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ELECTRIC IMPULSE GENERATOR FOR THE DETONATION OF CHARGES

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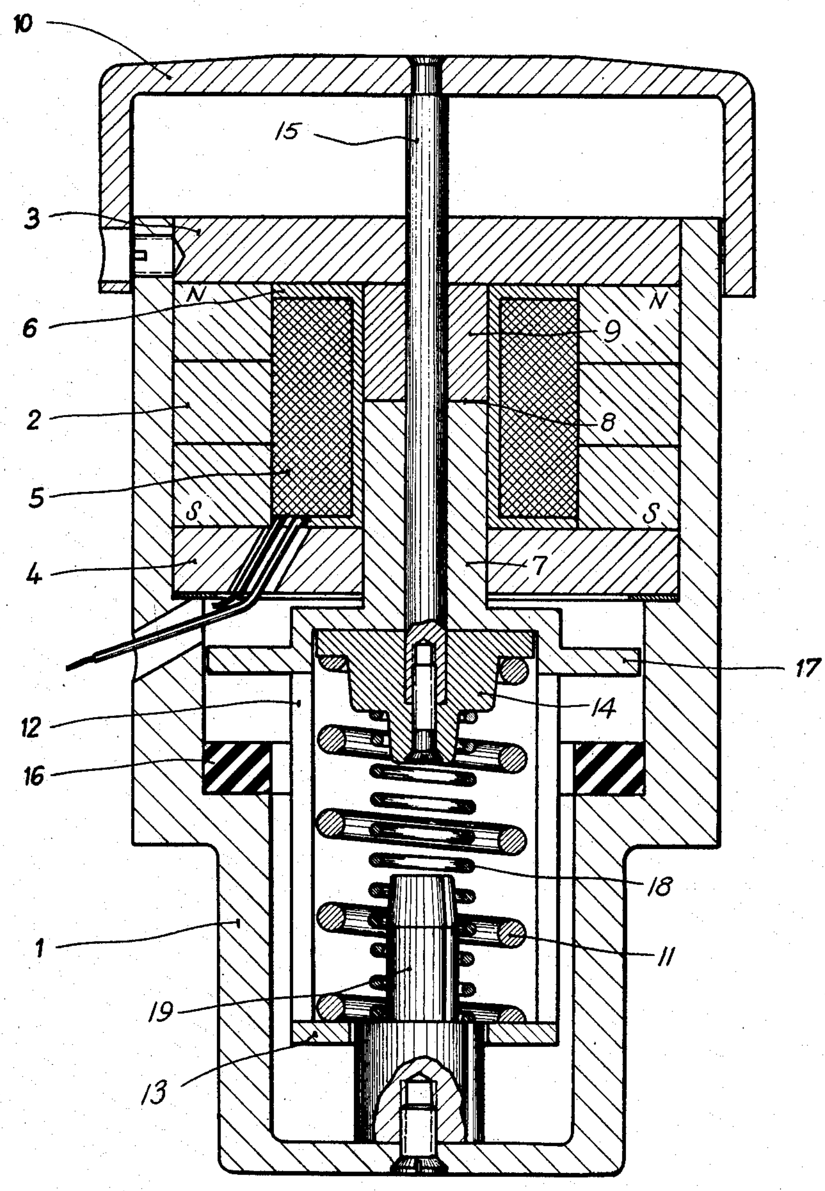

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1

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ELECTRIC IMPULSE GENERATOR FOR THE DETONATION OF CHARGES

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The present invention relates to an impulsive generator, more particularly for the detonation of propulsive or explosive charges, of the type in which the circuit of a permanent magnet is opened by a single rapid displacement of an armature by means of a mechanical push or pull exerted on an actuating component, thereby generating an electric impulse in an induction coil.

Electric impulse generators of this type used for the detonation of the explosive charge of artillery projectiles—so-called impulse generators—are already known, in which the sudden displacement of the armature is due to the direct transmission of the mechanical shock when the projectile impinges upon the target, thereby making or breaking the magnetic circuit. This causes a sudden change in the magnetic flux, thereby inducing the detonating current in the induction coil which is located within the field of the magnetic circuit.

Such impulse generators, as used for the fuse of artillery projectiles, are mostly designed for one single operation only. They also suffer from the disadvantage that the magnitude of the intended impulse cannot be estimated in advance, since it depends on the acceleration of the displaced armature in any particular case and hence on the force acting upon the armature when the projectile strikes the target.

Another impulse generator which has been proposed for the setting off of explosive charges can produce any desired number of electric impulses one after the other and it is claimed that due to a single closure of the circuit of a permanent magnet which takes place at a uniform rate for each detonation, it can generate the same detonating voltage every time. This impulse generator is furnished with a spring; when the magnetic circuit is opened, the armature slowly unscrews, thereby tensioning the spring which is maintained in that position by a locking mechanism. To detonate the explosive charge, i.e. to generate the electric impulse, a release mechanism has then to be operated which unlocks the spring and allows together with the armature to spring back into the closing position of the magnetic circuit.

One of the disadvantages of this type of impulse generator is the fact that—as mentioned above—the above mentioned spring must be tensioned only very slowly, since otherwise a voltage might be induced in the coil at the wrong time; in addition, the construction of the apparatus is very complicated, due to the tensioning, locking and release mechanism which are required and hence expensive and liable to go wrong. Finally it is also cumbersome and lengthy in operation, due to the two steps (tensioning—release) required for its actuation.

It is an object of the present invention to provide an impulse generator by which the said drawbacks can be overcome and which, whilst of simple design, can be used for the generation of impulses of uniform intensity in rapid succession. These advantages are of particular value in the case of electrical firing devices for guns, etc.

To solve this problem it is proposed in accordance with the invention to provide a means for storing energy between the armature and the actuating element, e.g. a spring which is released when the magnetic retaining force exerted by the magnet on the armature is overcome.

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2

storing means, the force exerting a mechanical push or pull on the actuating element, until it exceeds in magnitude the retaining force exerted by the magnet. As soon as this retaining force is exceeded, the energy released by the energy storing means will suddenly actuate the armature and open the magnetic circuit, so that an electric impulse is induced in the induction coil in the known manner.

It is an essential advantage of the impulse generator constructed in accordance with the invention that this simple arrangement will result in an acceleration of the armature always uniform in magnitude and depending on the retaining force of the magnet but not on the mechanical push or pull exerted upon the actuating element.

Since the means for storing energy is loaded and unloaded positively immediately afterwards in one single operation, only one actuation is required. Due to this single-step operation, electric impulses can be generated in rapid succession, in contrast to an apparatus in which the means for storing energy has to be tensioned, locked and released. The tensioning, locking and release mechanism otherwise required for the energy storing means are eliminated altogether, resulting in an exceptionally simple and sturdy construction of the impulse generator.

Further details and advantages of the invention will now be described in greater detail by reference to the accompanying drawing which is a longitudinal section through an embodiment of the impulse generator constructed by way of example in accordance with the invention.

The body **1** of the impulse generator accommodates an annular permanent magnet **2** whose pole faces are covered by the annular pole plates **3** and **4** made of soft iron. Inside the annular magnet **2** there is the induction coil **5** and its former **6** made of a non-magnetic material. The armature **7** can slide within the hole in the former **6**. According to an earlier proposal by the present applicants, the gap **8** of the magnetic circuit lies within the space enclosed by the induction coil **5**—in the case as illustrated in the drawing in the centre of the induction coil **5**—so that the stray field which exists in the air gap when the impulse generator is actuated, can also act upon the induction coil, thereby contributing towards its effectiveness. For this purpose the pole plate **3** is provided with a projection **9** which extends into the centre of the induction winding **5** or of the coil former **6**. In the arrangement as drawn, the magnetic circuit is made by the annular magnet **2**, the pole plate **3**, the projection **9**, the sliding armature **7** and the pole plate **4**. The movement of the armature **7** is initiated by an external pressure acting upon the actuating element **10** of the impulse generator. In the present case the actuating element **10** takes the form of a sliding cap covering the front end of the body **1** of the impulse generator on the outside. This design of the actuating member in the form of a cap provides a large area which is presented to the pressure force which is of particular advantage when the impulse generator is manually actuated. At the same time the cap protects the magnetic part of the impulse generator against external influences.

In order to ensure uniformity of the electric impulses under all conditions within the framework of the invention, a means for storing energy taking the form of a compression spring **11** is provided between the sliding armature **7** and the actuating element **10**; this spring is released automatically when the magnetic retaining force existing at the gap **8** between the armature **7** and the magnet is exceeded. The armature **7** contains a space **12** in which the spring **11** can be accommodated with advantage. Within this space, the spring rests at one end against the end plate **13** and hence the armature **7** and at the other end against the plunger **14** which is connected with the actuating cap **10** by a rod **15** made of a non-magnetic material such as brass.

Inside the body of the generator there are rubber pads **16** acting as stops for the flange **17** so as to protect the body against hard knocks and extreme pressure.

A return spring **18** for the sliding parts which is tensioned when the pressure cap **10** is actuated, is located between the plunger **14** and the body **1**. To support and guide this return spring, a guide pin **19** is attached to the body.

The method of operation of the proposed impulse generator is as follows:

If pressure is exerted on the cap **10**, for example by hand, this pressure will be transmitted by the rod **15** to the plunger **14**. This will cause the compression springs **11** and **18** in the space or housing **12** of the armature **7** to compress. If the force stored in the spring **11** is large enough to overcome the retaining force which obtains between the armature **7** and the projection **9** of the pole plate and which acts in the opposite direction, the spring **11** will cause the armature **7** and the space **12** to slide suddenly downwards; the spring **11** will lose its compression during this process. In order to ensure that the compression spring **11** will drive the armature **7** far enough, the compression spring is so dimensioned that the spring deflection corresponding to the retaining force of the magnet is equal to or greater than the required travel of the armature. On the other hand the return spring **18** which is located between the guide pin **19** and the plunger **14**, remains compressed as long as any pressure is being exerted on the actuating cap **10**. When the armature is moved, an air gap will form at the contact point **8**, suddenly altering the intensity of the magnetic flux and thereby giving rise to an induction impulse in the coil **5** which can be used for setting off propulsive or explosive charges of all kinds, for example for the electrical firing of guns.

After the pressure force ceases to act, the armature **7** and the cap **10** are returned to their original position as shown on the drawing by the return spring **18** which will lose its compression during that process. The impulse generator is then again ready for use.

The application of the impulse generator described herein is not limited to the setting off of propulsive and explosive charges; the idea of this invention can be employed with advantage in all those cases in which impulses of uniform intensity are to be generated in rapid succession. Instead of the spring **11** shown in the present embodiment, the means of storing energy could with equal effectiveness consist of a compressible gas. Similarly, the manual operation referred to above could also—still within the framework of the invention—be replaced by any type of mechanical or remote actuation.

What we claim is:

1. An impulse generator, more particularly for the detonation of propulsive or explosive charges comprising the circuit of a permanent magnet, an armature, an actuating element, an induction coil element, the permanent magnet producing a magnetic force, the displacement of the armature effected by means of a mechanical force exerted on the actuating element thereby generating an electric impulse in the induction coil, and spring means for storing energy between an extension of the armature and the actuating element and which is released when the magnetic force exerted by the magnet on the armature is overcome, said spring being mounted in a space between said armature extension and a part of the actuating element which are relatively movable.

2. An impulse generation according to claim 1, in which a rod is provided having a plunger and passing through the armature and connected to the actuating element so that the actuating element can exert a force on the spring which acts as a means for storing energy by means of the rod and the plunger.

3. An impulse generator according to claim 1, in which the actuating element includes a cap overlapping a front end of the generator.

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