HINTS REGARDING THE MANAGEMENT AND USE OF X-RAY APPARATUS.

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Mercury Interrupters.—There are several types of these to be obtained, each having its admirers, but as the Mackenzie-Davidson and the Jet Interrupters are now most commonly used, at least in the Service, descriptive details will be limited to these.

By the introduction of the Mackenzie-Davidson type a distinct improvement in mercury interrupters was effected. It is no doubt a most excellent instrument, and is very easily manipulated. In its action a motor rotates a spindle having a blade fixed at its lower end which makes contact by dipping in mercury. The blade is in the form of a sector, so that contact is gradually made and withdrawn. The mercury is contained in an iron jar in the case, and forms one pole. The spindle passes through the side of the jar, and revolves in an ebonite bush to insulate it from the iron, and forms the other pole. To the upper end of the spindle a grooved pulley is fitted, and to it a band from a motor arranged on the mahogany cover communicates motion. In order to adjust the degree of contact between the blade and the mercury, an iron ring is placed in the jar. The effect produced by raising or lowering this ring will be to more or less immerse the blade by the change brought about in the level of the mercury. The position of the ring is controlled...
by the manipulation of a screw on the cover. The motor is
driven from a 12-volt battery, but 32 volts are required for the
primary coil circuit. On the cover of the case terminals are pro-
vided for connecting the wires leading to coil and battery, and are
so marked. A double switch controls the motor and primary coil
circuits, so that the current can be simultaneously cut off from
both. This is a wise provision, as by stopping the motor alone
when perhaps the blade is in contact with the mercury, the flow
of current from the battery would pass through the primary coil
unchecked, and not only ruin it but the battery as well. The
speed of the motor is controlled by a rheostat fixed to the side
of the case, and by this means the frequency of the interruptions
in the primary circuit can be altered at will.

The following brief instructions are given for connecting and
working this interrupter:

(1) Remove the band which connects the motor and spindle
pulleys; (2) remove the mahogany top by unscrewing the brass
thumb screws; (3) remove the iron cover of jar by removing the
screws, and note screw under which the copper spring is held
in position; (4) pour about 3 lbs. of mercury into the iron jar,
and fill up to within one inch of top with pure methylated spirits.
Best paraffin oil may be substituted for the spirit, but the mercury
is more difficult to clean after use; (5) screw on the iron cover,
taking care that the copper spring is correctly replaced, vide
latter part of (3); (6) replace the band on the spindle pulley;
(7) replace the mahogany cover, and fix the band on both
pulleys; (8) connect the terminals marked "Battery" on cover
to a 12-volt battery; (9) connect the interrupter to coil by the
terminals marked "Coil" on the former, and "Mercury" on
the latter; (10) connect the terminals marked "Battery" on the
coil to a 32-volt battery; (11) should the coil not be provided with
special terminals for connecting with a mercury interrupter,
connect the pillar and spring which contain the platinum points
with the terminals marked "Coil" on the interrupter. Place
a piece of cork between the platinum points (because the inter-
rupter replaces these), and wedge another piece between the
hammer and end of core so as to stop vibration; (12) switch on
the motor, and when it has gained a good speed switch on the
coil by turning over the commutator. Should no spark pass
between the points of the discharging rods, even when about
two inches apart, switch off motor and coil, and add a little
more mercury through the vent hole in the cover. Keep adding
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more mercury very gradually in small quantities until the best results are obtained; (13) the height of the mercury in the jar is regulated by the milled ebonite screw on the cover, which when turned to the right raises the ring and lowers the level of the mercury; when turned to the left the ring is lowered and the level of the mercury is raised by displacement. The ring should be at bottom of jar before the mercury is introduced in the first instance; (14) when the tube glows very weakly, and is not improved by adjustment, this is an indication that the mercury has become foul and should be cleansed; (15) in order to cleanse the mercury, remove the covers and place the jar under a tap, allowing the water to run until the mercury appears quite bright. Stirring the mercury by a piece of wood will facilitate the process.

The method of making the necessary connections is shown in fig. 4.

Mercury Jet Interrupter.—This is a very powerful interrupter, and when properly used, is capable of securing the best effects from a coil. In addition, its ease of control places a great power in the hands of the operator, so that skiagraphing any part of the human body, from the bones in the hands to those situated in the deepest tissue, is rendered easy of accomplishment.
by its aid. Like the Mackenzie-Davidson type a motor is provided to actuate the mechanism. This motor, which is enclosed in an iron casing, can be supplied to work from any voltage. The interruptions take place in a glass jar containing the mercury. Three graduated blades connected to a vertical shaft suspended from the cover of the jar make contact as they pass in front of a jet of mercury. By means of a pump driven at the lower end of the shaft the mercury is forced up a vertical tube. Over this tube another is fitted to slide easily up and down, and in it is pierced a small hole facing the revolving blades. These blades being triangular in shape with base uppermost, it follows that the amount of lateral surface affected by the jet depends on the position of the small hole in the tube. By means of a milled ebonite thumb-screw on the cover, the position of the hole is regulated by moving the tube up or down, thus effecting absolute control on the amount of current passing through the interrupter. There is no churning up of the mercury similar to what takes place in the other types, and consequently it lasts longer without cleansing. It is true that a large amount of mercury is required at the start, but at the end it will be found that there has been very little waste as compared with those interrupters which churn it up into an emulsion. The Jet Interrupter is connected to coil and battery in the same manner as the Mackenzie-Davidson type. The terminals to connect with coil are placed on the cover of jar, and those to connect with battery for driving the motor are fitted to
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In preparing this interrupter for use the following procedure is recommended:

1. Remove the brass arm which connects the pin on cover with the cup-shaped opening on top of shaft;
2. Remove the four thumb-screws to be found on corners of cover;
3. Remove the band;
4. Carefully remove the cover to which the internal mechanism is attached;
5. Carefully wipe out the glass jar, and replace the cover;
6. Replace the four corner thumb-screws, also the band;
7. By means of a funnel, pour sufficient mercury through the hole in cover to completely submerge the pump chamber;
8. Fill up the jar to cover tops of blades with pure methylated spirits;
9. Pour a small quantity of mercury into the cup-shaped opening on top of shaft;
10. Replace the brass arm so that the point dips into the mercury on top of shaft;
11. Carefully lubricate all the bearings with the best oil;
12. Turn the milled ebonite thumb-screw to lower the tube with small hole to its full extent;
13. Make the necessary connections to coil and battery;
14. Switch current on to motor, and separate points of discharging rods on coil to a distance of four inches;
15. Start coil by turning over the commutator handle, and should no sparks take place between the separated rods turn the regulating ebonite screw to the right a little at a time until a full rich spark is obtained;
16. The mercury is cleansed in the same manner as for the Mackenzie-Davidson Interrupter.

It is very essential that all interrupter motors should be well lubricated, as they revolve at a high rate of speed, for the bearings would soon be ruined if allowed to heat from want of oil.

Motor Failures.—Provided the supply of electricity remains constant, and the bearings are well oiled, there is very little trouble to be anticipated from the motor. Often the flickering of the light in the tube is due to a slack band which does not grip the pulleys sufficiently, with the result that the motor is revolving at a higher rate of speed than the interrupter. The remedy for this is obvious. The commutator and the bearing faces of the brushes should be kept free from dirt and grease. All these will cause trouble if unattended to, and what may be only a trifling affair at first may, through inattention, develop into a serious breakdown. Should the motor suddenly cease to act, carefully examine voltage, wires, connections and brushes, and if none of these show a defect the motor should be sent to an electrician for examination, and, if need be, repair, for obviously the breakdown is serious. Failures regarding the interrupter are generally due to bad contact, resulting in an insufficient supply of current to the coil. Examine contacts, cleanse...
mercury, and if the motor is not out of order these will generally have the desired effect. Very often I have known interrupters absolutely unable to supply any current, and the owners quite oblivious of the fact that the mercury being so foul formed quite a resistance in itself to the passage of any current. All binding screws should be frequently examined, as the vibration of the motor causes them to work loose.

Electrolytic Interrupter.—In a glass jar containing a solution of sulphuric acid and water, a piece each of lead and platinum are suspended from the cover to form two poles. On the cover are fixed two terminals, one from the lead and the other from the platinum. In the passage of a current from the platinum to the lead through the solution the circuit is interrupted by electrolytic action in the latter. The number of interruptions thus effected must be enormous, as the violent electrolytic action produces a shrill note. A condenser to the coil is unnecessary, probably due to the rapidity of the "makes" and "breaks" limiting the production of self-induced currents in the primary coil. The illumination of the tube is most brilliant, and the quality of the rays very effective. So powerful indeed is the intensity of the current passing through the tube that the ordinary anode would very quickly be perforated, hence tubes in which the anode is connected to a water chamber have been devised for use with this interrupter. Although ordinary coils can be made to give increased output with an electrolytic interrupter, yet those specially wound give the best results. The specific gravity of the solution should be 1.2; and it should be possible to regulate the adjustment by exposing more or less of the platinum in the jar to the electrolytic action produced in the solution by the current. In connecting an electrolytic interrupter with a coil, it is placed in series with coil and battery, and when once connected the current cannot be reversed, as the platinum in the jar must always be positive. The voltage required is greater than for other interrupters, being at least fifty volts for a ten-inch coil. This interrupter is largely used on the continent, where it finds much favour. For screen work it is excellent on account of the steady light.

Tube Holders.—These are of various patterns, but can be divided for description into two classes, viz., stand and telescope.

Stand.—The short pattern is intended for use on a table, and the long to stand on the floor, and is very useful when taking a skiagraph of a patient in bed. All are of much the same construction, and consist of a weighted base to give steadiness, and an upright on which is secured an arm to hold the tube.
A Modified Artery Forceps

Telescopic.—This pattern can be fixed to a table top, and is very portable. It consists of a series of tube lengths, each supplied with a binding screw, and fitting into each other like the draws of a telescope. The lower length is attached to a clamp for fixing to the top edge of a table. Care is necessary in fixing that all binding screws are well secured, as the tendency is for the whole to drop when the tube is in position and the lengths are drawn out.

Tube holders to be efficient must necessarily be provided with adjustments to hold the tube in any position. Those constructed to stand on a table are of very limited utility, the pattern resting on the floor being the most serviceable. The holder supplied with a Mackenzie-Davidson's couch may be used for any purpose, as helpless patients can be accommodated on the couch.

The next paper will be devoted to the management of tubes.
(To be continued.)

A MODIFIED ARTERY FORCEPS.

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The forceps shown below has been devised to facilitate the tying of arteries situated at a depth from the surface of the body, and particularly in those cases where, owing to want of space, great difficulty is experienced in slipping a loop of ligature along the forceps already in situ. The writer has found them of great assistance in cranial surgery. The method of using is extremely simple. The ligature material, whether silk or catgut, is first looped over the notch in the lower blade and both ends crossed under the spring catch on the handle where they are held tightly. The forceps can now be applied to an artery. When the vessel has been clipped the ends of the ligature should be released and tied in a surgical knot. If the knot is tightened the ligature will be found to slip by itself off the nose of the forceps on to the artery. The forceps has been made for me by Down Bros.