Electrolytic medication (ionization) : theory, technique and clinical applications.

ELECTROLYTIC MEDICATION

("Ionization")

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(IONIZATION)

THEORY
TECHNIQUE AND
CLINICAL
APPLICATIONS

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FOREWORD

THIS little treatise is presented to the dental profession not as a textbook but as a concise explanation of electrolytic medication or ionization, a therapeutic agent which is proving very successful in the hands of many practitioners in dentistry and medicine.

We take pleasure in acknowledging the courtesy and help we received in the preparation of this book by members of the dental profession, and desire to mention especially Dr. George T. Fette, Cincinnati, O., and Dr. Albert E. Sager, Rochester, N. Y. We have also quoted liberally from the writings of Dr. Ernest Sturridge, London, England, and Dr. Hermann Prinz, Philadelphia, Pa., whose knowledge of the subject and useful suggestions we gratefully recognize. Without the assistance and experience of the actual practitioner a work of this character would be of little value.

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THEORY

Definition Electrolytic Medication, Electro-Sterilization, Ionic Medication, or Ionization, as the subject is variously called, is a comparatively new and valuable method of treatment in which drugs are introduced into the subcutaneous parts of the body by means of the electric current. Just how this is accomplished may not be very clear to all, so we will endeavor to explain it fully.

Molecules All matter is composed of molecules which are defined as "the smallest particles of any substance which can exist." Too small to be seen, even under a powerful microscope. If they could be seen, they of course could be divided, and therefore would not be the smallest particles

in existence. These molecules are entirely separated from each other by spaces called pores, in which they move constantly in rapid vibration. The chemist, however, tells us that molecules are composed of particles he calls atoms. This need not destroy our idea of molecules, for when a molecule is broken up into atoms, the nature of the substance is changed, so it no longer exists as such.

Electrolytic Dissociation or Ionization

When a chemical substance is dissolved in water the force of cohesion between the molecules is overcome and the molecules become uniformly dispersed throughout the solvent. In the event that the molecules do not themselves dissociate or split up, we have what is known as a molecular solution. Such a

solution is a *non-electrolyte* because it does not conduct the electric current. An example of this would be common sugar water. If, however, in the act of dissolving, the molecules themselves split up into the atoms or radicals of which they are composed, then the solution is said to be an *electrolyte* because, upon trial, it would be found to be capable of conducting the electric current. Now this phenonenon of the molecules splitting up into their particles is called *electrolytic dissociation* because the particles, as Arrhenius discovered, contain electric charges, one positive and one negative for each molecule thus dissociated, or multiples of them, for example, $NaCl \rightleftharpoons Na^{+} + \bar{C}l$; $ZnCl_2 \rightleftharpoons Z^{++}_{n} + 2\bar{C}l$.

Ions It is these electrically charged particles which conduct, and move along with the

electric current. These moving particles were called *ions* by Faraday, indicating by the term, something "going or moving." Now since these ions are formed in the very act of the molecules dissolving, the phenomenon is also called *Ionization*, so that ionization and electrolytic dissociation mean absolutely one and the same thing. Why the ions take on electric charges in the absence of any electric current is explained by the fact that they represent a different amount of chemical energy from the atomic form which they had in the undissociated molecules—the amount of the difference being the equivalent which could be obtained from the system as electricity.

Electrolysis An electric current has the power of decomposing or splitting up some

compound substances such as chloride of zinc. This process is called electrolysis, but how is the process to be understood? We saw that $ZnCl_2$, dissolved in water, is split up, or ionized into Zn^{++} and 2 Cl^{-}. If we can remove those electric charges from the zinc and chlorin ions set free, metallic zinc and free chlorin gas would be obtained. This is precisely what the electric current does; it neutralizes those charges on the ions by its own positive and negative nature. Where or in what part of the system is this neutralization effected? We say on the electrode surfaces and only those ions are set free which come in actual contact with the electrodes (on this depends the principle of electroplating). Now in proportion as the ions in contact with the electrodes are set free, in the same proportion other ions

move up and come in contact, to be in turn set free.

Ionic Migration This causes a movement in constant direction of all the ions included between the positive and negative electrodes; this movement or transport is known as *ionic migration.* We now note particularly that electrolysis and ionic migration are inseparably associated facts which we express summarily as an electrolytic process. We cannot have the one without the other and both are impossible where ionization (molecules dissociated into ions) has not been previously had. We readily understand now why in order to have migration of zinc ions (which is the antiseptic ion) we must necessarily have electrolysis at the electrodes. If water is subjected to the electric current the

products of electrolysis will be hydrogen and oxygen. At the positive pole will be given off oxygen and at the negative pole hydrogen, and between the two poles there is simply migration of hydrogen and oxygen ions, disregarding secondary changes which cannot be discussed here.

When a compound is split up into ions (electrically charged atoms) the ions become positively and negatively charged, and those which are positively charged are repelled by the positive pole and are called electro-positive, and those which are negatively charged are repelled from the negative pole and are called electro-negative.

In considering this it is well to bear in mind that a direct current

of electricity always flows from the positive to the negative pole, so in selecting ions for ionization treatments, they must be chosen with due regard to the direction in which they will migrate, in other words, ions must be chosen which will migrate from the positive pole toward the negative pole, if the former pole is applied to the part to be treated, which is the usual procedure.

Ionization A more appropriate name is Electrolytic Medication, suggested by Dr. George T. Fette, of Cincinnati, Ohio, meaning medication or sterilization produced by means of electrolysis, the theory of which has just been explained. In decomposing water into its elements, by passing a current of electricity through it, using two electrodes,

positive and negative, the products of electrolysis or electrolytic action set up are oxygen and hydrogen, and as oxygen ions are electro-negative, they will be repelled from the negative electrode passing through the water to the positive electrode where they will appear in the form of bubbles. Hydrogen ions, being electro-positive, will appear at the negative electrode, and their charges being neutralized will come off as a gas.

In Ionic treatments the tissues of the body take the place of the water and by applying a solution containing antiseptic ions to the surface of the tissue at the positive electrode, electrolysis takes place, the electro-positive ions being repelled from the positive electrode, migrate into the tissue endeavoring to reach the negative electrode, the

same as the hydrogen ions passed through the water to the negative electrode. It must be evident, then, if antiseptic solutions are of value for treating surface infections, electrolytic treatments must also be of value for reaching organisms lurking beneath the surface, and out of reach of antiseptic lotions, for from clinical evidence at hand, we can at least feel sure that ions can be driven in, to a sufficient depth to make them useful in treating conditions beneath the surface. Zinc or copper ions will be repelled from the positive electrode, and when either of these metals is used at the positive electrode, then a salt of the metal will migrate into the tissues. The highly antiseptic properties of zinc ions are well known.

Electrolytic Medication must not be confused with the therapeutic

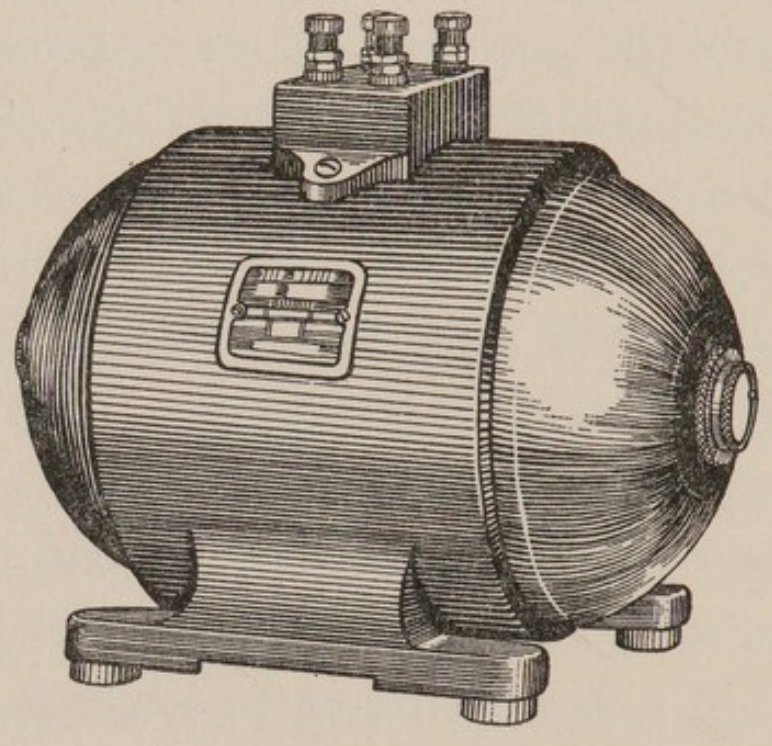
treatment formerly quite extensively used by dentists and known as Cataphoresis, this is based on the laws governing osmosis which involves the movement of suspended molecules en masse by means of the electric current, and electrolysis plays no part in these treatments.

TECHNIQUE

In applying Electrolytic Medication to the treatment of infected root canals and abscesses, certain ions must be chosen and then depend upon the therapeutic value of these for the results that are desired. At the present writing differences of opinion exist among those best qualified to speak on the subject, as to the relative merits of a zinc chloride solution and an ordinary common salt or sodium chloride solution. Both have their advocates and we cannot do better than refer the reader to an article by Dr. Hermann Prinz in the April, 1917, number of the Dental Cosmos, and to Chapters 10 and 11 of Dr. Ernest Sturridge's Book on Dental Electro-Therapeutics; also an article by Dr. Sturridge in the

August, 1917, number of the Dental Cosmos, in which he states, in substance, that chlorine, which is the sterilizing agent when using common salt, being an anion or electro-negative, does not migrate from the positive pole or electrode, and therefore can only act in a passive capacity on the surface of the root-canal, and does not penetrate the tubuli of the dentin. This agrees with the theory set forth in our definition of electrolysis, and for that reason we recommend the use of a 3 per cent. zinc chloride ($ZnCl_2$) solution in preference to the common salt solution; the zinc ion will dissociate from the chlorine at the positive pole or anode as the result of a passage of a current of only 2 or 3 milli-amperes, the zinc migrating into the tissue or dental tubuli, and the highly antiseptic properties of zinc ions are well

known. The effect of this is a destruction of the micro-organisms which have been absorbed by the tissues and to stimulate them to repair.



THE RITTER MOTOR GENERATOR

See Page 70

Only a current of electricity flowing constantly in one direction is suitable for ionization work; it may come either from a battery or from a dynamo generating direct current; alternating current will

not do. The alternating current, however, can be used for ionization work if means are provided for changing it to a direct current. This is most satisfactorily accomplished by means of a motor-generator, which consists, as the name indicates, of an alternating current motor and a direct current generator, the latter being driven by the former. Every outfit intended for giving electrolytic treatments, for operation on alternating current must therefore embody a motor-generator for converting the current from alternating to direct current.

The subject of electrolytic medication is at present receiving great attention by the leading practitioners and we earnestly recommend a thorough study of the subject, for the results that are being obtained

by intelligent application of the principles involved are truly remarkable, not alone in the treatment of root canals but in other work.

As to the advantages of ionization, Dr. Sturridge states as follows:

> "The advantages of ionic medication in dentistry are many. It is easily carried out; it is not painful as many other operations; it is effective; there are no ill effects; any discomfort caused at the time of administration disappears the instant the current is turned off; improvement is noticeable at once and is unmistakable by patient and operator; it places at our disposal a method of applying antiseptics, sedatives, stimulants, or styptics to a local

area which act in concentration on the part medicated."

"The therapeutic effects of ions on the oral tissue are to my mind of such importance that it should take the place of the present method of treatment of nearly every form of septic infection of the periodontal membrane."

"The writer has proved to his entire satisfaction that there is no pus-yielding pyorrhoea pocket about the teeth which cannot be treated and made perfectly healthy by the electrical introduction of ions into the tissues, provided that the calculus deposits which are nearly always present are completely removed."

During a recent visit of Dr. Sturridge to this country, he expressed himself on the subject of

"Ionization" as follows:

> "The technique of ionization is not difficult, but it should be based upon a thorough knowledge of electrophysics, as far as it pertains to the electrical apparatus, the conduction of current by the body and the electrolytic action of the current on drugs. Many minor phases of the action of the current are very puzzling and sometimes alarming to the patient; these should be understood from the standpoint of electro-physics, when they are readily explained and can often be avoided.
>
> Amongst these may be mentioned the stimulating action of the current on the optic nerve through its connection with the dental nerves. Sometimes flashes of light are observed by the patient; this is

due to slight break of contact or the sudden touching of a metallic filling in a tooth.

It is beyond the scope of this paper to go into details of clinical results; I might say, however, that I have good cause to be satisfied with results obtained by ionic medication, especially in the treatment of Phyorrea, and that although I have been practicing it for about twenty years, I have been reluctant in bringing forward claims of efficacy, which I have only done in recent years, after it had fully stood the surest test of all, which is time."

Current Regulator

The function of an ionization instrument, or current regulator, is to enable one to control the electric current so it can be applied very gradually and without the slightest

interruption or break in the circuit, and to convey to the operator at a glance the amount of current flowing so he can carry on the work in an intelligent manner.

The Ritter Ionization Current Regulator was designed particularly with these objects in view, and the degree of subdivision of the regulating resistance has been carried out to such an extent that the change in current strength between the divisions is not perceptible even in the most delicate operations.

The total length of the resistance element is twelve inches and this has been divided into 1200 sections, making the change from section to section exceedingly small.

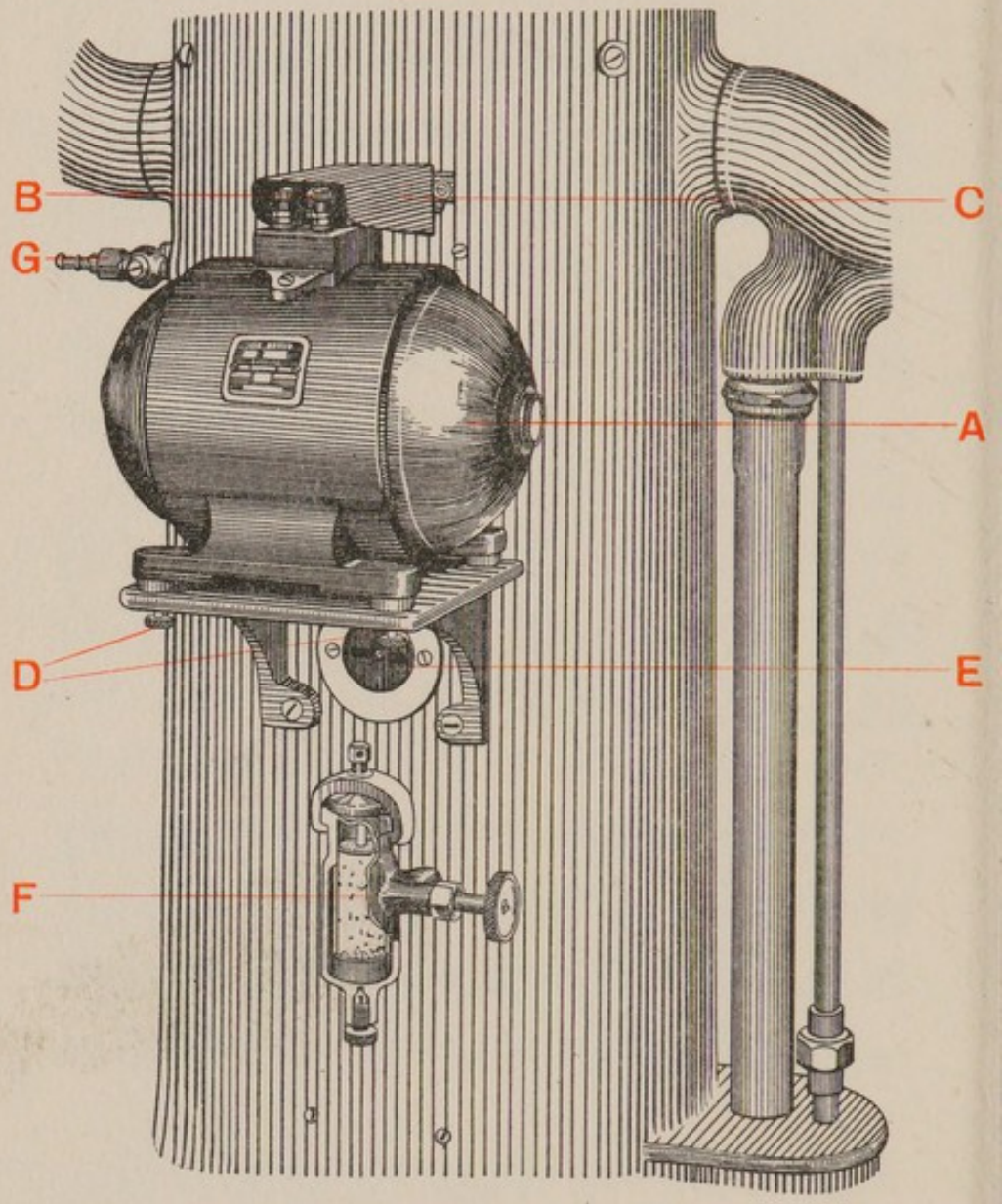
The current indicator is made expressly for us by The Weston

Electrical Instrument Company and it has a range from 0 to 10 milli-amperes with divisions readable in 1/20 of a milli-ampere. It not alone indicates the current flowing, but measures it accurately. A correcting device is provided whereby the needle can be adjusted so it will always rest or remain at zero when no current is flowing.

NOTE—Directions explaining how to use The Ritter Portable Ionization Equipment will be found on page 31.

Regulator on Ritter Unit Equipments

The complete Ionization outfit as furnished on The Ritter Unit Equipment consists of a small generator mounted on the back of the pedestal which supplies the necessary direct current, and this is started and stopped by means of



Section of Back of
THE RITTER UNIT EQUIPMENT
Showing Location of Ionization Generator

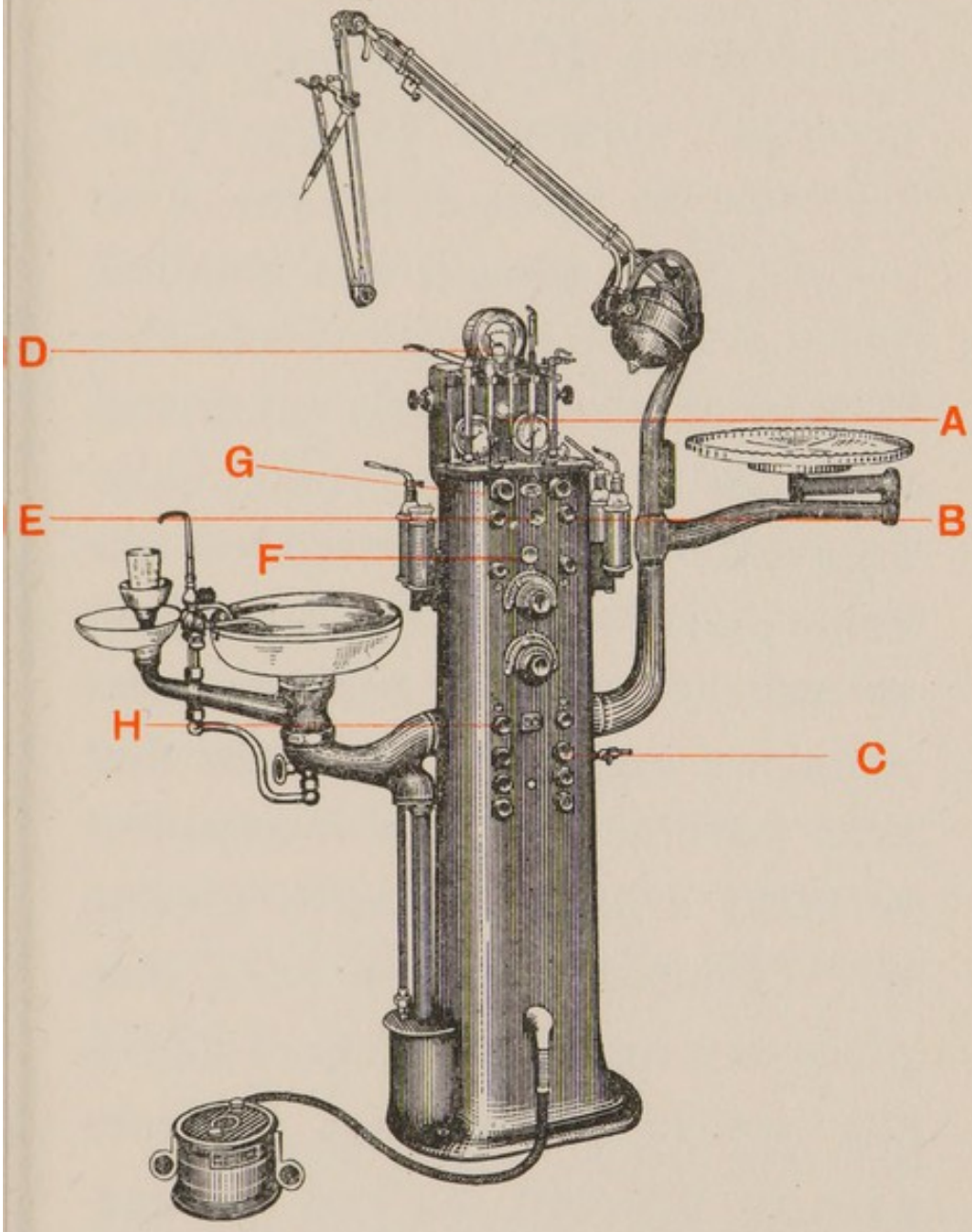
A—Ionization Generator
B—Binding Posts for Wire Connections
C—Cover for Wires
D—Thumb Screws for Holding Generator to Supporting Bracket
E—Branch Circuit Plug
F—Air Filter
G—Gas Cock

the switch marked "Ionization Generator Switch," see illustration of face of pedestal, page 29. The master switch, of course, must also be closed so pilot lamp is burning. The gradual application of the current is accomplished by turning the "Ionization Regulator Button," see cut page 29, to the right, or clockwise, starting at zero, as indicated on the dial just below the "Regulator Button," and turning very slowly.

The graduated dial has no particular bearing on the use of the instrument, excepting that it indicates to what extent the regulating resistance has been passed over; it is divided into 100 divisions, and if 50 divisions have been passed over when a treatment is finished it merely indicates that one-half of

the resistance has been cut out of the patient circuit by the movable brush. It does not give a reading in volts, but is simply an arbitrarily chosen scale to aid in the intelligent use of the instrument.

The milli-ampere meter at the top of the pedestal will register the amount of current flowing, if the polarity is correct. If the polarity is wrong the needle will move to the left, away from the scale, instead of moving over it. The plug with red and green cords attached, must be plugged into the two socket bushings on face of pedestal, marked "Ionization Terminals," *the red cord being the positive and the green negative,* and care must be taken to put the plug in accordingly, having reference to the markings on the name plate.



THE RITTER UNIT EQUIPMENT

A—Pilot Lamp
B—Ionization Generator Switch
C—Ionization Generator Fuse
D—Milliammeter
E—Ionization Regulator Button
F—Ionization Regulator Dial
G—Master Switch
H—Ionization Terminal Socket
Patient Circuit

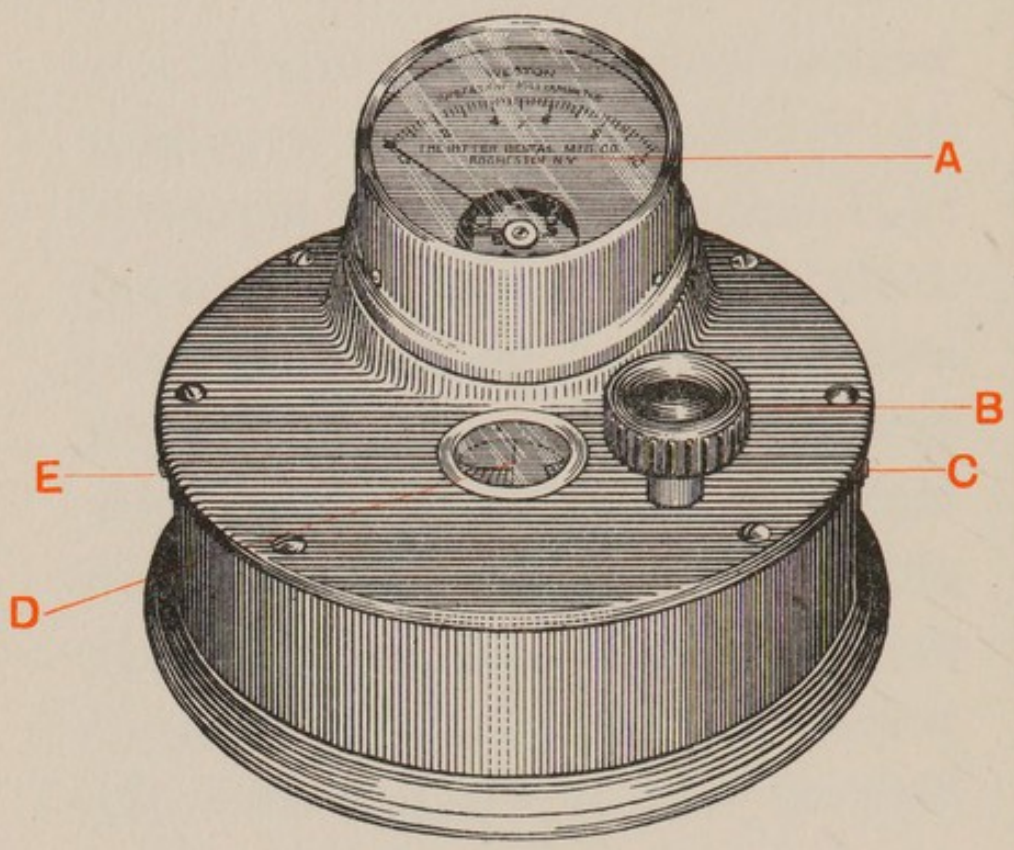
Polarity of Ionization Current on Ritter Unit Equipments

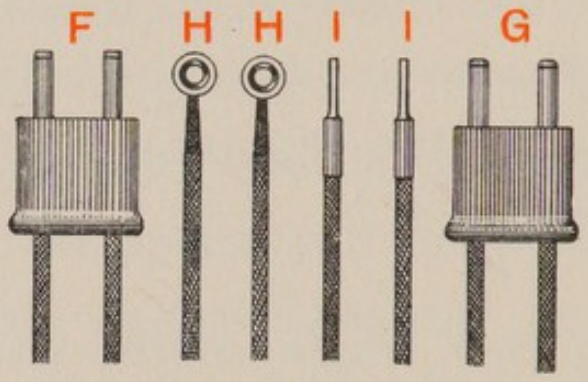
If the supply wires were properly attached to the Unit when it was installed, and the Ionization Generator also properly connected, the polarity of the two socket bushings will be as indicated on the name plate on face of pedestal; but to make sure that no mistake was made we suggest, at least the first time before using the instrument, to make a polarity test by placing the regulator button on zero, then place the moistened fingers across the two socket bushings on front face of pedestal marked "Ionization Terminals" and turn regulator button slowly until the milli-ampere meter shows current, if the needle moves over the scale, polarity is correct, if needle moves to the left, polarity is wrong.

Regulator on Ritter Portable Ionization Equipments

The portable ionization regulator may be placed in any convenient location, either on a small stand beside the chair or on the bracket table. Two cords are furnished, one for making connection between the generator and the portable regulator, the other for connections between the regulator and the patient, and each cord has a plug connector on one end which fits into a socket in the regulator as shown on page 32.

The two single cords, one red and the other green, are intended for connection between patient and regulator, and the red is "Positive" and the green "Negative" and they must be connected accordingly. The same also applies to the cord between regulator and generator,





THE RITTER IONIZATION CURRENT REGULATOR (PORTABLE)

A—Milliammeter
B—Regulator Button or Knob
C—Receptacle for Generator Terminal Connection Plug
D—Regulator Dial
E—Receptacle for Patient Terminal Connection Plug
F—Connection Plug for Patient Terminal Receptacle
G—Connection Plug for Generator Terminal Receptacle
HH—Connection Terminals for Generator
II—Connection Tips for Electrodes

red to "Positive," and green to "Negative." A suitable switch must be provided for starting and stopping the motor generator or motor-transformer as the case may be, for the button or knob on the regulator has no control over the current going to the motor, it only regulates the current going to the patient.

The gradual application of the current is accomplished by turning the button on top face of the regulator to the right, or clockwise, starting at zero, as indicated on the dial, and then turning very slowly.

The graduated dial has no particular bearing on the use of the instrument, excepting that it indicates to what extent the regulating resistance has been passed over; it is divided into 100 divisions, and if

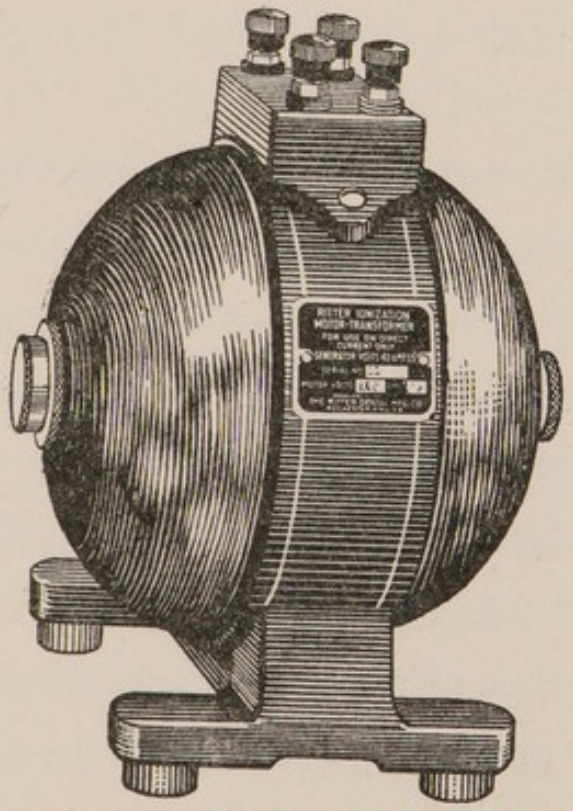
50 divisions have been passed over when a treatment is finished it merely indicates that one-half of the resistance has been cut out of the patient circuit by the movable brush. It does not give a reading in volts, but is simply an arbitrarily chosen scale to aid in the intelligent use of the instrument.

The milli-ampere meter will register the amount of current flowing if the polarity is correct. If the polarity is wrong the needle will move to the left, away from the scale, instead of moving over it. If this should be the case, examine the connections to ascertain the reason for it.

Danger From Shock

As the current used on the Ritter Ionization Equipments is derived from a small generator

whose winding is in no way connected with the main supply current, there is positively no danger from shock, either to patient or operator, so it is unnecessary to insulate the chair or to cover the patient with a rubber apron as suggested by some writers.



THE RITTER MOTOR TRANSFORMER

See Page 70

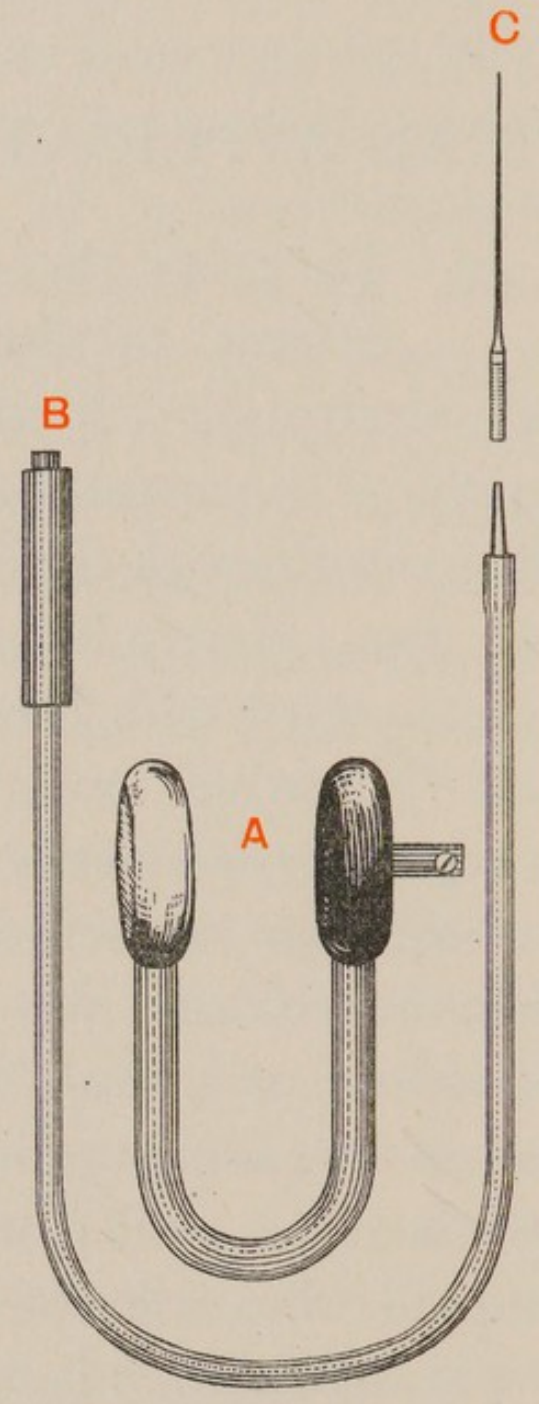
Some current regulators for ionization treatments are constructed

to operate from 110 volt direct current supply mains without the introduction of a motor-transformer such as is used by us. To make such a regulator is, of course, a very simple matter, but it exposes both patient and operator to great danger from shock and we would not, under any circumstances, recommend the use of such a regulator.

The motor-transformer reduces the direct current main line voltage from 110 or 220 to about 40 volts, which is enough for ionization treatments, and the transformer or generator is not electrically connected with the motor so all danger from shock is eliminated. The motor-transformer adds to the first cost, but security from severe shocks amply compensates for the additional outlay.

CLINICAL APPLICATIONS

Electrodes To cause the electric current to flow and produce electrolytic Medication (ionization) it is necessary to have a closed circuit through the body by applying two electrodes, which must be connected with the "Positive" and "Negative" poles of the current regulator by means of the plug and the two cords furnished. The positive electrodes may consist of zinc, copper or iridio-platinum, but there is an advantage in using an electrode of the same metal as is contained in the solution being used, for if the solution is exhausted during a treatment, ions will still continue to migrate into the tissues as a result of a decomposition of the electrode. *The zinc or copper needle-like electrodes sup-*



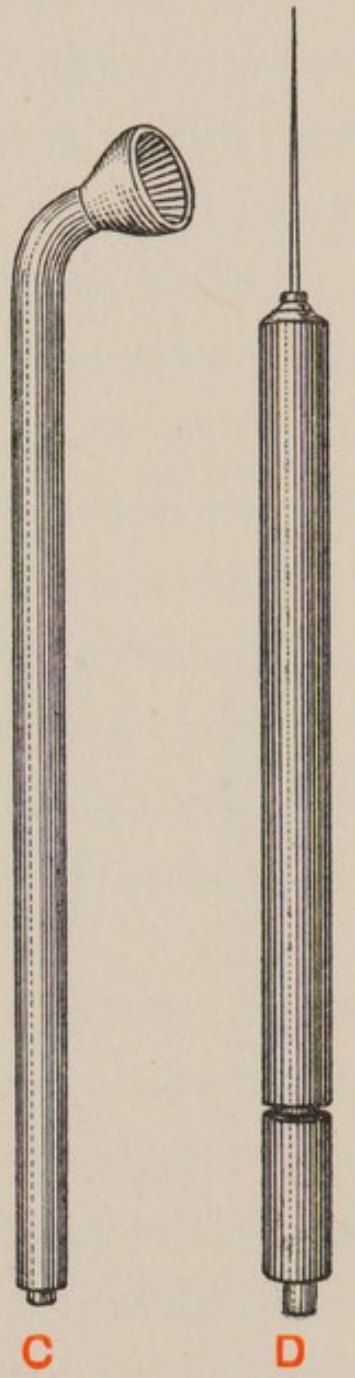
A—Ritter Spring Cheek Electrode

B—Ritter Flexible Holder

C—Ritter Wire Electrode with Spring Socket for Flexible Holder

plied, are made in tapering form so they are better adapted to suit all conditions, but as it is advisable to always use electrode needles of the largest possible cross section or size, so as to reduce the current density per given area, they may be shortened until the correct size or diameter is obtained. The positive electrode holders may be made in several ways, but we believe those supplied by us will be found all that are necessary.

The spring cheek electrode, shown on page 38, is for attaching to the negative pole and must be clamped around the patient's cheek. Operators who have used this style of an electrode for the negative pole claim that patients never complain of the tingling sensation which always seems to be present, more or less, with a sponge elec-



C—Ritter Cup Electrode

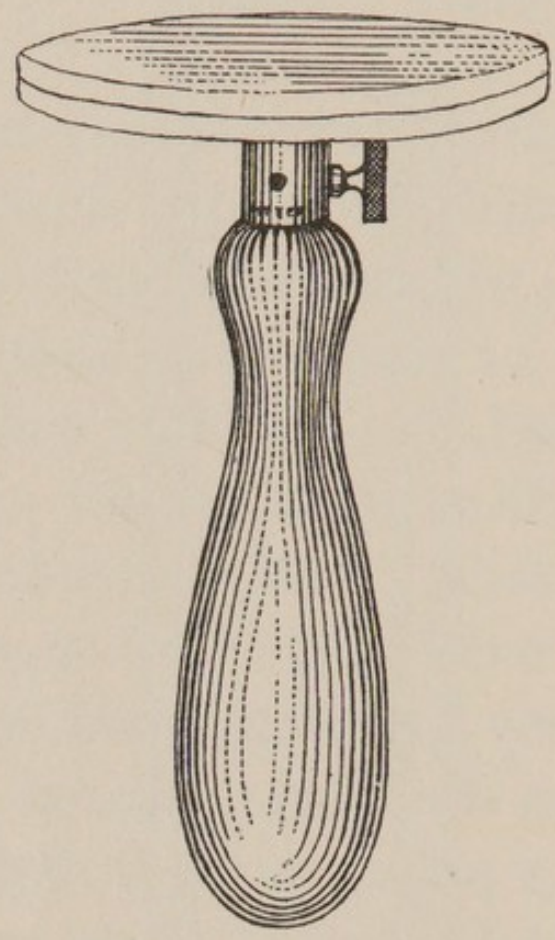
See Pages 52 and 67

D—Ritter Holder for Wire Electrodes

trode fastened to the face or wrist, and the current can be carried to the maximum much quicker on this account.

The other electrode may consist of a pencil-like holder shown on page 40 with a chuck for holding the zinc or copper wire electrodes in one end, and the other end provided with a connection for attaching the cord. This electrode may be held in the hand of the operator, or it may be simply laid in the mouth on the rubber dam, as some operators prefer to use it, but care must be taken not to allow any exposed metal to come in contact with the skin.

We have also provided a flexible holder for special spring socket wire electrodes as shown on page 38; this we have found very satis-



THE RITTER FACE ELECTRODE

See Page 66

factory and the method of applying it is explained on page 47.

IMPORTANT—If zinc wire is to be used for the positive electrode needles, then only chemically pure zinc will do, for if it contains arsenic and antimony serious results may follow, so do not, under any circumstances, use the ordinary commercial zinc. We can supply pure zinc or copper pointed, blunt or flat wire electrodes in any quantities desired.

Root Canals

The root canal of the tooth to be treated must be mechanically cleansed of its debris, and if necessary enlarged so as to give free access to the wire electrode. Chemical means may also be used to cleanse the canal before treatment, by the use of sodium potassium, pheno-sulphonic or Dr. Dakin's

solution.* The rubber dam may now be adjusted and before beginning the ionization treatment, the canal must be dried thoroughly, so no trace of moisture is present; this is important.

If the rubber dam cannot be applied, then the tooth must be kept dry by other means. Dr. Fette suggests in treating teeth on which the rubber dam cannot be used, to slip a piece of gutta percha over the needle, apply the cotton fibre as explained farther on, insert the needle and then slip the gutta percha forward on the needle until it seals the top of the tooth so no moisture can enter.

Place the negative or cheek electrode in the mouth by clamping it around the cheek with *the metal*

*See Dental Cosmos, October issue, 1917.

disc on the inside of the cheek, and the disc must be completely wrapped, so no metal is exposed, with several thicknesses of Japanese bibulous paper, moistened with sterile water, which will insure good connection, especially in a dry mouth, and prevent blistering. Another method is to cover the metal disc by slipping a little sack of felt over it, about $\frac{1}{32}''$ thick, and this must be thoroughly saturated with water. Several of these bags should be provided so there is always a sterile one on hand. The green or negative cord must be connected with the cheek electrode. Do not use zinc chloride on negative electrode. Place the plug connector with the red and green cords attached, into the socket bushings on the front face of pedestal marked "Ionization Terminals," or if it is the Ritter portable Regu-

lator, place plug connector into socket marked "Patient Circuit," on regulator, and then start the Generator as already explained, and if the poles are correct, introduce a 3 per cent. zinc chloride solution into the canal, being careful that it does not overflow, then introduce the positive electrode into the canal as near the apex as possible, and if it fits too loosely, wrap a few fibres of cotton around it moistened with the zinc chloride solution. The zinc chloride solution is preferably introduced by wrapping the zinc electrode with cotton fibre and saturating it with the solution, then inserting it into the root of the tooth, *almost to the apex but preferably not through it. Care must be taken to prevent the solution from overflowing the tooth and thus transferring the current to the gum tissues.*

The positive electrode may be held in the hand or any means may be resorted to for holding it which answers the purpose, simply taking care that no metal part of the positive electrode touches any part of the mouth so that a short circuit occurs. The electrode must not be disturbed during a treatment.

The flexible holder for special spring socket wire electrodes shown on page 38, provides an excellent means for applying the current. Wrap the wire electrode with sufficient cotton fibre to hold it firmly in the tooth and then saturate it with the solution. The wire electrode may be held in place also by passing it down over the chin of the patient and then placing a rubber elastic over it and around the head.

CAUTION—Be very careful not to short circuit the two electrodes, that is, do not let them come in contact with each other if the regulator dial stands off zero, if so the current through the milli-ampere meter will be too great and may damage the instrument.

The Ionization Regulator button must now be turned clockwise very slowly until the patient makes known by raising the hand that the current is painful, when it should be immediately reduced a little until the pain ceases, then advance the Regulator again very slowly and it will be found by proceeding in this manner that a point will soon be reached beyond which you cannot go without pain. When this point is reached the current should be left on for from 5 to 10 minutes, and the electrode must not

be disturbed or removed from the tooth while the current is on, otherwise the patient will experience a shock.

Dr. Hermann Prinz of Philadelphia, Pa., suggests an excellent rule for determining the length of time the current should be left on after the so-called "irritation point" has been reached, which he explains is the point or reading on the milli-ampere meter which it is impossible to exceed without causing pain. At this point take the milli-ampere meter reading and divide the numerical constant 30 by it, and the quotient will be the time in minutes for which the current should be applied. For example: if the milli-ampere meter reads 3 when the "irritation point" is reached, the current should be left on for 10 minutes, $30 \div 3 = 10$. While this

rule will apply in most cases, it seems to be the general opinion of those who have had considerable experience in the practice of ionization that it is not advisable to continue any treatment longer than 15 minutes, it being better to give two or three short treatments instead of a single long one. This should include the time consumed in reaching the so-called "irritation point."

Many find this rule excellent, but others do not leave the current on as long as indicated by this rule, and also get good results, so each operator will have to determine this for himself.

Dr. Fette states that with a zinc electrode the zinc chloride solution does not require replenishing during a treatment, but if the conduction is not good to start with he

returns to zero, replenishes the solution, and then starts over again. When the current has been once properly established, say 2 milli-amperes, he never disturbs the electrodes, but if there is a falling off in the current he simply steps it up by means of the regulator.

When the treatment is completed the Regulator button must be returned to zero, as indicated on the dial, before the electrode should be removed, otherwise the patient will receive a shock.

The average current used is usually about 2 to 3 milli-amperes.

When no apical abscess exists and there is reasonable certainty of aseptic conditions in the root canal and the ionization treatment was undertaken simply to make certain

of complete sterility, one treatment is usually enough and the canal should be filled immediately.

Zinc Chloride being caustic, the canal must be entirely free from it before filling.

If a tooth to be treated has a metal filling in it which is touching the mucous membrane, it should first be removed, otherwise the current is diverted from the canal. Each root canal of a multi-rooted tooth is preferably treated separately.

A haemorrhage following the removal of a nerve may be quickly arrested by giving a treatment with the usual chloride of zinc solution; coagulation of the blood takes place quickly.

After filling root canals, if the patient complains of soreness, this may be relieved by treating the gums with magnesium sulphate solution, using the cup electrode shown on page 40.

(See also pages 66 and 67.)

Abscess Treatments

In the treatment of apical abscesses, after the canal has been opened, chemical or mechanical means should be used to cleanse the *canal,* as already explained. This complete, apply the ionization treatment same as explained under the heading "Root Canals."

If considerable inflammation and pain exists, Dr. Fette suggests the use of iodin-ions to relieve this condition and would treat with the zinc ions at a subsequent sitting. He has obtained excellent results in

such cases and recommends the use of Lugol's solution, which consists of 5 parts of iodin crystals, 10 parts potassium iodide, 100 parts water, by weight; iodin-ions are counter irritant and have a remarkable softening effect on the tissues. Lugol's solution may be obtained from druggists.

Tincture of iodine is not an electrolyte and therefore is of no value in ionic treatments.

IMPORTANT — When using the above solution, namely, Iodin-ions, the negative pole must be applied to the part undergoing treatment, for iodin-ions are electro-negative and will therefore be repelled from the negative pole into the tissues.

Lugol's solution is black, but while undergoing electrolysis the

color gradually disappears until finally the cotton fibre on the needle will appear in its original condition, which is an indication that the treatment may be stopped, or the cotton replenished and the treatment applied once more, and as iodin-ions travel faster than zinc ions, the length of time for applying the current should be about one-third as long as when using zinc ions. It will be found that four or five minutes is time enough for iodin treatments. Either zinc or iridio-platinum needles may be used.

Following this treatment, about 36 or 48 hours, the zinc chloride treatment should be given, and repeated the second and third time, with intervals of two or three days intervening until sterility is complete.

If the canal near the apex is restricted so it is difficult to get the needle in, force a little additional solution to the apex; after the first zinc-ion treatment it will be found that the canal can be enlarged mechanically very easily, for the chlorine combines with the water forming hydrochloric acid which attacks the calcium of the walls of the canal. The needle should be wrapped with cotton fibre and then the solution applied, and twist the needle in the canal so it is held firmly, but do not push it through the apex.

In this connection we might add that no harm will result if the needle is passed through the root and into the abscess area, but the resistance to the current will be greatly reduced, that is, the conduction will be much better, and

if the needle should be pushed through while the current is being applied the milli-amperes would suddenly increase considerably the instant the point of the needle pierced the end of the root, thereby giving a slight shock to the patient. Dr. Custer of Dayton, Ohio, has suggested this as a means of accurately measuring the exact length of a root canal.

If a small part of the zinc needle should be accidentally broken off in the canal, and it is difficult to remove it, it is very improbable that harm will result if it is left in, for it will soon be electrolized by the body fluids and keep on furnishing zinc ions in the interim.

In extreme pus conditions it may sometimes be necessary, after the second or third zinc chloride treat-

ment, to add a little sulphuric acid, say such that the sulphuric acid constitutes one-fourth of the solution, the other three-fourths being zinc chloride.

Sometimes after treating the tissues, there may be slight discomfort to the patient for an hour or more, but it is only slight and is soon followed by a feeling of benefit. To lessen the discomfort, the gums may be painted with tincture of iodine.

To practice these treatments intelligently, bacteriologic tests should be made, but if this is impossible, make a smear, and examine it under a microscope to determine the specific micro-organisms producing the inflammation. Before each treatment a smear should be made to determine what

effect the ionization treatment has had, or to what extent the micro-organisms have been eliminated, and the canal must not be filled until all traces have disappeared.

After electrolytic treatments it is advisable to wipe out the excess of solution, if any, for free chloride of zinc is very caustic, and without using any dressing whatsoever, but the *cavity* should be immediately filled after each treatment with temporary stopping to protect the canal from further infection during the periods between treatments. Leaving the canal open allows a vent, or an expansion chamber for gases, or for the proliferation of any micro-organisms which have not been entirely obliterated by the ionization treatment, and you make your patient more comfortable and eliminate most cases of sore tooth.

Three treatments with zinc chloride are usually enough.

Pyorrhea Treatment

In pyorrhea pockets, after thoroughly scaling, wrap a flat zinc electrode with a little piece of cotton saturated with a 3 per cent. solution of zinc chloride, introduce it into the pocket and then treat in the usual way, running up the current to two milli-amperes, or three if the patient will allow it. Keep the current on from five minutes to fifteen minutes. If scaling is difficult treat first with Lugol's solution as explained on page 54, then follow at the next sitting with zinc or copper treatment. It will be found that in the interim the gums have receded so the deposits can be easily removed. As it is impossible to insulate the tooth as in root canal work, care

must be taken that the current is not diverted as a result of flooding with solution.

A copper electrode may also be used with a 2 per cent. copper sulphate solution. In bleeding gum conditions copper-ions are very desirable. If pocket is restricted so it is difficult to use the electrode wrapped with cotton, use it bare.

If there is any tendency for the copper electrode to adhere to the tissues, reverse the polarity of the current for a few seconds before removing it, as explained under heading "Alveolar Fistula," page 63.

Three or four treatments may be required and tests should be made the same as suggested under heading "Abscess Treatments."

Dr. Fette suggests the use of iodin-ions also in treating pyorrhea conditions when there is much inflammation, otherwise zinc or copper should be used. He says: "I use the iodin-ions sparingly and only where there is considerable inflammation and pain." He recommends the use of Lugol's solution, consisting of 5 parts of iodin crystals, 10 parts potassium iodide, 100 parts water, as already explained.

Tincture of iodine is not an electrolyte and therefore is of no value.

IMPORTANT — When using the above solution, namely, iodin-ions, the negative pole must be applied to the part undergoing treatment, for iodin-ions are electro-negative and will therefore be repelled from the negative pole into the tissues.

In pyorrhea treatments, on account of a little difficulty in getting enough solution into the pockets without flooding, it may be necessary to renew the solution during a treatment. To do this Dr. Fette suggests a very ingenious method by which this can be done quickly. Instead of returning the current regulator to zero, slide the electrode to the tip of the tooth gradually and then remove it. Replenish the solution on the needle and then apply it at the tip and slide it gradually into the pocket again.

Alveolar Fistula

A copper electrode is recommended for this with a 2 per cent. copper sulphate solution, and the electrode should be placed along the whole tract to the source of the trouble. After a current of from 2 to 4 milli-amperes has passed for

five minutes, it will be found that the electrode has adhered to the soft tissue. Reduce the current to zero by returning the Regulator button and then reverse the plug on front face of pedestal. On Ritter portable ionization equipments reverse the plug connector which enters the regulator case on the side marked "Patient Circuit." Do not reverse the other plug. Then apply the current again and keep it on for a few seconds when it will be found that the copper electrode can be easily withdrawn.

Following this treatment the fistula should be treated through the canal either with zinc or copper ions.

Dr. Fette states in regard to fistula treatments, that, "while zinc-ions are a little better than

copper-ions, I prefer the latter on account of their coloring the tissues blue, in depth proportionately to the current and time, which helps me as a guide. In treating a fistula I insert a copper electrode (bare or wrapped with cotton saturated with its solution) to the end of the tract and then treat with 2 to 3 milli-amperes for five minutes. At the subsequent sitting, if the fistula is healed, I treat the root canal, otherwise treat fistula again. Three to four treatments should be sufficient."

Oedematous Conditions

In treating these conditions about the mouth, Dr. Fette has obtained excellent results by using Dr. Martin Fischer's salt solution (4 or 5 per cent. magnesium sulphate) and applying it with a sponge or felt electrode to the

positive pole of the current. A flat, smooth piece of sponge or several thicknesses of felt should be used, saturate this with the solution and place over it a piece of zinc or copper gauze, to which the positive pole must be connected, and then apply the current as usual, using about 3 to 10 milli-amperes, depending on the electrode surface. Be sure no part of the metal touches the bare skin. The felt or sponge electrode may be held in place by means of a rubber dam holder.

Instead of the sponge electrode, the special face electrode which we furnish, shown on page 42, may be used, which the operator must hold in the hand. Saturate the felt thoroughly with the Fischer solution.

The Fischer solution that Dr. Fette recommends is a 4 or 5 per cent. solution of Magnesium Sulphate.

In reference to the results obtained by these treatments, we will quote from Dr. Fette's article in the Journal of the National Dental Association:

> "The one successful and rapid means of relieving those troublesome swellings about the gums which are so vexing to the dentist, and so painful to the patient, would amply justify the practitioner in familiarizing himself with the principles and technic of electrolytic medication."

If the gums are highly inflamed and swollen, the rubber cup electrode we furnish should be applied,

by holding it firmly against the part to be treated after filling the cup with cotton saturated with the magnesium sulphate solution, and connect with the positive pole.

After filling root canals, if the patient complains of soreness, this may be relieved by treating the gums with magnesium sulphate solution, using the cup electrode shown on page 40.

(See also pages 66 and 67.)

Pulp Tester

The Ionization instrument, or current regulator, may also be used for determining the vitality of pulps of teeth by proceeding as follows:

Place the cheek clamp electrode in the mouth the same as explained in the directions on Ionization, excepting it is unnecessary to wrap it

with bibulous paper. Attach the green cord as usual and with electrode attached to the red cord by means of pencil like holder, touch the teeth to be tested. The Ionization Regulator button should be on the zero position to start with, then it must be advanced gradually until the tooth responds. It is not necessary to hold the electrode in constant contact with the tooth, as in Ionization treatments, in fact it is better to make and break the current by means of the electrode. Keep advancing the Regulator button until the patient experiences a slight shock, which indicates that the tooth under test is alive. Should you fail to get any response after going to the highest point on the scale, then it is quite certain that the pulp is devitalized.

THE RITTER MOTOR GENERATOR

This machine, as the name indicates, is a combined motor and dynamo or generator. Its purpose is to obtain a direct current from an alternating supply current. It consists of an alternating current motor and a direct current generator, the latter being driven by the former.

(See also page 19.)

THE RITTER MOTOR TRANSFORMER

This machine reduces the 110 or 220 volts direct current to 40 volts, and prevents shock to patient and operator.

(See also page 26.)

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ILLUSTRATIONS