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IGNITION SYSTEM FOR AN INTERNAL COMBUSTION ENGINE

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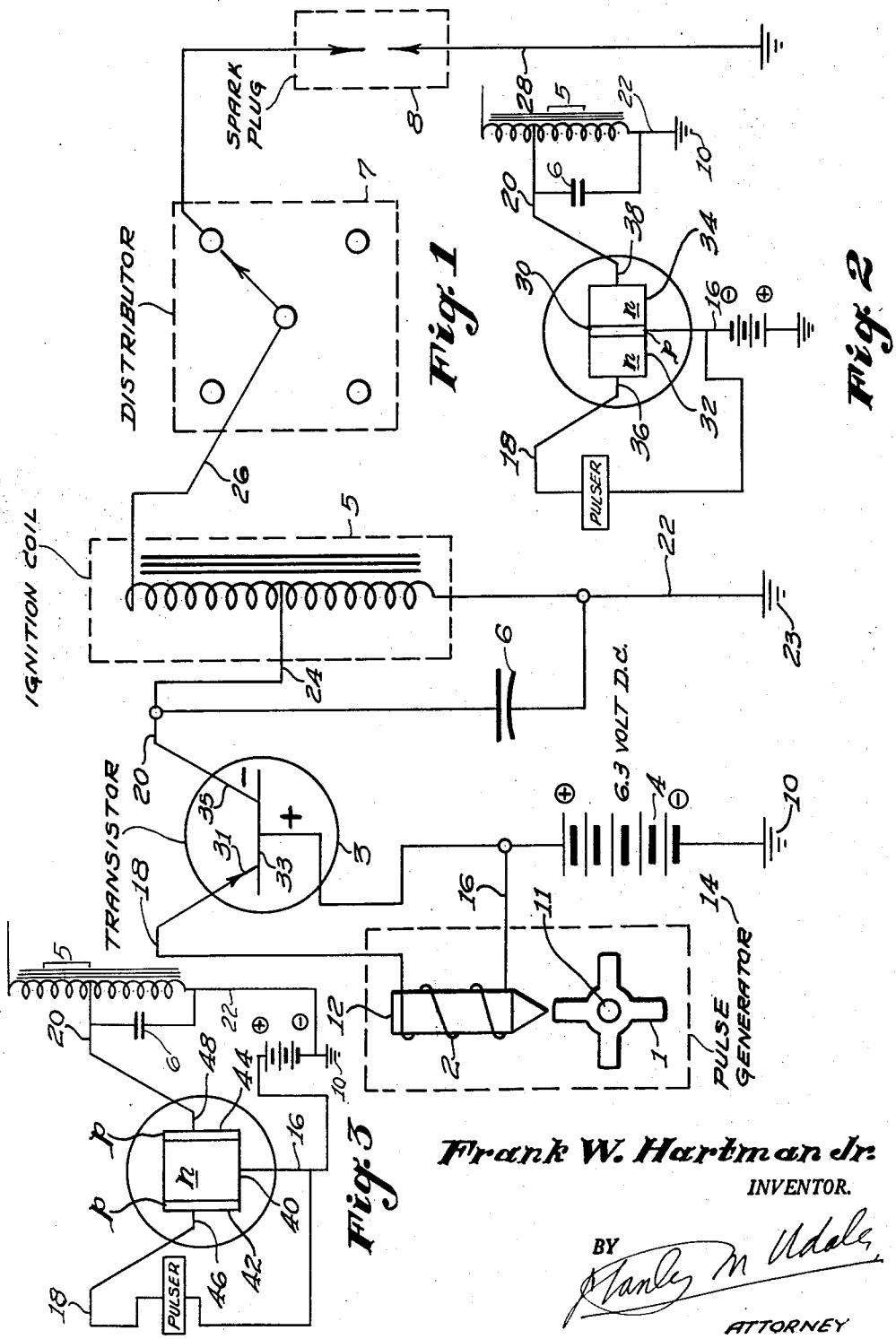


Fig. 1

Fig. 2

Fig. 3

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IGNITION SYSTEM FOR AN INTERNAL COMBUSTION ENGINE

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The object of this invention is to replace the ordinary circuit breaker with transistors so that this ignition system for an internal combustion engine includes in its circuit transistors which control the operation.

The existing ignition system consists of:

A coil—the primary connected to a battery and the secondary connected to a distributor.

A make-and-break switch commonly known as a circuit-breaker, with a condenser across the two points.

A cam operating the circuit breaker which controls the primary of the coil. The difficulty experienced during the last forty-seven years with this construction is that:

The cam follower on the circuit-breaker wears and the tungsten points of the circuit-breaker burn away. Obviously, the life varies with the load. The slower the engine runs, the greater the current and the more the points burn away. The faster the engine runs and the less the current, the more important relatively is the wear on the cam follower.

To adjust or replace the tungsten point occupies a large number of garage mechanics and adds considerably to the cost of operation. If the circuit breaker can be eliminated, the car owner can afford to pay for a relatively expensive substitute because the upkeep will be less. Again, ignition systems usually fail just when the truck or bus is most needed.

Figure 1 is a diagrammatic illustration of how my invention works with one or more point contact type of transistors.

Figure 2 is a detail of an alternative construction showing how a junction type of transistor of the type n. p. n. can be used.

Figure 3 is a detail of an alternative construction showing how a junction type of transistor of the type p. n. p. can be used.

In all cases, it is understood that a number of transistors coupled in parallel may be used to produce a powerful spark.

In Figure 1:

10 is the ground connection to the negative end of the battery 4 having a voltage equal to 6.3 volts.

1 is the rotor of permeable material (soft iron) carried on a shaft **11** rotated by the engine. The rotor **1** has four arms.

2 is a coil wound around a core **12** of magnetic material having a pointed end which just clears the ends of the four rotating arms of rotor **1**.

This assembly **14** is known as a pulse generator.

3 is the transistor which replaces the circuit breaker in general use.

The particular transistor shown in Fig. 1 is of the point contact type (comparatively weak) and consists of an emitter **31** and a base **33** of a semi-conducting rectifying material such as germanium with certain critical impurities.

35 is a collector biased in the non-conducting end of the semi-conducting material of the base **33**.

Germanium is the best material, although silicon can be substituted. Certain impurities are essential about which certain theories have been spun. Other rectifying crystal elements (other than silicon and germanium) may be substituted.

16 is the positive connection for the coil **2** and leads from the positive end of battery **4** and to the base **33** of transistor **3**.

18 is the other connection from coil **2** and leads to the emitter **31**.

The current is abruptly interrupted as it flows out of collector **35** and connection **20** to condenser **6** from the emitter **31** as the germanium acts as a rectifier so that the current cannot reverse its direction of flow. Now a pulse generator causes a current to alternate; that is, to reverse. If this reversal is checked suddenly, we have the equivalent of a circuit breaker.

22 is a conductor which leads from the grounded plate of the condenser **6** and is grounded at ground connection **23**.

Ignition coil **5** is connected to the collector **35**, the conductor **20** and to the non-grounded side of the condenser **6** through conductor **24**, which is located at the midway connection between the high tension and low tension coils of the ignition coil **5**.

The low tension portion of coil **5** is also grounded through conductor **22**.

26 is the high tension outlet from the high tension end of coil **5**.

A distributor **7** distributes high tension electricity from **26** to a number of spark plugs, one of which is indicated at **8**.

By oscillating the coil **2** and its core **12** around shaft **11** the timing of the ignition can be varied; but that, of course, is no part of this invention.

In Figure 2:

A junction transistor (type n. p. n) is shown consisting of a base **30** made of a thin slab of "p" type germanium "acceptors."

32 is the emitter end of the junction made of "n" type "donors" germanium.

34 is the collector end of the junction and is also made of "n" type "excess of electrons" germanium.

36 is the emitter.

38 is the collector.

The conductor **16** is connected to the base material **30**.

The "p" type contains an excess of "holes" (according to the generally accepted theory) due to the presence of small quantities of impurities such as aluminum, boron, or indium (valency 3). Valency 5 impurities such as phosphorus, arsenic and antimony are present in small quantities in the "n" type (ends **32** and **34**).

A modification of the electrical connections is required as compared with the electrical connection shown in Figure 1, but the principle of construction is the same.

In Figure 3:

In this example, a junction type of transistor of the p. n. p. type is used.

46 is the emitter connected to the "p" type at the end **42** of the central position **40** which is of "n" type.

44 is also of the "p" type and is located at the other end of central portion **40**.

48 is the collector.

OPERATION

Figure 1

As shaft **11** rotates, the magnetic lines in coil **2** and core **12** vary so there is an electric pulse transmitted to the transistor **3** which is abruptly interrupted by the rectifying characteristic of the transistor **3** as the arms of

the rotor pass the pointed tip of the core 12 of coil 2. This duplicates the action of a circuit breaker. After the circuit is broken, the condenser 6 discharges immediately and a rush of electricity produces the spark from coil 5 just as in an ordinary ignition system. The shaft 11 continues to rotate; another arm of rotor 1 comes into line with the pointed end of core 12 of coil 2. Meanwhile the condenser 6 is recharged and the cycle of operation is repeated. The current flows easily from 18 across to 20 through the transistor 3 and the condenser becomes charged. When the current is reversed, the flow is suddenly stopped and the condenser 6 discharges.

Figure 2

Here the polarity of the battery 4 is reversed; the central portion 30 of the "p" type is now connected to the negative end of the battery 4 (6.3 volts). Otherwise the operation remains unchanged.

Figure 3

Here the polarity is the same as in Figure 1 so the operation is practically identical with that of Figure 1.

What I claim is:

1. In an ignition system of the character described, an electrical circuit including a source of pulsating current consisting of a pulse generator, a supply source of direct current electricity connected to one end of said generator, said source having a ground connection, a condenser and a grounded transformer connected in parallel for transforming the pulsating electrical energy to a higher voltage including a primary coil and a secondary coil and a common connection therebetween, a transistor having a base of semi-conducting rectifying material, an emitter, and a collector, said transistor being located in the circuit between the generator and said common connection, a conductor connecting said base to said source of direct current, said collector being connected to said common connection and to said condenser, said emitter being connected to the pulsating current for controlling the flow of electricity from said generator to said transformer and to said condenser, and a high tension distributor connected to said secondary coil.

2. In an ignition system of the character described, including a source of direct current electricity having a ground connection, a transistor having a base connected to said source, an emitter, and a collector, a grounded

ignition coil having primary and secondary coils and having a common connection between said primary and said secondary coils connected to said collector, a high tension distributor connected to said secondary coil, a condenser in parallel with said primary coil and connected to said common connection, a pulse generator generating a pulsating flow of electrical current connected at one end to said emitter and to the other end to said base and to said direct current source, means for intermittently operating said pulse generator whereby the transistor is activated intermittently to pass current from said source through said transistor to said common connection for said coil and to said condenser and to discharge said condenser through said primary coil.

3. In an ignition system of the character described, including a source of direct current electricity having a ground connection, a transistor having a base connected to said source, an emitter element, and a collector element, a grounded ignition coil having primary and secondary coils and having a common connection between said primary and said secondary coils connected to one of said elements, a high tension distributor connected to said secondary coil, a condenser in parallel with said primary coil and connected to said common connection, a pulse generator generating a pulsating flow of electrical current connected at one end to the other of said elements and at the other end to the base of said transistor and to said direct current source, means for intermittently operating said pulse generator whereby the transistor is activated intermittently to pass current from said source through said transistor to said common connection for said coil and to said condenser and to discharge said condenser through said primary coil.

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