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Weber et al.

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[45] **Apr. 22, 1975**

[54] **INDICATING APPARATUS FOR MONITORING THE OPERATIVE STATUS OF A HEADING OR COAL FACE CUTTING MACHINE**

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[51] **Int. Cl.** **G08b 5/36**

[58] **Field of Search** ..... 340/378 A, 378 B, 225, 340/267 R

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Attorney, Agent, or Firm—Brown, Murray, Flick & Peckham

[57] **ABSTRACT**

Mining machines, e.g., a coal tunneling machine or a coal face cutting machine, are provided with a sealed indicating apparatus to monitor the operative status of the machine. The indicating apparatus includes a plurality of indicating lamps connected electrically to circuitboards and projecting into openings in a perforated plate. These parts and a symbol plate are sealed within a housing that includes a transparent plate to view each illuminated symbol on the symbol plate representing monitoring locations in the machine. A transparent film with machine function symbols is placed on the outer surface of the transparent plate such that these symbols are aligned with the symbols on the symbol plate within the housing.

11 Claims, 4 Drawing Figures

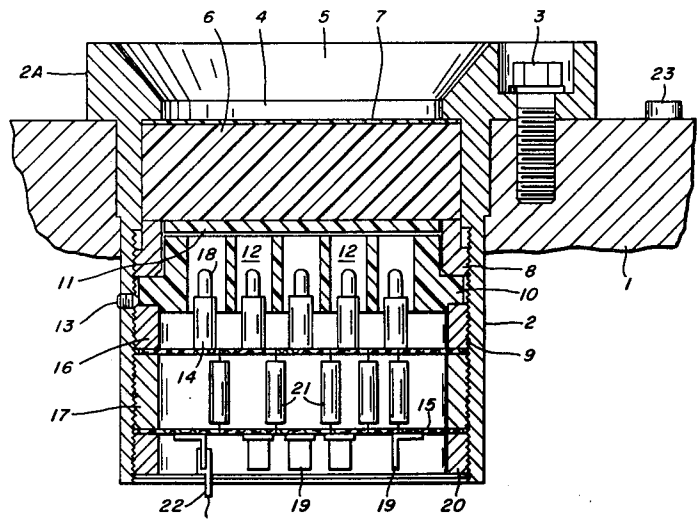


FIG. 1.

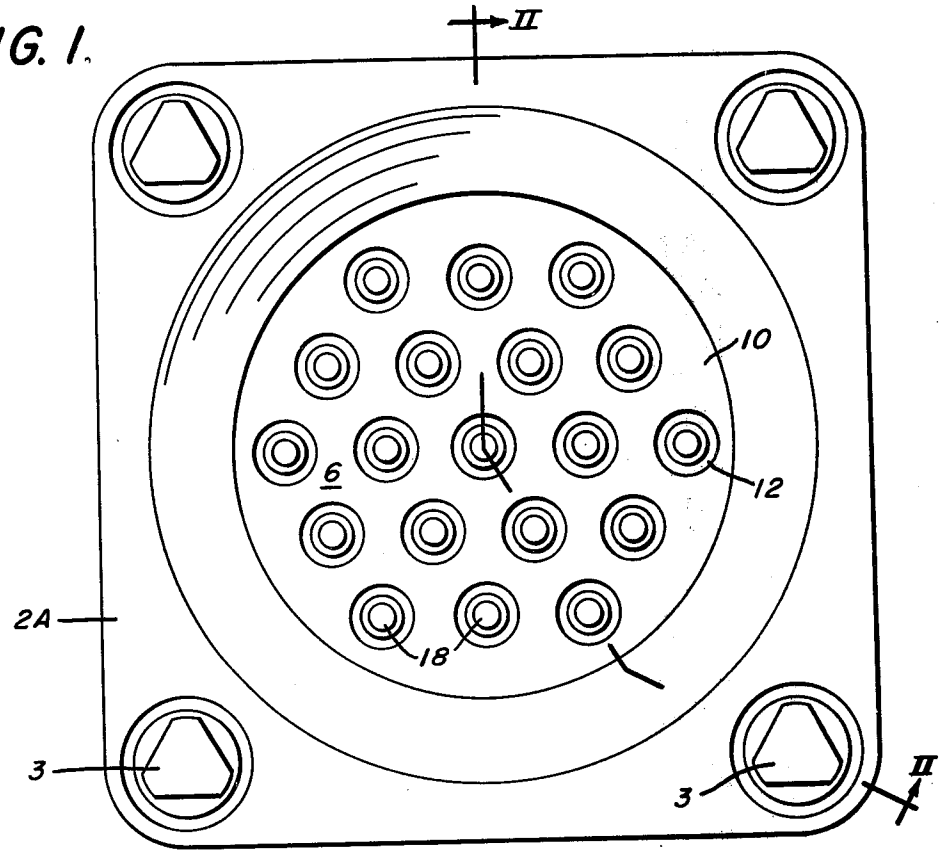

II
10
6
12
2A
18
3
3
II

FIG. 2.

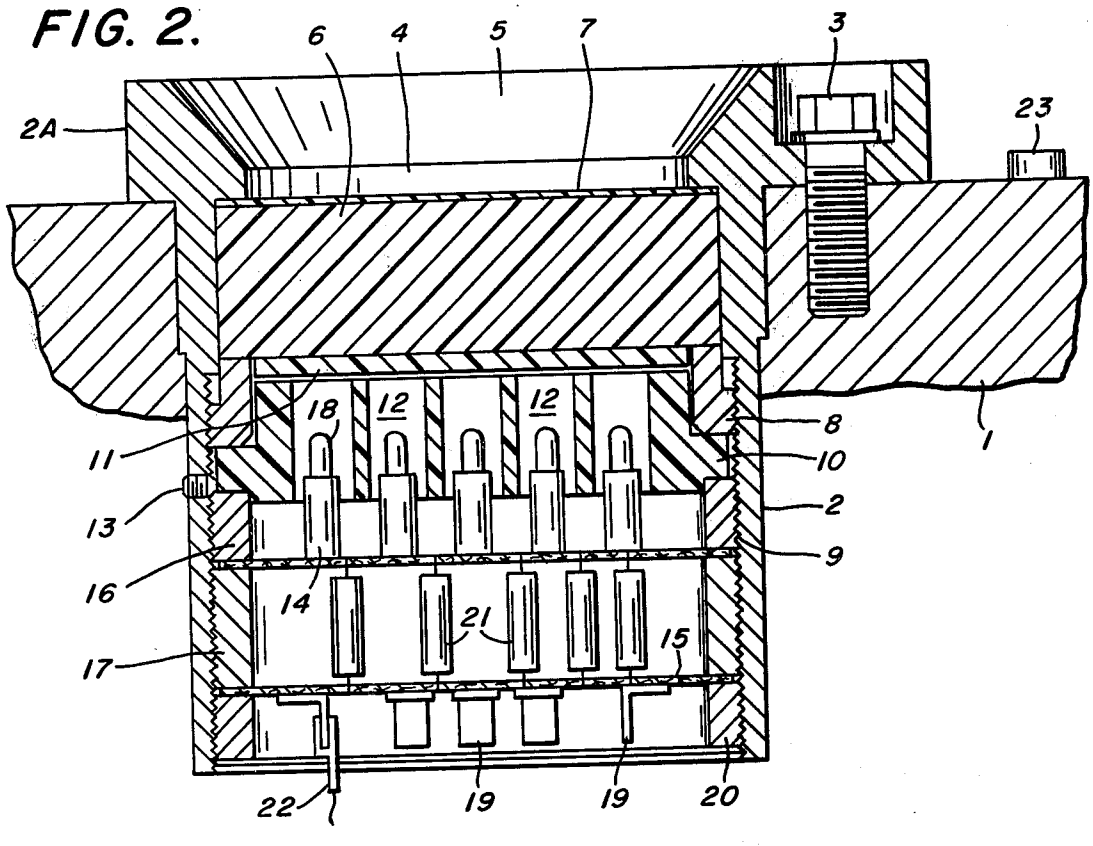

6
4
5
7
3
23
2A
18
12
12
11
8
10
13
2
16
9
14
21
15
17
22
19
19
20
1

FIG. 3.

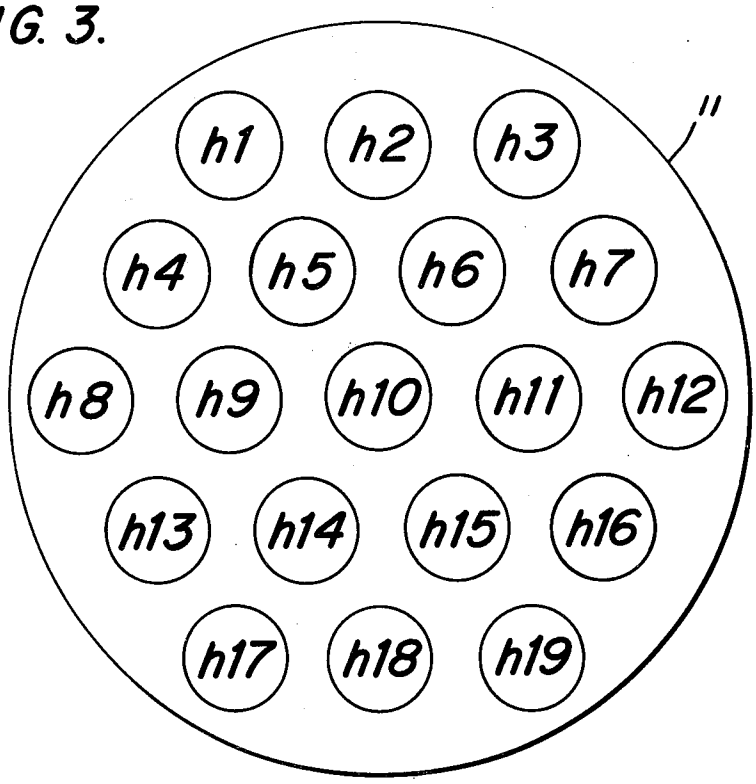
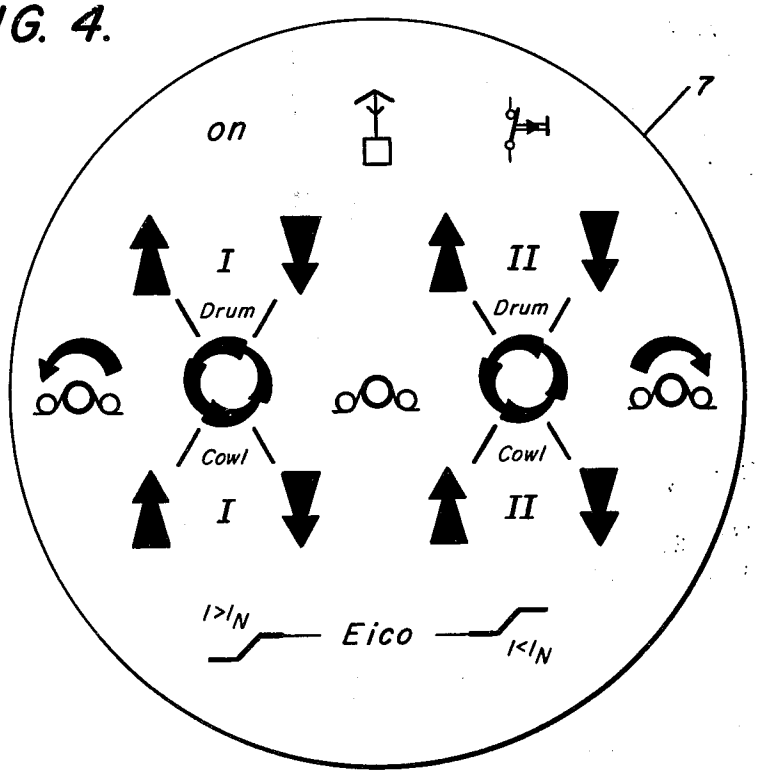

11
h1
h2
h3
h4
h5
h6
h7
h8
h9
h10
h11
h12
h13
h14
h15
h16
h17
h18
h19

FIG. 4.


7
on
I
Drum
II
Drum
Cowl
Cowl
I
II
I>IN
Eico
I<IN

INDICATING APPARATUS FOR MONITORING THE OPERATIVE STATUS OF A HEADING OR COAL FACE CUTTING MACHINE

BACKGROUND OF THE INVENTION

This invention relates to an indicating apparatus to enable the operative status of the component parts of a mining machine to be monitored. More particularly, the present invention relates to such an indicating apparatus incorporating a plurality of electric lamps which are mounted within a pressure-tight housing having a transparent plate with aligned symbols at opposite sides of the plate for illumination by individual lamps.

Coal heading machines, sometimes referred to in the art as coal tunneling machines, incorporate drive motors provided with early warning sensors which are responsive to the temperature of the motor windings and signal when the temperature of the windings rises above a predetermined value. When this occurs, the sensors actuate an optical or acoustical signaling device in order to inform the operator of the heading machine to reduce the feed or rate of advancement of the machine. Such coal heading machines as well as coal face cutting machines belong to a class of coal mining machines that are constructed in a very compact manner and therefore provide only limited possibilities for the mounting of an indicating apparatus. The use of such an indicating apparatus is highly desirable because it enables the measurement or observation of a whole series of monitoring points within the machine for controlling the machine and for indicating the operative state of its individual component parts. These parts may include, for example, the power generator, the drive motor, the machine hoist or winch and the swinging mechanism for the mining tool or the like. The indicating apparatus may also be employed to detect malfunctions of the mining machine. In this manner, the indicating apparatus will inform the machine operator by a single glance in regard to the existing operative state of the aggregate of abservation points in regard to the mining machine.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an indicating apparatus to monitor the operative status of a mining machine wherein the apparatus has a compact construction for support by the mining machine and sealed from the coal mine environment by a transparent plate for viewing by an operator of the machine.

It is a further object of the present invention to provide a mining machine indicating apparatus having a compact construction including two symbol indicating planes to supply the greatest possible amount of information in regard to the operative states and contingent defects of the mining machine.

It is a still further object of the present invention to provide an indicating apparatus to monitor the operative status of a mining machine by providing a plurality of spaced-apart indicating lamps projecting into a perforated plate enclosed within a housing that includes a transparent plate having at its opposed sides, pairs of aligned symbols that are concurrently illuminated by a given lamp to supply an operator with the greatest possible information in regard to the operative status of the machine.

More specifically, the present invention provides in a mining machine, such as a coal tunneling machine or a coal face cutting machine, an indicating apparatus to monitor the operative functions thereof such as the operative status of a power generator, the indicating apparatus, and controlled positioning of the mining machine parts, the indicating apparatus comprising a plurality of lamps for monitoring the operative condition of the machine, a perforated plate having openings each receiving individually one of the plurality of lamps, housing means including a transparent plate carried by the mining machine for forming a sealed chamber to contain the lamps and the perforated plate, and symbols on the outer surface of the transparent plate representing the operative functions of the mining machine for separate illumination through the transparent plate by a lamp.

The indicating apparatus according to the present invention may additionally comprise a transparent symbol plate within the housing where it is held against the inner surface of the transparent plate by the perforated plate.

The features and advantages of the present invention are fully realized by providing an indicating apparatus to monitor the electrical, mechanical and/or hydraulic operating functions of a heading or coal face cutting machine by providing an indicating apparatus with two indicating planes, one lying behind the other. A front indicating plane consists of symbols representing the operative functions and/or operational status of component parts of the mining machine. The rear indicating plane is located behind the front indicating plane at a distance equal to or greater than the size of the symbols. The rear indicating plane consists of symbols characterizing the measuring point to provide monitoring information as to the actual location of the operative part of the mining machine. This construction and relationship of parts enables the provision of an indicating apparatus having small dimensions required for incorporation into a heading or coal face cutting machine while at the same time provides a large indicating surface area for the symbols.

An important part of the present invention relates to providing a transparent disc to seal the indicating apparatus from its outside environment. A transparent film is adhesively attached to the exterior surface of the transparent disc and contains printed symbols. A transparent symbol plate abuts against the transparent disc opposite the surface that supports the transparent film. The symbol plate contains engravings characteristic of the monitoring points. Behind each engraved symbol there is located a lamp connected to the actual monitored point in the mining machine. Since these lamps only light when the machine is actuated and undamaged, the operator can always obtain accurate information as to the operative status of the machine.

A perforated disc is placed adjacent the transparent symbol plate such that the holes in the disc are aligned with the symbols engraved into the symbol plate. Each hole in the perforated plate receives a lamp which is, in turn, plugged into circuitboards lying behind the perforated disc. The indicating apparatus is preferably contained within a tubular housing that is inserted into an opening located in the mining machine. The housing has an internal flange against which the transparent disc is sealably positioned and the aforementioned transparent film is adhesively attached to the exposed surface of the transparent disc. Within the housing, the symbol plate is placed adjacent the transparent disc.

The symbol plate is, in turn, held in place by the perforated disc. Spacer rings are used for locating the circuitboards in a spaced-apart location which support and energize the lamps. At the end of the tubular housing opposite the transparent disc, internal threads receive an externally threaded ring for holding all the parts within the tubular housing. By constructing the indicating apparatus in the foregoing manner, it is very convenient to change individual component parts of the apparatus even at the job site within a coal mining environment.

In addition to the foregoing, the indicating apparatus preferably includes a control switch to energize all the lamps simultaneously to enable an operator to periodically check the operative condition of the lamps which may be carried out prior to or during the actual mining operations.

These features and advantages of the present invention as well as others will be more readily understood when the following description is read in light of the accompanying drawings, in which:

FIG. 1 is a plan view of the indicating apparatus according to the present invention;

FIG. 2 is a sectional view along line II—II of FIG. 1;

FIG. 3 is an illustration of the transparent symbol plate shown in FIG. 2; and

FIG. 4 is a detailed illustration of the transparent film attachment representing the operating functions of the mining machine.

In FIGS. 1 and 2 a coal mining machine, such as a coal face cutting machine or heading machine, is represented by the illustration of a portion of its frame 1 provided with a circular opening into which there is received a tubular-shaped housing 2 with an external flange 2A at one end of the housing. This flange is used to hermetically seal the housing to the mining machine for which purpose screws 3 pass through the four corners of the flange and into tapped holes provided in the machine frame 1. At this end of the tubular housing, there is located an internal flange 4 which is extended to the end of the housing by a chamfered surface 4. The opposite side of this flange defines a shoulder which provides a bearing surface for sealed contact with a transparent disc 6. On the outward face of the disc 6 there is adhesively attached a transparent film 7 which defines, by printing or other suitable means, symbols representing the operative conditions or functions of the mining machine. The symbols are illustrated in greater detail in FIG. 4 and will be more fully described hereinafter.

Internal threads 9 extend along the wall of the housing 2 from its end opposite the flange 2A to a point spaced from the disc 6. An externally threaded ring 8 is positioned along these threads into an abutting and holding relation with the disc 6 to urge it tightly against the flange 4. A perforated disc 10 includes a reduced diameter portion which projects into the central opening in threaded ring 8 and in contact with a transparent symbol plate 11. Plate 11 is illustrated in greater detail in FIG. 3 and will be described more fully hereinafter. The perforated disc 10 defines an array of holes 12 located for precise alignment with the symbols on the plate 11 and held in this aligned relation by a set screw 13. Two circuit-boards 14 and 15 are held in a spaced-apart relation by a spacer ring 17 which are, in turn, held in spaced relation from the perforated disc 10 by a spacer ring 16. The circuitboards include plugs 19 for individual connection to a plurality of lamps 18. The lamps 18 are spaced from each other so that they project into the openings 12 in the perforated plate 10. The circuitboards 14 and 15, spacer rings 16 and 17 and the perforated plate 10 are secured within the housing, as illustrated in FIG. 2, by an external threaded ring 20 having its threads in mating relation with the threads 9. The plugs 19 for the lamps 18 receive connectors 22, each having lead wires that extend to the various sensors and monitoring devices located in the machine. The present invention further includes a switch 23 located externally of the indicating apparatus on the frame of the mining machine to energize simultaneously all of the lamps 18 and thereby indicate the operative status of each of the lamps. For this purpose, each lamp 18 is connected in series with resistors 21 extending between the circuitboards.

An important feature of the present invention resides in the provision of a gas-tight enclosure for the indicating apparatus whereby the lamps and their electrical connection are sealed within the housing 2 to isolate them from the environment which exists externally to the mining machine. This is effectively brought about, according to the present invention, by employing the plate 6 which is clamped within the housing in a gas-tight manner and transparent sheet 7 placed externally of the housing as well as the symbol plate 11 disposed within the housing.

FIG. 3 illustrates in greater detail the arrangements of symbols on the symbol plate 11. These symbols are etched or engraved into the back surface of the plate 11 to form an array made up of symbols H1–H19 that are intended to characterize the monitoring locations in the component parts of the mining machine. The symbols are intended to convey to the viewer of the indicating apparatus the nature of the sensing means used to monitor the operations of the mining machine. Thus, for example, if a lamp 18 aligned with symbol H18 fails to light, a mechanic may be summoned to check a relay in order to eliminate a fault. Symbol plate 11 defines one indicating plane and a second indicating plane is defined by the transparent film 7. The distance between these planes, given by the thickness of the transparent disc 6, should exceed the diameter of the symbols on plate 11.

The following description relates to aligned symbols and it has reference to a two-head rotary longwall mining machine. One skilled in the art can readily visualize a superimposed relation of the symbols shown in FIG. 4 upon the symbols shown in FIG. 3. In the first row, H1 indicates whether the mining machine is in service; H2 represents whether the antenna, used for the remote control of the mining machine, is switched ON; and H3 indicates whether voltage is switched for delivery to the longwall or panel of the machine. In the second row, H4 indicates whether a first rotary cutting drum is operating on a seam roof in the mine; H5 indicates whether the first cutting drum is operating on the seam floor of the mine; and H6 and H7 have the same significance as H4 and H5 in regard to a second rotary cutting drum. In the third row, H8 has reference to the rotation of a winch for displacement of the cutting drum head through the longwall of the mine and represents an uphill run; H12 indicates a downhill travel; H9 indicates the left cutting drum is in operation; H11 indicates operation of the right cutting drum; and H10 indicates the drive for the mining machine is stationary. In

the fourth row, H13 and H14 represent the setting of the so-called cowl (i.e., a broad sheet of metal located behind the cutting drum) in contact with the roof or floor of the mine to deliver the coal released by the cutting drum to a conveyor; and H15 and H16 refer to the location of the cowl associated with the second cutting drum. In the fifth row, H18 indicates whether the electric control is switched ON for the drive system of the mining machine; H17 indicates whether the load on the cutting drum lies above a permitted value which causes the worm drive or winch current to be controlled to decelerate movement of the mining machine; and H19 indicates whether the load on the cutting drive lies below a predetermined value and that control can be effected to accelerate the rate of travel.

When the mining machine is switched ON, the drive motor is energized. The measuring point characteristic given by symbol H1 lights up and the aligned symbol (ON) in the transparent sheet 7 is also illuminated. Thus, as the sensors associated with the operative parts of the machine become energized or deenergized, an associated lamp 18 is correspondingly energized or deenergized. Based on the illumination by the lamps, it is always possible to recognize which unit or component part of the mining machine is in operation at a given moment and with the aid of the symbol plate 11, information is additionally provided which enables the viewer to recognize th part of the machine that is being monitored. If a fault develops in the mining machine parts, it is monitored and lamp or lamps 18 associated therewith will go out. In order to determine if the fault is a defective lamp 18, each of the lamps is simultaneously energized by the operator's control of the switch 23 to independently energize the lamps apart from their control by the individual sensors. In this manner, it is possible to immediately discover any defective lamp and install a replacement lamp.

Although the invention has been shown in connection with a certain specific embodiment, it will be readily apparent to those skilled in the art that various changes in form and arrangement of parts may be made to suit requirements without departing from the spirit and scope of the invention.

We claim as our invention:

1. In a mining machine such as a coal tunneling machine or a coal face cutting machine, an intrinsically safe indicating apparatus to monitor a plurality of different operative conditions and/or operative status of parts of such machines, said indicating apparatus comprising:

a plurality of individually energizable lamps for monitoring different operative conditions and status of a mining machine;

a plate having spaced-apart openings for individually receiving a lamp of said plurality of lamps;

elongated housing means enclosing an internal chamber defined between a wall flange at one end of the housing and a threaded surface at the other end thereof for receiving said perforated plate with said lamps projecting into said openings;

a transparent plate supported against said wall flange within said internal chamber for visual observation externally of said housing means,

fastening means carried by said threaded surface to extend toward said wall flange for holding said transparent plate in a sealed, gas-tight relation with said wall flange; and

means defining symbols upon the surface of said transparent plate externally of said chamber for separate illumination through said transparent plate by a lamp of said plurality of lamps.

2. The indicating apparatus according to claim 1 further comprising symbols at the face surface of said transparent plate within said internal chamber of the housing means for separate illumination with one of said symbols on the outer surface of said transparent plate by a lamp of said plurality of lamps, the arrangement being such that each of said lamps concurrently illuminates aligned symbols at opposed sides of said transparent plate.

3. The indicating apparatus according to claim 1 wherein said means defining symbols comprise a sheet with symbols therein attached to the outer surface of said transparent plate.

4. The indicating apparatus according to claim 3 further comprising a transparent symbol plate held against the inner surface of said transparent plate by said perforated plate.

5. The indicating apparatus according to claim 4 wherein said transparent symbol plate includes engraved symbols arranged in an aligned relation with the openings in said perforated plate and the symbols on the outer surface of said transparent plate.

6. The indicating apparatus according to claim 3 wherein said sheet with symbols therein is further defined as a transparent sheet bearing opening defining said symbols for adhesive attachment to the outer surface of said transparent plate.

7. The indicating apparatus according to claim 1 wherein said housing means includes a tubular shell having an internal projecting annular flange at one end for forming a sealed relation with said transparent plate.

8. The indicating apparatus according to claim 7 wherein said tubular shell further includes internal threads extending from the end thereof opposite said internal projecting annular flange, said apparatus further comprising an externally threaded ring engaging said internal threads for urging said transparent plate into sealed relation with said internal projecting annular flange.

9. The indicating apparatus according to claim 3 further comprising spacer rings between said threaded ring and said transparent plate.

10. The indicating apparatus according to claim 9 wherein said tubular shell further includes an external flange at said one end of the shell for mounting the indicating apparatus onto said mining machine.

11. The indicating apparatus according to claim 4 wherein said sheet means defines one indicating plane, and wherein said transparent symbol plate defines a second indicating plane, said indicating planes being spaced by said transparent plate at a distance greater than the size of a symbol on said symbol plate.

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