

Aug. 27, 1963

H. ERDMANN

3,101,528

DISPENSER FOR RETAINING RINGS

Filed Nov. 15, 1960

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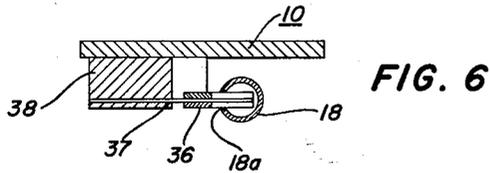


FIG. 6

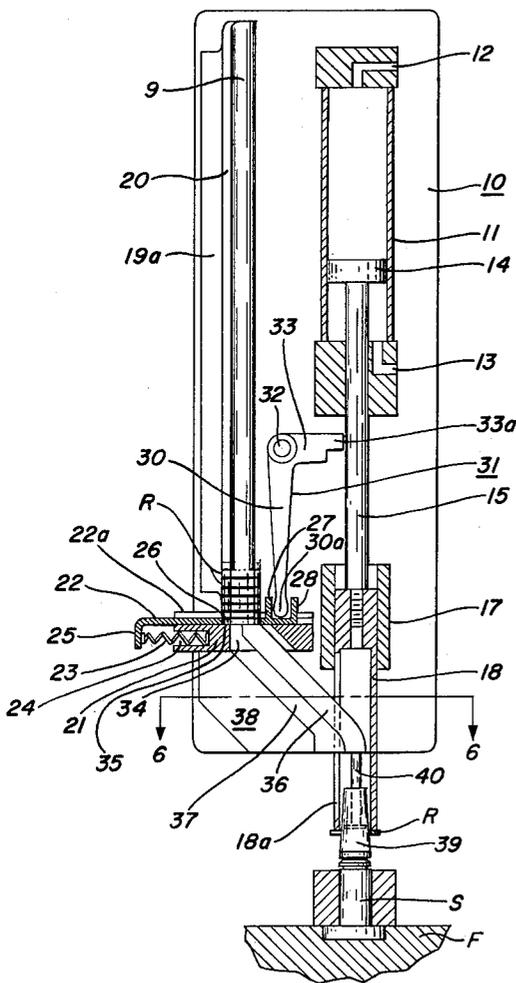


FIG. 3

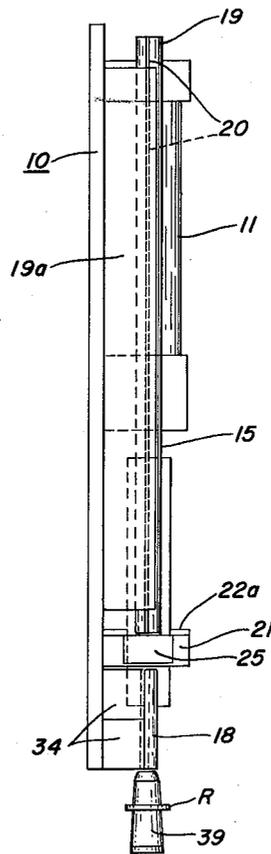


FIG. 4

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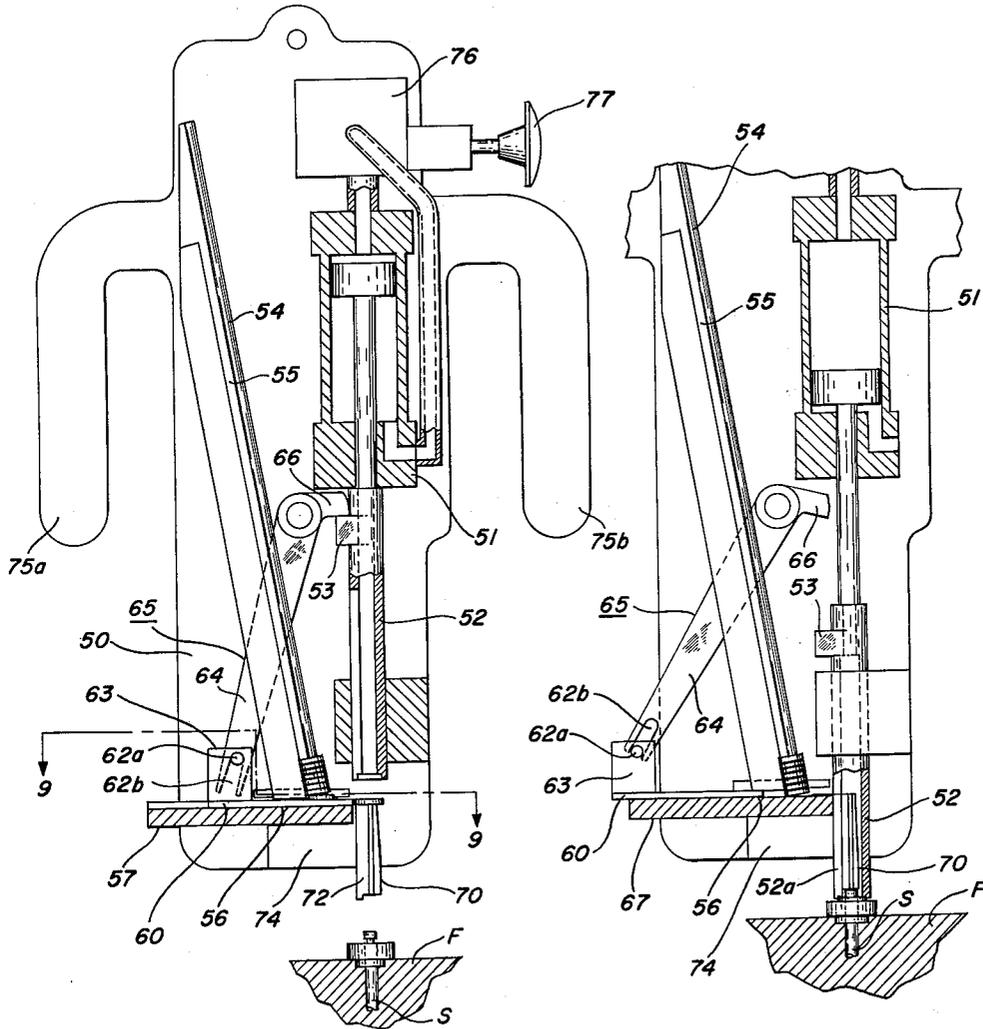


FIG. 8

FIG. 7

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FIG. 9

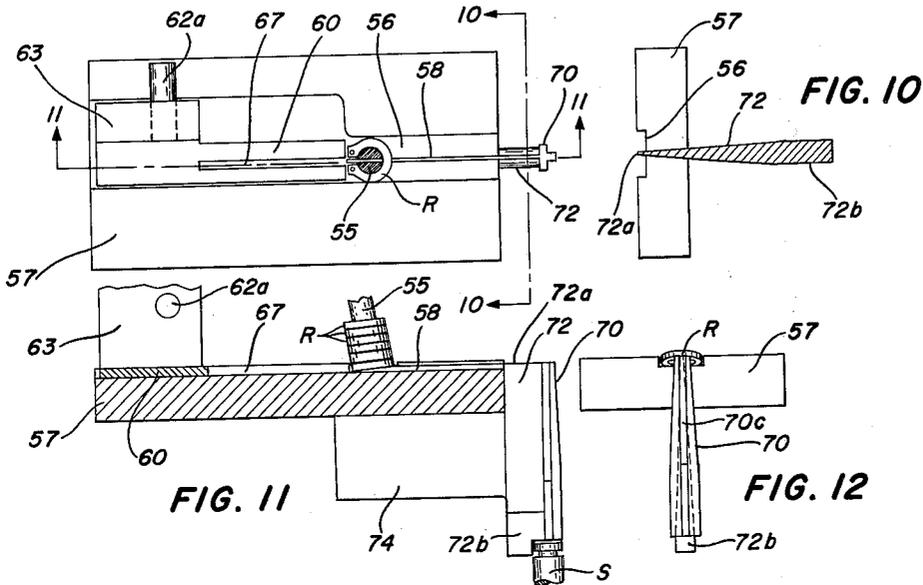


FIG. 11

FIG. 12

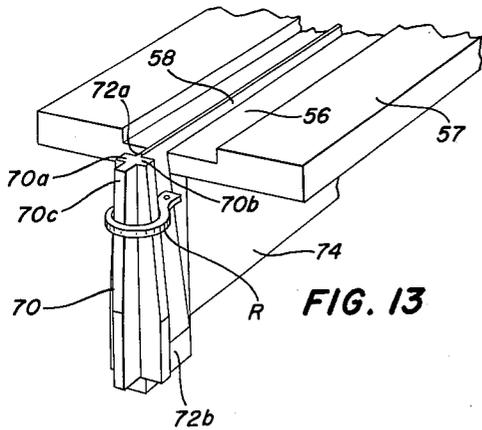


FIG. 13

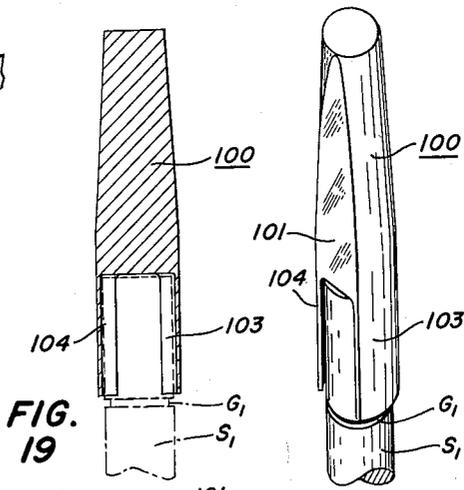


FIG. 19

FIG. 18

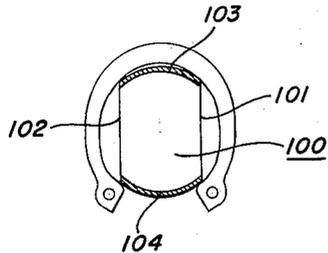


FIG. 21

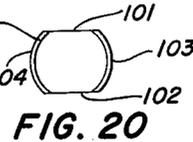


FIG. 20

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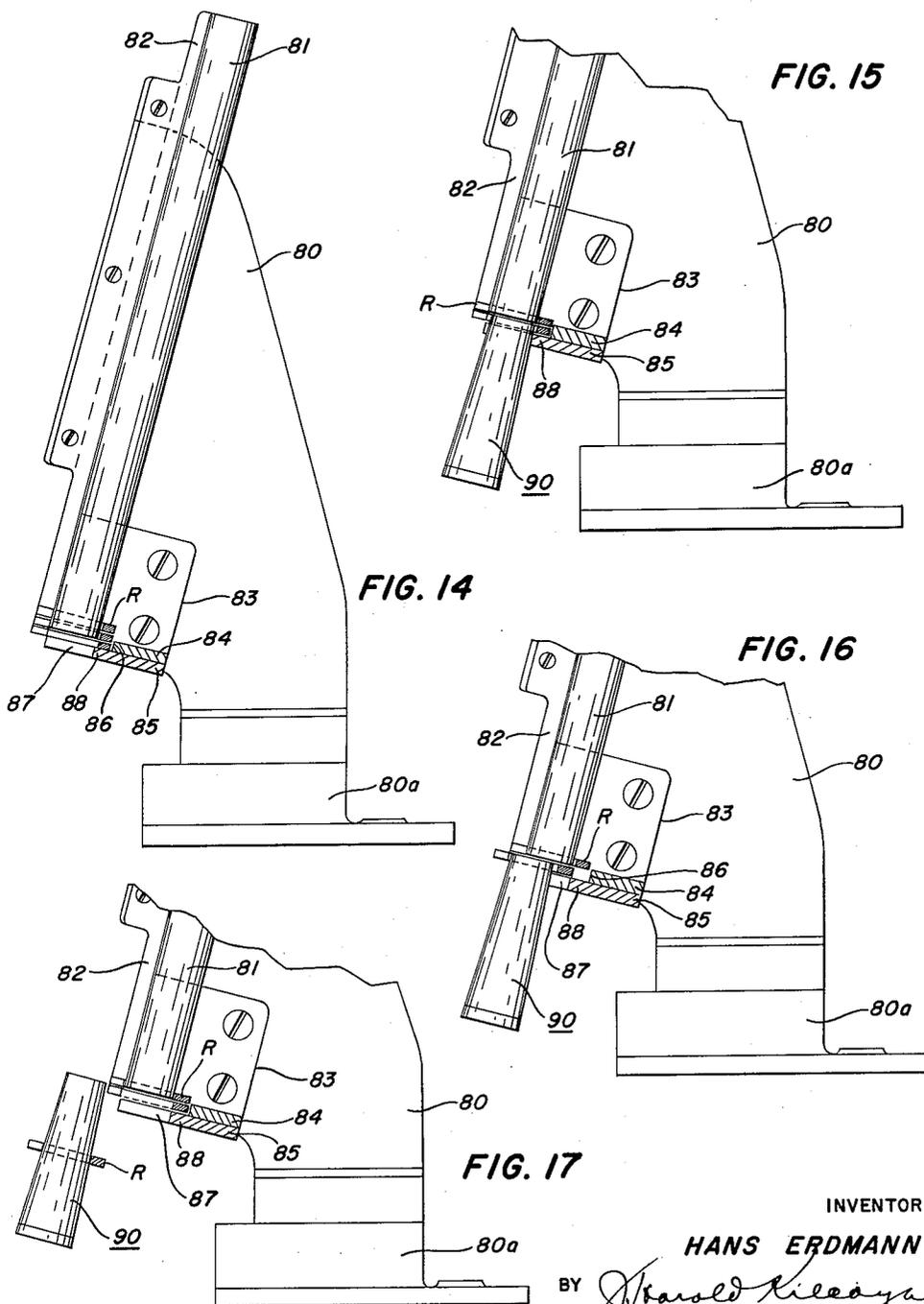
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DISPENSER FOR RETAINING RINGS

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5 Sheets-Sheet 5



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3,101,528

DISPENSER FOR RETAINING RINGS

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Filed Nov. 15, 1960, Ser. No. 69,475

5 Claims. (Cl. 29—211)

This invention relates to improvements in dispensers for spring retaining rings, and more particularly to an improved magazine-type dispenser for the so-called external "split" or nearly-closed retaining rings which are adapted, when spring-seated in the groove of a shaft, pin or the like, to form thereon an artificial locating shoulder for a machine part such as a pinion, bearing race and the like.

As is well known, the external split retaining ring, because of the small width of the gap between its open ends, is required to be assembled to its shaft or pin by first spreading it over an end thereof (usually the end of the shaft nearest the groove) and thereupon shifting said ring axially along the shaft until it reaches the plane of the groove, whereupon it snaps into same. Thus, as compared to dispensers for the so-called "open" retaining rings which also incorporate or are designed to be used in combination with special ring-to-shaft applying means, the prior split-ring dispensers similarly incorporating or designed for use in combination with ring-applying means have involved relatively cumbersome and expensive construction, quite out of keeping with the large-scale use of such rings and the demand for a readily available supply thereof, which exists in practically all branches of industry.

Stated broadly, a main object of the present invention is to provide a magazine-type dispenser and applicator for external split retaining rings which is simple in construction and inexpensive to manufacture, yet thoroughly dependable and efficient in operation.

Another object of the invention is the provision of a magazine-type dispenser and applicator for external split retaining means which incorporates simple yet highly effective means for automatically effecting one-by-one withdrawal of the rings to be assembled from a stack or column of such rings, and the controlled delivery of the so-withdrawn rings to combined or associated ring-applying means.

Yet another object of the invention is the provision of a magazine-type dispenser and applicator for external split retaining rings which is characterized by practical and dependable power-operated means for effecting one-by-one withdrawal of the rings to be assembled from a stack or column thereof and delivery thereof to combined or associated ring-applying means.

A more particular object of the invention is the provision of a form of dispenser and applicator for split external retaining rings wherein a plurality of split external retaining rings to be dispensed are arranged in stack or column formation on a plate or shelf-like member, characterized by a ring drop-through opening of size and configuration corresponding substantially to that of said rings but which is offset a small distance laterally from the lowermost ring of the column whereby to form an arcuate ledge on which said ring and all rings above same are normally supported along only an outer peripheral portion thereof, in conjunction with power-operated means

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for shifting the lowermost ring of the column laterally to a position in which it aligns with and thereupon proceeds to drop through said opening. In one design of dispenser and applicator incorporating the aforesaid ring "drop-through" feature, the ring falling through said plate- or shelf-opening drops on to a preferably rail-type chute which directs the ring on to the upper, smaller-diameter end of a frusto-conical mandrel (whose lower end has diameter corresponding to that of the shaft on which the ring is to be assembled) of an associated ring-applying means, whereupon the ring is forced downwardly along the mandrel by a power-operated plunger acting as a ring push head, thereby to effect spreading of the ring to a diameter such that it may readily be applied over the end of said shaft which it is contemplated will be mounted in a fixture disposed immediately below said mandrel and thus in a position to receive the ring.

A further object of the invention is the provision of yet another form of power-operated dispenser and applicator operating generally as last aforesaid but which does away with the ring chute and thereby simplifies the overall construction.

The invention contemplates and has for its object the provision of another very simple form of dispenser incorporating the ring "drop-through" feature as explained above, wherein a frusto-conical ring-spreading mandrel is itself employed as the means for moving the endmost ring of the column thereof to a position in which it directly overlies the offset drop-through opening, whereupon the ring drops through said opening on to the smaller-diameter end of the mandrel. Such mandrel may be mechanically motivated, but by preference it comprises the spreading head of a hand-operated tool also incorporating a push head as generally disclosed in my prior application Serial No. 817,668, filed June 2, 1959, now Patent No. 3,015,882, granted January 9, 1962. Thus, such a tool may also serve the additional functions of transferring the ring dropping through the plate or shelf opening of the dispenser to the workpiece, i.e. the grooved shaft or the like on which it is to be assembled, and thereupon of spreading the ring and shifting it over the end of said shaft to the plane of its groove.

Still another object of the invention is the provision of an improved split-ring spreading mandrel for use as the mandrel of any one of the aforesaid generally described forms of split-ring dispenser and/or applicator, the construction and configuration of which are such as to prevent over-stressing of the ring as it is being spread from its normally unstressed diameter to that of the shaft over which it must be spread and shifted in moving to the plane of its groove.

The above and other objects and features of advantage of a split external retaining ring dispenser taken alone and in combination with automatic ring-applying means according to the present invention, will appear from the following detailed description, in which reference is had to the accompanying drawings illustrating both the automatic and hand-operated forms of the dispenser as herein contemplated, in which—

FIGS. 1, 2 and 3 are side elevational views, partly in section, of one form of an automatic-type ring dispensing and applying tool according to the invention, said views illustrating the parts of the dispenser and applying means in the the various positions which they assume in the successive stages of a ring assembly operation;

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FIG. 4 is a side elevation of the dispensing and applying tool shown in the preceding figures, with the parts thereof in the position of FIG. 2;

FIGS. 5 and 6 are transverse sections taken on lines 5-5 of FIG. 2 and 6-6 of FIG. 3, respectively;

FIGS. 7 and 8 are views corresponding generally to FIGS. 1 and 2 but illustrating a modified form of power-operated dispenser and applicator which does not require the ring-chute between the dispenser proper and the applicator which characterizes the FIGS. 1-6 device, and thus results in simplified construction as compared thereto;

FIG. 9 is a section taken generally on line 9-9 of FIG. 8;

FIGS. 10 and 11 are sections taken on lines 10-10 and 11-11 respectively of FIG. 9;

FIG. 12 is an end view looking on to the mandrel end of FIG. 11;

FIG. 13 is an enlarged perspective view illustrating the ring slideway and the particularized mandrel construction employed in the FIGS. 7 and 8 modification;

FIG. 14 is a side elevation, partly in section, of a hand-operated form of dispenser for split external spring rings according to the invention;

FIG. 15 is a view similar to FIG. 14 illustrating the dispenser with a ring spreading mandrel initially cooperated therewith;

FIGS. 16 and 17 are detail views which illustrate the operation of said mandrel in freeing the endmost ring of the column thereof from the dispenser stack rod and the manner in which the ring drops on to said mandrel, respectively; and

FIGS. 18-21, inclusive, are a series of views illustrating a new construction and configuration of a ring-spreading mandrel designed to prevent over-stressing of external split retaining rings when pushed axially therealong.

Referring to the drawings in detail, and more particularly to FIGS. 1-6, inclusive, illustrating one form of a power-operated combined split external ring dispenser and applying means (also sometimes called a power-operated magazine-type applicator) according to the invention which incorporates the ring "drop-through" design feature which was generally described in the foregoing, reference numeral 10 designates an upright supporting plate or frame member to which the dispenser and the power operating means therefor is affixed, the latter comprising a double-acting air (or hydraulic) cylinder 11, to whose opposite ends pressure fluid from a suitable source thereof is alternately supplied and exhausted via inlet and exhaust ports designated 12, 13, under the control of a conventional four-way valve (not shown). Reciprocable within the cylinder is a piston 14 operating a piston rod 15 whose lower end is affixed (as by screw-threading) to the upper end of a coaxially related plunger 16 guided in its reciprocatory movement in a guide block 17. Illustratively, the lower end of the plunger 16 is formed as a hollow tube 18 having wall thickness corresponding substantially to the radial width of the retaining rings to be assembled and inner diameter corresponding to or only slightly exceeding the inner edge diameter of said rings, and thus the lower end-edge of the plunger is enabled to make face engagement with a retaining ring disposed in the path of its lowering movement, as will be hereinafter described.

Also secured to the frame member 10 in laterally spaced, parallel relation to the coaxially related cylinder 11 and plunger 18, as by means of an angled bracket 19a, is a stack rod 19 carrying throughout substantially its entire axial length a thin, radially projecting blade 20 which is adapted to extend outwardly through the gap between the free ends of the plurality of retaining rings mounted on the stack rod. Thus, said stack rod and its blade 20 is adapted to mount a plurality of split external retaining rings R to be dispensed in a vertical column whose rings are accurately aligned by said blade 20.

Below the stack rod 19, the support plate 10 mounts a horizontal table or shelf member 21 across whose upper surface a slide 22 operating in a slideway 22a is mounted

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for reciprocatory travel. Slide 22 is held in its normal or retracted position as by means of a spring 23 reactive between the blind inner end of a hole 24 provided therefor in the relatively outer side edge of said table and a downward flange 25 on the free or outer end of the slide 22. The slide is further provided with a ring opening 26 sized and configured substantially to the size and configuration of the outer edge of said retaining rings R. When the slide 22 is in its retracted position, in which it is shown in FIG. 1, said opening 26 directly underlies the stack rod 19, thus to accommodate the lowermost ring of the ring column disposed on the stack rod. To permit the slide to partake of its reciprocatory travel beneath the stack rod, the latter terminates at its lower end at a level which is just above the upper face line of said slide, and it will also be understood that the thickness of the slide corresponds substantially to the axial thickness of a single one of the retaining rings R.

At its inner end, the slide 22 is provided with a pair of laterally spaced upright lugs 27, 28 which together in effect define a socket in which is received the lower roughly ball-shaped end 30a of the generally upright arm 30 of a double-armed or bellcrank lever 31 pivoted to the support plate 10 as at 32 for swinging movement relative thereto. The other arm 33 of said lever extends generally horizontally into the path of upward movement of the plunger 16 and terminates in a finger 33a adapted to be engaged by the upper end of said plunger in the uppermost position of the latter, as is best seen in FIG. 2.

The aforesaid plate or shelf 21 mounting the slide 22 is provided with a ring "drop-through" opening 34, i.e. an opening of the size and configuration as will permit said lowermost ring of the ring column to drop through the same when said ring is aligned therewith. However, it is a feature of the invention that said drop-through opening 34 is offset a small distance laterally (to the right) from the slide opening 26 in the normal position of the latter, and similarly from the lower end of the stack rod 19. Accordingly, assuming the slide to be positioned in its normal or retracted position in which it is shown in FIG. 1, that portion of the upper surface of the table or shelf 21 (designated 35 in FIGS. 1 and 3) which bounds the drop-through opening 34 and is exposed by the slide opening 26 provides a supporting ledge on which a portion of the outer perimeter of the lowermost ring of the column is engageable and thus the ledge supports said ring and hence the entire ring column. However, when the slide 22 is shifted in rightwise direction the amount such that its ring opening 26 registers with the drop-through opening 34 in the table or shelf 21, said lowermost ring is brought into registry with the drop-through opening, whereupon it is free to and will drop by gravity through said opening. This inward movement of the slide 22 also brings the slide to a position in which its ring opening 26 is now disposed out of register with the stack rod and the column of rings maintained thereon. Accordingly, in the inner position of the slide 22 (see FIG. 2), the slide functions as a support for the column of rings disposed on the stack rod 19.

Extending into the table opening 34 from beneath is the upper end of an inclined rail-form ring chute 36 having a ring orienting blade 37 correspond to the stack-rod blade 20. Preferably, the chute 36 is supported in operative position (see FIG. 6) by a block 38 secured in inclined relation to the support member 10 below the ring table 21, the arrangement and disposition of the chute being such that it is operative to catch the ring dropping through the opening 34 and then to guide said ring in a downwardly inclined path on to the upper end of an upright frusto-conical spreading head or mandrel 39 operatively connected to the lower end of said chute and being disposed coaxial with and in the path of movement of the lower end of the plunger end 18. Rather than being rigidly connected to the lower end of the chute 36, the mandrel 39 preferably has an axially yieldable connection therewith comprising a rod or pin 40 affixed to

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and extending downwardly from the end of the chute and whose lower end projects axially through the mandrel which as seen in FIG. 2 is formed with an elongated bore. At its lowermost end, said rod 40 mounts a spring-retaining washer 41 and contained within the bore of the mandrel and reactive between its blind end and said washer is a coil spring 42 normally maintained partly compressed. Thus, the mandrel is normally held against the lower end of the chute 36 as in FIG. 2 but may move axially downwardly therefrom for a limited distance, as seen in FIGS. 1 and 3. This axial contraction and expansion of the mandrel is of advantage in automatically adjusting the tool to different lengths of shafts and shaft fixtures used in securing the shafts in position to receive a retaining ring from the mandrel.

As best seen in FIGS. 1 and 2, the ring-spreading mandrel 39 has an upper-end diameter which is somewhat less than the unstressed inner-edge diameter of the rings to be assembled and a lower-end diameter substantially equaling that of the shafts or pins on which the rings are to be assembled. Thus, a ring dropping on to the upper end of the spreading mandrel from the chute 36 is positioned thereon in readiness to be spread by its axial movement along said mandrel to an inner diameter enabling it to be readily shifted over the end of the grooved shaft on which it is to be assembled and thereupon pushed axially along said shaft to the plane of its groove, whereupon it will spring-seat itself in said groove. As will hereinafter appear, progressive axial movement of the ring along the mandrel and shaft end is effected by the tubular end 18 (acting as a push head) of the plunger 16 being actuated downwardly over the mandrel, as seen in FIGS. 3 and 1, respectively. To permit of this push-head movement which would otherwise be impeded by the chute 36, the tubular push head is provided with an axial slot 18a in its side wall portion in line with said chute, the action thereof in accommodating the chute being also seen in FIGS. 1 and 3.

While it is believed that the functioning of the combined power operated ring dispenser and applying tool or apparatus as aforesaid will be clear to those skilled in the art, such is briefly summarized as follows: Assuming that the tool parts are in their FIG. 1 position, in which piston 14 has just completed its downward or working stroke and the push head end 18 of the plunger 16 has just completed a ring-assembly operation and that accordingly the next cycle of tool operation is about to start, it will be seen that the slide 22 is in its normal or retracted position consequent to the upper end of the plunger 16 having fallen away from the finger 33 of the bellcrank lever 31, and that the ring column is being temporarily supported on the ledge surface 35 of the plate or table 21 which surrounds the drop-through opening 34 thereof. Upon pressure air being admitted to the lower end of the power cylinder 11 through the inlet port 13 thereof, the piston 14 is actuated to its uppermost position shown in FIG. 2. During the course of this movement, the plunger 18 retracts from the spreading mandrel 39, and also the finger 33a of the bellcrank lever 33 has been engaged by the upper end of said plunger, as results in counter-clockwise movement being imparted to the bellcrank lever as in turn causes the slide 22 to move to the right. Such slide movement results in the lowermost ring of the ring column which has previously been supported on the ledge surface 35 as aforesaid moving laterally until it directly registers with the drop-through opening 34 of the plate or shelf 21, whereupon said ring drops through said opening and thence on to the upper end of the rail-form chute 36, by which it is directed on to the upper end of the spreading mandrel 39 now fully axially contracted with respect to the pin 40 by which it is connected to said chute. Inasmuch as the plunger 16 is now in its fully raised position, the aforesaid ring is free to slide down the chute 36 without such movement being interfered with by the lower end of the plunger. Upon reaching the upper end of the

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spreading mandrel 39, the ring moves a small distance downwardly therealong, as in FIG. 2, consequent to the mandrel upper end having appreciably smaller diameter than that of the inner edge of said ring.

Upon the piston 14 reaching the uppermost end of its stroke, air supply to the cylinder 11 is reversed, whereupon the piston moves downwardly and imparts corresponding downward movement to the plunger 16. Just prior to the air supply being reversed as aforesaid and in any case before such plunger movement having taken place to an appreciable extent, a grooved shaft S supported for example in a fixture F and in whose groove G the ring now disposed on the upper end of the spreading mandrel is to be assembled, will have been moved into place beneath the mandrel 39, as is also shown in FIG. 2. During the early portion of the downward movement of the piston 14 and its plunger 16, the latter moves away from the finger 33a of the bellcrank whereupon the slide 22 returns to its normal retracted position under the bias of spring 23. Such brings the slide opening 26 in registry with the ring of the column next above and said lowermost ring which has just previously moved on to the mandrel 39, whereupon said next-above ring drops through said opening on to the ledge 35' of the plate or shelf member 21, and together with all rings above same is supported thereon. Continued lowering movement of the plunger and its cylindrical end 18 acting as a push head brings the lower edge of the latter into engagement with the upper face of the ring on the spreading mandrel. Assuming the spring 42 to be a relatively light spring, such engagement first causes the spreading mandrel to lower on to the upper end of the shaft S. However, upon the resistance of the spring having been overcome, final downward movement of the plunger 16 and its push head end 18 pushes the ring downwardly over the now fixed spreading mandrel, as effects spreading thereof to an inner diameter corresponding to that of shaft diameter. By design, the stroke of the piston 14 and plunger 16 is such as to cause the lower edge of the push head to move axially along the shaft S until the ring reaches the plane of the shaft groove G whereupon it spring-seats itself in said groove. Thereupon the cycle is completed and a new cycle corresponding to that just described begins.

Referring now to the modified embodiment of power-operated combination split retaining dispenser and applicator illustrated in FIGS. 7-13, such comprises a preferably handled frame 50 mounting along one side thereof a double acting air (or hydraulic) cylinder 51 whose piston powers a tubular plunger 52 having a laterally projecting lug 53 and along the other side thereof a stack rod 54 carrying a thin, radially projecting blade 55 adapted, by extending through the gap between the open ends of the rings R of a column thereof carried on said stack rod, to maintain said rings in accurate alignment, the aforementioned parts being generally similar to the basic like-captioned parts of the prior described combination dispenser and applicator.

Preferably, the lower end of the stack rod 54 inclines toward the axial line of the cylinder 51 and its plunger 52 and terminates a small distance above the floor or bottom of a slideway 56 formed in a horizontal table member 57 (corresponding generally to the table member 21 of the prior described embodiment). Said slideway extends towards said plunger line and is formed with a longitudinally extending, centrally disposed thin rib 58 whose relatively outer (left) end connects with the lower end of the aforesaid blade 55 and is thus adapted to enter the gap of the lowermost ring R of the inclined ring column and to support the middle portion of said ring slightly raised above the floor of the slideway, as is best shown in FIG. 11.

Said lowermost ring of the ring column is pushed in rightwise direction along said slideway 56 by means of a slide 60 operating therein and actuable in one direction (to the right) by said plunger 52 through a pin and slot connection 62a, 62b between a block 63 affixed to the outer

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(left) end of said slide and an arm 64 of a double-arm pivoted lever 65 whose other arm 66 is positioned so as to be engaged by the aforesaid plunger lug 53 as the plunger moves towards its uppermost end position. Return movement of the slide is effected by a spring (not shown) functionally similar to the aforesaid spring 23. To accommodate for the aforesaid longitudinal rib 58, the slide is formed with a slot 67 opening through its right end.

In its innermost (rightmost) position, the slide 60 by its push movement thereagainst positions said previously lowermost ring R directly beneath the plunger 52 (which is now raised) and directly above a mandrel 70 whose connection to the table member 57 and detailed construction is best shown in FIGS. 10-13. More particularly, said mandrel, although being effectively tapered from its smaller diameter upper end to its larger-diameter lower end as is the mandrel 39 of the prior described embodiment, is of fluted construction and comprises two aligned oppositely extending flutes 70a, 70b and a right angularly disposed intermediate flute 70c (FIG. 13). Also, said mandrel is fixedly connected to the right end of the table 57 so as to depend downwardly therefrom by means of a connecting web 72, which by reference to FIG. 10 is knife- or double-wedge shape in that it has increasing thickness from its top edge 72a, which is actually a continuation of the aforesaid slideway rib 58, to its bottom end portion 72b which has thickness corresponding to that of the widened gap of a ring R when the latter has been spread to an inner-edge diameter corresponding to that of the shaft or other workpiece S on which said ring is being assembled and which is generally shown in FIGS. 7 and 8. Illustratively, the mandrel 70 is secured to the under side of the table 57 by means of a supporting bracket 74 (FIGS. 11 and 13).

The operation of the FIGS. 7-13 embodiment is generally similar to that described above for the FIGS. 1-6 forms of combination dispenser and applicator, except that the slide 60 pushes the lowermost ring R from beneath the stack rod directly on to the smaller-diameter upper end of the mandrel 70, rather than providing for the ring dropping on to the upper end of a ring chute which in turn directs same to a spreading mandrel. More particularly, as the piston and plunger move upwardly, the slide is actuated to the right by engagement of the plunger lug 53 with the upper arm 66 of the swing lever 65, and moves the lower ring of the ring column along the slideway 56 (whereon the rib 58 gives it a slightly inclined position) until it moves over the upper end of the mandrel 70. On the downward stroke of the piston, the plunger 52 lowers on to said ring and forces it downwardly along the mandrel, during the course of which movement the ring is spread to a diameter enabling its movement over the end of the shaft S and thence axially therealong to the plane of the shaft groove. In its movement down said mandrel, its ends which define the ring gap move against the divergent side faces of the mandrel-connecting web 72 which are sloped proportionally to the taper of the mandrel proper, said divergent side faces thus serving to spread the ring ends away from one another, the mandrel proper meanwhile stabilizing the ring as a whole during spreading and also tending to prevent localized spreading and/or over-spreading.

It is noted that FIG. 8 shows both pair of side handles 75a, 75b affixed to the frame 50 whereby the device is rendered portable and further generally shows the four-way valve 76 for reversing direction of air flow to the opposite ends of the cylinder 51, to be push button controlled, as by the push button 77. It will be seen also that the tubular plunger 52 is slotted as at 52a to accommodate the mandrel-securing web 72 in the lower positions of said plunger.

The aforesaid ring "drop-through" feature characterizing the power-operated ring dispensing and apply tool form according to FIGS. 1-6, inclusive, may also be in-

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corporated into a simple hand-operated dispenser as well. Referring to FIGS. 14-17 illustrative of such a hand operated dispenser, numeral 80 indicates an upright frame or bracket, extending from a base 80a (such corresponding to the support plate 10 of the FIGS. 1-6 modification) said bracket mounting along one side edge thereof a stack rod 81 provided with an axially extending, radially projecting blade 82 which, by extending through the narrow gap of the plurality of rings R maintained on the stack rod in column formation, accurately orients said rings so that their gaps all face in exactly the same direction. To the bracket 80 adjacent the lower end of the stack rod 81 is affixed an angled part 83 to whose generally horizontally disposed flange or plate member 84 is affixed a somewhat similar but lower plate member 85, it being noted that both of said plate members extend in planes which intersect the axis of the stack rod and also that the respective levels of said plate members are such that the upper face of the upper plate member is about on a line with the lower end of the stack rod and that the upper face of the lower plate member is spaced downwardly from said stack rod a distance equalling the axial thickness of a ring R.

Said upper plate 84 is provided with a forwardly opening cut-out 86 of size and configuration as to conform substantially to the outer-edge configuration of the rings R mounted on the stack rod 81, such cut-out being further coaxially aligned with said stack rod so as to be capable of receiving the lowermost ring of the column of rings R positioned thereon. The aforesaid lower plate 85 is provided with a similar cut-out designated 87 of external diameter and configuration corresponding to that of the rings R, but said latter cut-out is offset forwardly with respect to the cut-out 86 of the upper plate 84 a distance such that its defining edge forms a ledge 88 which extends a small distance forwardly beneath said lowermost ring of the ring column, thereby providing a limited supporting surface for the entire ring column. Thus it will be seen that the aforesaid ring cut-outs 86 and 87 and the ring-supporting ledge 88 correspond generally to the ring openings 26 and 34 and ring ledge 35 of the FIGS. 1-6 embodiment.

With a tool as just aforesaid, a ring-dispensing operation may be effected by simple movement of the smaller-diameter upper end of an upright frusto-conical mandrel or spreading head 90 (which end has diameter somewhat less than that of the inner diameter of the rings R) into the cut-out 87 from the lower side thereof until it engages the lower end of the stack rod 81, followed by slight forward shift of said mandrel. In explanation, consequent to the lower end-face of the stack rod being spaced above the upper face of the lower plate member 85 on which the ring column is supported a distance corresponding to the thickness of one ring only, movement of the mandrel 90 against the lower end of the stack rod (as in FIG. 15) can result in but only one ring, i.e. the lowermost ring of the ring column supported on the ledge 88, being engaged thereby. Upon the mandrel 90 being shifted a small distance forwardly or to the left as aforesaid, as shown in FIG. 16, said lowermost ring is now moved laterally of the stack rod to a position in which it will directly overlie the cut-out 87 of the lower plate, whereupon it is free to drop through said cut-out on to the upper end of the mandrel 90, as is indicated in FIG. 17. The mandrel 90 may now be moved by hand against the end of a grooved shaft corresponding to the previously described shaft S, and the ring which has dropped therefrom may now be spread by forcing it axially along the mandrel, as by means of a tool having a spreading head consisting of a longitudinally slit hollow cylinder adapted to be telescoped over the mandrel, for example. Of course, instead of the mandrel 90 and the aforesaid ring spreading tool constituting physically different parts, they may be combined into a unitary ring spreading and applying tool of the general type disclosed

and claimed in my aforesaid application Serial No. 817,668, filed June 2, 1959.

According to yet a further feature of the invention, there is provided a ring spreading mandrel for use in substitution of any of the aforesaid mandrels 39, 70 and 90 (or otherwise) whose construction and design are such as to prevent over-stressing and thereby the possibility of the ring taking on a permanent set when being spread. In explanation, experience has shown that when an external split ring is spread on a conventional frusto-conical mandrel having full circular section (as has the mandrels 39 and 90) or effective circular section (as has the mandrel 70) there is a tendency towards over-stressing of the ring to the extent that it takes on a permanent set, due apparently to the fact that when spread uniformly in radial direction, the more non-elastic portions of the ring, which are required to spread to about the same degree as the more elastic portions, tend to become over-stressed. To avoid this danger the invention provides a ring spreading mandrel which effects what may properly be termed a non-circular spreading action of the ring; that is, a spreading thereof in portions where the ring is most elastic and accordingly well able to take the deformation which it must take in moving axially along the mandrel to its larger diameter end.

Referring more particularly to FIGS. 20 and 21, the improved mandrel 100 is characterized by its larger-diameter end portion having flat sides designated 101, 102. In the case of said larger-diameter end portion being formed hollow, as in FIGS. 18 and 19, as permits it to be telescoped over the end of a grooved shaft S_1 in whose groove G_1 the ring being spread is to be assembled, said flat sides are provided by milling, grinding away or otherwise relieving opposite portions of its tubular wall, whereby the remaining opposite arcuate wall portions designated 103, 104 form the larger-diameter spreading end of the mandrel.

It is contemplated that a ring R to be spread will drop or be pushed on to a mandrel as aforesaid with the necessary relative orientation that one arcuate portion 103 of the mandrel will be effective on the middle portion of the ring, whereas the opposite arcuate portion 104 will be effective on free end portions of the ring, as is illustrated in FIG. 21. The result of the aforesaid mandrel construction and ring disposition is that the ring R is deformed non-circularly, that is, its more elastic sides or arms tend to elongate, whereas its less elastic middle length portion and the usually lugged or eared free end portions which are less sensitive to distortion are only slightly deformed. Thus, by preventing over-stressing, the ring will inevitably return to its original circular shape when moving into its groove, rather than being permanently set as might otherwise occur when spread by a conventional full or effectively circular mandrel.

Without further analysis, it will be appreciated that combination split retaining ring dispenser and/or applicator tools of the invention, whether power or hand-operated, are relatively simple in construction and inexpensive to manufacture, yet at the same time they are thoroughly dependable, practical and fast in their operation. However, as many changes could be made in carrying out the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A power-operated combination dispenser and applicator for split external spring retaining rings comprising, in combination, an upright frame member, a table member mounted thereon, an generally upright stack rod affixed to the frame member above the table member, a ring-slideway provided on and extending across the top surface of the table member beneath the stack rod, the lower end of the stack rod being spaced above the bottom

of said slideway a distance approximating the axial thickness of one ring of a column of such rings mounted on the stack rod, a slide mounted for reciprocatory movement in said slideway and operative on its working stroke to push the lowermost ring of the column thereof disposed on the stack rod in sideward direction along the slideway, power means operatively mounted on the frame member above the table member and in generally parallel relation to the stack rod, a tubular plunger coaxial with and reciprocable by said power means in a path traversing that of ring movement, a ring-spreading mandrel disposed below and in coaxial alignment with said plunger and thereby in position to receive the ring moved sidewardly as aforesaid and to be telescoped by said plunger when the latter moves on its downward stroke, and means responsive to plunger travel in upward direction for actuating the slide throughout its working stroke thereby to effect transfer of said lowermost ring to and its positioning on the upper end of the spreading mandrel, whereby said plunger on its return stroke will actuate said ring axially downwardly along said spreading mandrel to effect spreading thereof, said spreading mandrel being positioned with its upper end in line with said slideway whereby the slide is adapted to push said lowermost ring directly onto the mandrel.

2. A combination dispenser and applicator for split external spring retaining rings according to claim 1, wherein said power means includes an air cylinder disposed above and operatively connected to said plunger, and a mechanical connection between the plunger and the slide for actuating the slide as aforesaid responsive to the return stroke of the plunger.

3. A combination dispenser and applicator for split external spring retaining rings according to claim 2, wherein said mechanical connection comprises a bellcrank lever mounted for rocking movement, the free end of one arm thereof being operatively connected to the slide and the free end of the other arm extending into the path of motion of the plunger.

4. A power-operated combination dispenser and applicator for split external spring retaining rings comprising, in combination, an upright frame member, a table member mounted thereon, a generally upright stack rod affixed to the frame member above the table member, a ring-slideway provided on and extending across the top surface of the table member beneath the stack rod, the lower end of the stack rod being spaced above the bottom of said slideway a distance approximating the axial thickness of one ring of a column of such rings mounted on the stack rod, a slide mounted for reciprocatory movement in said slideway and operative on its working stroke to push the lowermost ring of the column thereof disposed on the stack rod in sideward direction along the slideway, power means operatively mounted on the frame member above the table member and in generally parallel relation to the stack rod, a tubular plunger coaxial with and reciprocable by said power means in a path traversing that of ring movement, a ring-spreading mandrel disposed below and in coaxial alignment with said plunger and thereby in position to receive the ring moved sidewardly as aforesaid and to be telescoped by said plunger when the latter moves on its downward stroke, a longitudinal web connecting said spreading mandrel to the table member adjacent the delivery end of the slideway with its upper end at the level of the bottom of said slideway, and means responsive to plunger travel in upward direction for actuating the slide throughout its working stroke thereby to effect transfer of said lowermost ring to and its positioning on the upper end of the spreading mandrel, whereby said plunger on its return stroke will move said ring axially downwardly along the mandrel to effect spreading thereof, said longitudinal web being positioned to extend through the gap of a ring moving axially along the mandrel as aforesaid.

5. A combination dispenser and applicator for split external spring retaining rings according to claim 4, wherein said spreading mandrel comprises a plurality of angu-

larly related, progressively widening flutes and said longitudinal connecting web has progressively increasing thickness downwardly which corresponds substantially to the increasing width of the ring gap as the ring is spread by its movement along the mandrel as aforesaid.

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