work done, although the speed may be irregular; and its results can be made more accurate than that of the friction dynamometer, because not subject to the irregularities arising from differences in lubricants, temperature, etc., which makes it necessary to use adjusting screws in most forms of friction-brake dynamometers.

THE VALUE OF OIL AS AN INSULATOR FOR HIGH VOLTAGE CURRENTS.

BY DAVID BROOKS.

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Even as late as 1884, in the electrical works, oils were placed among conductors. For instance, James T. Sprague, in the second edition of his book, places them among conductors "in the order of their specific gravity." His first patent for the use of oil as an insulator was taken out in 1878, and now the matter is receiving great attention among the electricians of Europe. In the *London Electrical Review* there is an account of tests by Siemens and Halske, of Berlin, in which they state that an ordinary Siemens electric light cable was inserted, and broke down at a pressure of some 15,000 volts, but when oil was used, it perfectly withstood the pressure as high as 20,000 volts.

Oil has been used in Switzerland with complete success, not only for insulating wires, but also for transformers.

The writer has made the following experiment to show how much better oil is than the air for insulation. A large Holtz machine that sparked 7.5 inches through the air was unable to puncture the insulation of a cable of twisted wires separated one-fourth of an inch, when immersed in oil.

The ends of the twisted wires, were spliced to rubber-covered wires, and these were attached to the poles of the Holtz machine, after glass tubes had been drawn over them. The twisted wires were then placed in a jar contain-

ing oil with a layer of water floating on it, the oil being heavier than the water.

The spark broke through the tubes from wire to wire above the oil; the part of the jar containing water the tubes were broken opposite the splice, while the twisted wires in the oil stood the entire pressure of the machine, 7.5 inches spark. Such a spark would be equivalent to 175,000 volts, as defined by Warren De La Rue, between a point and a disk, but this spark of 7.5 inches was between two spheres which requires a much higher voltage.

When no glass tubes were used to protect the conductors, the voltage or tension was much reduced by silent or brush discharge, blue sparks passing through the rubber covering. When bare wires were used to connect the two poles of the Holtz machine, still less tension was produced on account of leakage through the air.

The experiment tends to show that the air is not a good insulator for very high voltages, and also to confirm the experiments made in Switzerland as to the value of oil for insulating transformers, and protecting them from destruction by lightning.

Experiments have also been made with heavily insulated electric light cables for conveying high voltages. None of them stood a tension above 12,000 volts, and most of them broke down by the use of less than 10,000 volts.