April 17, 1956 J. A. BOON 2,742,134

ARTICLE SORTING DEVICE

Filed Dec. 24, 1951

5 Sheets-Sheet 1

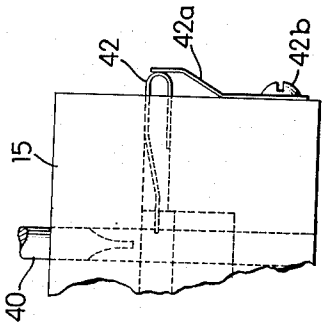


FIG. 1a.

FIG. 1.

INVENTOR
JOHN A. BOON
BY
G. C. Guyer
AGENT

April 17, 1956 J. A. BOON 2,742,134

ARTICLE SORTING DEVICE

Filed Dec. 24, 1951 5 Sheets-Sheet 2

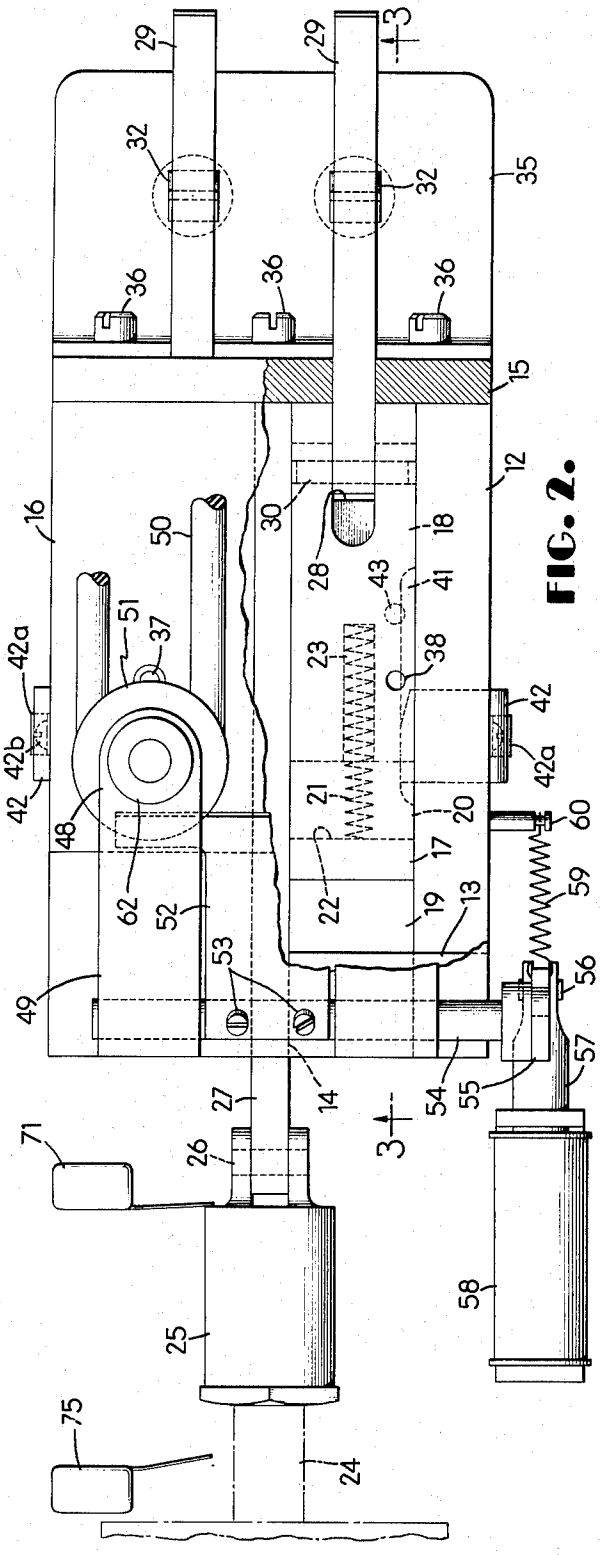


FIG. 2.

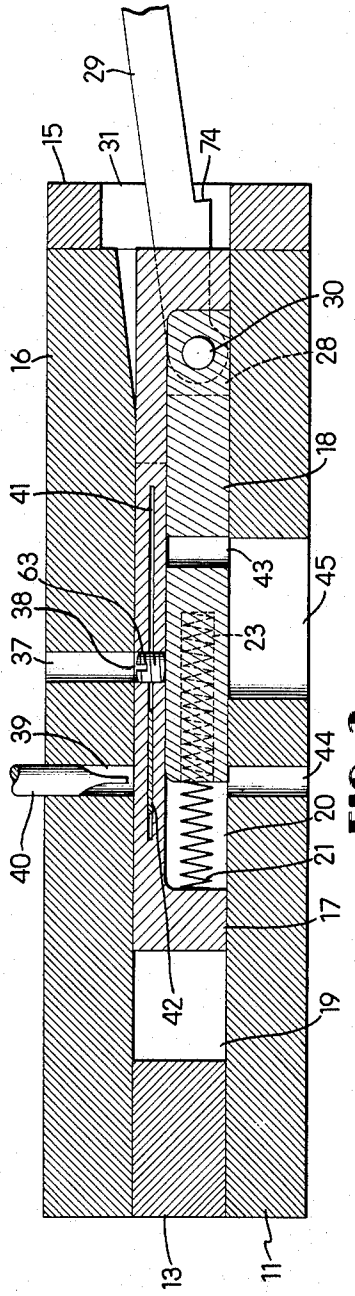


FIG. 3.

INVENTOR
JOHN A. BOON
BY
G. R. Geiger
AGENT

April 17, 1956 J. A. BOON 2,742,134

ARTICLE SORTING DEVICE

Filed Dec. 24, 1951 5 Sheets-Sheet 3

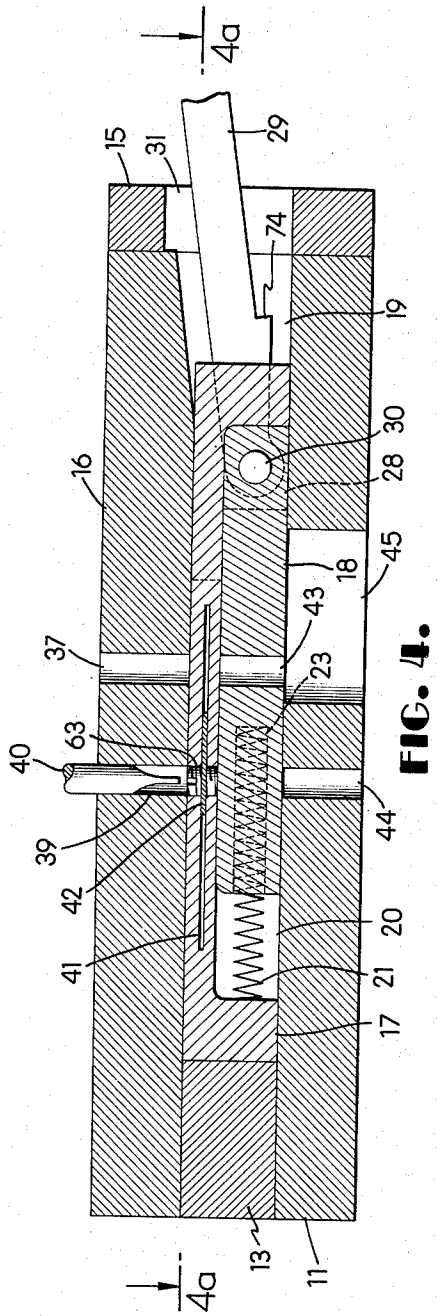


FIG. 4.

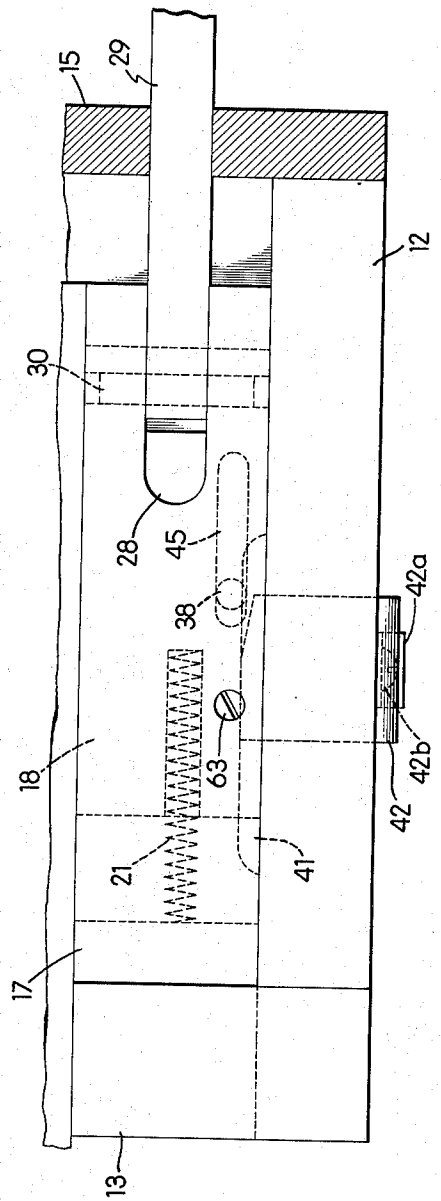


FIG. 4a.

INVENTOR
JOHN A. BOON
BY
G. R. Gugger
AGENT

April 17, 1956 J. A. BOON 2,742,134

ARTICLE SORTING DEVICE

Filed Dec. 24, 1951 5 Sheets-Sheet 4

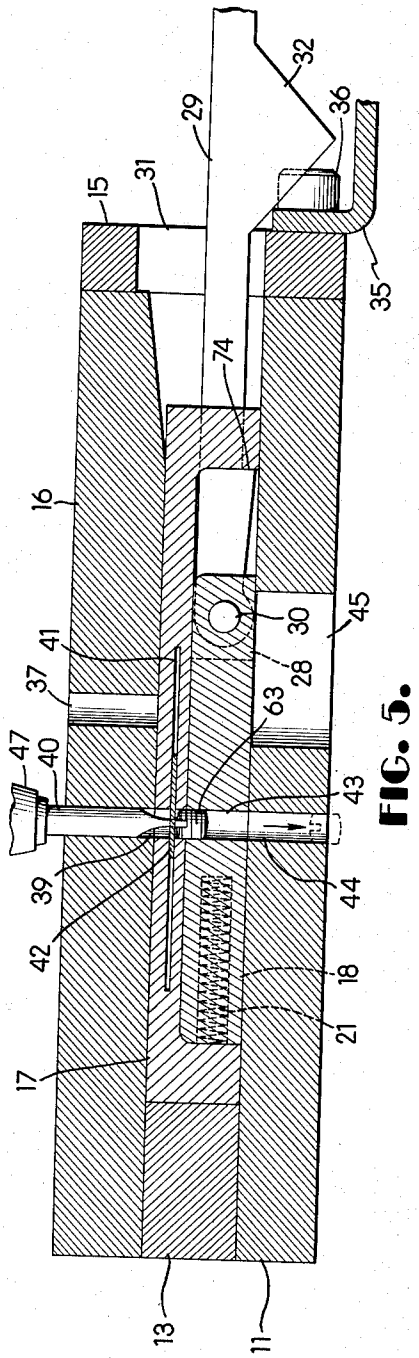


FIG. 5.

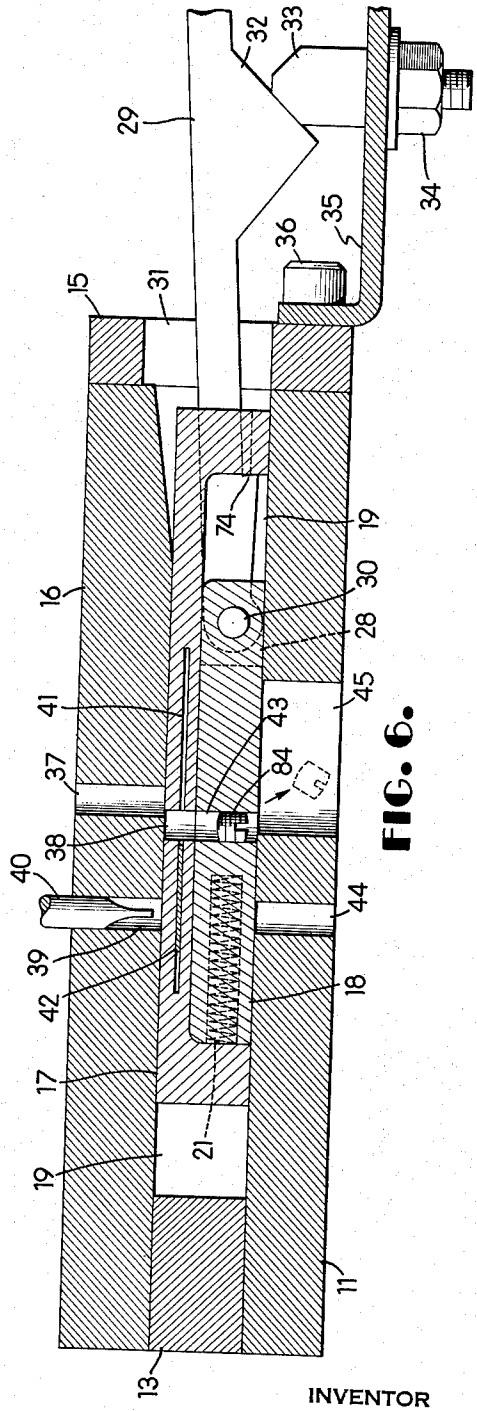


FIG. 6.

INVENTOR
JOHN A. BOON
BY
G. L. Guyer
AGENT

April 17, 1956 J. A. BOON 2,742,134

ARTICLE SORTING DEVICE

Filed Dec. 24, 1951 5 Sheets-Sheet 5

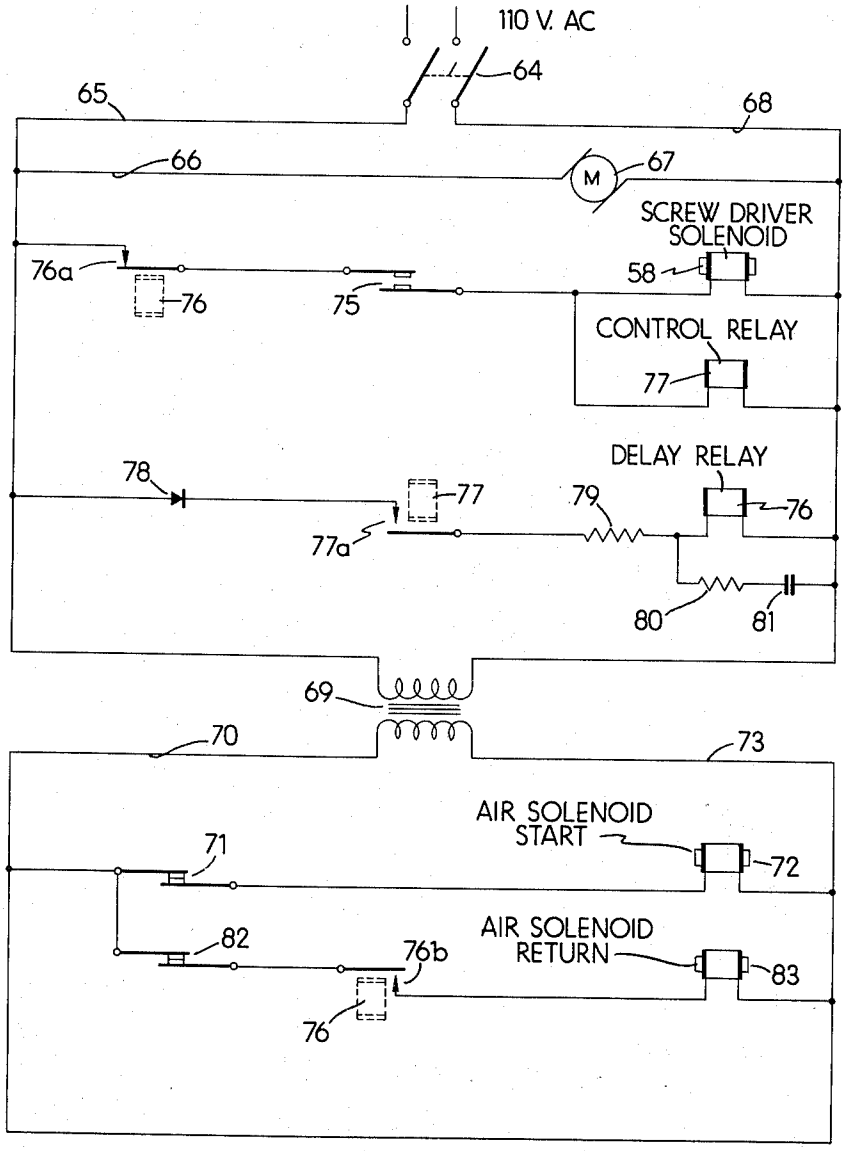


FIG. 7.

INVENTOR
JOHN A. BOON
BY
G. E. Bugger
AGENT

United States Patent Office

2,742,134

Patented Apr. 17, 1956

2,742,134

ARTICLE SORTING DEVICE

John A. Boon, Endicott, N. Y., assignor to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application December 24, 1951, Serial No. 263,109

1 Claim. (Cl. 198—31)

This invention relates generally to assorting mechanisms, and relates more particularly to mechanisms designed to assort articles having a non-circular opening in one end, such for instance, as the headless set screws used in the assembly of relays, this being the particular service of the invention as disclosed, although it will be understood that the mechanism may be employed for the assorting of other articles or objects.

In screw inserting machines of the type currently in use for such assembly operations, the screws are successively fed to an inserting station where each screw is positively driven into a tapped hole or the like in an article that is to be assembled. These articles are successively indexed into position to receive a screw. In such an operation the screws must discharge from the feed means in a predetermined manner in order to assume the proper position at the inserting station. Should the feeding means present a screw to the inserting station in a position other than the predetermined proper position then the positive drive means will fail to drive the screw from said station and the article in position to be assembled will be indexed away without receiving a screw resulting in a faulty assembly.

The feeding means commonly comprises a chute conveying the screws from a source of supply to the inserting station under the force of gravity. The screws are directed into the intake end of the chute from a supply bin or the like and due to the jumbled condition of the screws in the bin it quite frequently happens that screws enter the chute in other than the proper position thereby resulting in faulty assembly operations.

The primary object of the present invention is to provide novel means for rejecting improperly positioned articles from an intermittently movable line of such articles.

A further object of the present invention is to provide novel means for testing against one end of articles being conveyed in a line to reject those articles which are improperly positioned.

A further object of the present invention is to provide novel means for testing against one end of articles being conveyed in a line for the presence or absence of a non-circular opening and for rejecting those articles which do not present such an opening.

A still further object of the invention is to provide rejecting mechanism wherein a multiplicity of improperly positioned screws may be rejected from a feed line of screws during the interval between successive feeding movements of the screws.

Other objects of the invention will be pointed out in the following description and claim and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a vertical view of the device.

Fig. 1*a* is a partial end view showing the relationship between the blade member and the spring blade.

Fig. 2 is a detail plan view with certain of the upper structure removed.

Fig. 3 is an enlarged detail section taken on the line 3—3 of Fig. 2, showing an article to be tested fed into the selector mechanism.

Fig. 4 is a similar section showing the article shifted to a position for testing.

Fig. 4*a* is a section taken on line 4*a*—4*a* of Fig. 4 showing how the article is held in position by the blade member.

Fig. 5 is a section similar to Fig. 4 showing the action of the selector mechanism in selecting a properly positioned article.

Fig. 6 is a similar section showing the action of the selector mechanism in rejecting an improperly positioned article.

Fig. 7 is a wiring diagram of the device.

As shown in Fig. 1, the frame structure of the device includes a base **10** on which is mounted a base block **11**. With the exception of a portion of the two corners at the left end of the block, the two longer sides **12** of said block extend upward to give the block the shape of a U in the vertical plane. In each of said two corners there is attached a locating block **13** having the same height as the extended portion of the sides **12**. The locating blocks **13** extend across the width of the base block but do not meet, leaving a narrow passageway indicated at **14** in Fig. 2. At the right end of the base block there is attached an end plate **15** and mounted on top of the locating blocks and attached to the inside surface of said end plate is a cover plate **16** which completes the structure to form a housing within which a pair of selector mechanisms operate as will be presently described.

The present device as illustrated in Fig. 2 embodies a housing structure, as just described, which is divided in half, each half embodying one selector mechanism, to facilitate the simultaneous selection of articles from two separate conveying lines. Each half of the device is identical in arrangement and operation and therefore the detail description to follow will be restricted, for simplicity, to one selector mechanism which is sufficient to show the selection of articles from one conveying line of such articles.

A selector mechanism comprises a pair of slide members indicated as a top slide **17** and a bottom slide **18** arranged for reciprocation within a chamber **19** in the housing unit. The bottom slide is further arranged for reciprocation within a cavity **20** in the underside of the top slide, the two slides normally being positioned in the relationship shown in Figs. 1 and 3 by means of a spring **21** which extends between the inner surface **22** of the top slide and a spring retaining hole **23** in the bottom slide.

The bottom slide **18** is positively powered for reciprocation by a conventional air cylinder (not shown) having a piston shaft, indicated at **24** in Fig. 2, which is connected to a coupling **25**. The other end of the coupling is connected by means of a pin **26** to an arm **27** which extends through the passageway **14** and attaches to the side of the bottom slide.

The right-hand ends of the top and bottom slides are provided with a slot **28** into which extends a latch lever **29**. The latch lever is pivoted to the bottom slide by means of a pin **30** and extends out through the housing unit by way of a slot **31** in the end plate **15**. Said latch lever has a triangular projection **32** which is adapted to operate against a trip pin **33** (Fig. 1) fastened by means of a bolt **34** to a bracket **35** which is in turn fastened to the end plate **15** by the bolts **36**. As will be later shown, the latch lever and trip pin cooperate to latch the bottom slide against movement during a portion of its operating cycle.

The machine as illustrated herein is adapted more particularly for the feeding of headless set screws which are thrown into a hopper by any suitable means. The screws are conveyed from the hopper (not shown) through a suitable chute (not shown) and into a passageway **37** in the cover plate **16**. The cross-sectional area of the hopper chute and the passageway **37** is slightly greater than the similar area at the maximum diameter of the screws but less than the area of a longitudinal section of screw, so that the screws will be delivered into the passageway **37** only in lengthwise position for endwise movement.

With the top and bottom slides in their normal position as shown in Figs. 1 and 3, the lead screw will be allowed to fall into a passageway **38** in the top slide **17**. The thickness of that portion of the top slide between the cover plate **16** and the top surface of the bottom slide **18** is only very slightly greater than the length of one screw so that only one screw at a time can be positioned in the passageway **38** and so that the top slide can be reciprocated with a screw positioned therein. The cover plate is provided with another passageway **39** which serves as a communicating channel between a rotary driving member **40** and each screw in a manner to be described.

Cut into the side of the top slide **17** is a slot **41** which intersects a small portion of both passageways **38** and **39** as shown in Fig. 4*a*. A blade member **42** mounted in the side **12** of the base block **11** has its blade portion extending into the slot **41**, said slot providing a clearance space so that the top slide may be reciprocated past said blade member. As best shown in Fig. 4*a*, the blade member **42** extends slightly into the passageway **39** but tapers away from the passageway **38** making it possible to have a screw positioned freely in the passageway **38** when the slides are in their normal position and to allow the blade member to engage the threaded portion of the screw when the top slide is moved toward the left. As shown in Fig. 1*a*, a slight pressure is exerted against the blade member **42** by a spring blade **42***a* attached to the side of the base block **11** by means of a screw **42***b*. The blade member **42** is thus urged into positive engagement with the threaded portion of a screw when the top slide is moved toward the left. There will be sufficient friction between the blade member **42** and the screw to prevent the screw from being moved due to vibrations of the device and such friction can be maintained even though the edge of the blade member wears away after an extended period of operation of the device.

The bottom slide **18** has a passageway **43** which serves as a communicating channel between the passageway **38** and either of two passageways **44** or **45** depending upon whether the screw in passageway **38** is properly positioned or not. The passageways **44** and **45** extend through the base block **11** and base **10**, the passageway **44** accepting the properly posiitoned screws for conveyance to the inserting station of the assembling device while the passageway **45** accepts only the improperly positioned screws for conveyance to a reject box or the like.

The mechanism for testing against one end of each screw fed into the device to determine if each screw is properly positioned is shown in Fig. 1. This mechanism operates on the principle of continuously rotating the rotary driving member **40** and periodically causing it to descend into the passageway **38** to engage the end of a screw positioned therein and then retracting the rotary blade out of said passageway **38**.

The rotary driving member **40**, which in the present case is shown as a screw driver blade, is coupled to a shaft **46** by means of a collet **47**. The shaft **46** is slidably mounted in suitable bearings in two flanges **48** of a support column **49** and is caused to rotate by means of a belt **50** and pulley **51**. The belt **50** is hooked up to a suitable pulley and drive motor (not shown) which continuously drives the shaft **46** as long as the device is turned on for operation.

In the normal position as shown in Fig. 1, the screw driver blade is held out of the path of travel of the top slide **17** by means of a release plate **52**. The release plate is attached by means of the two screws **53** to a release rod **54** which is pivotally mounted in the column **49**. To one end of the release rod there is attached one end of a lever arm **55** which has its other end attached, by means of a pin **56**, to the plunger **57** of a solenoid **58**. A spring **59**, extending between the lever arm and a stud **60** on the cover plate **16**, normally causes the lever arm to pivot counterclockwise allowing the release plate **52** to push up against the underside of pulley **51**. As a result, the shaft **46** and screw driver blade are moved upward until a collar **61**, fixed on the shaft, strikes against the underside of the upper flange **48**.

It can be readily seen that energization of the solenoid **58** will cause the lever arm to pivot in a clockwise direction thereby dropping the release plate **52**. As a result, the shaft **46** and screw driver blade will descend until the blade is stopped by the screw. A second collar **62**, fixed on the shaft, limits the descent of the blade, after the screw is driven past the sationary blade, by striking against the top surface of the upper flange **48**. During the descent of shaft **46**, the passageway **38** will be in alignment with the passageway **39**, as shown in Fig. 5, to allow screw driver blade to engage against one end of a screw.

A complete cycle of operation of the device will now be described with references made to the wiring diagram shown in Fig. 7:

As was previously mentioned, this device is used to test one end of articles conveyed in a line (headless setscrews, for instance), the purpose being to select those which are properly positioned and to reject those which are improperly positioned. In the present application of the device, a suitable chute forces the individual delivery of the screws in an endwise direction from a hopper, but without attempting to force delivery with the slotted end first, or vice versa, the only condition being that they advance endwise through suitable channels leading to passageway **37**.

The operation of the device begins with the position of the parts in Fig. 3. In this position the passageways **37** and **38** are in alignment, so that the screw **63** delivered to passageway **37** will drop downward into passageway **38** until it comes to rest on the upper face of the bottom slide **18**. The screw **63** is shown with its slotted end up or, in other words, it was fed unslotted end first. All screws fed in this fashion are considered to be properly positioned and will pass through the device while those screws that are fed slotted end first are considered improperly positioned and will be rejected by the device.

Referring to the wiring diagram, closure of a switch **64** will complete a circuit from one side of the 110 volt A. C. supply, wire **65**, wire **66**, motor **67**, wire **68** to the other side of the supply. Energization of the motor **67** will impart rotary motion to the shaft **46** and screw driver blade **40** through the belt **50** and pulley **51**. At the same time transformer **69** is energized and current flows in the circuit leading from the secondary windings of **69**, through wire **70**, microswitch **71**, air solenoid **72**, line **73** to the other side of the transformer secondary.

As shown in Fig. 2, the micro-switch **71** is closed by the coupling **25** when said coupling and arm **27** are at the extreme right-hand end of their travel in which position the bottom slide **18** is up against the end plate **15** as shown in Fig. 3.

Energization of the start air solenoid **72** by the circuit just traced will result in the air cylinder piston shaft **24** being pulled toward the left taking with it the coupling **25** and arm **27**. During the course of such movement, the top and bottom slides are moved to the position shown in Fig. 4, the bottom slide being positively powered by the air cylinder and the top slide being moved by the bottom slide, by means of the spring **21**, until it strikes against the locating block **13**. It is to be noted that

in this position the passageway 38 and screw 63 are in alignment with the passageway 39 and screw driver blade 40.

The piston shaft 24 continues to move toward the left until the bottom slide 18 strikes against the side of the cavity 20 in the top slide 17, as shown in Fig. 5, at which time the shaft 24 has reached the limit of its travel. It should be noted that in this position the passageway 43 in the bottom slide is in alignment with passageways 38 and 39 and also the passageway 44 in the base block 11. The screw 63 is prevented from falling because the blade 42 engages the threaded portion of the screw, as shown in Fig. 4*a*, to hold it in the passageway 38. As the bottom slide reaches the limit of its travel toward the left, the triangular projection 32 on latch lever 29 clears the trip pin 33 and the lever drops to allow a notched portion 74 thereon to latch against the inner surface of the top slide. Thus, the top and bottom slides are locked against movement in either direction to maintain the passageways 38, 39, 43 and 44 in exact alignment.

Movement of the coupling 25 toward the left opens the micro-switch 71 and as it reaches the limit of its travel closes a micro-switch 75 (Fig. 2). Closure of micro-switch 75 completes a circuit from one side of the 110 volt supply, wire 65, the normally closed 76*a* points of a delay relay 76, the micro-switch 75, the screw driver solenoid 58 and a control relay 77 to wire 68 and the other side of the supply.

Energization of the solenoid 58 causes the lever arm 55 (Fig. 1) and release rod 54 to pivot clockwise lowering the release plate 52 a sufficient amount to allow the shaft 46 to descend until the screw driver blade 40 engages the end of screw 63 in the passageway 38. A time lapse now occurs to allow the screw driver blade to test the end of the screw. The blade is revolving in the same direction as the helix of the screw thread and it can be readily seen that a properly positioned screw having its slotted end up, as shown in Fig. 5, will have its slot engaged by the screw driver blade and will be screwed past the blade 42. The properly positioned screw is now free to fall through the passageways 43 and 44 to be conveyed to the inserting station of an assemlby device or the like. Conversely, if the screw is improperly positioned with the slotted end down, the screw driver blade just spins on the screw and the screw remains in the passageway 38 of the top slide.

The time lapse which occurs to give the screw driver blade time to complete its function is brought about in the following manner:

As was previously mentioned, at the same time that the screw driver solenoid 58 was energized, the control relay 77 was also energized by the same circuit. Energization of the control relay completes a circuit from one side of the 110 volt supply, wire 65, rectifier 78, the normally open 77*a* points of the control relay 77, now closed, a resistor 79, a resistor 80 and capacitor 81 to wire 68 and the other side of the supply. The resistor 80 and capacitor 81 are placed across the delay relay 76 and constitute a short circuit to delay the pick up of the relay until the capacitor becomes charged. This delay is sufficient to allow the screw driver to drive the screw past the blade 42 before the delay relay will pick up.

When the delay relay 76 picks up, its normally closed 76*a* points are opened to drop out the screw driver solenoid 58. At this point, then, the spring 59 (Fig. 1) will pivot the lever arm 55 and release rod 54 counterclockwise which results in the release plate 52 raising the shaft 46 until the screw driver blade is retracted clear of the top slide 17.

As the lever arm 55 returns to its home position it closes a micro-switch 82 attached to the side of the support column 49. This switch is normally closed, then, with the lever in its home position, but it does not complete a circuit until after the delay relay has picked, at which time a circuit is completed from one side of the 110 volt supply, wire 65, through transformer 69, wire 70, the closed micro-switch 82, through the normally open 76*b* points of the delay relay, now closed, a return air solenoid 83 and wire 73 to the other side of the supply.

Energization of the return air solenoid results in the piston shaft 24 and coupling 25 being forced toward the right, carrying therewith the bottom slide 18 which in turn is latched to the top slide 17. Therefore, as the slides start on their return stroke the passageways 38 and 43 remain in alignment since the two slides move in unison. Assuming that an improperly positioned screw, such as the one indicated at 84 in Fig. 6, was deposited in the passageway 38, the screw driver will fail to drive the screw and it can be readily seen that the improperly positioned screw will be carried by the top slide back toward the tapered portion of the blade 42 until it becomes free from said blade and drops into the passageway 43 in the bottom slide.

The slides will continue their return stroke, the top slide returning to its normal position against the end plate 15 at which time the projection 32 on the latch lever 29 will cam over the trip pin 33 unlatching the bottom slide so that it can return to its normal position against the right side of the cavity 20 in the top slide. As the passageway 43 passes over the passageway 45 the improperly positioned screw 84 will fall into said passageway 45 for conveyance to a reject box or the like.

It is to be noted that when the delay relay 76 picked up, its normally closed 76*a* points opened dropping out the screw driver solenoid 58 and the control relay 77. Dropping out of control relay 77 opened its 77*a* points which would tend to drop out the delay relay. However, it is not desired to drop out the delay relay at the time that the 77*a* points of relay 77 open because it is necessary to keep the normally open 76*b* points of the delay relay closed until the lever arm 55 returns to its home position and the micro-switch 82 is closed to bring about energization of the return air solenoid 83. The resistance capacitor combination across the delay relay takes care of this condition by delaying the actual drop out of the relay. When the 77*a* points of control relay 77 open, the charge on capacitor 81 discharges through resistor 80 and the delay relay to effectively hold the relay up until said charge is dissipated.

When the slides began their return stroke, coupling 25 opened the micro-switch 75 and upon reaching the home position closed micro-switch 71 to ready the device for another cycle of operation.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claim.

What is claimed is:

In a device for testing the end position of articles being conveyed in a line, said articles each having a threaded portion and a non-circular configuration in one end, means for engaging the threaded portion of an article and for holding said article in a vertical position, means for presenting articles individually to said engaging means, a rotary driving member having a bit portion conforming to said non-circular configuration said bit portion being positioned in proximity to said engaging means and in axial alignment with an article engaged thereby, means for imparting rotary and axial movement to said rotary driving member to engage same with one end of said article, an article presenting its configurative end to said bit portion being driven thereby free of said engaging

means and an article presenting its opposite end to said bit portion not being driven thereby but being retained by said engaging means, a discharge path for receiving an article driven free of said engaging means, a second discharge path for receiving an article retained by said engaging means, and means for conveying a retained article to said second discharge path.

References Cited in the file of this patent

UNITED STATES PATENTS

1,571,021	Meyer	Jan. 26, 1926
2,015,573	Strickland	Sept. 24, 1935
2,303,005	Swangren	Nov. 24, 1942
2,599,655	Netschert	June 10, 1952
2,638,945	Austin	May 19, 1953