

PATENT SPECIFICATION

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(54) ELECTRICAL CONTACT-BOUNCE COMPENSATOR

(71) We, THE PLESSEY COMPANY LIMITED, a British company of 2/60 Vicarage Lane, Ilford, Essex do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to electrical contact-bounce compensators.

Contact-bounce is particularly troublesome at an interface between electro-mechanical and so-called electronic equipment. Compensators are known which offset the effects of contact-bounce. An individual compensator is provided for each contact concerned.

According to the invention there is provided an electrical contact-bounce compensating assembly comprising:—

- (i) a supply terminal at which power is supplied;
- (ii) a supply resistor of relatively high value connected at one end to the supply terminal;
- (iii) a bus-bar connected to the other end of the supply resistor;
- (iv) a number of output terminals;
- (v) a respective electrical contact associated with each output terminal, each contact being connected between the bus-bar and the associated output terminal.
- (vi) a respective further resistor of relatively low value associated with each output terminal, each further resistor being connected between a source of reference potential and the associated output terminal;
- (vii) and, connected to the bus-bar, a contact bounce compensator normally operable in response to a change in bus-bar potential due to the closure of a said contact, to time a delay exceeding the persistence time of contact-bounce of the closed contact, and on the expiry of said delay firstly to

impose a period in which further operation of the compensator is inhibited, and secondly during the period of inhibition, to deliver to the bus-bar a signal which is applied by the operated contact to the output terminal associated therewith.

The invention will now be described with reference to the drawings accompanying the provisional specification in which:—

FIGURE 1 is a schematic diagram of an assembly according to the invention.

FIGURE 2 is a time chart showing the sequence of events connected with the operation of the assembly of FIGURE 1.

A source of power P is connected by a supply resistor R to a bus-bar B. The assembly has a number of output terminals, of which two are shown at o1, o2. Each output terminal is connected to the bus-bar B by a contact c1, c2 which is individual to the terminal. Each output terminal is connected to a source of reference potential, conveniently earth, by a further resistor r1, r2 individual to the terminal. The supply resistor R has a relatively large value, and the further resistors r1, r2 . . . each have a relatively low value. Normally the bus-bar B stands at the potential V of the power supply P. But when a contact, typically c1, is closed current flows from the source P through the supply resistor R, the bus-bar B, the contact c1 (closed) and the further resistor r1 to earth. The potential at the bus-bar B falls to a value v. On account of the relative values of the resistors R, r, the potential v is sufficiently close to earth potential to be negligible as an output signal at the output terminal o1.

A compensator, shown below the chain line l, includes a detector D, which is connected direct to the bus-bar B. The detector D includes a detector D, which is connected direct to the bus bar B. The detector D is capable of distinguishing between the potentials V, v which appear on

the bus-bar B, and of delivering corresponding distinctive outputs. When the bus-bar stands at the supply potential V, the detector output is used as a restore signal *rs*, so that all components of the compensator occupy a datum state and are ready for use.

The reduced voltage *v* appears on the bus-bar as soon as a contact, typically *c1*, is closed. The closure of contact *c1* is represented by the point 1 in FIGURE 2. The detector D delivers an output *vs*, which starts a first delay device *d1*. The contact *c1* then bounces. At each bounce, the potential V re-appears on the bus-bar, and the detector D delivers a restore signal *rs* which restores the delay device. Eventually, the bounces terminate, and the delay device *d1* works without interruption. The maximum time during which the contact *c1* is prone to contact-bounce, can be calculated from the mechanical characteristics of the contact. This maximum time is denoted by the reference *tp*. In any particular closure of the contact *c1*, however, the last bounce may occur—as shown at the point 2—in less than the maximum time, and the delay device *d1* will start to operate before the maximum time *tp* has expired. Therefore, in order to be confident that the bouncing of the contact *c1* has ceased, the delay device *d1* is arranged to time an interval *dt1* which is greater than the maximum interval *tp* during which the tendency to bounce persists. When the interval *dt1* expires, the delay device *d1* delivers a signal *ds1* as shown at the point 3.

The signal *ds1* is used in two ways. Firstly it is used to trigger a first monostable circuit M1, which delivers to the detector D an inhibit signal *is* of any suitable duration. Secondly it is used to start a second delay device *d2*. As long as the inhibit signal *is* is being delivered, the detector D is prevented from responding to potentials appearing on the bus-bar B. The delay device *d2* times an interval *dt2* sufficient to ensure that the detector D has been inhibited by the signal *is*, and at the expiry of the interval delivers a signal *ds2* as shown at the point 4. The signal *ds2* triggers a second monostable circuit M2 which delivers an output signal *os* whose duration is the same as that required for an output signal at the output terminal *o1*.

From the second monostable circuit M2 the signal *os* is delivered to the bus-bar B by a unidirectional device U which isolates the circuit M2 from potentials on the bus-bar B. The device U may have any suitable form, such as a suitably-poled rectifier. From the bus-bar B the signal *os* is applied over the contact *c1* (closed) to the output terminal *o1*. The potential of the signal *os* is such that, after allowing for

the resistor *r1*, a desired potential is attained at the output terminal *o1*.

The signal *os* terminates when the second monostable circuit M2 restores itself as shown at the point 5. Shortly afterwards, the first monostable circuit M1 restores itself, as shown at the point 6, terminating the inhibit signal *is*. If, by this time, the contact *c1* has been opened, the supply voltage V reaches the detector D, and the restore signal *rs* is effective to restore the device *d1* (as already explained), as well as the device *d2*, the circuits M1, M2 and, if need be, the unidirectional device U. On the other hand, if the contact *c1* is still closed, the potential *v* reaches the detector D, generating a signal *vs*, which however, is ineffective. When the contact *c1* subsequently opens, the supply voltage V reaches the detector D with the results just described.

In the foregoing description, it has been assumed that the contacts *c1*, *c2* are contacts of separate electromagnetic relays (not shown), and that the output terminals *o1*, *o2* are connected to separate load circuits of the so-called electronic type. However, the assembly will work under other conditions. In the compensator, the detector D, the delay devices *d1*, *d2*, the monostable circuits M1, M2 and the unidirectional device U are preferably of so called electronic construction.

It will be noted that the compensator is usable in common with each of the contacts *c1*, *c2*.

WHAT WE CLAIM IS:—

1. An electrical contact-bounce compensating assembly comprising:—

- (i) a supply terminal at which power is supplied;
- (ii) a supply resistor of relatively high value connected at one end to the supply terminal;
- (iii) a bus-bar connected to the other end of the supply resistor;
- (iv) a number of output terminals;
- (v) a respective electrical contact associated with each output terminal, each contact being connected between the bus-bar and the associated output terminal;
- (vi) a respective further resistor of relatively low value associated with each output terminal, each further resistor being connected between a source of reference potential and the associated output terminal;
- (vii) and, connected to the bus-bar, a contact bounce compensator normally operable in response to a change in bus-bar potential due to the closure of a said contact, to time a delay exceeding the persistence time of contact-bounce of the closed contact, and on the expiry of said delay firstly to impose a period in which further operation

the bus-bar B, and of delivering corresponding distinctive outputs. When the bus-bar stands at the supply potential V, the detector output is used as a restore signal *rs*, so that all components of the compensator occupy a datum state and are ready for use.

The reduced voltage *v* appears on the bus-bar as soon as a contact, typically *c1*, is closed. The closure of contact *c1* is represented by the point 1 in FIGURE 2. The detector D delivers an output *vs*, which starts a first delay device *d1*. The contact *c1* then bounces. At each bounce, the potential V re-appears on the bus-bar, and the detector D delivers a restore signal *rs* which restores the delay device. Eventually, the bounces terminate, and the delay device *d1* works without interruption. The maximum time during which the contact *c1* is prone to contact-bounce, can be calculated from the mechanical characteristics of the contact. This maximum time is denoted by the reference *tp*. In any particular closure of the contact *c1*, however, the last bounce may occur—as shown at the point 2—in less than the maximum time, and the delay device *d1* will start to operate before the maximum time *tp* has expired. Therefore, in order to be confident that the bouncing of the contact *c1* has ceased, the delay device *d1* is arranged to time an interval *dt1* which is greater than the maximum interval *tp* during which the tendency to bounce persists. When the interval *dt1* expires, the delay device *d1* delivers a signal *ds1* as shown at the point 3.

The signal *ds1* is used in two ways. Firstly it is used to trigger a first monostable circuit M1, which delivers to the detector D an inhibit signal *is* of any suitable duration. Secondly it is used to start a second delay device *d2*. As long as the inhibit signal *is* is being delivered, the detector D is prevented from responding to potentials appearing on the bus-bar B. The delay device *d2* times an interval *dt2* sufficient to ensure that the detector D has been inhibited by the signal *is*, and at the expiry of the interval delivers a signal *ds2* as shown at the point 4. The signal *ds2* triggers a second monostable circuit M2 which delivers an output signal *os* whose duration is the same as that required for an output signal at the output terminal *o1*.

From the second monostable circuit M2 the signal *os* is delivered to the bus-bar B by a unidirectional device U which isolates the circuit M2 from potentials on the bus-bar B. The device U may have any suitable form, such as a suitably-poled rectifier. From the bus-bar B the signal *os* is applied over the contact *c1* (closed) to the output terminal *o1*. The potential of the signal *os* is such that, after allowing for

the resistor *r1*, a desired potential is attained at the output terminal *o1*.

The signal *os* terminates when the second monostable circuit M2 restores itself as shown at the point 5. Shortly afterwards, the first monostable circuit M1 restores itself, as shown at the point 6, terminating the inhibit signal *is*. If, by this time, the contact *c1* has been opened, the supply voltage V reaches the detector D, and the restore signal *rs* is effective to restore the device *d1* (as already explained), as well as the device *d2*, the circuits M1, M2 and, if need be, the unidirectional device U. On the other hand, if the contact *c1* is still closed, the potential *v* reaches the detector D, generating a signal *vs*, which however, is ineffective. When the contact *c1* subsequently opens, the supply voltage V reaches the detector D with the results just described.

In the foregoing description, it has been assumed that the contacts *c1*, *c2* are contacts of separate electromagnetic relays (not shown), and that the output terminals *o1*, *o2* are connected to separate load circuits of the so-called electronic type. However, the assembly will work under other conditions. In the compensator, the detector D, the delay devices *d1*, *d2*, the monostable circuits M1, M2 and the unidirectional device U are preferably of so called electronic construction.

It will be noted that the compensator is usable in common with each of the contacts *c1*, *c2*.

WHAT WE CLAIM IS:—

1. An electrical contact-bounce compensating assembly comprising:—
 - (i) a supply terminal at which power is supplied;
 - (ii) a supply resistor of relatively high value connected at one end to the supply terminal;
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 - (iv) a number of output terminals;
 - (v) a respective electrical contact associated with each output terminal, each contact being connected between the bus-bar and the associated output terminal;
 - (vi) a respective further resistor of relatively low value associated with each output terminal, each further resistor being connected between a source of reference potential and the associated output terminal;
 - (vii) and, connected to the bus-bar, a contact bounce compensator normally operable in response to a change in bus-bar potential due to the closure of a said contact, to time a delay exceeding the persistence time of contact-bounce of the closed contact, and on the expiry of said delay firstly to impose a period in which further operation





of the compensator is inhibited, and secondly during the period of inhibition, to deliver to the bus-bar a signal which is applied by the operated contact to the output terminal associated therewith.

5 2. An electrical contact-bounce compensating assembly as claimed in claim 1 wherein the compensator includes a detector adapted to detect a change in bus-bar potential due to the closure of a said contact, and to deliver an out put signal.

10 3. An electrical contact-bounce compensating assembly as claimed in claim 2 wherein the detector input is connected to the bus-bar and its output is connected to at least two delay circuits, one of which is adapted to time said delay exceeding the persistence time of contact-bounce of the closed contact, and on the expiry of said delay firstly to impose said period in which further operation of the compensator is inhibited, and secondly during the period of inhibition to deliver a signal to a unidirectional device.

20 4. An electrical contact-bounce com-

pensating assembly as claimed in claim 3 wherein said one delay circuit includes a delay device which times said delay exceeding the persistence time of contact bounce of the closed contact, and a monostable circuit which delivers to the said detector an inhibit signal.

5. An electrical contact-bounce compensating assembly as claimed in claim 4 wherein the said at least two delay circuits are connected at one end to the said detector and at the other end to the unidirectional device which is adapted to deliver a signal to the said bus-bar, the delivered signal being applied by the operated contact to the output terminal associated therewith.

6. An electrical contact-bounce compensating assembly substantially as hereinbefore described with reference to the drawings accompanying the provisional specification.

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