The double valve tube rectifier / by Albert C. Geyser.

(12.)

With kind compliments

Geyser

THE DOUBLE VALVE TUBE RECTIFIER.

BY ALBERT C. GEYSER, M. D., NEW YORK.

Reprinted from THE JOURNAL OF ADVANCED THERAPEUTICS,
July, 1906

The Journal of
Advanced Therapeutics

Vol. XXIV. JULY, 1906. No. 7.

THE DOUBLE VALVE TUBE RECTIFIER.

BY ALBERT C. GEYSER, M. D., NEW YORK,

Clinical Instructor in Radiography and Radiotherapy at Cornell University Medical College; Member American Medical Association, American Electro-Therapeutic Association, New York State Medical Association, Harlem Medical Association, Medical Society of the Borough of the Bronx, Medical Society of Greater New York, Manhattan Dermatological Society, etc.

Nearly seventy-five per cent. of all X-ray operators avail themselves of the use of a properly constructed coil in preference to the time-honored static machine.

It is therefore not surprising that more energy has been devoted to the perfection of the output of a coil, than to the output of the static machine; besides the static machine has not differed in any material point of construction during the past fifteen to twenty years.

We must, however, bear in mind that for the production of the X-ray we require primarily a current of high potential. This high potential current the static machine furnishes and what is of equal importance it is unidirectional.

The question of amperage is of secondary importance, however not to be underestimated. The X-ray then is the result of at least three important factors, a current of high potential, unidirectional, and of sufficient amperage.

The static machine can furnish but two of these factors—the high potency and the unidirection of the current—being sadly lacking in amperage.

In the coil on the contrary we have all three of these factors present, as will be shown later.

When a properly exhausted X-ray tube is connected in the circuit of a static machine, and the machine set in motion, we have the means of producing the X-ray that seems to possess all the necessary qualifications for the work for which it is intended. It lacks, however, amperage which would improve the quality of the ray. Static machines have been built with

a view to increasing this not absolutely necessary but very desirable quality. The size of the plates have been increased until they have reached five feet in diameter; the speed has been increased from 300 revolutions to 3000 per min., the number of revolving plates have been increased almost without limit, so that we now have in Cornell Medical College a static machine with forty revolving plates, yet with all these changes, that third required factor—amperage—is still wanting. In the X-ray coil on the other hand we have the high potency and the amperage, but we have not the unidirection of the current under all conditions. In this particular the coil has so far shown its greatest deficiency. The current emanating from a secondary winding is by necessity an induced current. Each time that the interrupter makes or breaks the primary current, an induced current reversing its polarity with each make and break of the primary, is set up in the secondary.

This induced current is therefore an alternating current, but the current which results upon the breaking of the primary is several times stronger than the one formed upon the making, so that there results a decided preponderance of polarity at the break, hence the general polar effect in the X-ray tube.

X-ray tubes of the present day are all more or less constructed upon some general principles. They are spherical when made of flint glass or assume various shapes when made of a combination of lead with flint glass windows.

The vacuum reaches about the same degree, yet some tubes are supplied with devices for raising or lowering the vacuum at will. The cathode or negative pole is always concaved, saucer-shaped, the concavity of this saucer being relative to its distance from the anode, so that the current or stream of electrified gases or particles which emanate from the cathode, sometimes called the "cathode stream" will form a cone, the base of which conforms to the margin of the saucer-shaped cathode, and the apex of the cone strikes the platinum target—the anode, which is placed at such an angle in the tube that the reflections which take place from this target strike the inner surface of the glass tube upon one side only, so that we have emanating from this surface the X-rays of Roentgen.

The modern coils are capable of giving an enormous voltage. The coil in use at my clinic in Cornell Medical College fre-

quently consumes from five to twenty amperes. While we appreciate that the current produced at the break of the primary is the current which furnishes the X-ray effect, we are only too often reminded of the fact that the current produced at the make of the primary has a very deleterious effect upon the X-ray, causing a flickering or unsteadiness of the radiations.

The reverse currents which are so generated in the tube by the back E. M. F. interfere with the proper focusing of the tube; not only that, they produce a large number of secondary rays on the outside of the tube so that the radiograph as a result is flat and devoid of all sharp outlines.

Two years ago Cornell Medical College spent two hundred and fifty dollars for a compression apparatus, hoping by this means to be enabled to cut out these secondary rays. To a certain degree this was possible, but it remained for the French to bring out a *valve tube* that acted as a rectifier of the induced current. When a valve tube is connected in series with the X-ray tube from a coil apparatus, the current flows in one direction only and no reverse E. M. F. is noticeable, so that we may now have from a coil a current of high electromotive force, large range of amperage and a unidirectional current.

These three factors are the principal requisites for radiography and radio-therapy.

It was, however, apparent that something was yet lacking, the valve tube as originally constructed in France did not hold back all of the inverse currents, especially when working, as we do in America, with very heavy currents. Some changes became necessary and finally two such tubes were connected so that one modified valve tube was placed in series at either end of the X-ray tube, and when finally the proper degree of vacuum was reached some very interesting phenomena resulted.

In testing an ordinary Geissler tube it was observed that a single tube connected in series would cut out about 75 per cent. of all the inverse current so that the negative end would appear as a blue halo surrounding the metal terminal, while the positive would have a very much smaller red halo about its terminal, showing a very much improved polar effect. When, however, the two tubes were connected in such a manner that one was at either end of the Geissler terminal, then the nega-

tive end of the Geissler tube became intensely blue and filled with blue luminous rays, while the positive simply showed one bright red point at the very end of its terminal, no halo or other manifestation of the presence of any current whatsoever.

Experiments were then made upon X-ray tubes and the most perfect results obtained. In front of the target a very bright rich green color, with a sharp line of demarcation appears, while the back of the tube is almost black. The current can be crowded until the tube appears as it were at the bursting point with its brilliancy. The bones of the hand can be distinctly seen twenty feet from the target. Any degree of brilliancy or penetration can be had by simply increasing or decreasing the amperage in the primary. Never before did I realize so much the importance of a variable induction in the primary coil, by allowing the amperage to remain fixed, but changing the induction points to their various tappings, all degrees of variation could be induced in the tube. One induction would show the bones absolutely black with a brilliant light between the fingers, while the next change (the amperage remaining unchanged), would heat the target red and the bones of the hand become as transparent as the flesh.

While making some of these various tests, after cutting out the current, it was noticed that there remained in and around the tube, especially when one terminal was grounded, an unusual amount of residual or static discharge. In fact, when the crown electrode was substituted for the X-ray tube and connected with one terminal of the double valve tube rectifier, while the other terminal was grounded, a distinct breeze was felt, not unlike a static breeze. This was interesting,—the question arose, had we discovered a heretofore unknown current, or was it possible that the X-ray coil by this arrangement possessed the property of static machine currents?

Now my attention was turned to this new phenomenon, and all the various currents so near and dear to the static machine seemed to be reproduced from an X-ray coil.

To prove, however, that these currents were either identical or at least similar was the next step.

It is well known that a static machine when left standing with the pole pieces closed for several days discharges itself, and all static operators know that on damp or humid days it

is sometimes very difficult, if not entirely impossible, to generate enough current upon the charger to start the machine into action.

No other current can, of course, be used excepting one from a static machine of some kind, for the same current that comes out of the machine must be used in exciting it into action.

If now the current from the induction coil contained apparently all the principles of the static machine, it should then also be able to impart the initial charge to the static machine.

The static machine was, therefore, started into action to make sure that it was in a state of discharge. The terminals of the double valve tube rectifier were connected to the two sliding rods of the static machine, the coil circuit was closed and the sparks allowed to play between the sliding rods. The static machine was started and without the loss of a moment picked up the current furnished and the static machine was charged from an induction coil, proving that the alternating current from an induction apparatus, after passing through the double valve tube rectifier, possessed the unidirectional properties of the static machine currents.

The current from a static machine is a direct, continuous, or constant current of high electromotive force, other conditions being equal.

This current then has been reproduced by the modern induction coil, and hereafter, when the static machine refuses to work, can either be immediately charged by a powerful charger that never refuses to work, or in place of its utter refusal, may find itself substituted by another and more willing servant.

We have known for a long time that the X-rays from a static machine were very much less liable to produce burns. I believe the solution of that is found in the fact that the current from this machine is in the first place unidirectional and secondly of low amperage.

Since the new properties of the coil currents thus produced were discovered I have been treating all my skin cases, such as lupus, epithelioma, sycosis, etc., with the rectified coil current and I found that burns became practically a thing of the past, in spite of the fact that I now treat all skin lesions for local X-ray effect only by applying the tube as close as possible to the lesion. The results from this new technique are surprising; a new impetus has been given to radiotherapy. During the past year I have treated at my clinic and private practice a large number of chronic skin lesions, the results in nearly every case have been very gratifying. I believe I am safe in saying that the day of scientific radiotherapy is approaching.

1239 Madison Ave.