CHAPTER VII.

ELECTRODES AND OTHER ACCESSORIES.

Conducting Cords. Bare Metal and Pad Electrodes. Self-retaining Electrodes for Diathermy. Vacuum and Non-vacuum Electrodes. Cord Clips. Treatment Timers and Foot Switches. Treatment Tables and Couches.

Before presenting the various electrical currents and their technique of application each the means of applying these currents to the surface or the interior of the body are presented in order to save repetition in subsequent chapters.

CONDUCTING CORDS.

Conducting cords serve to convey the current from the terminals or binding posts of the electromedical apparatus to the electrodes. They consist of fine flexible copper wire covered with an insulating substance, silk or rubber, and terminating in bare metal tips. Conducting cords should be strong, durable and pliable. Their length should be from 4 to 5 feet. Too long and too heavy cords may have a tendency to pull out of their fastening on the electrode or dislodge a small electrode. In the rare cases where, on account of the distance of the patient from the apparatus, longer cords are needed so-called double split connectors serve to join a double length of cord. To lead off two cords of the same terminal bifurcated or double connectors are employed. (Fig. 60.)

Cords of different material were used formerly for low- and high-tension currents. For the former it was customary to use light cords with an insulating layer of cotton or silk and two different colorings, red and green. The red cord was connected to the positive and the green cord to the negative terminal of the apparatus. This was done mainly to remind the operator of a wall cabinet or switchboard connected to a source of direct current that the direction of current flow was liable to change each time the supply plug was inserted in a different direction, but, of course, it did not furnish an indication of the polarity without further tests. The newer types of low tension motor generators produce a current flow of unchanging polarity from their terminals, which are plainly marked with + and − signs, and, therefore, manufacturers nowadays furnish only cords of uniform color and thickness. Sufficiently heavy copper wiring is covered with enough rubber insulation to serve for the conduction of both low-tension (galvanic-faradic-sinusoidal) and high-tension (high frequency) currents. For the conduction

of the static wave current bare copper wire is just as good as insulated wire, because when an opportunity for grounding is offered even the heaviest insulation cannot prevent leakage of this current. Rubber insulated conducting cords are not affected by immersion in water as the older type of cheap cotton-covered ones were, but they must be protected against grease and fat, which destroy the rubber.

The chief possibility of troubles with cords are: (1) A break of the copper wire inside of the cord's insulation; (2) loosening or slipping of the contact between the wire and metal tip. A break may be detected by gentle pull: the cord will "give" at the point of the break and show a certain elasticity. A convenient way to

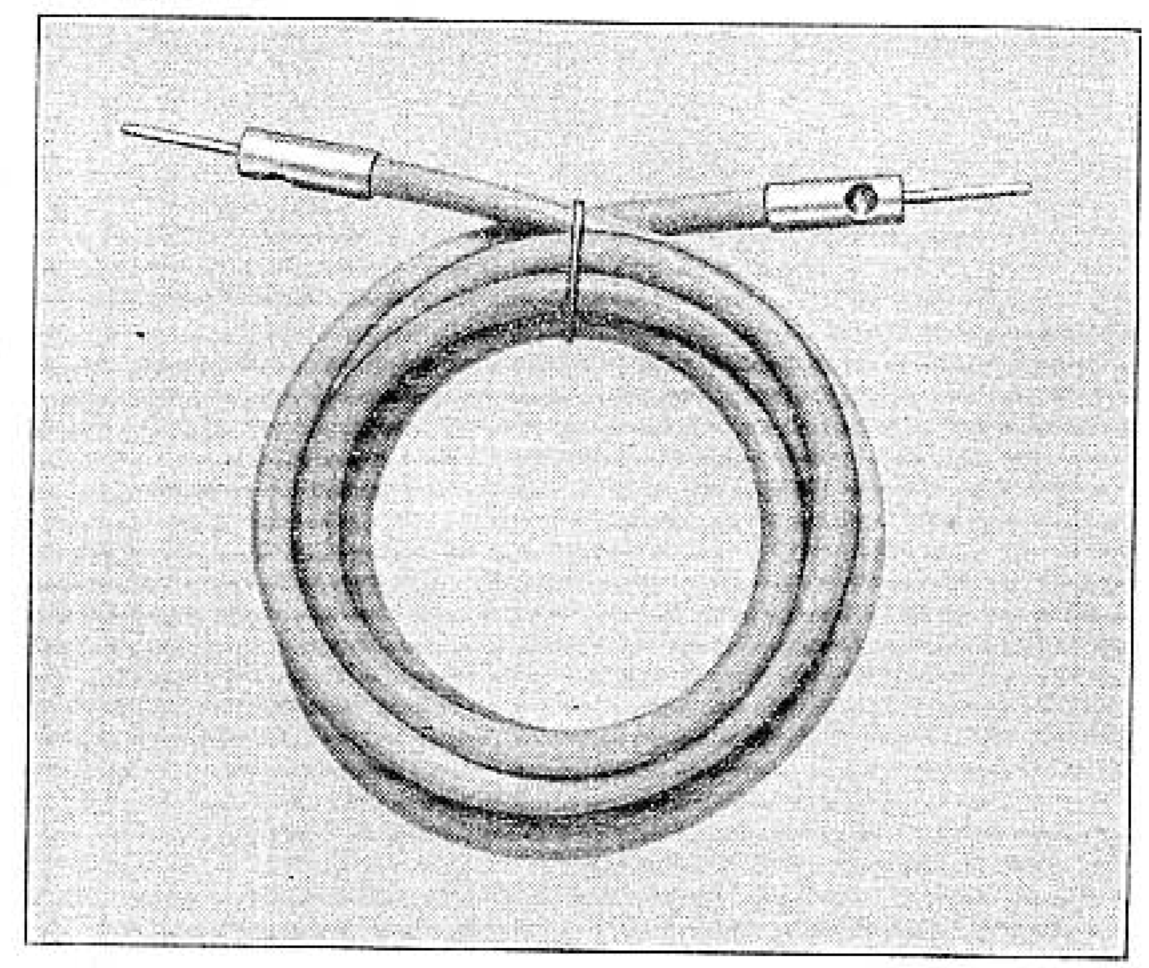

Fig. 58.—Diathermy cord.

prove that there is conduction through a cord is to connect two binding posts of a galvanic or diathermy apparatus by the cord in question and turn on a very small amount of current. If the wire is continuous and conduction is present the meter will register current at once. Broken cords are best discarded. In order to prevent the breaking of the copper wire inside of the cord the cords when not in use should be hung up and not rolled up. Loose contact between the wire and the cord tip can be easily remedied by scraping off some of the insulation at the end of the cord and tightening it by the binding screw. In order to prevent loosening at the cord tips cords should never be jerked out of the sockets but gently pulled out by holding on to their tips.

Cord tips should be kept clean from rust and metallic corrosion, especially in low-tension currents, because all such interposed material may interfere with the smooth conduction of the current. Conducting cords must be fastened securely at one end to the binding post of the apparatus, usually through a binding screw; on the other end to the electrode, usually through some clip arrangement. Supporting the cord along its way from the binding post will minimize the danger of its pulling out of the clip. Loose-fitting clips pull out easily and, causing an excessive density of current, may cause an instantaneous burn.

The various manufacturers unfortunately do not furnish the same size cord tips, and different apparatus have various size of openings on their binding posts for the insertion of cord tips. To overcome this inconvenience there are so-called cord tip adapters available; they enable to increase the size of a $\frac{3}{32}$-inch tip to $\frac{5}{32}$-inch and *vice versa*, decrease a $\frac{5}{32}$-inch size to $\frac{3}{32}$-inch one, these being the two most frequent sizes.

ELECTRODES.

The term electrode signifies a suitable surface of good conducting material through which the current is conveyed from the cord to the patient and which can be well adapted to the surface or cavity of the body under treatment. The simplest means of conducting any electrical current to the body would be by immersing the latter in plain tap or salt water, in which the tip of a conducting cord has been placed, since water is an excellent conductor and makes perfect contact with all parts. Some details of the technique of applying electricity through water will be found under Galvanic Baths. (See Chapter IX.)

For the majority of electrical treatments electrodes of plain metal, bare or covered with suitable wet padding, are used. The construction, shape and size of these electrodes vary considerably on account of the variety of purposes for which they are used. Electrodes may consist of flat metal pieces applied against the surface of the body and of variously shaped rods or cylinders for entering cavities. For surgical purposes needles or other sharp or blunt-pointed instruments are used. For some high-frequency and static treatments glass electrodes are employed. Some electrodes are mounted on insulated handles, made of wood or vulcanite, and the handle is fitted with attachments to make, break or otherwise regulate the current. Electrodes with handles permanently attached or removable are used mainly for short applications to small areas, such as in testing for electrical responses of muscles and nerves and also for treating weak or paralyzed muscles (motor point treatment).

Electrodes may be applied in pairs of even size and shape to facilitate an even flow of electricity through the area of entry and exit; at times two electrodes dissimilar in size and shape are used,

and then the smaller electrode is called the *active* and the larger one as the *dispersive* or indifferent (inactive) electrode. The effect of the current is determined by the current density and is thus greater under the smaller electrode. (See Chapter VI.)

For all around purposes electrode foil, consisting of an alloy of lead, tin and zinc, supplied in three thicknesses (18, 20 and 22 gauge) light, medium and heavy, is the most suitable and cheapest electrode material. It comes in rolls, is sold by the pound (about 50 cents

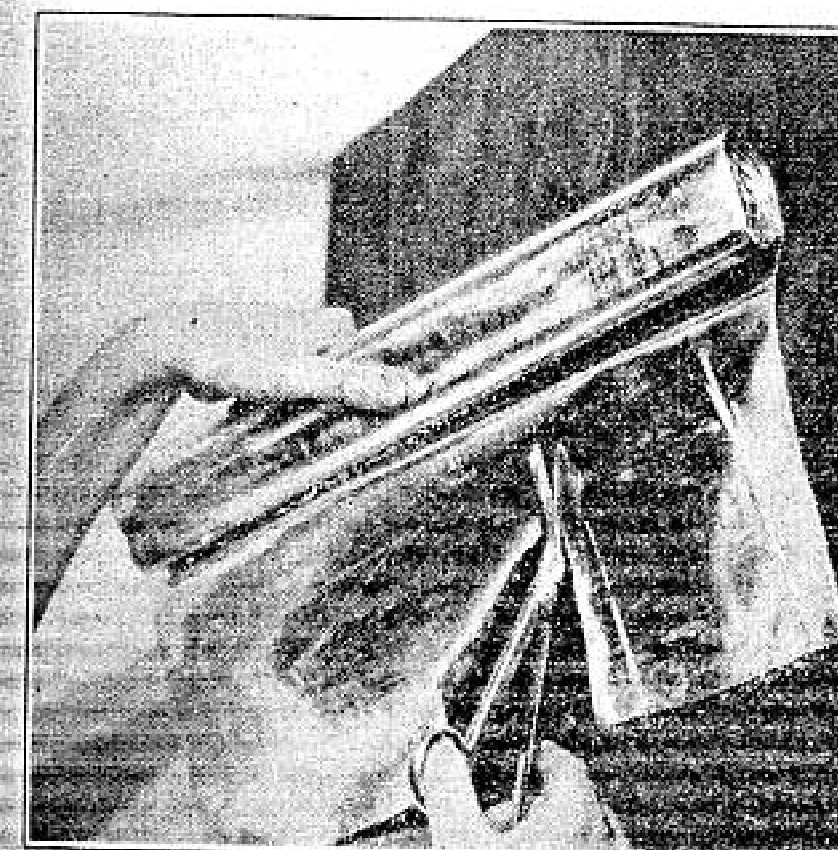

FIG. 59.—Cutting electrode foil.

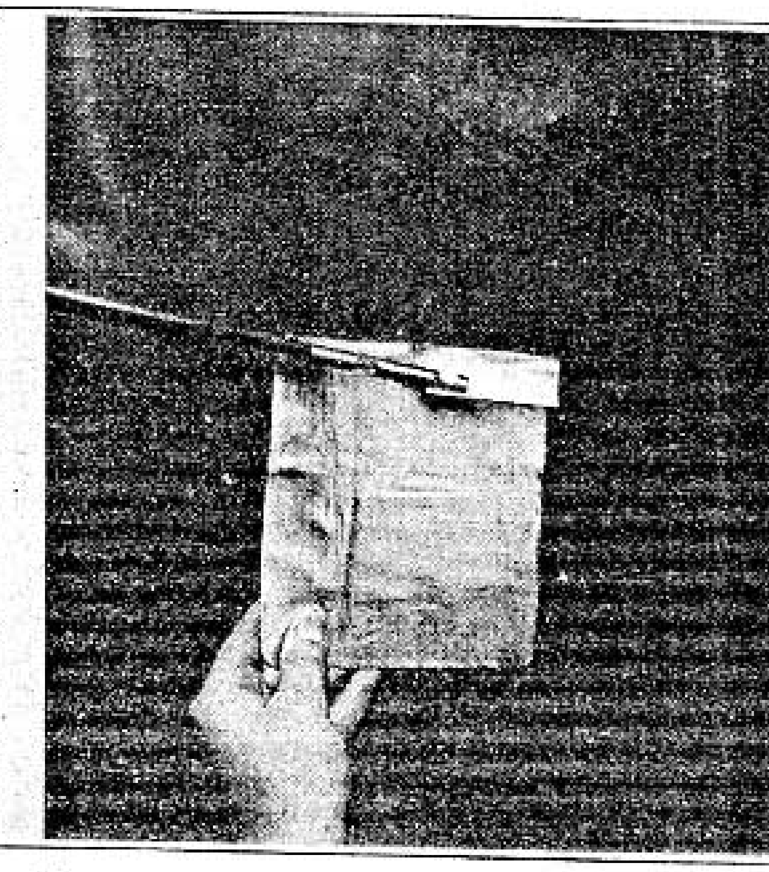

FIG. 60.—Plate electrode ready for use.

per pound) and can be cut or moulded into any desired size or shape. It is advisable to prepare a set of plain metal electrodes of various standard sizes by simply cutting them out of the rolls of metal. The following sizes are in every-day use in my clinic: 2 x 2, 3 x 3, 2½ x 4, 4 x 4, 3 x 5, 4 x 6, 6 x 8. When cutting these electrodes a small tongue, about 1 x ½ inch, is left on one side, which is folded flat against the back of the plate and serves as a convenient attachment for the cord tip. The edges of these electrodes and any

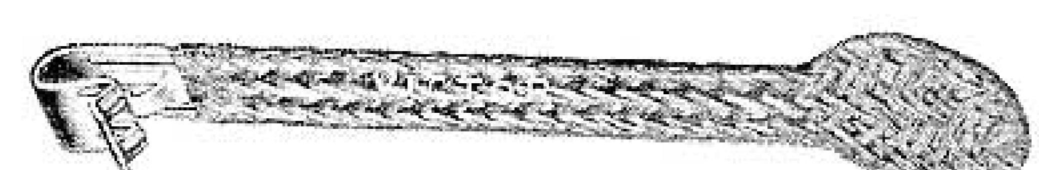

FIG. 61.—Flexible connector for electrode foil. (Courtesy of the General Electric X-ray Corporation.)

wrinkles in them must be smoothed out by a light roller like that used for photographic prints.

These plain metal electrodes are almost universally employed for the application of diathermy and the static wave current. No interposition of wet gauze, soap or so-called electrode jelly is necessary because the currents have sufficiently high voltage to overcome even the resistance of the dry skin and do not exert any electrolytic action. For the medical application of the galvanic current to the surface of the body bare metal electrodes cannot be used, on account of the inevitable electrolytic decomposition occurring under the metal and the danger of a burn due to acid or alkaline caustic action. If necessary, however, metal electrodes may be used for galvanic and other low-tension currents if four to sixteen layers of gauze are placed underneath them in sufficient width to overlap the edges of the metal by about ¼ inch. This allows for shrinkage of the gauze after it is moistened by tap water or saline solution.

Pad Electrodes for Low-tension Currents.—The ready-made pad electrodes for galvanic-faradic-sinusoidal treatments are used for routine treatments. They usually consist of a flexible metal plate covered on one side with a layer of soft rubber and bearing a suitable opening for the attachment of the conducting cord. On the side to be applied to the skin there is a pad of absorbent material of suitable thickness and strength, such as asbestos, and this is covered with linen, fastened to the metal plate in back. Electrodes are on the market in which the asbestos pad is removable. This enables better cleansing and sterilizing. The ordinary one-piece pad electrodes can be easily cleansed by soap and water, immersed in a lysol solution for sterilization and then laid out to dry until the next use. A simple method of offering a clean surface at each treatment is to cover the surface of the pad electrode with a new layer of loose sterile gauze for each patient.

In applying the pad electrodes their covering is soaked with tap water or 2 per cent saline solution. This serves to soften the horny layer of the skin and facilitates the passage of the current. The pad also absorbs and diffuses the products of electrolytic decomposition around the metal electrodes and thus prevents chemical burns, as long as the current is kept within the limits of physiological toleration. No sponge or chamois leather covering of metal discs is being used nowadays.

Self-retaining Diathermy Electrodes.—Ingenious ready-made and self-retaining electrodes have been on the market for the past few years and newer types appear constantly. Some of the principal types are: (1) Wire mesh, backed with felt or sponge, stretched over a plate and fixed by a ball and socket or other joint on a wooden frame; (2) metal plates of varying shape held opposite each other by an adjustable spring; (3) heavy metal moulded in conformance to various surfaces of the body and held by easily adjusted straps. Such electrodes have proved time-savers in busy offices and clinics because they are quickly applied and held without bandaging; they also readily allow the inspection of the site of treatment at any time. They must fit well and be secured with just the proper amount of pressure. They should be cleaned or sterilized like the

plate electrodes, and this is usually not difficult. They are, of course, more expensive and by no means replace the universal adaptability of the electrodes made of plain tinfoil. In order to insure accurate contact over delicate regions, the scrotum, finger tips, or some rounded portions of the body, electrodes made of fine mesh or tinfoil may be employed.

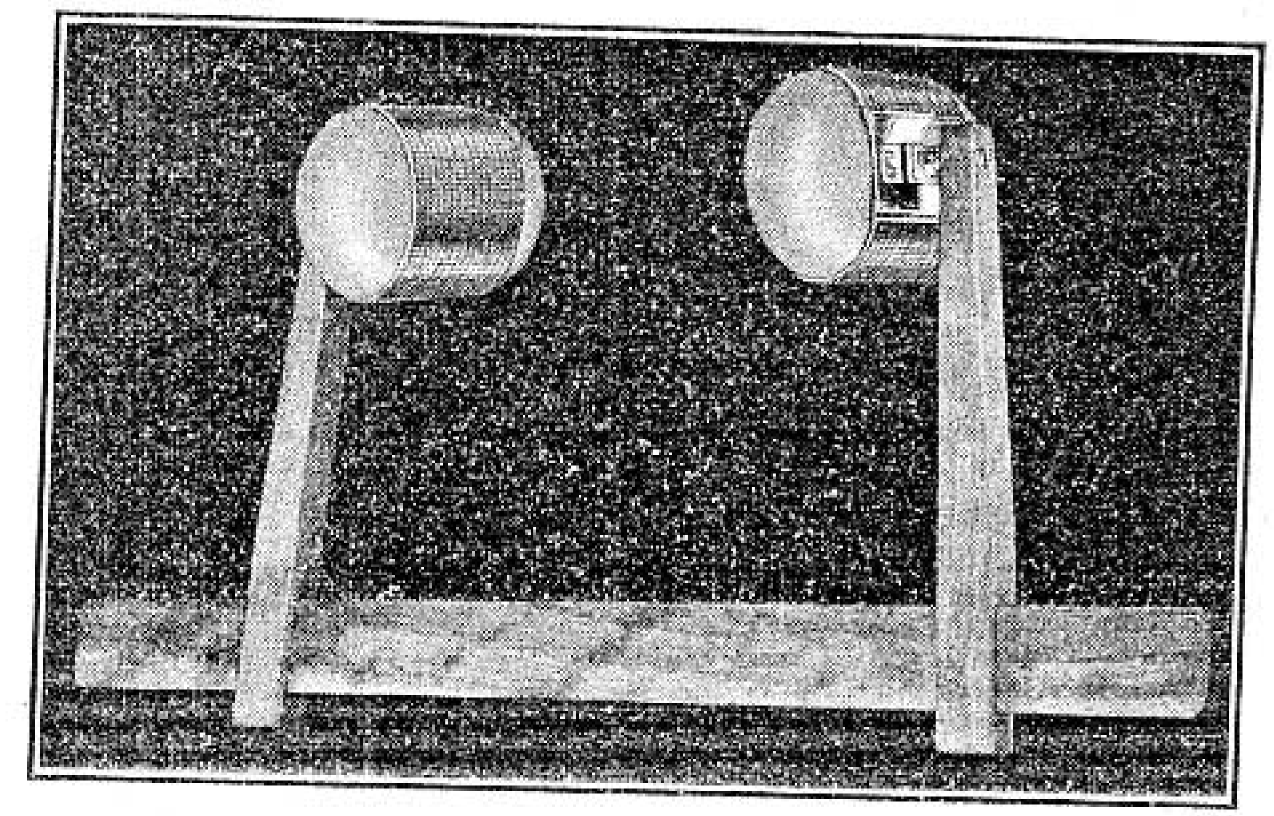

Fig. 62.—Self-retaining pair of electrodes for diathermy. (Courtesy of the Westinghouse X-ray Corporation.)

Securing the Electrodes and Cords.—Electrodes have to be applied and held snugly. Under the buttocks, the back of the chest, etc., the weight of the patient's body will hold the electrodes, and over the thigh, abdomen, front part of the chest a small sandbag and

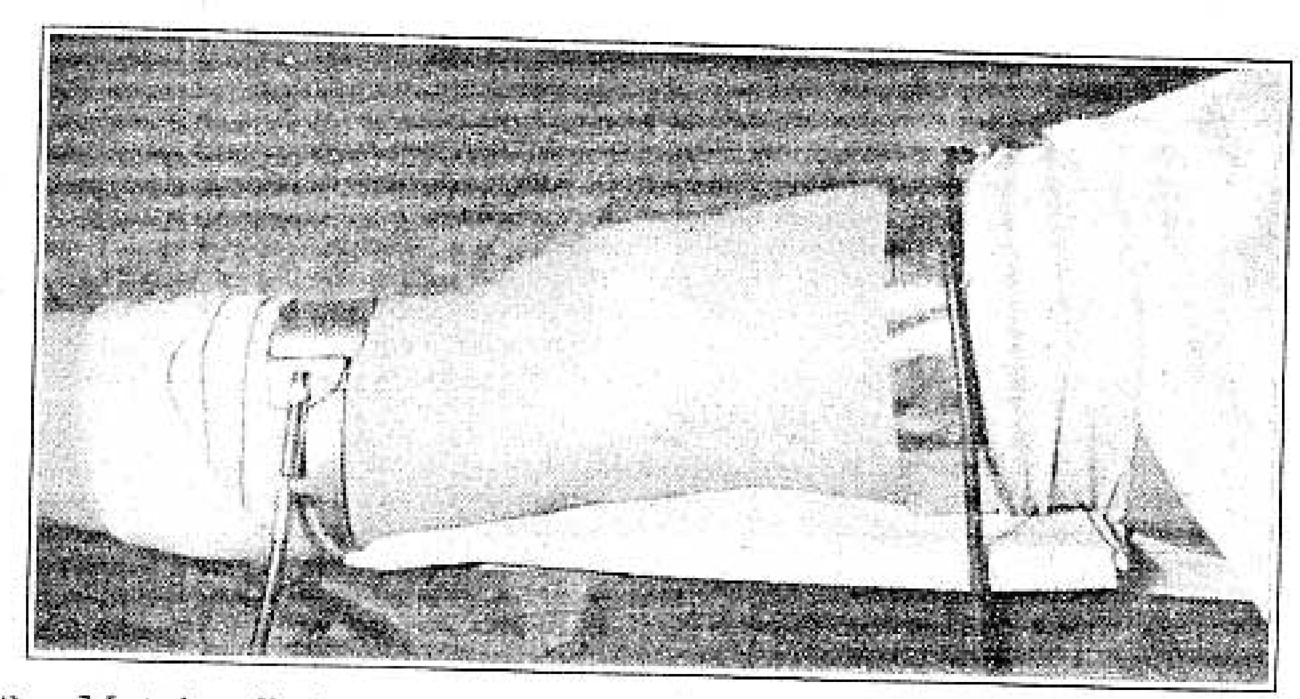

Fig. 63.—Metal cuff electrodes above and below knee. Secured by bandaging.

pillow can be utilized to hold the electrodes with the patient recumbent on his back. In applying electrodes over extremities, the face, or over rounded portions a few turns of a woven elastic bandage, 2½ inches wide, will insure an even contact. In bandaging moist pad electrodes it may be advisable to interpose oiled silk between the electrode and the bandage in order to prevent diffusion of the current due to the wet bandage, or else use a rubber bandage.

For fastening conducting cords to the back of the electrodes a variety of devices are in use, ranging from simply slipping the cord tip against the bent-over edge or tongue of the metal to the more secure fastening with clips or flexible connectors. In the low-tension pad electrodes a connection for the conducting cord is usually soldered onto the metal back, and the cord tip is held there by a spring. Such connection is subject to electrolytic deterioration and breaking and should be inspected from time to time. For the smooth application of low-tension currents all metal conducting parts, from the binding post of the apparatus down to the electrode plate, must be free from corrosion at all times and be in perfect contact.

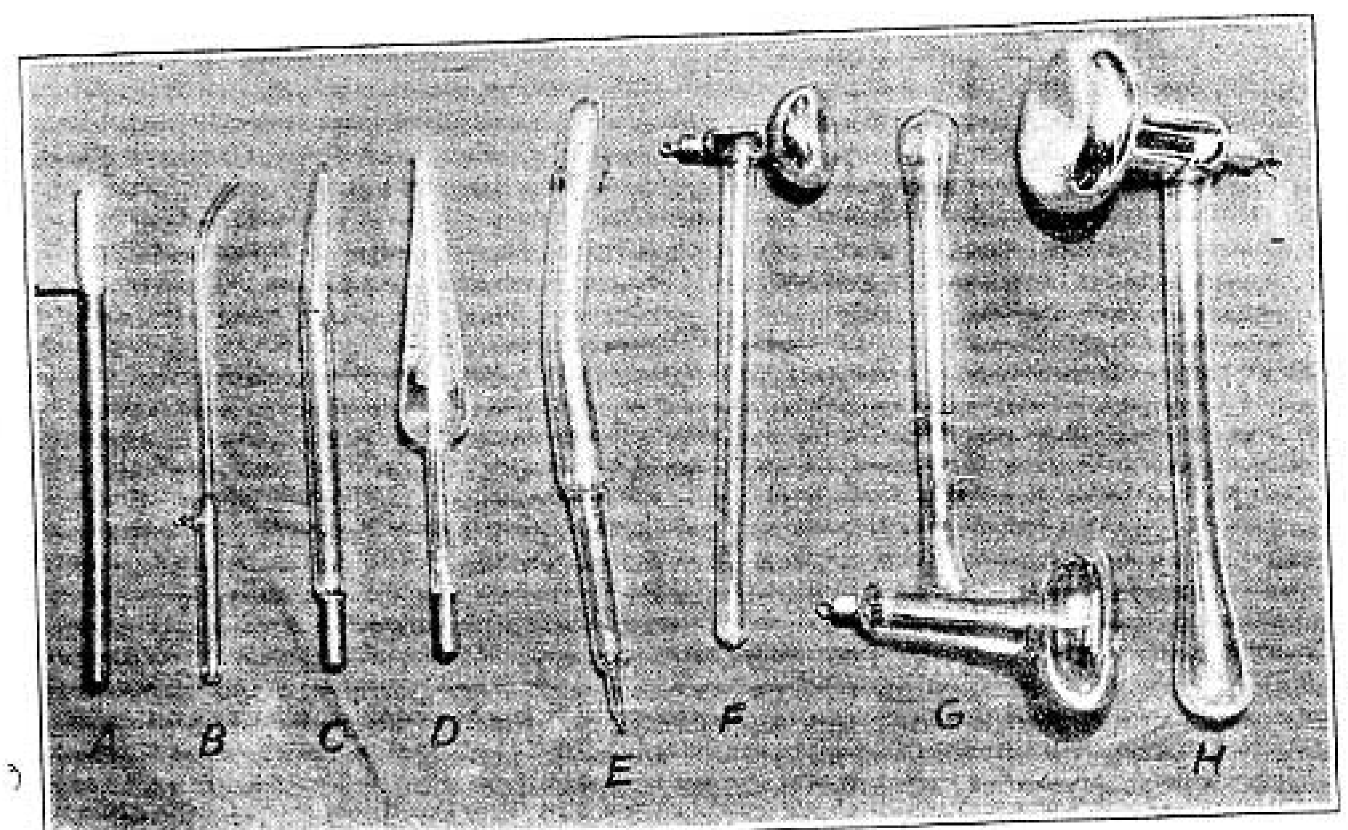

FIG. 64.—Vacuum and condenser electrodes. *A*, universal handle; *B*, nasal electrode (vacuum); *C*, rectal electrode (vacuum); *D*, rectal electrode (condenser); *E*, vaginal electrode (vacuum); *F*, *G*, *H*, body electrodes (condenser).

Vacuum Electrodes.—Vacuum electrodes serve for the application of certain forms of high-frequency and static treatments. They consist of hollow glass tubes or bulbs from which the air has been exhausted to a varying degree and to which the electric current is either conveyed by a wire passing through one end or by a metal collar surrounding the stem without any internal connection. These electrodes are made in varied shapes in order to conform to the surface of the body, nose, vagina, rectum, etc. An insulated handle is necessary to hold them, otherwise the high-tension current will leak off through the operator's fingers. When a high-voltage current is led into the vacuum tubes they light up after a fraction of a minute. The color varies in intensity with the degree of vacuum;

low-vacuum electrodes, where the air is only partly exhausted, show a reddish color and in higher degrees of vacuum the color becomes progressively pink, white and, later, apple green (high vacuum). Tubes of very high vacuum emit a very minute amount of roentgen-rays. In the Geissler degree of vacuum the air has a pressure of $\frac{1}{1000}$ atmosphere.

In the working of a vacuum tube no current passes through the glass wall to the patient, and the effect is one of induction. The metal socket of the handle or the lead in wire into the vacuum tube acts as the inner armature (coating) of a condenser; the dielectric is formed by the glass wall of the tube where it is in contact with the inner coating. The surface of the patient is the external armature of the condenser. With each rapid charging and discharging of the inner coating, charges of opposite character are induced on the outer surface and surge back and forth over the patient's body.

Condenser Electrodes.—Non-vacuum, or condenser, electrodes consist of tubes made of especially heavy glass, the inner surface is coated with silver and contains air at ordinary atmospheric pressure. The inner coat of these tubes is in metallic connection with the conducting cord from the apparatus and has a greater electric capacity than a vacuum electrode of the same size. A stronger current can thus be applied, and yet there is no danger of the tube getting out of commission due to a puncture and subsequent loss of vacuum or of breaking inside of the patient's orifices, as it has happened with the vacuum electrodes. The electrode itself does not get hot, and there is no violet glow inside, but on the part in contact with the surface of the patient's body the same minute sparking occurs.

Other Orificial Electrodes.—Besides the vacuum and non-vacuum electrodes there is a variety of appliances made of metal, copper or carbon which serve for rectal, vaginal, nose and throat and other orificial applications. They usually consist of hollow or solid variously shaped electrodes mounted on an insulated handle, the distal end of which serves for the attachment of the cord tip. Such electrodes are applicable for both low- and high-tension currents, and details of their uses will be found in the special chapters of Part IV.

A "hydrostatic" electrode for orificial use introduced by Hadley[1] consists of a sac of sausage casing, slipped over a piece of copper tubing and attached to a fountain syringe. The sac when collapsed can be placed easily through a narrow opening into a body cavity and is then expanded by water to fill the cavity. One conducting cord from a current source is slipped onto the copper tube and the other onto a dispersive electrode. The sac will hold the

[1] Hadley, L. A.: A Hydrostatic Electrode, Phys. Therap., April, 1929.

water but allow the passage of the galvanic, low-tension and low-frequency as well as high-frequency currents. This method allows the treatment of the vagina and rectum with even pressure on all surrounding tissues.

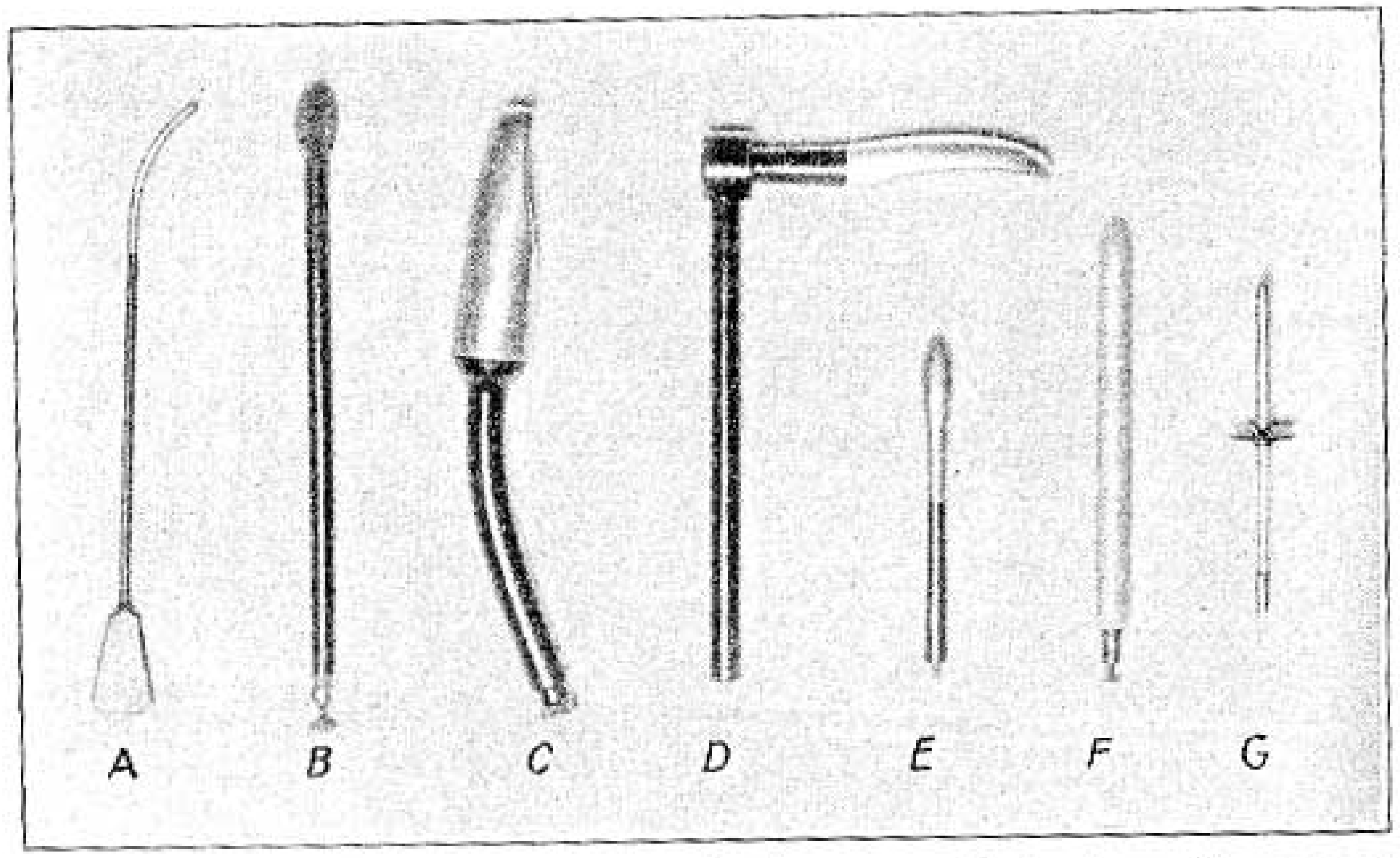

FIG. 65.—Orificial electrodes. *A*, cervical copper electrodes; *B*, carbon-tipped vaginal electrode; *C*, metal vaginal electrode; *D*, metal prostatic electrode; *E*, metal rectal electrode; *F*, cylindrical rectal electrode; *G*, electrode for female urethra.

For the safe retention of the electrodes, when not held by the operator, devices consisting of a stand, arms and clamps are available. In rectal and vaginal applications sandbags are usually sufficient, holding the electrode in a secure position.

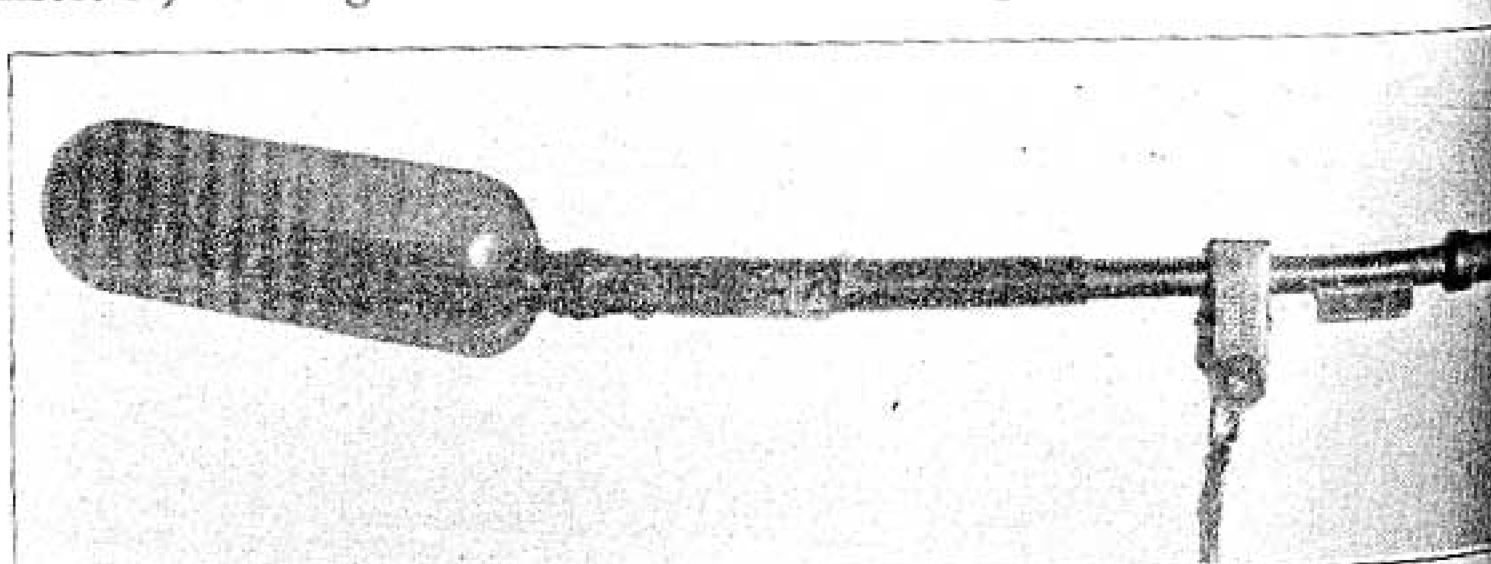

FIG. 66.—Hydrostatic electrode. (Hadley.)

OTHER ACCESSORIES.

Treatment Timers.—For the accurate measuring of treatment time, and as an added feature for safety of application, special alarm clocks or automatic clock turn-offs are well nigh indispensable. These clocks can be set usually for any number of minutes from one to sixty. Anyone practising electrotherapy should at the

CHAPTER XXI.

PRESCRIBING AND ADMINISTERING ELECTROTHERAPY.

When is Electrotherapy Warranted? Planning the Treatment. Frequency of Treatments. The Treatment Habit. Judging Results. General Rules for Electrical Treatment. Choice of Apparatus. Office Space and Office Assistance. Protection Against Radio Interference by Electrical Apparatus.

ELECTRICITY, with its varied action on the body, local and general, serves as a potent means to influence pathological and functional changes in the body. Electrotherapy allows the application of physical energies to be made by skilled hands to any part of the human system, either through the skin or through mucous orifices.

When prescribing an electrical treatment, the chief consideration should not be "Will a given apparatus fit a given diagnosis?" but rather "Will in a given pathological condition a remedial agent or a combination of agents be of benefit?" It is not electricity in itself, but the thermal, mechanical and chemical effects of the various currents that produce the desired therapeutic results. While in our mechanical age apparatus has become almost indispensable, physical therapy must not be necessarily identified with apparatotherapy. The relative value of the various remedial agents must be always taken into consideration, and the simpler methods not neglected for the complicated or spectacular ones. The prescribing and administering of electrical measures presupposes a knowledge of the theory and practice of all physical methods and real knowledge of general medicine.

A good clinician will make a better physical therapist than the man who excells only in the knowledge of physics and machinery. The real physician will always choose from all available medical, surgical and other therapeutic measures, and will not neglect all for the sake of one in which he happens to be particularly interested. Seasoned experience and balanced judgment are needed to counteract the therapeutic enthusiast who exploits a single measure for a multitude of conditions.

The application of some forms of electrotherapy should be considered when, in the opinion of the physician, it will benefit either the principal lesion or one of the main symptoms or sequelæ, *e.g.*,

as pain, or functional disturbance. This allows a wide latitude of judgment at the start, and must be, therefore, somewhat qualified. First, in every case a definite diagnosis by all known methods is essential. Uncertain abdominal pain treated with diathermy has turned out to be cancer of the pancreas or chronic appendicitis; shooting pains down the legs have been caused by a new growth in the spinal cord; a "bursitis" of the shoulder has turned out to be a traumatic neuritis of the circumflex nerve with paralysis of the deltoid muscle, and so on. It may be somewhat easier to avoid pitfalls of diagnosis in one's own patients, but it requires both knowledge and tact when a patient comes referred for physical therapy from a fellow physician. Sterotyped diagnosis, like neuritis, bursitis, chronic arthritis, lumbago, neurasthenia, on closer investigation may prove to be something entirely different. Another source of embarrassment is having patients referred with a statement that their condition is hopeless or functional only, and that treatment is to be administered merely as a placebo. A careful consideration of all factors in a given case, diagnostic, prognostic and social, will help in determining in such instances whether electrotherapy is warranted or not.

Planning the Treatment.—Fortunately, in the average patient there are usually well-defined indications or contraindications for the application of remedial agents. If some form of electrotherapy or its combination with other physical agents is deemed best, the next step is to determine what technique is to be used and how often and how long it is to be applied. In other words, an exact prescription for electrotherapy has to be given, just as in the case of prescribing drugs. To tell a patient that he should get some "electricity" is equivalent to telling him to get some "medicine." In physical therapy clinics regular prescription records are used, such as the standard sheet from the Polyclinic Medical School and Hospital, shown in Chapter XXXVII. Such charts enable the accurate prescribing of the strength, duration and technique of application of each measure and the use and recording of each treatment. On the reverse side there is space provided for a short history, physical examination, progress notes and time of discharge and the recording of the final result.

Electrotherapy is applicable at the bedside, as well as in the doctor's office and in the out-patient clinic. Much valuable time is wasted and needless suffering is maintained in hospitals which do not provide physical measures when they are indicated. This is being more and more recognized, and in many modern hospitals the physical therapy department forms a unit for treating both on in- and out-patients.

Frequency of Treatments.—Electrotherapy ought to be administered as often as required by the exigencies of the condition.

Acute and very painful conditions, as a rule, require daily treatments or even two or more per day. One designates as "bridging" those kept up just often enough, for instance, to relieve a painful condition. With improvement, the frequency can be reduced. For the average patient suffering from some chronic ailment treatment every other day is sufficient and may be administered even less often, but this, of course, depends on the diagnosis and the progress noted.

Judging Results.—No electric treatment should be continued beyond a period of reasonable length if it is not bringing about visible improvement or relief of pain. Either the diagnosis must be wrong or the treatment inappropriate if results are not forthcoming. It is impossible, of course, to make a general statement as to how soon results should be obtained, because it all depends on the individual condition. Patients very often will ask, "How long will I have to take these treatments?" In many instances the experienced physician will be able to give an approximate estimate, once he is thoroughly familiar with all the facts. If electrotherapy is directed for the relief of pain it should effect improvement within a few treatments; if it is directed toward the increase of function results must be clinically measurable and demonstrable after a few weeks.

Definite data put down on initial examination furnish the most desirable means of comparison for later examination. In traumatic conditions, for instance, one must note: (1) State of injury or repair, measurements, circumference of limbs and joints, conditions and measurements of wounds and scars; (2) state of function, range of motion in joints, strength of individual muscles or groups of muscles (grip). Electrical tests of the response of muscles, preferably by condenser testing, furnish another definite evidence for subsequent comparison.

Both in the clinic and in the physician's office a definite procedure should be established to discharge patients and record the result. Treatment should be discontinued when on repeated examination no further improvement is found in the pathology or in the function of a diseased or injured part, or when, according to one's experience, further improvement ought to take place through the forces of natural recuperation. Often, however, it may be advisable to follow a successful course of treatments, directed toward the relief of local pathology, by a course of general restorative measures.

It is not often that the physician can claim to have "cured" a patient by remedial agents, for that would imply complete anatomical and functional restoration. In the practice of physical therapy we often learn to appreciate full functional recovery more often than a full anatomical one. A knee deformed by arthritis may never return to its normal contour, but as long as it is usable and does not

pain we can state that "recovery is perfectly satisfactory" (r. p. s.). In chronic prostatitis there still may remain a palpable mass, but most of the inflammatory infiltration can be removed and the unpleasant tenesmus and painful sensations relieved, again permitting putting down "r. p. s." One may state that "the condition is improved" if at least some of the principal symptoms or some of the pathological changes have been favorably influenced. "Maximum possible improvement attained" ought to be stated when the fullest amount of restoration has been achieved and no further physical therapy is indicated.

The Treatment Habit.—Certain chronic patients have a tendency to develop a "treatment habit," insisting on a certain line of treatment indefinitely. This is no doubt undesirable and should be discouraged. Patients coming in aimlessly year in and year out may add to the physician's financial credit but never to his professional reputation. However, the other side of the picture should be considered also. If some form of physical treatment keeps a chronic sufferer comfortable and does not hold him back from other really indicated, sometimes vital, treatment it is perhaps a lesser evil to continue with such treatment, which serves both as a physical and as a moral support, than to let him drift. "The treatment habit" by physical methods is far less dangerous than by possibly habit-forming drugs.

GENERAL RULES FOR ELECTROTHERAPY.

1. Calm and business-like methods of procedure. Most patients are apprehensive when receiving electrical treatment for the first time, and a nervous, fidgety operator adds to their uneasiness. Tell the patient that modern electrical treatments do not hurt and do not burn and that there is never more current administered than he can comfortably tolerate.

2. Before the patient is brought near the apparatus one should make certain that it is in good working order, that all switches are off or in zero position and that the apparatus is properly connected up.

3. Place the patient in a position in which he will remain comfortable during the entire treatment period. Patients with lesions of the head, abdomen, pelvis and thigh or entire lower extremity are best put in a recumbent position. Treatment to the shoulder and upper arm should usually be given with the arm propped (as much abducted as possible) up on pillows on a table; treatment to elbow and forearm should also be administered with the part resting on a table. For neck or chest treatment patients may be sitting propped up in an arm-chair. For the knee or leg or foot an arm-chair with a foot-part which can be raised, like the foot-rest on steamer chairs, is convenient.

4. Inspect carefully the parts to be treated to make sure that the continuity of the skin is nowhere broken and that tactile and heat sensations are normal. Special precautions are needed in cases of recent scar tissue, peripheral nerve injuries, hysterical anesthesias. Preliminary exposure of ten to fifteen minutes to luminous heat is usually advisable as a routine measure to warm up and relax the parts and decrease skin resistance.

5. Choose the electrodes of proper material and size, moisten and warm them when using wet pads for low-tension currents and warm them up in case of plain metal plates for diathermy or static treatment. The correct position in which to apply the electrodes, transverse or longitudinal, depends on the condition to be treated. Make sure of good contact all the way through. See that the electrodes *stay* secure in the proper position. It is of advantage whenever possible to have one of the electrodes secured by the part resting upon it, while the opposite electrode is held in position by a small sandbag or by a few turns of an elastic bandage.

6. Secure the conducting cords to the electrodes and to the binding posts of the apparatus. See that these connections will stay securely fastened. With practice, the placing and securing of electrodes and the attachment of conducting cords to them can be performed in one operation.

7. Everything being ready, set a time-clock or an automatic switch for the contemplated time. Admit the supply current through the main switch. Tell the patient to report any undue sensation of pricking or heat at once, and proceed to turn on the required strength of current by gradually opening the various controls. Watch the milliampere meter for correct working and the amount of current applied. If there is any discrepancy between the patient's tolerance and the amount of current registered on the milliampere meter, never try to push up the amount of current without investigating.

8. Allow about five minutes in which to reach the maximum amount of current to be employed. This provides for gradual overcoming of skin resistance and avoids stimulation of sensory reflexes. If the patient complains at any time during the treatment about pain, burning or other unpleasant sensation, investigate, if necessary, by taking off and inspecting the electrodes and their site, making sure all switches are at zero before taking off the electrodes. Afterward turn on the current as gradually as on first starting. As a rule, never leave the patient alone during treatment; at least have an arrangement whereby, if necessary, he can instantly shut off the current himself. Most forms of modern apparatus are equipped with such a switch; make sure that the patient knows how to use it.

9. The strength of current to be employed will depend on the

size of the active electrode and the condition to be treated. Outside these primary factors, however, one must take into consideration varying temperaments and reactions of patients. The sensitive, nervous type usually stands less current at the beginning. There are patients who like to boast how much current they can tolerate and are not satisfied unless they get the maximum. (They are like the patient who does not believe that the medicine can be active unless it has a nasty taste.) In nervous children, in order to get them used to the situation, it may be advisable at the first sitting to apply the electrodes without turning on the current. It is generally more beneficial to use a moderate amount of current for a longer period than pushing up the current to the limit of toleration and applying short intensive treatments quickly.

10. At the termination of treatment turn the controls off gradually in the reverse order to that in which they were turned on. Take off the electrodes only after the current has been turned off entirely. Inspect their site carefully, noting any changes. In inclement weather do not let patients who have been considerably warmed up during treatment go out immediately; let them rest for ten to fifteen minutes.

Observing these simple precautions will greatly help to avoid embarrassing moments at the beginning of one's electrotherapeutic practice. Accidents resulting in burns or other mishaps may occur unavoidably from time to time, but as long as the physician has used a technique accepted as standard by those practising in the same community, and the accident is not the result of any neglect or improper act, he will be relieved from all unreasonable responsibility.

Choice of Apparatus.—The Committee on Physical Therapy of the Medical Society of the State of New York[1] says: "A general practitioner may possess a reasonable amount of equipment such as: (1) A lamp to administer infra-red or luminous rays; (2) a lamp to administer ultraviolet rays; (3) a diathermy apparatus for the production of penetrating heating and for the removal of superficial growths; (4) a galvanic-faradic-sinusoidal outfit, along with the knowledge of hand massage and corrective exercise in order to obtain mechanical effects. He should know how to use these measures efficiently and safely, this implying adequate previous instruction by physicians and not by a sales agent, and, not least, the allotment of proper office space for undisturbed application and for a proper length of time for each patient. A busy physician should not attempt to do much in physical therapy without the aid of a skilled assistant."

One of the most frequent and most embarrassing questions asked from teachers in electrotherapy is "What makes of apparatus do

[1] New York State Jour. Med., February 15, 1930.

you recommend?" The reply may be a counter question, "What make of automobile do you recommend?" and may be followed by the statement that manufacturers who have been in business long enough and turn out standard types of apparatus earnestly strive to give physicians their money's worth, moreover competition tends to keep the prices to a reasonable level where more money spent usually means better workmanship and materials. If the prospective purchaser can bring himself to disregard argumentation of the sales firm emphasizing some special features in the apparatus in question, he should satisfy himself (1) that it is a fairly standard type and (2) that he can expect prompt service from the manufacturer or his authorized representative. Under the conditions of ordinary medical practice a piece of apparatus practically lasts a lifetime, and the only replacements ever needed are new bulbs or burners in phototherapy apparatus.

The prices for the different types of apparatus vary as follows: A luminous heat or infra-red generator on a suitable stand, from $15 for a 150- to 250-watt device to $100 to $150 for a 1500- to 2000-watt one. Portable diathermy machines can be had from $225 upward to be run on alternating current; for direct current an additional $75 to $100 are required for a rotary converter. Diathermy machines of larger capacity sell up to $750. Small surgical diathermy outfits for both cutting and coagulation can be bought from $250 up to $1500 for elaborate apparatus. Small twin arc lamps with 15 to 20 amperes consumption sell from $50 upward; air-cooled mercury vapor lamps from $275 upward, those on direct current being somewhat less expensive. A simple galvanic-faradic outfit for electrodiagnosis run on dry cells costs about $75, one wall-plate furnishing galvanic-faradic-sinusoidal from $300 upward, while a motor generator capable of delivering the galvanic current and its many modifications are sold for $500 and more. A *used* 12-plate static machine can be still purchased for about $500 to $600, a 16-plate machine for about $900, while a new 16-plate machine sells for about $1800. A portable type of whirlpool bath, delivering a very useful combination of gentle massage and whirling hot water, without the necessity of any extra plumbing, can be bought for about $150. The price of accessories—electrodes, cords, treatment timers—need not exceed $25 for a physician starting with an outfit embracing only one basic type of each apparatus.

It thus is evident that the installation of a modest layout for the chief electrotherapeutic measures can be had for less than $1000, and can be started piece-meal on much less than that. Compared to the expense of a roentgen-ray outfit, which so far as general practice is concerned is of hardly any value for therapeutic purposes, a modest electrotherapeutic installation is for the average medical man a very useful and relatively inexpensive investment which

will pay liberal returns during a lifetime, provided that its owner will devote himself to its proper study and use.

Office Space and Office Assistance.—The question of office space for the proper use of electrical and other physical measures should not present unsurmountable difficulties. Even if the physician has only one room in which to see and to treat patients, one or two spaces, about 8 by 5 feet, can be screened or partitioned off and will hold one treatment table or cot and the apparatus and provide privacy. If there are two such spaces available one may contain a comfortable arm-chair or steamer chair in which patients can be treated in sitting position, with a comfortable support for the lower extremities. Providing electrical outlets for the attachment of apparatus is simple enough. One or two treatment-timers or automatic cut-off clocks should be used from the start to insure the methodical and efficient timing of treatments. Most busy practitioners, especially those caring for post-traumatic or compensation cases, find it of advantage to install physical therapy apparatus in a room adjoining their office, and employ a masseuse or physical therapy technician to carry out most of the technical details of the treatments. This is quite satisfactory, provided that the detailed order for treating each patient is issued by the physician himself, and that he constantly supervises the treatments and reëxamines the patient frequently. Treatments of internal medical, gynecological or such other nature as require the physician's knowledge and technical skill, of course, must be attended by him at all times.

In choosing an assistant in physical therapy those of the standards recommended by the American Physiotherapy Association (a technician's association) are naturally desirable; yet, when there is not sufficient work to warrant the employment of a highly trained person, the physician who has himself had sufficient training should not hesitate to train his nurse or any bright office attendant to assist in carrying out the technical details of many treatments. For further remarks on technical personnel see Chapter XXXVII.

Protection Against Radio Interference by Electrical Apparatus.—Installation of radio apparatus in homes has become universal, and every physician operating a high-frequency, roentgen-ray or static machine is undoubtedly often reminded by his neighbors of its disturbing influence on radio reception. In some localities there are definite ordinances forbidding the operation of electrotherapeutic apparatus in the evening hours.

As the demand for a minimum of interference by electrical apparatus is not unjustified, physicians should have knowledge of the means of protecting neighboring radio sets. The chief disturbance is due to leakage waves set up through the air and walls by the high-tension apparatus; low-volt and low-frequency apparatus causes as little trouble as an electric fan or any electric motor would. The protection against these leakage waves consists of full metallic shielding of the rooms in which apparatus is housed and grounding the metal sheath in an approved manner.

Successful protection by this shielding alone has been installed in the author's offices, located on the ground floor of an eleven-story steel and concrete apartment building, during the construction period of this building. Fine wire mesh (metal lath) was used to cover all walls in their entirety before they were plastered over. The same metal lath was placed under the flooring. The ceiling being of metal lath construction, no extra wire mesh had to be suspended. The metal lath of the ceiling, of the side walls and of the floor were all electrically connected by a network of fine copper wiring (No. 12) laid out forming squares of about 1 foot square and soldered to the wire mesh. Metal doors and frames were installed throughout and the copper wiring was also soldered on to these and then grounded. In a finished building a similar shielding can be effected by covering the walls with beaver board coated on the side walls with tinfoil and forming a panel effect.

The second somewhat minor source of disturbance of radio reception is back-surging of high frequency and other high-volt (static) currents through the house wiring. This can be eliminated by the installation of a leakage condenser and inductance (choke coil) between the line connection to the apparatus and ground for the prevention of any surge of high frequency passing back through the house wiring to the radio sets. Such a device can be installed for little cost. In the author's apartment shielding alone fully prevents any interference from four high-frequency and one static machine operated simultaneously, as proved by tests taken with a radio set inside and outside of the premises.