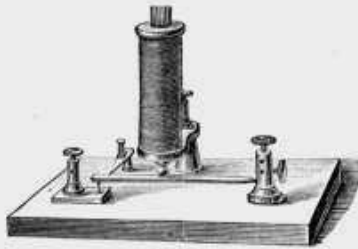
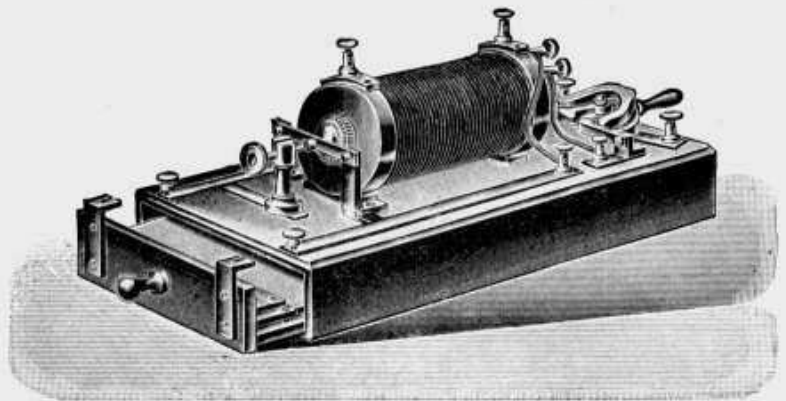




6590.



6589.



6611.

Experiment V. The galvanometer is disconnected and the contact breaker inserted, screwing down the spring strip so that it remains in contact with the platinum point *b*. The battery (2 volts) is attached to 5 and 6; the switch is turned to 4 and the contact breaker comes into action.

Experiment VI. The two metal handles are attached to 7 and 8. On pushing 2 over 1 a shock is experienced which is the stronger the more 2 covers 1.

Experiment VII. The iron core and coil 2 are removed; the handles are connected with 6 (upper terminal) and with 1. A shock is again experienced which is caused by the extra current; the shock is the stronger the more 1 is covered by 2.

Experiment VIII. Terminals 7 and 8 are connected together by a short wire so that coil 2 is closed; otherwise as in experiment VII. If 2 is pushed over 1, the shock experienced becomes weaker the more 1 is covered by 2.

Experiment IX. Coil 2 which is pushed over 1 is included in the extra current circuit; for this purpose 1 and 7 are connected by a wire and the handles attached to 6 and 8. The shock caused by the current is intensified.

6589. **Extra current apparatus with automatic contact breaker and brass handles.** [Fig.  $\frac{1}{5}$  nat. size.] . . . . .

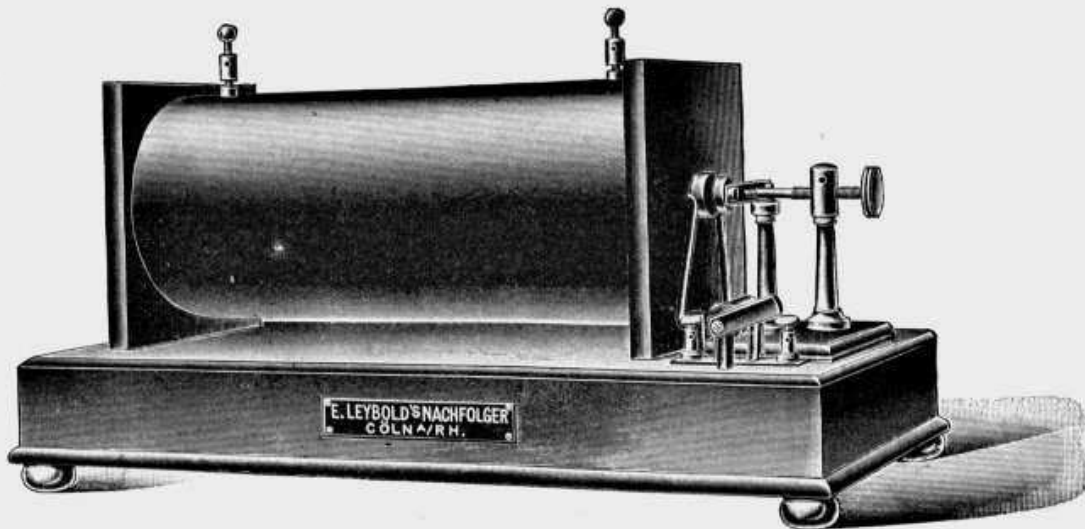
§ 4,50

The current from the positive pole of a generator (2 volts) enters the coil at 1 passes through it, reaches the platinum point, passes from this through the spring to terminal 2 and thence to the negative pole of the generator. The circuit closed in this way makes the iron core a magnet which affects the spring as in the ordinary contact breaker, opening and closing the circuit. The extra current is felt by grasping the two handles provided, which have been attached to terminals 2 and 3. If the iron core is previously removed from the induction coil the pulses are feeble, but on putting the iron wires successively into the coil, the shock grows in intensity. As the attractive force of the core increases simultaneously, the spring which at first moved very easily may be tightened by screwing down the spring attached to 4. Interruptions become more frequent and the pulsations follow each other so rapidly as to be unbearable especially when all the iron wires have been placed in the coil.

6590. **Wire coil for same, to show induction currents.** [Fig.  $\frac{1}{5}$  nat. size.] . . . . .

• 1,75

On pushing the secondary coil over the principal coil of the extra current apparatus and allowing current to pass through the primary, every sudden increase of the latter induces an oppositely directed current in the secondary, whilst every sudden decrease of the current in the primary induces a current of the same direction in the secondary. In order to show the action of the primary coil on the secondary, the greater proportion of the iron wires is removed from the primary, and the handles attached to terminals 5 and 6 are grasped whilst the secondary coil is moved slowly over the primary. The person holding the handles experiences greater pulsations the more the primary coil penetrates into the secondary. On connecting, however, the terminals 5 and 6 by means of a short wire and the handles with



6620.

the terminals 2 and 3 of the extra current apparatus, only a small shock is felt on grasping the handles, when the secondary nearly covers the primary; the shock increases on removing the secondary coil.

6611. **Rühmkorff's induction coil**, all parts detachable. All connections visible; the iron core, the primary and the condenser can be removed. The action of these parts can thus be clearly shown. With Bertin's commutator. Length of spark about 25 mm. [Fig. 1/4 nat. size.]

\$ 38,00

**Small induction coils with platinum contact-breaker** and simple commutator for use with small Geissler tubes etc.

	No. 6612.	6613.	6614.	6615.
Spark-length	1	1,5	2	3 cm
	§ 5,50	7,50	12,50	19,00

To generate the current one to two cells are sufficient.

**Larger induction coils** with condenser, simple contact-breaker and Rühmkorff's commutator. The platinum contact-breaker is fastened on a slide and can be exchanged for another contact-breaker or the plate No. 6637. The latter enables the induction coil to be driven by an automatic contact-breaker. These induction coils have the special advantage of using little current.

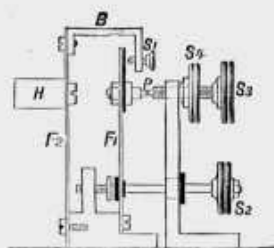
Instead of a simple platinum contact-breaker, the Deprez interrupter is frequently used. The latter gives a higher frequency and moves more easily than the ordinary contact-breaker, but is inferior to the latter as regards the length of spark with the same induction coil. The use of the Deprez contact-breaker is unnecessary if one of the subsequently described induction coils, with a Vril interrupter is chosen.

	No. 6616.	6617.	6618.	6619.	6620.	6621.
Spark-length	6	8	10	15	20	25 cm
	§ 35,00	45,00	53,00	68,00	88,00	106,00

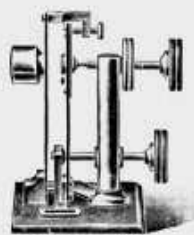
In use the following points should be especially noticed. The two terminals of the Rühmkorff's commutator as well as two terminals of the secondary coil are marked with a + and -. On connecting the terminals in a corresponding manner with the current generator,



6628/6630.



6631/6633.



6631/6633.



6637.

the handle of the commutator must be turned to the left in order that the poles of the secondary coil may correspond. The point of the sparking arrangement must be connected with +, the plate being connected to -; with a Röntgen tube, + is connected with the anode, - with the cathode. Only when the sparking arrangement or Geissler tube is in the circuit is the current allowed to pass, by suitably turning the commutator. Sometimes it may happen that on closing the circuit the contact-breaker fails to act; in this case it is given a slight tap with the finger, which can be done without danger. In order to drive the coil with a Wehnelt interrupter, the platinum contact-breaker is removed by loosening the two screws which hold it. These form at the same time the connection of the condenser with the primary. After removing the screws the condenser is thrown out of circuit; the Wehnelt interrupter is then connected directly with the terminals of the primary coil.

An induction coil of 15–20 cm spark requires with a platinum contact-breaker about 6–8 volts and about 5–6 amperes. To drive it, either the bichromate battery No. 5565, or 3–5 of the accumulators No. 5503–5504 may be employed. In the latter case the four cells of the separate sets are arranged in parallel, the sets themselves in series.

In driving an induction coil by means of primary cells or a small battery of accumulators, it is convenient to insert a sliding resistance in the primary circuit by the aid of which the length of spark may be regulated; this is of special service in certain cases, for example, in experiments on the Röntgen rays. In connecting the coil with a strong current generator, for example when using our Normal switchboards, the coil is inserted in the shunt circuit.

**Induction coils with condenser, Vril interrupter and simple commutator.** The Vril contact-breaker is mounted on a slide and can be replaced by the plate No. 6637 in order to drive the coil with the contact-breakers 6686–6692.

The Vril interrupter is a modified platinum contact-breaker. The platinum contact is at *P* on a special spring  $F_1$ , the hammer at *H* on a second spring  $F_2$ . When the hammer is attracted, the spring  $F_2$  first moves and a certain time elapses before the screw  $S_1$  touches spring  $F_1$  whereby the platinum contact *P* is removed and the current in the primary circuit suddenly broken. Owing to this prolonged period of contact the iron core is magnetised up to the saturation limit, whereby a considerably greater electromotive force is induced than in the case of the simple contact-breaker. The length of contact is regulated by  $S_1$ ; the further  $S_1$  is from the spring  $F_1$  the longer is the time during which the circuit is closed, and the more sudden is the interruption. In this way the intensity of the discharge can be adapted to the condition of the tubes in experiments with Röntgen rays.

The Vril interrupter is, moreover, superior to the ordinary contact-breaker inasmuch as the platinum contact undergoes less heating and less wear.

To set the Vril interrupter into motion, the screw  $S_2$  is turned until the vibrator  $F_1$  stands, when free, in the middle of the gap *B*; the screw  $S_1$  is turned until it has a distance of about 1½ mm from the vibrator. The screw  $S_3$  is then turned until the platinum point *P* just touches the vibrator; this position is then fixed by means of screw  $S_4$ .

The position of the screw  $S_2$  should only be altered when using currents of a smaller voltage.

By bringing near, or removing the screw  $S_1$  the frequency is altered; its best position for any experiment is easily found by trial.

The same general rules apply to the use of induction coils fitted with the Vril interrupter as hold for coils with the ordinary platinum contact-breaker.

No.	6622.	6623.	6624.	6625.	6626.	6627.
Spark	6	8	10	15	20	25 cm
\$	41,25	52,50	60,00	75,00	93,75	112,50

**Simple platinum contact-breaker**, alone, mounted on slide. [Fig.]

No.	6628.	6629.	6630.
For spark-length	6-10	15-20	25 cm
\$	7,50	10,00	11,25

**Vril contact-breaker**, alone, mounted on slide, for interchange. [Fig.]

No.	6631.	6632.	6633.
For spark-length	6-10	15-20	25 cm
\$	13,75	15,00	16,25

**Deprez contact-breaker.** (Journ. de Phys. 1ère série X, p. 360, 1881.)

No.	6634.	6635.	6636.
For spark-length	6-10	15-20	25 cm
\$	11,25	12,50	13,75

6637. **Ebonite plate with 2 binding screws**, to replace contact-breakers No. 6628-6636, so as to drive coils No. 6616-6627 with the contact-breakers No. 6686-6692. [Fig.]

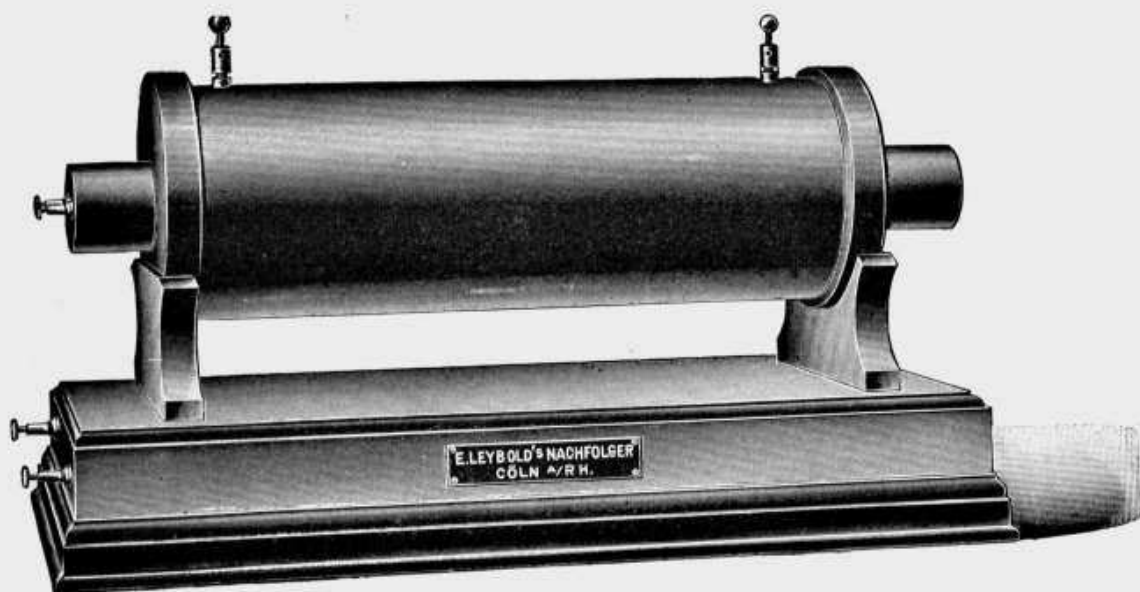
\$ 1,50

**Induction coils with condenser, without contact-breaker.** These coils are constructed especially strongly for prolonged and continuous running, and do not lose in spark-length even when used at full power several hours daily. The coils can be driven by either continuous or alternating current. [Fig. p. 230.]

Coils up to 25 cm spark-length can also be used with the platinum contact-breaker No. 6693. For greater sparking distance, however, and for prolonged running, the motor contact-breakers only can be employed. When a Wehnelt contact-breaker is used the condenser is omitted. If the coil is to be driven with a Wehnelt contact-breaker for a long period, as well as with a motor interrupter, the induction coils No. 6650-6651 or 6674-6685, fitted with a control, are to be recommended.

No.	6638.	6639.	6640.	6641.	6642.	6643.
Spark	10	15	20	25	30	40 cm
\$	45,00	60,00	75,00	92,50	125,00	200,00
No.	6644.	6645.	6646.	6647.	6648.	6649.
Spark	50	60	70	80	90	100 cm
\$	300,00	425,00	550,00	675,00	800,00	962,50

**Induction coils with condenser and control switch** to alter self-induction in the primary. When the coils are to be used not only with a motor contact-breaker but also with a Wehnelt interrupter for work with the Röntgen rays, it is advisable that the coil be provided with a control arrangement by means of which the self-induction of the primary coil may be varied. For this purpose coils giving a spark up to 35 cm have the primary wound in three layers, the ends of which are brought out to the front of the coil. With the aid of the plugs, 2 or 3 of the coils can be arranged



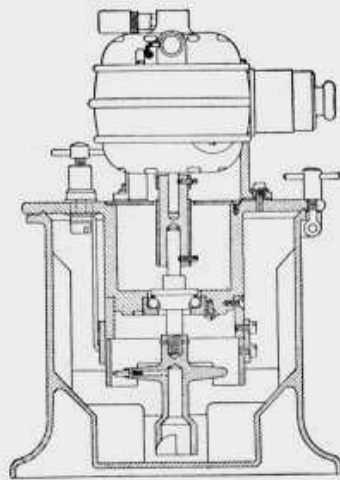
6638/6649.

in series or all three coils may be arranged in parallel. The three plugs are marked «soft» (3 coils in series), «moderately hard» (2 coils in series) and «hard» (3 coils in parallel). With the last arrangement the self-induction of the coil is at a minimum and the apparatus gives the normal sparking distance; as the number of coils in series increases the self-induction of the primary coil diminishes, the number of interruptions also decreases and the sparking distance becomes smaller. The coil can thus be adapted to working either a soft, moderately hard or hard Röntgen tube according to requirements. Coils giving a greater spark than 35 cm are wound in four layers.

No.	6650.	6651.	6652.	6653.	6654.	6655.
Spark-length	10	15	20	25	30	40 cm
	\$ 60,00	75,00	90,00	105,00	140,00	215,00
No.	6656.	6657.	6658.	6659.	6660.	6661.
Spark-length	50	60	70	80	90	100 cm
	\$ 315,00	440,00	565,00	690,00	814,00	980,00

**Induction coils with variable condenser**, for special scientific experiments; by means of a handle 4 condensers of different capacity can be inserted, or the condenser can be entirely omitted. Without control switch to alter self-induction and without contact-breaker.

No.	6662.	6663.	6664.	6665.	6666.	6667.
Spark-length	10	15	20	25	30	40 cm
	\$ 58,00	75,00	88,00	105,00	140,00	213,00
No.	6668.	6669.	6670.	6671.	6672.	6673.
Spark-length	50	60	70	80	90	100 cm
	\$ 315,00	440,00	565,00	690,00	815,00	980,00



6686.



6691.

**Induction coils with variable condenser and control switch** to alter self-induction, without contact-breaker.

No.	6674.	6675.	6676.	6677.	6678.	6679.
Spark-length	10	15	20	25	30	40 cm
	\$ 75,00	85,00	100,00	120,00	150,00	230,00
No.	6680.	6681.	6682.	6683.	6684.	6685.
Spark-length	50	60	70	80	90	100 cm
	\$ 330,00	455,00	585,00	710,00	845,00	1000,00

6686. **Mercury turbine contact-breaker** for continuous current. The contact-breakers are constructed for tensions of 16, 24, 32, 65, 110 and 220 volts. They are especially noteworthy as giving extreme accuracy in the number of interruptions, with small expenditure of current and smooth running. By altering the speed of the motor any number of interruptions from 10 to 100 per second can be obtained. Directions for use are supplied. The voltage to be used should be stated in ordering. [Fig. 1/4 nat. size.] To fill: 3500 g mercury and 700 g alcohol . . . . .

\$ 30,00

A metal tube bent a right angles is arranged so that its vertical part dips into mercury, which is covered with a badly conducting liquid, to such a height that the horizontal part of the tube is covered by this liquid. If the tube is rapidly rotated round the vertical limb, the mercury is sucked into it by centrifugal force and is projected from the horizontal limb in the form of a strong jet. By surrounding such a turbine with a metal ring in which orifices are cut, the jet alternately strikes the metal ring and passes through the openings. If the ring and the rapidly rotating tube are inserted in the primary circuit of an induction coil, the circuit is closed when the jet strikes the ring and broken when the jet passes the orifices.

According to the number of revolutions of the turbine and the number of orifices in the concentric ring the number of interruptions may easily be varied from 10 to 1000 per second. For observations with the fluorescent screen a frequency of 60 to 100 per second (3600 to 6000 per minute) is best; higher frequencies are of use in experiments with Tesla currents, Hertzian vibrations, ozone production etc.

The orifices in the segmented ring are of such dimensions usually that the time of make is equal to the time of break of current. For many induction coils used with low tension, the time of making contact must exceed the time of interruption of current; for such cases rings are provided with the segments broader than the openings. Full particulars are provided.