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 DEVICE FOR SIGNALING THE HEIGHT OF
 A PILE OF IRON ORE AND THE LIKE
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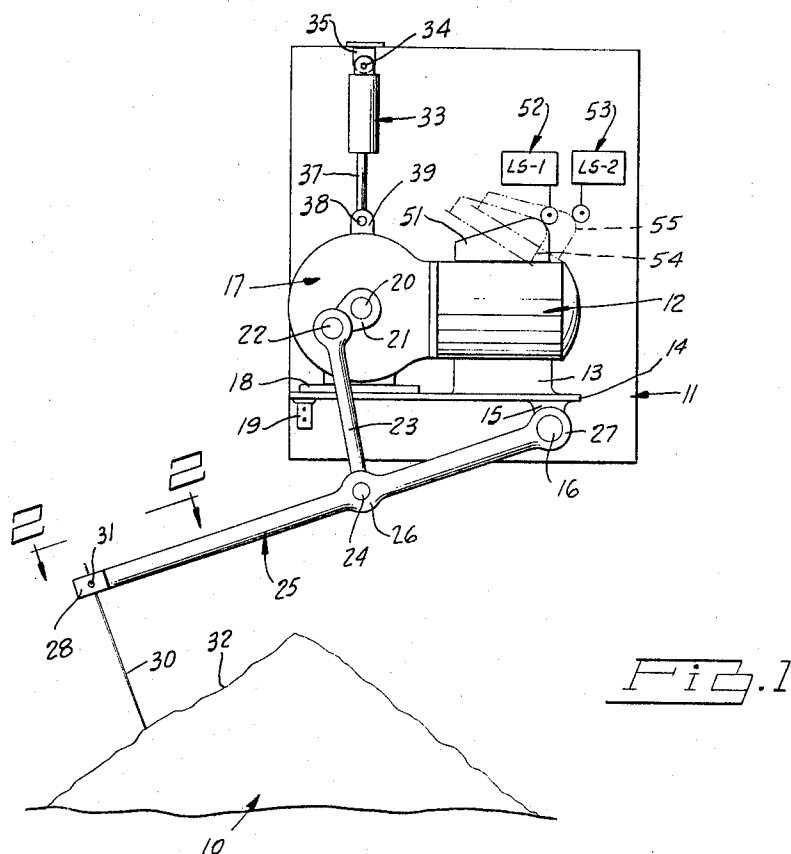


FIG. 1

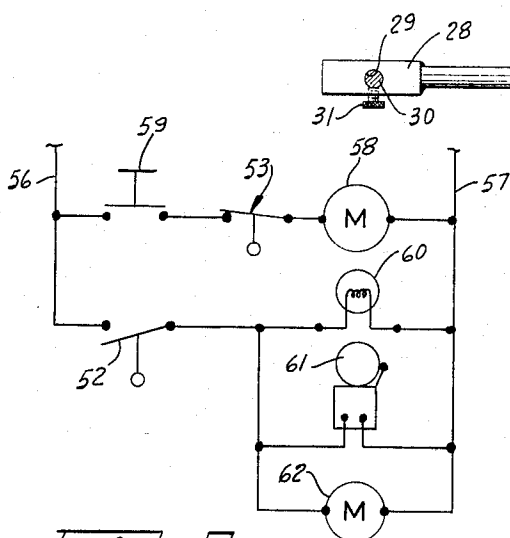


FIG. 2

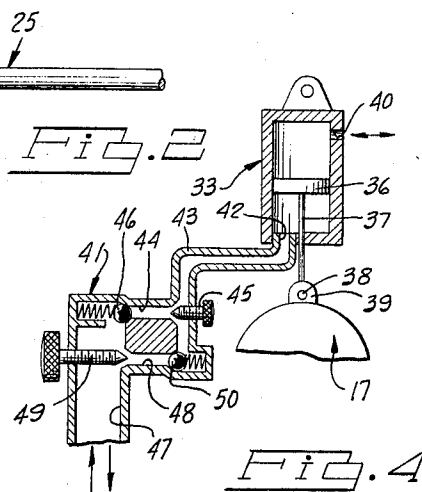


FIG. 3

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DEVICE FOR SIGNALING THE HEIGHT OF A PILE OF IRON ORE AND THE LIKE

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This invention relates generally to devices for indicating the level of stock piled material, and more particularly, to an electromechanical level indicator for detecting the relative height of stock piled material and for sending an electrical signal to indicate various conditions of the pile.

The problem of detecting the height of stock piled material may be solved easily when the material is magnetic. However, a further problem exists when the material being stock-piled is non-magnetic, non-conductive, and virtually non-detectable by conventional electronic means. Heretofore, attempts have been made to overcome the problems involved in determining the level of stock piles of the last mentioned materials. Examples of such attempts are shown in the various indicators described in U.S. Patents Nos. 2,961,842, 3,019,310, and 3,114,804. However, the prior art devices shown in the enclosed patents do not solve the problem of indicating the height of stock piles of material stock-piled in the open. Furthermore, the prior art devices are subject to being damaged or destroyed by the material being stock-piled, as for example, six inch limestone rock.

In view of the foregoing, it is an important object of the present invention to provide a novel and improved stock pile level indicator which can detect the relative height of material being stock-piled and which can send an electrical signal to indicate various conditions of the stock pile. The signal may be used to activate visual or audio alarms, or to cause the stacking machine to be moved to a new location.

It is another object of the present invention to provide a novel stock pile level indicator which is adapted to indicate the height of a stock piled material regardless of whether the material is non-magnetic, non-conductive or non-detectable by conventional electronic means.

It is a further object of the present invention to provide a novel and improved electromechanical level indicator to indicate the relative height of stock piled material.

It is still another object of the present invention to provide a novel stock pile material level indicator which is constructed to prevent itself from being physically damaged or destroyed by the material being stock-piled, such as limestone rock material.

It is still another object of the present invention to provide a novel stock pile level indicator which is adapted to be mounted on a movable stacking machine, and which includes a motor that drives a stock pile level sensing arm upwardly and downwardly, said motor being pivotally mounted, whereby when the level of the stock pile reaches a certain height the sensing arm will be retarded in its upward and downward movement, and such retarding action will be offset by the motor pivoting about its support, and switch means actuated by the motor when it is pivoted about its support to send an electric signal to an alarm or to cause the stacking machine to move to a new location.

Other objects, features and advantages of this invention will be apparent from the following detailed description, appended claims, and the accompanying drawing.

In the drawing:

FIG. 1 is an elevational view of a level indicator made in accordance with the principles of the present invention,

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and showing the level indicator in operative position over a stock pile of stacked material;

FIG. 2 is a fragmentary plan view of part of the structure illustrated in FIG. 1, taken along the line 2—2 thereof, and looking in the direction of the arrows;

FIG. 3 is a schematic view of an illustrative electrical control circuit for the structure of FIG. 1; and,

FIG. 4 is a schematic view of a dash pot apparatus adapted to be used in the structure of FIG. 1.

Referring now to the drawing and in particular to FIG. 1, the numeral 10 generally indicates a stock pile of material being piled in an open field by a conventional stacking machine. The numeral 11 generally designates a vertically disposed mounting plate which would be carried on the stacking machine in a suitable position for carrying a stock pile level indicator apparatus as described hereinafter. The numeral 12 generally designates a suitable electric motor which is fixed on the mounting bracket 13. The bracket 13 is fixed on a platform or base plate 14. As shown in FIG. 1, the platform 14 is horizontally disposed and is provided on the lower side thereof, on the right end thereof, as viewed in FIG. 1, with a base plate mounting journal 15.

As shown in FIG. 1, a horizontally disposed stub shaft 16 is fixed on the lower end of the mounting plate 11, adjacent the lower right corner thereof. The platform mounting journal 15 is pivotally mounted on the shaft 16. A speed reduction means 17 is operatively connected to the electric motor 12. Any suitable speed reduction means may be used, as for example, a suitable gear reduction unit. The speed reduction means 17 is fixed on the mounting bracket 18 which is secured to the left end of the platform 14, as viewed in FIG. 1. The platform 14 is supported at the left end thereof, as viewed in FIG. 1, by the angle bracket 19 which forms a stop means or support means for the left end of the platform 14.

The numeral 30 indicates the power output shaft of the speed reduction means 17. Fixed on the output shaft 20 is the rotary drive crank arm 21 which rotates with the shaft 20 when the electric motor 12 is operating. The short crank arm 21 carries the shaft 22 on the outer end thereof. Pivotally mounted on the shaft 22 is the long crank arm 23. The lower end of the crank arm 23 is connected pivotally by the pin 24 to the knuckle 26 formed at a substantially intermediate point on an oscillating arm 25. As shown in FIG. 1, the inner end of the oscillating arm 25 is provided with the journal 27 which is mounted pivotally or hingedly on the outer end of the motor support shaft 16. The outer end of the oscillating arm 25 is provided with a rod holder 28 for holding the steel rod or tine 30. The steel rod 30 is mounted in the hole 29 formed in the holder 28. The rod 30 is secured in an adjusted position by means of the set screw 32. As shown in FIG. 1, the lower end of the rod 30 is adapted to engage the sloping surface 32 of the stock piled material 10 for indicating the level of the material 10.

As shown in FIGS. 1 and 4, the motor 12 and the speed reduction means 17 are connected to a dash pot means, generally indicated by the numeral 33. Fixed to the upper side of the speed reduction means 17 is a bracket 39 which is connected by the pin 38 to the piston rod 37. The rod 37 is fixed to a piston 36 which is operatively mounted in the cylinder of the dash pot 33, as shown in FIG. 4. The cylinder of the dash pot 33 is connected by the hinge pin 34 to the bracket 35 (FIG. 1) which is in turn supported on the upper end of the mounting plate 11. As shown in FIG. 4, the cylinder of the dash pot 33 is provided with an opening 40 in the upper end thereof which communicates the upper closed end of the cylinder to the atmosphere and permits free entry and exit of

atmospheric air. The lower end of the dash pot cylinder is also enclosed and the piston rod 37 is slidably mounted through the lower closed end of the dash pot cylinder in a suitable manner.

The opening 40 in the dash pot cylinder permits the piston 36 to move freely upward and the movement of the piston 36 downwardly is controlled or regulated by the check valve means, generally indicated by the numeral 41. It will be understood that the check valve means 41 is merely illustrative of one suitable means which may accomplish the function of controlling the air flow into and out of the lower end of the dash pot cylinder.

The check valve means 41 is connected by the conduit 43 which has one end thereof, indicated by the numeral 42, communicating with the lower end of the dash pot cylinder. The other end of conduit 43 communicates with the passage 44 of the check valve means 41. The entrance end of the passage 44 is normally closed by the spring biased check valve 46 which is made in the form of a ball. The amount of air flowing through the passage 44 is controlled by the threadably mounted, adjustable needle valve 45. It will be seen that air can be conducted from the lower end of the dash pot cylinder through the conduit 43 and the passage 44. The air forced out of the dash pot cylinder by the downwardly moving piston 36 will unseat the ball check valve 46 and permit the exhausting air to pass out through the passage 47 to the atmosphere. Air may be drawn into the lower end of the dash pot cylinder through the passage 47 and the inlet passage 48 which communicates with the conduit 43.

The amount of intake air flowing into the inlet passage 48 is controlled by the setting of the needle valve 49. When the dash pot piston 36 is moved upwardly, air will flow into the lower end of the dash pot cylinder by the unseating of the spring biased ball check valve or ball 50. The needle valves 45 and 49 will be adjusted to admit the proper volume of air to flow into and out of the dash pot cylinder during movements of the piston 36 upwardly and downwardly so as to cushion the downward movement of the motor 12 and speed reduction means 17, yet permit free upward movement of the piston.

As shown in FIG. 1, a cam 51 is adjustably mounted on the upper side of the motor 12 and it is adapted to engage the limit switches 52 and 53 when the motor 12 and the speed reduction means 17 is pivoted in a clockwise direction, as viewed in FIG. 1, as explained hereinafter. The numerals 54 and 55 indicate the various operative positions of the cam 51 when it operates the limit switches 52 and 53, respectively.

It will be understood that the stock pile level indicator shown in FIG. 1 may be used to perform various control functions. An illustrative control circuit is schematically illustrated in FIG. 3. The numerals 56 and 57 indicate a pair of power lead wires connected to a suitable source of electrical power. The numeral 58 indicates the electric motor which would operate the stacking machine. The numeral 59 indicates a manual start switch which would be closed to energize the control circuit when the stacking machine is started. As shown in FIG. 3, the stacking machine operating motor 58 is connected between the power lines 56 and 57 by the manually operated switch 59, and the cam operated limit switch 53. A suitable visual indicator or alarm 60 in the form of a lamp is connected between the power lines 56 and 57 by the limit switch 52. The limit switch 52 is a normally open switch, and the limit switch 53 is a normally closed switch. An audio alarm such as an electrically operated bell may also be energized by the closing of the limit switch 52, as shown in FIG. 3. The numeral 62 indicates a motor for the drive mechanism which would propel the stacking machine to a new location when the limit switch 52 is closed.

In use, when the stock pile level indicator apparatus

of the present invention is mounted on a stacking machine, the motor 12 would be energized to operate the speed reduction means 17 which would rotate the arm 21 and in turn move the crank arm 23 upwardly and downwardly to oscillate the arm 25 upwardly and downwardly. Assuming that the surface 32 of the stock pile 10 is below the lowest point to which the arm 25 travels downwardly, the arm 25 will oscillate upwardly and downwardly in a free motion. As the surface 32 of the stock pile 10 rises the arm 25 will be restricted in its oscillating movement. The platform 14 is mounted so that it will pivot about the shaft 16, and accordingly, when the lower end of the rod 30 commences to strike the surface 32 of the stock pile 10, as the surface 32 rises, a reactive force will be transmitted from the rod 30 and pass to the arm 25 and through the crank arms 23 and 21 to the motor 12 and speed reduction means 17 to cause the platform 14, motor 12 and speed reduction means 17 to pivot about the shaft 16 in a clockwise direction, as viewed in FIG. 1. The rod 30 is strong and rigid to support the weight of the motor 12 and speed reduction means 17 during the pivoting of the same. As the level 32 of the stock pile 10 rises, the motor 12 will be pivoted an ever increasing amount, whereby the cam 51 will eventually move to the dotted position marked by the numeral 54 so as to actuate the limit switch 52. As shown in FIG. 3, when the limit switch 52 is actuated, a suitable audio alarm 61 and a suitable visual alarm 60 may be energized and the stacking machine propelling motor 62 energized to move the stacking machine to a new location. The moving of the stacking machine will permit the arm 25 to again oscillate freely throughout its whole length of travel without having the lower end of the rod 30 engage the surface 32 of the pile 30. The surface 32 of a stock pile at the new position to which the stacking machine has been propelled will be lower than the maximum downward movement of the arm 25, and the lower end of the rod 30, and the motor 12 and speed reduction means 17 will not be rotated. The platform 14 remains in a seating position on the stop member 19.

It will be understood that the normally open limit switch 52 is used for a normal signal and for energizing the propelling motor 62 to move the stacking machine to a new location. The normally closed limit switch 53 is actuated when the motor 12 is pivoted to a position so as to bring the cam 51 to the dotted line position indicated in FIG. 1 by the numeral 55. The limit switch 53 is then open and may be used for a high alarm or shutdown condition. It will be seen that the cam 51 must be rotated further to actuate the limit switch 53 as compared to the position for actuating the limit switch 52. The cam 51 may be set for any desired high stack condition for the stock pile.

It will be understood that the dash pot 33 provides relatively free movement of the piston in the upward direction, but the movement of the piston 36 may be restricted in the downward direction by the check valve means 41 which restricts the escapement of air out of the lower end of the cylinder of the dash pot 33. This restricted downward movement of the piston 36 and the motor 12 and speed reduction means 17 permits the platform 14 to be seated on the stop 19 without an abrupt stopping condition.

Experience has shown that the stock pile level indicator of the present invention is an efficient and practical means for determining the level of a stock pile of material disposed in an open lot, and it will function on a stock pile of material which is non-magnetic, non-conductive and non-detectable by conventional electronic means.

While it will be apparent that the preferred embodiment of the invention herein disclosed is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What I claim is:

1. In an apparatus for indicating the level of a stock pile, the combination comprising:

- (a) a support member;
- (b) a horizontal shaft on said support member;
- (c) an arm having one end pivotally mounted on said horizontal shaft and the other end freely movable upwardly and downwardly in an arcuate path about said shaft;
- (d) a horizontal platform having one end pivotally mounted on said horizontal shaft and the other end normally disposed on a stop member and being movable upwardly from said stop member in a swinging movement about said horizontal shaft;
- (e) means on said platform for moving said arm upwardly and downwardly in an oscillatory motion;
- (f) means carried by said arm engageable with the level of a stock pile when the level of a stock pile reaches a predetermined height, whereby said arm is retarded in the downward movement and a reactive force is exerted on said platform to pivot the same about said shaft and create a signal; and,
- (g) a dash pot means operatively connected to said platform and means for moving said arm to restrict the downward movement of the platform and provide free upward movement for the platform.

2. The apparatus for indicating the level of a stock pile as defined in claim 1, wherein:

- (a) said dash pot means includes an air cylinder and means for controlling the air flow into and out of said air cylinder.

3. The apparatus for indicating the level of a stock pile as defined in claim 1, wherein:

- (a) said means for moving said arm upwardly and downwardly includes a motor on said platform adjacent said horizontal shaft, and a speed reduction means on the other end of said platform and operatively connected to said motor.

4. The apparatus for indicating the level of a stock pile as defined in claim 3, including:

- (a) an output shaft on said speed reduction means;
- (b) a first crank having one end fixed to said output shaft and the other end provided with a pivot pin; and,
- (c) a second crank having the upper end pivotally mounted on said pivot pin and the lower end pivotally connected to said arm.

5. The apparatus for indicating the level of a stock pile as defined in claim 4, wherein:

- (a) said means carried by said arm includes a rod engageable with the surface of a stock pile when the stock pile reaches a predetermined height, whereby said arm will be restricted in the downward movement and a reactive force will be exerted through said first and second cranks and through said speed reduction means to said platform so as to pivot the platform about said shaft and create a signal.

6. The apparatus for indicating the level of a stock pile as defined in claim 5, wherein:

- (a) said dash pot means is connected to said speed reduction means.

7. The apparatus for indicating the level of a stock pile as defined in claim 1, wherein:

- (a) a cam is operatively mounted on said means for moving said arm; and,
- (b) the apparatus for indicating the level of a stock pile includes a control system actuated by said cam.

8. The apparatus for indicating the level of a stock pile as defined in claim 7, wherein:

- (a) said control system includes at least two limit switches operated successively by said cam when said platform is pivoted about said shaft.

9. The apparatus for indicating the level of a stock pile as defined in claim 8, wherein:

- (a) said control system further includes an alarm means energized by said limit switches; and,
- (b) said control system also includes means for shutting down the apparatus when said platform is pivoted about said shaft a predetermined distance.

10. The apparatus for indicating the level of a stock pile as defined in claim 9, wherein:

- (a) said dash pot means is connected to said speed reduction means; and,
- (b) means for controlling the air flow into and out of said cylinder to restrict the downward movement of the platform and provide free upward movement for the platform.

11. The apparatus for indicating the level of a stock pile as defined in claim 10, wherein:

- (a) said cam is adjustably mounted on said motor.

12. In an apparatus for indicating the level of a stock pile, the combination comprising:

- (a) a support member;
- (b) an arm having one end pivotally mounted on said support member;
- (c) means for moving said arm upwardly and downwardly in an oscillatory motion;
- (d) a platform having one end pivotally mounted on said support member and the other end normally disposed on a stop member and being movable upwardly from said stop member in a swinging movement about the pivot on said one end;
- (e) said means for moving said arm being mounted on said platform;
- (f) means carried by said arm engageable with the level of a stock pile when the level of a stock pile reaches a predetermined height, whereby said arm is retarded in the downward movement and a reactive force is exerted on said platform to pivot the same and create a signal; and,
- (g) a dash pot means operatively connected to said platform and means for moving said arm to restrict the downward movement of the platform and provide free upward movement for the platform.

13. The apparatus for indicating the level of a stock pile as defined in claim 12, wherein:

- (a) said dash pot means includes an air cylinder and means for controlling the air flow into and out of said air cylinder.

14. The apparatus for indicating the level of a stock pile as defined in claim 13, wherein:

- (a) said dash pot means includes a piston slidably mounted in said air cylinder, a piston rod connected at one end to said piston and at the other end to said means for moving said arm upwardly and downwardly.

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