United States Patent

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[54] **MACHINE FOR TESTING SMALL INSULATED OBJECTS**
8 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **209/73,** 209/81
[51] **Int. Cl.** **B07c 5/344**
[50] **Field of Search** 209/73, 74, 81

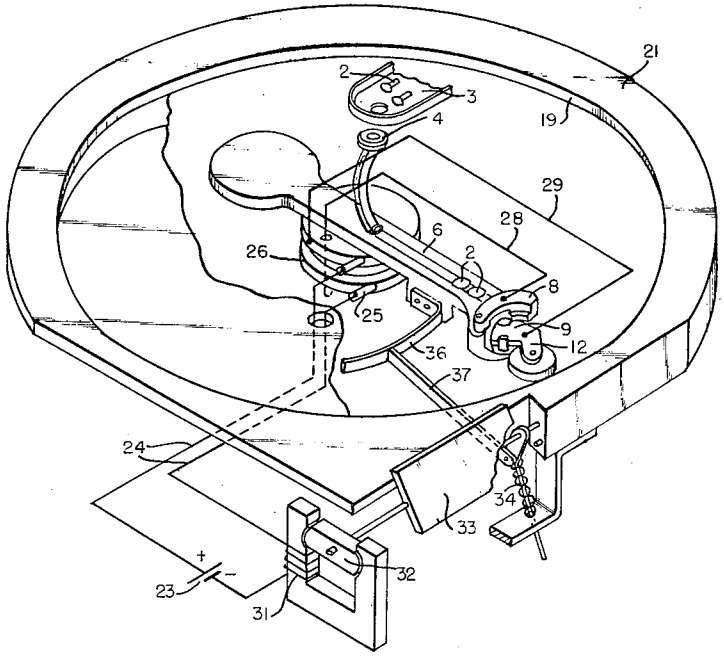
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Primary Examiner—Allen N. Knowles
Attorney—Max L. Libman

ABSTRACT: A machine for automatically testing small insulated objects such as anodized aluminum rivets, by subjecting them to an electric potential and determining whether they pass current. The properly anodized rivets are coated with an insulating layer; the defective ones pass a current which is used to actuate a gate-controlling deflector to separate them from the acceptable ones. A rotary feed arm supplies the rivets by centrifugal force to a testing head at one point in the revolution of the feed arm, and releases them individually at another point in the rotation of the arm after testing, into a path determined by the position of the deflector.



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FIG. 1.

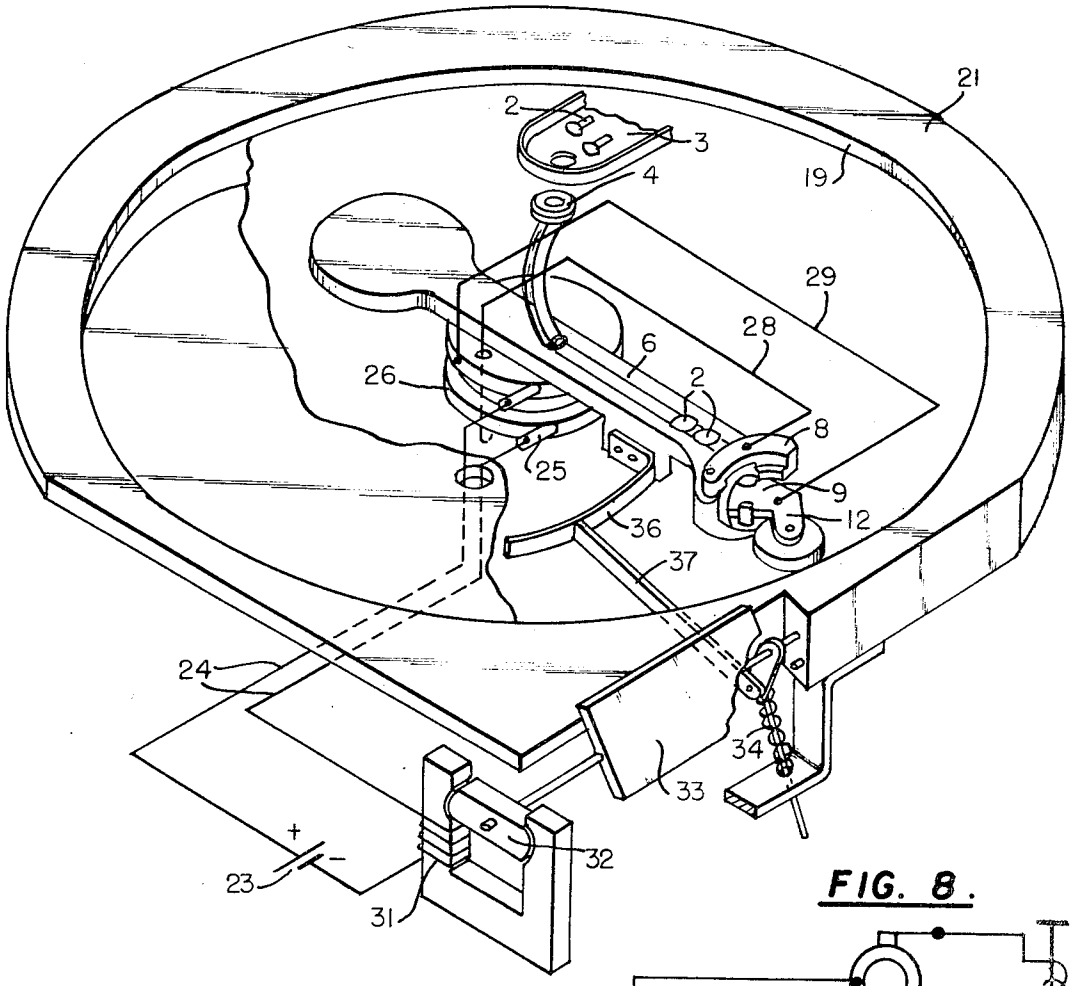


FIG. 8.

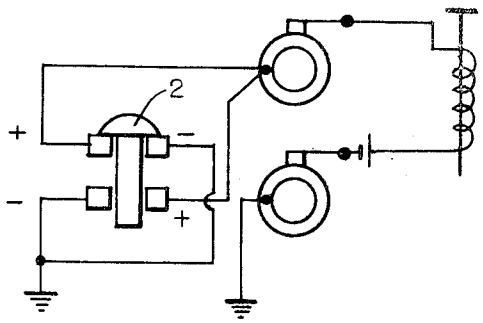
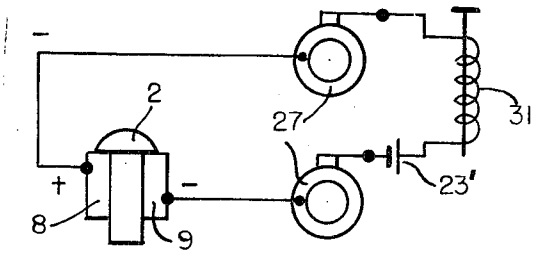


FIG. 7.

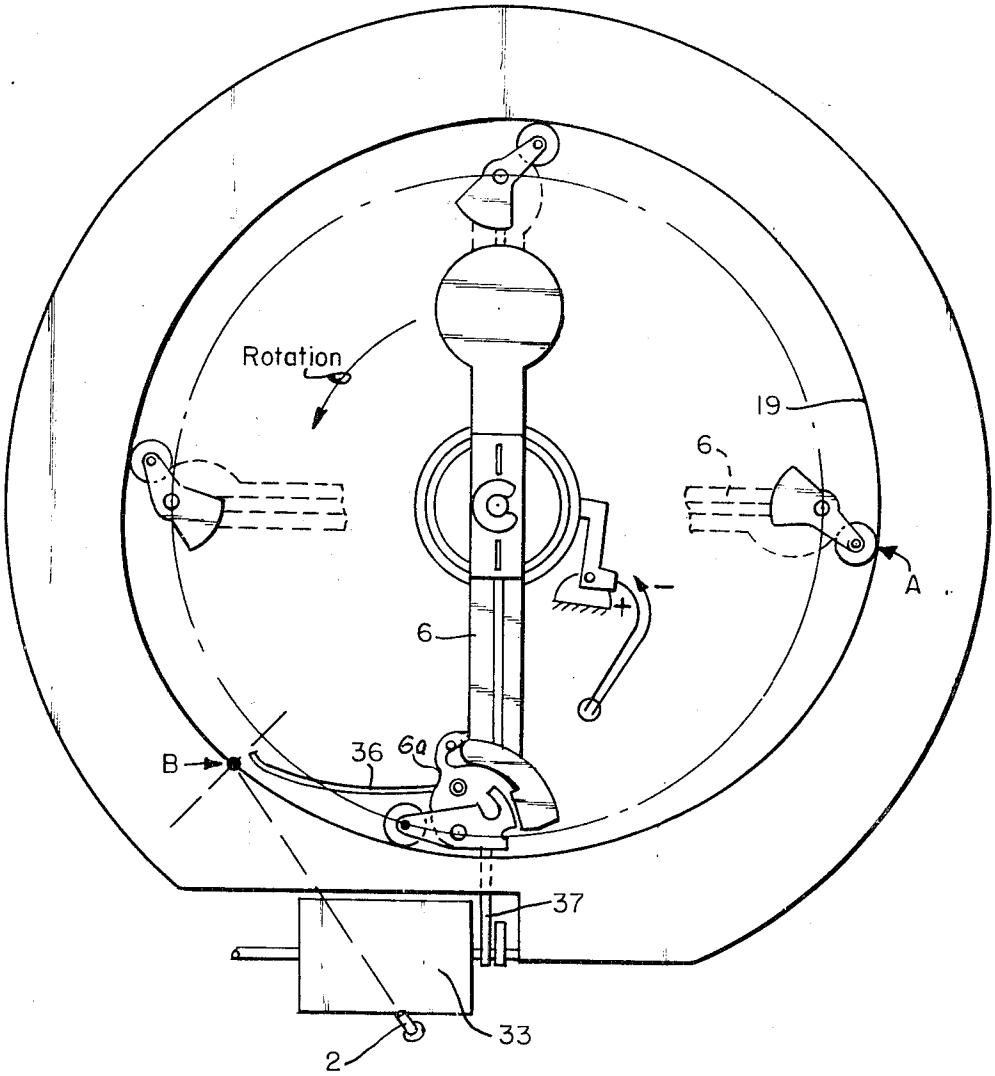


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FIG. 2.

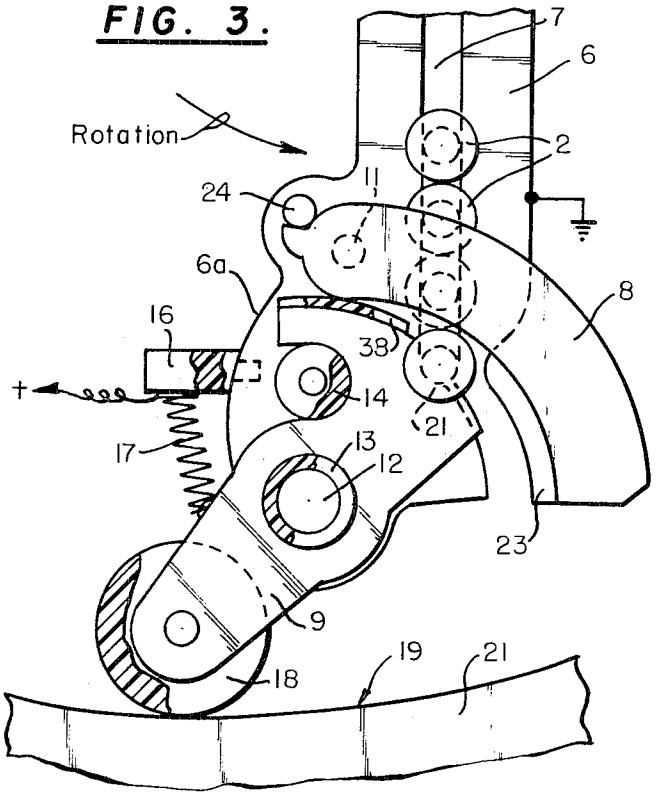


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FIG. 3.



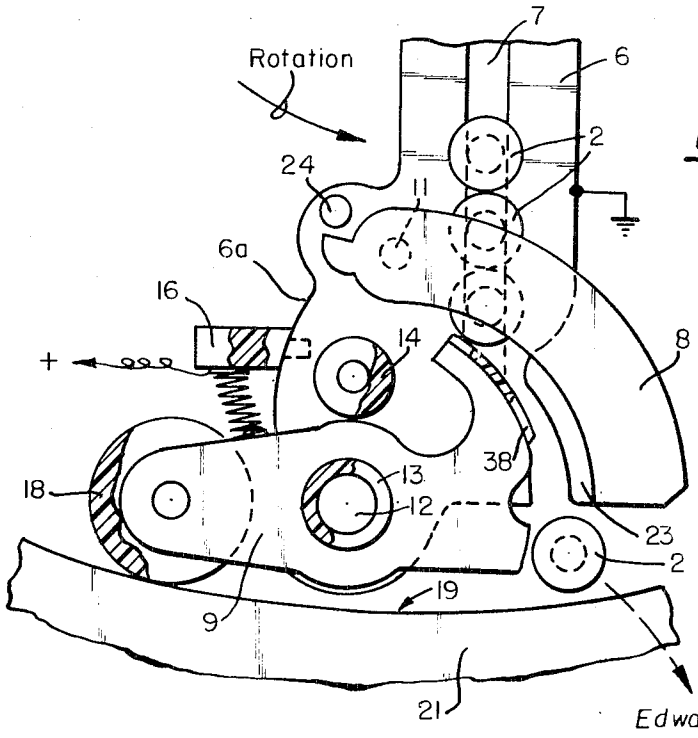


FIG. 4.

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FIG. 5.

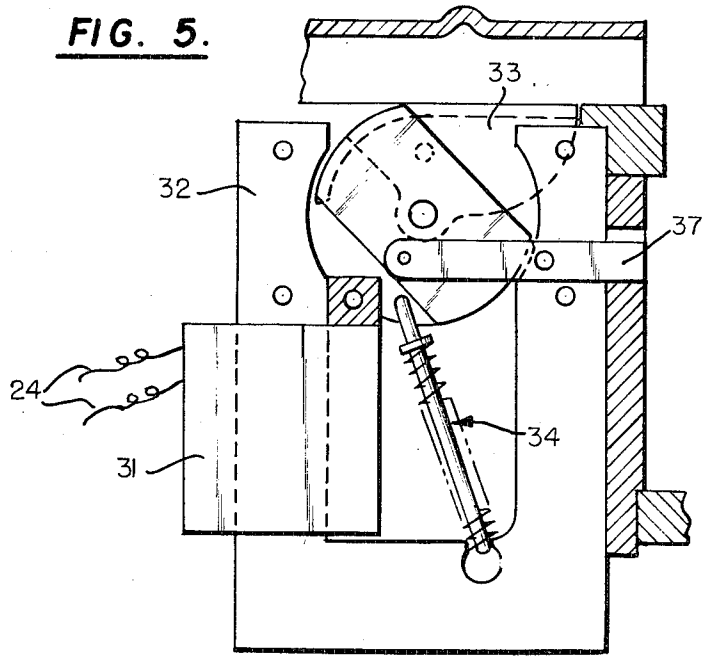
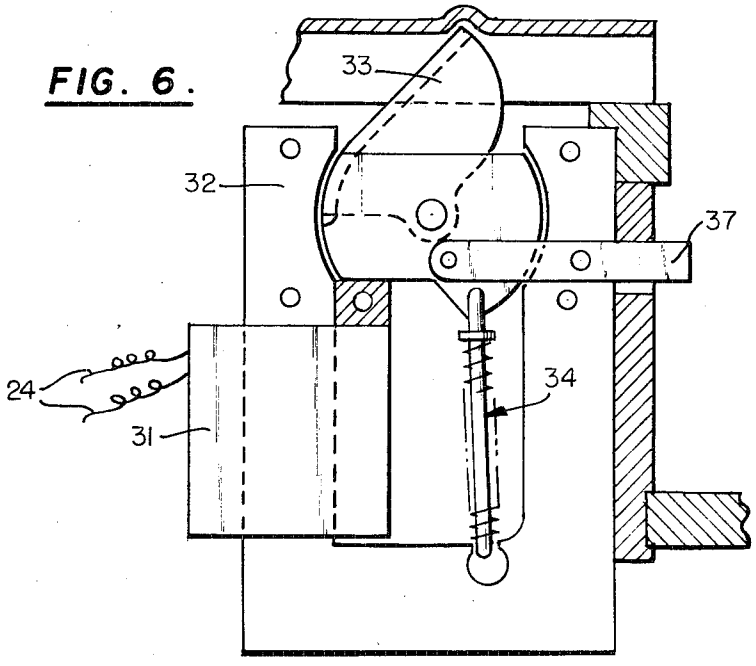


FIG. 6.



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MACHINE FOR TESTING SMALL INSULATED OBJECTS

Anodizing is an electric oxidation process in which the surface of a metal, when anodic, is converted to a coating having desirable protective properties. Anodizing is widely used to provide aluminum objects with a protective surface coating. Anodic coatings on aluminum have good resistance to abrasion, as the oxide of the coating compares in hardness with corundum, and is also a good dielectric material. Anodized aluminum rivets are widely used in airplane construction, because the insulating oxide coating of the rivet prevents battery action from occurring between the rivet and the surrounding aluminum material of the airplane structure, which under conditions of moisture cause very rapid local deterioration and resultant failure of the rivet, and consequently of the airplane. In the anodizing cycle of such rivets, the insurance of 100 percent electrical contact of each rivet to the anodizing rack is impossible. Thus, there is always a small percentage of unanodized rivets in each batch, typically about 5 percent, and these must be separated from the anodized rivets in order to prevent their being used in an airplane. This is done at present by visual inspection and manual separation, which is a tedious monotonous job and makes high-quality control impossible.

It is a major object of the present invention to provide a machine for automatically testing small insulated objects such as anodized aluminum rivets, and automatically rejecting all those which have imperfect insulation. The testing process is electrical, a potential being applied between spaced points on the surface of the presumably anodized rivet—if it is properly anodized, no current will pass as the anodic coating is excellent insulating material; if it is not properly anodized, it will pass current, which is then used to trigger an ejecting mechanism so that the defective rivets can be separated from the acceptable ones.

In accordance with the invention, the rivets are supplied by means of a known type of vibrating feed device to a rotating feed arm which has a slot capable of loosely receiving the stems of the rivets but not the heads, so that the rivets are aligned in the slot with their stems down. Due to the rotation of the feed arm, typically at about 5 revolutions per second, the thus-aligned rivets are urged outwardly in the slot toward the rotating extremity of the feed arm. At this end, the rotating arm carries a mechanism which receives the outermost rivet of those aligned in the slot, and moves it, by means of a cam mechanism in accordance with the angular position of the feed arm, between one or more sets of electrical contacts which supply an electrical potential to the rivet. During a portion of rotation of the feed arm, the rivet is thus being tested, preferably being rotated during this process, and if during this time any portion of the rivet is not anodized, a current will pass through it between the test contacts, which current is utilized to operate a solenoid actuating a selector gate to deflect the defective current-bearing rivet into a different path from the satisfactory rivets, so that it can be separated from them. If no current passes through the rivet, this indicates that it is properly anodized, and the selector gate is not operated, so that the rivet passes straight through to a collecting station. A special feature of the invention is the use of a rotary solenoid to actuate the selector gate mechanism, and the use of a toggle mechanism to keep the deflector gate open once it has been actuated during any portion of the travel of the rivet during testing, together with an automatic resetting mechanism which resets the gate after it has been opened so that it will be in proper position for the testing of the next rivet, which is picked up by the same mechanism during the next rotational cycle of the feed arm.

The specific nature of the invention, as well as other objects and advantages thereof, will clearly appear from a description of a preferred embodiment as shown in the accompanying drawings, in which:

FIG. 1 is a schematic view of the invention in perspective, for the purpose of explaining the principle of the invention;

FIG. 2 is a plan view of the rotating feed arm and cam mechanism, showing its operation in various stages of rotation of the feed arm;

FIG. 3 is a detail view of the end of the feed arm showing the rivet receiving and testing mechanism at the point when a rivet is first received by it;

FIG. 4 is a view of the same mechanism at the point of rivet release;

FIGS. 5 and 6 shown the reflector plate and its actuating mechanism in open and closed position respectively; and

FIGS. 7 and 8 are circuit diagrams showing different forms of contact arrangements.

The rivets to be tested are shown at 2 being red by a vibrating tray 3, which is a known device and not a part of the present invention, into the entrance tube 4 of the rotary feed arm 6. It will be understood that the inlet of the entrance tube 4 is exactly aligned with the axis of rotation of the feed arm so that it remains in the same position during rotation of the feed arm.

The vibrating feed tray 3 aligns the rivets in known fashion, and the feed design is such that the rivets are deposited serially in slot 7 of the feed arm 6, the slot being large enough to take the stem of the rivets while the heads are aligned on the top surface of the feed arm as shown, for example in FIGS. 1 and 3. The top of the slot is shown open in the Figures for clarity, but in practice a top cover may be provided sufficiently loose to permit movement of the rivets within the slot 7, but sufficiently close to the heads to prevent the rivets from jumping out of the slot.

At the end of rotary feed arm 6, a projection 6*a* of the feed arm carries two pivotal members 8 and 9, which are respectively pivoted on pins 11 and 12 carried by projection 6*a*. As will be shown below, these two members provide the electrical contacts through which a potential is applied to the rivet, and therefore at least one of them must be insulated from the feed arm 6 which supports it; in the present example, member 9 is shown insulated from the feed arm by means of nylon bushing 13 between its pivot pin 12 and the body of the member, while it is also insulated at all points of contact with any portion of the feed arm 6, for example, a nylon stop 14 is used to limit counterclockwise rotation of the member 9, which will be referred to as the positive member, since it is shown in the present example as connected to the positive side of the testing circuit. A nylon spring stop member 16 is used to support one end of compression spring 17 which is used to bias the positive contact and selector member 9 in a counterclockwise direction. A nylon roller 18 is employed to bear on the cam surface 19 of circumferential cam 21 which causes positive member 9 to oscillate about its axis 12 during rotation of the feed arm so as to move individual rivets from the end of the slot through the testing contacts and release them for selection in accordance with the test results, during each rotation of feed arm 6.

FIG. 3 shows the position of members 8 and 9 at the point where a rivet is admitted and about to be tested. Oscillating member 9 is in its extreme counterclockwise position, into which it has been urged by spring 17, so that it is resting against stop 14, with a small recess 21 at the end of member 9 aligned with slot 7, so that the outermost rivet in the slot 7 is now forced by centrifugal action into the recess 21 as shown in FIG. 3. This constitutes the rivet entrance, and occurs at the position A in FIG. 2, due to the fact that the clearance between cam surface 19 and pivot 12 is a maximum at this point. As the feed arm 6 continues its rotation in the counterclockwise direction, due to the eccentricity of the cam surface 19, the distance between the cam surface and pivot point 12 decreases, which carries the rivet being tested from the reception position shown in FIG. 3 to the release position shown in FIG. 4 which occurs at point B, where the distance between the cam surface 19 and the pivot point 12 is at a minimum, and the clockwise rotation of member 9 has reached its maximum extent. As can best be seen in FIG. 1, from point B back to point A, this cam distance increases once more so that member 9 oscillates back into its initial position for the reception of another rivet. It will be noted that with the configuration shown in FIG. 2, the cam surface is not a true eccentric surface, but is so shaped as to provide a longer testing period and a relatively shorter resetting period.

In the course of moving from the position in FIG. 3 to that shown in FIG. 4, the rivet is quickly moved into engagement with arcuate surface 23 of pivotal member 8, which is urged into good contact with the rivet due to centrifugal action caused by rotation of the feed arm 6, which tends to rotate the arm 8 about its pivot 11 in a clockwise direction. This motion is initially restrained by stop 24 on the feed arm projection 6a, in which position the arcuate gap between surface 23 of member 8 and the nearest end of member 9 is sufficiently small so that the rivet pushes the arcuate member 8 back more or less into the position shown in FIG. 4, which shows member 8 immediately after the rivet has left it and while it is still in its testing position. Thus there is assured a positive wiping contact between the rivet and contact surface 23, which tends to rotate the rivet during its passage from position A to position B, thus ensuring thorough testing of the cylindrical surface of the rivet shank, which is the most important element to be tested. At the same time, the underside of the head of the rivet is also resting on top of elements 8 and 9, so that the underside of this head is urged by gravity into contact with these two terminal members, so that this surface is also being tested. If the anodizing is properly applied to the rivet, it will pass no current, while if the rivet is defective, it will pass current. This current is supplied from any suitable source, indicated as a battery 23' in FIG. 1, through leads 24 and brushes 25, to sliprings 26 which rotate with the feed arm, and thence by means of suitable conductors 28 and 19 to the two pivotal terminals 8 and 9. In the example shown, element 8 is indicated as being connected to the negative side of the battery and may be grounded through the arm and frame itself, so that element 9 is required to be insulated from the frame which carries it, as described above. Preferably the current is fed to element 9 through its biasing spring 17, in order to avoid the necessity for a wiping contact at this point, and in practice a torsion spring wound around pivot 12 is preferred to the type of compression spring which is shown in the drawing for the sake of clarity.

When the rivet being tested is defective, it will pass a current, and this current will energize coil 31 of rotary solenoid 32, which will move deflector plate 33 into the path of the rivet as it is being released, so that the unanodized or improperly anodized rivet is deflected from the normal rivet path into a special container, while the properly anodized rivets are thrown into a different shoot and can be separately collected.

Since an unanodized spot on a rivet may be detected at any time during the travel of the feed arm from position A to position B, a toggle spring assembly 34 is provided to hold the deflector plate in its deflecting position once it has been actuated, even though the pulse of current may have subsided by the time the rivet is ejected from the feed arm assembly. After the defective rivet has been deflected, continued rotary movement of the feed arm carries reset lever 36 to the point where it actuates reset arm 37 to reset the deflector plate into its normal position. Thus, each time the deflector plate is actuated during the cycle, it is reset into its normal position at the end of that cycle. It will be understood that the normal percentage of rejects is very small, usually less than 5 percent, so that most of the time the deflector plate remains in its normal condition, and only once is a while is it actuated to separated out a defective rivet. However, it may be that in a given batch, a number of defective rivets will occur one after the other, and it will be seen that in this case the mechanism of the deflector plate will be operated once for each revolution.

As best shown in FIG. 4, it will be clear that while one rivet is being tested between the electrical terminals, the next rivet in the slot will be urged out by centrifugal force against the member, if bad, which can be accomplished as shown by providing an insulator strip 38 to prevent electrical contact between the last rivet in the slot and the member 9. Of course, if the rivet is perfect, it will be insulated in any case, but if it is imperfect, it will result in rejection of the rivet between the electrodes, which may be perfectly sound, and to prevent this, the insulator strip 38 is provided.

FIG. 7 shows a wiring diagram corresponding to the above description. It will be seen that the applied potential is such as to pass current between terminals 8 and 9 in a generally radial direction through the stem of the rivet, or across the underside of the rivet head. FIG. 8 shows how the same wiring diagram may be employed but with a somewhat different terminal arrangement, to tend to pass current in several directions through the rivet. This may be accomplished by providing suitable insulated terminal inserts on the tow pivotal members 8 and 9, and maybe of advantage in detecting the horizontal discontinuity in the stem of the rivet. Similarly, it will be apparent that other electrode arrangements may be employed which may be of advantage in detecting certain types of rivet failures if such types are found to exist.

I claim:

1. a. Means for automatically testing small insulated objects comprising

b. a rotary arm having a radial channel,

c. feeder means for feeding said objects into said channel for serial alignment therein, said objects being sufficiently loose in the channel for radial outward movement in said channel under centrifugal force when the rotary arm is being rotated,

d. test means carried by said rotary arm at its outward end for receiving the outermost one of the aligned objects in said channel at one point in the rotation of said arm,

e. cam-controlled means for releasing said object from said test means at another point in the rotation of said arm,

f. said test means including contact means for applying an electric potential to at least two spaced points on the surface of said object during continued rotational movement of said arm between said two points.

g. electromotive means in circuit with said contact means and responsive to the electric impedance between said contact means due to said object,

h. path control deflector means actuated by said electromotive means for deflecting said object after release by said cam-controlled means and into another path when said electromotive means is not operative.

2. The invention according to claim 1,

i. wherein said objects are anodized rivets having a head and a round shank,

j. said channel being slightly wider than the rivet diameter, said channel having upper edges spaced and located so that the rivet heads rest by gravity on said edges when the rivet shanks are disposed loosely within the channel.

3. The invention according to claim 2,

k. said contact means including electrode means for applying an electric potential diametrically across said shank.

4. The invention according to claim 3,

1. said electrode means including two elongate spaced electrodes movable relative to each other by said cam-controlled means to as to rotate said shank between them prior to release of the rivets from the test means.

5. The invention according to claim 4,

m. said cam-controlled means comprising a cam follower arm pivotally mounted on said rotary arm, and a stationary cam surface against which the follower bears, as said rotary arm rotates, so as to cause pivotal oscillation of the follower arm between two extremes positions, in one of which positions the rivet is received and in the other of which the rivet is released.

6. The invention according to claim 5,

n. one of said electrode means being mounted on said cam follower and another being mounted on said rotary arm, said electrode means being moved relative to each other by said pivotal oscillation movement of said cam follower.

7. The invention according to claim 1,

i. said deflector means comprising toggle means for retaining said deflector means in one deflecting position after it has been actuated by said electromagnetic means,

j. and reset means for resetting said deflector means to its original position after the rotary arm has passed the rivet release position.

8. The invention according to claim 7, and reset means comprising a reset operator carried by said rotary arm.

* * * * *