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ELECTRIC PULSE GENERATING MEANS

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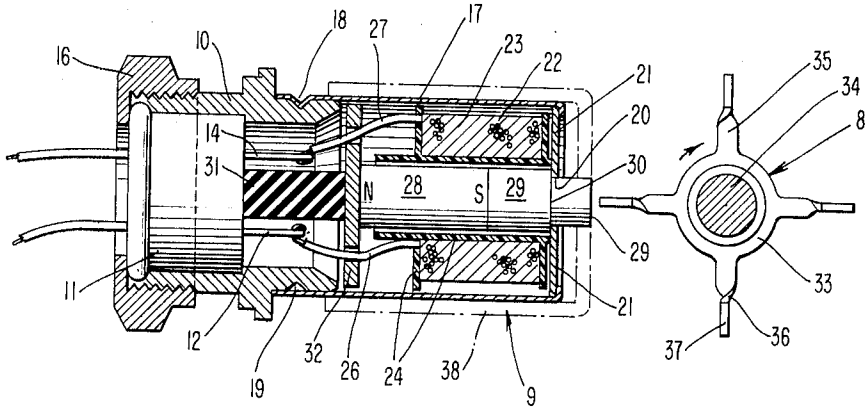

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ELECTRIC PULSE GENERATING MEANS

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This invention relates to electrical apparatus and more particularly to devices for generating pulses of electrical energy.

One of the objects of the present invention is to provide novelly constructed means whereby timed pulses of electrical energy may be generated, such as pulses adapted for triggering electronic valves, electronic switching devices, relays, and the like.

Another object is to provide novel electrical apparatus of the above character which comprises a minimum number of parts that may be readily manufactured and assembled at relatively low cost.

Still another object is to provide novel electric pulse generating means which is so constructed and operated that the pulses are generated by disturbance or distortion of the magnetic field in the vicinity of the pole of a stationary magnet.

A further object is to provide an electrical pulse generator which is admirably suited for use in an engine ignition system to provide accurate timing of the ignition sparks which varies in a desired manner with changes of engine speed or accurate timing that is unaffected by such changes of speed.

A still further object is to provide a novel and efficient method of assembling and magnetizing apparatus of the above character to insure maximum output capability per unit of size and weight.

Another object is to provide a novelly constructed electromagnetic device of small size and convenient shape for generating relatively powerful electrical pulses.

The above and further objects and novel features of the present invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawing. It is to be expressly understood, however, that the drawing is for the purpose of illustration only and is not intended as a definition of the limits of the invention.

In the drawing, the single figure is an axial sectional view, with some parts shown in side elevation, illustrating one form of pulse generating apparatus contemplated by the invention.

The single embodiment of the invention illustrated in the drawing, by way of example, is in the form of an electromagnetic device for generating electrical pulses adapted for triggering an electronic valve, such as in an engine ignition system, or for other comparable purposes, the same being capable of triggering said valve either at a fixed time during each pulsing cycle or at variable times during such cycle in response to variations in a reference speed. The apparatus as illustrated comprises a rotor or triggering wheel **8** and a magnetic stator unit **9**. The latter is shown as comprising a tubular casing **10** of aluminum or the like which may be a part of a larger housing that encloses other equipment, such as the parts of an ignition distributor.

An electrical connecting device **11** is mounted in the end of the casing and comprises two conductors or contacts **12**, **14**. Connector device **11** may be a part of a separable plug and socket type connector of any suitable known construction and the separable parts thereof may be held in assembled relation by a ring nut **16** which is illustrated as securing device **11** in the casing.

The pulse generating unit **9** of the invention comprises electromagnetic means consisting of a novel assembly of parts which is combined in a novel manner with and supported by casing **10**. As illustrated said assembly comprises a shell or housing **17** of non-magnetic material, such as brass, which telescopes with the cylindrical end portion of casing **10** and is secured thereto by staking at a number of circumferentially spaced places, as at **18**, into a groove **19** in the outer wall of the casing. The other end of shell **17** is closed, except for a central opening **20**, by a washer **21** which is also preferably made of non-magnetic material. Said washer may, if desired, be an integral part of shell **17**.

Within shell **17**, **21** and preferably seated against washer **21**, is a coil **22** having the winding **23** thereof wound on a spool **24** of insulating material, such as nylon. The inner and outer turns of winding **23** are connected by leads **26**, **27** to contacts **12** and **14**. Mounted within spool **24** is a longitudinally magnetized permanent magnet **28** which is preferably cylindrical and a combination pole piece and coil core **29** of magnetic material, such as silicon iron which may be cadmium plated.

The pole piece **29** extends through washer **21** and is preferably provided with a radial shoulder **30** or the equivalent which engages washer **21** to limit movement of the pole piece and magnet to the right, as viewed in the drawing. The magnet and pole shoe **29** are held against movement toward the left by a spacer **31** of resilient insulating material, such as synthetic rubber or other non-magnetic material. The spacer is interposed between connector **11** and magnet **28** under compression and greatly facilitates manufacture and assembly of the whole device since it takes up the tolerances permitted in the manufacture of the individual parts. For reasons to hereinafter appear pole piece or core **29** extends into coil **23** to approximately the axial mid point thereof.

In order to improve the output ability of the assembled unit **9**, it is preferable to magnetize the magnet **28** in situ after assembly. This may be done by placing the unit in the charging block of an external magnetizing machine but is preferably accomplished by energizing coil **23** in a condenser discharge circuit. To stabilize the magnet assembly at the most useful point on the BH demagnetization curve for the material used and hence maximize the permanent magnetic charge induced into the magnet, a plate or disc **32** of steel or other magnetic material is interposed between the upper or left end of magnet **28** and spacer **31**, as illustrated in the drawings, and the unit is temporarily placed in cup-shaped fixture or casing **38** of magnetic metal shown in dot-dash lines in the drawing. The lower or right end of casing **38** is shown with an opening for receiving pole piece **29** but the bottom of the casing may be solid and have butting engagement with the pole piece, if desired. The plate **32** and casing **38** thus form a substantially closed magnetic flux path wire core **29** and magnet **28**. When coil **23** is suitably energized, the material of the magnet is subjected to high ampere turns and will assume a strong permanent magnetic charge. When the temporary casing **38** is then removed, the lines of magnetic flux externally of the magnet will extend from plate **32** to pole piece **29** through the turns of coil **23**.

To hold the assembly within shell **17**, **21** against movement therein and to hold the parts of the assembly against undesirable relative movement, the space within the shell and casing **10** around the assembled parts may be, and preferably is, filled with a suitable insulating compound which has been omitted from the drawing in the interest of clarity. The filling of the space may, for example, be accomplished by injecting a flowable compound under vacuum and thereafter causing the compound to set by chemical reaction with or without the aid of heat.

Means illustrated in the form of a triggering wheel **8** are shown for periodically or intermittently disturbing or distorting the external magnetic flux field of magnet **28**

momentarily and sufficiently in relation to the turns of winding **23** to induce or generate momentary pulses of electrical energy in the winding and the circuit to which it is connected through terminals **12** and **14**. In the form shown, said triggering wheel is made of a magnetic material, such as sheet steel, and comprises a hub portion **33** drivably connected to a rotatably shaft **34**. A plurality of arms or fingers **35** extend radially from and are preferably integral with hub portion **33**. Fingers **35** are twisted, as at **36**, through 90° so that the operative end portions or vanes **37** thereof are thin in the direction of motion as they rotate close to and past the outer end of pole shoe **29**. Each electric pulse thus generated in winding **23** when a vane **37** passes through the magnetic flux field in the vicinity of the end of pole shoe **29** has the advantageous characteristic that it changes almost instantly from a maximum of one polarity to a maximum of the opposite polarity. This reversal occurs as the thin finger portion or vane **37** passes the plane containing the longitudinal axis of the pole shoe and magnet. The vanes **37** do not appreciably vary the flux intensity of the magnetic field but rather merely distort or disturb the field causing relative movement of the lines of flux and the turns of winding **23**. Upon each passage of a vane a single pulse is generated in the winding without any oscillations. Because of the extension of the core **29** into the coil, a greater distortion of disturbance of the magnetic flux occurs during each passage of a vane **37** and hence a more powerful pulse is obtained than if the winding surrounded only the magnet. For optimum output, core **29** should extend to at least near the middle of the winding.

There is thus provided a novel electrical pulse generating apparatus which is rugged, yet of simple and inexpensive construction and which is capable of generating single distinct pulses of electrical energy at selected predetermined intervals in relation to a moving part, said pulses being without oscillations and admirably suited for triggering electronic valves, such as silicon controlled switches, transistors, and the like, for any purpose and more particularly for controlling the operation of condenser discharge type ignition systems for combustion engines and the like. The novel unit **9** hereby provided is symmetrical and hence may be conveniently mounted without the necessity of orientation relative to the wheel **8**. Additionally, the novel device contemplated by the invention is not direction sensitive so that the trigger wheel may be rotated in either direction.

Although only a single embodiment of the invention has been illustrated and described in detail in the foregoing specification, it is to be expressly understood that the invention is not limited thereto. Various changes may be made, such as in the design and arrangement of the parts illustrated as well as in the materials suggested for use, without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

What is claimed is:

1. In electrical pulse generating apparatus, an electromagnetic unit comprising a core including a permanent bar magnet made of magnetic material such as aluminum nickel alloy and a bar of magnetic material such as silicon iron alloy, said bars being in abutting end-to-end relation, a coil wound around said core and electrically insulated therefrom, said bars projecting from opposite ends of said coil and having the abutting ends thereof in the vicinity of the axial midpoint of the coil, and non-magnetic means securing said core and coil in assembled relation.

2. Electrical pulse generating apparatus as defined in claim **1** comprising a disc of magnetic material spanning the projecting end of said magnet and extending radially therefrom over an adjacent end of the coil.

3. Electrical pulse generating apparatus including an electro-magnetic unit comprising non-magnetic casing means having a central opening in one end wall thereof, a core member of magnetic material having a reduced pole shoe portion extending outwardly through said opening and a radial shoulder engaging said end wall around the opening, an axially magnetized permanent magnet in end-to-end relation with said core member, means including a resilient block interposed between said magnet and the other end wall of said casing means to position the magnet and core axially of the casing means, a non-magnetic spool surrounding the adjacent ends of said magnet and core member for positioning the same radially of the casing means, and an electrically conductive coil wound on said spool, the junction of said magnet and core member being intermediate the ends of the coil.

4. In electrical pulse generating apparatus, the combination comprising an assembly of parts including a spool formed of non-magnetic material, an electrically conductive coil wound on said spool, an axially magnetized permanent magnet extending into and projecting from one end of said spool, a core member of magnetic material extending into and projecting from the other end of said spool, and non-magnetic means holding the parts of said assembly in assembled relation.

5. In electrical pulse generating apparatus, the combination comprising an assembly of parts including a spool formed of non-magnetic material, an electrically conductive coil wound on said spool, a magnetic flux conducting core extending through said spool and coil, said core comprising an axially magnetized permanent magnet and a substantially unmagnetized core member of magnetic material in end-to-end relation with the magnet, the junction of said magnet and core member being in the vicinity of the axial midpoint of the coil.

6. Electrical pulse generating apparatus as defined in claim **5** comprising a disc of magnetic material engaging the projecting end of said magnet and extending radially over the adjacent end of said coil.

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