Nov. 11, 1952 J. L. BISCH 2,617,851

ELECTRIC IMPULSE GENERATOR

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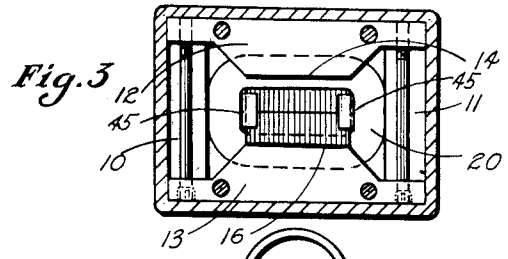


Fig. 3

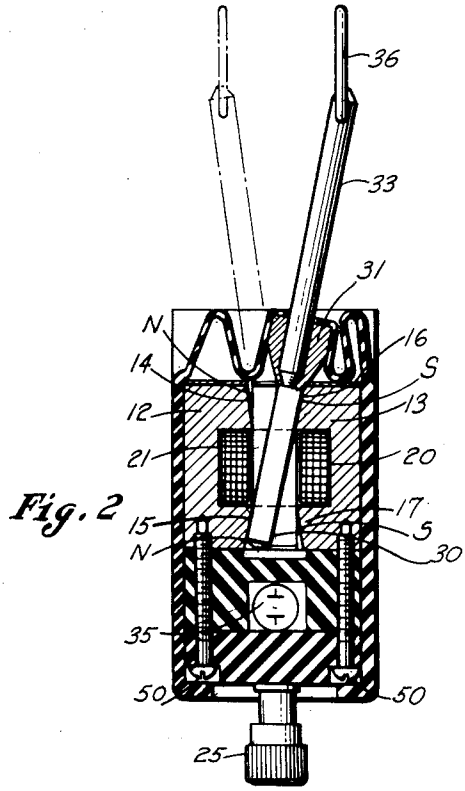


Fig. 2

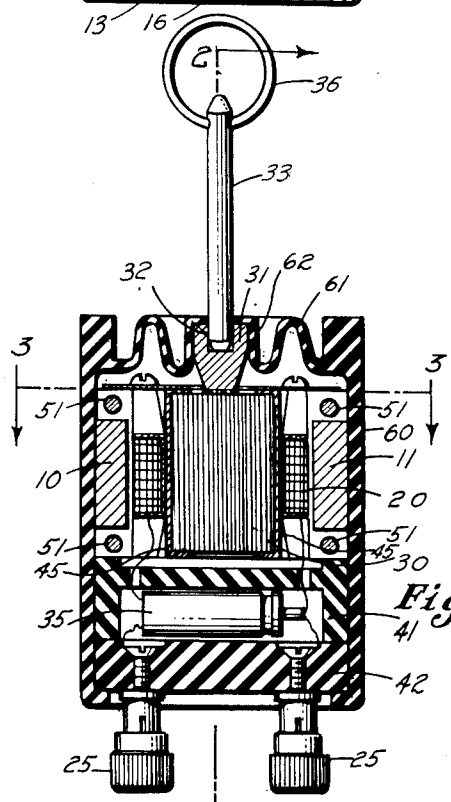


Fig. 1

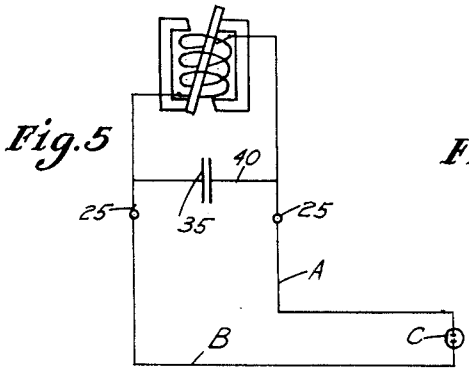


Fig. 5

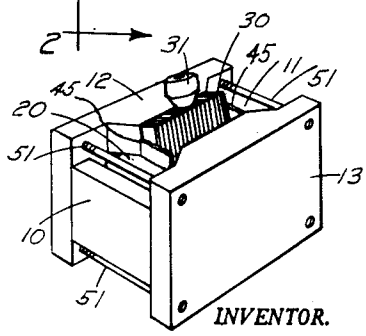


Fig. 4

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ELECTRIC IMPULSE GENERATOR

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This invention relates to an electric impulse generator of the type having two opposed pairs of magnetic pole pieces housing an electric coil and a bar armature extending through the coil and adapted to contact on its opposite sides with pole pieces of opposite polarity, and then to be shifted to contact with the other pole pieces of the two pairs, such operation causing a reversal of the direction of flow of magnetic flux in the armature, and generating an impulse current in the circuit of the surrounding coil.

It is an object of the invention to provide such a device in a small, light and readily portable structure in which the mere swinging of the armature is effective to cause a sudden flow of current of proper capacity to discharge an ignition cap of a blasting charge.

In accomplishing the result, I provide in the device a condenser which may allow the current to accumulate on it the first portion of the movement of the armature and then discharge such current as the armature completes its movement, thus eliminating the high inductance peak which normally would ignite gaseous mixtures which may be present in a mine.

In my device, the coil, magnetic field structure, and condenser within its case, are all mounted in very compact relationship. All these parts are preferably within an insulating envelope which has a yielding tubular neck which embraces an extension of the armature. The magnetism flowing through the armature from pieces of opposite polarity maintains the armature normally in one of its extreme positions and the yielding neck of the envelope adapts itself thereto; then, when the device is to be operated the handle of the armature is suddenly swung to the opposite position, the yielding neck and cap of the envelope bending as the armature handle changes position.

The above-outlined features will be more fully described in connection with a preferred embodiment of my invention illustrated in the drawings.

In the drawings, Fig. 1 is a longitudinal central section through the device; Figs. 2 and 3 are sections taken on planes indicated by the correspondingly numbered lines in Fig. 1; Fig. 4 is a perspective view illustrating the coil, field structure and armature, and Fig. 5 is a diagram of the electric circuit.

My field structure comprises two identical permanent magnets 10 and 11 which are disposed at opposite ends of a field structure. Engaging opposite poles of these magnets are two pieces 12 and 13 of soft iron or other material of high

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magnetic susceptibility. Each of the field pieces 12 and 13 has a pair of spaced pole faces as 14, 15 or 16 and 17. Between the two poles in each of the pairs is a transverse recess occupied by an electric coil 20. The coil is of substantially rectangular shape and surrounds a correspondingly shaped opening 21, which registers with the spaces between opposed poles. These latter spaces flare away from the coil opening, that is downwardly and upwardly when the device is in the position of Fig. 2.

The armature 30 is a laminated steel member having a suitable extension 31 which has a socket 32 for receiving a detachable handle 33. The laminations may be held together by a layer of silver solder which extends across each end of the armature. This extension may conveniently be made of steel and may be soldered to the laminated member. The armature occupies the coil opening and extends above and below it so that below the coil one face of the armature will engage one of the pole pieces and above the coil the opposite face of the armature will engage another pole piece of opposite polarity.

If we assume, for instance, that the two pole pieces shown at the left of the armature, Fig. 2, are north poles, designated N and the two at the right south poles, designated S, then the armature standing in the position shown will receive magnetic flux from the lower north pole piece and such flux will flow upwardly through the armature to the upper south pole piece. Now if the armature is thrown to the other position, indicated in broken lines in Fig. 2, the flux from the upper north pole piece flows downwardly through the armature to the lower south pole piece. It results therefrom that the mere shifting of the armature, changing the direction of magnetic flux therein, causes an impulse current through the coil, which is inductively connected with the armature.

To increase the quantity and suddenness of the delivered impulse current, I provide a condenser 35 which is connected across the two terminals of the coil. As the impulse current starts to form, resulting from the shifting of the armature, it first causes an accumulation on the condenser, then as the impulse current increases with the further movement of the armature the overloaded condenser discharges and thus controls the current characteristics so as to eliminate the objectionable high inductance peak.

In Figs. 1 and 2, I have shown two binding posts 25 forming terminals of the coil. The condenser which is in a line 40, bridged across the terminal

lines, is contained in a cavity in a pair of casing members 41 and 42, of insulating material secured to the field structure.

I have indicated the casing members 41 and 42 as held in place by bolts 50 passing through the members into the field structure, there being preferably four of these bolts, two being shown in Fig. 2. I have also shown four bolts 51 holding the magnets and field structure together in a rigid open frame embracing and holding the coil. This makes a very simple construction.

The armature, standing in the space within the coil and between the pole pieces, is held in one position or the other by the magnetism of the engaged pole pieces. I provide a cover for the device which is at once an insulator and a dust protector for the open space about the armature. This cover comprises a rubber envelope 60, rectangular in cross section, with an open bottom and with a top 61 which is closed except for a tubular neck 62 through which the armature handle extends. The top portion 61 is shown as having a corrugated formation which allows a bending action of the rubber-like material whenever the armature is swung from one position to another. Moreover, a close fitting neck portion 62 surrounds the extension 31, except for an opening through which the handle 33 may be inserted, and thus operates to keep the interior of the device free from moisture, dust and foreign substances.

It is advantageous to make the handle 33 detachable from the armature so as to avoid the danger of inadvertent operation of the armature. For convenience, the handle is provided with a ring 36 by means of which it may be fastened to the belt of an operator. Thus the generator may be deposited upon the ground until the wiring operations are completed and then it may be operated wherever desired.

To avoid chafing of the insulation for the coil consequent upon shifting of the armature, I provide a pair of guides which are in the form of channel-shaped copper strips 45 which extend through the space 21 and which are disposed on the opposite longitudinal edges of the armature. These strips have a close fitting engagement with the interior portion of the coil and are, therefore, stationary with respect to the coil. Thus, they operate to protect the coil against abrasion.

My device is well adapted to comply with requirements of the U. S. Bureau of Mines in regard to the operation of blasting machines in dusty or gassy coal mines, and to this end it may generate a current sufficient to fire an electric blasting cap through 4½ ohms resistance while producing an arc which shall not last more than 35 miliseconds. To effect this I prefer to make the coil of 22-gauge wire with 175 turns and I use Alnico V magnets. I prefer to use a condenser of 5 microfarad capacity at 50 working volts. I have found that operation of the device without the condenser will produce an arc of objectionable duration, so as to cause an explosion in a gassy coal mine.

It will be seen from the description given that I have provided a very simple hand device, small and light and of convenient shape and adapted to be readily carried from place to place. It is thoroughly insulated, and the interior is protected from dust. Moreover, it is ready for immediate operation whenever desired, to give the required impulse. It is only necessary to attach the conductors, as A and B, Fig. 5, from the detonating terminals C to the two binding posts 25 and then the device is ready for operation.

While I have described the invention as being suitable for use in discharging an ignition cap of a blasting charge, nevertheless it is not limited to such application but is intended for use wherever an electric impulse generator having the construction shown and claimed herein may be utilized.

I claim:

1. In an electric impulse generator, a field structure comprising a permanent magnet and two opposed and separated pairs of poles, there being a space between the poles of each pair, a coil occupying the last-mentioned space and having an internal passageway registering with the spaces between poles, an armature occupying the coil and the spaces between the poles of opposite polarity, and having an extension thereon, a handle adapted to engage said extension whereby the armature may be swung back and forth between two extreme positions, and an envelope surrounding the field structure having a yieldable cover with a tubular neck embracing the extension said tubular neck having an opening for receiving said handle and said neck being yielding to allow the armature to shift between its extreme positions.

2. In an electric impulse generator, a field structure comprising a permanent magnet, two opposed and separated pairs of poles, there being a space between the poles of each pair, a coil occupying the last-mentioned space and having an internal passageway registering with the spaces between the poles of opposite polarity, an armature occupying the coil and the spaces between the poles of opposite polarity, a handle for said armature whereby the same may be swung back and forth between two extreme positions, an insulating casing secured to the field structure beyond the region of the armature, means to limit the impulse current in the coil circuit to a predetermined safe value, said means comprising a condenser in said insulating casing and connected across the coil circuit, an envelope surrounding the field structure and casing and having a corrugated top and a tubular neck embracing a portion of the armature, said top being yielding to allow the armature to shift between its extreme positions.

3. The combination of a permanent magnet and a pair of extensions of material of magnetic susceptibility, each extension being secured to the magnet and each having two pole faces, the pole faces being spaced apart on each extension and there being spaces between the opposed pole faces of the two extensions, a coil in the spaces between the pole pieces of the same extension, an armature within the coil and engaging a pole piece of one polarity on one side of the coil and a pole piece of the opposite polarity on the opposite side of the coil, said pole pieces being so arranged that the direction of magnetic flux through the armature when the armature is in one extreme position is opposite to that when the armature is in the other extreme position, a handle for moving said armature to either of said positions, a pair of insulating casing members mounted one on the other and both secured to the field structure, said casing members having an internal cavity, a pair of binding posts carried by and external to the outer casing member forming terminals for conductors leading from the coil, means to limit the impulse current in the coil circuit to a prede-

termined safe value, said means comprising a condenser in the cavity of the casings bridged across the lines from the coil to the binding posts, and an insulating cover extending around the field structure and around the casings and having a yielding tubular neck through which the handle of the armature extends, said cover having a laterally yieldable top portion which operates to allow the armature handle to swing from the one extreme position to the other.

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