

12 **EUROPEAN PATENT APPLICATION**

21 Application number: 82305803.7

51 Int. Cl.³: **E 21 F 17/18**
G 08 B 7/04

22 Date of filing: 02.11.82

43 Date of publication of application:
16.05.84 Bulletin 84/20

84 Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

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54 **Alarms.**

57 An alarm device comprises a visual and/or audible alarm 11 which is adapted to be actuated by hydraulic pressure fluid, and preferably includes a unit for converting the energy of the pressure fluid to electrical energy. The alarm device preferably comprises a control arrangement which inhibits flow of hydraulic pressure fluid to machinery, for a predetermined delay period after the alarm has been actuated.

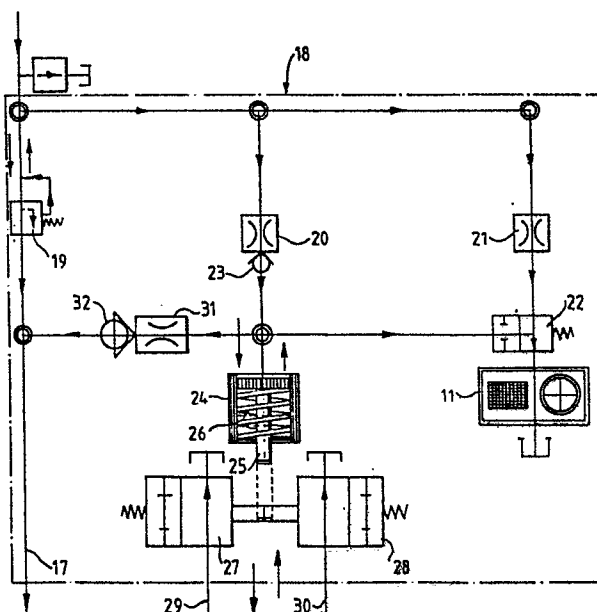


FIG.2.

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ALARMS

5 This invention relates to alarms, and is particularly although not exclusively concerned with alarms for use in underground mines.

10 At present, much underground mining is carried out by automatic machinery. Due to the very nature of mining, such machinery is usually very large and powerful, and operates under generally adverse conditions where both light and accessibility are poor. Often, a single operator can be responsible for the start-up and operation of a large machine, of which the operational parts are extremely dangerous at the work area. It is often impossible for the operator to see the work area, not only because of the size of the machine, but also because electric lighting systems are traditionally prohibited in such areas. Some machines are provided with interlock systems of varying degrees of sophistication, which prevent the start-up of the machine until a set check procedure has been carried out. However, it is known that such check procedures are sometimes bypassed, and in any event, if any warning is given of start-up of a machine, it is often insufficiently loud or insufficiently early to allow evasive action to be taken by any person who is inadvertently in the work area of the machine. Thus, it is unfortunately the case that accidents repeatedly occur with underground mining machinery, due to workers being present in the work area of the machinery when it is started up.

30 Preferred embodiments of the present invention aim to provide alarm devices which may be improved in this respect.

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More generally, according to a first aspect of the present invention, there is provided an alarm device comprising an alarm and control means adapted to inhibit flow of hydraulic pressure fluid to machinery for a predetermined delay period after the alarm has been actuated, both the alarm and the control means being arranged to be actuated by hydraulic pressure fluid.

The alarm may be a visual and/or audible alarm. The alarm may be electrically driven, the device including means for converting hydraulic pressure fluid energy to electrical energy, in the manner of the portable power units disclosed in our International Application No: PCT(GB 82/00085), to which the reader's attention is directed. Alternatively, where the alarm is an audible alarm, it may be driven directly by hydraulic pressure fluid, as a siren, for example.

The alarm may be a continuous alarm or an intermittent alarm (e.g. providing pulses of light and or sound).

The device may be a self-contained unit, or may be incorporated into a machine to be controlled. In either case, the device is preferably housed in a flameproof and water proof housing.

Preferably, the control means further comprises an hydraulic cylinder having a spring-biassed piston therein, and said delay period is defined by the time taken for said piston to travel a predetermined distance under the influence of hydraulic pressure fluid and against said spring bias.

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Preferably, the control means is arranged to build-up hydraulic pressure progressively in the device during said delay period, until the pressure reaches a limit value at which the control means responds to permit flow of hydraulic pressure fluid, to machinery to be controlled.

The control means preferably comprises at least one control valve operative to inhibit flow of hydraulic pressure fluid to machinery to be controlled during said delay period.

In an especially advantageous arrangement, one control valve is operative to control a main flow of hydraulic pressure fluid to machinery to be controlled, and prevents such flow unless hydraulic pressure in the device exceeds a limit value, and at least one other control valve is operative to control flow of hydraulic pressure fluid to parts of such machinery, and is controlled directly by said piston.

In another aspect of the invention, there is provided machinery powered and/or controlled by hydraulic pressure fluid, in combination with an alarm device in accordance with the first aspect of the invention.

In an especially advantageous embodiment, said machinery comprises mining machinery.

In a further aspect of the invention, there is provided an alarm unit comprising a housing and, mounted within the housing, an electrically operable alarm, an hydraulic motor, and an electric generator which is arranged to be driven by the hydraulic motor and is arranged to supply the alarm with electrical energy.

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The alarm may be audible and/or visual. The housing is preferably flameproof and waterproof. Preferably, the unit is portable. Alternatively, it may be built into machinery (especially underground mining machinery), and/or may be arranged to emit an alarm signal prior to start-up of machinery.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 is a schematic diagram of an hydraulically driven underground lighting system, in which an alarm unit is incorporated;

Figure 2 is a schematic circuit diagram of an alarm device; and

Figure 3 is a perspective view of one example of a physical embodiment of the alarm unit of Figure 1.

The lighting system shown in Figure 1 comprises a hydraulic fluid supply system 1, in which hydraulic fluid from a tank 2 is supplied under pressure by means of a pump 3 driven by a motor 4. By way of example, the pump 3 may be arranged to deliver hydraulic fluid at a rate of 3 gallons per minute, and the motor 4 may be a 3 horsepower motor. An on/off valve 5 is provided for controlling the flow of hydraulic fluid from the supply system 1, and flow and return ports 6 and 7 are provided for making connections to the hydraulic fluid supply system 1. Hydraulic fluid is supplied under pressure along a flow line 8 to a plurality of lamp units 10, and returned along a return line 9. The lamp units 10 are all arranged in parallel across the flow and return lines 8 and 9. Each lamp unit 10 comprises

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an hydraulic motor, an electric generator driven thereby, and an electric lamp supplied with electricity from the generator. Thus, the lighting system is essentially similar in operation to the systems disclosed in our co-pending Application referred to above.

An alarm unit 11 is also connected in parallel with the lamp units 10, between the flow and return lines 8 and 9. One example of physical construction of the alarm unit 11 is shown in Figure 3, where the unit 11 is contained within a flameproof and waterproof housing 14. Fluid flow and return lines 12 and 13 are connected to the system flow and return lines 8 and 9 respectively, and lead into the housing 14. Mounted within the housing 14 are an hydraulic motor (not shown) and an electric generator (not shown), which are arranged to convert the energy of the hydraulic pressure fluid flowing along the lines 12 and 13 into electrical energy, in just the same manner as the lamp units 10. The electrical energy thus obtained is then applied both to an electrically operable audible alarm 15, and an electrically operable visual alarm 16.

The audible alarm 15 may preferably be an electric horn arranged to give either a continuous or intermittent sound, or an alternating two-tone sound. The visual alarm 16 may comprise a lamp arranged to give either a continuous light or a flashing light, or the lamp may be arranged to rotate. Thus, when actuated, the alarm unit 11 gives both audible and visible warnings, for any desired period of time. In a simpler alternative, either only an audible alarm or only a visible alarm may be provided. Instead of providing an electrically operable alarm 15, the audible alarm may be actuated directly by hydraulic fluid pressure, in the manner of a siren, for example. However, in an underground mining environment, this would not usually be preferred, as sirens are prone to clogging by dust and other foreign objects.

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Figure 2 shows an example of a circuit diagram of an alarm device 18 when adapted for use with underground mining machinery to be controlled. In this case, the alarm device 18 is connected in series with a main flow line 17 of the machinery.

Pressure fluid in the line 17 is arranged to flow in parallel to a spring operated sequence valve 19, a first restrictor valve 20, and a second restrictor valve 21. The sequence valve 19 is so biased as to open only when the pressure of the fluid supplied thereto exceeds a predetermined limit value - for example 1,000 PSI. Thus, at the moment the alarm device 18 is actuated, the valve 19 remains closed, thereby preventing flow of pressure fluid to the machinery.

The second restrictor valve 21 allows pressure fluid to flow therethrough more quickly than does the first restrictor valve 20. Consequently, pressure fluid flowing through the restrictor valve 21 passes through a subsequent spring operated pilot valve 22 into an alarm unit 11, which may be, for example, as shown in Figure 3. The alarm unit 11 then provides a visual and audible alarm.

Meanwhile, after a time lag fluid flowing through the first restrictor valve 20 passes through a non-return valve 23 to an hydraulic cylinder containing a spring biased piston 25. The piston 25 is biased by a spring 26 normally into an upper (as seen) position. The pressure of the fluid arriving from the restrictor valve 20 and non-return valve 23 then acts on the piston 25 to push the same progressively downwardly (as seen). The piston 25 then continues to move downwardly until, after a predetermined time delay, it reaches its lowermost position. At this point, the fluid pressure obtaining in the cylinder 24 builds-up to system pressure, which is reflected at the flow port of sequence valve 19.

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Consequently, the valve 19 opens, and supplies hydraulic fluid under pressure to the machinery, which is then enabled to operate. Also, the pressure of the fluid at the cylinder 24 then operates on the pilot valve 22 to shut-off the same, thereby shutting off the alarm unit 11.

It will be seen that the stem of the piston 25 also operates, via a cam mechanism (not shown), on two control valves 27 and 28. These valves act respectively on flow lines 29 and 30 to respective parts of the machinery (such as motors, cutters, etc.), and when the piston 25 is in its upper most position, the valves 27 and 28 are open to divert the flow of pressure fluid from the machinery parts to tank, thus inhibiting operation of those parts. When the piston 25 reaches its lower most position, the valves 27 and 28 are closed, thereby enabling hydraulic fluid under pressure to pass to the machinery parts, which may then be operated.

When it is desired to shut down the system, fluid pressure on the line 17 is reduced, closing the sequence valve 19. Then, oil trapped at the cylinder 24 is allowed progressively to decay into the system via a restrictor valve 31 and non-return valve 32.

It may be appreciated that the illustrated alarm device 18 may be of immense value when used to control underground mining machinery. As soon as a start-up procedure of the machinery is initiated, the alarm device 18 is activated, and the alarm unit 11 provides both an audible and visual warning that the machinery is about to start. The machinery is then prevented absolutely from operating for a predetermined delay period, whilst pressure at the cylinder 24, and therefore at the flow port of the sequence valve 19, progressively builds-up. This delay can be as much as 45 seconds, which in most cases, can be ample for any person

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in a dangerous position (e.g. a maintenance worker in the vicinity of the work area of the machinery) to take evasive action. For example, "abort" controls may be provided at regular intervals over the machinery, or at least in the vicinity of the dangerous areas thereof, to abort altogether operation of the machinery until a worker has been able to move to safety. It may be appreciated that the alarm device 18 is especially safe and reliable in operation, as it has no external electrical connections whatsoever, its few electrical connections being housed together with the few electrical components within the sealed housing of the alarm unit 11. Although the alarm device 18 is driven entirely by hydraulic power, it may nevertheless be readily incorporated into any electrical control or delay system, if required. Preferably, the maximum voltage occurring within the alarm unit 11 may be 12 or 24 volts DC.

The alarm device 18 may be used with any suitable hydraulic pressure fluid, such as wholly water, or wholly oil, or a water/oil emulsion (e.g. 60/40 or 95/5). The alarm device 18 may either be custom designed to be an integral part of machinery to be controlled, or it may be used as a unit separate thereto. The illustrated alarm device 18 is particularly advantageous for use in hazardous atmospheres, for example in gaseous environments which occur in mining, quarrying and chemical industries. However, it may be used in any other suitable situations.

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CLAIMS:

1. An alarm device comprising an alarm and control means adapted to inhibit flow of hydraulic pressure fluid to machinery for a predetermined delay period after the alarm has been actuated, both the alarm and the control means being arranged to be actuated by hydraulic pressure fluid.
2. An alarm device according to Claim 1, wherein the alarm is electrically driven, the device including means for converting hydraulic pressure fluid energy to electrical energy.
3. An alarm device according to Claim 1, wherein the alarm is driven directly by hydraulic pressure fluid.
4. An alarm device according to Claim 1, 2 or 3, wherein the control means comprises a hydraulic cylinder having a spring-biased piston therein, and said delay period is defined by the time taken for said piston to travel a predetermined distance under the influence of hydraulic pressure fluid and against said spring bias.
5. An alarm device according to Claim 4, wherein the control means is arranged to build-up hydraulic pressure progressively in the device during said delay period, until the pressure reaches a limit value at which the control means responds to permit flow of hydraulic pressure fluid to machinery to be controlled.
6. An alarm device according to Claim 4 or 5, wherein the control means comprises at least one control valve operative to inhibit flow of hydraulic pressure fluid to machinery to be controlled during said delay period.

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7. An alarm device according to Claim 6, wherein one control valve is operative to control a main flow of hydraulic pressure fluid to machinery to be controlled, and prevents such flow unless hydraulic pressure in the device exceeds a limit value, and at least one other control valve is operative to control flow of hydraulic pressure fluid to parts of such machinery, and is controlled directly by said piston.
8. An alarm unit comprising a housing and, mounted within the housing, an electrically operable alarm, an hydraulic motor, and an electric generator which is arranged to be driven by the hydraulic motor and is arranged to supply the alarm with electrical energy.
9. An alarm unit according to Claim 8, arranged to emit an alarm signal prior to start-up of machinery.
10. An alarm unit or device according to any preceding claim, wherein the alarm is audible.
11. An alarm unit or device according to any preceding claim, wherein the alarm is visual.
12. An alarm unit or device according to any preceding claim, housed in a flameproof and waterproof housing.
13. An alarm unit or device according to any preceding claim, being constructed as a self-contained unit.
14. An alarm unit or device according to Claim 13, being portable.

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15. An alarm unit or device according to any one of Claims 1 to 12 when built into machinery.

16. Machinery provided with an alarm unit
5 or device according to any preceding claim.

17. Machinery according to Claim 16, being mining machinery.

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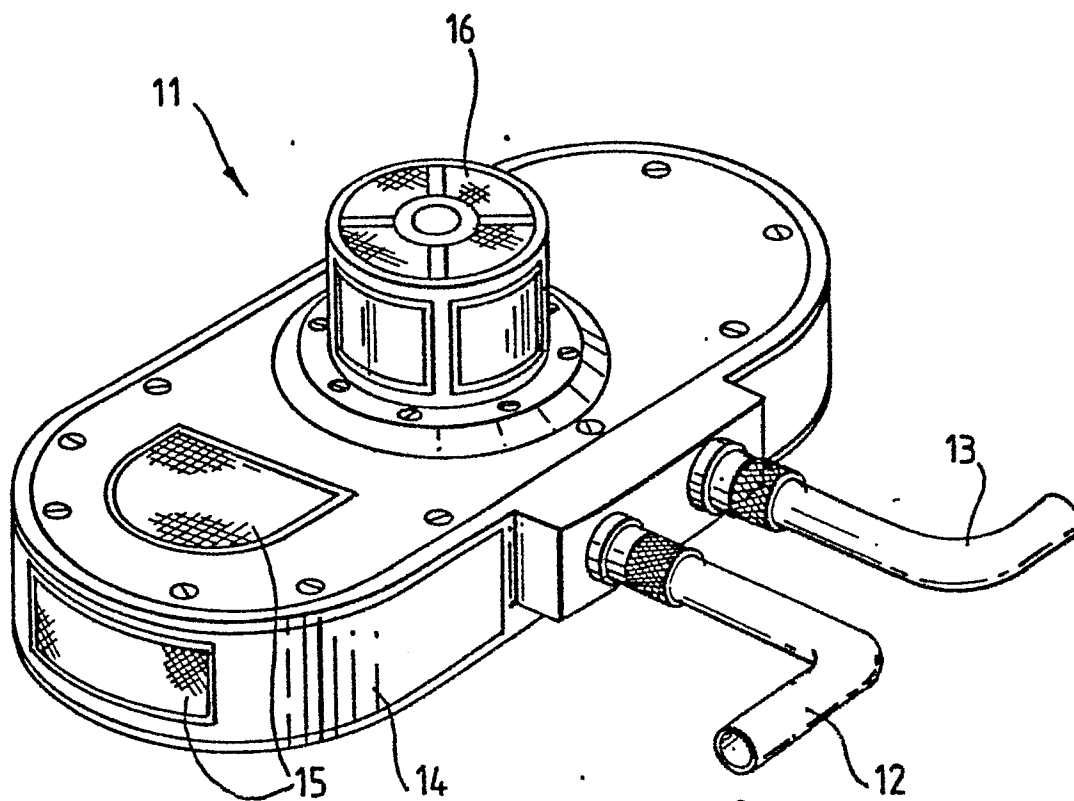


FIG.3.



European Patent
Office

EUROPEAN SEARCH REPORT

0108174

Application number

EP 82 30 5803

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. *)
X	GB-A-2 079 511 (DALE) * Whole document *	1, 3, 10, 15	E 21 F 17/18 G 08 B 7/04
A	US-A-4 110 742 (HAWKINS) * Column 1, lines 20-32 *	1, 10, 11	
A	DE-B-1 430 973 (FUNKE) * Claims *	8	
A	DE-B-2 008 669 (CEAG) * Column 1, lines 1-36 *	1, 10, 11, 13, 14	
			TECHNICAL FIELDS SEARCHED (Int. Cl. *)
			G 08 B E 21 F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 06-07-1983	Examiner SGURA S.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			