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R. N. STODDARD

2,326,696

BLASTING MACHINE

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Fig. 1.

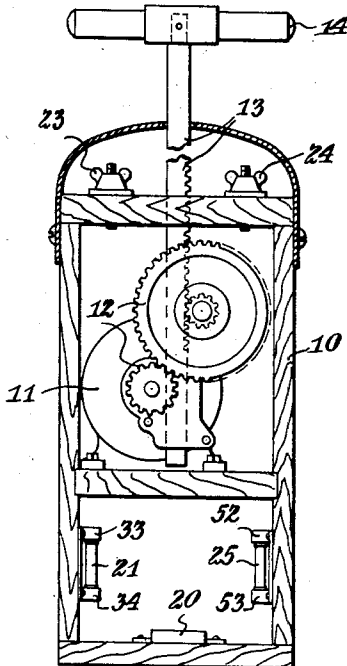


Fig. 2.

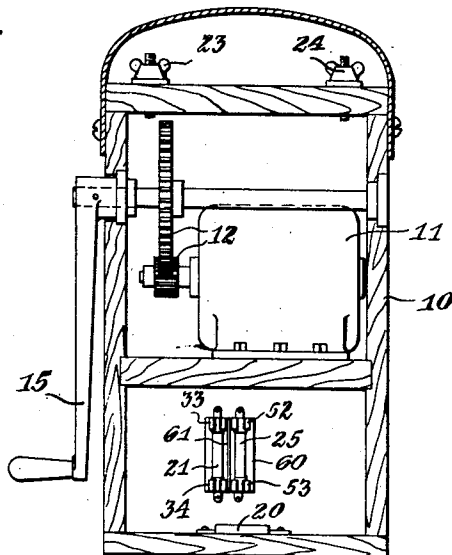


Fig. 3.

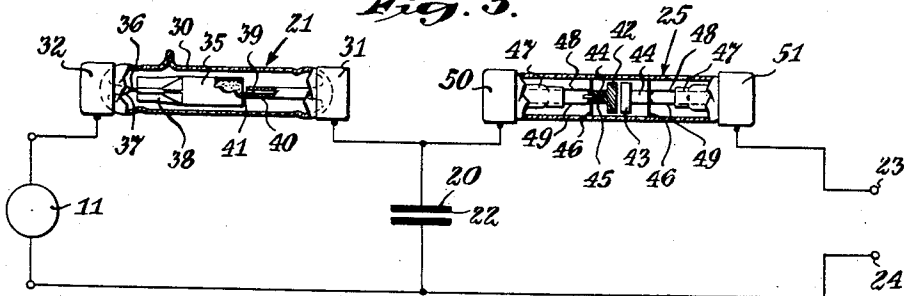
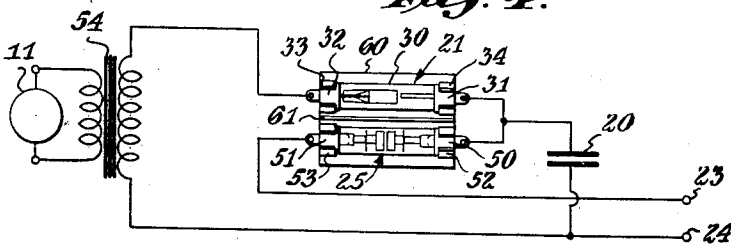


Fig. 4.



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BLASTING MACHINE

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4 Claims. (Cl. 175—115)

The invention relates to a circuit for an improved portable dynamo, and especially for such a circuit utilized for supplying the necessary current for firing a plurality of firing devices, such as blasting caps.

An object of the invention is to provide a firing circuit that will always insure the firing of all the blasting caps connected thereto.

Another object of the invention is to provide a condenser for storing the electrical energy of a portable dynamo and to make the discharge of this condenser into the output circuit independent of the time or speed of rotation of the portable dynamo.

Another object of the invention is to utilize an electric circuit in connection with a portable dynamo and condenser whereby the generator can stop or come to rest without discharging any of the stored energy in the condenser.

Still another object of the invention is to provide a readily replaceable rectifier and voltage control tube assembly.

Other objects and advantages of the invention will be apparent from the following description and drawing in which:

Fig. 1 is a front elevational view, partly in section, of a preferred structural embodiment of the invention, illustrating a "push down" type of blasting machine.

Fig. 2 is a side elevational view partly in section of an alternative embodiment of this machine, consisting of a hand crank blasting machine.

Fig. 3 is a view partly diagrammatic and partly structural, with the structural parts illustrated mainly in cross-section, of an electrical circuit and discharge tubes therein for the blasting machines of Fig. 1 or Fig. 2.

Fig. 4 is a modification of the circuit of Fig. 3. This invention is an improvement on the application of Joseph Stuart, II, Ser. No. 313,264, entitled "Blasting machine." As explained in the Stuart application referred to, 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. With machines of this type an operator may fire up to 30, 50 or 100 caps at one time, and the preference of the industry for the push-down type, over the type in which a hand crank operates through a series of gears, is that the push-down type can supply a maximum current output more quickly.

The push-down type, however, is unsatisfactory in its operation because the amount of cur-

rent 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.

5 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 loss of unexploded powder, loss of labor and decrease in production.

10 The electrical current generated by push-down blasting machines 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 current 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 a current of widely different values. The current developed by the hand crank machine will vary as much as the push-down type due to different speeds of operation.

20 The firing or detonation of a modern electric blasting cap usually occurs within 0.01 second after the current 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 current delivered by the machine during the critical interval is much reduced.

25 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.

30 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.

35 As previously stated, it is an object of this invention to charge the condenser independently of the time or speed of rotation of the dynamo,

and to permit the dynamo to stop or come to rest without discharging any of the stored energy in the condenser.

In Fig. 1 I have illustrated a preferred embodiment of the invention, illustrating a push-down type of blasting machine. The machine and connections thereto are placed in a suitable casing 10. This casing supports a generator 11 which has an armature rotated through gears 12 and rack bar 13 by pressure exerted on a handle 14, as is well known. In Fig. 2 the casing 10 also has the generator 11 with its armature rotated by gears 12 under force applied to a hand crank 15.

The electric portions of the circuit are illustrated structurally in Figs. 1 and 2, and partly structurally and partly diagrammatically in Fig. 3. In order to store sufficient energy to discharge the caps, I provide a condenser 20 connected to the generator 11, as illustrated in Figs. 3 and 4. In one of the connections between the generator and condenser, I place a rectifier 21 which is preferably of the special type illustrated in detail in Fig. 3. Between the condenser plate 22 to which the rectifier is connected and the output circuit connections 23 and 24 I insert a breakdown tube 25, preferably of the construction illustrated in Fig. 3. The utilization of the rectifier 21 intermediate the generator 11 and condenser plate 22 permits the generator to be of the alternating current type where a commutator and brushes are eliminated. The condenser 20 will be charged independently of the time or speed of rotation, since the tube always sends the current through in one direction to the condenser.

If the movement of the generator stops, the charge on the condenser will not leak back, but will be stored on the condenser because of the presence of this particular type of rectifier intermediate the condenser and the generator. It will be noted that both the rectifier 21 and the breakdown tube 25 have gaps between the electrodes that will prevent the leakage of the charge from the condenser in either direction.

In operation the generator 11 will send a current through the discharge tube 21 to build up a charge on the condenser 20. A circuit, of course, is completed through the condenser to a generator when the generator is in operation. The breakdown tube 25 is designed to prevent the discharge of current therethrough until the charge on the condenser 20 has been built up sufficiently to supply a current that will be adequate to ignite all the blasting caps that are connected in the output circuit 23 and 24. When this charge on condenser 20 is sufficient, the tube will break down and the caps ignite. There will be no partial ignition of the caps because of insufficient current supplied to the output circuit and any exertion on the push-down bar 14 or the crank handle 15 will store energy in the condenser 20 until it is desired to utilize this energy. The output circuit 23 and 24 will, of course, have suitable switches and connection to firing devices, as is well known.

The connections 23 and 24 may take the form of the binding posts illustrated in Figs. 1 and 2 in the upper portion of the casing. The rectifier tube 21 and the breakdown or voltage control tube 25 and condenser 20 may take the form and position illustrated in the lower part of the casings of either Figs. 1 or 2.

The rectifier tube 21 which I have found to be especially suitable for my invention is illustrated in Fig. 3. This rectifier comprises a glass cas-

ing 30 having two ends 31 and 32 which, with the glass portion 30, are of the size of a 60 ampere fuse. The ends 31 and 32 can make connections in the circuit by being inserted between two fuse clips 33 and 34. The casing is filled with a noble gas at a low pressure, preferably with helium at a pressure of about 5 to 10 mm. of mercury pressure. The cathode 35 is preferably of a cup-shaped form having an interior coating of barium, strontium and calcium oxides. This cup-shaped coating has its exterior portion clamped about a conductive lead 36 extending through the seal 37 to the exterior cap 32. Fins 38 about the base of the electrode permit the radiation of heat from the electrode. The anode 39 is preferably a very small wire covered entirely with glass 40, except for the very tip end 41 of the wire which terminates approximately at the center of the cathode opening and is spaced a distance approximately $\frac{1}{8}$ " from the rim of the cathode. The wire 39 extends through the casing to the cap 31.

The breakdown or voltage control tube 25 is also preferably constructed as disclosed in Fig. 3. This tube comprises two electrodes 42 and 43 having parallel faces spaced approximately $\frac{1}{8}$ " from each other in a gaseous atmosphere. These electrodes have shanks 44 and the screw threaded connection 45 to these shanks passes through the center portion of two mica spacers 46, whose purpose is to locate the two electrodes 42 and 43 in the center of the tube and to space them from the glass walls of the tube. These mica spacers also confine the discharge to the two electrodes. In order to make adequate connection to the heavy electrodes 42 and 43, I preferably use a press 47 having double leads 48 and 49 therethrough and connect both of these leads to the screw 45 where it passes through the mica spacers 46. Both of the connections 49 are connected at one end to the cap 50 and the connections 48 and 49 to the other electrode 43 are likewise connected to a cap 51 at the opposite end of the tube. The size of this breakdown tube 25 with its caps 50 and 51 is the convenient size of the 60 ampere fuse, so that it can be inserted, as illustrated in Figs. 1 and 2, between fuse clips 52 and 53.

Both the rectifier tube 21 and the voltage control tube 25 just described are approximately the size of a 60 ampere fuse. The tube accordingly permits the use of a supporting base 60 of insulating material, such as porcelain with a ridge 61, if desired, to separate the two tubes. The clips may be bolted or otherwise secured to the porcelain base. The assembly of the tubes may be fastened to one of the walls of the casing as illustrated in Fig. 2. This construction permits the ready removal and replacement of a defective tube. The base 60 is approximately $3\frac{1}{4}$ " x $4\frac{1}{2}$ ".

In Fig. 4 I have illustrated the electric circuit of Fig. 3 with a transformer 54 inserted between the generator 11 and the rectifier tube 21 and its connection to the condenser 20. This permits the generator 11 to be wound and inserted for low voltages, giving an economic advantage in the cost thereof without the attendant troubles of high voltages with the rotating armature. The generator may, of course, be of the various types, such as self-excited, or have a permanent magnetic field.

Although I have disclosed the types of rectifier and voltage control or breakdown tubes that have very special advantages for this particular type of installation, yet other types may be used therein, such for example as a heater

cathode type of rectifier. In fact, many modifications may be made in the form, number and arrangement of the various elements disclosed in my preferred embodiments, and accordingly I desire only such limitations to be imposed upon my invention as are necessitated by the spirit and scope of the following claims.

I claim:

1. The method of firing a plurality of electric blasting caps which comprises generating an alternating current, rectifying the current, accumulating and storing the rectified current of less than firing value, preventing discharge at less than firing value, automatically discharging the stored current upon attaining firing value into a firing line, and supplying firing current to the plurality of blasting caps simultaneously.

2. The method of firing a plurality of electric firing devices which comprises generating an alternating current, rectifying the current, accumulating the electrical energy until the electrical pressure attains a value sufficient to fire all of said firing devices, preventing the leakage of the accumulated said energy, and automatically discharging the accumulated energy upon attaining firing value to all said firing devices simultaneously.

3. In a blasting machine, the combination with a plurality of firing devices, of a source of current supply, means for cumulatively storing electrical energy connected to said source of energy, means preventing the electrical energy in said storing means from leaking back to said source, means preventing the discharge of said electrical energy until the electrical pressure has reached a predetermined value, and automatically permitting discharge simultaneously to all of said firing devices when accumulation in said storing means attains said predetermined value.

4. A blasting assembly comprising a plurality of firing devices, a manually operable A. C. dynamo, a condenser connected in the output circuit of said dynamo to receive electrical energy therefrom, a rectifier in one of the connections between said dynamo and said condenser to provide unidirectional charging means for said condenser and to prevent leakage of said electrical energy from said condenser back to the dynamo, output connections from said condenser to said firing devices, and a voltage control tube in one of said output connections, said voltage control tube passing current of firing value to all of said firing devices simultaneously.

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