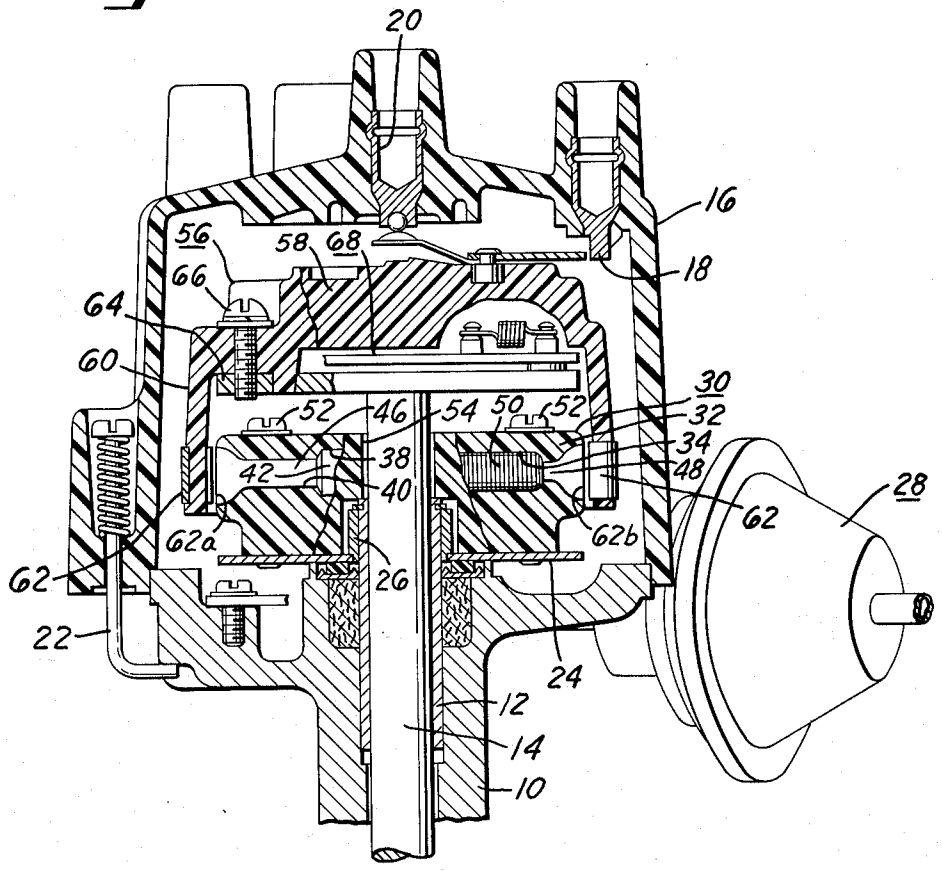
June 28, 1966 E. M. SAWYER 3,258,551

PULSE GENERATOR WITH MAGNETIC INSERTS ON ROTOR

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Fig. 1



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Fig. 2

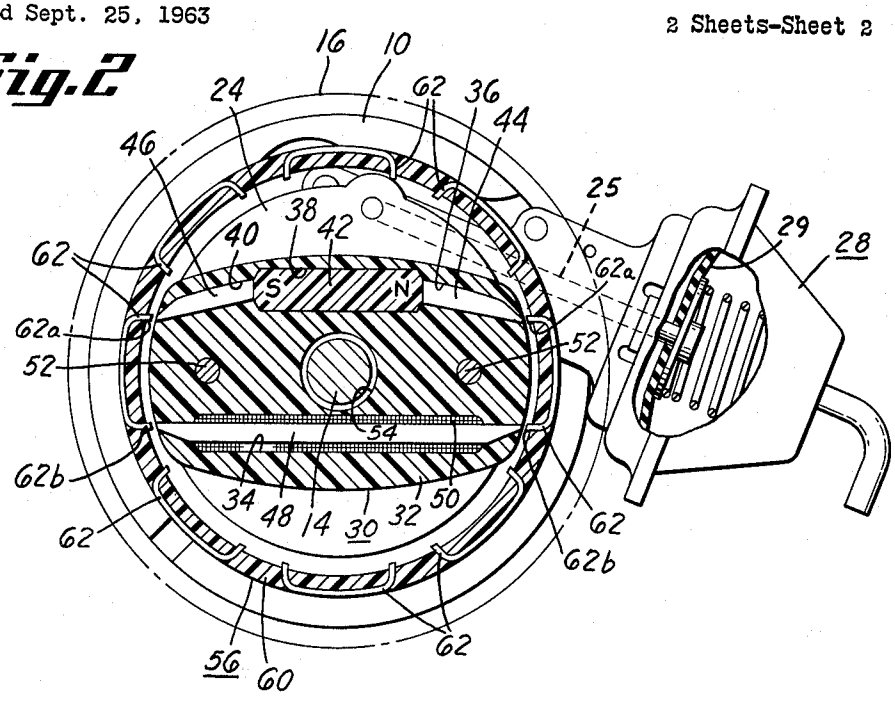
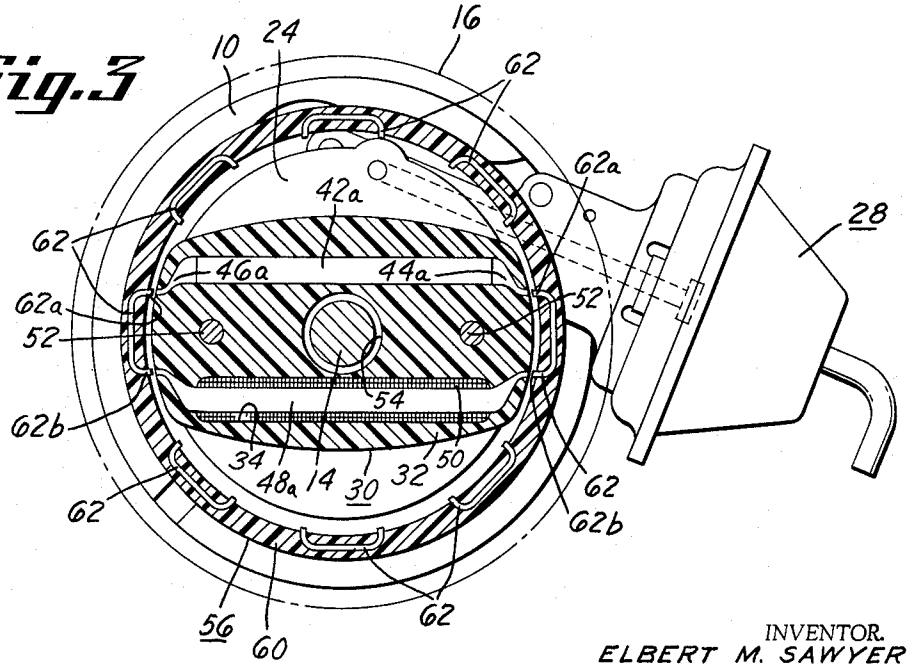


Fig. 3



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PULSE GENERATOR WITH MAGNETIC INSERTS ON ROTOR

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Filed Sept. 25, 1963, Ser. No. 311,348
14 Claims. (Cl. 200—19)

This invention relates to a magnetic pick-up, and more particularly to a magnetic pick-up type of distributor which can be used to control an internal combustion engine ignition system.

The present invention relates to an improved magnetic pick-up which can be used in an ignition system of the type shown in the Short et al. patent, 3,087,001, and can be substituted for the magnetic pick-up shown in that patent.

One of the problems encountered in the design of magnetic pick-ups for controlling a semiconductor ignition system such as that shown in the above-mentioned Short et al. patent is the generation of sufficient voltage by the magnetic pick-up when the engine is being cranked at low speed such as is experienced in cold weather. Thus, the magnetic pick-up must control ignition timing both when the engine is operating at high speed and when it is being cranked by an electric starting motor at low speed and it is important that sufficient voltage be developed at low cranking speed to properly control ignition timing.

It accordingly is one of the objects of this invention to provide a magnetic pick-up type of distributor which is capable of producing higher output voltages than those heretofore known.

Another object of this invention is to provide a magnetic pick-up wherein the working air gaps can be placed at a larger diameter than is normally possible. This means that with the same pole tip widths as have been used in previous magnetic pick-ups, the flux change will take place in a shorter period of time and a larger induced voltage will result.

Another object of this invention is to provide a magnetic pickup wherein it is possible to obtain a larger number of turns for the magnetic pick-up coil without appreciably increasing the diameter of the coil. This object is important since it makes it possible to have a low mean-length-of-turn which allows the resistance of the coil to be kept quite low.

A further object of this invention is to provide a magnetic pick-up wherein the rotor of a distributor carries magnetic means for forming the magnetic path between a flux generating device such as a permanent magnet and the core of a magnetic pick-up coil. In carrying this object forward, the rotor which is formed of insulating material has a depending annular skirt which carries horseshoe shaped magnetic parts that are capable of completing the flux path between the permanent magnet and the core of a pick-up coil.

Still another object of this invention is to provide a magnetic type of pick-up distributor wherein a molded part carries a permanent magnet and a pick-up coil assembly and wherein this molded part is fixed to a vacuum advance plate of the distributor and further wherein a distributor rotor has magnetic inserts for completing the flux path between the permanent magnet and the core of the pick-up coil assembly carried by the molded part. In carrying this object forward, a centrifugal advance mechanism may be provided which is connected between the driving shaft of the distributor and the distributor rotor to adjust the distributor rotor relative to the driving shaft in accordance with the speed of rotation of the shaft.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiment of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a sectional view of a magnetic pick-up made in accordance with this invention.

FIGURE 2 is a sectional view of a magnetic pick-up made in accordance with this invention with the distributor cap removed and illustrating the positioning of the permanent magnet and pick-up coil in a molded part that is carried by the distributor timing plate.

FIGURE 3 is a view similar to FIGURE 2 but illustrating a modified structural arrangement for the permanent magnet and pick-up coil.

Referring now to the drawings and more particularly to FIGURE 1, the reference numeral **10** designates the metal base of the magnetic pick-up distributor made in accordance with this invention.

The base **10** carries a bearing sleeve **12** which journals a driving shaft **14**. The shaft **14** is suitably driven by the internal combustion engine which has its ignition timing controlled by the magnetic pick-up of this invention. It will be appreciated that the base **10** will have a lower section which can support another sleeve bearing for journalling the shaft **14**.

The base **10** supports a conventional distributor cap **16** having a plurality of circumferentially spaced metal inserts **18** which correspond in number to the number of cylinders of the engine. This distributor cap is formed as a molded plastic part and carries the usual center electrode **20** which is connected to the secondary winding of an ignition coil as is well known to those skilled in the art. The distributor cap **16** is attached to the base **10** by any suitable fastening means such as the spring biased hooks **22**.

The magnetic pick-up of this invention includes a timing plate **24** which is connected with a bearing member **26** journalled on the outer portion of the upper end of the sleeve bearing **12**. The timing plate **24** is connected with the actuating rod **25** of a conventional vacuum motor generally designated by reference numeral **28**. This vacuum motor **28** has the usual spring biased diaphragm **29** which is connected with the rod member that in turn shifts the timing plate **24**. It will be appreciated that the timing plate **24** is journalled for rotation around the longitudinal axis of the shaft **14** and when the vacuum unit **28** is connected with a source of vacuum on the engine, the timing plate **24** is adjusted in a manner well known to those skilled in the art. In usual practice, the timing plate **24** is adjusted by vacuum to advance spark timing.

The timing plate **24** carries a pick-up assembly which is generally designated by reference numeral **30**. This pick-up assembly **30** is comprised of a one-piece molded part **32** which is formed of a suitable plastic material. The molded part **32** has slots **34**, **36**, **38** and **40**. The slot **38** receives a permanent magnet **42** while the slots **36** and **40** respectively receives soft iron pole tips **44** and **46**. The slot **34** receives an iron rod **48** which has a pick-up coil **50** wound thereon. The permanent magnet **42** can take various forms and may be of the ferrite type having a plastic binder.

In fabricating the pick-up coil assembly **30**, a molded part is first provided having the required slots for receiving the permanent magnet, the pole tips and the core **48** and coil winding **50**. The iron rod **48** is coated with a plastic material which may be applied to this rod by heating the rod to a high temperature and then impinging a finely divided plastic material against the rod whereby the plastic material melts and coats the rod in its entirety. Following this, the coil winding **50** is wound on the rod and the wire that forms this coil winding is coated with a cement which solidifies when the coil winding is heated by passing a

current through the coil winding for a few seconds. This cement coating eliminates the cost of the coil form or the bobbin and therefore reduces the cost of the coil winding and its core.

After the permanent magnet **42**, pole pieces **44** and **46**, core **48** and coil winding **50** have been assembled in the slots of the molded plastic part **32**, the slots are filled with an epoxy resin or other suitable material to encapsulate these parts and hold them in place. It is apparent that the assembly **30** might be fabricated by other methods.

The assembly **30** is secured to the timing plate **24** by screws **52** which are threaded into the timing plate. The molded plastic part **32** has a central opening **54** which receives the shaft **14** in a manner shown in the drawings.

The magnetic pick-up of this distributor has a rotor which is generally designated by reference numeral **56**. This rotor comprises a molded part **58** formed of a suitable plastic material and has an integral annular skirt section **60**. The annular skirt section **60** carries a plurality of horseshoe shaped parts **62** which are formed of a magnetic material such as soft iron. These horseshoe shaped parts each have tips **62***a* and **62***b* which at times complete a magnetic circuit between the ends of the coil winding core **48** and the ends of the pole tips **44** and **46** as is clearly apparent from FIGURE 2. In the FIGURE 2 position of the rotor, flux will flow from one end of the permanent magnet, for example, the end that engages the pole tip **44**, through the pole tip **44**, through one of the magnetic inserts **62**, through the core **48**, through another magnetic insert **62** and then through the pole tip **46** back to an opposite side of the permanent magnet **42**. It, of course, will be appreciated that there are times when the magnetic inserts **62** are not aligned with the ends of pole tips **44** and **46** and the core **48** whereupon the flux path through the core **48** is broken.

The rotor member **56** is secured to a weight base **64** by one or more fasteners **66**. The weight base **64** is driven through a conventional centrifugal advance mechanism generally designated by reference numeral **68**. This centrifugal advance mechanism is arranged such that the weight base **64** is adjusted relative to the shaft **14** in accordance with the speed of rotation of the shaft. This centrifugal advance mechanism is of a type shown in the patent to Hartzell et al. 2,872,537, and has two flyweights, two springs and a cam plate which is driven by shaft **14** in addition to the weight base **64**. This type of centrifugal advance mechanism is also shown in the Short et al. patent, 3,087,001, noted above. The centrifugal advance mechanism is positioned within the plastic molded part **58** in the same manner as shown in the Hartzell et al. patent mentioned above.

The magnetic pick-up of this invention as pointed out above is useful in controlling semiconductor ignition systems of the type shown in the Short et al. patent, 3,087,001. It is to be understood, however, that this magnetic pick-up could be used in any type of ignition system wherein pulses of voltage can be used to control a switching function. In addition, the magnetic pick-up can have other uses and in general is useful wherever it is desired to control some device by periodically occurring voltage pulses.

When the shaft **14** is rotating, it drives the rotor assembly **56** and the magnetic inserts **62** therefore progressively pass by the ends of the core **48** and the pole tips **44** and **46**. In the FIGURE 2 position of the rotor **56**, maximum flux will flow through the core **48** and a voltage will be induced in the coil winding **50**. As the ends of the magnetic insert **62** move out of alignment with the pole pieces **44** and **46** and the ends of core **48**, the flux path for the core **48** is broken and no voltage is induced in the coil winding **50** except for a voltage that may be induced by the collapse of flux. The device of this invention therefore will provide a periodically varying train of voltage pulses, the frequency of which is directly proportional to the speed of the shaft **14**. In addition, where this magnetic pick-up is used as a timing device for an ignition system of an internal combustion engine, the device is capable of providing both a vacuum and a centrifugal advance. Thus the occurrence of voltage pulses as related to position of the shaft **14** is adjusted by the centrifugal advance mechanism **68** which adjusts the rotor **56** with respect to the shaft **14** in accordance with the speed of shaft **14**. The vacuum advance is obtained by adjusting the timing plate **24** which in turn adjusts the magnetic pick-up assembly **30** relative to the rotor **56** and therefore relative to the magnetic inserts of this rotor.

The magnetic pick-up of this invention has a number of advantages as compared to those previously used. First of all, by placing the magnetic inserts **62** in the depending annular skirt **60**, it is possible to provide a maximum diameter for the working air gaps of the magnetic pick-up. This causes a larger voltage to be induced in the coil winding **50** as compared to previous devices of this type.

Another advantage which is achieved by this invention is the reduction in the resistance of the pick-up coil. This is achieved by reducing the diameter of the coil winding which is made possible by winding it in a long length on the rod **48**.

All of the above-noted advantages work to the ultimate result of providing a magnetic pick-up which is better adapted to provide sufficient voltage at low cranking speeds of an engine to adequately time the ignition pulses for the engine.

Referring now to FIGURE 3, a modification of the pick-up assembly **30** is illustrated. In FIGURE 3, the same reference numerals have been used as in FIGURE 1 to identify the same part in each figure. The only difference between FIGURE 3 and FIGURE 2 is that in FIGURE 3 the magnet **42***a* is longer than the magnet **42** shown in FIGURE 2. In addition, the pole tips **44***a* and **46***a* are somewhat shorter in length and are a slightly different configuration at their ends. The core **48***a* in FIGURE 3, has a slightly different configuration at its ends as can be seen by a comparison of FIGURES 2 and 3.

The FIGURE 3 embodiment operates in the same manner as that shown in FIGURES 1 and 2 and is an alternative arrangement for construction of the magnetic pick-up assembly **30**.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A voltage generating device comprising, first and second relatively rotatable parts, a permanent magnet carried by said first part, first and second magnetic members carried by said first part located in a magnetic circuit with said permanent magnet and terminating in first and second pole tips, a core member formed of magnetic material carried by said first part, said core member terminating in third and fourth pole tips, a coil winding wound on said core member, and magnetic means carried by said second part aligned with said pole tips for completing and interrupting magnetic circuits between said first and fourth and said second and third pole tips of said first part.

2. An ignition timing control device comprising, a cap member of insulating material having a center electrode and a plurality of circumferentially spaced electrodes, a rotor member of insulating material carrying contact means which progressively connect the center electrode of said cap member with said circumferentially spaced electrodes when said rotor member rotates, a pick-up coil, a source of flux, and a magnetic circuit magnetically coupling said source of flux and said pick-up coil, said magnetic circuit including at least one magnetic part carried directly by the insulating material of said rotor member.

3. An ignition timing device comprising, a cap member of insulating material having a center electrode and a plurality of circumferentially spaced outer electrodes, a rotor

part of insulating material, said rotor part carrying contact means which connects the center electrode with said outer electrodes of said cap as said rotor part rotates, a pick-up coil, a source of flux, and a magnetic circuit coupling said pick-up coil and said source of flux, said magnetic circuit including inserts of magnetic material carried by said rotor part.

4. An ignition timing control device comprising, a part of insulating material, a permanent magnet carried by said part, a coil winding wound on a core member carried by said part, a rotor member of insulating material carrying a contact means for transferring ignition pulses to a plurality of spark plugs, and magnetic inserts in said rotor member positioned to periodically complete a magnetic circuit between said permanent magnet and said core.

5. An ignition control device comprising, a base member, a distributor cap having electrical inserts carried by said base member, a shaft rotatably mounted in said base member, a support, a permanent magnet, a core member and a coil winding each carried by said support, said core member and coil winding being magnetically coupled, a rotor member of insulating material having electrical contact means for electrically connecting the electrical inserts of said distributor cap, and magnetic means embedded in said rotor member positioned to periodically complete a magnetic circuit between said magnet and core member carried by said support.

6. The ignition timing device according to claim 5 wherein a centrifugal advance mechanism drives said rotor member from said shaft.

7. The ignition timing device according to claim 5 wherein the support which carries the permanent magnet and coil winding is secured to a timing plate which is adjusted by a vacuum unit.

8. A voltage generating device comprising, first and second relatively rotatable plastic parts, a permanent magnet, a core and a coil winding each disposed within the plastic material of said first part, said coil winding being magnetically coupled to said core, said core terminating in a first pair of pole tips, a second pair of pole tips magnetically connected to opposite ends of said permanent magnet disposed within the plastic material of said first part, and means formed of magnetic material carried by said second plastic part and located adjacent said pole tips for periodically completing a magnetic circuit between ends of said first and second pairs of pole tips.

9. The voltage generating means according to claim 8 wherein the core and coil winding are encapsulated in said first plastic part and wherein said permanent magnet and pole tips are encapsulated in said first plastic part.

10. An ignition control device comprising, a base member, a distributor cap of insulating material carried by said base member having conductive inserts, a shaft journalled for rotation in said base member, a pick-up assembly including a support member, a permanent magnet, a core member and coil winding each carried by said support member, a timing plate, means securing said pick-up assembly to said timing plate, a vacuum unit including an actuator connected to said timing plate, a rotor member including a body member of insulating material, said body member carrying electrical contact means which periodically connect the conductive inserts of said distributor cap, centrifugal advance mechanism interconnecting said shaft and said rotor member, and a plurality of generally U-shaped magnetic inserts carried by said body member adjacent said pick-up assembly for periodically completing a magnetic circuit between said permanent magnet and said core member.

11. A voltage generating device comprising, first and second relatively rotatable parts, a first magnetic circuit branch carried by and extending transversely across said first part terminating in first and second pole tips located at opposite ends of said first magnetic circuit, a second magnetic circuit branch carried by and extending transversely across said first part terminating in third and fourth pole tips located at opposite ends of said second magnetic circuit branch, said first pole tip being spaced from said third pole tip and said second pole tip being spaced from said fourth pole tip, said first and second magnetic circuit branches being comprised of a permanent magnet and a magnetic core carrying a coil winding, and a pair of magnetic means located on opposite sides of said second part, said magnetic means in one position of said parts magnetically connecting respectively said first and third pole tips and said second and fourth pole tips, said parts in another position disconnecting said pole tips.

12. A voltage generating device comprising, first and second relatively rotatable parts, first and second magnetic circuit branches carried by said first part terminating respectively in first and second and third and fourth pole tips, said first and third pole tips being spaced from each other and located at one side of said first part, said second and fourth pole tips being spaced from each other and located at an opposite side of said first part, said magnetic circuit branches including a flux generating means and a coil winding, and a pair of magnetic means carried by said second part aligned with said pole tips and operative upon relative rotation of said first and second parts to complete and interrupt a flux path between said first and third and second and fourth pole tips.

13. A rotor member for a voltage pulse generator type of distributor comprising, a body section of insulating material, said body section carrying electrical contact means which are adapted to connect the center electrode and outer circumferentially spaced electrodes of a distributor cap, and a plurality of circumferentially spaced generally U-shaped magnetic parts carried by said body section.

14. A rotor member for a voltage pulse generating type of distributor comprising, a body member formed of insulating material, said body member carrying electrical contact means which are adapted to connect the center electrode and outer circumferentially spaced electrodes of a distributor cap, and a plurality of circumferentially spaced magnetic segments embedded in said body member and carried thereby.

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