This invention relates to the treatment of animal tissue to facilitate the performance of surgical operations, more particularly for the separation of diseased tissue from healthy tissue, and the invention has for its chief object among others, the reduction to a minimum of the painful and distressing reaction of the healthy tissue which is incident to surgical operations.

The invention consists of an improved method of treating the tissue with this object in view; and also of an improved means or instrument for carrying the method into effect.

The improved method consists in subjecting the animal tissue along a definite and controllable line or area, to the action of an electric current of high frequency, high voltage and low amperage, in order to locally coagulate or destroy the tissue along the treated area, and thereby enable the tissue to be separated at the line of coagulation.

The improved instrument for applying the coagulating current, comprises two active electrodes adapted to be applied to the tissue in opposed relation to each other and connected in an electric circuit carrying an electric current of the character above described; whereby the current will pass through the tissue in the plane of said electrodes and will coagulate the tissue along a definite and controllable area.

In the accompanying drawings:

Fig. 1 is a diagrammatic view illustrating the application of the improved method in coagulating animal tissue.

Fig. 1 is a similar view showing how the tissue may be severed by the electrodes along the coagulated area.

Fig. 2 is a side elevation of one form of instrument suitable for practising the method.

Fig. 3 is a cross section through one of the jaws of said instrument.

Fig. 4 is a perspective view of an instrument in slightly modified form.

Referring to the drawings:

In the practice of the improved method, two active electrodes 1, 1, see Fig. 1, are applied in opposed relations to each other in contact with the animal tissue 2 which is to be coagulated, which electrodes are connected to conductors 3 in a circuit supplied from a suitable source with an electric current of the so-called D'Arsonval type, which current is characterized by high voltage, say from 3000 to 5000 volts, low amperage, say less than two amperes, and high frequency of alternations, say above one million per second. Due to the opposing relation of the electrodes and the fact that both are active electrodes, the electric current will pass through the body of intervening tissue in a definite and controllable plane of limited area and will act to locally coagulate the tissue along said plane so that it may be readily separated along the line of coagulation. It is desirable that the electrodes be of such cross sectional form as to present a line of contact with the treated tissue rather than a flat surface of contact, so as to cause the current traveling from one electrode to the other to pass through the tissue in a concentrated path or plane, thereby localizing the area of coagulation to a definite and controllable area. To effect this object the electrodes may be of the cross sectional form shown in Fig. 1 presenting abrupt edges to contact with the tissue; or they may be of other cross sectional forms such as round, elliptical, or the like so as to present a line of contact rather than a flat surface of contact.

After the process of coagulation or destruction of the tissue has proceeded to the desired extent, the electrodes may be removed, and the tissue separated along the coagulated area by any suitable means or instrument. Or the two electrodes may, without removal from the treated tissue, and after the required degree of coagulation has been reached, be brought forcibly together on the coagulated tissue and thereby effect the separation of the diseased tissue as shown in Fig. 1.

By the treatment of the tissue in the manner described, the removal of such diseased animal tissue as tumors, hemorrhoids, tonsils, and the like, may be readily effected in a bloodless manner, and with a minimum of the painful and distressing reaction of the healthy tissue which usually follows such operations as now practised.

In Figs. 2, 3 and 4 I have illustrated different forms of instruments by way of example, suitable for the application of the coagulating electric current in practising the method above described. Referring particularly to Figs. 2 and 3, the instrument therein shown comprises two jaws 6 connected to stems 7 crossing each other and pivoted together as at 8 and provided with
handles 9 for opening and closing the jaws. The jaws consist each of an electrode carrying plate or member 10 which plates are provided in their adjacent faces with sockets or grooves in which are removably seated the electrodes 1. The plates 10 are preferably fastened detachably to the ends of the stems by the provision of threaded holes in the plates which receive the threaded ends of the stems, thereby permitting the ready removal of the plates and their substitution by others of different lengths to meet the varying conditions encountered in the practical use of the device as regards the form and size of the parts to be operated on. In the examples shown, the electrodes 1 are suitably insulated from the carrying plates 10, and the electrodes are electrically connected by suitable means to circuit conductors 13 of a circuit supplied with an electric current of high frequency, high voltage and low amperage, such as was hereinbefore described.

In the use of the instrument, the jaws are opened and applied to the opposite sides of the tissue to be coagulated and then closed on the tissue so as to cause the adjacent edges of the electrodes to contact therewith. The electric circuit is now closed and the current will flow through the electrodes and intervening tissue in concentrated lines of force in a plane including the two electrodes, thereby coagulating the tissue in the definite local area of said plane.

After the coagulation has proceeded to the desired extent, the jaws may be closed so as to forcibly pinch the coagulated tissue between them, and the adjacent edges of the jaws acting on the tissue along the coagulated area, will completely sever the same from the healthy tissue. To enable the electrodes to thus sever the coagulated tissue when closed thereon, the adjacent edges of the electrodes may be serrated as at 14, Fig. 2, or they may be formed with smooth sharp edges as shown in Fig. 3.

In the form of the instrument shown in Fig. 2 the electrodes are shown as disposed in the same plane as that of the handles and stems, which adapts the instrument for use in certain situations. In other situations however, on account of the different disposition of the parts to be operated on, the electrodes may be disposed in a plane at right angles to the plane of the stems and handles as shown in Fig. 4, and it is obvious that the electrodes may be arranged relative to the stems in other relations to adapt the instrument for the particular conditions of use encountered. By seating the electrodes removably in sockets or grooves in the plates 10, electrodes having active edges of different lengths and forms may be readily substituted without removing the plates from the stems.

The term “coagulate” employed in the specification and claims is intended to embrace any destructive action on the tissue which will be brought about by the employment in the manner set forth, of an electric current possessing the characteristics described.

It will be understood that the construction of the device may be variously changed and modified with respect to the details thereof without departing from the spirit of the invention, as various changes and modifications of the details will suggest themselves to the skilled mechanic and still be embraced within the scope of the invention; and it will be further understood that the invention is not limited to any particular form or construction of the parts except in so far as such limitations are specified in the claims.

Having thus described my invention, what I claim is:

1. The method of separating diseased animal tissue from the healthy tissue, which consists in applying active electrodes to the region where the diseased tissue joins the healthy tissue, and passing through the electrodes and intervening tissue, an electric current of high frequency, high voltage and low amperage; whereby coagulation will be produced in the tissue and the removal of the diseased tissue permitted.

2. The method of separating diseased animal tissue from healthy tissue, which consists in applying active electrodes to the region where the diseased tissue joins the healthy tissue, passing through the electrodes and intervening tissue, an electric current of high voltage, low amperage and high frequency to produce coagulation in the tissue in the area in the path of the current, and forcing the electrodes together on the coagulated tissue to sever the same.

3. An instrument for the treatment of animal tissue to produce coagulation in the same, said instrument comprising two active electrodes constituting a bipolar pair adapted to be applied to the tissue, and electric circuit conductors connected to said electrodes and adapted to carry a current of high frequency, high voltage and low amperage.

In testimony whereof, I have affixed my signature hereto.

WILLIAM BIERMAN.