

Aug. 31, 1965

F. RECK

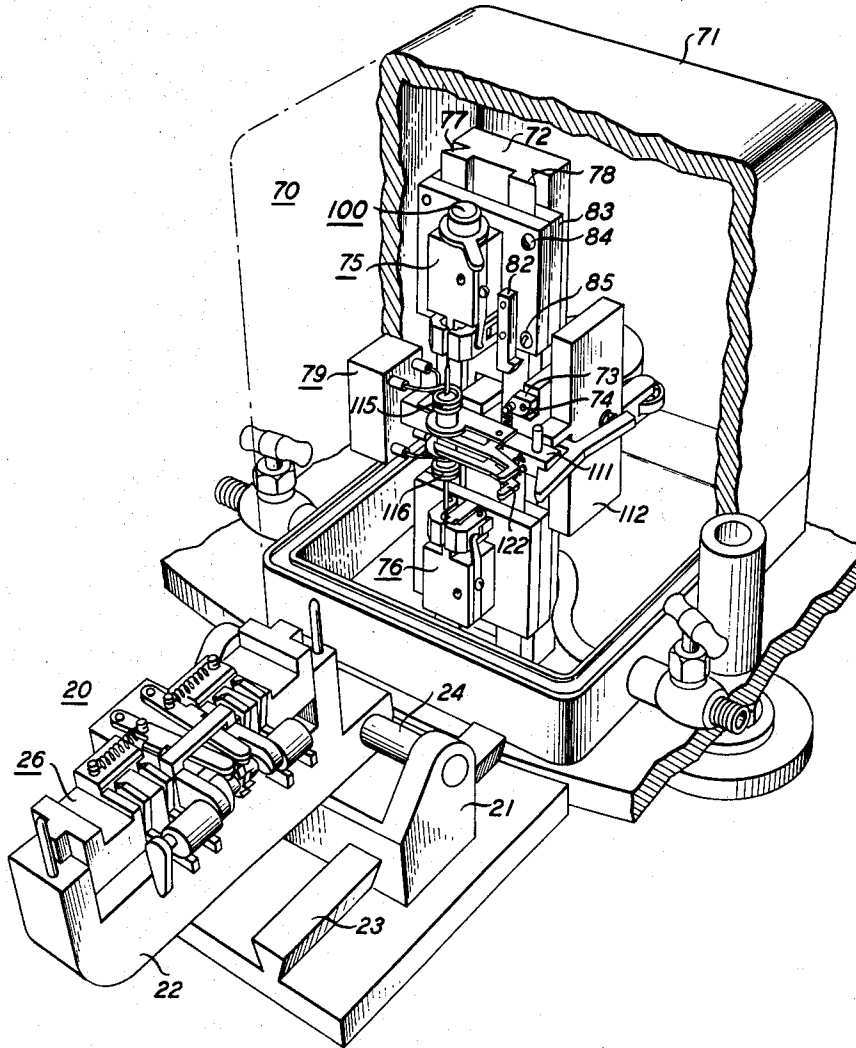
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APPARATUS FOR MAKING SEALED CONTACT REED SWITCHES

Filed Dec. 30, 1963

7 Sheets-Sheet 1

FIG. 1



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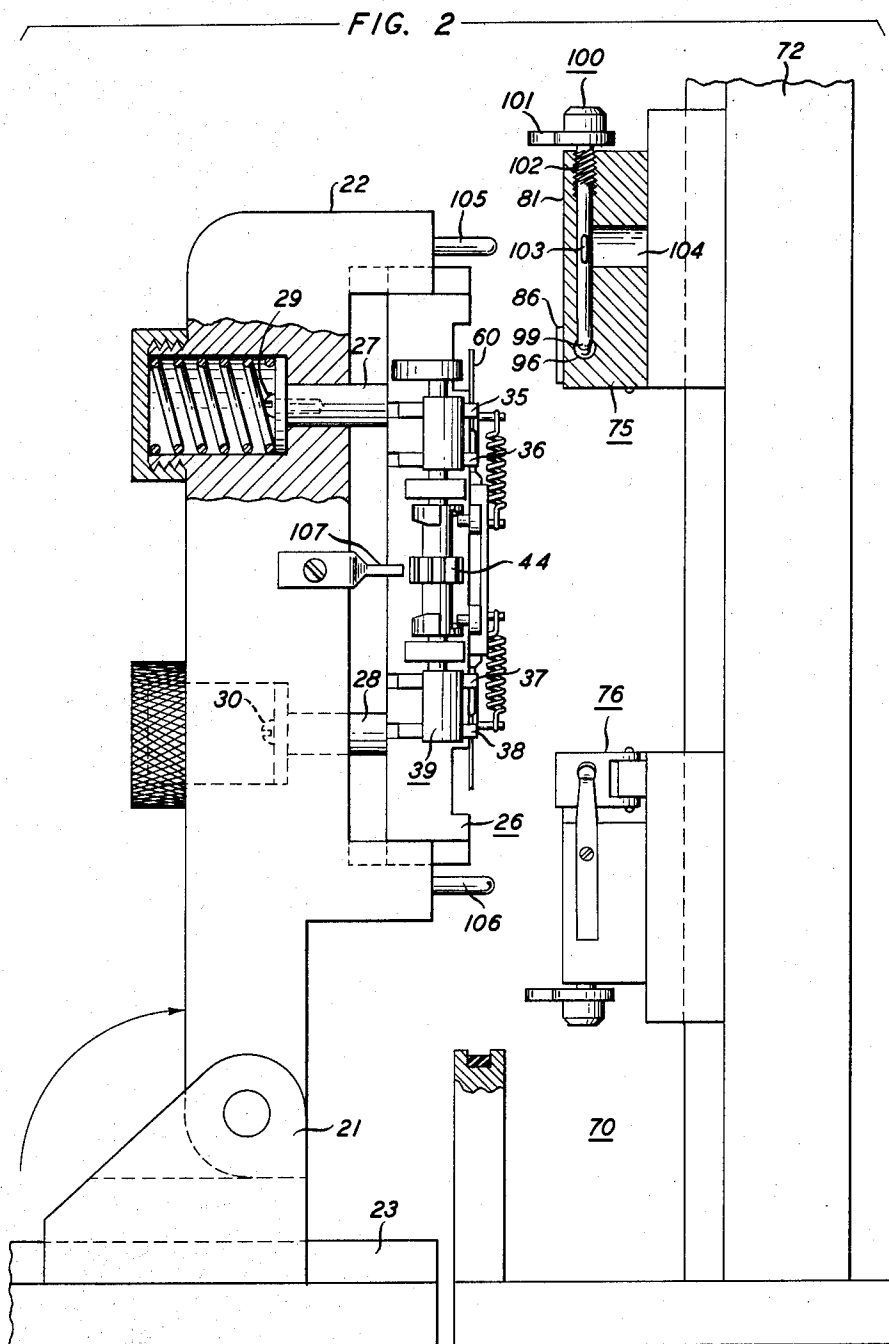
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APPARATUS FOR MAKING SEALED CONTACT REED SWITCHES

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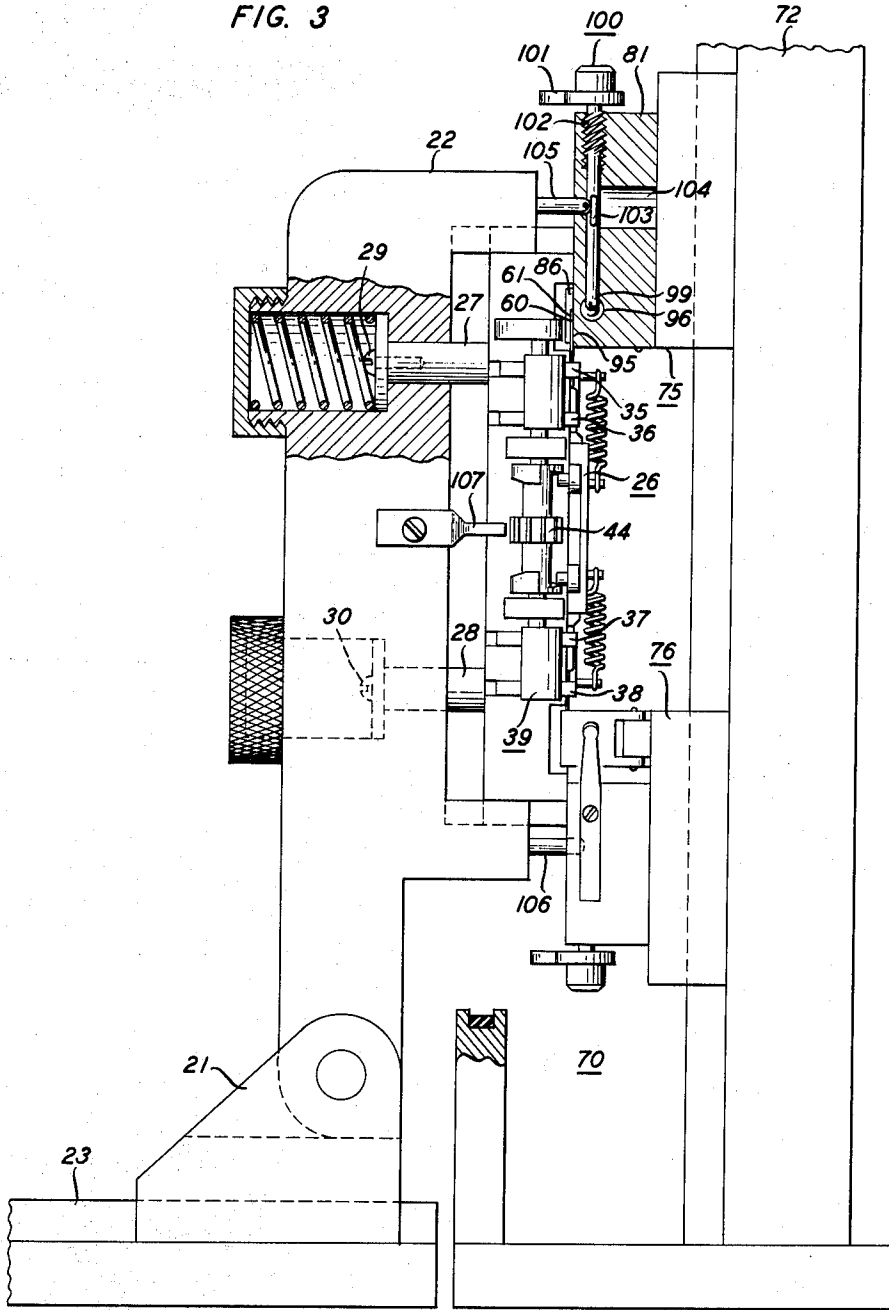
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APPARATUS FOR MAKING SEALED CONTACT REED SWITCHES

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FIG. 3



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FIG. 5

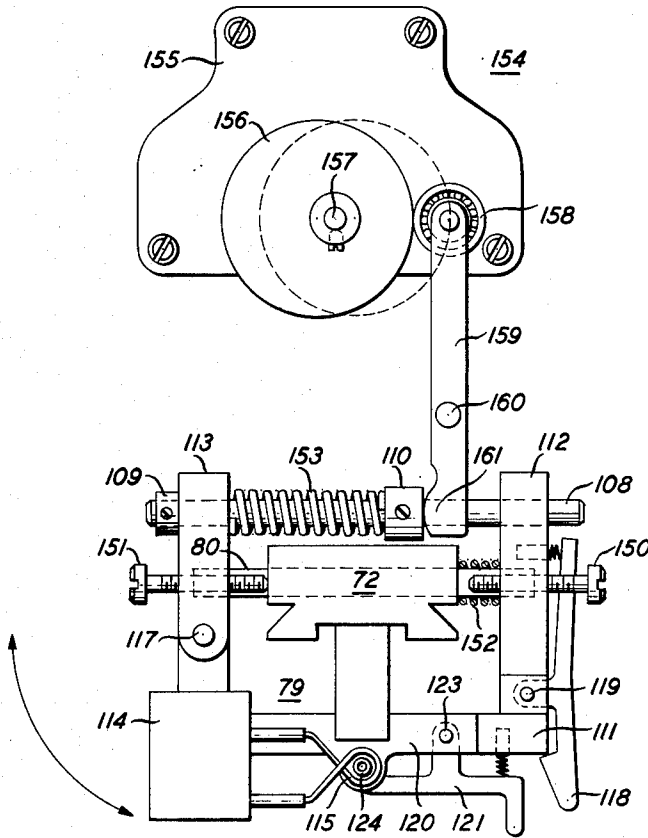


FIG. 10

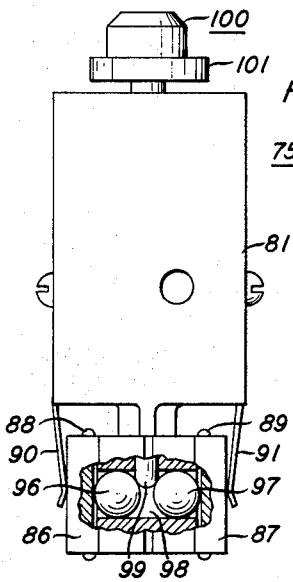
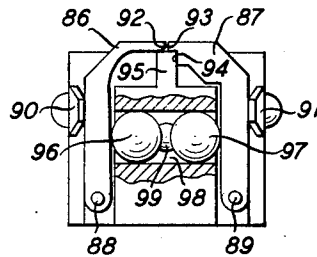


FIG. 11



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FIG. 6

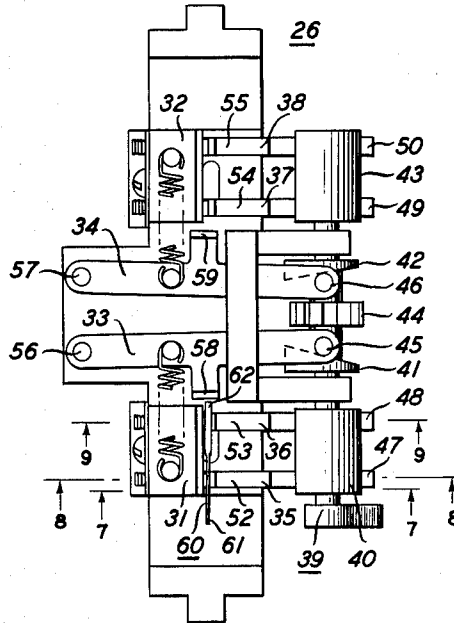


FIG. 7

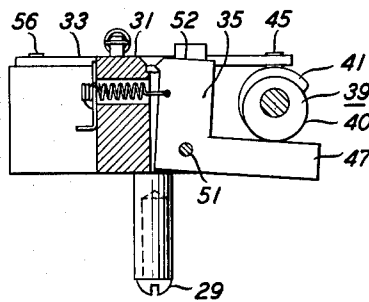


FIG. 9

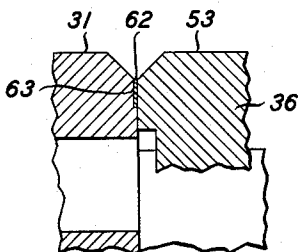
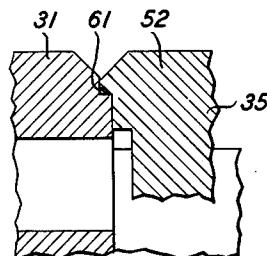


FIG. 8



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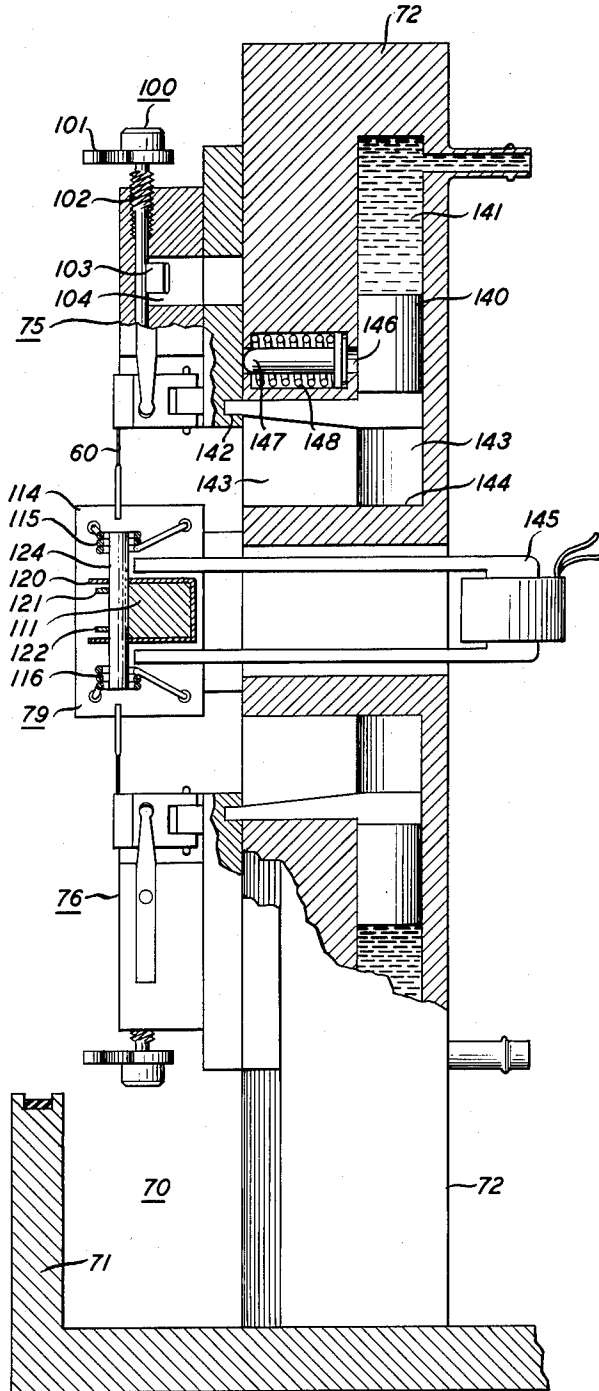
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APPARATUS FOR MAKING SEALED CONTACT REED SWITCHES

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FIG. 12



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**APPARATUS FOR MAKING SEALED CONTACT
 REED SWITCHES**

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 10 Claims. (Cl. 29—203)

This invention relates to apparatus for fabricating reed switches.

In one basic form, a reed switch comprises two flexible reeds cantilevered from opposite ends of a sealed tubular vessel. Within the vessel, the free ends of both reeds are disposed to overlap. The overlapping ends of the reeds provide electrically conducting, cooperating contact surfaces. Ordinarily, the vessel enclosing these surfaces is either hermetically sealed under vacuum or provided with a protective gas to prevent oxidation or other deterioration of the contact surface.

The overlapping ends of the reeds are spaced apart in order to provide an electrically nonconducting air gap therebetween. The size of the air gap must be accurate if the switch is to function properly upon the application of a predetermined magnetic field. This requirement is further emphasized by the need of obtaining a parallel relationship between the contact surfaces and by the need of obtaining these operating characteristics within close tolerances for groups of such switches.

Switches of this type have been fabricated in various ways but none has proven to be entirely satisfactory. In one arrangement, the mechanism for setting the gap between the reeds is made as part of one jaw of a pair used to slide the reeds into overlapping relationship. With this arrangement, however, the movement of the gap setting mechanism as it separates the reeds must be made compatible with the movement of the sliding jaws as they overlap the reeds.

Heretofore, such compatibility has been achieved by placing the gap setting mechanism in a restricted space. As a consequence, the use of expensive machining techniques is required in order to construct a gap setting mechanism that will consistently produce reed switches having uniform gaps. Therefore, a simpler gap setting mechanism is needed in order to reduce manufacturing costs.

In addition to the need of a less expensive device, the delicacy inherent in the adjustment of a gap setting mechanism situated within a restricted space has given rise to a need for a sturdier mechanism.

Accordingly, it is one object of this invention to obtain uniform gap settings in reed switches with a gap setting mechanism that moves independently of the reed carrying jaws and that is sturdy and insensitive to external influences but nevertheless is simple to adjust.

Another difficulty in the manufacture of reed switches lies in the adjustment of reed overlap. In available machines for mass producing reed switches, overlap is not readily adjustable. As a result, not much flexibility in switch design is obtainable.

It is advantageous to be able to easily adjust reed overlap. When the overlap is large, contact resistance tends to decrease because of the large area of contacting surface. Pull force, however, also decreases. Therefore, while the switch has a reduced contact resistance, it is less positive acting.

Conversely, when the overlap between reeds is small, flux density in the air gap is increased. Since pull force is proportional to flux density, pull force will increase and the switch will be more positive acting. However, because of the decreased area of contacting surface, the contact resistance tends to increase.

Each of the foregoing situations has certain advantages. In the first, a switch made in accordance therewith will have a low contact resistance, while in the second, a switch made in accordance therewith will have a small size. Each type of switch serves a particular field of use. Accordingly, it is advantageous to have an apparatus for making reed switches in which adjustment of the reed overlap may be readily obtained.

It is therefore another object of this invention to provide an apparatus whereby adjustment of the overlap between reeds may be readily obtained.

Where it is desired to make particularly small reed switches, still another difficulty arises. In tiny switches, the gap between reeds is very small. As a result, a limit is placed on the magnitude of electrical potential which can be placed across the air gap before the air breaks down and current passes between the reeds. While gases other than air have been tried in an attempt to achieve higher breakdown potentials, none has proved to be entirely satisfactory at atmospheric pressure. It has been found, however, that if the gas within the reed switch is sealed therein under pressure, a substantial increase in the breakdown potential can be obtained.

It is therefore an object of this invention to achieve flexibility of reed overlap and sturdy but precise control of the gap between reeds in a device for making miniature reed switches in a pressurized atmosphere.

Broadly, this invention comprises an arrangement whereby miniature reed switches are assembled within a pressurized atmosphere by an apparatus that combines a gap setting mechanism that is both sturdy and reliably precise with a mechanism wherein the amount by which the reeds overlap may be readily adjusted.

Specifically, this invention comprises a loading arm and a pressure chamber. The loading arm is characterized by a loader having a referencing surface for aligning reed contact faces in a preselected position with respect to the pressure chamber, a mechanism for spacing reeds apart a predetermined distance, and a pair of reed clamps for holding the aligned and spaced reeds on the loading arm.

The pressure chamber includes a pair of reed chucks, a carriage for holding and sealing an encapsulating vessel or tube, and a support or column. The reed chucks are disposed on the column to slide towards one another until they are separated by a predetermined distance. Moreover, each reed chuck includes a jaw block disposed to accept reeds from the loader on the loading arm and hold them as they are carried into overlapping relationship within a vessel held by the tube carriage. Furthermore, one of the jaw blocks is arranged to release its reed when the tips of both reeds overlap within the vessel.

The carriage serves to hold a vessel or tube firmly within a pair of heating coils. The carriage also serves as a mechanism for setting the gap between reeds. It is characterized by an ability to slide on the column an adjustable distance in a direction perpendicular to a plane in which the referencing surface on the loader lies whereby one reed sealed in the end of a vessel held therein may be spaced apart a precise distance from the other reed.

In accordance with one feature of this invention, the carriage is moved when one reed is fixed and the other is sealed in one end of a tube held by the carriage whereby precise but sturdy control of the size of the gap between reeds is achieved.

In accordance with another feature of this invention, a parallel relationship is maintained between the blades of the reeds during the gap setting operation by relating the movement of the tube carriage to the referencing surface on the loader.

In accordance with still another feature of this invention, reed overlap is determined in a loader removably attached to the loader arm. As a result, flexibility in switch design is obtained with interchangeable loaders.

The principles of the invention and additional objects and features thereof will be apparent from the following detailed description of an illustrative embodiment when taken in conjunction with the accompanying drawing in which:

FIG. 1 is an isometric view showing a loading arm and a pressure chamber with parts broken away to show the switch assembling mechanism;

FIG. 2 is a fragmentary side elevation view showing a loading arm prior to delivering a pair of reeds to reed chucks in a pressure chamber and a cut away view of a jaw opening cam;

FIG. 3 is a fragmentary side elevation view showing a loading arm delivering a pair of reeds to reed chucks in a pressure chamber;

FIG. 4 is a fragmentary side elevation view showing reed chucks clamping a pair of reeds delivered from a loading arm;

FIG. 5 is a fragmentary top view showing a tube carriage, a column, and a driver for moving the tube carriage with respect to the column;

FIG. 6 is a top view of a loader;

FIG. 7 is a section view of a loader taken along line 7 to show the operation of a reed clamp;

FIG. 8 is an enlarged fragment of a section view of a loader taken along line 8 to show another portion of a reed clamp;

FIG. 9 is an enlarged fragment of a section view of a loader taken along line 9 to show a portion of a reed clamp and a referencing surface;

FIG. 10 is an elevation view with parts broken away of a jaw block;

FIG. 11 is an end view of the jaw block shown in FIG. 10 with parts broken away; and

FIG. 12 is a fragment of a pressure chamber assembly to show the manner in which a reed chuck carries a reed into a tube held by a carriage.

FIG. 1 illustrates a loading assembly 20 and a pressure chamber assembly 70. The loading assembly 20 comprises a carriage 21 and an arm 22. The carriage 21 is preferably movable and is shown slidably mounted on a track 23. The arm 22 rotates and is shown fastened to the carriage 21 by a pivot pin 24.

The transfer of reeds into the pressure chamber assembly 70 by the loading assembly 20 is accomplished by the arm 22. A preferred form of the arm 22 is illustrated in detail in FIG. 2. One component of the arm 22 is a loader 26 that has a pair of rods 27 and 28 attached thereto. The loader 26 slides in a recess in the arm 22 on the rods 27 and 28. The rods 27 and 28 are spring biased and are held to the arm 22 by a pair of screws 29 and 30. As can be readily seen, the loader 26 is easily removed from the arm 22 by unscrewing the screws 29 and 30.

The loader 26, as shown in detail in FIG. 6, includes a pair of aligners 31 and 32, a pair of spacer arms 33 and 34, four reed clamps 35, 36, 37, and 38, and a cam 39. The cam 39 includes surfaces 40, 41, 42, and 43 and a rigidly attached pinion gear 44. The cam 39 is disposed on the loader 26 in such a manner that it will rotate in response to movement of the pinion gear 44.

The cam 39 is disposed with parts thereof engaging corresponding parts of the spacer arms 33 and 34 and the reed clamps 35, 36, 37, and 38. As shown in FIG. 6, the cam surface 41 engages an end 45 on the spacer 33 and the cam surface 42 engages an end 46 on the spacer 34. The cam surface 40 engages an end 47 on the reed clamp 35 and an end 48 on the reed clamp 36, while the cam surface 43 engages an end 49 on the reed clamp 37 and an end 50 on the reed clamp 38.

Each of the reed clamps 35, 36, 37, and 38 is held

under spring tension. Moreover, as shown in FIG. 7, the reed clamps are held in the loader 26 by a pivot pin 51 in such a manner that a pair of ends 52 and 53 on the reed clamps 35 and 36 are rotatable towards the aligner 31, and a pair of ends 54 and 55 on the reed clamps 37 and 38 rotate towards the aligner 32 in response to rotation of the cam surfaces 40 and 43, respectively.

Both spacer arms 33 and 34 are maintained under spring tension, and each is held on the loader 26 by a pair of pivot pins 56 and 57 in such a manner that a spacer 58 on the spacer arm 33 is rotatable towards the aligner 31, and a spacer 59 on the spacer arm 34 is rotatable towards the aligner 32. Both rotate in response to rotation of the cam surfaces 41 and 42, respectively.

The loader 26 is designed to accept reed members in pairs and is symmetrically divided into two sides. Therefore, a description of the operation thereof with regard to one side will suffice to describe the operation of identical parts on the other side. Accordingly, only the side containing the aligner 31, the reed clamps 35 and 36, the spacer arm 33, and the cam surfaces 40 and 41 will be described.

As illustrated in FIG. 6, a reed 60 having a cylindrical end or stem 61 and a contacting flat surface or blade 62 is placed between the ends 52 and 53 generally in contact with the aligner 31. The stem 61 is associated with the end 52, while the blade 62 is associated with the end 53. The tip of the blade 62 is extended beyond the aligner 31, preferably to a position in contact with the spacer 58 on the spacer arm 33.

With the reed 60 placed in the reed clamps 35 and 36, the cam 39 is rotated in such a direction that the cam surface 40 engages the ends 47 and 48 and rotates the ends 52 and 53 towards the reed aligner 31. At the same time, the cam surface 41 rotates the spacer arm 33 and moves the spacer 58 towards the aligner 31.

As the spacer 58 moves, it engages the tip of the blade 62 and pushes the reed 60 until the spacer 58 is stopped by the aligner 31. At this point, the tip of the blade 62 is aligned with the edge of the aligner 31. Moreover, since the foregoing operation is duplicated by corresponding parts on the other side of the loader 26, the tip of the blade 62 will be spaced a precise distance from a corresponding tip on a reed aligned by the spacer 59 on the spacer arm 34.

With the tip of the blade 62 aligned, the end 52 on the reed clamp 35 and the end 53 on the reed clamp 36 clamp the reed 60 against the aligner 31. FIG. 8 illustrates how the stem 61 is clamped between the end 52 of the reed clamp 35 and the aligner 31, and FIG. 9 illustrates how the blade 62 is firmly clamped against a reference surface 63 on the aligner 31 by the end 53 of the reed clamp 36. The reference surface 63 is located on the loader 26 with respect to the pressure chamber assembly 70 in a manner to be described in detail later.

With the conclusion of the foregoing operations, the loader 26 is prepared to deliver a pair of reeds into the pressure chamber assembly 70.

The pressure chamber assembly 70 is illustrated in FIG. 1 and comprises a housing 71, a column 72, a spring biased cam ratchet 73 fastened to the column 72 by a pivot pin 74, a pair of reed chucks 75 and 76 slidably mounted on the column 72 on a pair of dovetailed portions 77 and 78, and a tube carriage 79 attached to the column 72, as illustrated in FIG. 5, by a pair of slide pins 80 and another not shown whereby the tube carriage 79 is slidable thereon in a direction perpendicular to a center line through the reed chucks 75 and 76.

With the exception of a cam follower, a pair of springs, and a jaw opener to be later described, the reed chuck 75 is identical to the reed chuck 76. Therefore, a description of the components of one will suffice to describe the components of the other. Accordingly, only the reed chuck 75 will be described.

The reed chuck 75 includes a jaw block 81, a cam follower 82, and a guide member 83. From FIG. 1, it will be seen that the cam follower 82 does not have a counterpart on the reed chuck 76. The jaw block 81 is centrally located on the reed chuck 75. Moreover, the jaw block 81 and the cam follower 82 are rigidly attached to the reed chuck 75, while the guide member 83 is adjustably fastened thereto by a pair of spring loaded screws 84 and 85. Each spring is disposed between the guide member 83 and a foot on the end of its associated screw. Neither spring is shown. The screws holding the counterpart of the guide member 83 on reed chuck 76, however, need not be spring loaded.

The jaw block 81, shown in detail in FIG. 10, includes a pair of jaws 86 and 87. The jaws 86 and 87 are rotatably mounted on the jaw block 81 by a pair of hinge pins 88 and 89, respectively, and each jaw is biased by a pair of springs 90 and 91.

The free end of the jaw 86 includes an inclined clamping surface 92 for engaging one side of a reed stem (not shown). The free end of the jaw 87 includes a clamping surface 93 for engaging the other side of a reed stem (not shown), and a stop 94 for contacting a ridge 95 on the jaw block 81.

The ridge 95 is disposed between the jaws 86 and 87. A ball 96 spaces the jaw 86 from one side of the ridge 95, and a ball 97 spaces the jaw 87 from the other side of the ridge 95. Both balls move in a slot 98 in the ridge 95, and each is held against its respective jaw by a cam point 99.

As shown in detail in FIG. 2, the cam point 99 is part of a cam 100 which includes a rigidly attached first handle 101, a threaded portion 102 disposed in a matching tapped hole in the jaw block 81, and a second handle 103 disposed in a slot 104 in the jaw block 81.

In operation, the biased jaws 86 and 87 are separated to accept a reed therebetween when the cam 100 is rotated by turning the first handle 101 or the second handle 103. As the threaded portion 102 on the cam 100 screws into the jaw block 81, the cam point 99 forces the balls 96 and 97 apart. The balls 96 and 97, in turn, force the jaws 86 and 87 apart. It will be seen that both jaws move away from the ridge 95. As a consequence, the area over the front of the ridge 95 is unobstructed when the jaws 86 and 87 are fully opened.

Reversing the direction of rotation of the cam 100 reverses the foregoing sequence. As the cam point 99 moves from between the balls 96 and 97, they become free to move together in the slot 98. As a result, the jaws 86 and 87 are free to rotate about the hinge pins 88 and 89, respectively, in a direction towards the ridge 95 under tension exerted by the springs 90 and 91.

Under the influence of the spring 91, the jaw 87 moves until the stop 94 makes contact with the ridge 95. When the jaw 87 stops, the clamping surface 93 is spaced from a plane passing through a center line through the jaw block 81 a distance equal to the radius of the stem of a reed contact.

The jaw 86 moves concurrently with the jaw 87. The jaw 86 moves until the clamping surface 92 engages a reed stem (not shown) placed therebetween. Thereafter, the reed stem and the jaw 86 move together across the ridge 95. Movement stops when the reed stem (not shown) contacts the clamping surface 93 on the jaw 87. Although movement of the reed stem has been under the impetus of the jaw 86 in the foregoing operation, it will be readily apparent that the jaw 87 can be used to position the reed in a similar manner. As a result, the jaws 86 and 87 are inherently self centering as they position the reed.

The tension exerted by the spring 91 on the jaw 87 is adjusted until it is greater than the tension exerted by the spring 90 on the jaw 86. As a result, the stop 94 cannot be moved away from the ridge 95 when the reed stem is pressed against the clamping surface 93 by the

jaw 86. Accordingly, the distance between the clamping surface 93 and a plane passing through the center line of the jaw block 81 cannot be changed by movement of the jaw 87. Therefore, when a reed is clamped between the jaws 86 and 87 in the reed chuck 75, the center line of its stem will be disposed in the aforesaid plane that passes through the center line of the jaw block 81. Each pair of jaw blocks, of course, is selected to match the diameter of the reed stems being worked.

Reeds for clamping are delivered to the reed chucks 75 and 76 by the loader 26. Again, since the reed chuck 75 contains the same components as the reed chuck 76, the description of events taking place in the reed chuck 75 will describe similar events in the reed chuck 76.

When the process of transferring reeds into the pressure chamber assembly 70 begins, the reed clamps 35 and 36, as shown in FIG. 2, hold the reed 60 in the loader 26 spaced a precise distance from a reed similarly held in the reed clamps 37 and 38. Moreover, the reference surface 63 on the aligner 31 (as shown in FIG. 9) is disposed in a plane offset a spaced distance from a center line plane that passes through the jaw block 81 on the reed chuck 75. As a result, the blade 62 is referenced by the reference surface 63 in such a manner that it will lie in the aforesaid center line plane before and after the reed 60 is transferred into the reed chuck 75. Finally, the jaws 86 and 87 are spaced apart by the cam 100 to a position ready to clamp the stem 61 of the reed 60 therebetween.

As can be seen from FIG. 3, the carriage 21 slides along the track 23 towards the column 72 and pushes a pin 105 mounted on the arm 22 into the slot 104 of the jaw block 81. In a like manner, a pin 106 is pushed into a similar slot in the counterpart of the jaw block 81 on the reed chuck 76.

As the carriage 21 continues to move, it pushes the loader 26 into contact with the jaw block 81. At this point, the loader 26 stops. Furthermore, when the loader 26 stops, the stem 61 of the reed 60 is against the ridge 95 between the jaws 86 and 87.

Although the loader 26 stops, the carriage 21 continues to move and the pin 105 engages the second handle 103. As the carriage 21 moves, the pin 105 rotates the second handle 103 and closes the jaws 86 and 87 to clamp the stem 61 of the reed 60 therebetween, as hereinbefore described.

As shown in FIG. 4, the reed 60 is securely gripped between the jaws 86 and 87 and the arm 22 has slid on the spring biased rods 27 and 28 over the loader 26. As the arm 22 slid over the loader 26, a pawl 107 fastened thereto engaged the pinion gear 44 thereby causing it to rotate the cam 39 and release the reed 60 in a manner hereinbefore described. The pawl 107 is arranged so that it can turn the pinion gear 44 in one direction only.

At the conclusion of the foregoing operations, the loader 26 is moved away from the column 72, the housing 71 is closed, and the reed chucks 75 and 76 are each loaded and ready to deliver a reed into a tube held by the tube carriage 79. Gas is introduced into the pressure chamber assembly 70 and subsequent operations take place in a pressurized atmosphere.

The tube carriage 79 is illustrated in detail in FIG. 5 and comprises a slide rod 108 on which are mounted two locking collars 109 and 110, a tube chuck 111, and two end members 112 and 113, all arranged to form a substantially rectangular frame. The slide rod 108 extends slidably through the end members 112 and 113. The two end members 112 and 113 are connected by a pair of slide pins 80 and another not shown. Both slide pins pass through holes in the column 72 and connect the tube carriage 79 slidably thereto in a manner hereinbefore described.

As shown in FIG. 5, one end of the tube chuck 111 terminates in a block 114. The block 114 includes two heater coils 115 and 116 and is connected to the end

member 113 by a pivot pin 117. As a result, the tube chuck 111 is rotatable with respect to the end member 113. The free end of the tube chuck 111 abuts the end member 112 and is held firmly thereto by a biased latch 118. The latch 118 is rotatably mounted on the end member 112 by a pivot pin 119 to swing in an arc sufficient to release the end of the tube chuck 111.

A tube guide 120 having a pair of holes therein and a pair of tube holders 121 and 122 are affixed to the tube chuck 111. The tube guide 120 is disposed with the holes therein aligned between the openings in the heater coils 115 and 116 in such a manner that when the tube chuck 111 is latched, the center line of the holes is disposed in a plane spaced from the ridge 95 on the reed chuck 75 (and the counterpart of the ridge 95 on the reed chuck 76) by a distance equal to the radius of the stem of the reeds being worked. As a result, when the tube chuck 111 is latched, the center line of a tube disposed in the tube guide 120 will coincide with the center line of reed stems held in the reed chucks 75 and 76. It will be apparent that the hole in the tube guide 120 may readily be adjusted to accommodate various tube diameters.

The tube holders 121 and 122 are held rotatably on the tube chuck 111 by a pivot pin 123. Each tube holder 121 and 122 is biased to rotate in such a direction that a tube 124 placed in the heater coils 115 and 116 and the tube guide 120 will be firmly clamped against the tube chuck 111. As a result, for loading and unloading purposes, the tube 124 may readily be rotated about the pivot pin 117 merely by releasing the latch 118 and moving the tube chuck 111.

As shown in FIG. 12, the tube 124 is clamped in the tube guide 120 by the tube holders 121 and 122 in a position ready for insertion of a pair of reeds therein. The manner in which the reeds are inserted therein will become clear from the following description. Again, since the operation is symmetrical, an explanation of how one reed is inserted serves equally to describe how the other is inserted with a single exception which will become apparent in the description. Accordingly, the insertion by the reed chuck 75 of a reed into the tube 124 will be described.

As shown in FIG. 12, the reed chuck 75 is controllable as it slides over the column 72 driven, for example, by a slidable hydraulic ram 140 having one end in contact with a fluid 141 and the other end movably attached to the reed chuck 75 in a slot 142. When the fluid 141 is placed under pressure, the ram 140 slides in a chamber 143 in the column 72 thereby moving the reed chuck 75 towards the tube carriage 79.

Referring to FIG. 1, it will be seen that as the reed chuck 75 moves, the cam follower 82 thereon engages the cam ratchet 73 on the column 72. As a result, the reed chuck 75 skews to one side. The required give permitting the reed chuck 75 to skew is obtained by compressing the springs clamped between the guide member 83 and the screws 84 and 85. The reed chuck 75, however, rights itself when the ratchet cam 73 slides beyond the cam follower 82. As a consequence, the tip of the reed 60 slides freely past the tip of a reed held in the reed chuck 76 without any possibility of an end-to-end collision. Since only one reed need be skewed for passing, the skewing action of the reed chuck 75 does not have a counterpart action in the movement of the reed chuck 76.

Referring to FIG. 12, the ram 140 continues to move until it strikes a stop 144 located in the chamber 143. As the ram 140 stops, an electromagnet 145 disposed on the column 72 is energized, the reed chuck 75 stops, the jaws 80 and 81 are opened and the reed 60 is released therefrom. Although stopped in a similar manner, the reed chuck 76, as hereinbefore explained, does not include a mechanism for automatically opening the jaws to release a reed clamped therein.

As shown in FIG. 12, the electromagnet 145 is dis-

posed in the column 72 with its pole faces adjacent to the tube 124. After the reed chucks 75 and 76 converge, the reeds clamped therein are overlapped within the tube 124 with each reed adjacent to a pole face of the electromagnet 145. Accordingly, when the electromagnet 145 is energized, flux passing from one pole face to the other passes along the reeds and the reeds are attracted. Therefore, when the reed 60 is released from the reed chuck 75, the blade 62 will be aligned and held magnetically in parallel alignment against the blade of the reed clamped in the reed chuck 76. The electromagnet 145 is energized when the ram 140 activates a switch (not shown).

From the foregoing, it will be apparent that the positioning of the reeds in the reed chucks determines the amount of reed overlap. When the reeds are spaced widely apart in the loader 26, they will be spaced widely apart when they are inserted in the reed chucks 75 and 76 and the overlap will be small. Conversely, when the reeds are spaced close together in the loader 26, they will be spaced close together when they are inserted in the reed chucks 75 and 76 and the overlap will be large. As a result, control of reed overlap is readily obtainable by using interchangeable loaders. For example, the screws 29 and 30 shown in FIG. 2 are easily removed whereby the illustrated loader 26 can be exchanged for another wherein the spacing between reed tips has been changed.

When the ram 140 strikes the stop 144, the reed 60 is automatically released from the jaws 80 and 81 by a jaw opening mechanism. One convenient type of jaw opening mechanism comprises the hydraulic system shown in FIG. 12. As will be apparent from an inspection thereof, when the ram 140 strikes the stop 144 and stops, an opening 146 through the column 72 will be uncovered. One end of the opening 146 will be open to the fluid 141 and the other end thereof will be open to the slot 104 in the reed chuck 75.

The opening 146 contains a plunger 147 biased away from the reed chuck 75 by a spring 148. When the opening 146 is uncovered, the fluid 141 flows therein from the chamber 143 and pushes the plunger 147 through the slot 104 into the reed chuck 75. As the plunger 147 enters the reed chuck 75 it engages the second handle 103, rotates the cam 100, and thereby releases the reed 60 from the jaw block 81 in a manner hereinbefore described.

The released reed 60 is held in place by the electromagnet 145, as described above, and the heater coil 115 is energized to heat the end of the tube 124 until a seal is formed around the reed stem 61. At the conclusion of the sealing operation, the electromagnet 145 is de-energized and the reeds are ready to be separated a desired distance or air gap. The desired air gap is established by moving the tube carriage 79 a controlled distance. Since the reed 60 is sealed in the tube 124 and the other end (now shown) is clamped in the reed chuck 76, moving the tube carriage 79 will move the tube 124 and separate the reeds.

As hereinbefore described, the tube carriage 79 is slidable with respect to the column 72. The amount the tube carriage 79 slides, however, is adjustable by means of a pair of adjusting screws 150 and 151 as shown in FIG. 5. Each screw 150 and 151 is screwed into a threaded hole in the end members 112 and 113, respectively. The tube carriage 79 is biased in one direction by a return spring 152 until the adjusting screw 151 abuts the column 72. In a like manner, the extent of movement of the tube carriage 79 in the other direction is controllable by the adjusting screw 150. As a result, it will be readily understood that the amount of travel by the tube carriage 79 with respect to the column 72 and, as a consequence, the gap between the reeds is easily controlled by the adjusting screws 150 and 151.

A spring 153 is mounted under compression on the slide rod 108 between the end member 113 and the col-

lar 110. The collar 109 maintains the spring 153 at a desired level of compression when it abuts the end member 113. The tube carriage 79 becomes a gap setting mechanism when the slide rod 108 interacts with a driver 154.

The driver 154 comprises a motor 155, a cam 156, and a shaft 157. The shaft 157 interconnects the motor 155 and the cam 156 for transmitting movement therebetween.

A follower 158, disposed on one end of a lever 159 rotatably mounted on a pivot 160, engages the cam 156. At rest, as shown in FIG. 5, the follower 158 is disposed a spaced distance from the cam 156. As a result, operation of the tube carriage 79 will not be affected by irregularities on the cam 156. The other end of the lever 159 includes a part 161 in contact with the collar 110.

Impetus from the driver 154 is transmitted through the slide rod 108 to the tube carriage 79 by the part 161 of the lever 159. As shown in FIG. 5, movement of the slide rod 108 in a direction that carries the collar 110 towards the end member 113 will compress the spring 153. Compression will continue until the force exerted by the part 161 equals the bias force of the return spring 152. Thereafter, the force exerted by the part 161 will compress both springs 152 and 153 and cause the tube carriage 79 to slide until the adjusting screw 150 engages the column 72, thereby preventing further movement of the tube carriage 79. Upon further movement of the part 161, the spring 153 will continue to compress and overdrive by the part 161 will be absorbed.

When the pressure on the collar 110 is removed, the return spring 152 urges the carriage 79 back until the collar 109 abuts the end member 113 and the slide rod 108 is returned to its rest position as shown. Therefore, as a result of the interaction between the return spring 152 and the driver 154, the tube carriage 79 reciprocates with respect to the column 72 through a distance controlled by the adjusting screws 150 and 151. Clearly, a reed sealed in one end of the tube 124 will travel through the same distance and can readily be spaced a controlled distance from another reed held stationary with respect to the tube 124.

The driver 154 is arranged to provide a pause when the tube carriage 79 has moved through the first half of its travel and engaged the adjusting screw 150. During the pause, a switch (not shown) energizes the heater coil 116 which causes the unsealed end of the tube 124 to melt and seal the counterpart of the reed 60 therein. As a consequence, both reeds are sealed within the tube 124 with their contact blades spaced a desired distance apart. Moreover, both contact blades are squared off and disposed in parallel planes. Finally, since the sealing operations have taken place in a controlled atmosphere, any gas introduced into the pressure chamber assembly 70 will be encapsulated within the tube 124 at a preselected level above or below atmospheric pressure.

In conclusion, therefore, a device for assembling reed contact switches has been disclosed wherein flexibility in obtaining reed overlap is combined with an improved gap setting mechanism and a chamber for assembling a reed switch in a controlled atmosphere. It is understood that the embodiment described herein is merely illustrative of the principles of the invention and modifications within the scope and spirit thereof can readily be constructed by anyone skilled in the art.

What is claimed is:

1. In a device for assembling reed switches the combination comprising: support means, carriage means slidably disposed on said support means for holding a tube, for sequentially sealing inserted reeds into the ends of the tube, and for carrying said tube a spaced distance between reed sealing sequences, jaw means slidably disposed on said support means for accepting and inserting reeds into said tube, means for enclosing said tube in a controlled

atmosphere, and loading means for inserting prepositioned reeds into said jaw means.

2. In a device for assembling reeds in a tube the combination comprising: carriage means for holding said tube, for sequentially sealing reeds inserted into the ends thereof, and for setting a gap between said reeds by moving said tube and one of said reeds sealed therein a spaced distance in a first direction; and jaw means for holding one of said reeds immobile while said carriage means moves in said first direction and for inserting reeds into said tube in overlapping relationship while acting along a path lying in a second direction.

3. A combination in accordance with claim 2 wherein said first direction is perpendicular to said second direction.

4. A combination in accordance with claim 3 wherein said loading means comprises: moving means for moving said loader to a transfer position adjacent said jaw means, and a loader removably attached to said moving means for inserting a pair of flat bladed reeds into said jaw means when said loader is moved to said transfer position and the flat blades of said pair of flat bladed reeds are disposed on said loader a fixed distance apart and in a pre-aligned position with respect to planes passing through the paths of travel defined by said first and second directions.

5. In a device for assembling reeds into tubes the combination comprising: an elongated column having a long axis, a carriage for holding a tube in parallel alignment with said long axis and for sealing reeds into the ends of said tube, said carriage slidably disposed on said column to set the spacing between said reeds by moving said tube and one of said reeds sealed therein a controlled distance in a direction perpendicular to said long axis, a pair of slidable jaws for inserting said reeds into said tube, said pair of jaws juxtaposed on said column to overlap said reeds within said tube by moving them in a direction parallel to said long axis, and a loader arm for inserting prepositioned reeds into said pair of jaws.

6. A combination in accordance with claim 5 wherein said loader arm comprises: an arm, a loader removably attached to said arm, said loader adapted to hold a pair of flat bladed reeds, a pair of reed referencing surfaces on said removable loader wherein each surface is offset a predetermined distance from a center line through said pair of jaws, clamping means for holding the blade of each reed in a plane passing through said center line and against a reference surface, and a pair of spacers on said loader for aligning said pair of flat bladed reeds with respect to said pair of reed referencing surfaces whereby each reed is spaced apart from the other on said loader a predetermined distance.

7. In a device for assembling reed switches the combination comprising: a support, a carriage for holding a tube and sealing the ends thereof around a pair of reeds inserted therein, a pair of pins for slidably interconnecting said support and said carriage, a pair of adjusting screws mounted on said carriage to engage said support for controlling the movement of said carriage with respect to said support, a pair of jaws slidably mounted on said support for accepting and inserting reeds into said tube, means for enclosing said tube in a controlled atmosphere, and a loader arm for inserting prepositioned reeds into said pair of jaws.

8. A combination in accordance with claim 7 wherein said loader arm comprises: an arm, a loader removably attached to said arm, said loader adapted to hold a pair of flat bladed reeds, a pair of reed referencing surfaces on said removable loader wherein each surface is offset a predetermined distance from a center line through said pair of jaws, clamping means for holding the blade of each reed in a plane passing through said center line and against a reference surface, and a pair of spacers in said loader for aligning said pair of flat bladed reeds with respect to said pair of reed referencing surfaces whereby each reed

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is spaced apart from the other on said loader a predetermined distance.

9. In a device for assembly reed switches the combination comprising: an elongated column, a carriage slidably disposed on said column for holding a tube and sealing the ends in sequence around a pair of reeds inserted therein, said carriage arranged to adjust the gap between reeds by moving said tube and a reed sealed therein in a first direction, a pair of slidable jaws juxtaposed on said column for accepting and inserting reeds into said tube, said jaws arranged to adjust reed overlap by sliding in a path lying in a second direction, said second direction being co-extensive with said elongated column, means for enclosing said tube in a controlled atmosphere, and means for inserting prepositioned reeds into said pair of jaws.

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10. A combination in accordance with claim 9 wherein said first direction is perpendicular to said second direction.

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