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A. M. CURTIS

2,476,843

CONTACT PROTECTION NETWORK

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FIG. 1

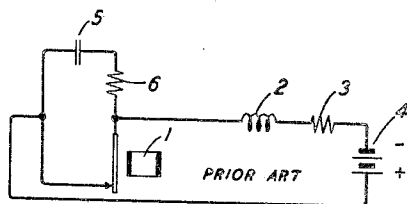


FIG. 2

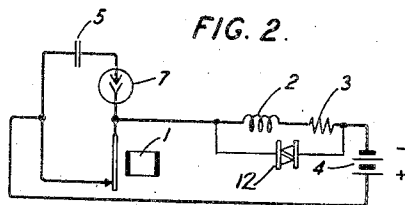


FIG. 3

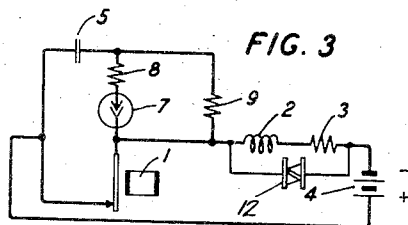
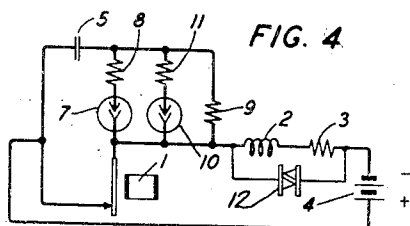


FIG. 4



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2,476,843

CONTACT PROTECTION NETWORK

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3 Claims. (Cl. 175-294)

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This invention relates to circuit makers and breakers and particularly to electrical networks to protect such devices from the erosive effects of current flow during the operations thereof.

It has long been known that a condenser 5 bridged about a pair of contacts forms an effective protector against sparking on the opening of the contacts and for this purpose the larger the capacity the better the protection. But this introduces a new defect, for the greater 10 the capacity the condenser has, the greater amount of energy can be stored which must be discharged through the contacts when they are again brought together. Therefore a resistance 15 must be introduced in the condenser circuit to prevent an undue rush of current at this time and hence the greater the resistance, the better the protection. However these considerations are mutually conflicting.

The ideal arrangement would be one in which the resistance in series with the condenser is extremely low when the contacts are opened to avoid hindrance to the functioning of the condenser and very high when the contacts are closed to limit the initial current flow from the discharge of the condenser to a value that could be handled by the contacts without undue heating.

A rectifier or asymmetric cell has such properties and its use in substitution for the usual resistance in the condenser resistance contact protection network would be possible provided an appropriately sized device of this nature having the required electrical constants were available. Applicant has discovered that a rectifier constructed of a crystal of germanium may be produced having physical dimensions so small that the whole unit may be mounted as part of a relay assembly or potted with a condenser. Since such a small unit may be constructed with an electrical resistance of about 10 ohms in one direction and several thousand ohms in the other directions it forms an ideal unit for the purposes set forth.

A general characteristic of most known types of rectifiers or asymmetric cells is that there is a practical limit to the surge peak potential applied thereto. The said germanium crystal appears to operate indefinitely if the surge peak is limited to 150 volts but has been found to fail after several hundred operations with current in the neighborhood of 1 ampere at a surge peak between 500 and 1,000 volts. The rectifier combined with an appropriate condenser therefore 55

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provides a satisfactory contact protection unit for most uses in communication systems.

In situations where especially severe service conditions will be encountered, a third element in the form of a varistor, an element having a naturally high electrical resistance but which changes to a low resistance when a comparatively high potential is applied, will be added. Thus a varistor may be bridged about a relay winding or other inductive load element to block the surge peak which will be produced when the circuit therethrough is opened.

A feature of the invention is therefore the combination of a varistor, an asymmetric cell and a condenser for the protection of a pair of contact makers and breakers. In this combination, the condenser acts as an absorber to hold the potential across the opening contacts down and thus prevent the formation of a spark or an arc, the asymmetric cell acts as a gate to provide a low resistance path to the condenser on the opening of the contacts and a high resistance path on the closing thereof and the varistor, normally of little effect in the circuit acts as a drain when abnormally high voltages appear, thus protecting the asymmetric cell.

Other features will appear hereinafter.

The drawings consist of a single sheet having four figures, as follows:

Fig. 1 is a schematic circuit diagram showing the prior art arrangement;

Fig. 2 is a similar schematic circuit diagram showing the fundamental arrangement of the circuit elements according to the present invention;

Fig. 3 is a similar schematic circuit diagram showing a modification of the arrangement in which a series resistance and a shunt leak of substantially the same resistance values as exhibited by the asymmetric cell are used for the protection thereof; and

Fig. 4 is a similar schematic circuit diagram showing the use of a plurality of rectifiers used in parallel.

The conventional contact protecting means is shown in Fig. 1. Here a relay is shown in control of an armature and back contact. This contact controls a load here illustrated as an inductance 2 and a resistance 3 in circuit with a source of current 4. The contact protection is provided by a circuit bridged about the contacts and consists of a condenser 5 and a resistance 6. The values of these two elements must be always a compromise for the condenser 5 should be of great capacity to protect the contacts when they

are opened and the resistor 6 should be of high resistance to protect the contacts when they are closed. These two requirements are mutually conflicting for the higher the resistance, the less effective is the condenser.

In accordance with the present invention, an asymmetric cell 7 is substituted for the resistance 6. With this arrangement, when the armature of relay 1 is moved away from its back contact, the asymmetric cell presents little or no hindrance to the flow of charging current in the condenser 5.

However, when the contacts are closed, this asymmetric cell 7 constitutes a high resistance to the discharge current of the condenser 5 and by thus limiting the rush of current through the contacts provides adequate protection therefor.

Applicant has found that a germanium crystal rectifier which has physical dimensions comparable to those of the conventional resistors used in radio receivers may be constructed to present a resistance of about 10 ohms in one direction and about 10,000 ohms in the other direction, these figures, of course, being subject to wide variation and being given only by way of example.

A varistor 12 may be bridged about the load 2 and 3 in situations where especially severe service conditions are expected. This will be normally of little effect but will act as a drain when abnormally high voltages appear.

Fig. 3 shows a variation of the arrangement in which a series resistance 8 which may be in the order of 10 ohms and a shunt leak resistance 9 which may be in the order of 10,000 ohms are used in combination with the asymmetric cell 7. These resistances of substantially the same values as exhibited by the asymmetric cell 7 are employed for the protection thereof. The series resistance 8 adds 10 ohms to the inherent resistance of 10 ohms of the asymmetric cell so that the charging current of the condenser 5 will encounter a low resistance of substantially 20 ohms. The shunt resistance of 10,000 ohms in parallel with the substantially 10,000 ohms of the asymmetric cell then presents a resistance of 5,000 ohms to the discharge path of the condenser. Again it must be noted that these values are given by way of example and are also subject to variation in accordance with different circuit conditions encountered.

Fig. 4 shows two asymmetric cells in parallel each with its series resistance and a single shunt resistance designed to afford greater protection where the value of the load and other factors in

the circuit require it. Other arrangements which will be clear from this teaching may be made within the scope of this invention.

What is claimed is:

1. A contact protection means consisting of a condenser in series with an asymmetric cell bridged about a pair of contacts to be protected and protecting means for said cell comprising a series resistance of a value to limit the current through said cell substantially to the value produced by said cell in normal operation, and a shunt resistance of a value to limit the potential across said cell substantially to the maximum value to which said cell is subjected in normal operation.

2. A contact protection means consisting of a condenser in series with an asymmetric cell bridged about a pair of contacts to be protected and protecting means for said cell comprising a series resistance of a value to limit the current through said cell substantially to the value produced by said cell in normal operation, a shunt resistance of a value to limit the potential across said cell substantially to the maximum value to which said cell is subjected in normal operation and a varistor responsive to abnormal potentials caused by the operation of said contacts in series with a load having a substantial inductive component to minimize surges produced thereby.

3. A contact protection means consisting of a condenser in series with a germanium crystal rectifier bridged about a pair of contacts to be protected and protecting means for said rectifier comprising a series resistance of the order of ten ohms and a shunt resistance of the order of ten thousand ohms.

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Deceased.

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