round the arc of the two foci producing the X rays, it will not fail to pass into the above-mentioned plane. To this end we have constructed a separate connecting-piece, on which the tablet, fixed to a slide, can slide and describe the necessary movement.

Mounting.—The intermediate piece of the radioscopic apparatus is removed. The connecting-piece is placed in the hollow vertical rod and fixed perpendicularly to the lower branch.

The photographic frame is attached to it.

On the connecting-piece is a slide to receive the tablet, which is exactly at the same distance and in the same position as for the radioscopy. The visual way passing by the rings which serve as sights corresponds to the centre of the anodic mirror. In the course of a research one may successively use both processes by changing the intermediary piece without having to regulate the position of the tube.

Manner of using the Instrument.—It will vary with the parts of the trunk or head under observation, and depends on whether they are thick or not.

For the trunk, fix the vice on the edge of the table at the right place already determined—so we should advise—by a previous radiograph.

Fix the rod which bears the foci by tightening a screw of the vice.

Fasten the photographic frame to the curved piece.

Draw out the first photographic plate. Develop it.

Replace the first plate in the frame. A marking index allows you to replace it exactly as for the first proof. Slide the tablet along the curved piece so that the rod representing the X rays touches the first shadow.

Do the same for the second proof with the second focus, and then finish as in the case of a radioscope.

For the radiography of the head the direction of the apparatus must be changed in order that the X rays may meet the skull on its lateral face.

To accomplish it, the vice is unscrewed, the rod laid on the table, and the connecting-piece which surmounts it fixed on this table by means of two screws. The rod into which slide the tubes, the frame and the tablet become vertical.

The head is placed as near as possible to the frame; it is raised a little above the level of the table by a sort of block, and held by a band of aluminium. This band, transparent for the X rays, serves at the same time to insure immobility and to give marks for the operation. If the needle which has served to determine the seat of the projectile cannot serve as a guide, fix on to the aluminium band another metallic rod, either jointed or flexible, as we have already indicated in the article of radioscopy.

Duration of the Experiments.—The duration of time required for radioscopic researches is *two minutes.*

The duration of the manipulations necessitated by the radiographic process varies from nineteen to thirty minutes. We have succeeded in shortening it by taking two radiographs on the same plate, but cannot always rely on a good result from this double proof.

INFLUENCE MACHINES.

By JAMES WIMSHURST, F.R.S.

Dr. Lewis Jones has pressed me with all kindness to state the work which I have gone through the last twenty years towards perfecting the "influence machine." It may be thought that my doing so savours of egotism; for this reason, and also because the time of the meeting is short, I will state the chief of my steps only. If any of the members desire to look into the matter further, I shall be pleased to afford them every opportunity.

I may say that from the schoolboy upwards I have always possessed my home-made electrical machines, but business and other cares prevented me from giving much thought to the subject of improvements. In 1879 circumstances caused me to look further into the subject, and led me to make a large Carée machine, and to its flying plate I added inductors, which materially increased its outputs of electricity.

At this time I learned that Mr. Spottiswood had some large machines of the Holtz type, and that they gave him much trouble. In the first place, these machines were not self-exciting, and when they were excited there was great difficulty in keeping all of the revolving discs to a like polarity; next, when the sparking length was taxed to the full, the current altered in its directions; and again a drying compound was needed inside the glass case. He tried many ways to overcome these difficulties. One machine he had thickly coated with paraffin wax; this caused it to be less affected by the moisture in the atmosphere, but the trouble in keeping it clean more than balanced the advantage of the wax. Learning of these many troubles, I determined to try to overcome them, and to this end I constructed a machine with considerable modifications.

It consisted of twelve rotating discs of 30 inches diameter; between each of these discs I fitted horizontal slips of glass, which carried the paper inductors; then, to maintain a like polarity on the one side of the machine, I connected the whole of the paper inductors together by means of wire. This machine gave splendid results, except only that it needed the drying compound inside its case and a small initial charge.

I communicated the results to Mr. Spottiswood, and he sent on two occasions to take particulars of it for his future use.

I then made a compound Voss machine, which was used at the lectures on electricity given at the Crystal Palace during the Electrical Exhibition. It remained on exhibit throughout the season. I then made some smaller machines with the horizontal slips of glass between the discs, and put a small Voss inside the case to give the initial charge; all the glass within the case was thickly coated with shellac. These machines were complete in themselves, and did not require any drying compound. I exhibited one of them at a soirée given by the Charing Cross Hospital in 1881. A little later Messrs. Patterson and Cooper made up a few of them. They were noticed by *Engineering*, vol. xxxiv., p. 323.

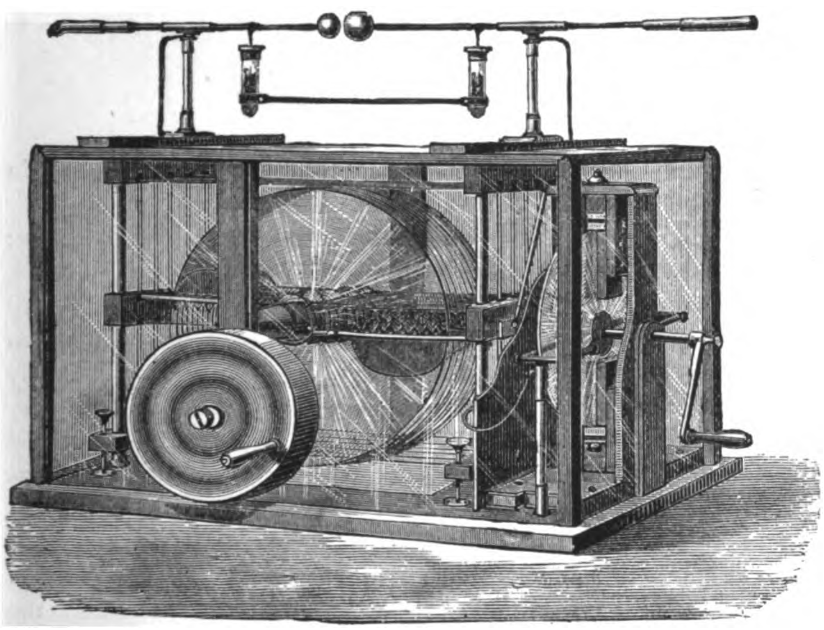

FIG. 1.

To obtain a machine which was self-exciting, which did not capriciously change the direction of its current, which needed neither the protecting glass case nor the drying compound, was my aim, and each of my thoughts to that end, as they arose, were put to practical test. It then seemed to me that if the back or fixed plate of the Voss were substituted by a duplicate of the front revolving plate, and it were rotated in the opposite direction, many of the points I sought might be obtained. I put this to the test in 1882, with the happy result that the first motion of the discs gave excitement. Further tests showed me that my objects were obtained.

I then made up four of these machines—the first of them with no sectors upon the discs, the second machine with six sectors, the third with eight sectors, the fourth with twelve sectors—and found that the discs with no sectors were self-exciting only while the varnish and the contact brushes were new, and the atmosphere fairly dry; the discs with six sectors upon them were but little better, those with eight sectors might be relied on under almost every condition, those with twelve sectors were still more reliable. These machines were noticed by *Engineering*, vol. xxxv., p. 4.

I then increased the number of sectors, and made a machine with discs of 36 inches diameter, each taking ninety-four long and narrow sectors. This machine was freely self-exciting even when the discs were made opaque with moisture, and it showed a torrent of sparks leaping from sector to sector. Dr. Tyndall used this machine in his Christmas lectures given at the Royal Institution.

To better distinguish this type of machine from the induction machine, or system of coils, I named them "influence machines," and am pleased that this name has held in favour.

When discs with no sectors upon them are used, and provided all other parts of the machine are suitably designed, a little more electricity is perhaps given off, and the spark length between the terminals is rather greater; but beyond question the most generally useful machines carry twelve or more sectors on each disc.

My next consideration was the best method of stopping the leakage of electricity from the sectors, which may sometimes be seen when the machine is being taxed to its full power. To check this I thickly coated the discs and the sectors with shellac, which is preferable to paraffin, because it does not harbour dirt. Then next I cemented covering glasses (a second disc) over the sectors, but I found that the additional weight and cost more than balanced the slightly increased output.

In these experiments I not only used flat sheet glass, but I also used cylindrical glasses, cut from the cylindrical glass shades. These drum machines answer fairly well when only the one pair of cylinders is needed, but the form of machine is not easily adapted to multiplication. (See Fig. 3.)

They should be constructed to rotate from a verticle axis, in order that the cylinders may not in themselves or in their attachments settle down, and so come into contact with each other.

In 1885 I made a large machine for South Kensington. It had discs of 7 feet diameter. It was afterwards exhibited at the Inventions Exhibition, and obtained a medal. It was noticed by *Engineering*, in January, 1885. (See Fig. 4.)

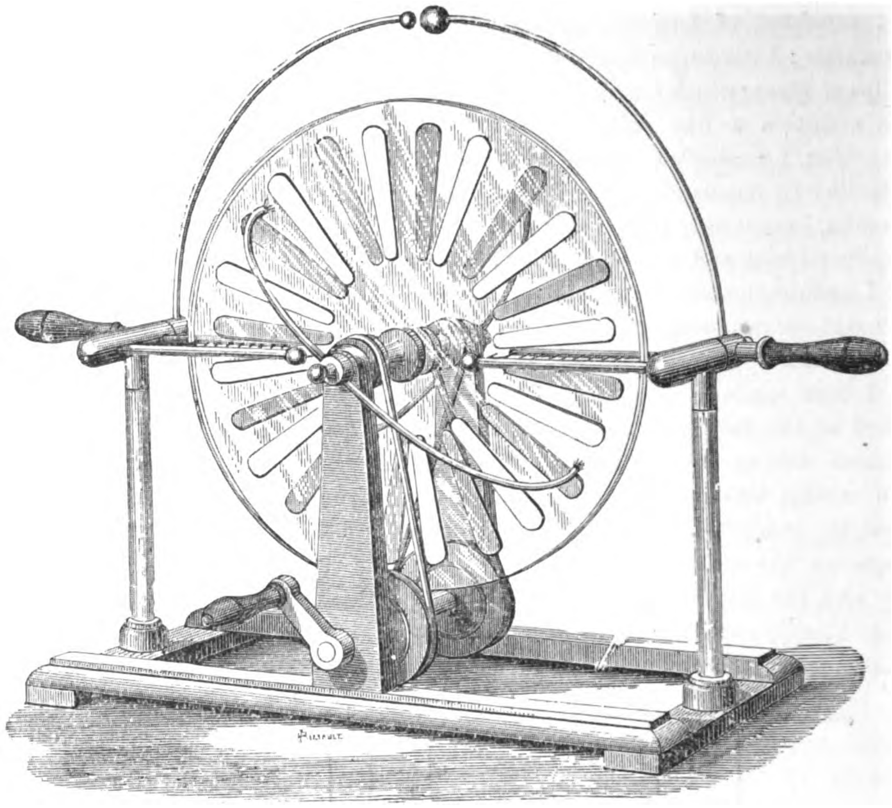

Fig. 2.

In 1887 I made a machine with twelve discs of 30 inches diameter; it has been constantly used since that date by me, or by my friends, for experimental work; it has always behaved reliably and well, and in no instance given any trouble; yet now, after nearly fourteen years' use, its condition and appearance are quite equal to new. Lately I have taken off the sixteen short sectors, and have attached twenty sectors 7 inches long and very narrow; this alteration has improved the output. It was noticed by *Engineering* in April, 1888, and was used at the Royal Institution in that year. (See Fig. 5.)

I next endeavoured to determine the difference in the output of such machines which might be caused by increasing the distance between the discs; for this purpose I made three machines: the one had discs of 6½ inches diameter, the second had discs of 15½ inches diameter, and the third had discs of 37½ inches diameter. I had many discs for each of the three machines, and on each pair of discs the sectors differed in number and in length; they were driven at increasing distances apart. These experiments confirmed the conclusions which I had earlier reached as to the best size and numbers of sectors for average practical uses; they moreover enabled me to find that electrical excitement may be obtained even when the discs are separated to a distance equal to one-twelfth of their diameter, but at that distance they will not give any spark at the terminals, unless a small charge is first given to either one set of the collecting combs; they then promptly

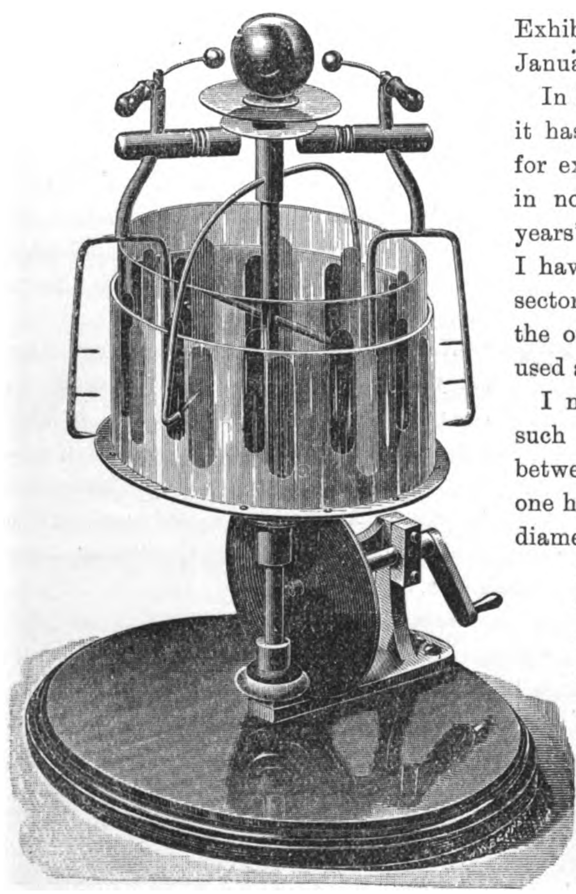

Fig. 3.

give one spark of the maximum length, and immediately resume their former condition, and again show only the just-perceptible excitment at the brushes.

I then made a machine with 17-inch glass discs the discs shattered, parts of them cutting a passage through the wood. The box was then strengthened with hard wood, new discs were fitted, and the experiment repeated with about the same results.

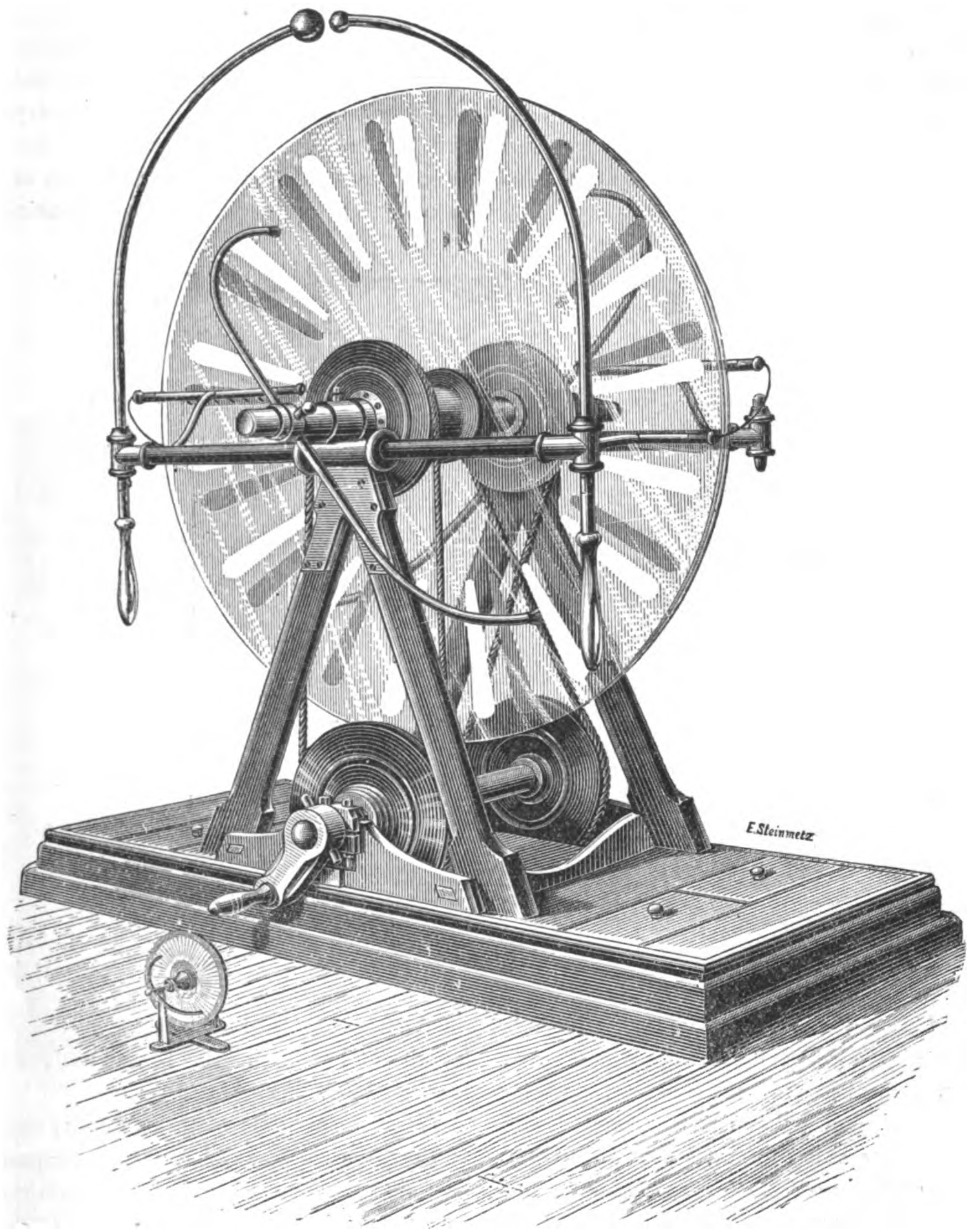

Fig. 4.

fitted inside a stout wooden box; it was placed on the floor, heavily weighted, and driven up to breaking speed, the output being noted with each increase of speed. The output appeared to increase proportionally to the increase in the revolutions; at about 6,000 revolutions per minute

Next I tried a material named "dermatine," but it being flexible, the discs were dragged together at the top and the bottom. Owing to the unlike charges at these places, this rubbing together caused so much friction that the driving-belts slipped.

I then made a machine consisting of two rollers and an endless band of guttapercha; this band carried sectors, and the two parts of it were held nearer together by supplemental rollers, which were utilized as contacts or brushes, but the results did not justify the expenditure of any further time.

In 1891 I designed and made a machine which gave rapidly alternating charges, and in the same frame might be built up in less than a minute almost every other type of machine. It seemed to me that this adaptability for readily illustrating the several features of the many forms of statical electrical machines would cause it to become a favourite with the student, and for the purposes of education or experiment, and I still hold this favourable opinion of it. Yet up to the present no one except myself, so far as I know, has taken interest in it. It was noticed by *Engineering* in April, 1891. (See Fig. 6.)

In 1893 I introduced another form of machine which had two discs of 42 inches diameter. Between the discs were vertical slips of glass; these carried the inductor patches. The discs were furnished with the usual collecting combs and neutralizing brushes, all the glass was coated with shellac, and eight sectors were carried by each disc. It was freely self-exciting, and worked well in any atmosphere without any drying compound. It was noticed by *Engineering* in May, 1893. (See Fig. 7.)

In 1897, under the pressure of my friends, I designed and made a large machine for the Earl's Court Exhibition; it had twenty-four discs of 36 inches diameter, it was freely self-exciting, needed no drying compound, and worked well in the exhibition the whole season, It gave about 16 to 17 inches length of spark between each of its two terminals, thus making an apparent length of 32 or 34 inches. It was noticed by *Engineering* in May, 1897. (See Fig. 8.)

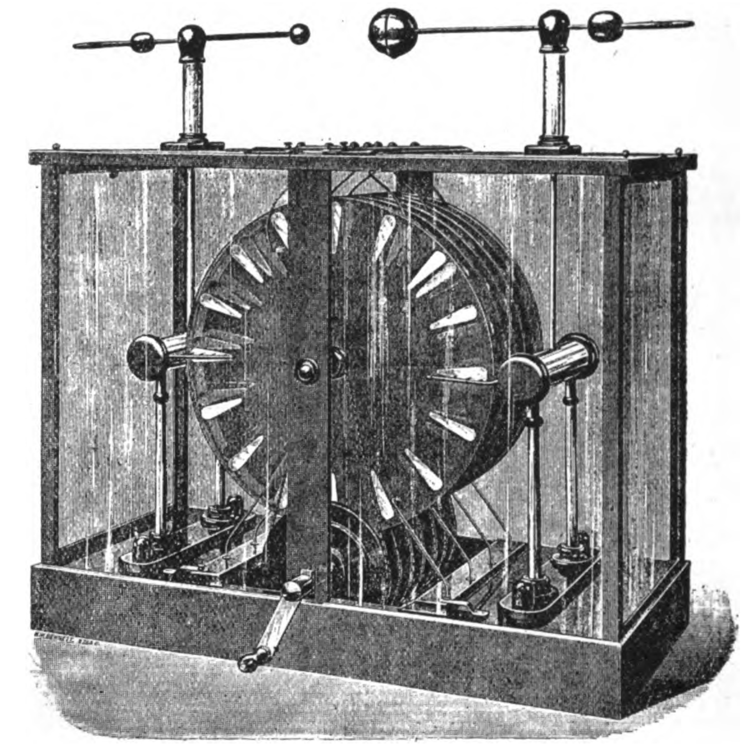

Fig. 5.

Vulcanite of some qualities rapidly changes its colour and becomes useless for electrical purposes, but for the past six years or more I have had another quality under severe test; it appears to suffer no depreciation by age or light. Knowing that a portable and unbreakable machine is an acquisition, my son has lately made up two of such machines with twelve discs of 20 inches diameter, and I hope they will be found useful where rough usage is to be expected.

This shortly-stated history gives the chief of my work,

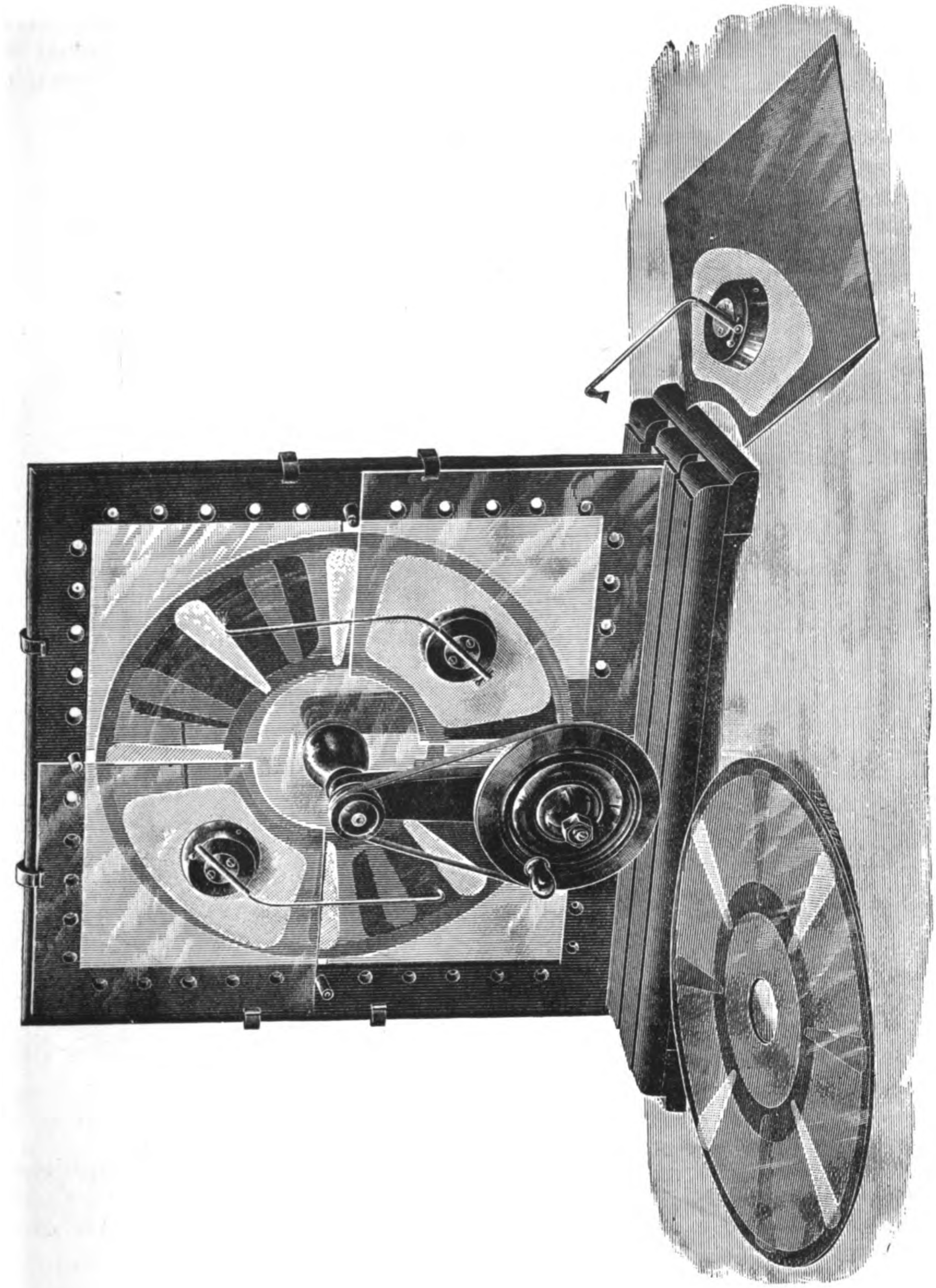

FIG. 6.

and will, I hope, enable you to see the steps by which the influence machine of the present day has matured, since the time of its parent, the Nicholson Revolving Doubler, in 1788.

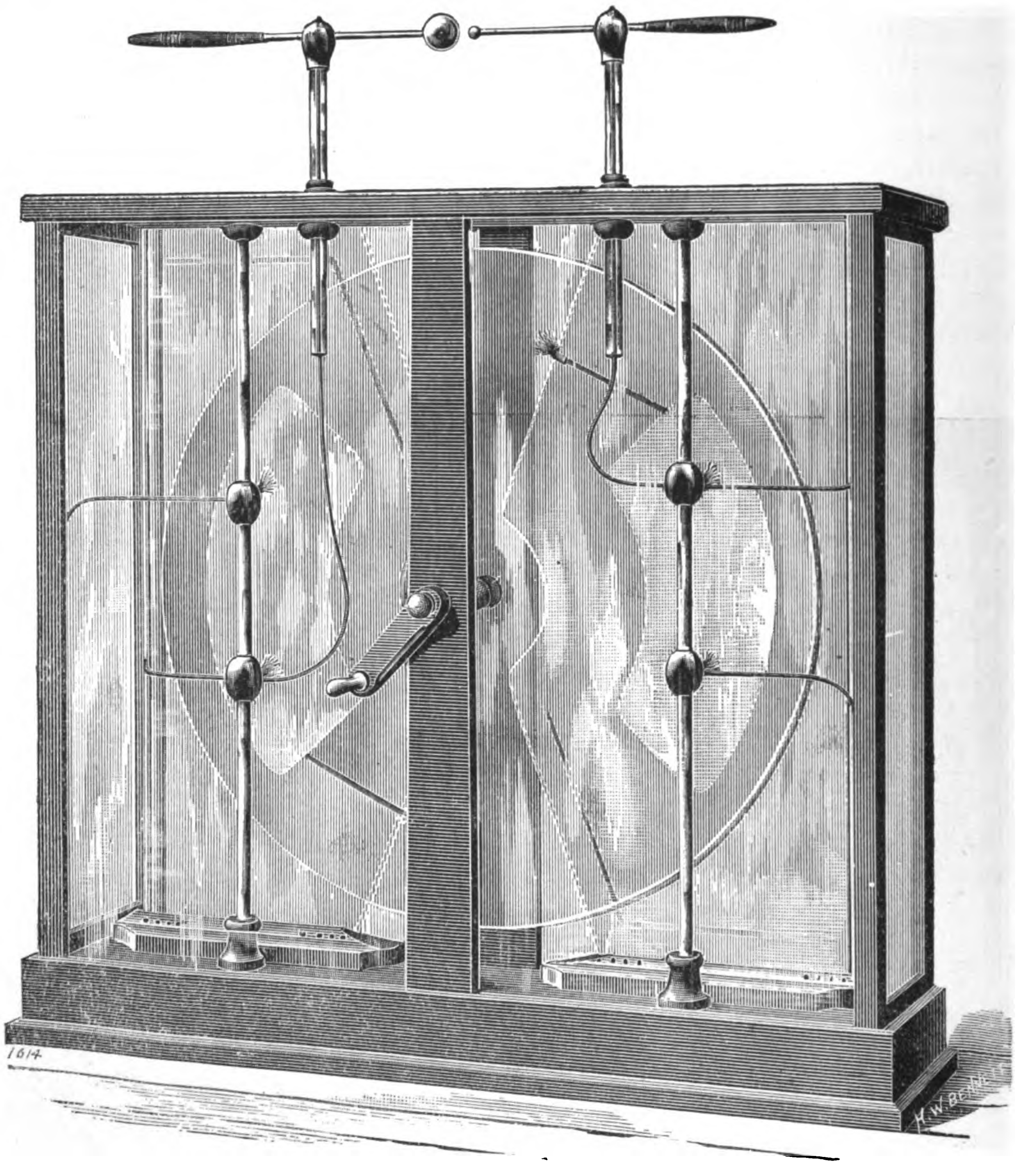

Fig. 7.

In conclusion, I may say that possibly in some ways I may have been at fault, because the simplicity, the efficiency, and the economy of the influence machine are such that the machine merits a far higher position amongst the members of this Society than it has attained. My consolation, however, comes from the fact that we all are human, and being so, the nature prompts us to buy our own experiences. Following on this thought, have no doubt that ere long the experiences will be completed, and that the merits of properly-constructed influence machines will place them in the position they o thoroughly deserve.

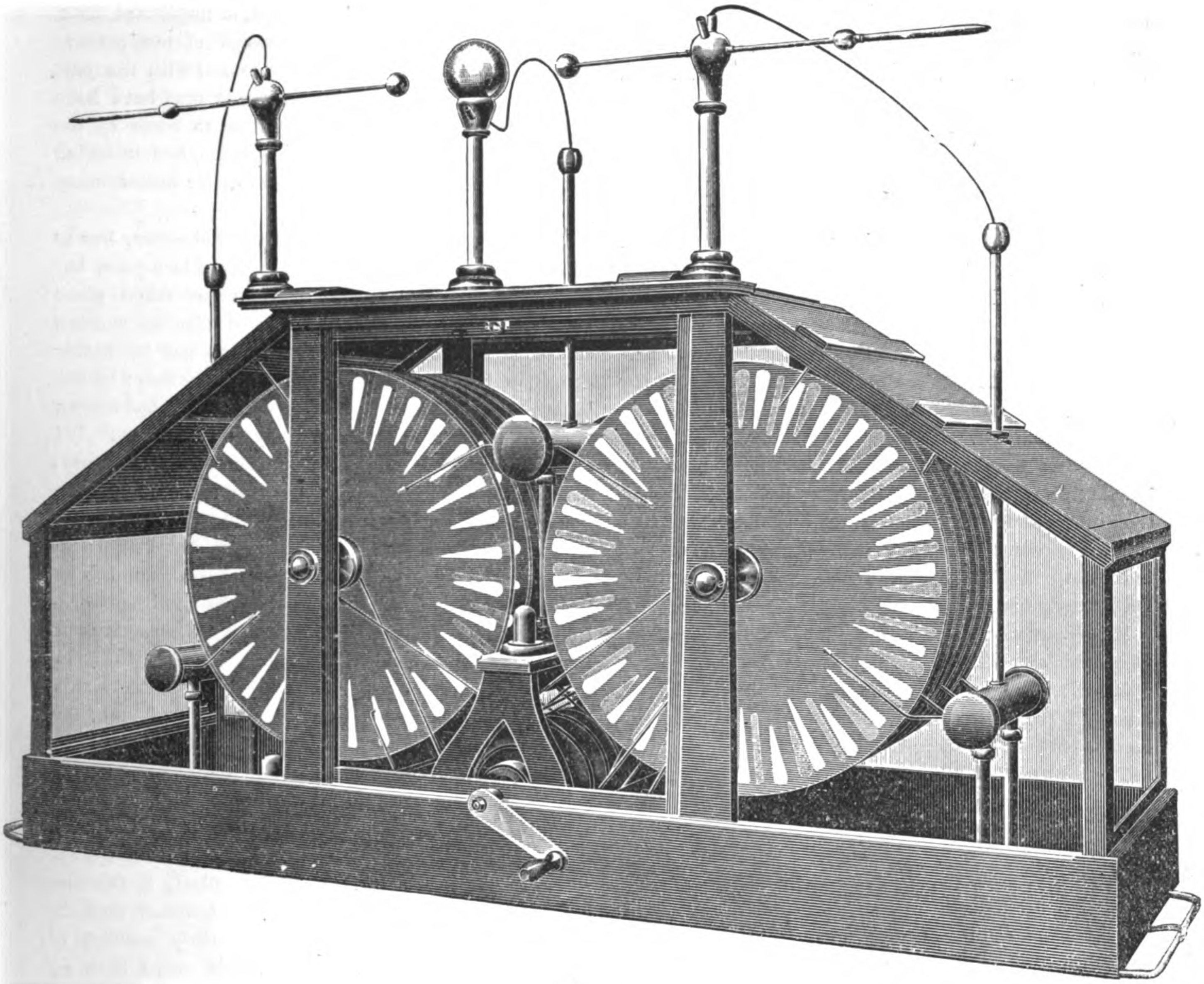

Fig. 8.

THE ROENTGEN SOCIETY.

The Annual General Meeting was held on Thursday, July 5, at 20, Hanover Square, Mr. Wilson Noble, President, in the chair.

The following were elected members of the Society: Charles H. Fowler, W. J. Hancock, Septimus T. Pruen, M.D.

Mr. J. H. Gardiner read a "Note on the Coloration of Glass by Roentgen's and other Radiations."

The Annual Report was read by the Secretary, Dr. F. Harrison Low, and the Balance-sheet was read by Mr. Vezey, in the absence of the Treasurer, Mr. Thomas Moore.

The Report was adopted unanimously on the proposal of Mr. Talbot, seconded by Dr. Chisholm Williams.

Members then proceeded to the election of Officers and Council for the ensuing year, as follows:

President: John Macintyre, M.B., F.R.S. Edin.

Vice-Presidents: Lord Blythswood; the Rt. Hon. the Earl of Crawford; Professor D. Ferrier, M.D., F.R.S.; J. H. Gladstone, D.Sc., F.R.S., F.C.S.; A. A. Campbell Swinton; Professor Dawson Turner, M.D.

Council: Barry Blacker, M.D., B.S.; J. Mackenzie