

Nov. 18, 1952

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2,618,267

CONTROL MEANS FOR ELECTROSURGICAL CUTTING INSTRUMENTS

Filed March 4, 1950

2 SHEETS—SHEET 1

Fig. 1

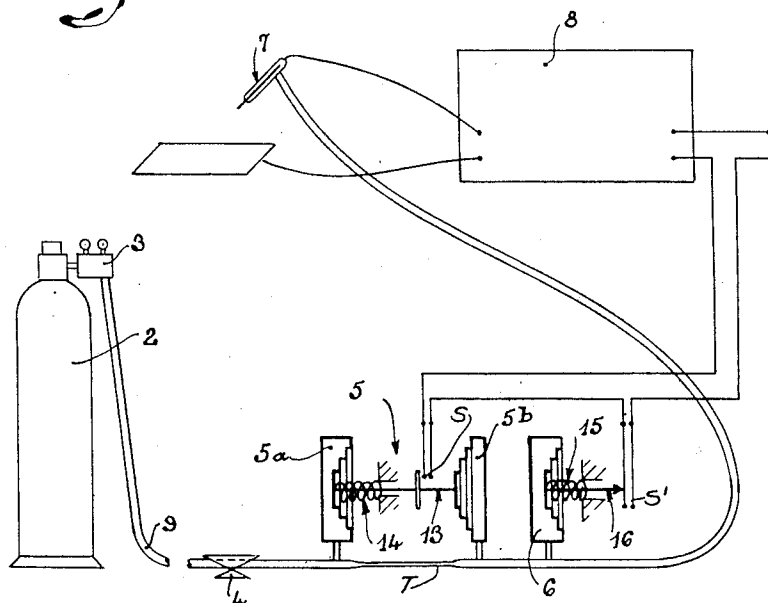


Fig. 2

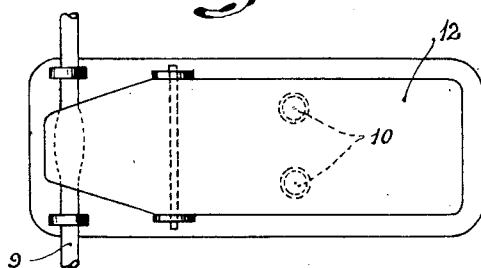
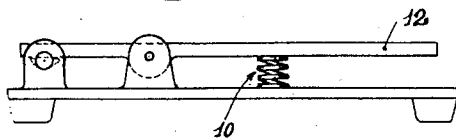


Fig. 3



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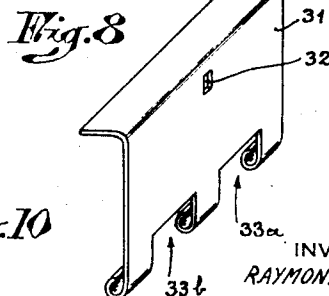
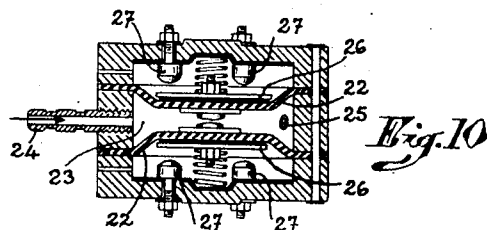
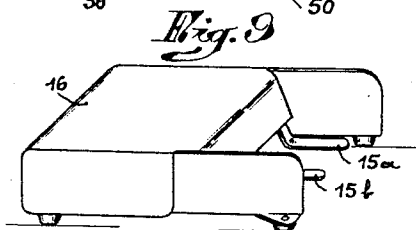
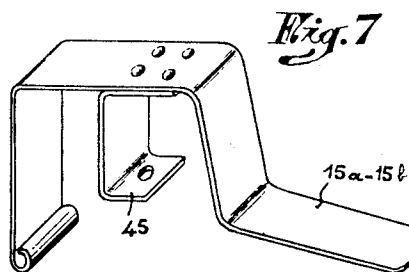
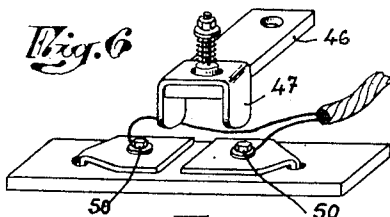
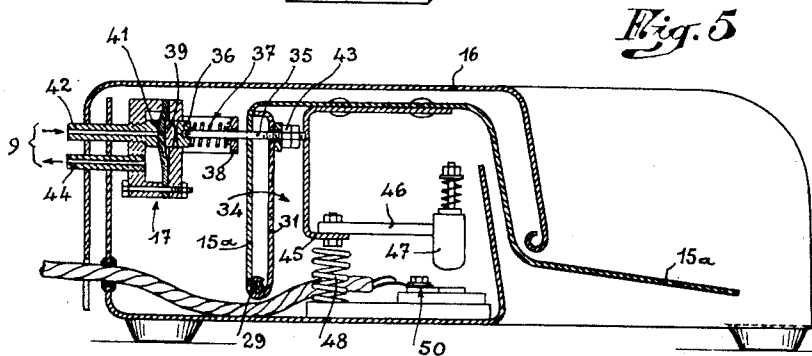
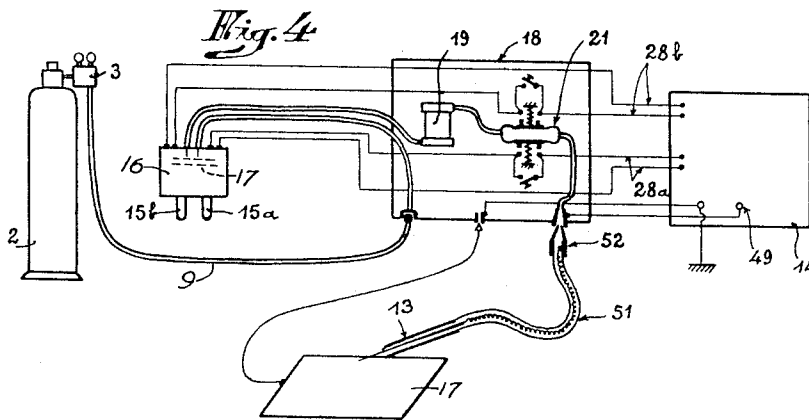
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2 SHEETS—SHEET 2



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CONTROL MEANS FOR ELECTROSURGICAL
CUTTING INSTRUMENTS

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6 Claims. (Cl. 128—303.14)

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The use for important surgical operations of modern anaesthetics that have a low toxicity, prevents the use of electrically controlled lancets in many cases, where the undisputable advantages of such a technique are associated with a considerable danger of explosion of these anaesthetics. These gases constituted e. g. by a mixture of oxygen and ether or oxygen and cyclopropane form, as a matter of fact, explosive mixtures, the ignition of which, by means of the spark produced by the electrical lancet, has already been the cause of most serious accidents.

The so-called "Crawford method" has been proposed, it is true, that consists in producing round the active electrode a sheath of neutral gas that is injected through an annular port round the latter and that is to remove any possibility of ignition. However, this method is efficient only inasmuch as the gas current is not fortuitously reduced or cut off while the generator of high frequency current is still operative.

My invention removes this drawback and has for its object an improvement in the means controlling the operation of the electric lancet whereby the high frequency generator is rendered utterly inoperative so as to cut out any possibility of producing a spark, as long as the pressure and output of neutral gas are not both sufficiently high.

I have illustrated by way of example in accompanying drawings, two embodiments of my invention. In said drawings:

Fig. 1 is a general view of my improved arrangement.

Fig. 2 is a detail view showing the control pedal as seen from above.

Fig. 3 is a further view of the pedal in side view.

Fig. 4 is a general view of a modified arrangement.

Fig. 5 is a longitudinal cross-section of the pedal controlling the arrangement shown in Fig. 4.

Figs. 6, 7 and 8 are perspective views of the component members of said pedal.

Fig. 9 is a perspective view of the same pedal.

Fig. 10 is an axial sectional view of a safety relay incorporated to last mentioned arrangement.

The arrangement illustrated in Fig. 1 includes the following members:

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A bottle 2 containing a compressed neutral gas, such as nitrogen e. g. and feeding the lancet 7 through a yielding pipe 9.

A pressure-reducing manometer 3 that lowers the pressure of the protecting gas down to a suitable value, say 100 to 200 gr. per sq. cm. or thereabouts.

A pedal-actuated valve 4 controlling the operation of the arrangement.

A differential pneumatic relay 5 providing for the closing of an electric switch as soon as the volume of gas passing through said relay per unit of time reaches a predetermined value considered as suitable for operation.

A pneumatic relay 6 establishing in a similar manner, an electric contact as soon as the pressure applied reaches a value considered as sufficient for operation.

An electrically operated lancet 7 associated with an admission of neutral gas.

A high frequency generator 8 connected with the circuit fed by the relay.

The pedal-actuated valve 4 is constituted by a member urged against its seat by a spring; it is brought into its operative position, by a pressure exerted on said pedal to allow the passage of the gas through the pipe. Any type of valve may be used: thus, the yielding tube 9 connecting the compressed gas bottle 2 with the control relays 5 and 6 is flattened down as illustrated in Figs. 2 and 3 by clamping means submitted to the action of a spring 10 that may be compressed when the actual pedal 12 is compressed, so as to release the tube and allow the passage of gas through same.

The output-sensitive relay 5 is constituted by two pressure-measuring instruments mounted in mechanical antagonism through the sliding system 13, the elementary instruments 5a and 5b being fed respectively through the upstream and the downstream side of the relay inside which the pipe 9 is throttled by means of a gauged port or a portion of tube assuming a reduced cross-section, as shown at T so as to provide a drop in pressure across said portion or to either side of such a gauged port, so that it is an easy matter to obtain the throughput of gas by measuring said drop in pressure. As soon as the volume of gas passing through the pipe 9 reaches a predetermined value, the manometric instrument 5a

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on the upstream side exerts on the sliding system 13 a stress that is higher than that exerted on it by the downstream instrument 5b. A spring 14 engaging the instrument 5a allows the shifting of said sliding system only if the difference between the pressures prevailing in the two manometric members reaches a predetermined value, said difference in pressure depending in its turn on the output of gas. As soon as said predetermined value is reached, the electric switch S closes.

The pressure-sensitive relay 6 is similar to the manometric instruments 5a and 5b of the output-sensitive relay. Said pressure-sensitive relay is constituted by a manometric instrument that is submitted to the pressure of a spring 15. As soon as the pressure reaches a predetermined value, the movable member 16 is shifted by the relay so as to close the electric switch S'.

The switches S and S' of the two relays 5 and 6 are connected in series so that the generator 8 cannot be operative unless each of the relays fulfills the conditions required for a reliable and safe operation and is thus allowed to close the corresponding switch.

The pressure-measuring instruments are constituted in the case illustrated by a metal cup closed by a yielding gas-tight diaphragm, against which bears a metal disc adapted to transmit pressure from the instrument to the other members.

Any other arrangement submitted to the mechanical action of gas pressure may, of course, be used as well, such as e. g. a piston adapted to move inside a cylinder or a Sylphon tube adapted to expand. The yielding diaphragm referred to hereinabove may also be constituted by a thin corrugated sheet of metal. It is also possible to use as a control member, a rubber pouch contained, if desired, inside a yielding case that is not or is but little expansible.

The relays 5 and 6 defining respectively the values of output and pressure of the gas may be associated, of course, so as to form a single relay, provided the downstream manometric instrument of the output-sensitive relay receives the same gas pressure as the corresponding member of the pressure-sensitive relay. It is thus possible to use a pouch, one surface of which serves for measuring pressure, while the other surface is mechanically associated with an identical pouch submitted to the pressure prevailing on the upstream side of the throttled portion of the feed tube that produces the loss of head.

The electric energization is cut off in all cases immediately the neutral gas flows with a reduced speed as may occur through lack of pressure when the gas bottle is empty, its cock is closed, its pipe is broken through or stopped ahead of the relays, or again through lack of output, if the pipe or the lancet is stopped.

In the arrangement illustrated in Fig. 4, the lancet 13 may be fed, as desired by the surgeon, with two different current values from the high frequency generator 14; two pedals, 15a and 15b, are then required, which pedals are both arranged inside a common case 16 as illustrated in Figs. 5 and 9 and control both the same valve 17 so as to cut off the passage of gas through the pipe when the lancet is not in use, while allowing the gas to pass through the tube as soon as either of said pedals is depressed.

This arrangement includes therefore as chief components as illustrated in Fig. 4: The bottle 2 for neutral gas; the manometer and pressure re-

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ducer 3a; the case 16 enclosing the pedals 15a and 15b controlling the valve 17 that controls in its turn the passage or the stopping of the gas; a box 18 containing a filter 19 inserted in the gas pipe 9 and the safety relay 21; the high frequency generator 14 connected with two circuits respectively controlled by the pedals 15a and 15b in the case 16; the electrically controlled lancet 13 round which is introduced the neutral gas.

The relay 21 in the box 18 is constituted as illustrated in Fig. 10 by a casing inside which an expansible chamber 23 is formed between two elastic diaphragms 22, in which expansible chamber the neutral gas is admitted through the pipe 24 and out of which it passes through the port 25. The outer surface of each of the diaphragms 22 carries a copper disc 26 that provides when the chamber 23 expands for the connection two by two of the contact-pieces 27 forming switches in the corresponding circuits 28a and 28b feeding the high frequency generator 14.

In each of said circuits is inserted furthermore another switch controlled by the corresponding pedal 15a or 15b housed inside the case 16 (Fig. 5); round the stationary spindle 29 is pivotally secured inside said case a member 31 shown separate in Fig. 8 and that is provided near its upper edge with an opening 32 and along its lower edge with cut out portions 33a and 33b. Round the same stationary spindle 29 are pivotally secured, through their ends that engage the cut out portions 33a and 33b of the member 31, the two pedals 15a and 15b that, as will be readily understood, produce through depression of their other end projecting outside the case 16 a rocking of the system in the direction illustrated by the arrow 34 in Fig. 5. Through the port 32 in the member 31 is fitted a rod 35 carrying at one end a stop 36 that under the action of a spring 37, bearing against a stationary member 38, urges normally the valve 39 and the diaphragm 41 co-operating therewith outwardly against a seat formed inside the small valve casing 17 by the end of a pipe section 42 admitting the gas, while the other end of the rod 35 carries a nut 43 bearing against the rear surface of above mentioned member 31.

Thus, through depression of either pedal 15a or 15b, it is possible to produce a rocking of the member 31 and consequently a drawing out of the rod 35 which has for its result to remove the valve 39 from its seat; the neutral gas admitted through the pipe 42 enters then the small valve casing 17 and escapes therefrom through the pipe 44 that passes through the above described safety relay 21 before reaching the actual lancet.

Each of the pedals 15a and 15b (Figs. 5 and 7) carries furthermore on its lower surface a lug 45 to the lower end of which is secured an insulating plate 46. The end of the latter carries in its turn a metal blade 47 adapted to engage when a sufficient depression is exerted on the corresponding pedal the two contact plates 50 forming switches that are inserted in the corresponding circuits 28a and 28b feeding the electric generator 14. A spring 48 (Fig. 5) holds during the inoperative periods the pedal raised and consequently the admission of neutral gas closed and the electric circuit open.

When depressing one of the pedals 15a or 15b, it is thus possible to provide in succession for the admission of neutral gas to the lancet 13 and the closing of the corresponding electric circuit through automatic operation of the relay switch

and through a positive actuation of the pedal switch.

It should be remarked that, in the arrangement disclosed, the lancet 13 is connected with the operative terminal 49 of the generator through a hollow flex pipe 51 provided with a connecting jack 52. This flex pipe provides simultaneously for the passage of the neutral gas and of the electric lead which cuts out in practice any danger of a fortuitous stopping on the downstream end of the pressure relay, whereby it is possible to cut out the differential current output-sensitive relay incorporated to the arrangement illustrated in Fig. 1.

What I claim is:

1. An automatic protective system for an electrically controlled surgical cutting instrument adapted to operate in a body of anaesthetic gas, comprising a source of high frequency current, a circuit operatively connecting said source with the surgical cutting instrument, a switch controlling said circuit, a source of neutral anti-explosive gas, a pipe connecting said source of gas with said instrument, to form a protective sheath of neutral gas round the latter and round the anaesthetic gas body surrounding same, a manometric device subjected to the pressure of the neutral gas in said pipe and controlling the switch to close same whenever the pressure acting on the manometric device has reached a predetermined value.

2. An automatic protective system for an electrically controlled surgical cutting instrument adapted to operate in a body of anaesthetic gas, comprising a source of high frequency current, a circuit operatively connecting said source with the surgical cutting instrument, two switches inserted in series in said circuit, a source of neutral anti-explosive gas, a pipe connecting said source of gas with said instrument to form a protective sheath of neutral gas round the latter and round the anaesthetic gas body surrounding same, a plurality of manometric devices subjected to the pressure of the neutral gas in said pipe, one of said manometric devices controlling one of the switches in the circuit to close same whenever the pressure of a gas reaches a predetermined value, and means differentially controlled by two manometric devices and adapted to close the other switch as soon as the difference in pressure therein reaches a predetermined value corresponding to a predetermined throughput of neutral gas.

3. An automatic protective system for an electrically controlled surgical cutting instrument adapted to operate in a body of anaesthetic gas, comprising a source of high frequency current, a circuit operatively connecting said source with the surgical cutting instrument, a switch controlling said circuit, a source of neutral anti-explosive gas, a pipe connecting said source of gas with said instrument, to form a protective sheath of neutral gas round the latter and round the anaesthetic gas body surrounding same, a valve normally closing the throughput of neutral gas through the pipe, a pedal adapted to actuate said valve to release said pipe, a manometric device subjected to the pressure of the neutral gas in said pipe on the downstream side of the valve and controlling the switch to close same as soon as the pedal has actuated the valve to release the pipe.

4. An automatic protective system for an electrically controlled surgical cutting instrument adapted to operate in a body of anaesthetic gas, comprising a source of high frequency current,

a circuit operatively connecting said source with the surgical cutting instrument, two switches inserted in series in said circuit, a source of neutral anti-explosive gas, a pipe connecting said source of gas with said instrument to form a protective sheath of neutral gas round the latter and round the anaesthetic gas body surrounding same, a valve normally closing the throughput of neutral gas through the pipe, a pedal adapted to actuate said valve to release said pipe, a plurality of manometric devices subjected to the pressure of the neutral gas in said pipe on the downstream side of the valve, one of said manometric devices controlling one of the switches in the circuit to close same as soon as the pedal has actuated the valve to release the pipe, and means differentially controlled by two manometric devices and adapted to close the other switch as soon as the difference in pressure across said means reaches a predetermined value corresponding to a predetermined throughput of neutral gas.

5. An automatic protective system for an electrically controlled surgical cutting instrument adapted to operate in a body of anaesthetic gas, comprising a source of high frequency current, a circuit operatively connecting said source with the surgical cutting instrument, and including selectively operative shunt circuits adapted to provide different conditions of energization for the instrument, a switch in each shunt circuit, a source of neutral anti-explosive gas, a pipe connecting said source with the instrument to form a protective sheath of neutral gas round the latter and round the anaesthetic gas body surrounding same, a valve normally closing the pipe between the source of gas and the instrument, a rocking member adapted to release the valve, two separate juxtaposed pedals controlling independently said rocking member and controlling respectively the switches in the corresponding shunt circuits to close the latter when releasing the valve, a further switch inserted in series with each of the first switches in the corresponding shunt circuit, a manometric device in the pipe on the downstream side of the valve and adapted to close both further switches, whenever the pressure in the pipe reaches a predetermined value.

6. An automatic protective system for an electrically controlled surgical cutting instrument adapted to operate in a body of anaesthetic gas, comprising a source of high frequency current, a circuit operatively connecting said source with the surgical cutting instrument, and including selectively operative shunt circuits adapted to provide different conditions of energization for the instrument, a switch in each shunt circuit, a source of neutral anti-explosive gas, a pipe connecting said source with the instrument to form a protective sheath of neutral gas round the latter and round the anaesthetic gas body surrounding same, a valve normally closing the pipe between the source of gas and the instrument, a rocking member adapted to release the valve, two separate juxtaposed pedals controlling independently said rocking member and controlling respectively the switches in the corresponding shunt circuits to close the latter when releasing the valve, a further switch inserted in series with each of the first switches in the corresponding shunt circuit, a manometric device in the pipe on the downstream side of the valve and adapted to close both further switches whenever the pressure in the pipe reaches a predetermined value, a relay responsive to the throughput of neutral gas

in the pipe on the downstream side of the valve, a further switch inserted in series in each shunt circuit with the different above-mentioned switches and controlled by last mentioned relay to close the corresponding shunt circuit whenever the throughput of neutral gas acting on last mentioned relay reaches a predetermined value.

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