July 22, 1958 H. SCHAFFLER-GLOSSL 2,844,747

DYNAMO-ELECTRICAL IGNITING MACHINE

Filed April 5, 1955 2 Sheets-Sheet 1

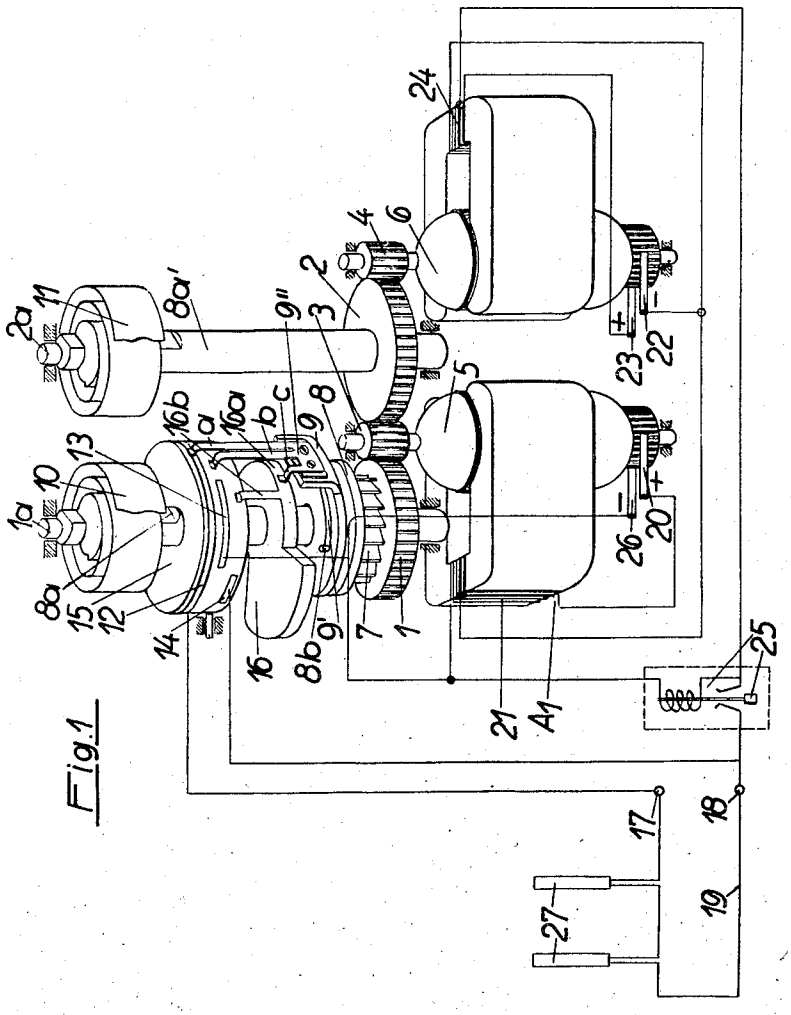

Fig.1

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Fig. 3

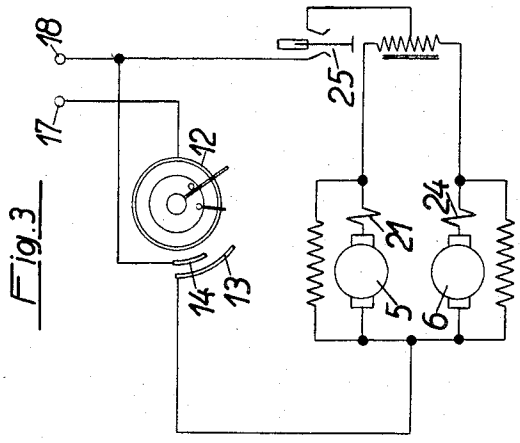
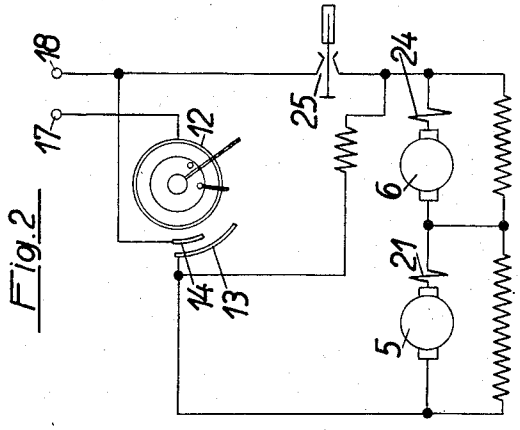


Fig. 2



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2,844,747

DYNAMO-ELECTRICAL IGNITING MACHINE

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1 Claim. (Cl. 310—69)

This invention relates to a dynamo-electrical igniting machine.

In mines where firedamp or vagabond currents occur the use of an electric igniting machine requires a relatively large number of blasts. An increase in the number of blasts is possible with series-connected detonators only by the use of a high voltage, and with parallel-connected detonators only by a high current value. To ensure an appropriate safety against firedamp explosion the current pulse should not exceed four thousandths of a second.

To comply with the above requirements the output of the machine must be about 1 kilowatt (1000 volts × 1 ampere) within four thousandths of a second. This requires a considerable increase in the size of the machine if an intermittent firing from high-current mains, with its dangers and disadvantages, is to be avoided. On the other hand, dynamo-electrical igniting machines, which are most suitable for the above-mentioned power values, cannot be constructed beyond a certain size, as would be required for higher current and/or voltage values, because the manufacture of the strong mainsprings for the armature involves great difficulty and it is hardly possible or even entirely impossible to strain such springs by hand. For this reason it has been suggested to couple two individual igniting machines, constructed for lower current and voltage values, in such a manner that their current or voltage values add up during firing.

Comprising two or more complete individual igniting machines, which are mechanically coupled, that known apparatus still forms a complicated, heavy machine.

It is an object of the present invention to provide an igniting machine which comprises two or more mainspring-driven armatures and which is capable of carrying a high overload for a short time, and is relatively small and, for that reason, can be carried easily. The armatures are extremely small in diameter to give the machine an impulse-like running-down characteristic. To achieve a considerable reduction of the weight and a compact construction of such igniting machines provided with two or several spring-driven armatures, only a single firing mechanism is provided for them according to the invention. Moreover, the armatures are positively coupled to each other. That coupling is suitably effected by interposing the drive pinion of one armature between the two drive gears mounted on the shafts carrying the springs.

Thus the invention provides a dynamo-electrical igniting machine comprising at least two electrically connected armatures each of which is adapted to be driven by a separate mainspring, which machine is characterized by means positively mechanically coupling said armatures and a single firing mechanism associated with all said armatures.

It is another object of the invention to provide a dynamo-electrical igniting machine with a safety device which prevents an igniting current to flow in the absence of a predetermined minimum electrical operating parameter

of the machine. To this end the invention provides a relay having a normally open contact in series with the output of the machine and responsive to a predetermined minimum electrical operating parameter of the machine, e. g. to a predetermined minimum output voltage thereof.

Further details will be apparent from the following description of the invention with reference to an illustrative embodiment thereof.

That illustrative embodiment of the invention is shown in the accompanying drawings in Fig. 1 in a perspective view with a wiring diagram, in the form of an igniting machine comprising two igniting dynamos.

Figs. 2 and 3 are circuit diagrams showing the series and parallel connections, respectively, of said two igniting dynamos.

In Fig. 1, numerals **1** and **2** designate the drive gears meshing with the drive pinions **3** and **4**, respectively, of the igniting dynamos **5** and **6**. The drive gear **1** is connected to a ratchet wheel **7**, which cooperates with the locking and release pawl (not shown). The drive gear **1** is further coupled to a control disk **8**, which has a sleeve **8***a* surrounding the shaft **1***a* of the drive gear **1**. A second control member **9** formed as a camwheel, is freely rotatably arranged on the sleeve **8***a*. The camwheel **9** has a concentric guide slot **9′** extending around about ¾ of a circle and slidingly receiving a driving pin **8***b* of the control disk **8**. Thus the camwheel **9** is coupled to the control disk **8** in both directions with a lost motion corresponding to the length of slot **9′**. The free end of the control disc sleeve **8***a* has firmly connected thereto the inner end of the mainspring **10**, whose second end is affixed to the stationary spring casing (not shown).

The camwheel **9** has an extension which is formed with two engaging faces and which has insulatedly affixed thereto a contact spring **9″** consisting of three parts **9***a*, **9***b*, and **9***c*. These several spring parts cooperate with contact paths **12**, **13** and **14** arranged on a stationary insulating disk **15** surrounding the control disk sleeve **8***a*. The spring part **9***a* cooperates with a slip ring **12**, spring part **9***b* cooperates with a contact path **13** and the shortest spring part **9***c* cooperates with a contact path **16***a* of an insulating disk **16**, which is disposed between the camwheel **9** and the insulating disk **15** and is coupled to be driven by the latter. That contact strip **16***a* has a contact spring **16***b* which cooperates with the short-circuiting path **14** on the insulating disk **15**.

According to the invention the drive pinion of the igniting dynamo **5** meshes with the drive gear **1** and with the drive gear **2**, which latter meshes with the pinion **4** of the igniting dynamo **6**. Owing to that construction of the igniting machine both springs **10** and **11** can be wound up by turning only one of the sleeves **8***a* and **8***a′* surrounding the shafts **1***a* and **2***a* of drive gears **1** and **2**, respectively, the second spring being wound up positively through the intermediary of the drive pinion **3**. Likewise, only one firing system is used, which is effective in the manner to be described hereinafter, upon release of the mainsprings **10** and **11**.

After release of the mainspring **10** the camwheel **9** remains still for a time. Only after the control disk **8** rotating in the clockwise sense has performed approximately three quarters of a turn is the camwheel driven by the former through the intermediary of its pin **8***b*. After further approximately three quarters of a turn the extension of the camwheel **9** carrying the tripartite contact spring **9″** engages the engaging edge of the insulating disk **16** to drive the latter also in the clockwise sense. During that operation the spring part **9***b* of the tripartite contact spring **9″** insulatedly arranged on the camwheel **9** slides on the circuit closing contact path **13** of the insulating disk **15** and closes the igniting circuit in conjunction with the spring part **9***a* wiping over

the slip ring **12**. After an igniting current has flown for about four thousandths of a second the spring part **9***b* leaves the contact path **13**. In the meantime the contact spring **16***b* of the contact path **16***a* has reached the short-circuiting contact path **14** and interrupts the igniting current by short-circuiting the igniting machine. The mainspring **11** released together with the mainspring **10** drives the dynamo **6** through the intermediary of drive gear **2** and pinion **4** to produce an igniting current. When the igniting circuit is closed in the manner described hereinbefore the igniting currents produced by the dynamos **5** and **6** will add up in voltage or current value.

According to Fig. 1 the leads between the two compound-excited direct current igniting dynamos **5** and **6** and the two terminals **17** and **18** for the series igniting line **19** extend from the collector brush **20** of the igniting dynamo **5** through the series exciter winding **21** to the collector brush **22** of the igniting dynamo **6** and through the collector brush **23**, the series exciter winding **24** for the igniting dynamo **6** and a contact relay **25** to the terminal **18**, and on the other hand through the collector brush **26** of the igniting dynamo **5** to the circuit closing contact path **13** and from the slip ring **12** to the terminal **17**. From terminal **18** one lead extends to the short-circuiting contact path **14** and another lead, containing the winding of contact relay **25**, to the circuit closing contact path **13**.

Figs. 2 and 3 are diagrams showing the series and parallel connections, respectively, of the two igniting dynamos. When the dynamos are in series their voltages will add up and when they are in parallel their currents will add up in the common igniting line.

The contact relay **25** inserted in the lead to terminal **18** serves to interrupt that line in the case of a change of the current conditions upon a breakage of a spring casing or another defect, in order to prevent that the occurrence of a voltage or current value not complying with the requirements in the igniting line **19** leads to an ignition of only part of the detonators **27**.

What I claim is:

A dynamoelectrical igniting machine comprising at least two mainsprings, at least two electrically connected armatures arranged one beside the other with their axes parallel, each of said armatures being arranged to be driven by one of said mainsprings, means positively mechanically coupling said armatures, a single firing mechanism associated with all said armatures, a relay having a normally open contact in series with the output of the machine and responsive to a predetermined minimum electrical operating parameter of the machine, and a contacting device electrically connected to the output of the machine and mechanically connected to one of said armatures and operable thereby to limit the delivery of power by the machine to a predetermined period of time.

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