force both from the positively charged nucleus and from the electron cloud surrounding it, if we consider c to be comparable with nuclear dimensions. If the vibrations take place about this position of equilibrium, it is not difficult to conceive of the existence of the line.

We can also introduce an hypothesis that the quantum relation still holds in the neighbourhood of the nucleus; then the particle can move in stationary orbits. The perturbations in such a state will also give rise to vibrations, but in this case there may be many lines having similar character.

Perhaps there are lines showing similar behaviour in atoms of different elements, but the above is the only one which has come to our notice. A single line is insufficient to prove definitely that the electrons within the mercury nucleus can exist as one mass, but it may be looked upon as an experimental fact for supporting the hypothesis as regards the change in the law of electric action within the nucleus, as 120 electrons apparently form a particle near the core of mercury atom.

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Intense Magnetic Fields and the Disturbance of Electronic Orbits in Magnetic Materials.

IN recent years a great deal of attention has been centred on the problem of permanent magnetism, and some remarkable developments in the manufacture of permanent magnet steels have taken place, results having been obtained which, ten years ago, would have been considered unbelievably good. For example, steel made in accordance with Prof. Honda's specification gives a remanent induction density of 11,600 lines per square centimetre and a coercive force of 226 gauss.

In a paper read before the Institution of Electrical Engineers in 1920, S. Evershed gave a general idea of the magnetic intensity due to the electronic currents in the atoms of a substance, and he showed that, in order to reduce this current by one per cent., an impressed magnetic intensity of 1,500,000 gauss is necessary.

It has appeared to the writer that an attempt to produce magnetic fields sufficiently powerful to influence the electronic orbits might form a very fruitful line of investigation, and it would appear that one of the new permanent magnet steels might be expected to be specially favourable for this work. Means have now been devised by the writer for doing this, and it is hoped that it will be possible to publish at an early date a preliminary account of the results obtained.

The root idea of the method adopted is briefly as follows: If a current is passed through a coil for a sufficiently short time, the strength of the current may be almost indefinitely large. If, therefore, a magnetic specimen is provided with an exciting coil in which this very large current is allowed to pass, extremely high values of the magnetic intensity will be produced in the specimen under test. The easiest method of producing and controlling a very large current for this purpose is to use a large capacity condenser charged to a high potential and to discharge it through the exciting coil of the specimen. For example, suppose a short tube of magnetic material is provided with an exciting coil of 100 turns, and let the mean length of the magnetic circuit be 3 cm. If a current of 3000 amperes is passed through this coil, the intensity of the magnetic field so produced along the mean magnetic circuit will be 125,700 gauss.

Now it is true that a magnetic field of this intensity is small relatively to that required to produce an appreciable effect on the electronic orbits, and any influence which this field intensity may have on the orbits can be only a very minute one. *If, however, this field intensity be repeatedly applied to the specimen, a cumulative effect will be produced*, and it is expected that this cumulative effect will be easily measurable. The effect will be detected by an examination of its influence on the B-H curve of the specimen.

In Fig. 1 is shown a diagrammatical sketch of the general arrangement of the apparatus.

Condensers are used having a total capacity of 600

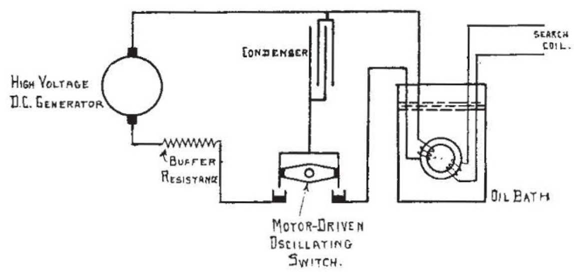

FIG. 1.

microfarads and capable of standing a pressure of 2000 volts. The condensers are charged from a high-voltage direct-current dynamo and then discharged through the exciting coil of the specimen, the charge and discharge operation being controlled by means of a motor-driven oscillating switch with mercury cup contacts. The rate of oscillation of the switch may be controlled between wide limits as found necessary, down to about one oscillation in 5 minutes.

The magnetic specimen is wound with a search coil in addition to the exciting coil, and the whole is deeply immersed in a large oil bath to allow the heat which is generated in the exciting coil to dissipate as quickly as possible.

The routine of the observations made is as follows: (1) The B-H curve of the specimen is taken. (2) The exciting coil of the specimen receives a large number of discharges of the condenser, say 1000 such discharges, and an oscillogram of the current for a representative discharge is taken. The interval between successive discharges is so regulated that the exciting coil remains sufficiently cool. (3) The B-H curve of the specimen is again taken. (4) A further series of condenser discharges is passed through the exciting coil. (5) The B-H curve of the specimen is again taken. This procedure will be continued so long as may be reasonably necessary to obtain some indication of the effect that is being produced.

It may be of interest to note that the central idea of the above experimental arrangement has found one immediately practical application, as was described by the writer in *Engineering* for March 7, in which a method is given for the magnetic testing of small samples. This method permits of the determination of the B-H curves up to values of the magnetic intensity of about 2000 gauss, the sample being in the form of a closed magnetic circuit of only two or three ounces weight.

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