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2,648,167

MACHINE FOR MANUFACTURING SWITCHES

Filed Dec. 18, 1948

2 Sheets-Sheet 1

FIG. 1

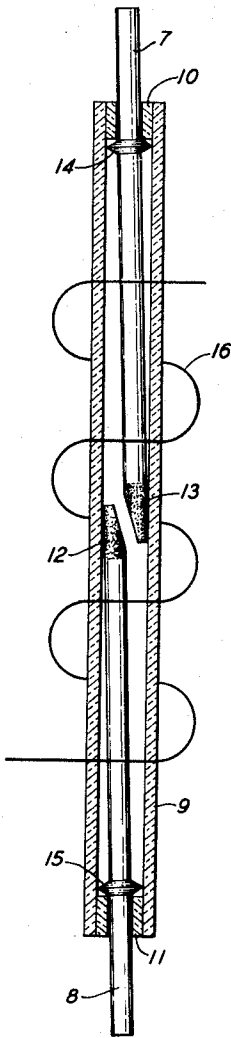


FIG. 2

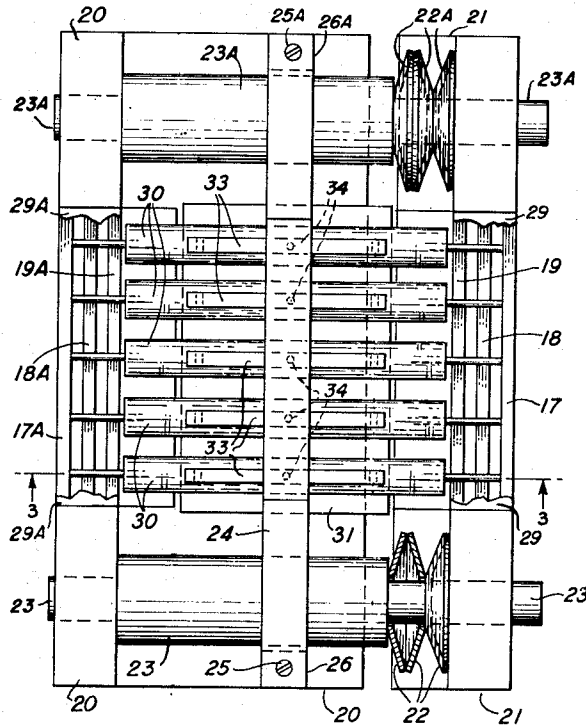


FIG. 3

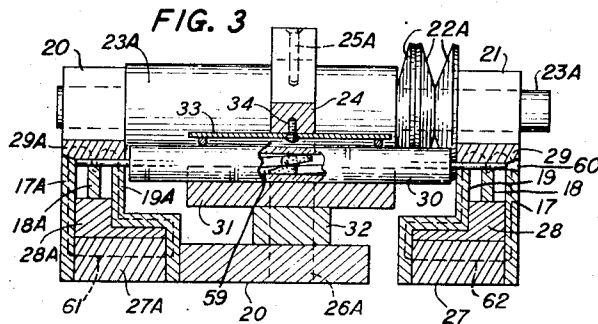
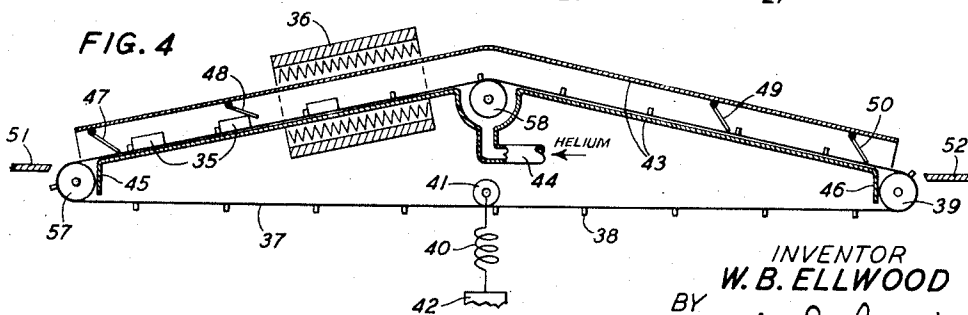


FIG. 4



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FIG. 5

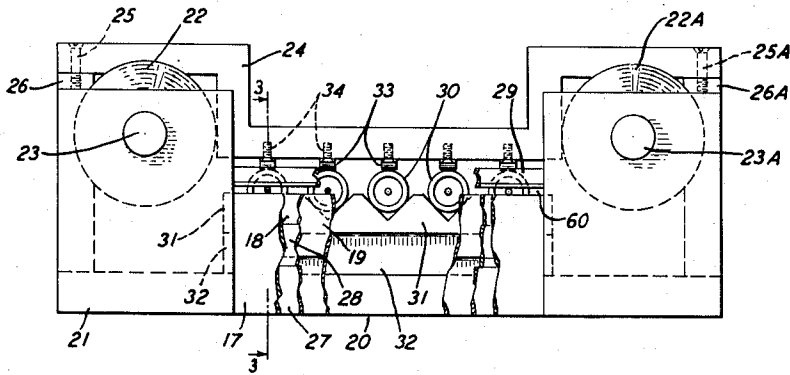
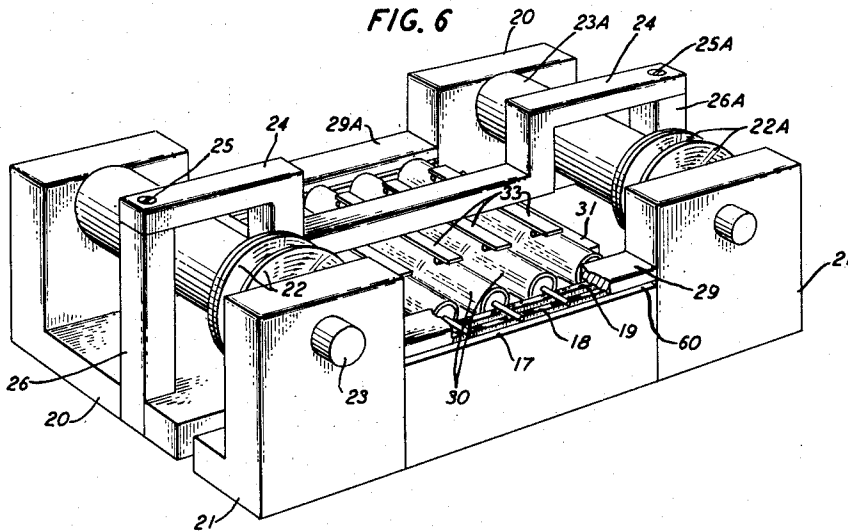


FIG. 6



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MACHINE FOR MANUFACTURING SWITCHES

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Application December 18, 1948, Serial No. 66,084

10 Claims. (Cl. 49—14)

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This invention relates generally to means for manufacturing switches, and more specifically the invention relates to apparatus for manufacturing dry reed switches.

Another object of the invention is a machine for manufacturing switches whereby a uniform, reproducible gap between the switch electrodes is attained.

Another object of the invention is to reduce the temperature used in sealing the switch electrodes to the glass envelope enclosing said electrodes by using an assembling process which employs a sealing glass of low fusion temperature which bonds the switch electrodes to the glass switch envelope at temperatures below the softening point of said glass envelope.

The switch shown in the accompanying drawings is also disclosed in my copending application, Serial No. 319,483, filed November 8, 1952.

There has been difficulty in the past in manufacturing dry reed switches with a high degree of electrode space gap uniformity. Applicant overcomes this difficulty and attains his objects as enumerated supra by a switch envelope wherein electrodes are placed substantially end to end in a longitudinal manner with respect to each other, and having the contact ends of said electrodes beveled in such a fashion that the beveled surfaces lie in two parallel planes. The gap between said two beveled contact surfaces is accurately and uniformly determined by the amount of thermal expansion of an element in a temperature responsive jig which holds switches while the electrodes are spaced and the switch envelope is sealed in a furnace. A belt guide is used to carry a series of these switch holding jigs into a temperature controlled furnace where the spacing and sealing steps occur.

The invention, the attainment of its objects, and the nature thereof, may be more fully understood from the detailed description infra, read in conjunction with the drawings in which:

Fig. 1 shows a front view in section of an assembled switch in a non-operating condition;

Fig. 2 shows a partially broken away top view of the jig which holds the switches during the electrode spacing and envelope sealing steps;

Fig. 3 shows a section view of the jig taken through 3—3 of Fig. 2;

Fig. 4 shows a view of a belt guide carrying a

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plurality of jigs identical in structure to the jig of Fig. 2 into a furnace where the spacing of the switch electrodes and the sealing of the switch envelopes are accomplished;

Fig. 5 shows a partially broken away side view of the jig of Fig. 2; and

Fig. 6 shows a perspective view of the jig of Fig. 2.

In Fig. 1 the two electrodes 7 and 8 of a complete switch whose electrodes are in a non-operated position are enclosed in the tubular glass envelope 9. In an exemplary embodiment electrodes 7 and 8 are made of a nickel-iron alloy consisting of about fifty-one per cent nickel and forty-nine per cent iron which has very nearly the same coefficient of expansion as that of annular glass seals 10 and 11. It is to be noted, however, that any electrical conducting material possessing magnetic properties may be used as electrodes. The contact tips 12 and 13 of electrodes 7 and 8, respectively, are plated with a metal assuring hard, long wearing, low resistance contact surfaces. Rhodium is suitable although other metals can be employed. Each of the two electrodes 7 and 8 has an upset flange 14 and 15 respectively thereon. These upset flanges center the electrodes in the glass tube during the sealing process. They also define the cantilever length and serve as location stops for the annular glass seals 10 and 11. The contact surfaces of the electrodes are beveled in such a manner that the two surfaces lie in planes approximately parallel to each other, thus providing for good contact when the relay is activated. The annular glass seals 10 and 11, which are inserted in envelope 9 before the spacing and sealing steps occur, have a very low melting point so as to reduce the furnace temperature required for sealing. The seals should also have the same expansion coefficient as the glass envelope 9 and the metallic electrodes 7 and 8, otherwise the seals are apt to crack when subjected to temperature variations. The melting point of the glass seals should be below the softening point of the glass envelope so that the cylindrical form of the envelope will not be materially changed during the sealing step. Glasses having a sufficiently low melting point are now available on the market. As is represented by the wire 16, the assembled switch is adapted for use in conjunc-

tion with a coil or other source of magnetic flux to form an electromagnet relay.

In Fig. 2 the assembled switches 30 are positioned in the V grooves of V-block 31 of the jig. Pole pieces 17, 18, 19, 17A, 18A and 19A, which are constructed of magnetic material, cooperating with permanent magnets 27 and 27A constitute two magnetic chucks which grip the electrodes of each switch, holding them in a fixed position with respect to frame 20 and end piece 21 as well as the chucks which are permanently affixed to frame 20 and end piece 21 while the heating, spacing and sealing steps occur. As will be seen from Fig. 3, one of the electrodes for each switch abuts against pole-piece 17A which aids in properly positioning the electrodes prior to the spacing and sealing of the electrodes in a furnace. In an exemplary embodiment of the invention bimetal washers 22 and 22A are placed on support rods 23 and 23A, respectively. Said rods are supported by frame 20 and end piece 21. When the jig is heated in a furnace the bimetal washers expand and the depth of the cone formed by washers 22 and 22A increases, forcing end piece 21 away from frame 20. It is to be noted, however, that other expansion elements may be employed in place of the bimetal washers. Friction joints are provided between support rods 23 and 23A and the contacting surfaces of end pieces 21, whereas the rods 23 and 23A are permanently fixed to frame 20. These friction joints prevent end piece 21 from moving back towards frame 20 when the jig is cooled and the washers return to normal, otherwise the electrode spacing created by the washer expansion would be destroyed. Spring clamp holder 24 is held in place by screws 25 and 25A which are inserted in common supports 26 and 26A. Frame 20, end piece 21, and support rods 23 and 23A are all made of non-magnetic material, otherwise the magnetic lines of force of the chucks will be interfered with.

Magnets 27 and 27A are composed of magnetic material which will retain its permanent magnet properties to a high degree at temperatures in excess of 500° C.; a material of this type which is suitable is disclosed in Kelsall et al. United States Patent 2,190,667, dated February 20, 1940, as containing 29 per cent nickel, 50 per cent iron and 13 per cent aluminum; other alloys of suitable properties are also known in the prior art.

Metallic piece 28 must be of non-magnetic material since its primary purpose is simply to support pole-pieces 17, 18 and 19 without shorting; likewise, metallic piece 28A must be of non-magnetic material as its functions with respect to pole-pieces 17A, 18A and 19A are identical to those of metallic piece 28 with respect to pole-pieces 17, 18 and 19. Top clamp plates 29 and 29A, which are constructed of magnetic material, are laid on the top of the projecting extremities of the switch electrodes so as to reduce the reluctance of the magnetic path for the magnetic chucks as is best shown in Fig. 3. V-block 31 is firmly supported by and fastened to block 32, the combination of which is secured to frame 20. Fastened to spring clamp holder 24 by rivets 34 is a series of spring clamps 33, one for each switch being manufactured. These spring clamps help to hold the glass envelopes in a fixed position during the spacing and sealing steps.

In Fig. 4 jigs 35, which hold the switches to be spaced and sealed, are carried through heater furnace 36 on conveyor belt 37. Regularly spaced

on the conveyor belt 37 are stops 38 designed to hold and position jigs 35 as they pass through tube 43 and heater furnace 36. The conveyor belt is guided and driven by pulleys 39, 57 and 58. An idle pulley 41 and spring 40 with a weight 42 attached to said spring 40 is provided to maintain a desired tension in the conveyor belt. The conveyor belt 37 passes through the stainless cylindrical metal tube 43. Said tube has an extension 44 leading to a helium supply or any other type gas with which it is desired to fill the glass envelopes of the switches. Also attached to metal tube 43 are flexible flaps 45, 46, 47, 48, 49 and 50, preferably made of a silicone rubber although other suitable heat resistant materials impermeable to gases may be used. These flexible flaps help to prevent air contamination of the helium or other gas injected into the metal tube 43. The purpose of injecting this gas into the metal tube 43 is to allow the unsealed envelopes of the switches to become filled with the injected gas by diffusion before the ends of the glass envelope are sealed in heater furnace 36. At both ends of the conveyor belt are platforms, platform 51 being designated as the entrance platform and platform 52 as the exit platform. The loaded jigs are manually placed on the conveyor belt and automatically leave the conveyor belt and rest upon exit platform 52.

The method of manufacture will now be described in detail. Each switch is assembled by placing two electrodes having a structure identical to that of electrodes 7 or 8 in a glass envelope such as envelope 9. The beveled surfaces of these electrodes should be forced against one another in a manner shown in the broken section 59 of Fig. 3. Annular glass seals such as 10 or 11 should be inserted through the projecting extremities of the electrodes until they rest on the upset flanges. The assembled switches are then placed in the jig in a manner which is best shown in Fig. 6. In particular the assembled switches rest in the V-grooves of block 31. The electrodes at the same end of each switch should rest against pole-piece 17A as is shown in Fig. 3. The top plates 29 and 29A which are constructed of magnetic material rest on top of the projecting extremities of the electrodes. To make sure the electrode elements are positioned so that the contact surfaces are touching each other and each electrode is also in contact with the inner wall of the glass envelope as is shown in the broken section 59, each electrode end exposed by aperture 60 can be tapped lightly. The electrodes are held in a fixed position with respect to frame 20, end piece 21 and the magnetic chucks by the forces exerted by the magnetic lines of forces 61 and 62 shown in Fig. 3. Positioned as shown in Fig. 1 the glass seals 10 and 11 will melt when subjected to the heat of the furnace and upon cooling will form a seal. The jigs are moved from the entrance platform 51 so as to approach the furnace 36 through tube 43, the glass envelopes are filled with helium by diffusion, and by the time the seal is made, the glass envelope contains helium of sufficient purity for useful operation of said switch. As the switch is heated the bimetal washers 22 and 22A also heat and of course expand, pushing end piece 21 and its associated magnetic chuck away from frame 20 and since the magnetic chuck is fastened securely to end piece 21, the electrodes of each switch are pulled apart a certain fixed and uniform distance depending upon the coefficient of expansion of the bimetal washers and the temperature to which

they are heated. There is a friction surface between support rods 23 and 23A and end piece 21 so that upon cooling, the end piece 21 does not return to its original position, but remains in the position it was in during the heated period. Thus, the gap between the electrodes is a reproducible one since the temperature is controllable. It should be noted here that magnets 27 and 27A should be arranged as to polarity so that the contact ends of the electrodes are of the same magnetic polarity and thus will repel each other as one is drawn away from the other during the manufacturing process. Thus, the electrodes will repel each other into continued contact with the inner surface of the glass tubes during the entire manufacturing process, insuring a uniform, reproducible gap between said electrodes.

It is to be understood that the above description is an exemplary embodiment of the invention and that other materials, elements, and arrangements may be utilized without departing from the spirit of the invention or the subjoined claims.

What is claimed is:

1. A machine for manufacturing a switch of the type having a plurality of contact electrodes comprising a plurality of magnetic chucks to hold the electrodes of each of said switches, means for holding said magnetic chucks in variable spaced relationship, and a heat responsive expansion unit mechanically coupled to said means whereby the magnetic chucks holding said switch electrodes are moved with respect to one another in response to heat from a furnace or the like.

2. A machine for manufacturing a switch of the type having at least two spaced electrodes comprising first means for holding one of said electrodes, second means for holding another of said electrodes in an initial position with respect to said one of said electrodes, and thermally-expansible means connected to both of said means for controlling the relative positions of said first and said second means to critically space said electrodes.

3. A machine for manufacturing a switch of the type having at least two spaced electrodes within a sealed envelope, comprising first means for holding one of said electrodes, second means for holding another of said electrodes in an initial position with respect to said one of said electrodes, means for supporting said envelope, thermally-expansible means connected to both of said means for controlling the relative positions of said first and said second means to critically space said electrodes, and means for sealing said electrodes within said envelope.

4. A machine for manufacturing a switch of the type having at least two spaced electrodes within a sealed envelope, comprising first means for holding one of said electrodes, second means for holding another of said electrodes in an initial position with respect to said one of said electrodes, means for supporting said envelope, thermally-expansible means connected to said first and said second means for controlling the relative positions of said first and said second means to critically space said electrodes, means for filling said envelope with a gas, and means for thereafter sealing said electrodes within said envelope.

5. A machine for manufacturing a switch of the type having at least two spaced electrodes within a sealed envelope, comprising first means for holding one of said electrodes, second means

for holding another of said electrodes in an initial position with respect to said one of said electrodes, means for supporting said envelope, thermally-expansible means connected to said first and said second means and effective upon the application of heat thereto for controlling the relative positions of said first and said second means to critically space said electrodes, means for retaining said first and said second means in the latter position during cooling, and means for sealing said electrodes within said envelope.

6. A machine for manufacturing a switch of the type having at least two spaced electrodes of magnetic material, comprising first magnetic means for holding one of said electrodes, second magnetic means for holding another of said electrodes in an initial position with respect to said one of said electrodes, and thermally-expansible means connected to both of said means for controlling the relative positions of said first and said second means to critically space said electrodes, like poles of said magnetic means engaging said electrodes.

7. A machine for manufacturing a switch of the type having at least two spaced electrodes of magnetic material, comprising a first magnet for holding one of said electrodes, a second magnet for holding another of said electrodes in an initial position with respect to said one of said electrodes, first and second support means individual to and holding said magnets, and means including thermally-expansible means intermediate and engaging said first and said second support means for controlling the relative positions of said first and said second support means thereby moving said electrodes into a critically spaced relation.

8. A machine for manufacturing a switch of the type having at least two spaced electrodes of magnetic material, comprising a first magnet for holding one of said electrodes, a second magnet for holding another of said electrodes in an initial position with respect to said one of said electrodes, like poles of said magnets engaging said electrodes, first and second support means individual to and holding said magnets, and means including thermally-expansible means intermediate and engaging said first and said second support means for controlling the relative positions of said first and said second support means thereby moving said electrodes into a critically spaced relation.

9. A machine for manufacturing a switch of the type having at least two spaced electrodes of magnetic material in a sealed envelope, comprising a first magnet for holding one of said electrodes, a second magnet for holding another of said electrodes in an initial position with respect to said one of said electrodes, means for supporting said envelope, first and second support means individual to and holding said magnets, means including thermally-expansible means intermediate and engaging said first and said second support means and effective upon the application of heat thereto for controlling the relative positions of said first and said second support means thereby moving said electrodes into a critically spaced relation, means for retaining said first and said second support means in position during cooling, and means for sealing said electrodes within said envelope in said critically spaced relation.

10. A machine for manufacturing a switch of the type having at least two spaced electrodes of magnetic material in a sealed envelope, compris-

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ing a first magnet for holding one of said electrodes, a second magnet for holding another of said electrodes in an initial position with respect to said one of said electrodes, like poles of said magnets engaging said electrodes, means for supporting said envelope, first and second support means individual to and holding said magnets, means including thermally-expansible means intermediate and engaging said first and said second support means and effective upon the application of heat thereto for controlling the relative positions of said first and said second support means thereby moving said electrodes into a critically spaced relation, means for filling said envelope with a gas, means for retaining said first and said second support

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means in position during cooling, and means for sealing said electrodes within said envelope in said critically spaced relation.

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