. The upstream and downstream end parts of each of these guide rails 14, 14 are provided with inner surfaces 15, 15 which are beveled to flare outward. The upstream and downstream ends of the frame 6, on the two lateral sides thereof, are provided with bearing plates 16, 16, which rotatably support the ends of a plurality of transverse conveyor rollers 17 disposed with an upper conveying plane coincident with the conveying plane of the conveyor belt slats 10, which together with these rollers 17 constitute a can body conveying mechanism C.

The frame 6 is provided on its left side, approximately at the middle part between the upstream and downstream ends thereof, with a column structure comprising, essentially, a pair of vertical column rails 18, 18 each of channel-shaped cross section, which are spaced apart from each other with their open trough sides 19, 19 or flange parts facing each other and are fixed to the frame 6 with an alignment in the upstream-downstream direction. These column rails 18, 18 are joined by a reinforcing cross beam 20 spanning and fixed to their upper ends.

A member 21 is adapted to operate as a vertically moving carriage between the column rails 18, 18 and is provided at its upper and lower parts with guide wheels 22 for rolling along the flanges of the column rails 18, 18 on the inner faces thereof. At the lower outside part of the carriage member 21, a vertical power cylinder 23 operated pneumatically, for example, is provided for raising and lowering the carriage member 21. The power cylinder 23 is provided on opposite sides at a part thereof approximately midway between the upper and lower ends thereof with trunnions 24 extending respectively in the upstream and downstream directions and rockably journaled by bearing blocks 25 fixed
respectively to the outer of left sides of the column rails 18.

The power cylinder 23 has therein a piston (not shown) to which is connected the lower end of vertical piston rod 26. The upper end of the piston rod 27 is in the form of a threaded rod 28 passed through an attachment sleeve 27 and loosely through a hole in an attachment bracket 29 secured to the upper part of the carriage member 21 and projecting outward or toward the left. The bracket 29 is clamped between a seat flange 30 provided at the upper end of the sleeve 27 and a washer 31 over which a nut 32 engaged with the threaded rod 28 is tightened. By this construction, the position of a bracket 29 relative to the piston rod 26 can be readily adjusted and then set.

At the upper end part of the carriage member 21 and on the inner side thereof opposite from the bracket 29, there is fixed the base end of a support arm 33 extending upward and toward the right to a region above the conveying surface formed by the slats 10 of the can body conveying mechanism C. A hanger bracket 34 having two opposed and spaced apart flanges is fixed to the outer end of this support arm 33.

Between the two flanges of this hanger bracket 34, there is vertically mounted a power cylinder 35 operated by a fluid such as compressed air, for example, for crimp crowning and having a downwardly extending, vertical piston rod 38. The power cylinder 35 is so positioned that the axis of the piston rod 38 passes through the midpoint of the aforementioned spacing distance S between the left and right guide rails 14, 14. The power cylinder 35 is supported on the hanger bracket 34 by a pair of trunnions 36 which are fixed to opposite sides of the lower part of the power cylinder and extend therefrom in the upstream and downstream directions, and which are loosely fitted in vertical slots 37 formed parallelly in the two flanges of the hanger bracket 34.

Furthermore, as shown in FIGS. 10 and 11, a mounting disk 39 is fixed horizontally to the lower end of the piston rod 38 of the power cylinder 35 and is provided with a specific number of cutout slots 40 formed in radial arrangement and accommodating the upper ends of respective actuating links 41 pivotally connected to the mounting disk 39. These actuating links 41 are all of equal length and extend radially outward and downward through respective vertical slots 43 formed around the cylindrical wall of a vertical guide cylinder 42 suspended from and fixed to the lower end of the power cylinder 35.

The lower end of the guide cylinder 42 is formed into an annular pressing flange 44 of a specific diameter, and an auxiliary ring 45 of the same diameter as the flange 44 is superimposedly secured to the bottom surface of the flange 44. On the upper annular surface of the pressing flange 44, pivot members 46 of the same number as the actuating links 41 are fixed in radial alinement at respective positions corresponding to respective actuating links 41. Each pivot member 46 extends outward from the outer periphery of the flange 44 and pivotally supports a crimping lever 47 at a pivot point thereof intermediate between its two ends, this crimping lever 47 thus having upper and lower arms on opposite sides of the pivot point.

The distal or upper end of the upper arm of each crimping lever 47 is pin connected to the outer, lower end of a corresponding actuating link 41. At the distal or lower end of the lower arm of each crimping lever 47, a crimping jaw 48 of a specific width and an arcuate shape in plan view is provided so that, as viewed in plan view, the crimping jaws 48 in a circle with a small constant gap between each pair of adjacent jaws. The inner side of each jaw 48 is sloped downward, and the upper and lower surfaces thereof converge to form a tapered inner edge 49, which is bent inward. The above described parts thus constitute a crimp crowning mechanism D.

Below the crimping jaws 48 arranged in a circle in plan view and symmetrically on the left and right sides of the machine frame 6, there are rotatably supported vertical shafts 50 for positioning of can bodies. Stop arms 51 for positioning are fixed at their proximal ends to the upper ends of respective shafts 50 and extend horizontally and convergently downstream. A shock-absorbing pad 52 made of a resilient material such as rubber is fixed to the distal end of each stop arm 51.

A crank arm is fixed to the lower end of each shaft 50 and is connected at its outer end by way of a link or connecting rod 53 to the outer end of a piston rod 55 of a power cylinder 54 used commonly for the two shafts 50 and actuated by a fluid such as compressed air. Actuating movements of the piston rod 55 are thereby transmitted to the two stop arms 51 to cause them to undergo coordinated opening and closing movements in the laterally outward and inward directions.

At a specific distance upstream from the above described can positioning mechanism including the stop arms 51, there is provided a similar mechanism for determining can bodies in a standby position, which comprises vertical shafts 56, stop arms 57 provided with shock-absorbing pads 58, crank arms and connecting rods 59, and a power cylinder 60 with a piston rod 61, which are all arranged similarly as in the above described positioning mechanism. Thus, a conveying control mechanism E is constituted.

The details of design of an apparatus constituted, as shown in the drawings, by an organic combination of the above described can body conveying mechanism C, the can crimp crowning mechanism D, and the conveying control mechanism E must, of course, be changed in accordance with the size of the pail cans, that is, the outer diameter and height thereof.

Accordingly, the organization of the apparatus illustrated in the drawings is designed with the following relationships on the basis of the shapes and dimensions of the can body A and the lid B of the pail can.

The transverse spacing distance S between the left and right guide rails 14 is set at a value which is slightly greater than the outer diameter of the can body A of the pail can yet does not resist the sliding movement of the can body.

The outer diameter of the pressing flange 44 and the auxiliary ring 45 is made slightly less than the inner diameter of the wall part 2 at the inner wall part of the annular trough part 3 of the lid B of the pail can, and, at the same time, the total thickness of the pressing flange 44 and the auxiliary ring 45 is made greater than the depth of the wall part 2 of the lid.

Furthermore, the diameter of the circle in which the crimping jaws 48 of the crimping levers 47 are arranged is so set that, when the crimping jaws 48 carry out their crimp-crowning action as a result of the inward rotation of the lower parts of all crimping arms 47, they bend inward the tabs 4 of a lid B placed on a can body
A and wrap these tabs tightly around the bead 1 of the can body.

The angle at closure of the stop arms 51 for positioning disposed in their aforedescribed mutually divergent attitude as viewed in plan view is so set that, when the can body A of the pail can riding on the conveyor belt slats 10 of the can body conveying mechanism C and positioned inside of the stops arms 51 is stopped by these stop arms 51, the center of can body A coincides with the center of the circle in which the crimping arms 47 are arranged as viewed in plan view. The angular positions of the stop arms 51 when they have swung outward to their opened positions are so set that the can body A being conveyed on the conveyor belt slats 10 can move past and clear of these stop arms 51.

The angle at closure of the stop arms 57 for detaining can bodies disposed in their above described mutually divergent attitude as viewed in plan view is so set that a can body A riding on the conveyor belt slats 10 is arrested by these stop arms 57. The degree of opening of these stop arms 57 when they swing outward to their opened positions is so set that the can body riding on the conveyor belt slats 10 can move past and clear of these stop arms.

Then, in order cause the above described mechanisms to operate in a prescribed work order, a limit switch LS1 for standby detention, a limit switch LS2 for start of crimp crowning, a limit switch LS4u for return, a limit switch LS4D for lower limit of up-and-down movement, a limit switch LS5u for upper limit of crimp crowning, and a limit switch LS5D for lower limit of crimp crowning are installed at specific points in these mechanisms and wired to an appropriate electrical control circuit (not shown) whereby automatic control of the operations can be accomplished.

The limit switch LS1 is so fixed to the machine frame 6 on one side and at an upper part thereof its switch actuator a is disposed at the midpoint between the stop arms 51 for positioning and the stop arms 57 for standby detention and, moreover, on one side and above the conveyor belt slats of the can body conveying mechanism thereby to be pressed and actuated by a can body which has passed by the stop arms 57. When the switch actuator a is thus pressed and actuated, and the limit switch LS1 is thereby closed, the above mentioned electrical control circuit and the operational system of the related working fluid medium for the power cylinder 60 for standby detention are rendered operative for operating the power cylinder 60 thereby to move the stop arms 57 to their convergent closed position.

The limit switch LS2 for start of crimp crowning is so fixed to a downstream part of one of the stop arms 51 for positioning that its switch actuator b projects in the direction opposite to the direction of travel of the conveyor from the vicinity of the proximal end of that stop arm 51 and is pressed and actuated by can body which has been stopped by the two stop arms 51 in convergent closed state. When the switch actuator b is thus pressed and actuated, the electrical control circuit and the operational system of the related working fluid medium for the power cylinder 23 are rendered operative thereby to stop the operation of the motor 11 and the movement of the conveyor belt slats 10 and to operate the power cylinder 23 to lower the carriage member 21.

A limit switch LS3 for return is so fixed to the machine frame 6 at the upper part on one side thereof that its switch actuator c is positioned downstream from the positioning stop arms 51 and above one lateral side of the conveyor belt slats 10 of the can body conveying mechanism C and, moreover, is pressed and actuated by a can body sent downstream from the positioning stop arms 51 which have been opened. The operational system of the working fluid of the power cylinder 60 and the electrical control circuit therefore are so adapted that when the switch actuator c of this return limit switch LS3 is thus pressed and actuated, the power cylinder 60 for standby detention is operated to open widely the stop arms 57 for standby detention, which have been closed up to that moment, simultaneously to close the stop arms 51 for positioning, which have been opened, to their convergent closed state, and, further, to return all electrical control circuits to their states at the time of starting in order to prepare them for the succeeding cycle of the same work process.

The limit switch LS4u for upper limit of up-and-down movement and the limit switch LS4D for lower limit of up-and-down movement are fixed the outer surface of one of the column rails 18 respectively at upper and lower positions spaced apart by a predetermined distance, at which positions the switch actuator d of the limit switch LS4u and the switch actuator e of the limit switch LS4D are pressed and actuated respectively by a pressing member 62 fixed to the outer surface of the carriage member 21 when this carriage member 21 reaches predetermined upper and lower limiting positions thereof.

The aforementioned electrical control circuit and related operational system of the working fluid of the power cylinders are so adapted that the following operations are carried out. When the pressing member 62 presses against and actuates the switch actuator a as a result of the descent of the carriage member 21, the operation of the power cylinder 23 for driving the carriage member 21 is stopped to stop the carriage member 21 at its lower limiting position, and, at the same time, the power cylinder 35 for crimp crowning is operated to cause the actuating links 41 of the lid crown crimping mechanism D to descend. When the pressing member 62 presses against and actuates the switch actuator d of the limit switch LS4u for upper limit of up-and-down movement as a result of the rise of the carriage member 21, the operation of the power cylinder 23 for raising and lowering the carriage member 21 is stopped, whereby the carriage member 21 stops at the predetermined upper limit position, and simultaneously the stop arms 51 which have been closed up to this time are opened widely, the geared conveyor motor 11 being started at the same time thereby to start the conveying operation of the conveyor belt slats 10.

The limit switch LS5u for upper limit of crimp crowning and the limit switch LS5D for lower limit of crimp crowning are respectively fixed by way of a mounting plate 63 to the power cylinder 35 for crimp crowning with a specific distance maintained therebetween. In addition, a vertical push rod 65 is slidably fitted in spacedapart upper and lower guides 66 fixed to the power cylinder for crimp crowning and is pin connected at its lower end by way of a connecting link 64 to one of the actuating links 41. A pressing member 67 is fixed in a vertically adjustable manner to an upper
part of the push rod 65 so as to actuate a switch actuator \( f \) of the limit switch LS5u and a switch actuator \( g \) of the limit switch LS5D, respectively, when the actuating links move upward to a predetermined upper-limit position and move downward to a predetermined lower-limit position.

The electrical control circuit and related operational system of the working fluid of the power cylinders are so adapted that the following operations are carried out. When the pressing member 67 presses against and actuates the switch actuator \( g \) of the limit switch LS5D as a result of the downward movement of the actuating links 41, the operation of the power cylinder 35 for crimp crowning is stopped thereby to stop the actuating links 41 at their predetermined lower-limit position and is again started with a short delay after the links 41 have been thus stopped at their lower-limit position, this delayed restarting being effected by means such as a timer combined with the electrical control circuit, thereby to raise the actuating links 41. When the pressing member 67 presses against and actuates the switch actuator \( f \) of the limit switch LS5u for upper limit of crimp crowning as a result of the rising movement of the actuating links 41, the operation of the power cylinder 35 is stopped thereby to stop the links 41 at their predetermined upper-limit position, and, at the same time, the power cylinder 23 for vertically driving the carriage member 21 is operated thereby to start the carriage member 21 in rising movement.

The various limit switches described above, the electrical control circuit, and the working fluid system related thereto for driving the power cylinders may be of any suitable design provided that they carry out effectively the intended operations in the apparatus of this invention and contribute to the achievement of the objects of the invention.

In the installation and use of an apparatus based on this invention of the above described construction, in general, a continuously conveying device such as a roller conveyor from a preceding commodity charging process step wherein a metered quantity of a commodity to be packaged is charged into each can body A, and then a lid B is fitted onto the can body is connected to the upstream end of the can body conveying mechanism C of the apparatus of the invention thereby to receive automatically pail cans from the preceding process step, and, at the same time, means such as a roller conveyor is connected to the downstream end of the conveying mechanism C to convey automatically out pail cans comprising can bodies A with lids B crimp crowned thereon by the apparatus of the invention.

The pail cans successively fed to the apparatus of the invention by a continuously conveying mechanism are subjected to repetitions of cycles of work steps, in each of which a lid B is crimp crowned on a respective can body A. First, at the start of operation of the apparatus of the invention, the geared motor 11 for conveying is started so that the conveyor belt slats 10 move continuously in the arrow direction F in FIG. 6. At the same time, the upstream stop arms 57 for standby retention are kept in their opened state by the operation of the power cylinder 60 so that a can body can pass therebetween. In addition, the carriage member 21 is lifted by means of the power cylinder 23, and the power cylinder 35 for crimp crowning is stopped in its upper-limit position after its upward movement, by which the mounting disk 39 is placed to raise the crimping jaws 48 in their outwardly opened state.

For placing the apparatus of the invention in the operation starting state in this manner, an electrical control circuit in which this is accomplished by closing a starting switch in an electrical circuit is employed, or an electrical control circuit in which this is accomplished by detecting the pail cans sent into the apparatus of the invention by installing a limit switch at the upstream end of the can conveying mechanism C, that is, the point of connection between the conveying mechanism C and the upstream continuous can conveying mechanism is employed.

Particularly in the case where a limit switch for detecting passage of cans is installed at the above mentioned point of connection between the conveying mechanism C and the upstream conveying mechanism, full automation is achieved, whereby the effectiveness of this invention is further elevated.

One cycle of the work process from the start of work will now be described in detail in the sequence of steps.

Each pail can conveyed to the upstream end of the can conveying mechanism C of the apparatus of this invention by the continuously conveying mechanism of the preceding process step rides on the conveyor rollers 17 and then rides onto the conveyor belt slats 10, which are in conveying operation. At the same time, as it is carried by the moving conveyor belt slats 10, the cam is guided by the beveled surfaces 15 into the space between the guide rails 14 in mutually opposed disposition and thus advances downstream as its position in the transverse direction is maintained unchanged by the guide rails 14. Therefore, the can advances on and along the conveying mechanism C without deviating from the centerline of the work flow path.

Then, as the can is thus carried on the conveyor belt slats 10, it passes by the stop arms 57 for standby detention, which are in their outwardly opened state, and then contacts and actuates the switch actuator \( a \) of the limit switch LS1 for standby detention. Then, traveling further, the can strikes against and is arrested by the stop arms 51 for positioning, which are in their convergently closed positions. At the same time, the can presses against and actuates the switch actuator \( b \) of the limit switch LS2 for crimp crowning.

As a result of the actuation of the switch actuator \( a \) of the limit switch LS1, the power cylinder 60 for standby detention in the conveying control mechanism E operates to rotate the stop arms 57, which were in opened state up to this time, into their convergently closed position. The succeeding can successively fed is thereby detained in standby state to await the start of the succeeding cycle of the crimp crowning process step.

Furthermore, as a result of the actuation of the switch actuator \( b \) of the limit switch LS2 for start of crimp crowning, the geared motor 11 for conveyance is stopped to stop the conveying movement of the conveyor belt slats 10 of the can conveying mechanism C, and the can is held at rest in a predetermined position at which it was arrested. At the same time, in the lid crimp crowning mechanism E, the power cylinder 23 operates to lower the carriage member 21 and, therefore, the power cylinder 35 for crimp crowning, whereby the crimping jaws 48 in circular arrangement descend to approach the lid B of the can held in the
above mentioned predetermined position as indicated in FIG. 12.

When the power cylinder 35 descends thus and approaches the lower limit of its travel, the pressing flange 44 at the lower end of the guide cylinder 42, together with the auxiliary ring 45 on its lower surface, fits into recessed part 2 of the lid B and progressively presses the same downward as it descends further.

When the power cylinder 35 for crimp crowning reaches its lower-limit position, the pressing member 62 of the carriage member 21 presses against and actuates the switch actuator e of the limit switch LS4D for lower limit of vertical movement, whereupon the downward operation of the power cylinder 23 for vertical movement stops with the pressing flange 44 at the lower end of the guide cylinder 42 in the state wherein it has pushed down the lid B of the can as indicated in FIG. 13. The power cylinder 35 is thereupon fixed in its lower-limit position and, at the same time, begins its downward acting operation, and its piston rod 38 presses down on the mounting disk 39 to which the upper ends of the actuating links 41 are pin connected. However, since the lower ends of the actuating links 41 are pin connected to the upper ends of respective crimping levers 47 pin connected at their lower ends to pivot members supported on the pressing flange 44 formed around the periphery of the lower end of the guide cylinder 42 suspended from the pressing cylinder 35, the pressing down of the mounting disk 39 causes the actuating links 41 to be forcibly splayed outward, whereby the angle between each link 41 and its respective lever 47 at their pin connection on their inner side decreases. That is, the upper ends of the crimping levers 47 arranged in a circle are all pressed radially outward in unison. Consequently, the levers 47 rotate about their pivotal pins connecting them to their respective pivot members 46, and the crimping jaws 48 at the lower ends of the crimping levers 47 move inward, as indicated in FIG. 13, and press against and forcibly bend the tongue-like tabs 4 around the outer periphery of the lid B on the can body A.

Then, as the actuating links 41 reach their predetermined lower-limit position, the lower ends of the crimping levers 47 are rotated fully inward, as indicated in FIG. 14, and the curved inner edges 49 of the crimping jaws 48 arranged in a continuous circle in plane view force the tabs 4 of the lid B to be wrapped inward around the lower part of the bead 1 on the upper rim of the can body A and, at the same time, to bite inward thereby to be fixedly locked under the lower part of the bead 1. Thus, the lid B is fixed by crimp crowning onto the can body A of the pail can.

When the actuating links 41 reach their lower-limit position as described above, the pressing member 67 fixed to the push rod 65, which has been pulled down together with the descent of the actuating links 41, presses against and actuates the switch actuator g of the limit switch LS5D for lower limit of crimp crowning. Consequently, the lowering operation of the power cylinder 35 for crimp crowning stops, and the crimp crowning action due to the curved inner edges 49 of the crimping jaws 48 is sustained for a very brief pause period to ensure full bending and locking in place of the tabs 4 as described above.

Then, after this brief pause period, the power cylinder 35 begins its raising operation, and the mounting disk 39 is raised by the rising piston rod 38 and simultaneously raises the upper ends of the actuating links 41. Consequently, the lower arms of the crimping levers 47 rotate in the direction opposite to that for crimp crowning, that is, outward, and open thereby to terminate the crimp crowning action.

Then, when the actuating links 41 reach their predetermined upper-limit position, the pressing member 67 mounted on the push rod 65 presses against the actuates the switch actuator f of the limit switch LS6s for upper limit of crimp crowning, whereupon the raising operation of the power cylinder 35 stops. At the same time, the power cylinder 23 begins its raising operation thereby to raise and return the power cylinder by way of the carriage member 21.

When the carriage member 21 thus raised reaches its upper-limit position, the pressing member 62 presses against and actuates the switch actuator d of the limit switch LS4s for upper limit of vertical movement. As a result, the power cylinder 23 stops its raising operation, and the geared motor 11 starts to drive the conveyor belt slats 10 of the can conveying mechanism C. At the same time, the power cylinder 54 for positioning in the conveying control mechanism E operates to open outward the stop arms 51, which have until now been in their convergently closed state. Consequently, the pail can which has until now been held by the stop arms 51 for positioning is released and, traveling on the conveyor belt slats 10, is sent out to the succeeding process.

As the pail can thus released is sent out, it presses against and actuates the switch actuator e of the limit switch LS3 for return, whereupon the power cylinder 54 for positioning operates to close the stop arms 51 for positioning to their convergently closed positions, and, simultaneously, the power cylinder 60 for standby detention operates to open the stop arms 57 for standby detention thereby to release the succeeding pail can, which has been detained in standby state, and which is now conveyed toward the positioning stop arms 51. Thus, one cycle of the crimp crowning process step is completed and is followed by the succeeding cycle.

By repeating the above described cycle of the crimp crowning process step, the lids B of the successively arriving pail cans are crimp crowned and fixed to their respective can bodies A thereby to seal in the commodity accommodated in the cans, this crimp crowning operation being carried out automatically and continuously.

As described above and as shown in FIG. 13, the lid B is secured by crimp crown onto the can body A in the apparatus according to this invention by an automatic process wherein the crimping jaws 48 arranged in a circle bend and wrap the tabs 4 of the lid B around and under the bead 1 at the rim of the can body A as the lid B fitted onto the can body A is pressed downward by the pressing flange 44 at the lower end of the guide cylinder 42. Accordingly, the upper rim of the can body A is intimately contacted by the elastic packing 5 provided within the annular trough part 3 of the lid B, and the interior of the can is fully sealed from the outside. Furthermore, the commodity contained within the can cannot leak out even if it is highly fluid, and, moreover, rain water and snow cannot infiltrate into the can when it is left outdoors. Thus, a commodity contained in a pail can which has been crimp crowned by the apparatus of this invention is fully protected.
We have found that optimum crimp crowning operation can be positively carried out when the parts of the crimp crowning mechanism D are so constructed that the cramping jaws 48 arranged in a circle are made in position, spacing, and width to coincide correspondingly with the tabs 4 of the lid B.

In the operation of the apparatus of this invention, a succeeding can is automatically detained in standby state until the completion of the cycle of the above described crimp crowning process for securing the lid B on the can body A of the preceding can and then, upon completion of the cycle, is automatically released and conveyed to the specific position for the crimp crowning operation. Accordingly, there is no work involving human labor, and the crimp crowning operation is made highly rational and efficient.

Furthermore, pail cans conveyed in the apparatus for the above described crimp crowning step are always positioned accurately for this step since the movement of each can is arrested and simultaneously stopped by the stop arms 51 for positioning, which are closed in converging state as viewed in plan view. This accuracy of positioning is based on the principle that the center of a circle tangently inscribed between two intersecting lines forming an angle (less than 180°) therein lies on the bisector of that angle. A can body A corresponds to the circle, while the stop arms 51 correspond to the two intersecting lines, the stop arms 51 in closed state being convergently disposed with their extremities in the downstream direction intersecting at a point on the longitudinal centerline of the conveyer path.

In addition, since the stopping of a pail can in a specific position is accomplished by means of a mechanism wherein the advancing and retracting movements of the piston rod 55 of the power cylinder 54 for positioning are transmitted by connecting rods 53 and shafts 50 to actuate the stop arms 51 on the two lateral sides in opening and closing action, a complicated mechanism for stopping a can accurately in the specific position is unnecessary, and the entire apparatus can be made small and simple. One result of this feature is that the floorspace required for installation of the apparatus of the invention can be greatly reduced.

We claim:
1. Apparatus for automatically crimp crowning lids on cans comprising:
   a. a conveying mechanism (C) having a traveling surface (10) with a longitudinal centerline and operated by a motor to convey thereon cans (A) with respective lids (B) fitted thereon in a downstream direction;
   b. a lid crimp crowning mechanism (D) comprising:
      a. a movable support structure (21, 33) adapted to be vertically movable at a station on one side of said traveling surface,
      b. first motive power means (23) for thus moving the movable support structure,
      c. second motive power means (35) supported on the movable support structure above the traveling surface and being operable to produce vertical driving movements of a push-pull rod (38) directed downward and aligned with said longitudinal centerline,
      d. a guide cylinder (42) suspendedly supported coaxially with the push-pull rod by the second motive power means and having at the lower end thereof an annular pressing flange (44) for press-
   c. a plurality of crimping levers (47) pivotally supported by the guide cylinder around the lower peripheral part thereof with uniform circumferential spacing and having at the lower ends thereof respective crimping jaws (48) arranged with uniform spacing around a circle coaxial with the guide cylinder and with a crimp crowning position of each can, the crimping levers being pivotally operable to cause the crimping jaws to press inward against the outer periphery of each lid thereby to crimp crown and fasten the lid onto the respective can, and
   d. power transmitting means (39, 41) connected between the lower end of the push-pull rod and the upper ends of all of the crimping levers and operated by the push-pull rod to actuate the crimping levers in crimp crowning operation;
3. a conveying control mechanism comprising
   a. positioning means for arresting and holding at said crimp crowning position each can traveling on said traveling surface for said crimp crowning operation and thereafter releasing said can upon completion of the crimp crowning operation, and
   b. standby detention means for arresting and holding a succeeding can in a standby detention position upstream from the crimp crowning position until said completion of the crimp crowning operation on the preceding can and then releasing said succeeding can;
4. an automatic control system for detecting the operational states of the lid crimp crowning mechanism and the conveying control mechanism and the positional states of the cans on the can conveying mechanism and operating in accordance with said states thus detected to control the operations of the can conveying mechanism, the lid crimp crowning mechanism, and the conveying control mechanism in a predetermined manner thereby to accomplish automatic and continuous crimp crowning operation on cans.
2. Apparatus for automatically crimp crowning lids on cans as claimed in claim 1 in which:
   said positioning means comprises
   stop arms (51, 51) rotatably supported at proximal ends thereof to rotate about respective vertical axes on opposite lateral sides of said traveling surface (10) and at a height level above the traveling surface between a closed state for arresting a can traveling on the traveling surface, in which state the stop arms are directed in converging downstream directions and symmetrically disposed relative to said longitudinal centerline, and an opened state clear of the traveling surface for permitting a can to be conveyed freely on the traveling surface,
   third motive power means (54, 55), and
   power transmitting means (53, 50) for transmitting actuating power from the third motive power to the stop arms thereby to actuate the stop arms in closing and opening actions; and
   said standby detention means has a construction and action substantially the same as those of the positioning means and comprises
   stop arms (57, 57).
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a fourth motive power means (60, 61), and
power transmitting means (59, 56).

3. Apparatus for automatically crimp crowning lids
on cans as claimed in claim 2 in which each of said first,
second, third, and fourth motive power means com-

prizes a power cylinder-and-piston actuating device op-
erated controllably by a pressurized fluid, and said au-
tomatic control system comprises an electrical circuit
including limit switches.

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