May 30, 1950 R. S. STANTON 2,509,703

PROTECTING CIRCUIT

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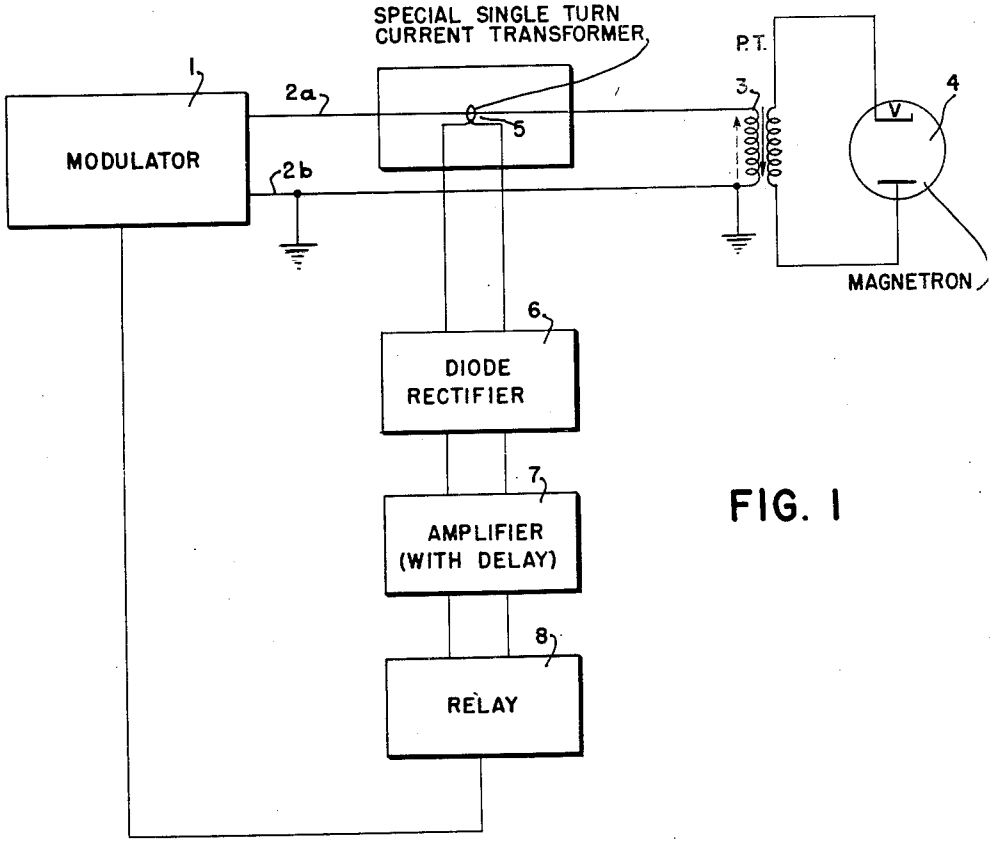


FIG. 1

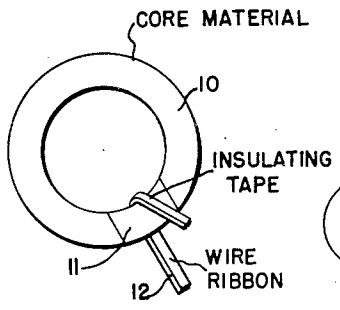


FIG. 3

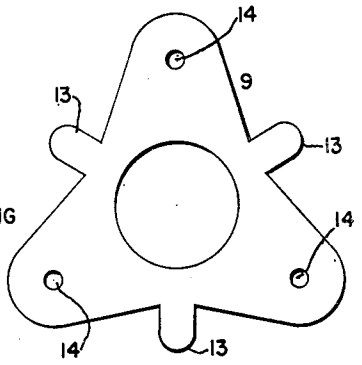


FIG. 2

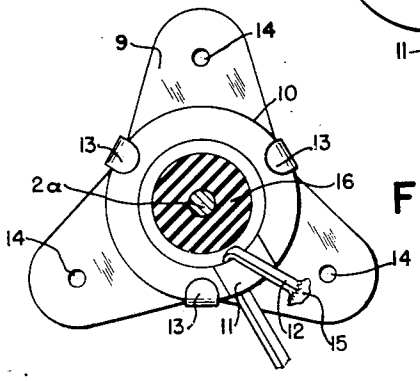


FIG. 4

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7 Claims. (Cl. 332—5)

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This invention relates to a means for protecting apparatus from overload currents, and particularly for protecting modulator components used in a radar system.

In the radar art, a modulator is used to provide energy which is connected through a line to a pulse forming transformer, which in turn, energizes a magnetron or other oscillator device. These pulse transformers are necessarily of a precise design which makes it possible to pass a high power short duration pulse to the magnetron oscillator. If the magnetron becomes gassy, it acts as a direct short and overloads the modulator and the pulse transformer. More specifically, a gassy magnetron allows the pulse forming network to discharge at approximately twice the normal current, and leaves an opposite charge on the network which tends to discharge in the reverse direction. This current will thus be reflected from one end of the pulse forming line to the other with the result that the primary winding of the pulse transformer will be subjected to several reflections of a current high enough to damage the transformer.

It is the primary object of this invention to provide means for monitoring a pulse line and protecting modulator components from abnormal conditions as indicated by the existence of reverse currents of a high magnitude.

Another object of this invention is to provide a light weight apparatus for protecting modulator components from overload currents.

Another object of this invention is to provide a coupling means for the pulse line to secure a relay actuating voltage, without appreciable loading effect on the line.

Other and further objects will be apparent upon consideration of the following description together with the accompanying drawing, in which:

Fig. 1 shows generally a block diagram of an embodiment of this invention;

Fig. 2 and Fig. 3 show parts of a transformer used in the system of Fig. 1; and

Fig. 4 is a view of the transformer.

In Fig 1, energy is transferred from a modulator 1 thrugh any conventional transmission line 2a and 2b to a pulse transformer 3 in order to modulate a magnetron 4. The normal current flow through the pulse transformer is as indicated by the solid arrow. In the event of a short circuit or a gassy magnetron a reverse current flows as shown by the broken arrow. A coupling means 5 for monitoring the pulse energy is connected to a diode tube rectifier 6, which is polarized to conduct only with a reversed current. The output from this rectifier is fed into a delayed amplifier 7, whose output, when sufficiently large, operates a relay 8, arranged to turn off the modulator 1.

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The coupling means 5 is itself a feature of the invention, and its construction is shown in detail in Figs. 2, 3 and 4. Fig. 2 shows a brass blank approximately 1/64 of an inch thick, and stamped out in the shape shown to form a mounting plate for the coupling means 5 (Fig. 1) which is essentially a current type transformer adding only negligible load or impedance to the pulse line 2a.

In Fig. 3 is shown the core 10 of the transformer consisting of a stack of thirty rings of .003 inch thickness transformer core material. A strip of insulating tape 11 is wound around the core so formed, and a single loop of ribbon type wire 12 is passed around the insulated portion. The entire core is then dipped in transformer sealing material to form a covering. This single turn loop 12 forms the secondary for the transformer, which is connected to the rectifier 6.

The completed transformer is shown in Fig. 4. The core 10 is placed on the brass mounting plate 9 and the three tabs 13 are bent over the core to hold it into place. In the particular case here shown, one end of loop 12 is soldered to the plate 9, as indicated at 15. The completed transformer is placed over the pulse terminal, which may be a socket or standoff insulator 16 on a chassis or grounded panel (not shown) and the plate 9 held in place by screws passing through the mounting holes 14 to the chassis or panel. The primary of the transformer becomes the lead or wire 2a through the insulator 16 to the pulse transformer. Hence, a relatively simple current monitoring transformer with a minimum loading characteristic results.

Referring again to Fig. 1, a reverse current flow will be picked up by the single turn transformer 5 and fed into the diode rectifier 6 which is polarized in such a manner as to conduct only in response to this reverse current. The resulting direct current output from the rectifier 6 is fed into an amplifier 7 with a time constant delay in its grid circuit so that random surges or minute stray arcing will not produce a voltage of sufficient duration to operate the relay. If a reversed current persists for a time sufficiently long, with respect to the delay time constant of the amplifier grid circuit, it will cause the relay to operate, thereby interrupting the modulator power supply holding circuit and

stopping its operation. When the modulator is stopped, the modulation energy is removed from the pulse transformer, thereby providing an efficient safety device for the pulse transformer as well as the modulator.

The invention is only to be limited by the appended claims.

What is claimed is:

1. In an electrical system including a modulator, a load, and a line feeding the modulator output to said load, an apparatus for protecting said modulator from reverse currents comprising a low impedance coupling means for the modulator output forming a current type transformer with said line, means for rectifying the output of said transformer, a relay responsive to the output of said rectifier for disabling said modulator, and said rectifying means being so polarized as to conduct only said reverse currents.

2. In an electrical system including a modulator, a pulse transformer, a line feeding the output of said modulator to said pulse transformer, apparatus for protecting said modulator and said pulse transformer from reverse currents, comprising a pick up means forming a current type transformer with said feed line, said transformer being connected to a rectifying means so polarized as to conduct only in response to reverse currents in said line, a relay responsive to the output of said rectifier, said relay upon operation disabling said modulator in order to protect said modulator and said pulse transformer from said reverse currents.

3. In an electrical system including a modulator, a load and a line coupling the modulator output to said load, an apparatus for protecting said modulator from reverse currents comprising a low impedance coupling means to the modulator output forming a current type transformer with said line, said transformer including a mounting plate, a core formed from rings of core material secured to said plate, a secondary including a loop of wire passed around a portion of said core and insulated therefrom, said mounting plate being adapted to receive said line passing axially therethrough and acting as the primary of said transformer, means for rectifying the output of said transformer, a relay responsive to the output of said rectifier for disabling said modulator, and said rectifying means being so polarized as to conduct only in response of said reverse currents.

4. In an electrical system including a modulator, a load, and a line feeding the modulator

output to said load, apparatus for protecting said modulator from reverse currents, comprising a pickup means forming a current type transformer with said feed line, means for rectifying the output of said pickup means, and means responsive to the output of said rectifying means for disabling said modulator.

5. In an electrical system including a source of pulse energy, a load, and a line feeding the energy source output to said load, apparatus for protecting said energy source from reverse currents, comprising coupling means for the energy source output forming a current type transformer with said line, means operative only by said reverse currents for rectifying the output of said transformer, and switching means responsive to the output of said rectifier for disabling said energy source.

6. In an electrical system including a source of pulse energy, a pulse transformer, and a line feeding the output of said energy source to said pulse transformer, apparatus for protecting said energy source and said pulse transformer from reverse currents, comprising a pickup means forming a current type transformer with said feed line, means operative only in response to reverse currents in said line for rectifying the output of said transformer, and switching means responsive to the output of said rectifier for disabling said energy source.

7. In an electrical system including a source of pulse energy, a load, and a line feeding the pulse energy source output to said load, apparatus for protecting said energy source and said load from reverse currents, comprising a coupling means forming a current type transformer with said line, means operative only by said reverse currents for rectifying the output of said transformer, and switching means operative by the output of said rectifier for disabling said energy source.

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