An Influence-Machine

1897 Proc. Phys. Soc. London 16 253

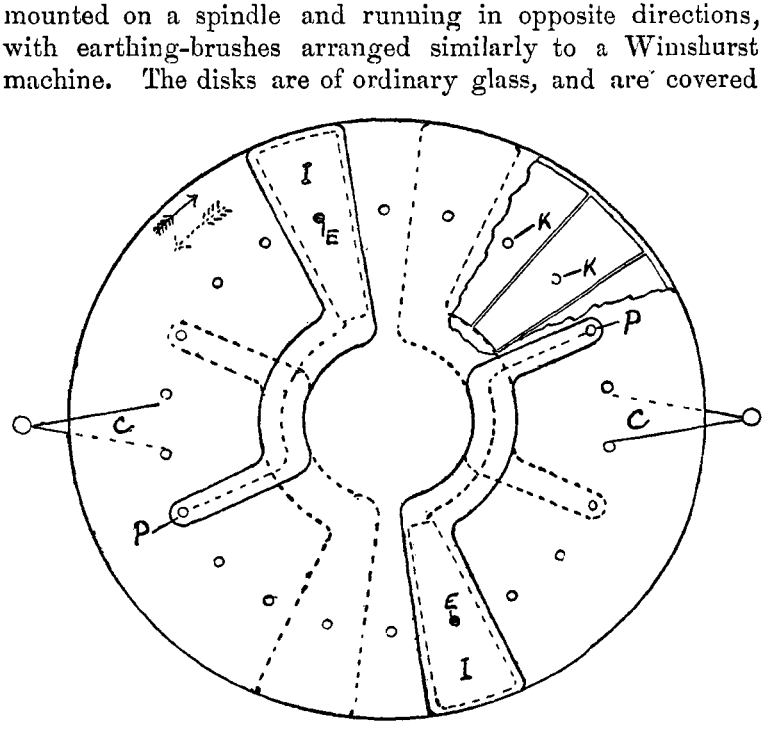
(http://iopscience.iop.org/1478-7814/16/1/330)

XXVIII. *An Influence-Machine.*

By W. R. Pidgeon, *M.A.**

On June 23rd, 1893, I showed an influence-machine at a Meeting of this Society, which was described in the Phil. Mag. for September 1893, but which had the disadvantage of being an expensive machine to make. I now show a form of machine which not only gives better results, but is both cheap to manufacture, and has qualities which may, I think, interest the Members of this Society, especially in regard to its suitability for exciting Röntgen-ray tubes.

The machine consists of one or more pairs of glass disks mounted on a spindle and running in opposite directions, with earthing-brushes arranged similarly to a Wimshurst machine. The disks are of ordinary glass, and are covered



with sectors about an inch or an inch and a half wide at the circumference, and placed about one-eighth of an inch apart.

* Read October 28, 1898.

These sectors stand radially, and each carries a small brass contact-knob K. The disks are covered with wax composed of half paraffin and half rosin by weight. The wax covers up and insulates the whole of each sector except the small brass contact-knob which peeps above it. Each of the earthing-brushes, E, passes through and supports a fixed insulated inductor, I, which is formed of tinfoil stuck to an ebonite backing and insulated with wax. The surface of the wax on all the inductors and disks is carefully varnished several times with filtered shellac to protect the wax and give it a hard surface. Each inductor is kept charged by a stationary point, P, connected to it and placed so as to collect, from the revolving disk, shortly before the main collecting brushes C. The sectors on each of the disks are earthed at the moment when they are passing between the opposite disk on the one hand and the fixed inductor on the other, both of which carry a charge of the same sign. The sectors therefore receive their charge at a moment when their capacity is at a maximum, owing to their standing between two charged inductors. As each sector moves away from the brush to the right and out of the influence of the inductor its capacity decreases, and therefore its potential rises, and when it is opposite the point at which its fellow disk is being earthed, its potential is proportionately much higher than in the Wimshurst form of machine; and it therefore induces a proportionately higher charge on the sector being earthed. This sector, as it moves away from its inductor to the left, again rises in potential; and on arriving at the earthing-brush induces a still higher potential on the sectors moving to the right. This cumulative action goes on in a sort of geometrical progression until, as a matter of fact, the output of this form of machine rises to about four times that of a Wimshurst of a similar size when measured by the overflow of a leyden-jar (25 oz.).

It may help to make the action of the machine more clear if we regard it from the point of view of its being a condenser, the plates of which can be charged in one position, then shuffled, to bring the positives and negatives together, and thus discharged. For the fact that each sector is imbedded in an insulator enables it to receive a charge on each face as it stands between the disk and the inductor, like a plate in a

condenser. It therefore carries forward a double charge, so to speak, as compared with that carried forward by a machine without inductors. Again, the drop of capacity and consequent rise in potential of the sector as it moves away from the inductor is so great, that the induction of the machine is also practically doubled, and hence the total output is multiplied by four. That is to say, a machine having inductors which act upon numerous insulated sectors is equivalent in output to four machines of the same size of the ordinary type.

W. R. Pidgeon's machine with one pair of plates—					A 15-in. Wimshurst same day requires 64 sq. ft. per spark.				
of 12 in. diam. requires 22 sq. ft. of area to pass the collecting-brushes per spark.									
of 17 in. diam.	do.	17·1	sq. ft.	do.	A 15-in.	do.	76	do.	do.
18 in.	do.	18·5		do.	A 15-in.	do.	70	do.	do.
19 in.	do.	19·4		do.	A 15-in.	do.	70	do.	do.
2 pairs of 27 in.	do.	16·4		do.					
Average		17·85	sq. ft.		Average...		70	sq. ft.	

Comparative efficiency nearly 4 to 1.

Mr. Wimshurst's 8-plate 15-in. machine, which he kindly tried for me himself, requires 97·07 sq. ft. per spark.

The length of spark between knobs is approximately the same as in a Wimshurst of the same size, but, if anything, slightly less. If, however, the fixed inductors are taken away and the wax disks run with the brushes on alone, the machine gives much longer sparks; but its output is then decreased to a little less than double that of a Wimshurst.

My machine, 19 in., without inductors, requires 45 sq. ft. per spark.

The wax which covers the disks prevents the sectors leaking from any point except the small brass contact-knobs, and thus enables the machine to work in the dampest weather; in fact, it may be sponged with water, or have water squirted at it, and yet will work if only it is first wiped up with a duster. Dirt, likewise, makes almost no difference; and usually the induction starts up before the disks have made a revolution, even though the machine may have been left standing for weeks. It will, moreover, work on short circuit;

and in all but the very worst weather, or after standing idle for a long time, it is not necessary for any of the brushes to actually touch the contact-knobs.

The fact that the only place from which a sector can leak electrically is from its small brass collecting-knob, makes it possible to run disks so large as to almost touch the first motion-shaft below or the collectors on either hand. This obviously allows the machine to be snugged up, and so save cupboard-room.

The collectors have been covered with ebonite, and everything has been done to expose as little naked surface as possible, partly for convenience in handling, but chiefly to enable the machine to be used in bad weather.

When exciting a Crookes or Jackson tube the knobs of the dischargers should be brought to either end of the tube, the terminals of which should also be capped with brass knobs to prevent any brush-discharge.

The tube should be of a sufficiently high resistance to use all the potential of the machine and not require a spark-gap; it should be roughly suitable for a coil-spark of 6 in. to 14 in., according to the size of machine with which it is excited.

The illumination produced will then be good and steady, and the tube may be run for an almost indefinite period without running the slightest danger of over-heating its terminals or of being troubled by its resistance changing.

A pair of 19-in. disks is adequate to show brightly the bones in the hand and arm, and, with some people, to faintly indicate the ribs on a screen; while a pair of 12-in. disks exciting a suitable tube is sufficient to show the hand- and wrist-bones clearly.

Discussion.

Capt. J. H. Thomson, R.A., said that, apart from its electrical merits, the machine possessed advantages in mechanical construction. He thought there was still room for improvement in this respect. The counter-shaft should be done away with, and ball-bearings should be introduced. The inductor was a distinct improvement; he thought the

efficiency might be increased by adding other inductors. Platinum-iridium was the best material for brushes of such machines.

Prof. AYRTON asked what efficiency was obtained with modern influence-machines in general.

Capt. THOMSON had found that when running a machine by a motor, about 80 per cent. of the power was wasted in mechanical friction ; of the remaining 20 per cent. a great deal was lost as electrical leakage.

Prof. S. P. THOMPSON thought it had been pointed out by Mr. Wimshurst that influence-machines did not work well unless there were at least two thicknesses of glass between the inducing and induced conductors. That was why Mr. Wimshurst put his sectors on the outer faces of the glass disks. Mr. Pidgeon had departed from this. The advantage of the narrow spacing of the sectors was not very apparent.

Mr. WIMSHURST (abstract of communication). Waxing the disks reduces leakage and increases the output ; the wax-coating virtually doubles the number of plates. Inductors contribute a further increase to the output. In 1883 Mr. Wimshurst tried thick coatings of shellac, and also duplicating the glass, with in some cases sectors upon the second glass to increase the capacity. The output was increased, but the construction lost simplicity. The indifference of Mr. Pidgeon's machine to dirt and dust was a most valuable result.

Mr. PIDGEON, in reply, showed a set of secondary inductors such as Capt. Thomson had just proposed. They improved the output by about 15 per cent., but they were troublesome to keep in order, for they increased the tendency to "reverse."