Dec. 30, 1947. J. A. LAIRD 2,433,462

ELECTRIC SPARK IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES

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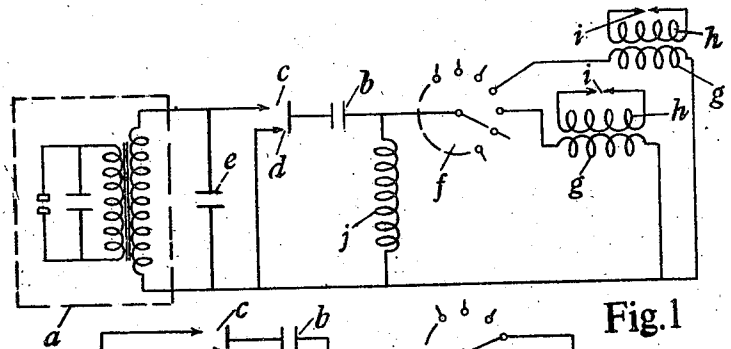

Fig.1

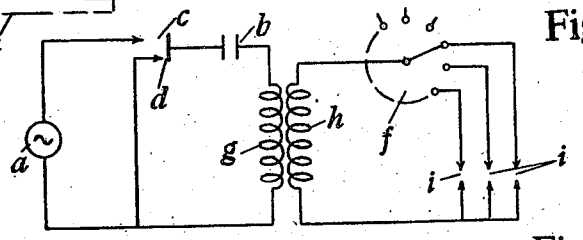

Fig.2

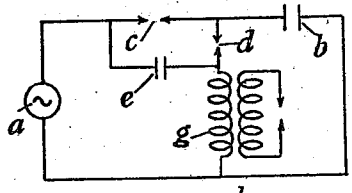

Fig.3

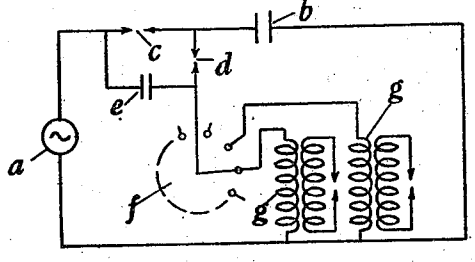

Fig.4

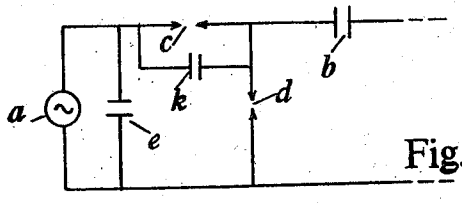

Fig.5

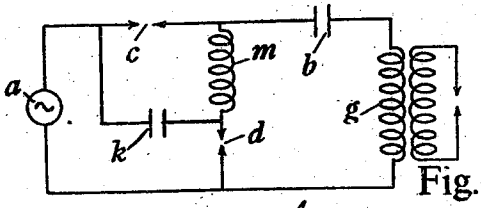

Fig.6

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2,433,462

ELECTRIC SPARK IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES

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3 Claims. (Cl. 315—254)

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This invention has for its object to provide improved electric spark ignition systems for internal combustion engines, of the type in which a transformer, or each of a plurality of transformers, for generating the required sparks at the engine sparking plugs, is excited by discharge of a condenser, the latter being intermittently charged by a magneto or other alternating-current source.

The invention comprises a system of the type aforesaid in which a pair of spark gaps are included, one electrode of one of the gaps (herein termed the first gap) being connected to one terminal of the magneto or other alternating-current source, the other electrode of this gap being connected to or forming part of the corresponding electrode of the second gap and being also connected to one side of the condenser, and the other electrode of the second gap being connected to the other terminal of the said source, either directly or through the primary winding (or each of the primary windings in turn) of the spark-generating transformer (or transformers), the sparking voltage of each gap being greater than the voltage to which it is required to charge the condenser.

In the accompanying sheet of explanatory diagrams:

Figure 1 illustrates an electric spark ignition system embodying one form of the invention.

Figures 2 to 6 illustrate respectively five modified forms of the invention.

In carrying the invention into effect as illustrated in Figure 1, I employ as the alternating-current source a magneto *a* which is capable of giving the required charge to a condenser *b* in each half alternation of its action. To one terminal of the magneto *a* is connected one electrode of a spark gap *c*, the other electrode of this gap being connected to one side of the condenser *b* to be charged. The last mentioned electrode of the gap *c* is also connected to or made integral with one of the electrodes of a second gap *d*, and the other electrode of the second gap is connected to the other terminal of the magneto *a*.

The sparking voltages of the two gaps, *c*, *d* are each greater than that to which the condenser *b* is required to be charged, and it is usually advantageous (and may be necessary) to arrange that the first gap *c* shall have a higher sparking voltage than the second gap *d*. For example, in one satisfactory arrangement in which it is required to charge the condenser *b* to 3 kv., the sparking voltage of the first gap *c* is 8 kv. and that of the second gap *d* is 4 kv.

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I also find that in order to get the best results it is desirable to associate with the secondary winding of the magneto *a* a suitable capacity. In some cases the distributed capacity inherently associated with that winding is sufficient. Otherwise, capacity is added by connecting a condenser *e* across the secondary winding, and the optimum amount of this capacity is easily ascertained by experiment.

The other side of the condenser *b* to be charged is connected to a distributor *f* by which it can be put into communication with one end of each in turn of the primary windings *g* of a plurality of separate spark-generating transformers having their secondary windings *h* directly associated with the engine sparking plugs as *i*, the other ends of these windings being connected together and to the same terminal of the magneto *a* as the second electrode of the second gap *d*. When the distributor *f* is of the jump-spark type it is advantageous to connect one end of a small choke coil *j* between the condenser *b* and the distributor, the other end of the choke coil being connected to the side of the system associated with the above-mentioned second terminal of the magneto *a*.

Instead of employing a magneto as illustrated in Figure 1 any other suitable alternating-current source may be used.

In the modification illustrated in Figure 2 I employ a single spark-generating transformer having its primary winding *g* connected at one end to the side of the condenser *b* remote from the spark gaps *c*, *d*, and at the other end to the same terminal of the alternating-current source *a* as the second mentioned terminal of the second gap *d*, the secondary winding *h* of this transformer being connectible by a distributor *f* to each in turn of the sparking plugs as *i*. In other respects the example illustrated in Figure 2 is similar to that illustrated in Figure 1 and is indicated by the same reference characters.

In a further modification the second mentioned electrode of the second gap *d* is connected either to one end of the primary winding *g* of a single spark-generating transformer as exemplified in Figure 3, or through a distributor *f* to each in turn of the primary windings *g* of a plurality of separate spark-generating transformers as exemplified in Figure 4, the other end or ends of this primary winding or windings being connected to the second mentioned side of the condenser *b* to be charged and the second mentioned terminal of the alternating-current source *a*. In either of these examples the above-mentioned added ca-

pacity is preferably introduced by connecting a condenser *e* across the first mentioned electrode of the first gap *c* and the second mentioned electrode of the second gap *d*.

In the modification illustrated by Figure 5, I connect a condenser *k* across the terminals of the first gap *c*. In addition a condenser *e* may be connected as in the example first described across the secondary winding of a magneto *a* from which the impulses required for charging the main condenser *b* are supplied.

In the modification illustrated by Figure 6, I insert a high frequency choke *m* between the two adjacent electrodes of the two gaps *c*, *d*. Alternatively I may connect in this position the primary winding *g* of the spark generating transformer, or, when a plurality of such transformers are used, I may arrange for the primary winding of each to be connected in turn to such gap electrodes by means of a distributor. Also I may then connect the additional condenser *k* above mentioned across that part of the system which includes the choke *m* or primary winding *g* (or windings) and the first gap *c* which is in series with the source *a*.

By the use of two gaps as above described in ignition systems of the type specified I am able to obtain regular action of such systems in a very simple and satisfactory manner. The invention is not, however, restricted to the examples above described as it may be applied in essentially the same manner to other circuit arrangements, and subordinate details may be modified to suit different requirements.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. An electric spark ignition system of the type specified, comprising in combination a condenser, an alternating-current source for intermittently charging the condenser, at least one spark-generating transformer adapted to be excited by discharge of the condenser, and a pair of two-electrode spark gaps, one electrode of one of the gaps being connected to one terminal of the alternating-current source, the other electrode of this gap being electrically connected to the corresponding electrode of the other gap and being also connected to one side of the condenser, and the other electrode of the second mentioned gap being connected to the other terminal of the said source, the sparking voltage of each gap being greater than the voltage to which it is required to charge the condenser.

2. An electric spark ignition system as claimed in claim 1, in which the first gap has a higher sparking voltage than the second gap.

3. An electric spark ignition system as claimed in claim 1 and having a capacity associated with the alternating-current source.

JOHN ANDREW LAIRD.

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