United States Patent

Douglas et al.

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[54] APPARATUS FOR TESTING AND DETONATING BLASTING CAPS

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[58] **Field of Search** 102/70.2, 28, 18; 108/11

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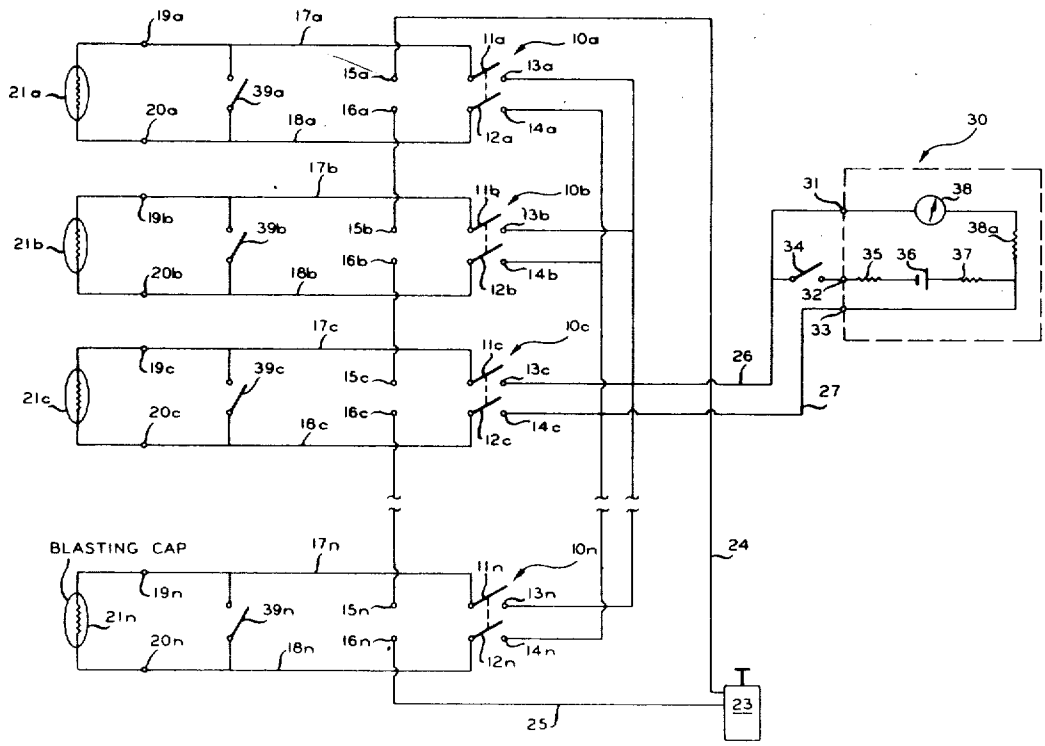
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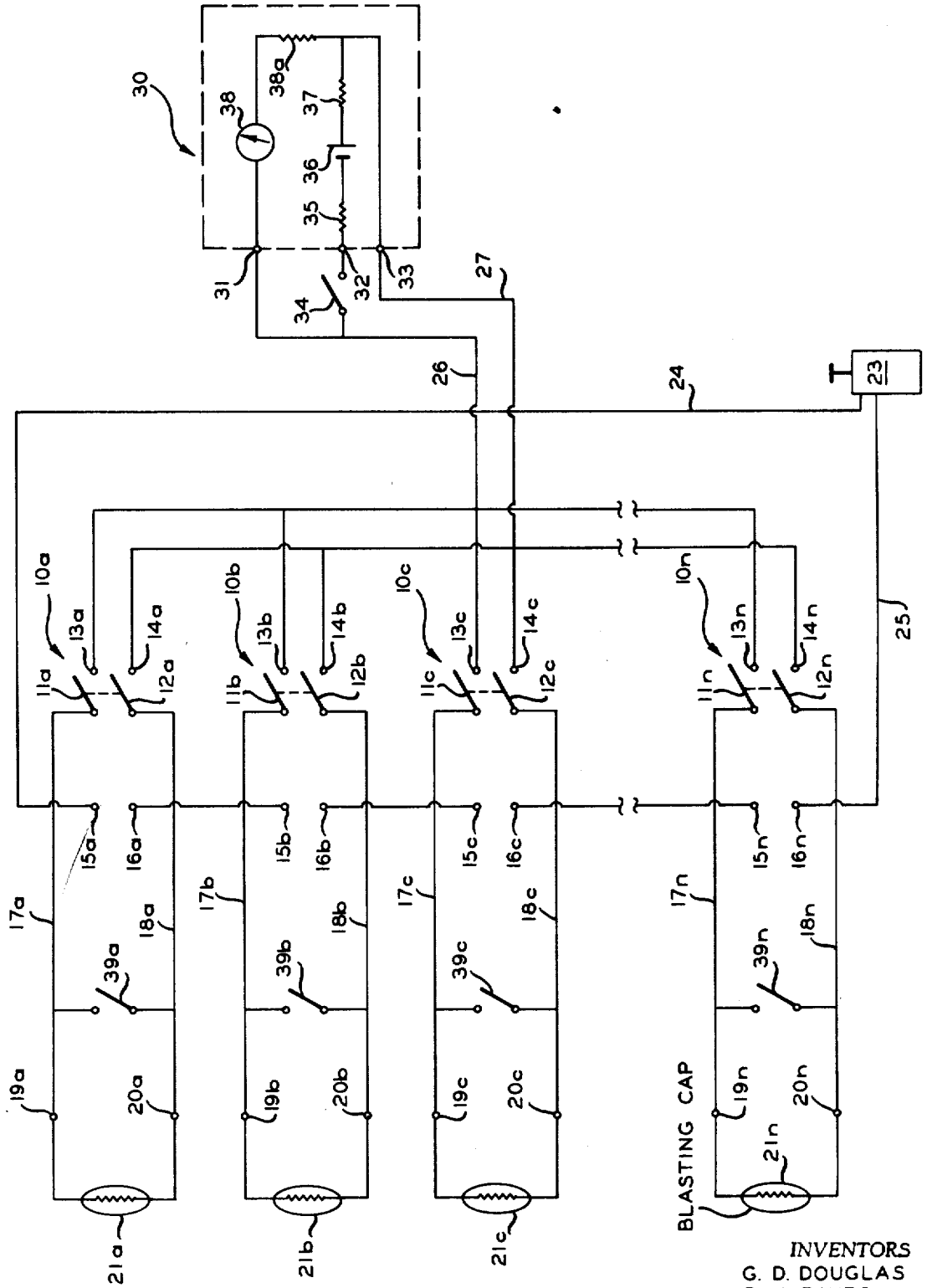
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[57] **ABSTRACT**

Apparatus is provided for testing individually a plurality of blasting caps and for detonating such caps simultaneously. A plurality of double-pole, double-throw switches to serve to connect the blasting caps selectively to a circuit continuity meter or to a detonating device.

3 Claims, 1 Drawing Figure





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APPARATUS FOR TESTING AND DETONATING BLASTING CAPS

In mining, excavating and seismic exploration operations, it is often necessary to detonate a relatively large number of explosive charges simultaneously. This is accomplished by connecting the blasting caps associated with the individual charges to a common detonating device. However, it is not uncommon to find that one or more of the charges does not detonate because of a faulty blasting cap. It is apparent that the presence of an explosive charge and blasting cap which have not been detonated can present a serious hazard unless detected and removed before workmen enter the area. In addition, the presence of a faulty blasting cap in a string of caps may prevent the detonation of more than one charge if the blasting caps are connected in series with the detonating device.

This invention provides apparatus which is capable of connecting a circuit continuity meter selectively to a plurality of blasting caps before they are detonated. The blasting caps are then connected together to a detonating device and detonated simultaneously. Thereafter, the continuity meter can again be connected selectively to the circuits leading to the individual blasting caps to determine if each blasting cap has been detonated.

The accompanying drawing is a schematic representation of an embodiment of the apparatus of this invention.

Referring now to the drawing in detail, a plurality of double-pole, double-throw switches **10***a*, **10***b*, **10***c* . . . **10***n* are shown. Switch **10***a*, for example, comprises two switch arms **11***a* and **11***b* which engage respective terminals **13***a* and **14***a* in a first position and respective terminals **15***a* and **16***a* in a second position. The two switch arms are mechanically connected to one another to be moved in unison. Conductors **17***a* and **18***a* extend from respective switch arms **11***a* and **12***a* to respective output terminals **19***a* and **20***a*. A blasting cap **21***a* is connected between terminals **19***a* and **20***a*. The remainder of the switches are of similar construction and have corresponding conductors and blasting caps connected thereto.

The first terminal of a detonating device **23** is connected by a conductor **24** to terminal **15***a*. Terminal **16***a* is connected to terminal **15***b*. Similarly, terminal **16***b* is connected to terminal **15***c* and terminal **15***c* is connected to a **15** terminal of the fourth switch, not shown. The **16** terminal of the next to the last switch in the series is connected to terminal **15***n*. Terminal **16***n* is connected by a conductor **25** to the second terminal of detonating device **23**. The detonating device can be a generator which establishes a current when the plunger is depressed, or it can comprise a battery and switch. It can be seen that all of the switches are connected in circuit with the detonating device so that blasting caps connected to each of the switches are detonated when the switch arms of the switches are connected to the **15** and **16** terminals. If all of the switch arms are so connected, all of the blasting caps are detonated simultaneously.

Terminals **13***a* and **14***a* are connected by respective conductors **26** and **27** to a circuit continuity meter **30**. The specific meter illustrated, which can be of the type described in U.S. Pat. No. 2,492,459, is provided with three output terminals **31**, **32** and **33**. Conductors **26** and **27** are connected directly to respective terminals **31** and **33**. Conductor **26** is connected through a switch **34** to terminal **32**. The continuity testing meter comprises a resistor **35**, a current source **36** and a resistor **37** which are connected in series relationship between terminals **32** and **33**. A current meter **38** and a resistor **38'** which can be included within the meter, are connected between terminals **31** and **33**. When switch **34** is closed, there is current flow from source **36** through meter **38**. If switch arms **11***a* and **12***a* engage respective terminals **13***a* and **14***a*, there is also current flow from source **36** through blasting cap **21***a*. The apparatus is calibrated so that meter **38** is deflected a predetermined amount when such a blasting cap is connected to the circuit. This provides an indication that the blasting cap has an unbroken circuit. Current source **36** and resistors **35** and **37** must be selected so that the amount of current flowing through a blasting cap under test is not sufficient to detonate the cap. Suitable circuit values which can be employed for this purpose are described in detail in U.S. Pat. No. 2,492,459. However, other types of circuit continuity measuring instruments known in the art can be employed in place of the illustrated meter.

In a normal operation, the blasting caps are connected to explosive charges to be detonated (not shown) and are connected to the output terminals of the circuit of this invention. The switches are then operated sequentially to connect each blasting cap individually to meter **30**. This enables the operator to determine that all of the blasting caps have complete circuit paths therethrough. Thereafter, the switch arms are moved to the second positions so that all of the blasting caps are connected in circuit with detonating device **23**. Device **23** is then actuated to detonate the blasting caps and the explosive charges associated therewith. Thereafter, the continuity testing procedure is repeated for each of the blasting caps. If one or more of the blasting caps has not detonated, this is indicated by a reading on meter **30** which is indicative of a circuit being complete through the cap. If this is observed, corrective measures are taken to remove the blasting cap and associated explosive charge before workmen enter the area of the blast.

If the initial testing should indicate that a blasting cap, such as **21***b*, for example, is defective, this blasting cap can be replaced before the charges are detonated. However, in some operations it may be more convenient to leave the faulty cap in place rather than delay the shooting. If this procedure is to be followed, switch **39***b* can be closed to connect terminal **15***b* with terminal **16***b* when switch arms **11***b* and **12***b* engage respective terminals **15***b* and **16***b*. This effectively removes cap **21***b* from the detonating circuit. The remainder of the detonation circuits are provided with similar switches. Switches **39** also permit use of a fewer number of blasting caps than there are circuits in a particular apparatus.

It should thus be apparent that there is provided in accordance with this invention simple, reliable apparatus which is capable of testing a plurality of blasting caps individually before and after the string of caps is detonated and for simultaneously detonating the caps. This is accomplished with the minimum amount of equipment at a single location. The three operations can be performed without making any wiring changes.

While the invention has been described in conjunction with a presently preferred embodiment, it should be evident that it is not limited thereto.

What is claimed is:

1. Apparatus for use in testing individually and detonating simultaneously a plurality of blasting caps, comprising:

detonating means to establish a current to detonate a plurality of blasting caps;

a circuit continuity testing meter;

a plurality of double-pole, double-throw switches, each having switch arms movable together to engage respective first and second terminals in a first position and to engage respective third and fourth terminals in a second position;

a plurality of first circuit means, each comprising first and second conductors connected at first ends to respective switch arms of a respective one of said switches, the second ends of the first and second conductors of each first circuit means being adapted to be connected to a blasting cap;

second circuit means connecting said detonating means to the third and fourth terminals of said plurality of switches; and

third circuit means connecting the first and second terminals of said plurality of switches to said circuit continuity testing meter.

2. The apparatus of claim **1** wherein said second circuit means connects said detonating means and said switches in series; and further comprising a plurality of second switches, each connected between the first and second conductors of a respective one of said first circuit means.

3. The apparatus of claim 1, further comprising a plurality of blasting caps, each connected between the second ends of first and second conductors of a respective one of said first circuit means.

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