March 9, 1943. J. STUART, 2D 2,313,101

BLASTING MACHINE

Filed Jan. 10, 1940

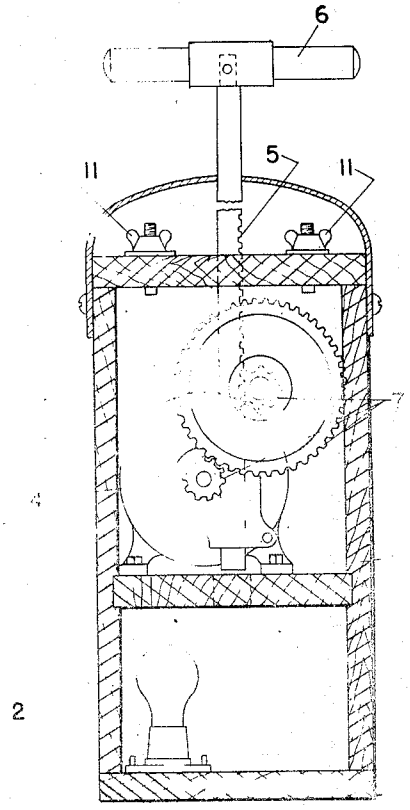


FIG-1

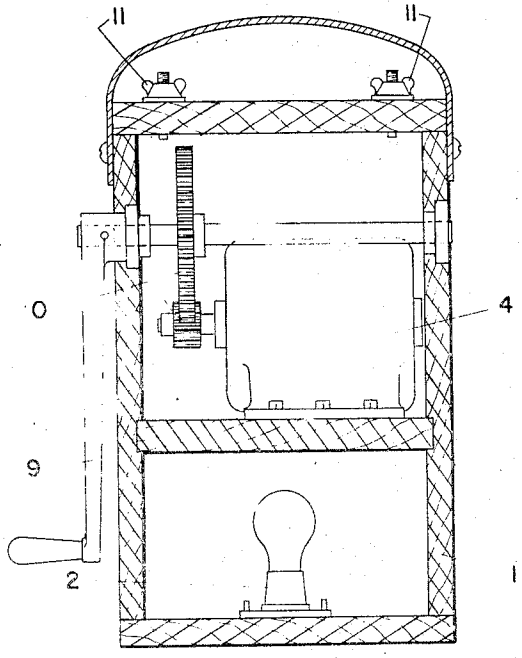


FIG-2

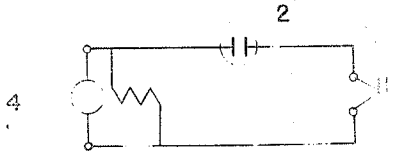


FIG-3

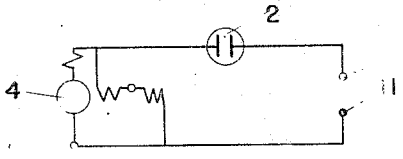


FIG-4

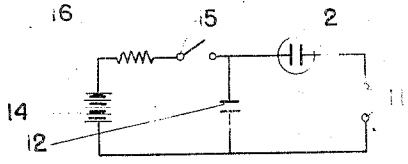


FIG. 6

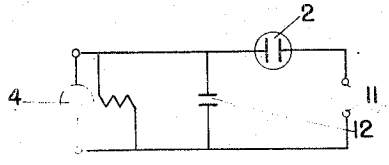


FIG-5

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2,313,101

BLASTING MACHINE

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7 Claims. (Cl. 171—76)

This invention relates to an improved portable dynamo for supplying the necessary electrical energy for firing a plurality of electric firing devices and more particularly to an improved blasting machine for firing electric blasting caps.

The blasting machines having a capacity in excess of ten caps are usually those of the "push down" type, that is, the dynamo is operated by a rack bar that turns a pinion gear on the armature shaft. Machines of this type are in general use for firing a plurality of caps and are furnished in such sizes that an operator may fire up to 30, 50 or 100 caps at one time. The industry has also been supplied with blasting machines operated by a hand crank and a series of gears, but, due to difficulties in obtaining maximum current output quickly, this type machine has not been as desirable as the "push down" type.

While the "push down" type machine is the most satisfactory blasting machine known to the art, there are difficulties encountered in its operation. This type of machine is unsatisfactory in its operation because the amount of current developed depends upon the force or speed with which the rack bar is operated. The current developed is seldom uniform and is often not up to the rated capacity of the machine. This non-uniform operation of the machine may result in failure of all or part of the firing devices to detonate which partially or completely spoils the blast and results in a loss of unexploded powder, loss of labor and decrease in production.

The electrical energy generated by means of a push down blasting machine is usually delivered to the firing line upon the closing of a mechanical switch which is positioned to be operated at that time when the energy generated by the machine is at its highest value. This theory and operation always holds true but since the electrical energy is dependent upon the speed with which the armature rotates and the speed of rotation depends upon the operator, there may be delivered to the firing line electrical energy of widely different values. The energy developed by the hand crank machine will vary as much as the "push down" type due to different speeds of operation.

The firing or detonation of a modern electric blasting cap usually occurs within 0.01 second after the energy is applied to it, so that it is apparent that the effectiveness of the blasting depends on its operation immediately upon closure of the mechanical switch. Unfortunately, the switch points are liable to become corroded or pitted and in some instances, it is observed that the switch does not close with positive action, but completes and opens the circuit many times before finally closing, with the result that the effective energy delivered by the machine during the critical interval, is much reduced.

Numerous attempts have been made to overcome the deficiencies of the operators, and the effects of wear. Larger machines have been constructed, but the advantages are offset by increased weight and cost. One of the most promising developments has been the employment of relatively light and inexpensive electrical condensers, placed across the terminals of the generator.

However, in practice, the benefits of the condenser are partly nullified by the fact that the discharge of the condenser produces heavy arcing at the switch points and shortens their life. The discharge also consumes power and the energy of the condenser, instead of aiding in firing the caps, is partly lost at the switch.

It is the object of this invention to provide a dynamo which can deliver electrical energy to the firing line only when the voltage has reached a predetermined value.

It is a further object of this invention to provide a blasting machine for initiating electric firing devices which cannot deliver a current below a predetermined value.

A further object of this invention is to provide a "push down" type blasting machine having means adapted to permit flow of current to a firing line at a predetermined voltage.

A further object of this invention is to provide a blasting machine in which the current output does not vary with the operation.

A still further object of this invention is to provide a blasting machine having voltage control or regulator tube which prevents the delivery of any but a definite minimum current.

Other and further objects of this invention will be obvious upon an understanding of the illustrative embodiments about to be described or will be indicated in the appended claims and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawing forming a part of the specification wherein:

Fig. 1 is a front elevation view, partly in section, of a preferred embodiment of the invention

illustrating a "push down" type blasting machine.

Fig. 2 is a side elevation view, partly in section, of an alternative embodiment of this invention and consists of a hand crank blasting machine.

Figs. 3, 4, and 5 indicate the various electric circuits which may be used in the embodiments shown in Figs. 1 and 2; and

Fig. 6 shows an alternative method of using the principle of this invention by substituting for the generator a source of current such as a battery or other electrical energy supply.

Described generally the energy supplying machines of my invention comprises a source of electrical energy such as a generator, battery or electrical power lines connected through a suitable circuit including a voltage control or regulator tube and contact terminals. To the terminals of the machine of my invention there will be connected a suitable number of electric firing devices and, upon proper operation of the generator or closing of switches, the electrical charge is fed into the generator or dynamo circuit including the voltage control or regulator tube which, upon building up to a predetermined value, will discharge into the firing line and cause the detonation or ignition of the firing devices.

Referring again to the drawing and more particularly to Figs. 1 and 2, there is shown a suitable casing 1 in which is mounted a voltage control or regulator tube 2. Also within casing 1 there is mounted a source of electric current such as the generator or dynamo 4. The armature of this generator 4 may be rotated by the rack bar 5 having handle 6 through gears 7 (Fig. 1) or by hand crank 9 through gears 10 (Fig. 2). In either case the generator 4 produces electrical energy and establishes a voltage potential across the electrodes of the voltage control tube 2. At a given voltage the voltage control tube 2 discharges through terminals or binding posts 11 to which may be attached any suitable number of firing devices.

Typical methods of electrically connecting the generators shown in Figs. 1 and 2, are shown in Figs. 3, 4, and 5.

In Fig. 3 a shunt wound generator is shown with one of its output terminals electrically connected directly to one of the binding posts or contact terminals 11 and with its other output terminal connected to the other binding post 11 through the voltage control tube 2.

It is to be noted that the generator circuit including the voltage control tube 2 and the contact terminals 11 to which may be connected a plurality of firing caps is permanently closed through the output terminals of the generator thereby forming a fixed electrical circuit through the terminals.

In Fig. 4 a compound wound generator is shown which has its output terminal connected to the binding posts 11 in the same manner as described above.

In the wiring diagram of Fig. 5, there is shown a condenser 12 across the terminals of the shunt wound generator, located between the generator and the tube, to cause the current to build up to the desired point and to increase the capacity of the blasting machine.

In addition to the use of the manually operated generators, the electrical energy needed for firing the firing devices may be supplied by a battery 14 such as is shown in Fig. 6 or other well known sources of electrical energy such as any suitable power line available at the blasting location. Thus, a high voltage, low current battery 14 may be connected through a switch 15 to the condenser 12 and voltage regulator tube 2. The battery may be of the type commonly known as a "B" battery, having a high internal resistance, which is designated by the resistance 16. If the battery were connected directly to the firing line by closing the switch, misfires would probably result, because the internal resistance of the battery would limit the current to a low value insufficient to fire the electric blasting caps. However, when the condenser and regulator tube are used, upon closing the switch the condenser is charged, until the critical voltage of the regulator tube is reached. The regulator tube then automatically discharges the energy stored in the condenser into the firing line. By suitable choice of circuit constants a heavy current may be passed through the firing circuit, even though the battery which supplied the original energy is capable of providing only a fraction of this current.

A preferred voltage control tube 2 may be of the type manufactured by Westinghouse and known as type KX–642. While this tube has three electrodes only two are utilized and accordingly only two electrodes are illustrated on the drawing. The tube is rated as follows:

Breakdown voltage A. C.–R. M. S. ---volts--	300–500
Maximum discharge current for 2 sec. periods ---amperes--	50
Maximum discharge current for 10 min. periods ---amperes--	7
Maximum A. C. operating voltage R. M. S. ---volts--	230
Operating line voltage A. C.–R. M. S.---do---	115
Average arc drop ---volts D. C.---	20–30
Maximum short circuit current at which tube will clear at first current zero:	
At 230 volts ---amperes--	10
At 115 volts ---do---	15
Maximum overall length ---inches--	5
Maximum diameter ---do---	$2\frac{3}{16}$

The tube may be arranged to allow the passage of current of any predetermined voltage and thus by using a tube of the proper rating in the blasting machine of this invention, any desired number of firing devices may be fired. The tubes preferably are rated to break down when sufficient current is applied to insure the firing of 50 electric blasting caps. It will be understood however that I may manufacture a blasting machine by using a tube which will break down under any specified breakdown voltage. Thus, I have found that I may, by using the proper tube, produce a blasting machine having any desired cap rating.

From the foregoing description it will be seen that the present invention provides a blasting machine which cannot discharge into the firing line unless sufficient current is available to fire all devices connected on the line. This eliminates all shots in which part or all of the caps fail to shoot due to lack of sufficient current in the line. The use of the control tube insures proper operation of the machine and prevents the use of generators which are defective. It allows inexperienced operators to be efficient blasters because they can set off a series of blasting caps only when they operate the machine properly. It allows a closer calibration of machine capacity, and gives assurance each shot

fired will be successful. The machines with regulator tubes also have the advantage of not requiring a mechanical switch and thus pitting of switch with the attending loss of power is no longer a factor. These advantages have not been obtainable with the blasting machines used heretofore and the machines of the present invention are, therefore, a definite improvement over the prior machines. The machine is rugged in construction and the tube incorporated therein is located in a manner which provides assurance that it will function perfectly even under the rough usage to which blasting machines may be subjected.

As various changes may be made in the form, construction, and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

What I claim and desire to protect by Letters Patent is:

1. In a blasting machine the combination of a manually operable dynamo, contact terminals adapted to receive a plurality of blasting caps in electrical contact therewith, conductor elements forming a fixed circuit between said dynamo and said terminals whereby energy from said dynamo may be conducted instantaneously from said dynamo directly to said terminals, and a voltage control tube in said circuit adapted to permit the flow of said energy under a predetermined electrical potential.

2. In a blasting machine the combination of a manually operable dynamo, contact terminals adapted to receive a plurality of blasting caps in electrical contact therewith, conductor elements forming a circuit in fixed electrical contact with said dynamo and said terminals whereby energy from said dynamo may be conducted instantaneously from said dynamo directly to said terminals, and a voltage control tube in said circuit adapted to permit the flow of said energy under a predetermined electrical potential.

3. In a blasting machine the combination of a manually operable dynamo, contact terminals adapted to receive a plurality of blasting caps in electrical contact therewith, a circuit permanently connecting said dynamo with said terminals whereby energy from said dynamo may be conducted instantaneously from said dynamo directly to said terminals, and a voltage control tube in said circuit adapted to permit the flow of said energy under a predetermined electrical potential.

4. In a blasting machine the combination of a manually operable dynamo, contact terminals adapted to receive a plurality of blasting caps in electrical contact therewith, conductor elements forming a closed circuit through said dynamo and said terminals including a plurality of blasting caps, whereby energy from said dynamo may be conducted instantaneously from said dynamo directly to said terminals, and a voltage control tube in said circuit adapted to permit the flow of said energy under a predetermined electrical potential.

5. In a blasting machine the combination of a manually operable dynamo including a dynamo circuit, contact terminals in said circuit adapted to receive a plurality of blasting caps in electrical contact therewith, and a voltage control tube in said dynamo circuit adapted to permit the flow of energy from said dynamo directly and instantaneously to said terminals at a predetermined electrical potential.

6. In the method of firing a plurality of electrical firing devices with a source of electrical energy which includes a manually operable dynamo, the step of directly subjecting an electrode of a voltage control tube to an electrical potential flowing directly from said dynamo to said electrode, and the step of permitting the instantaneous flow of said energy to said firing devices under a definite predetermined voltage potential.

7. In a blasting machine, the combination of a manually operable dynamo including a dynamo circuit, contact terminals in said circuit adapted to receive a plurality of blasting caps in electrical contact therewith, and a switch in said circuit, said switch consisting of a gas-filled, cold cathode tube having a break-down voltage between about 300 and about 500 volts, and a current capacity of about 50 amperes for at least 2 seconds, said switch being adapted to automatically permit the flow of energy from said dynamo to said terminals at a predetermined electric potential.

JOSEPH STUART, II.