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SPARK IGNITION APPARATUS

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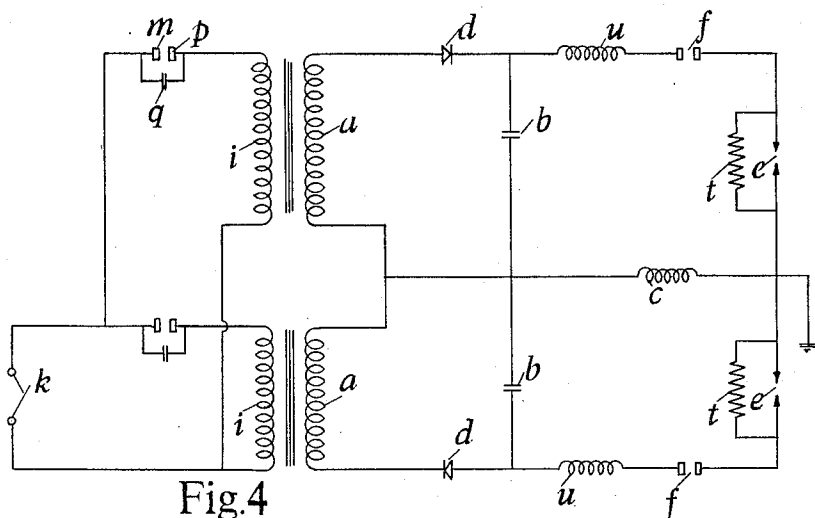


Fig. 4

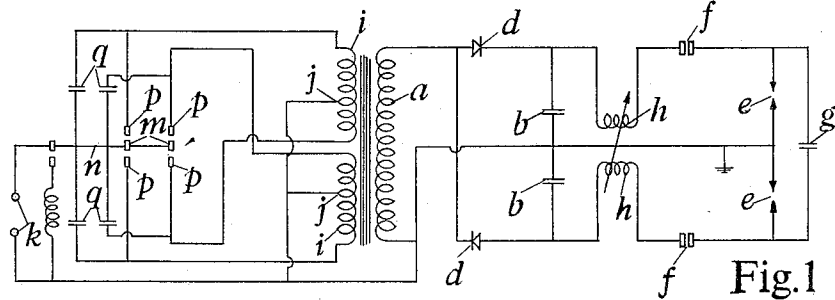


Fig. 1

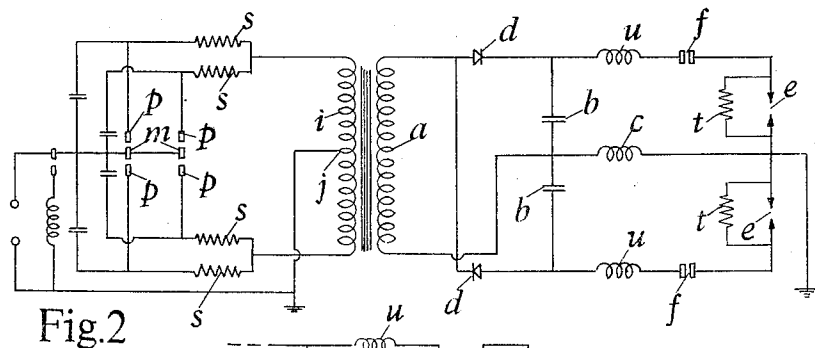


Fig. 2

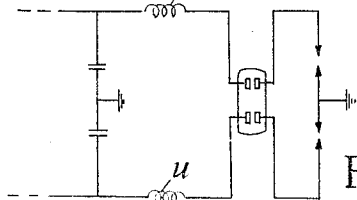


Fig. 3

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SPARK IGNITION APPARATUS

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This invention has for its object to provide improved spark ignition apparatus adapted for use more particularly on jet-propulsion engines, or gas turbines for aircraft where difficult ignition conditions may be encountered necessitating relatively large energy discharges in the sparks, and where two sparks are required to be produced substantially simultaneously at separate gaps.

The invention comprises a pair of interconnected systems each including a condenser, a rectifier through which the condenser can be charged, and a control gap.

The invention also comprises the combination with the systems specified in the preceding paragraph, of a step-up transformer or transformers for charging the condensers through the rectifiers.

In the accompanying drawings:

Figures 1-4 are diagrams illustrating various embodiments of the invention.

Referring to Figure 1, the ends of the secondary winding *a* of a step-up transformer are connected to a pair of interconnected high tension circuits, and in parallel with each circuit is connected a condenser *b* of appropriate capacity. Between one end of the winding *a* and one side of each condenser is arranged a rectifier *d* such that the condensers will receive unidirectional charges alternately. Also between and in series with each condenser and the associated main discharge (or ignition) gap *e* is arranged a control gap *f*, the latter being such that a discharge can occur across it when the charge in the associated condenser reaches a predetermined voltage, the discharges across the control gaps serving to initiate the discharges across the main gaps.

The portions of the circuits between the condensers and control gaps are coupled to ensure simultaneous discharge of the gaps, the coupling being effected by a pair of coils *h* forming a mutual inductance. Alternatively a condenser *g* may be connected across the main gaps *e*. Or both such devices may be used. The other end of the winding *a* is connected to the condensers and main gaps as shown in the diagram.

For energising the system the winding *a* has associated with it (in this example) a pair of primary windings *i* each of which is provided with a central tapping *j*. The parts of the primary windings are connected through an interrupter to terminals *k* to which current is supplied from any convenient source, such as a storage battery. The interrupter comprises a pair of movable contacts *m* carried by a vibratory arm *n*, and in association with the movable contacts are arranged

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two pairs of fixed contacts *p* connected to the parts of the windings *i* in the manner shown. Also condensers *q* are provided for suppressing sparking at the contacts. When the interrupter is in action, current is supplied alternately, first to one half of each of the windings *i*, and then to the other half.

Each condenser *b* is progressively charged by the transformer until the break-down voltage of the control gaps is reached, and the subsequent discharges across these gaps result in the production of the required substantially simultaneous sparks at the main gaps *e*.

In the example shown by Figure 2, one end of the secondary winding *a* of the transformer is connected to a point between the condensers *b* to be charged, the other sides of the condensers being connected to the other end of the said winding through the rectifiers *d* arranged in the manner shown. Also the condensers are connected through the control gaps *f* to the main gaps *e*. Further there may be connected across each main gap *e* a high resistance *t*. This resistance may also be used in the arrangement shown in Figure 1, but for most purposes the normal leakage resistance across the main gap *e* suffices.

For ensuring simultaneous discharges across the control gaps (and hence across the main gaps) an inductance *c* is arranged at the position shown. Alternatively (and as shown in Figure 3) the control gaps *f* are arranged adjacent to each other so that a discharge across either will ionise the other and thereby initiate a substantially simultaneous discharge across the other. Further in the arrangement shown in Figure 3 inductances *u* may also be provided if desired at the positions shown for prolonging the duration of the discharges.

In the example shown in Figure 2, the secondary winding *a* has associated with it a single primary winding *i* having a central tapping *j*. When the amount of current to be supplied to the primary winding is relatively large, it is preferred to provide an interrupter having a pair of movable contacts *m* in association with two pairs of fixed contacts *p*, each pair of fixed contacts being arranged in parallel circuits so that one half of the required current passes through each and thereby obviates an excessive current passing through the contacts. Also resistances *s* are arranged in series with the contacts. In other respects the parts associated with the primary winding and the mode of operation are similar to those above described with reference to Figure 1. It may be

mentioned also that the interrupter shown in Figure 2 may (in a duplicate form) be applied to the arrangement of primary windings shown in Figure 1.

In the arrangement shown in Figure 4, there are employed two transformers each comprising a secondary winding *a* and a primary winding *i*. An interrupter operable mechanically, or by an electromagnet is provided in association with each primary winding, the interrupter comprising fixed and movable contacts *m*, *p*, which may be bridged by a spark-suppressing condenser *q*. Current is supplied to both windings from a common source connected to the terminals *k*. To one end of each secondary winding *a* is connected a condenser *b* of appropriate capacity through a rectifier *d* arranged as shown, and between each condenser and its associated control gap *f* may be arranged a choke *u* for the purpose above mentioned. Also a third (and preferably high impedance) choke *c* is provided between the condensers and a point between the main gaps, the various parts being arranged and interconnected as shown. Also the mid-point between the main gaps may be earthed. Further there may be connected across each main gap *e* a high resistance *t*.

When the systems shown in Figure 4 are in action, each condenser is progressively charged until the break-down voltage of the associated control gap is reached. As the systems are interconnected, a discharge across the control gap in either system ensures substantially simultaneous discharge in both systems.

By any of the arrangements above described, substantially simultaneous discharges at the main gaps can be reliably ensured.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. In spark ignition apparatus, the combination of a pair of ignition systems each including a condenser, a rectifier to which the condenser is connected and through which the condenser can be charged, and a control gap which is also connected to the condenser and a cross which a discharge can occur when the charge in the condenser reaches a predetermined voltage, the two ignition systems being interconnected and adapted to ensure substantially simultaneous discharges across the two control gaps.

2. In spark ignition apparatus, the combination of a pair of ignition systems each including a condenser, a rectifier to which the condenser is connected and through which the condenser can be charged, and a control gap which is also connected to the condenser and across which a discharge can occur when the charge in the condenser reaches a predetermined voltage, the two ignition systems being interconnected and provided with auxiliary means to ensure substantially simultaneous discharges across the two control gaps.

3. A spark ignition apparatus according to claim 2, in which the auxiliary means comprises an inductance common to both systems and connected in series with each control gap.

4. A spark ignition apparatus according to claim 2, in which the auxiliary means comprise a pair of coupled inductances respectively connected between the condensers and control gaps of the two ignition systems.

5. A spark ignition apparatus according to claim 2, in which the auxiliary means comprises a condenser connected across the two ignition systems.

6. A spark ignition apparatus according to claim 1, in which the control gaps are arranged adjacent to each other so that discharge across either initiates discharge across the other.

7. A spark ignition apparatus according to claim 1 and including a step-up transformer by which charging current can be supplied to the condensers through the rectifiers, the transformer having a secondary winding forming a part of both ignition systems.

8. A spark ignition apparatus according to claim 1 and including a step-up transformer by which charging current can be supplied to the condensers through the rectifiers, and which comprises a secondary winding forming a part of both ignition systems, and a two-part primary winding, means being provided for alternately exciting the two parts of the primary winding for effecting alternate charging of the condensers.

9. A spark ignition apparatus according to claim 1 and including a step-up transformer by which charging current can be supplied to the condensers through the rectifiers, and which comprises a secondary winding forming a part of both ignition systems, and a pair of two-part primary windings, means including an interrupter being provided for simultaneously exciting first one part and then the other part of each primary winding.

10. A spark ignition apparatus according to claim 1 and having a pair of transformers by which charging current can be supplied to the condensers through the rectifiers, the transformers having secondary windings forming parts of the two ignition systems respectively.

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