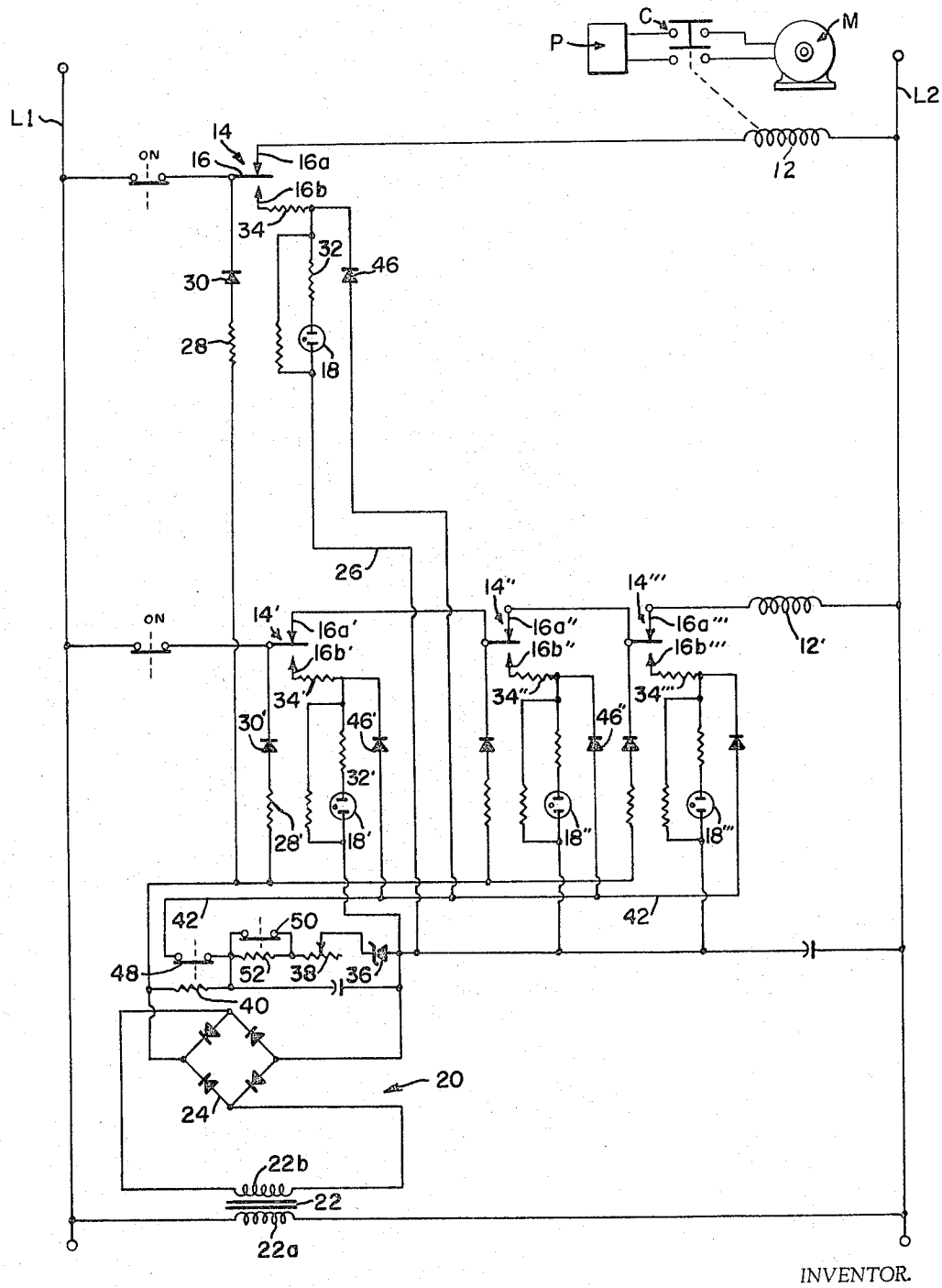
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ANNUNCIATOR FOR SYSTEM MALFUNCTIONS

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ANNUNCIATOR FOR SYSTEM MALFUNCTIONS

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This invention relates to apparatus for indicating which of one or more sensors or transducers in a boiler or like system has sensed a system malfunction as manifested by a preselected magnitude of temperature, pressure or the like. The invention is described in connection with a gas or oil fired boiler but is not to be considered limited to such application.

A typical boiler installation has numerous transducers associated therewith for disabling the system should a dangerous or undesirable operating condition or like malfunction be detected. Should such boiler be disabled by the aforementioned equipment, it is desirable that the boiler be promptly refired on abatement of the malfunction and that a permanent indication be provided as to which particular sensor or transducer caused the disabling of the burner in order that the particular unit can be inspected and repaired if necessary. Transducers normally respond to a system malfunction by opening and/or closing electrical contacts in response to the sensing of a preselected magnitude of an operating parameter. Such transducers are typically provided with only a single pole-double throw switch in order to minimize inertia of moving parts so that the differential between actuation and deactuation of the transducer is minimized.

Because system components, such as pumps, fans, and the like, are energized through the transducer contacts and because the inertia of additional moving contacts cannot be tolerated, devices for indicating system malfunction are preferably actuated by the same contacts that energize system components. Care must be taken, however, to avoid unwanted sneak current paths between the system components and the indicating devices, lest one adversely affect the other.

Therefore, it is an object of this invention to provide an indicating device which can be operated from the same transducer contacts that disable the entire system when an undesirable condition is sensed by the transducer. This object, in a broad sense, is achieved by providing indicating lamps, an auxiliary power supply for energizing the lamps and a device for permitting unidirectional current flow in order that current be supplied to the lamp but not to the input valve solenoid.

Another object is to provide an indicating device wherein the indicating lamps will remain illuminated even after the adverse operating condition is abated to the end that operating personnel can determine which particular operating transducer caused interruption of the system operation. This object is achieved by providing neon lamps for indicating purposes which lamps sustain illumination at a voltage lower than that required to initially fire them to an illuminated conductive state. A second auxiliary power supply is provided having an output voltage sufficient to maintain conduction of the lamp but insufficient to initiate such conduction.

A feature and advantage of this invention is that an immediate and storable visual indication is given which identifies the particular adverse condition which may arise or may have arisen to disable a boiler or like system. Such indication is important, in addition to the reason referred to above of providing maintenance personnel with indication of a malfunctioning portion of the system, in order to conform with various regulations imposed by governmental and/or insurance interests that a visual indication of system malfunction be immediately visually indicated.

Another feature and advantage is that equipment made in accordance with the present invention can be readily installed on existing equipment which is provided with transducers having only single pole-double throw electrical contacts which contacts are thrown in response to sensing of a pre-selected magnitude of a system operating parameter.

These and other objects will be more apparent after referring to the attached specification and accompanying drawings in which:

The sole figure is a schematic drawing of the preferred embodiment of my invention.

A typical application of my invention is in an oil fired boiler wherein fuel oil is supplied by a pump driven by a motor M or like system component. Motor M is driven from any conventional power source P through relay contacts C. A coil **12** is arranged to effect closure of relay contacts C when energized. During normal operation of the boiler or like system, coil **12** is energized by power from power lines L1 and L2 through normally closed contacts of transducer **14**. Transducer **14**, as depicted in the drawing, is exemplary of any one of a number of conventional devices. For example, transducer **14** can be a device sensitive to pressure, temperature, flow rates of fluids, level of material and the like. The transducer includes an armature **16** which normally is connected to a fixed contact **16***a*. That is to say, when the transducer senses a normal or a desired condition, a circuit is established between armature **16** and fixed contact **16***a* to the system component. Transducer **14** also has a second fixed contact **16***b* to which armature **16** is connected in response to sensing by transducer **14** of malfunction in the system. For example, in an oil fired boiler, transducer **14** can be sensitive to steam pressure and can operate when steam pressure exceeds a pre-selected level. Thus, in the example here under discussion, should steam pressure exceed a pre-selected amount (a condition generically referred to hereinafter as a malfunction) the circuit established by armature **16** and fixed contact **16***a* would be interrupted. Such interruption will de-energize coil **12**, as a result of which operation of motor M and the fuel oil supply to the boiler is interrupted.

The moving parts of typical transducers are constructed of extremely light weight materials in a quest for high sensitivity. For this reason most high quality sensitive transducers have only single pole-double throw contacts as exemplified in the drawing. Thus, as soon as the malfunction is abated, armature **16** contacts fixed contact **16***a* and system operation is resumed. A visual indication of system malfunction is necessary to apprise operating personnel that a malfunction has occurred. Such indication is preferably a permanent one so as to not require constant attention by the operator. The present invention affords such indication.

Associated with transducer **14** is a neon bulb **18** which provides the desired visual indicia. Power for illuminating neon bulb **18** is provided by a power supply **20** which includes a transformer **22** having a primary winding **22***a* across lines L1 and L2 and a secondary winding **22***b* which is rectified by a conventional bridge rectifier **24**. A conductor **26** is provided for connecting the negative side of rectifier bridge **24** to one terminal neon bulb **18**. The positive output terminal of rectifier bridge **24** is connected through a resistor **28** and a diode **30** to transducer armature **16**. The opposite terminal of neon bulb **18** is connected to fixed contact **16***b* through resistors **32** and **34**. Thus, when a system malfunction is sensed by transducer **14**, thereby causing connection of armature **16** to fixed contact **16***b*, a voltage from bridge rectifier **24** is applied

across neon bulb **18** causing the bulb to fire to a conductive illuminated state. Illumination of bulb **18** apprises the operator that transducer **14** has sensed a malfunction.

An inherent characteristic of a neon bulb, or the like, is that a higher voltage is required initially to fire the bulb from a quiescent state than is necessary to maintain conduction once the bulb has been fired. My invention takes advantage of this characteristic to provide a storable indication of system malfunction with the result that a visual indication of malfunction will subsist even though the system has automatically corrected the malfunction and is restored to normal operation. A second voltage of a magnitude sufficient to maintain neon bulb **18** in a conductive state but insufficient to fire the bulb a quiescent state includes a zener diode **36** in series with a rheostat **38** and a fixed resistor **40** connected in series across the output terminals of rectifier bridge **24**. Adjustment of rheostat **38** establishes a voltage on conductor **42** having the desired magnitude. Such voltage is connected through a diode **46** to the common connection between resistors **32** and **34** as a consequence of which a second voltage is established across neon bulb **18**.

The operation of the invention can now be understood by assuming that the system is functioning normally with armature **16** connected to fixed contact **16***a*. Should a malfunction be sensed by transducer **14**, armature **16** will move to fixed contact **16***b* thereby connecting a voltage across neon bulb **18** of sufficient magnitude to fire the bulb to an illuminated conductive state. After transducer **14** senses abatement of the malfunction and armature **16** again is connected to fixed contact **16***a*, neon bulb **18** will be maintained in an illuminated conductive state by power from conductor **42** applied to the bulb through diode **46** and resistor **32**. Upon observation of the illuminated condition of the neon bulb **18**, operating personnel can take whatever steps are deemed necessary to inspect or repair the system.

In series with conductor **42** is a normally closed push button switch **48** for extinguishing neon bulb **18** when a visual indication of the malfunction is no longer desired. Thus, when an operator presses push button switch **48** to interrupt current flow through conductor **42**, neon bulb **18** will be extinguished if the malfunction has been abated and armature **16** no longer is connected to fixed contact **16***b*. On the other hand, should neon bulb **18** remain illuminated upon actuation of the push button switch **48**, the operator is apprised that transducer **14** is still sensing the malfunction and is maintaining armature **16** in contact with fixed contact **16***b*.

A normally closed push button **50** in shunt with a fixed resistor **52** is provided for testing neon bulb **18**. Depressing push button **50** opens its contacts and thereby increases the voltage on conductor **42** to a magnitude sufficient to fire neon bulb **18** from a quiescent state. Illumination of bulb **18** in response to depression of push button **50**, release of push button **50**, and extinguishment of the bulb by depressing push button **48** indicates that the bulb and the adjustment of rheostat **38** are proper.

The circuit is designed to eliminate interaction between power for energizing coil **12** from lines L1 and L2 from power for firing neon bulb **18** from rectifier bridge **24**. Resistor **28** is of sufficient magnitude to prevent operation of coil **12** from rectifier bridge **24** and diode **30** is polarized to afford a high resistance path from lines L1 or L2 back to the rectifier bridge. Thus, although the two circuits cooperate with one another, they are effectively isolated from one another.

A second system energizing coil **12′** is provided and is well suited, for example, for controlling an air blower in an oil fired boiler. Coil **12′** is energized from power lines L1 and L2 through transducers **14′**, **14″**, **14‴**, which transducers can be conventional devices for measuring temperature, pressures, and other operating parameters in other parts of the system. Associated with each of the transducers is a circuit identical to that described above. For convenience of description, the same reference numerals are used followed by an appropriate prime indication.

It will be seen that when a system malfunction is sensed by one or more of transducers **14′**, **14″**, and **14‴**, neon bulb **18′**, etc. associated with the particular transducer will be illuminated as described above. By way of example, if transducer **14″** senses a system malfunction, armature **16″** will connect a firing voltage to neon bulb **18″** through fixed contact **16***b*″. After the malfunction has been abated, either automatically or by an operator, neon bulb **18″** will continue to glow by virtue of the second voltage applied to the bulb through diode **46″**. When armature **16″** is in contact with fixed contact **16***b*″, firing voltage will be applied only to neon bulb **18″** since both fixed contacts **16***b′* and **16***b‴* are open. Additionally, when armature **16″** is in the position last described in response to a malfunction sensed by transducer **14″**, insufficient current is supplied to coil **12′** through resistor **28‴** to energize the relay.

In one apparatus made in accordance with my invention the components of the circuit have values as tabulated below:

Neon bulb	GE NE51H.
Resistor **28**	220K ohms.
Resistor **32**	18K ohms.
Resistor **34**	220K ohms.
Zener diode **36**	1N1370 (62 v.).
Rheostat **38**	1K ohms.
Resistor **40**	3K ohms.
Resistor **52**	5K ohms.
Diodes **30** and **46**	Silicon 400 PIV, point 2 amps.

Such values provide power at about 185 volts for firing bulb **18** and power at about 69 volts for maintaining a bulb in a conductive state once it has fired.

In the apparatus mentioned, transducers **14** are provided for sensing flame failure, fan motor starter malfunction, excessively high steam pressure, excessively low water supply, excessively high gas pressure, excessively low temperature, and excessively low steam pressure in a fuel oil atomizer. Armature **16** and fixed contact **16***a* associated with each of such transducers supply power to conventional protective circuits to interrupt system operation until the parameter, which is the subject of the malfunction, had been restored to its desired operating value.

Thus, it will be seen that I have provided a circuit for indicating system malfunctions and for storing such indication even after the malfunction has abated. The circuit of the invention can be installed in existing systems wherein single pole-double throw transducers are provided for interrupting system operation after detection of a malfunction. The system is arranged so that sneak current paths between the system and the indicating circuit are avoided.

Although one embodiment of my invention has been shown and described, it will be obvious that other adaptations and modifications can be made without departing from the true spirit and scope of the invention.

What is claimed is:

1. Apparatus for indicating a malfunction in an operating system of the type having an armature connected to a first fixed contact for supplying energy to sustain system operation and a second fixed contact to which the armature is moved when the system malfunctions, thereby interrupting energy supply to the system, and which armature returns to the first fixed contact upon abatement of the malfunction, the indicating apparatus comprising a neon bulb which fires to a conductive state at a first relatively high voltage and maintains a conductive state at a second relatively low voltage, means for producing said first voltage, means for producing said

second voltage, means connecting said second voltage across said neon bulb, and means including said armature and said second fixed contact for connecting said second voltage producing means across said neon bulb.

2. In a system having a transducer of the type that has an armature normally connected to a first fixed contact to complete a circuit to a device for energizing the system and which armature is movable to a second fixed contact in response to a system malfunction, thereby interrupting system operation in response to a malfunction, apparatus for providing a storable visual indication of system malfunction comprising a neon bulb fireable to a conductive state in response to a first relatively high voltage and maintainable in a conductive state in response to second relatively low voltage, direct current power supplies for producing said first and second voltages, said power supplies having common negative terminals and separate positive terminals, one terminal of said neon bulb being connected to said negative terminal, means including a series resistor for connecting the positive terminal of said first power supply to said armature, means connecting the other neon bulb terminal to said second fixed contact, and means including a diode for connecting the positive terminal of said second power supply to said second fixed contact.

3. The invention of claim 2 in combination with means for selectively interrupting the connection of said second power supply to said second fixed contact to extinguish said neon bulbs after abatement of a malfunction and means for selectively increasing the output voltage of said second power supply to a value sufficient to fire the neon bulbs from a quiescent state thereby to afford testing of the neon bulbs by actuation of said voltage increasing means.

4. In a system of the type wherein a malfunction is manifested by closure of a normally open electrical contact and wherein abatement of the malfunction causes opening of the contact, said system including a normally closed contact operatively associated with the normally open contact and adapted to open a system driving circuit when the malfunction is sensed, apparatus for establishing a storable visual indication of the malfunction comprising a neon bulb which fires to a conductive state at a first relatively high voltage and maintains a conductive state at a second relatively low voltage, means for producing said first voltage, means for producing said second voltage, means connecting said second voltage across said neon bulb, said connecting means including a normally closed push button switch operable to extinguish the neon bulb, and means including said normally open electrical contact for connecting said first voltage across said neon bulb.

5. In a system having a plurality of sensors for sensing the magnitude of operating parameters in the system, a relay operated device for interrupting system operation when a system malfunction is sensed by any one of the

sensors, first and second electrical contacts associated with each sensor, an armature associated with each sensor and movable from said first contact to said second contact in response to a malfunction in the system and from said second contact to said first contact in response to abatement of the malfunction, a power source for operating the relay, and a series connection from the power source to the relay through each of the armatures and first fixed contacts; apparatus for providing a storable visual indication of the particular sensor that senses system malfunction comprising: a neon bulb associated with each said sensor, each said bulb being fireable to a visible conductive state by a first relatively high voltage and being maintainable in a conductive state by a second relatively low voltage, means for producing said first and second voltages, each said voltage producing means having a pair of output terminals, means including a resistor and a diode in series for connecting one terminal of said first voltage source to each of said armatures, each said diode being polarized to afford a high resistance path from said armature to said power source, means connecting the other terminal of said first voltage source to one terminal of each said neon bulb, means connecting the other terminal of each said neon bulb, to said second associated fixed contact, means including a second diode for connecting one terminal of said second voltage source to said second fixed contact, said second diode being polarized to afford a high resistance path from second fixed contact to said voltage source, and means connecting the other terminal of said second voltage source to the other terminal of said neon bulb.

6. The invention of claim 5 wherein said second voltage producing means comprises at least three series resistors connected across the output terminals of said first voltage producing means to form a voltage divider, and a normally closed switch shorting out the center one of said resistors, said resistors having relative values so that on opening of said switch the output voltage of said second source is sufficient to fire said neon bulbs from a quiescent state, whereby said bulbs can be simultaneously tested.

References Cited by the Examiner

UNITED STATES PATENTS

2,859,431	11/1958	Morris.	
3,160,866	12/1964	Meili	340—213 X

FOREIGN PATENTS

240,360	2/1961	Australia.

OTHER REFERENCES

Keister, W. et al.: Design of Switching Circuits, Princeton, N.J., D. Van Nostrand Co. Inc., 1951, pp. 358–363.

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