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(54) **A rocket firing system and a method of firing a rocket.**

(57) A rocket firing system comprises a magnetic core D, a co-axial driver coil A, and a sensor coil or coils B1, B2 which are connected to a device which detects the presence and the desired state of a further coil C which is inductively linked to core D. In use a low-power signal voltage is first applied to coil A; subject to the detector device indicating the presence and desired state of the firing circuit of the rocket, which includes coil C, an operating power voltage is then applied to coil A to induce a firing voltage in the firing circuit. As shown two sensor coil parts B1, B2 lie transversely of the driver coil A. Alternatively the coil parts may be arranged co-axially with core D. Coil C produces an asymmetrical flux pattern relative to coil parts B1, B2, which are preferably connected in a bridge circuit.

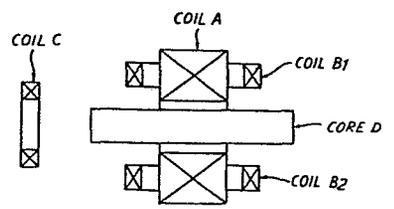

FIG.1

EP 0 052 675 A1

A ROCKET FIRING SYSTEM AND A METHOD OF FIRING A ROCKET

This invention relates to a rocket firing system and to a method of firing a rocket; the rocket firing system is positioned on a launcher device.

It is already known to fire rockets and other pyrotechnic devices by electrical means, in particular using an inductive linkage. However, a complete system for firing rockets should preferably also enable a pre-firing check upon the presence of the rocket, and upon the effectiveness of the firing circuit of the rocket itself. Effective systems embodying these features have not previously been known.

Accordingly, the invention provides a rocket firing system comprising a magnetic core and a driver coil mounted co-axial therewith, a sensor coil inductively linked with the core and driver coil, and a detector device connected to the sensor coil to determine the state of any further coil brought into inductive linkage with the core. Preferably, the sensor coil is in two parts lying transversely of and closely adjacent the driver coil.

The firing system may be embodied in a rocket

launcher device.

Further, the invention provides a method of firing a rocket having an inductive firing circuit adapted to be magnetically linked by a firing system having a magnetic core, a driver coil and a sensor coil, wherein first the core is brought to link magnetically with the firing circuit, then a low-power signal voltage is applied to the driver coil, the presence and state of the firing circuit being monitored by a signal generated in the sensor coil, and thereafter an operating power voltage is applied to the driver coil so as to induce a firing voltage in the firing circuit.

In order that the invention shall be clearly understood an exemplary embodiment thereof will now be described with reference to the drawings in which:-

Figure 1 shows the physical disposition of the components of the firing system according to the invention; and

Figure 2 shows the electrical connections of the firing system.

The firing system which is mounted on the rocket launcher comprises in essence a magnetic core D, which is surrounded by a driver coil A. Mounted in close physical proximity to the coil A is a sensor coil B which is divided into two parts B_1 and B_2. The coil B has its magnetic axis perpendicular to that of coil A and to the core D.

The system is positioned on the launcher such that the core D aligns with a coil C mounted on a rocket

positioned in the launcher. The coil C is connected in circuit with a detonator match in the form of a low-voltage, high-current hot wire coil onto which has been deposited a heat sensitive pyrotechnic material. The firing circuit driving coil C has an internal diameter larger than the core D, and when the rocket is in position, the core D enters the coil C and makes an inductive link therewith.

Coil A is connectible to a suitable alternating current supply and which is controlled at two power levels, a low power signal level for testing purposes and a full operating power level for firing. The coil B is connected to a suitable voltage detection circuit. In use, the firing system is set up by moving core D with no rocket present and with the coil A energised at the signal level until the induced voltage in coil B is at a minimum. The core D is then locked in position.

When a rocket is introduced into the launcher, with the signal power voltage applied to the coil A a signal current, well below the safety level of the firing circuit, will flow in coil C. This will result in a major distortion of the magnetic field of coil A and core D. The coil B will detect this change from the normal and the resultant voltage detected by the detection device will indicate the presence of a rocket, and the satisfactory state of the firing circuit on the rocket.

If the rocket is present, but the firing circuit is open-circuited, then no current will flow in the coil C and there will be only minor distortion of the magnetic field when the signal power voltage is applied to coil A.

In the preferred form shown, the coil parts B_1 and B_2 are wound in position, and positioned so that one part will cut more flux than the other when the flux pattern becomes asymetrically distorted by the presence of coil C. This gives a greater sensitivity, and since signal in coil B is a minimum in the balance of a rocket, allows the use of a threshold detector in the circuit to eliminate external effects. The coil parts are preferably connected in a bridge circuit. A single sensor coil, or one co-axial with the core D, could in theory be used but is very much less sensitive.

In another preferred form two sensor coils coaxial with the core D are used, preferably in a bridge circuit.

Such a firing system is adapted well to being applied to a series of launchers, and testing and firing can be carried out remotely, either sequentially or in unison.

Claims:

1. A rocket firing system characterised in that it comprises a magnetic core and a driver coil mounted co-axial therewith, a sensor coil inductively linked with the core and driver coil, and a detector device connected to the sensor coil to determine the state of any further coil brought into inductive linkage with the core.

2. A system according to claim 1, wherein the sensor coil is in two parts lying transversely of and closely adjacent the driver coil.

3. A system according to claim 1, wherein the sensor coil is in two parts each of which is co-axial with the driver coil.

4. A system according to Claim 2 or 3, wherein the sensor coil parts are connected in a bridge circuit.

5. A system according to any of claims 2 to 4 wherein the sensor coil parts are wound and positioned so that, when a said further coil is brought into inductive linkage with the core, one coil part cuts more flux than the other coil part.

6. A system according to any of claims 2 to 5 wherein a threshold detector is connected to said sensor coil parts.

7. A system according to any preceding claim wherein the driver coil is connected to an alternating current supply and is switchable to at least two power levels.

8. A method of firing a rocket having an inductive firing circuit adapted to be magnetically linked by a firing system having a magnetic core, a driver coil and a sensor coil, the method being characterized in that first the core is brought to link magnetically with the firing circuit, then a low-power signal voltage is applied to the driver coil, the presence and state of the firing circuit being monitored by a signal generated in the sensor coil, and thereafter an operating power voltage is applied to the driver coil so as to induce a firing voltage in the firing circuit.

9. A method of firing a rocket according to claim 8 wherein, before the core is brought to link magnetically with the firing circuit, the firing system is set up by applying said low-power signal voltage to the driver coil and moving the core until the voltage induced in the sensor coil is at a minimum, the core then being fixed in position.

10. A method of firing a rocket according to claim 8 or claim 9 wherein the presence and desired state of the firing circuit cause an asymmetrical flux pattern relative to the sensor coil.

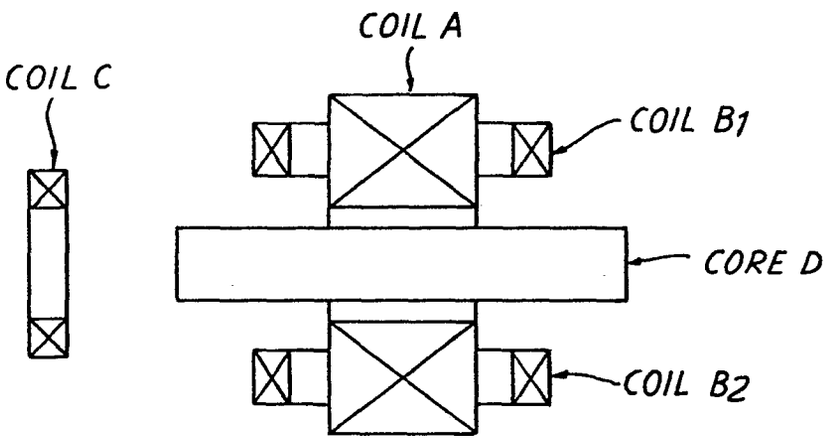
COIL A
COIL C
COIL B1
CORE D
COIL B2

FIG. 1

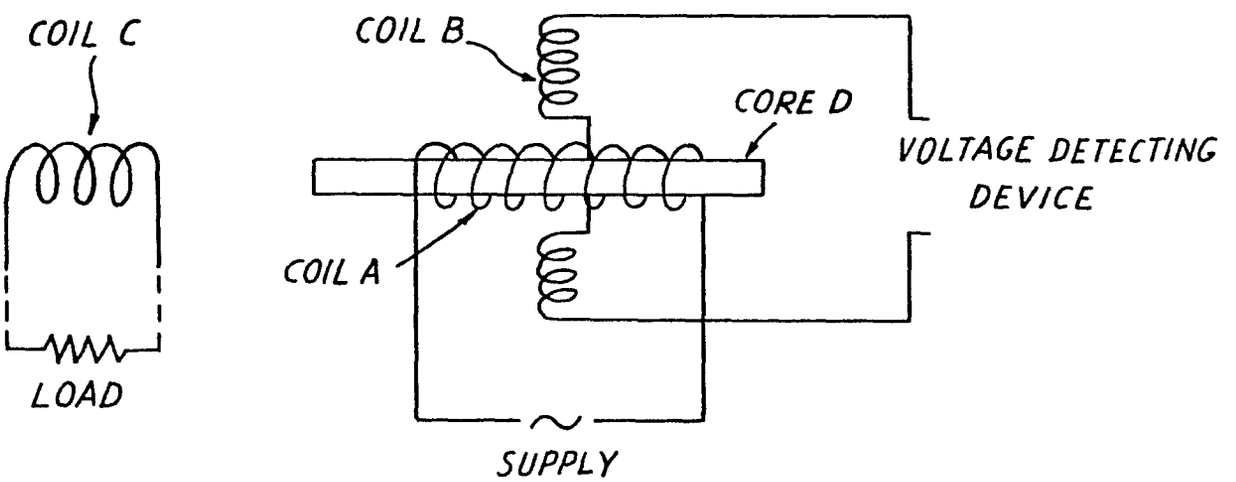
COIL C
COIL B
CORE D
VOLTAGE DETECTING DEVICE
COIL A
LOAD
SUPPLY

FIG. 2

0052675

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 80 30 4163

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	GB - A - 640 893 (STANDARD TELEPHONES) * Column 3, lines 79-112; figure 2 *	1,2
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A	US - A - 4 142 442 (TUTEN)	
A	US - A - 2 555 384 (WATT)	
A	FR - A - 2 304 053 (OERLIKON)	
A	US - A - 3 123 002 (SPOOL)	

CLASSIFICATION OF THE APPLICATION (Int Cl.³)

F 41 F 15/00
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21/00

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

F 42 C
F 42 B
F 41 F
F 41 C
H 01 F

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22-07-1981	VANHEUSDEN