The present invention relates to an improved apparatus for automatically feeding circular workpieces. More particularly, the present invention relates to a mechanism for automatically feeding circular workpieces in succession to a desired position at predetermined intervals.

It is an object of the present invention to provide an improved apparatus of the above mentioned type which is simple in design, economical, of manufacture and reliable and efficient in operation.

A further object of the present invention is to provide an improved apparatus of the above mentioned type including a plurality of independently movable feeding elements which are independently operable to effect feeding of the workpieces so that in the event that one of these elements becomes jammed or for any other reason inoperable, damage to the apparatus will be avoided and the remaining elements will continue to function.

It is also an object of the present invention to provide an improved apparatus of the above mentioned type adapted to be driven by a chain or other similar means and effective when so driven to automatically feed said workpieces to receptacles secured to and carried by the chain or other similar means.

It is also an object of the present invention to provide an apparatus having a hopper and a passage extending from said hopper adapted to receive flat circular workpieces, which apparatus embodies improved means for collecting said workpieces in said passage and maintaining said passage substantially full of said workpieces at all times with said workpieces disposed in said passage at right angles to the axis of said passage.

Other and more detailed objects of the present invention will be apparent from a consideration of the following specification, the appended claims and the accompanying drawings, wherein:

Figure 1 is a plan view of an apparatus embodying the present invention;

Figure 2 is a transverse sectional view of the structure illustrated in Figure 3, taken substantially along the line 2—2 thereof;

Figure 3 is a vertical sectional view of the structure illustrated in Figure 1, taken substantially along the line 3—3 thereof;

Figure 4 is a transverse sectional view of the structure illustrated in Figure 3, taken substantially along the line 4—4 thereof;

Figure 5 is a broken and reduced sectional view of the structure illustrated in Figure 3, taken substantially along the line 5—5 thereof; and,

Figure 6 is a broken sectional view of the structure illustrated in Figure 5, taken substantially along the line 6—6 thereof.

It will be readily appreciated from a complete understanding of the present invention that the improvements thereof may readily be embodied in mechanisms of widely varying types and sizes and adapted for handling a wide variety of workpieces. In an illustration but not a limiting sense, the improvements of the present invention are illustrated and described herein as embodied in an apparatus for use in connection with the packaging of spark plugs. This apparatus is adapted to facilitate the rings used on spark plugs to facilitate their assembly with the spark plug in connection with the packaging thereof.

The apparatus of the present invention comprises an improvement in a part of the complete apparatus for use in connection with packaging spark plugs which is illustrated and described in the present applicant's copending application Serial No. 163,873, filed May 24, 1950, and now abandoned. For the present purpose it is sufficient to state that in the apparatus of this copending application cylindrical thread protectors formed of cardboard or other suitable material are fed to receptacles carried by a conveyor chain which carries these receptacles to an apparatus which feeds the gasket rings into the receptacles where they are received and rest upon the upper end of the vertically disposed thread protector. In the course of packaging the spark plugs, an operator moves the threaded base of the spark plug through a gasket ring and down into the thread protector which fits the threaded base sufficiently snugly to remain in place upon withdrawal of the spark plug from the receptacle. The embodiment of the present invention illustrated in the drawings and described herein is an improved apparatus for feeding the gasket spark plug rings to the receptacles carrying the thread protectors.

Referring to the drawings, the apparatus of the present invention generally comprises a base 10, a generally centrally disposed vertically upwardly extending shaft 12 mounted in the base 10, a sprocket wheel 16 journaled on the shaft 12 and around which a chain 14 illustrated at 16 is trained, a hopper 18 disposed at the upper portion of the shaft 12 and adapted to receive a quantity of the gasket rings 20, a plurality of tubes 22 for receiving the rings 20 from the hopper 18 and delivering them to a mechanism generally indicated at 24 for feeding rings 20 from successive tubes 22 to successive receptacles 26 secured to and carried by the chain 16.

Considering the above mentioned structure in greater detail, the base 10 is mounted on a table top 28 or other suitable supporting structure, having a bushing 30 receiving a lower end portion of the shaft 12. The base 10 is accurately positioned on the table top 28 by any suitable means. In the embodiment illustrated a knurled headed pin 31 extends through a bushing 32 mounted in a peripheral portion of the base 10 and downwardly into a co-operating opening in the table top 28 and co-operates with the engagement of the lower end portion of the shaft 12 in the bushing 30 to properly locate the base 10. The base 10 is secured to the table top 28 by a plurality of screws 34.

In the embodiment illustrated the chain 16 turns through an angle of 90° in passing around the sprocket wheel 14. The base 10 has a lower upwardly extending wall portion 36 to the upper surface of which is secured an arcuate shaped supporting rail 38 upon which the lower inner surface of the receptacles 26 are supported as they are carried around the ring feeding apparatus of the present invention by the chain 16. These receptacles 26 are square blocks having vertically extending cylindrical bores 40 therethrough which are preferably beveled as indicated at 42 at their upper ends to facilitate the reception of the rings 20 as hereinafter described. These blocks 26 are secured to the chain 16 by conventional attaching elements 44 and have slots 46 formed in their under sides in which is received a rail 48, the upper surface of which supports the thread protector tubes 50 which are delivered to the receptacles 26 prior to their movement to the ring feeding apparatus of the present invention. The rail 48 may be adjusted for different lengths of tubes 50 so that these tubes 50 are supported with their upper edges disposed in
spaced relation below the top of the bores 40 a distance slightly greater than the thickness of the gasket rings 20. Between the incoming portion of the chain 16 and the outer portion thereof the base 10 has a higher upwardly extending wall portion 52 which carries an arcuately shaped supporting member 54, the upper surface of which is disposed at the elevation of the upper surfaces of the receptacles 26. The opposite end portions of the arcuately shaped supporting member 54 are disposed over the chain 16 in the slots 26 and to closely approach the receptacles 26 carried thereby and are cut away as indicated at 56 to prevent interference with the chain 16.

The base 10 has a central upwardly extending boss 58 having a centrally disposed through aperture 60 receiving the lower end of the shaft 12. A thrust bearing 62 is supported on the upper surface of the boss 58 and in turn supports the sprocket wheel 14 which carries a bearing bushing 64 and is freely rotatable relative to the shaft 12. The shaft 12 is secured against rotation relative to the base 10 by a set screw 66 mounted in the boss 58. The base 10 also has a boss 67 (see Figure 3) spaced radially from the central boss 58 and which carries a thrust bearing 69 mounted on and held in position by a pin 71. The bearing 69 is disposed to support the sprocket wheel 14 adjacent its periphery at a point where the chain 16 has completed one-half of its turn in traveling about the sprocket wheel 14. In the embodiment illustrated this is at a point where the chain 16 has turned through an angle of 45 degrees.

The above mentioned mechanism generally indicated at 24 for receiving the rings 20 from the tube 22 and feeding them to the receptacles 26 includes an annular plate 65 disposed over the arcuately shaped support 54 and which is supported on and secured to the sprocket wheel 14 by a plurality of screws 70. The annular plate 65 is of a diameter such that, and is supported at an elevation such that its upper surface 72 is substantially continuous with the upper surface of the arcuately shaped supporting member 54. A plurality of radially extending recesses 74 are formed in the upper surface 72 for receiving the lower ends of pins 76 extending vertically through the pusher elements 78 adapted to move radially inwardly and outwardly upon the upper surface 72 of the plate 68. A resiliently supported ring 80, also concentrically disposed about the sprocket wheel 14, is secured to the upper surface 72 of the plate 68 by means of a plurality of screws 82.

At its upper side the ring 80 has a plurality of recesses 84 which are formed therein in any suitable way and disposed in circumferentially and equiangularly spaced relation to each other. These recesses 84 are individual to and radially aligned with the recesses 74 in the upper surface of the plate 68, and each one of the recesses 84 receives the lower end portion of one of the tubes 22 to position the lower end of the tubes and support the tubes and the other elements hereinafter described which are carried by the tubes 22. The ring 80 also has a through aperture 86 aligned with each of the tubes 22 and of a diameter equal to the internal diameter of the tubes 22, through which the rings 20 may move from the lower end of the tube through the annular ring 80 and onto the upper surface of the stationary and arcuately shaped ring 90, which supports the lower boss of the upper body 94. The annular plate 65 is disposed in its undersurface, individual to the apertures 86, and extending radially inwardly therefrom in alignment with the recesses 74 of the plate 68. These slots 88 are adapted to slideably receive a flat and relatively thin outer end portion 90 of the pusher elements 78, the outer end portion thereof being disposed in arcuately shaped end indentations 92 (see Figures 2 and 4) adapted to fit the outer circumference of the rings 20. It will now be appreciated that the engagement of the lower end of the pins 76 in the recesses 74 and the engagement of the outer end portions 90 of the pusher elements 78, in the notches 88 of the ring 80, cooperate to maintain the pusher elements 78 in proper radial position during the movement of these elements radially inwardly and outwardly upon the upper surface 72 of the plate 68. Also the ring 80, radially outwardly of the apertures 86, is provided with a plurality of other slots 94 formed in the undersurface thereof individual to the apertures 86, adapted to permit passage of the gasket rings 20 outwardly therethrough under the influence of the pusher elements 78. It will be appreciated, of course, that during this movement, the pins 76, because of their disposition in the slots 94 continue to rotate about the shaft 12 with the ring 80.

The pins 76 which extend vertically through the thicker radially inner end portion of the pusher elements 78 extend upwardly above the upper surface of the pusher elements 78 and carry cam follower bushings 96. These cam followers 96 are received in a recess 98 in the underside of a circular plate 100 which is mounted at the upper side of the annular plate 68, on a thrust bearing 102 which rests upon the upper surface of the hub portion of the sprocket wheel 14 and is disposed within a central aperture 104 in the plate 68. The cam plate 100 is secured to the shaft 12 by means of a set screw 106 extending radially through a centrally disposed boss 108 on the cam plate 100 and engaging the shaft 12 at a recess 110. The outer periphery of the circular cam plate 100 fits within the large central opening of the ring 80 which rotates relative to the sprocket wheel 14. The embodiment illustrated is intended to facilitate an understanding of the present invention. The cam plate 100 has a cam surface 112 which forms the radially outer wall of the recess 98 in the underside of the cam plate 100 and along which the cam followers 96 are moved. The shape of this cam surface 112 is best illustrated in Figure 2 when the sprocket wheel 14 is set in the outer periphery of the cam plate 100, which is at the outer side of the annular plate 68. It will be seen that the cam surface 112 has a low point at the upper side of Figure 2 indicated at 114. It will be seen that the cam surface 112 makes its closest approach to the periphery of the cam plate 100 at this point and that this portion of the cam surface 112 extends in a counterclockwise direction from the point 114 to the point 116 is cylindrical and concentric with the periphery of the cam plate 100. Continuing in a counterclockwise direction from the point 116, the cam surface 112 rises to a high point 118 where the cam surface 112 is at its maximum distance from and spaced radially inwardly of the periphery of the cam plate 100. Continuing in a counterclockwise direction from the point 118, to the point 120, the cam surface 112, between these points, is again cylindrical and concentric with the periphery of the cam plate 100. Continuing in a counterclockwise direction from the point 120 the cam surface 112 gradually drops off to the low point 114.

The cam plate 100 carries a pivotally mounted backup element 122 which is disposed within the recess 98 in the underside of the cam plate 100 and has an arcuately shaped outer surface 124 similar to the portion of the cam surface 112 between the points 120 and 114. The backup element 122 is spring loaded to back up and yieldably hold the cam followers 96 against this portion of the cam surface 112 during operation of the apparatus. The backup element 122 is pivotally connected to the cam plate 100. Also the cam plate 100 has an aperture 128 (see Figure 5) extending through its upper surface and communicating with the recess 98. A lever 130 is pivotally mounted on the pivot pin 126 at the upper side of the cam plate 100 and has an arm portion 132 connected to the backup element 122 by screws 134 extending through the center portion of which terminates in an arm portion 136, the outer end portion of which is connected to one end of a spring 138, the other end of which is connected to an angle bracket 140 secured to the upper side of the cam plate 100. The aperture 128 is partially covered, and a second aperture 129, in the cam plate 100, for providing access to the recess 98 at the outer end of the backup element 122, is completely covered by a
cover plate 131 fastened to the upper side of the cam plate 100 by screws 133. An outer stop, or guard strip 141 is mounted on the supporting member 54 by screws 143 and extends above the upper surface of the member 54. The stop 141 is preferably formed of spring steel or other suitable resilient material. The stop 141 and the supporting member 54 are independently indexed on the cam surfaces 26, as illustrated in Figure 4. The stop 141 functions to yieldable movement of the rings 20 outwardly beyond the apertures 146 in the recees 74. It will be noted that it extends a substantial distance in each direction from the cam point 114.

The tubes 22 which are supported in and carried by the ring 80 as above described, extend vertically upwardly therefrom and are provided in their radially outer sides with vertically extending slots 142 through which an operator may see whether the tubes are properly loaded and through which, if necessary, a suitable implement may be inserted for properly positioning any rings 20 which may have become improperly disposed in the tubes 22.

An annular plate 144 is supported on the upper ends of the tubes 22 and has a plurality of circumferentially and equiangularly spaced apertures 146 individual to the tubes 22 and extending vertically upwardly through the plate 144 from the upper ends of the tubes 22. These apertures 146 have their upper ends beveled to facilitate the collection of the rings 20 in the apertures 146 from which they move downwardly through the tubes 22. The upper surface of the annular plate 144 defines a portion of the bottom of the hopper 18. The remainder of the hopper 18 is defined by a cylindrical wall member 150 which is carried by and supported on the annular plate 144, and a conically shaped element 152 defining the remainder of the hopper bottom and which overlies a portion of the upper surface of the annular plate 144 and covers the central opening therein. The element 152 is held against rotation by a key 154 connecting the element 152 to the stationary shaft 12. The element 152 has its lower and radially outer edge substantially tangent to the beveled upper ends of the apertures 146 in the plate 144 as illustrated in Figures 1 and 3. The inclination of the conical surface of the element 152 is such that the rings 20 will slide downwardly therealong toward the upper surface of the annular plate 144.

The element 152 also carries spring fingers 156, the outer end portions of which are adapted to move along the upper surface of the plate 144 and sweep over the beveled upper ends of the apertures 146 to properly position the uppermost ring 20 in the aperture 146 or remove from the aperture 146 any rings 20 improperly projecting above the upper surface of the plate 144. The fingers 156 have their inner end portions projecting into suitable recesses provided in the stationary element 152 and are fastened in place by means of set screws 158. As illustrated in Figure 1, these finger elements 156 are disposed at a wiping angle relative to a radius from the shaft 12 which in the preferred embodiment illustrated is an angle of approximately 30°.

Lubrication for the above described apparatus may be provided by any suitable means and in the preferred embodiment illustrated a lubrication fitting 160 is provided at the upper end of the shaft 12 which is provided with passages through which lubricant received through the fitting 160 is delivered to the thrust bearings 102 and 62 and through suitable passages provided in the base 10 to the thrust bearing 69 providing support for the sprocket wheel 14 adjacent its periphery. Also an oiler cup 162 is mounted at the upper side of the cam plate 100 and drips oil into the recess 98 for lubricating the engagement of the cam followers 96 with the cam surface 112 and from this recess the oil passes to the upper surface 72 of the cam plate 100 and drips out through the recess 150 at 152 for lubricating the engagement of the pusher elements 78 with the upper surface of the plate 68 and for the engagement of the pins 76 in the recesses 74. Also in the preferred embodiment illustrated, passages 164 extend from the recesses 74 downwardly and diagonally outwardly to provide a supply of oil to the periphery of the sprocket wheel 14 for lubricating the engagement thereof with the chain 16.

It is believed that in general the operation of the apparatus of the present invention will be apparent from a consideration of the above described and the accompanying drawings and accordingly, it is only briefly set forth below. Movement of the chain 16, with the receeptacles 26 carried thereby, in the direction indicated by the arrows in Figures 1 and 4, produces rotation of the sprocket wheel 14, and the parts carried thereby in a counterclockwise direction. It will be appreciated that the parts carried by the sprocket wheel 14 and rotating therewith are the plate 68 secured to it by the screws 70, the ring 80 which is secured to the plate 68, the tubes 22 carried in the ring 80, the annular plate 144 carried on the upper ends of the tubes 22, and the cylindrical wall member 150 of the hopper 18. This movement of the chain 16 also brings to the apparatus of the present invention receeptacles 26 in which are carried the thread protectors 50 previously delivered thereto by means described in the applicant's above mentioned application.

In preparing the apparatus of the present invention for operation it is necessary to properly load the tubes 22. Initially the tubes 22 with rings 20 so that the rings 20 will be properly disposed in the tubes 22. Once the operation of the present apparatus is initiated with the tubes 22 and the apertures 146 properly filled with rings 20, the action of the finger elements 156 in the hopper 18 will maintain the tubes 22 and apertures 146 properly filled so long as an adequate quantity of rings remains in the hopper 18. It will now be appreciated that, upon operation of the apparatus, properly loaded with rings 20, at each of the tubes 22, where the associated pusher elements 76 are withdrawn so that the flattened outer portion 90 thereof is clear of the apertures 86 in the ring 80 at the lower end of the tube 22, a ring 20 will have moved downwardly from the aperture 86 onto and be supported upon the upper surface of the arcuately shaped supporting member 54. Considering a given one of the pusher elements 78, as the cam follower 96 thereof passes the point 120 of the cam surface 112 and moves toward the points 114, the pusher element 78 will be moved radially outwardly and its arcuately shaped outer end 92 will engage the ring 20 supported on the upper surface of the member 54 and move it radially outwardly along the slot 94. During this movement of the cam followers 96 between the points 120 and 114, they are yieldably held against the cam surface 112 by the backup plate 122 which is urged in a counterclockwise direction about the pivot 126, as viewed in Figure 2, by the action of the spring 138. By mounting the backup plate 122 in this manner damage to the parts of the apparatus is prevented as a result of one of the rings 20 being of incorrect proportions or for any other reason becoming jammed in the machine and incapable of proper movement out through the slot 94 and delivery to one of the receeptacles 26.

As illustrated in Figure 4, when the cam follower 96 of this particular pusher element 78 reaches the low point 114 of the cam surface 112, the ring 20 has been pushed outwardly thereby to a position in which it is coaxial with and drops into the bore 40 in one of the receeptacles 26 carried by the chain 16. In the preferred embodiment illustrated there are twenty-four tubes 22 and associated pusher elements 78 and the circumferential spacing of the tubes and pusher elements is such that successive pusher elements 78 become aligned with and deliver gasket rings 20 to successive receeptacle blocks 26 carried by the chain 16. It will be appreciated that while each pusher element 78 is illustrated in the assumed condition when it reaches the low point 114, the flat outer end portion 90 thereof underlies the portion of the ring 80...
in which the associated aperture 86 is formed, and supports the column of rings 20 disposed in the aperture 86 and the tube 22. It will also be appreciated that the pusher element 78 remains in this extended position while the cam follower 96 thereof moves from the low point 114 around to the point 116, and is gradually returned to its retracted position during movement of the cam follower 96 from the point 116 to the point 118. When the latter point is reached the pusher element 78 is fully retracted and the flat outer end portion 90 thereof is withdrawn from the path of the next ring 20 disposed in the aperture 86 and it is permitted to move to the flat position illustrated in Figure 3 wherein it is supported primarily upon the upper surface of the arcuately shaped supporting member 54, with a small portion thereof overlying and supported on the outer portion of the plate 68, from which position it may be moved outwardly by its associated pusher element 78 for delivery to one of the receptacles 26 as above described.

While only one specific embodiment of the invention has been illustrated and described in detail, it will be readily appreciated by those skilled in the art that numerous modifications and changes may be made without departing from the spirit of the present invention.

What is claimed is:
1. An automatic mechanism for feeding flat circular workpieces in succession to a desired location at predetermined intervals, said mechanism comprising a hopper, an annular member mounted for rotation about a fixed axis defining at least a portion of the bottom of said hopper and defining a plurality of cylindrical passages adapted to receive said flat circular workpieces horizontally disposed, said passages having their upper ends opening through said portion of the bottom of the hopper, a plurality of stationary finger elements mounted in said hopper extending over said portion of the bottom of said hopper and effective upon rotation of said first named means to sweep across said upper ends of said passages, a plurality of cylindrical tubes individual to and providing downwardly extending continuations of said passages, each of said tubes adapted to contain a column of said flat circular workpieces each disposed horizontally, and pusher elements operated in response to rotation of said first named means about said fixed axis to successively push the lowermost workpiece from the bottom of each of said columns to said desired location while the workpiece is horizontally disposed.
2. An automatic mechanism for feeding flat circular workpieces to a plurality of receptacles carried by a chain, said mechanism comprising a base, a vertically disposed shaft fixed on said base, a sprocket wheel rotatably mounted on said shaft and adapted to have said chain trained thereabout, a hopper disposed in spaced relation above said sprocket wheel and including an annular member rotatable about said shaft and defining at least a portion of the bottom of said hopper, said annular member defining a plurality of cylindrical passages adapted to receive said flat circular workpieces horizontally disposed, a plurality of cylindrical tubes individual to and providing downwardly extending continuations of said passages adapted to receive a column of horizontally disposed workpieces, a second annular member interconnecting the lower ends of said tubes and connected to said sprocket wheel for rotation therewith, pusher elements and cooperating actuating mechanism mounted on said wheel and said shaft for successively pushing the lowermost workpiece from the bottom of each of said columns to one of said receptacles carried by said chain, said tubes providing the sole driving connection between said annular members.

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