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[54] **DEVICE FOR WARNING OF MALFUNCTIONS OF ENGINE PRESSURE SYSTEMS AND OF ITSELF**

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[51] **Int. Cl.** **B60q 1/00,** B60q 5/00, F16n 29/04

[58] **Field of Search** ..... 340/60, 62, 52 F, 240

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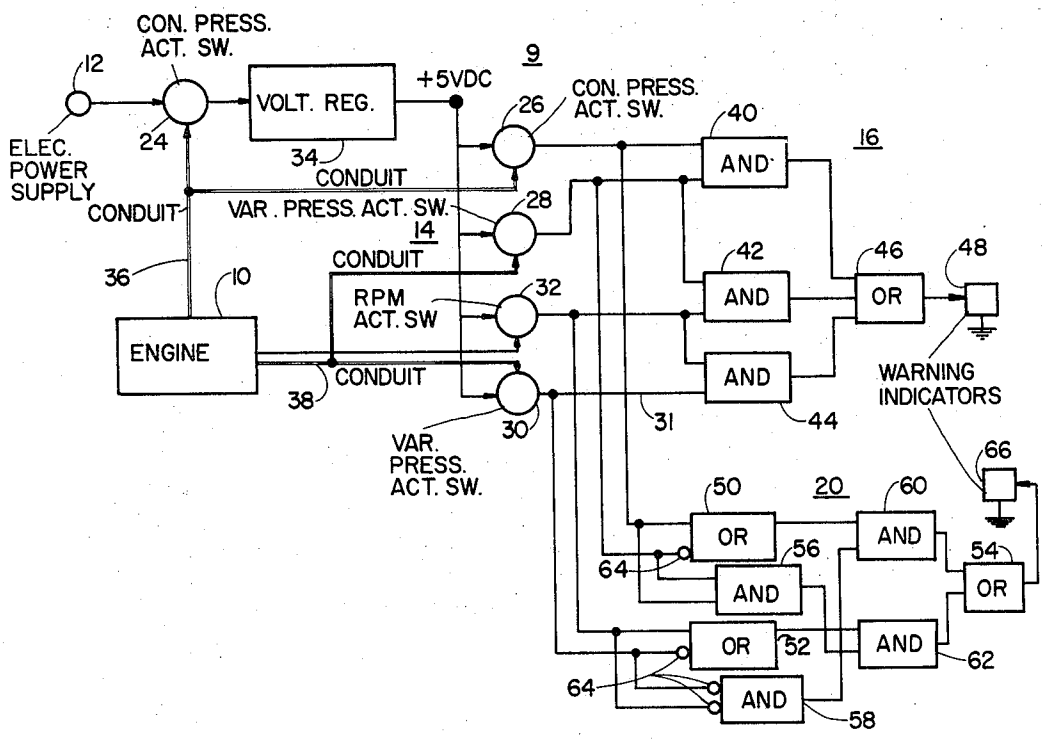
Primary Examiner—Glen R. Swann, III

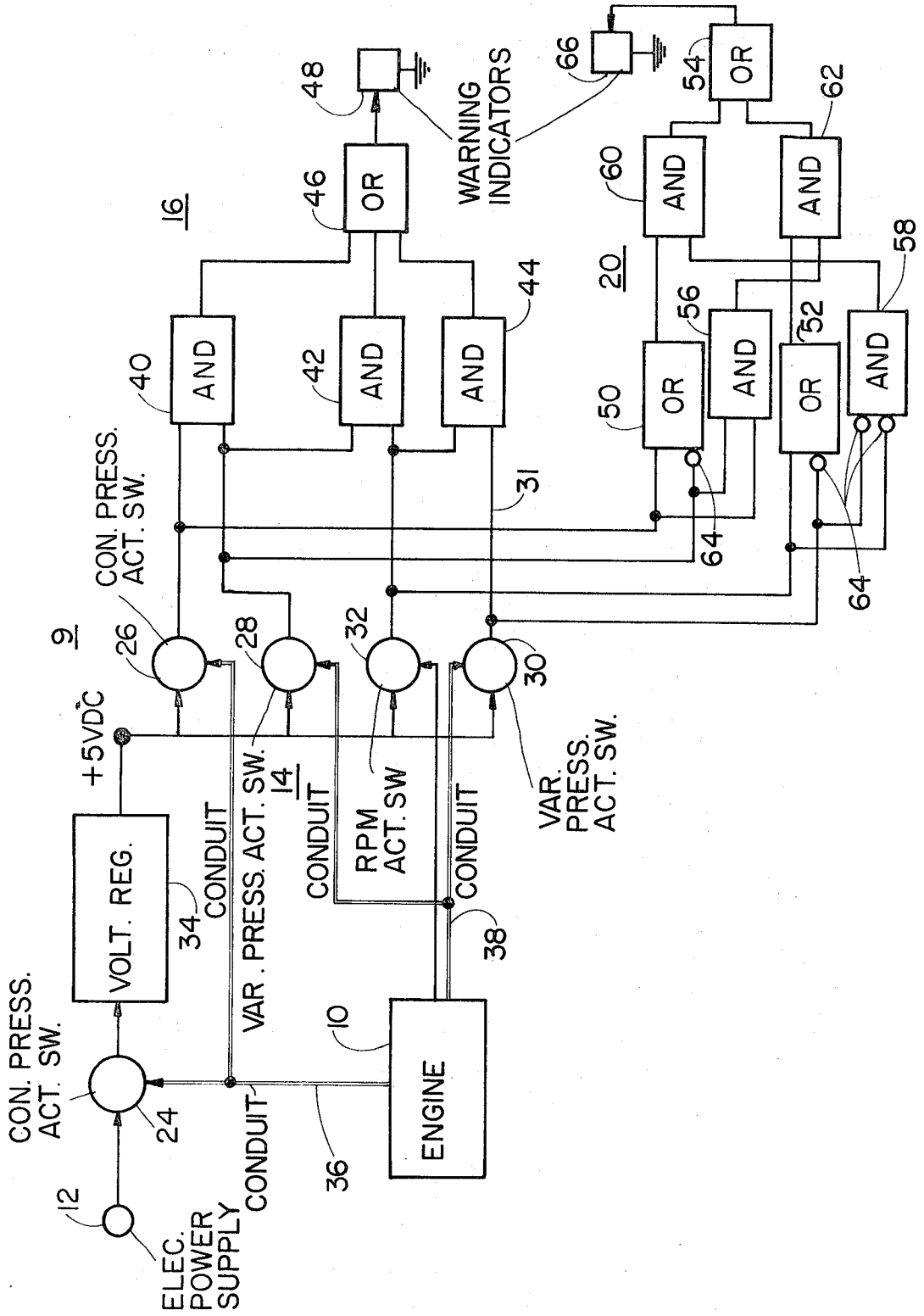
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[57] **ABSTRACT**

A plurality of pressure-activated electric switches are connected to pressures which are variable with an engine's speed of rotation or to comparatively constant fuel pressure, respectively; and an engine speed-of-rotation activated electric switch is connected to said engine which has an associated electrical power supply for use with said switches. Said power supply is connected through one of the constant-fuel-pressure-activated switches and a voltage regulator to electrical input terminals of the remainder of said switches in parallel circuits. These switches are activated in various combinations in accordance with the fuel-pressure/rpm/oil-pressure conditions which exist. A first logic circuit activates an alarm when the switch combination indicates a malfunction in the engine oil pressure. A second logic circuit is connected in parallel with said first logic circuit and is adapted to conduct only when impossible fuel-pressure/rpm/oil-pressure conditions are indicated which indicates malfunctions of said switches. An alarm is energized when said second logic circuit conducts.

2 Claims, 1 Drawing Figure




ELEC. POWER SUPPLY
12
CON. PRESS. ACT. SW.
24
VOLT. REG.
+5VDC
9
CON. PRESS. ACT. SW.
26
VAR. PRESS. ACT. SW.
28
RPM ACT. SW
32
VAR. PRESS. ACT. SW.
30
CONDUIT
34
CONDUIT
14
CONDUIT
36
CONDUIT
38
ENGINE
10
16
AND
40
AND
42
AND
44
OR
46
48
WARNING INDICATORS
66
20
OR
50
AND
56
OR
52
AND
58
AND
60
OR
54
AND
62
64
64
31

DEVICE FOR WARNING OF MALFUNCTIONS OF ENGINE PRESSURE SYSTEMS AND OF ITSELF

FIELD OF THE INVENTION

The invention relates to warning devices for engines, and more particularly to devices warning of malfunctions in engines' lubricating pressure systems, and of its own possible malfunctions.

It is well known that oil pressures in operating engines vary with engine speed or r.p.m. while fuel pressure remains comparatively constant. In a diesel engine, oil pressure varies with the speed from about 9 lbs. at idling to over 45 lbs at high speeds. The invention was primarily made for use with diesel engines and is so described hereinafter, but it could be easily applied to any variable pressure system.

DESCRIPTION OF THE PRIOR ART

It is old in the art to provide warning devices to warn of a drop in oil pressure below that required at idling speeds. However an engine can be damaged seriously by a drop in oil pressure insufficient at high speeds to set off a low speed alarm.

It is an object of the invention to provide a warning device that will warn of insufficient oil pressure at low and high speeds and wherever desired therebetween of an associated engine.

It is also an object of the invention to provide a warning device that will warn of its own possible malfunctions.

Other objects and a fuller understanding of the invention may be had by referring to the following specifications, claims and drawings, in which:

BRIEF DESCRIPTION OF THE DRAWING

The FIGURE is a block diagram of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the FIGURE, the invention **9** comprises in combination with an engine **10** and an electrical power supply **12**, pressure and speed sensing switches **14** connected to said power supply and engine and responsive thereto for said switches to be opened and closed in combinations in accordance with parameters of pressures and speeds sensed. Switches **14** are electrically connected to a first logic circuit **16**, which is responsive to malfunctions of said engines pressure systems as electrically disclosed by said combinations to energize a first warning indicator **48**. A second logic circuit **20** is connected to said switches **14** in parallel with said first logic circuit **16**. This second logic circuit is responsive to malfunctions of switches **14** and probable malfunctioning of both switches and engine pressure systems to energize a second warning indicator **66**.

In more particularity, the switches **14** comprise constant pressure activated switches **24** and **26**, variable pressure activated switches **28** and **30**, and switch **32**, all arranged as shown in the FIGURE. Switch **24** electrically connects power supply **12** to a voltage regulator **34** which produces a controlled voltage compatible with logic circuits **16** and **20**. Switches **26, 28, 30** and **32** are connected in parallel circuitry to voltage regulator **34**. A conduit **36** connects switches **24** and **26** to a comparatively constant pressure fuel system of the engine **10** and closes them to "on" position when engine **10** is running. A second conduit **38** connects switches **28** and **30** to a variable pressure oil system of engine **10**; switch **28** being closed to on position under 15 lbs pressure and open to "off" position over 15 lbs, and switch **30** being closed to on position by pressures under 45 lbs. Any convenient means for sensing revolutions per minute of engine **10** is connected to switch **32** which is closed to on position by over 1400 rpm and to open to off position by less than 1400 rpm.

First logic circuit **16** comprises three "and" gates **40, 42,** and **44,** and an "or" gate **46.** Gate **40** is electrically connected to the outputs of switches **26** and **28,** gate **42** is electrically connected to output of switches **28** and **32,** gate **44** is electrically connected to switches **30** and **32,** and gate **46** is connected to the outputs of gates **40, 42,** and **44,** all as shown in the FIGURE. A first warning indicator **48** is connected to the output of gate **46.**

Second logic circuit **20** comprises three "or" gates **50, 52** and **54** and four "and" gates **56, 58, 60** and **62.** Gates **50** and **56** are respectively connected in parallel circuitry to the outputs of switches **26** and **28** with an inverter **64** inverting the output of switch **28** to gate **50.** Gates **52** and **58** are respectively connected in parallel circuitry to the outputs of switches **30** and **32** with inverters **64** inverting the output of switch **30** to both gates **52** and **58,** and an inverter **64** inverting the output of switch **32** to gate **58** only. Gate **60** is connected to the outputs of gates **50** and **58,** and gate **62** is connected to the outputs of gates **56** and **52.** Gate **54** receives the output of gates **60** and **62.** A second warning indicator **66** is connected to the output of gate **54.**

The device operates as follows. With engine **10** not running there is no constant pressure to activate switch **24** to close, thus there is no voltage applied to the logic circuits of invention **9.** When the engine is started, constant pressure activated switches **24** and **26** are activated by engine fuel line pressure through conduit **36** to close to "on" positions. Power supply **12** supplies ac/dc voltage to voltage regulator **34** which generates a voltage that is applied to switches **26, 28, 30** and **32,** and is also applied (not shown) to bias gates of logic circuits **16** and **20.** The state of each switch either "off" or "on" determines whether no voltage or a voltage is supplied the logic circuits by them individually. Switch **26** is adapted to always be closed with the engine running. Therefore only the three remaining switches **28, 30** and **32** are positionable to either "off" or "on" positions in various combinations of positions. In all there are nine possible switch outputs to the gates of the logic circuits. These and resulting voltage to warning indicators **48** and **66** can be tabulated as follows in a truth table.

Combs.	switches					1st. W.	2nd. W.
	24	26	28	32	30	Ind.	Ind.
1	1	0	0	0	0	0	1
2	1	1	0	0	0	0	1
3	1	1	0	0	1	0	0
4	1	1	0	1	0	0	0
5	1	1	0	1	1	1	0
6	1	1	1	0	0	1	1
7	1	1	1	0	1	1	0
8	1	1	1	1	0	1	1
9	1	1	1	1	1	1	1

In the above table, the "off" or open position of switches is indicated by "0", and the "on" or closed po-

sition by "1" to represent a no voltage or a voltage output, respectively, of each of said switches.

In combination **1**, switch **26** is malfunctioning and the second warning indicator is energized. Both switches **24** and **26** are activated by engine running.

In combination **2**, with switch **28** opened by over 15 lbs. pressure and switch **32** opened by less than 1400 rpms, switch **30** is malfunctioning by not being closed by less than 45 lbs. pressure for the indicated rpms. Second warning indictor is energized.

In combination **3**, normal operation is indicated in the under 1400 rpm speed range and no warning indicators are energized.

In combination **4**, normal operation is indicated in the over 1400 rpm range and no warning indicators are energized.

In combination **5**, switch **32** indicates rpm over 1400 and switch **30** indicates oil pressure below 45 lbs to energize first warning indicator.

In combination **6**, there are two possibilities, either switch **30** is malfunctioning in showing over 45 lbs pressure at low speed of under 1400 rpms to energize the second warning indicator, or the engine is malfunctionig and running with too high oil pressure to energize the first warning indicator. Since engine malfunctions can be readily checked with pressure gauges, determination of which warning is correct is easily ascertainable.

In combination **7**, switches **28** and **30** properly indicate low oil pressure below 1400 rpm speed range, and first warning indicator is energized.

In combination **8**, either switch **30** or **32** is malfunctioning with switch **32** showing more than 1400 rpms and the oil pressure should be lower than 15 lbs if switches **30** and **32** are normal. Both warning indicators are energized.

And in last combination **9**, either obvious switch malfunction or caused by rapid oil pressure drop while running above 1400 rpm to energize both warning indicators.

The number of ranges (rpm/pressure) can be increased as desired by adding switches and gates to the logic circuits.

What is claimed is:

1. In combination with an engine having a variable-pressure oil system and an electrical power supply, a warning device comprising:

a. Engine-running sensing means connected to the engine and electrical power supply and responsive thereto for sensing if said engine is running and to provide an electrical output in accordance therewith;

b. Variable-pressure sensing means connected to said engine and electrical power supply and responsive thereto for sensing variations of pressure in said variable-pressure oil system and to provide and electrical output in accordance therewith;

c. Speed sensing means connected to said engine and electrical power supply and responsive thereto for sensing rpm of said engine and to provide an electrical output in accordance therewith;

d. First logic circuit means connected to the respective electrical outputs of said engine - running sensing means, pressure and speed sensing means for comparison and responsive thereto produce an electrical output indicative of engine malfunctioning;

e. Second logic circuit means connected to the respective electrical outputs of said engine - running sensing means, pressure and speed sensing means, and in parallel circuit with said first logic circuit means, for comparison and responsive thereto provide an electrical output indicative of said sensing means malfunctioning;

f. And warning indicator means connected to respective electrical outputs of said first and second logic circuit means for energization thereby to warn of malfunctioning.

2. A warning device as described in claim **1** wherein said engine-running sensing means comprises:

constant pressure activated switches connected to the fuel line of said engine and adopted to be switched to on position by the pressure in said fuel lines, and to "off" position by no pressure.

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