PATENT SPECIFICATION

Convention Date (United States of America): Jan. 31, 1941. 559,753

Application Date (in United Kingdom): Aug. 28, 1942. No. 12115/42.

Complete Specification Accepted: March 3, 1944.

(Under Section 6 (1) (a) of the Patents &c. (Emergency) Act, 1939, the proviso to Section 91 (4) of the Patents and Designs Acts, 1907 to 1942, became operative on Oct. 6, 1942.)

COMPLETE SPECIFICATION

Improvements in or relating to Apparatus for Exhausting and Sealing the Envelopes of Wireless Valves and Similar Devices

We, MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, a British company, of Marconi Offices, Electra House, Victoria Embankment, London, W.C.2, assignees of NEWELL RALPH SMITH, of 9, Barnet Street, Bloomfield, New Jersey, United States of America, a citizen of the United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to the manufacture of exhausted envelopes such as are employed in wireless valves and particularly to means for sealing the exhaust tubes of such envelopes.

Wireless valves usually comprise an envelope closed at one end with a re-entrant stem or button type glass disc or header with an exhaust tube which must be sealed and tipped off at the completion of exhaust. The exhaust tube is usually pushed into a rubber bushing to make hermetic connection with the exhaust pumps and a machine carrying the bushings is rotated step-by-step to move the envelopes into high frequency coils or gas flames, depending on whether the envelope is of metal or glass. When the envelope is pumped out, so-called "tip off" flames are pointed and directed on the exhaust tube as near to the bulb as possible to melt the exhaust tube and seal it without damaging the envelope. It is desirable of course to make the seal exhaust tube as short as possible. These tip-off flames are slow in raising the glass to melting temperature and because the flames cannot be carried along with the envelope on the exhaust machine, the machine must be brought to rest while the flames melt the tube. This operation usually determines the maximum speed at which the machine may be operated.

The usual exhaust machine, further, is provided with a grooved copper track parallel to the line of travel of the envelope. Long flexible lead-in conductors of the envelope drag along in the track so that when the tracks are energised, electrodes in the tube may be heated or bombarded during exhaust. Where the external ends of the leads are short and stiff, as when they are used as contact pins, the leads cannot be held with uniform pressure against the track. Further, these short stiff leads cannot be bent out of the way of the tip-off fires that must be played on the exhaust tube.

The object of the invention is to provide a device for sealing off the exhaust tubes of an envelope such as the envelope of a wireless valve without damaging the envelope by heating, which will leave an exhaust tube tip of minimum length, which will reduce or eliminate oxidisation of the lead-in conductors or contact pins, which is not limited in operating speed by the tipping operation and which is easy to operate.

According to the present invention, a device for sealing the exhaust tube of an envelope is provided comprising a supporting member of electrical and heat insulating material having an opening for receiving said exhaust tube, said opening being slightly larger than said exhaust tube, and an electric heater arranged within said supporting member substantially co-axially with said opening so as to embrace said tube. In the preferred form of the invention, the aforesaid supporting member has one or more holes for receiving one or more lead-in conductors projecting from said envelope, there being a contactor or contactors in alignment with said hole or holes for engaging said conductor or conductors when the exhaust tube is in position to be heated.

The invention also includes a machine for exhausting an envelope and sealing

[Price 1/-]

the exhaust tube thereof including in combination a device as above set forth, means for making an hermetic connection between the end of said tube and an exhaust pump connection, and means for causing relative movement between said device and said means for making said hermetic connection to remove an unwanted portion of said tube after said tube has been sealed.

In the machine embodying the invention which is particularly described below, said means for making said hermetic connection comprises a bushing of rubber or rubber like material having an opening co-axial with the opening in said supporting member, said opening in the bushing serving to receive said tube so that said tube is tightly gripped therein to make said hermetic connection and to enable said unwanted portion to be removed. The machine also includes a push rod mounted in said exhaust pump connection and adapted to be reciprocated to cause said push rod to enter said opening in said bushing to cause the ejection therefrom of said unwanted portion of said tube.

In order that the invention may be more clearly understood and readily carried into effect, details of a machine incorporating a device constructed in accordance therewith will now be described by way of example, with reference to the accompanying drawings, in which:

Figures 1 and 2 are elevational views in section of such a machine in two operating positions,

Figures 3 and 4 are plan views showing the machine in the two positions represented, respectively, in Figures 1 and 2,

Figure 5 is an elevational view taken at right angles to the view of Figure 1,

Figure 6 is a side elevational view partly in section of a complete assembly of the machine, and

Figure 7 is a sectional view taken along lines 7—7 of Figure 6.

The envelope 1 to be exhausted may be the envelope of a wireless valve as shown in Figure 1, with a conventional button or disc type glass header 2 and an exhaust tube 2*a* joined to the centre of the header. Sealed through the header and concentric with the exhaust tube are the lead-in conductors 3 for the electrodes, the outer ends of the conductors being relatively short and stiff so that they may be used as contact pins on the finished tube. The envelope 1 is mounted on device termed a "tip-off head" comprising a supporting plate 4 having upper and lower facing sheets 4*a* and 4*b* with a filler body 4*c* between them, the whole being formed of heat and electrical insulating material. The lower sheet 4*b* of the plate 4 is provided with a central opening or port 5 just large enough to receive the exhaust tube, and the members 4*a* and 4*c* are suitably apertured to allow the tube to pass through them the body 4*c* being recessed sufficiently to accommodate an electrical heating coil 9 which surrounds the exhaust tube. The opening in the sheet 4*a* may be similar to the port 5. The plate 4 is also provided with a plurality of holes arranged in a circle concentrically with the port 5 to receive the contact pins. The insulating plate 4 is preferably thinner than the length of the contact pins so that when the tube rests upon the plate, the contact pins protrude from the underside and come into contact with spring fingers 7 electrically connected with exterior binding posts 8. An electrical heating coil 9 in the insulating plate and co-axial with the port 5 may be heated by passing current through the coil from binding posts 10 on the tip-off head and heat of glass-melting temperature is applied to the exhaust tube immediately adjacent the header. The entire tip-off head, generally indicated by reference character 11, is mounted on and may be vertically reciprocated by the carriage piston 12. In operation the exhaust tube is heated by the coil until the tube collapses and, by moving the head upward, the exhaust tube is pulled in two leaving a short tip of glass 13 at the centre of the glass header.

The tip-off head overlies the bushing 14 of soft rubber or rubber-like material that will make a hermetic seal with the smooth sides of the glass exhaust and, as better shown in Figure 6, the exhaust tube communicates through an air-tight pipe 15 with a hose 16 which leads to the exhaust pump. Surrounding the pipe is the coil of solenoid 17 and inside the pipe is a plunger 18 centrally bored to complete the exhaust passage through the pipe. At the upper end of the plunger is provided a push-rod 19 which when elevated by the solenoid will eject the tipped off portions of the exhaust tubes from the rubber bushing. The plunger returns to its lower position by gravity and by a compression spring 20.

To protect the glass header with its large number of lead-in seals from heat during exhaust the lower end of the envelope is enclosed in a chamber 21 through which cooling air is forced. The top side of the chamber is closed by two lids 22 which are shaped to fit closely around the envelope on opposite sides thereof pivotted eccentrically of the axis of the head so that they may be opened, as shown, in Figure 4, to permit the in-

sertion and withdrawal of radio tubes. The cooling chamber lids are each provided with arms 23 beyond their pivot so that they will move to the open position as the head rises on its piston. Two fixed cams 24, Figures 4 and 5, preferably carried on the stationary portion of the machine, are positioned above the arms so that the arms will ride onto the cams and force open the lids as the head rises. Coiled compression spring 25 between the arms biasses the lids to closed position. Cooling air is admitted and discharged through openings or ports 26, Figure 7, in the sides of the chamber and is directed in a circular path around the base end of the tube by the baffle 27 located between the openings 26. In case the envelope is of metal the baffle is preferably of metal spring pressed against the sides of the envelope to ground the envelope to the machine.

A plurality of exhausting and sealing assemblies, each of the form shown in Figure 6, may be mounted on the periphery of the rotating table of a conventional exhausting machine usually known as a "sealex" machine. The machine may be moved step-by-step or rotated continuously to carry the envelopes of the tubes to be exhausted into the gas flames of burners such as shown at 28, Figure 6, or into high frequency coils. At the loading position the head is preferably in its lowered position with the lids 22 open. As the machine rotates the lids close, and the exhaust pumps commence to evacuate the envelope. Cooling air is admitted and exhausted through ports 26 of the cooling chamber as heat is applied to the envelope to degas the metal parts. Low temperature heat may, if desired, be applied to the exhaust tube by the tip-off coil 9 during exhaust, and near the completion of the exhaust process, the current through the coil may be increased suddenly, rapidly to melt the exhaust tube glass. The exhaust tube now collapses, sealing the envelope, and the melted tube may be pulled in two by moving the head 11 upwardly. The exhausted and sealed envelope, however, may not immediately be removed from the machine but the heat from coil 9 may be applied until the glass tip 13 balls and sucks in slightly. The exhausted and sealed envelope is then removed and a new envelope inserted. While the head is in the elevated position solenoid 17 is energised, core 18 rises and push rod 19 ejects the tipped off exhaust tube which may be delivered, by a blast of air, to a receptacle. It will be noted that the machine need not be stopped while the exhaust tube is being melted and tipped off since the heat may be applied during any portion of the exhausting cycle. If desired a canopy or hood type oven may be constructed over the line of travel of the envelope to heat the envelope continuously during exhaust and the exhausting and tipping off may be completed without interrupting the movement of the machine.

Good results have been obtained in exhausting and sealing wireless receiving valves with metal shells closed by glass button headers where the header may be only .625 inch in diameter carrying a central exhaust tube .137 inch in outside diameter and a circle of nine .04 inch contact pins, and where the heating coil is 8½ to 9½ turns of "nichrome No. 5" ribbon .010 by .031 inch edge wound with an inside diameter of .156 inch. Although the large amount of metal embedded in and surrounding the small glass button would be seriously heated and oxidised if gas flames were played upon the exhaust tube through and between the leads, it has been found that the exhaust tube may be sealed and tipped off without damage to the pins, headers or seals. The temperature of the rim of the head is easily adjusted by the cooling air to 200° to 300° C. during exhausting and sealing.

When the sealing device described is employed it will not oxidise lead-in conductors, the sealing operation is effected very rapidly, the envelope or the header is not damaged by heat, a tip of minimum length is made and the device is easy to operate at high speeds.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A device for sealing the exhaust tube of an envelope, said device comprising a supporting member of electrical and heat insulating material having an opening for receiving said exhaust tube, said opening being slightly larger than said exhaust tube, and an electric heater arranged within said supporting member substantially co-axially with said opening so as to embrace said tube.

2. A device according to Claim 1 wherein said supporting member has one or more holes for receiving one or more lead-in conductors projecting from said envelope, there being a contactor or contactors in alignment with said hole or holes for engaging said conductor or conductors when the exhaust tube is in position to be heated.

3. A device for sealing the exhaust tube of an envelope substantially as herein described with reference to and as shown

in Figures 1 to 7 of the accompanying drawing.

4. A machine for exhausting an envelope and sealing the exhaust tube thereof including in combination a device according to any of the preceding claims, means for making an hermetic connection between the end of said tube and an exhaust pump connection, and means for causing relative movement between said device and said means for making said hermetic connection to remove an unwanted portion of said tube after said tube has been sealed.

5. A machine according to Claim 4 wherein said means for making said hermetic connection comprises a bushing of rubber or rubber-like material having an opening co-axial with the opening in said supporting member, said opening in the bushing serving to receive said tube so that said tube is tightly gripped therein to make said hermetic connection and to enable said unwanted portion to be removed.

6. A machine according to Claim 5 including a push rod mounted in said exhaust pump connection and adapted to be reciprocated to cause said push rod to enter said opening in said bushing to cause the ejection therefrom of said unwanted portion of said tube.

7. A machine according to Claim 4, 5 or 6 wherein said device comprises a cooling chamber on one side of said supporting member which receives said envelope during the sealing operation, said chamber having two pivotted lids which are shaped to fit closely around said envelope on opposite sides thereof, said lids each having arms extending beyond their pivot and means being provided for engaging said arms when said device and said means for making said hermetic connection are moved relatively to each other for causing said lids to be opened or closed.

8. A machine according to Claim 7 wherein said chamber has two openings for circulating cooling fluid and a baffle between said openings extending from the wall of the chamber to said envelope, the arrangement causing cooling fluid entering one opening to circulate around the envelope and to leave the chamber through the other opening.

9. A machine according to Claim 8 wherein said baffle is made of metal so as to afford an electrical connection to said envelope when the latter is made of conducting material.

10. A machine for exhausting the envelope and sealing the exhaust tube thereof substantially as herein described with reference to and as shown in Figures 1 to 7 of the accompanying drawing.

11. A wireless valve, the envelope of which has been exhausted and sealed in a device or machine in accordance with any of the preceding claims.

Dated this 27th day of August, 1942.

F. W. CACKETT,
Chartered Patent Agent.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1944.

559,753 COMPLETE SPECIFICATION

SHEET 1

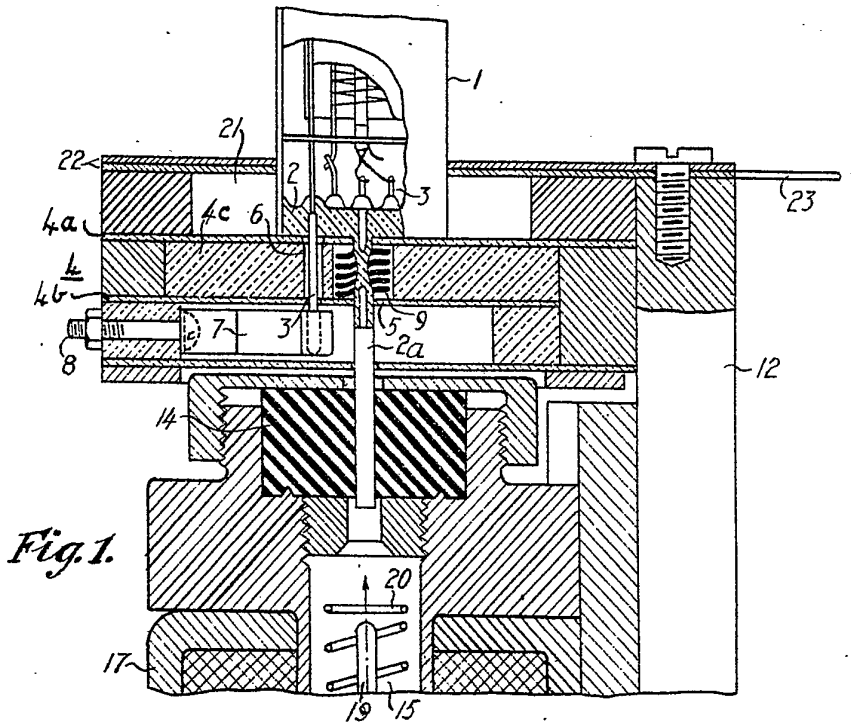


Fig. 1.

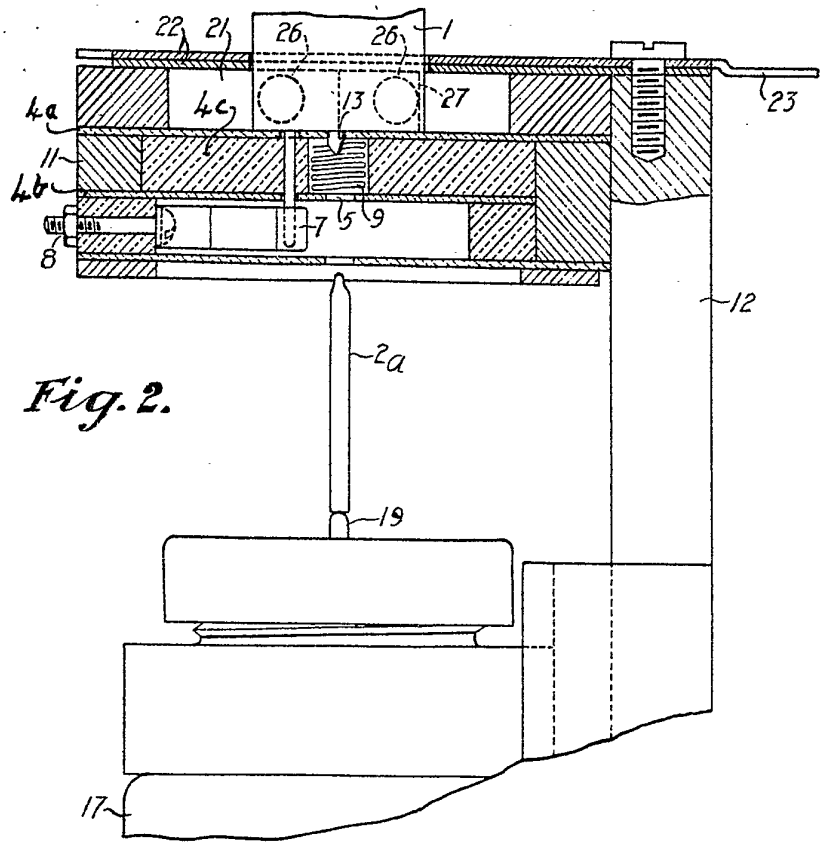
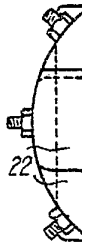
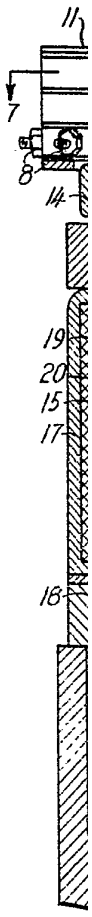


Fig. 2.





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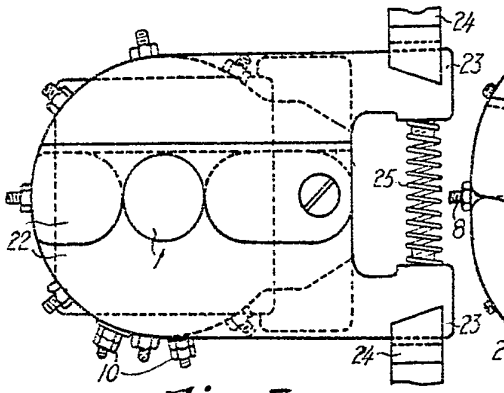

Fig. 3.

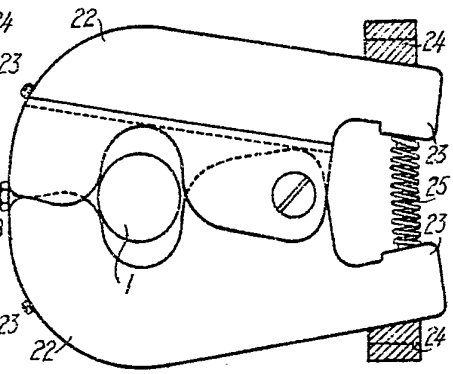

Fig. 4.

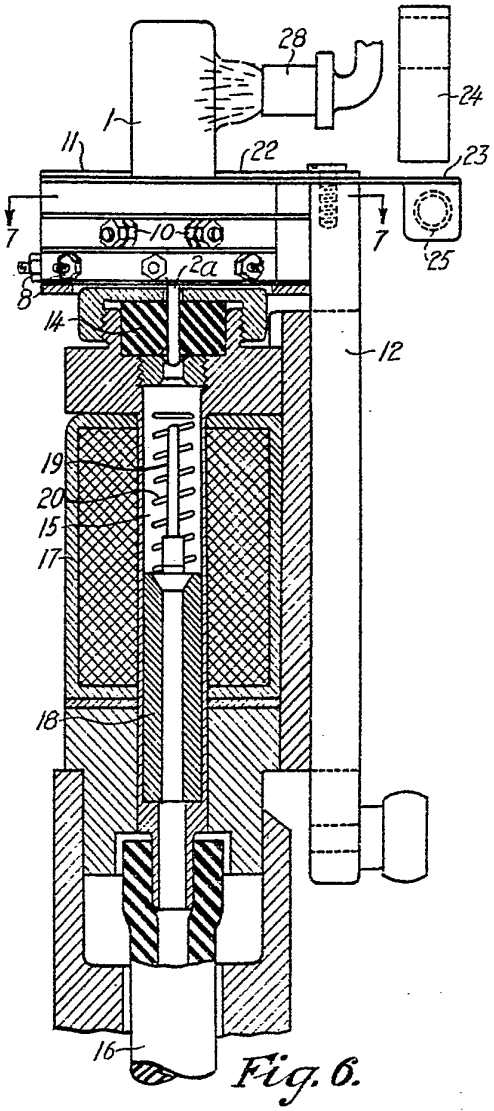

Fig. 6.

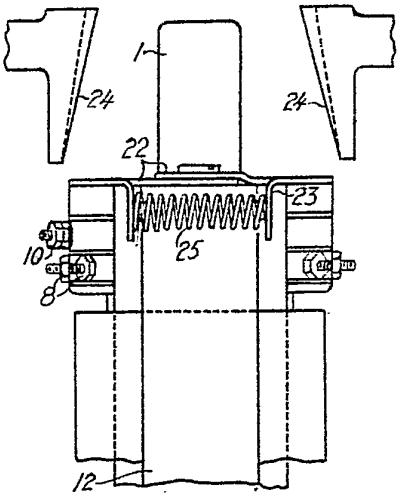

Fig. 5.

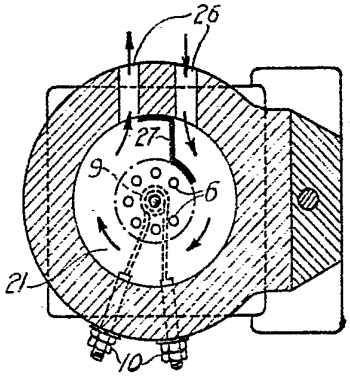

Fig. 7.

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559,753 COMPLETE SPECIFICATION

2 SHEETS

SHEET 1

SHEET 2

[This Drawing is a reproduction of the Original on a reduced scale.]

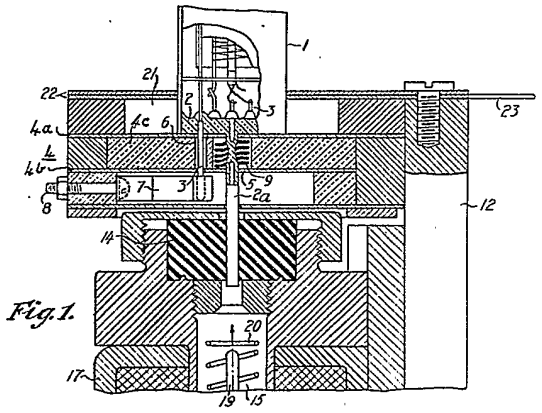

Fig. 1.

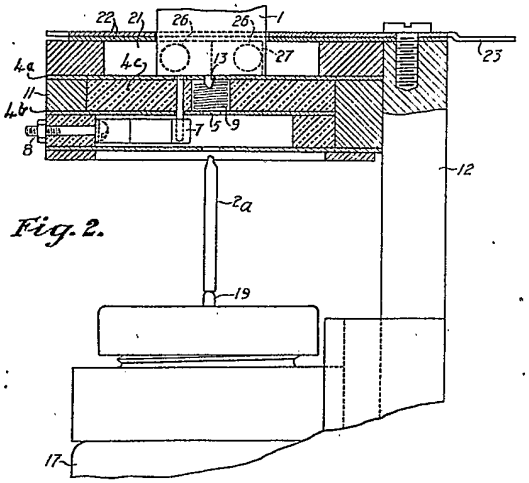

Fig. 2.

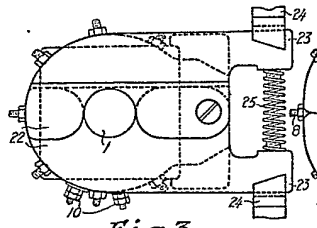

Fig. 3.

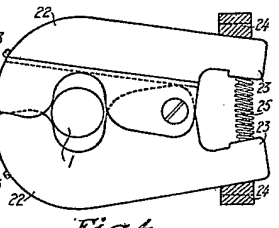

Fig. 4.

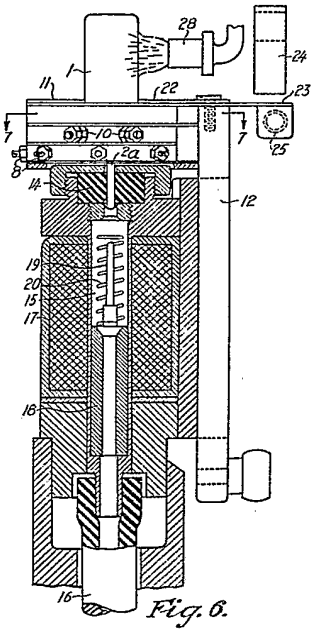

Fig. 6.

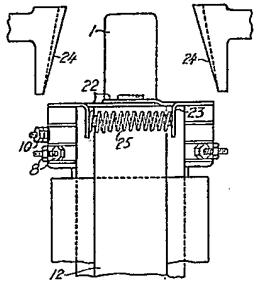

Fig. 5.

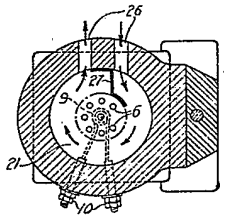

Fig. 7.

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