

[54] **CRANE HOIST HEIGHT CONTROL**
 [75] Inventor: **George F. Schwartz**, Hampton Township, Allegheny County, Pa.

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[73] Assignee: **United States Steel Corporation**, Pittsburgh, Pa.

[22] Filed: **Feb. 2, 1973**

[21] Appl. No.: **328,976**

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Attorney, Agent, or Firm—Rea C. Helm

[52] U.S. Cl. **212/21, 212/10, 212/131, 340/205**
 [51] Int. Cl. **B66c 17/18**
 [58] Field of Search 212/10, 11, 21, 131; 254/173; 214/658, 16.4 A; 340/267 C, 271, 282, 205

[56] **References Cited**
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[57] **ABSTRACT**

A crane hoist height signal system has a trolley mounted grooved cable drum with a pulse generator and a tensioned constant torque spring motor mounted on the drum shaft. A cable is attached to the crane hoist block and wrapped around the drum. As the hoist block is raised or lowered, the drum rotates causing the pulse generator to send pulses to an add-subtract receiver which may be used to display block height to the crane operator or to control the crane hoist block movement.

3 Claims, 5 Drawing Figures

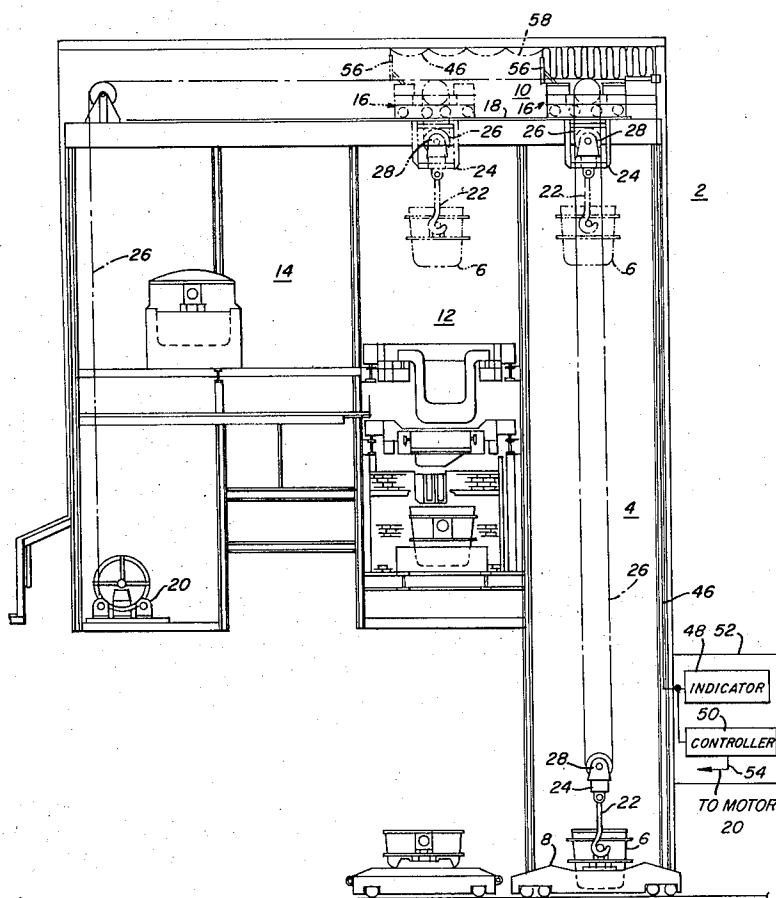


FIG. 1

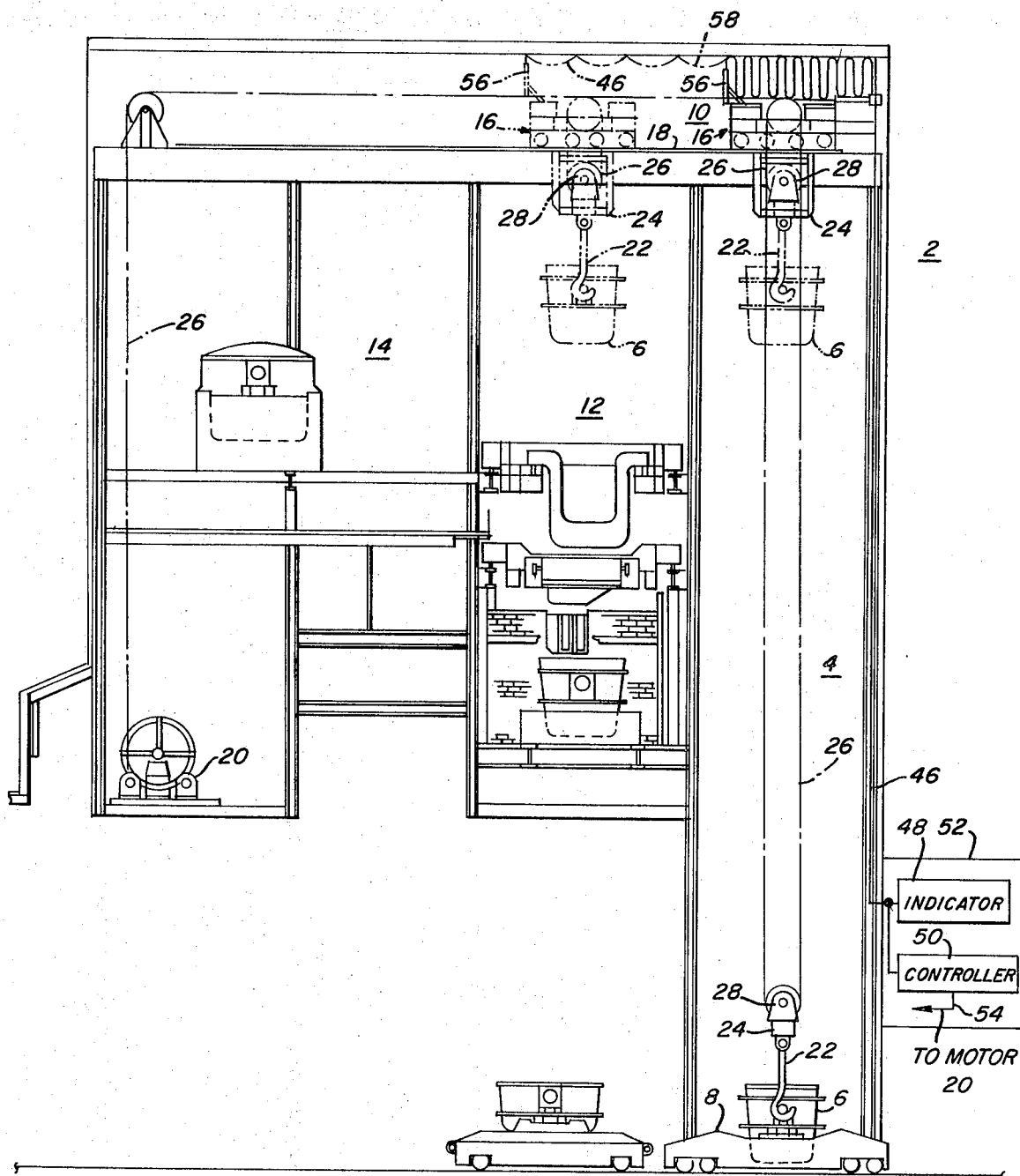


FIG. 2

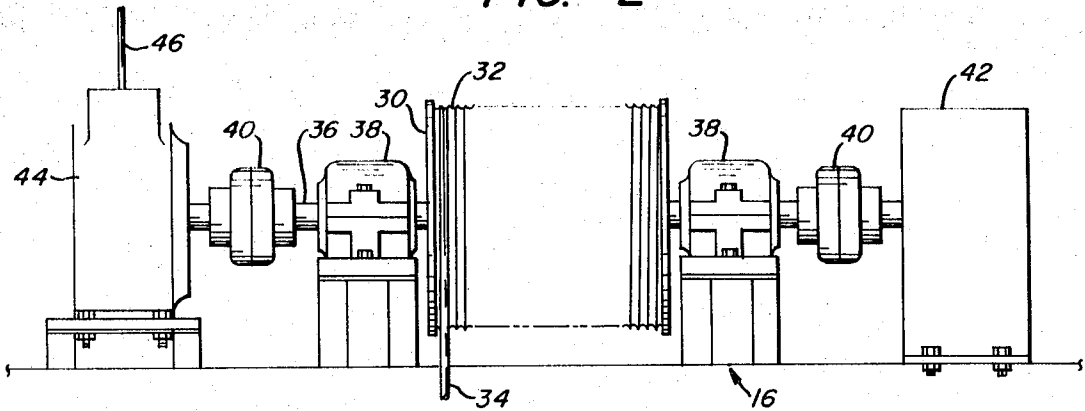


FIG. 3

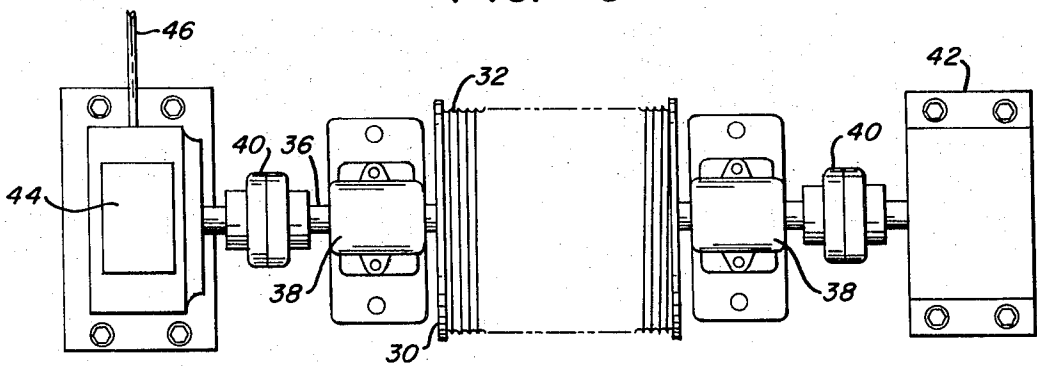


FIG. 4

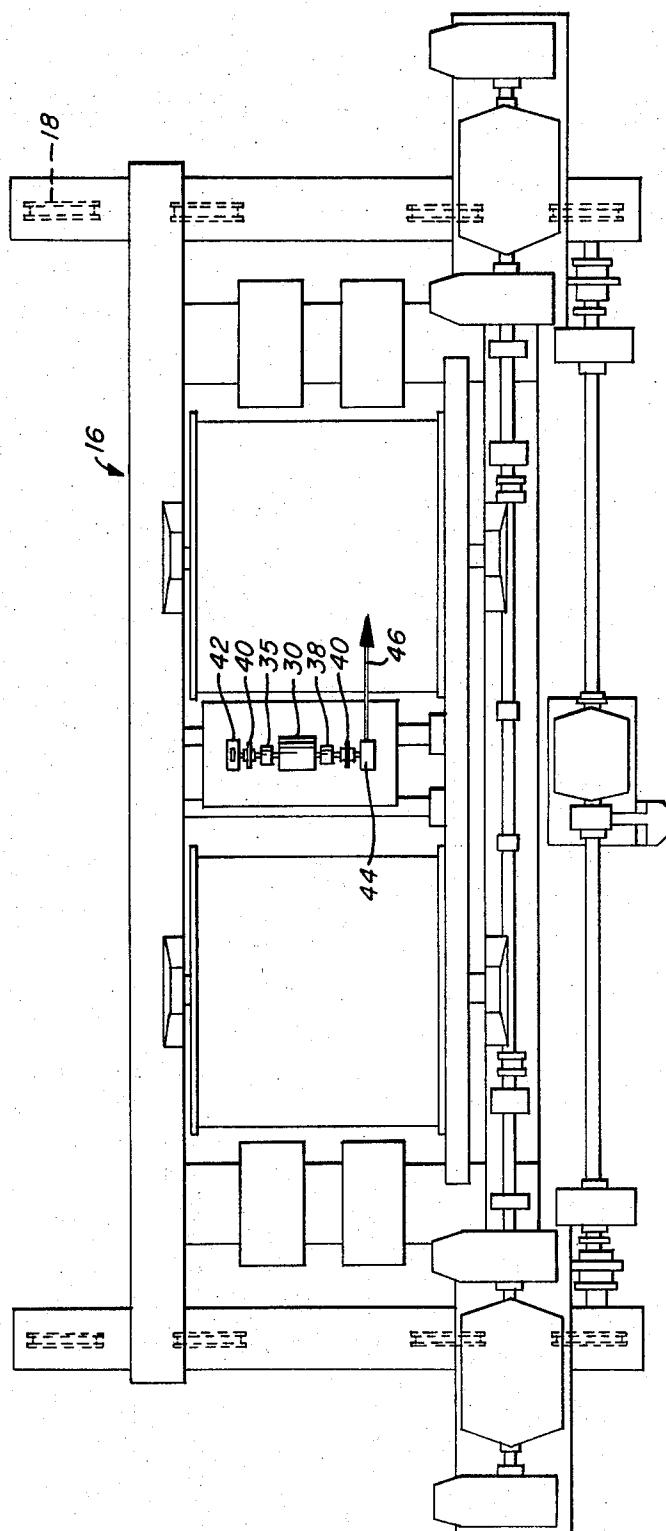
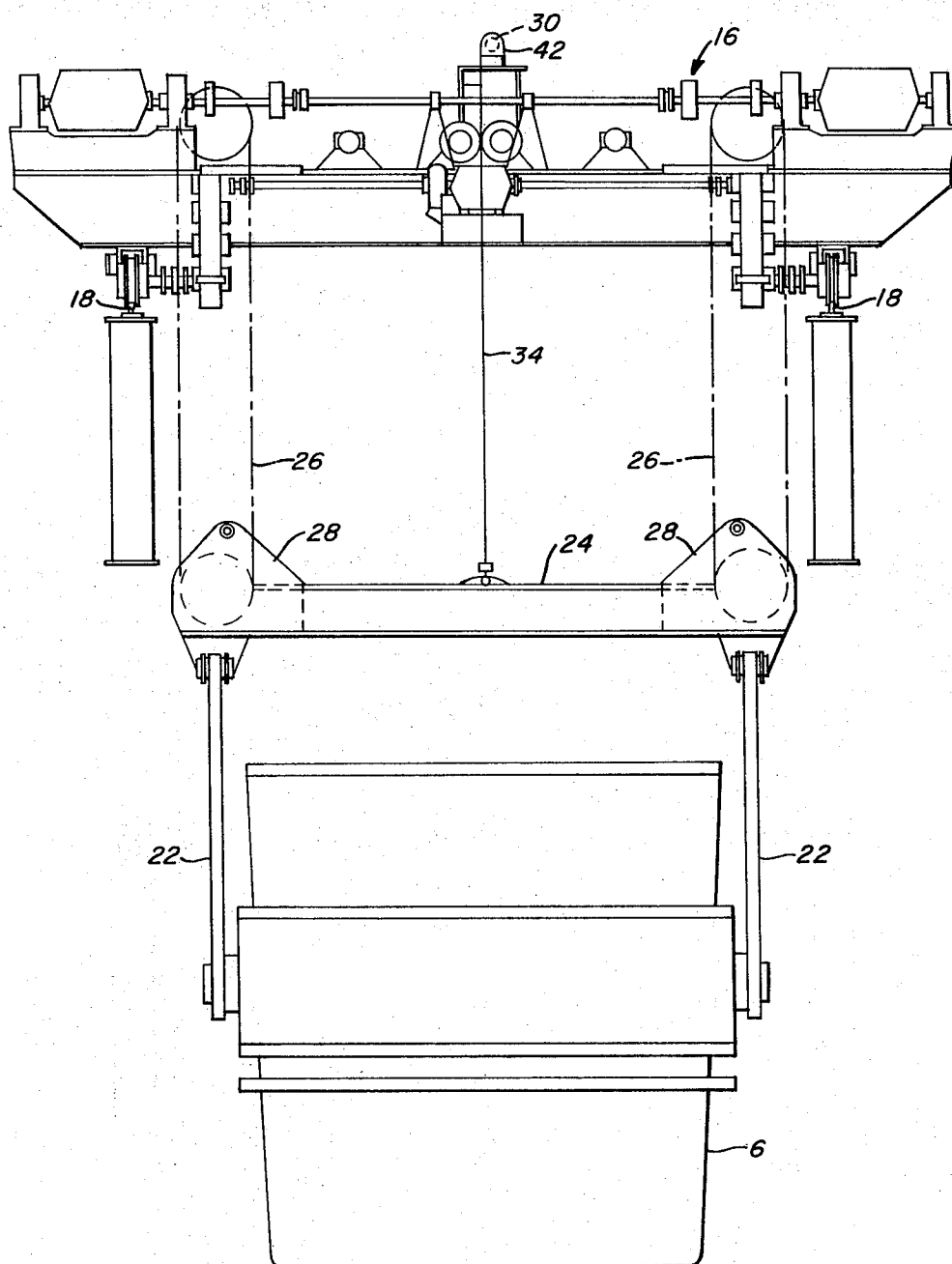


FIG. 5



CRANE HOIST HEIGHT CONTROL

This invention relates to crane hoist height control and more particularly to apparatus for providing a continuous height signal for a hoist beam or block which may also be used to control the hoist movement.

In certain types of hoisting installations, requirements for accurate movement are complicated by the size of the installation and the distance involved. For one example, in the continuous casting of steel, the bays in the typical casting structure are very high and the distance between the hoist operator and the hot metal ladle make it difficult for a hoist operator to accurately spot the ladle at the proper height so that some remote indication of hoist height is required. Indicators using screw or rotary type limit switches may be attached to a hoisting rope sheave or drum. Such indicators give unreliable indications because of substantial stretching of the hoist cable, which is related to the weight suspended. Varying loads carried at varying elevation result in variable cable stretch and incorrect indications of height. Usually the error is too great for accurate positioning. Indicators having track or tripper type limit switches may be used where the hoist operates in stationary guides or tracks. This type of indicator is consistent in its relationship to the height indication of a load beam or block, but has mechanical restrictions that require total movement through the switch tripper by the beam or block attached to the tripper actuator, or require manual reset of the switch tripper under certain conditions. If the actuator movement does not clear the tripper, either a false signal can be created by subsequent actuation or a physical failure can be experienced in the tripper mechanism.

In accordance with my invention, a grooved cable drum is placed on the crane trolley. A cable is wrapped around the drum with one end of the cable attached to the drum and the other end attached to the beam or block of the hoist. A tensioned constant torque spring motor and a digital pulse generator are attached to the drum shaft. As the beam or block is raised or lowered, the drum and shaft rotate and the pulses from the pulse generator are counted in an add-subtract receiver-indicator to show height. Where high speed hoisting is required, accelerating and decelerating cycles of operation are automatically programmed by the sequential signals of the height indicator.

It is therefore an object of my invention to provide apparatus that will continuously and accurately indicate the height of a hoist block.

Another object is to provide apparatus that will control the operation of a hoist block.

These and other objects will become more apparent after referring to the following specification and drawings, in which:

FIG. 1 is a partial general elevational view of an overhead traveling crane trolley embodying the present invention;

FIG. 2 is a side elevation view of the drum, motor and pulse generator;

FIG. 3 is a top plan view of the drum, motor and pulse generator;

FIG. 4 is a top plan view of an overhead traveling crane trolley showing the drum, motor and pulse generator of my invention; and

FIG. 5 is a side elevation view of an overhead traveling crane trolley showing the drum, motor and pulse generator of my invention.

Referring now to FIG. 1, reference numeral 2 refers to a steel continuous casting facility of which only the parts essential for the operation of my invention are included. Generally, such structures include a hoisting bay 4 where a hot metal ladle 6 is moved into position by a ladle transfer car 8 to be picked up by a crane shown generally at 10. Crane 10 also covers a casting bay 12 and a storage and preheat bay 14. Crane 10 in this case excludes a bridge and includes a trolley 16 which moves along rails 18 to position the trolley over the proper bay, a remote hoist motor 20; hooks 22 which support ladle 6 and are connected to a spreader bar 24 supported by cables 26 on blocks 28. This is a conventional continuous casting arrangement. cables

Referring now to FIGS. 2 and 3, reference numeral 30 indicates an independent cable drum having a single layer of spiral grooves 32, only part of which are shown, to accommodate a cable 34. Drum 30 is supported on a shaft 36 which is journaled in bearings 38 supported on trolley 16. At the ends of shaft 36 are couplings 40, one of which is coupled to a constant torque spring motor 42, such as the "NEG'ATOR" manufactured by AMETEK/HUNTER Spring Division of Hatfield, Pennsylvania and the other is coupled to a digital pulse generator 44, such as a Type 85 Zero-Speed Rotopulser manufactured by the Dynapar Corporation Division of Louis Allis Company of Gurnee, Illinois.

FIGS. 4 and 5 show the location of drum 30, motor 42 and pulse generator 44 with respect to trolley 16. Cable 34 is attached to the center of spreader bar 24. The location of drum 30, either plan wise or elevation wise, is immaterial so long as cable 34 starts to pay off vertically directly over the attachment to spreader bar 24 when spreader bar 24 is at its maximum height.

A shielded cable 46 connects pulse generator 44 to a digital add-subtract position indicator 48 and a digital add-subtract controller 50 located in an operator's control room 52. Controller 50 is connected by a cable 54 to motor 20. Cable 46 is connected from pulse generator 44 to a bracket 56 mounted on trolley 16 and then to a festooned cable track 58 mounted adjacent the crane runway to permit crane trolley movement.

With spreader bar 24 in its uppermost position, all the cable is wound on drum 30 and motor 42 is set with an initial winding so that there is some torque present in the uppermost position. Indicator 48 is then calibrated to indicate the height of the hook trunnion centerline or some other desired reference location with respect to ladle 6. As the spreader bar is lowered, drum 30 rotates and winds up motor 42 further than the initial setting. Rotation of drum 30 also rotates pulse generator 44 to provide minus pulses to indicator 48 and controller 50. Indicator 48 will then continuously show the height of spreader bar 24. When spreader bar 24 is raised, pulse generator 44 provides plus pulses and the adder-subtractor feature of indicator 48 will continue the proper height indication.

In an installation as shown in FIG. 1 and assuming a hoist bay with a payoff length for cable 34 of about 120 feet, cable 34 may be a 1/4-inch diameter prestressed steel cable. Drum 30 should have the grooves 32 as close together as possible, for example, with 1/4-inch cable; the grooves 32 may be spaced three tenths of an inch apart. A convenient pitch diameter of twelve inches would then require approximately forty grooves. As spreader bar 24 descends, cable 34 leaves drum 30

at a point that progresses horizontally away from the center of spreader bar 24 because it follows the grooves 32 spaced about three tenths of an inch apart. This causes cable 34 to be suspended at a slight angle to the vertical which introduces an error. The error is negligible, amounting to the additional length caused by moving approximately thirty-eight inches of cable to one side about three tenths of an inch. The total elevation error would be less than one eighth of an inch which is an acceptable accuracy with a calibration of one tenth of a foot of spreader bar travel per pulse from generator 44. Errors are minimized by using prestressed cable. The compensating constant torque spring motor insures that unavoidable slight stretching of the cable is constant thereby providing a simple adjustment for stretching.

Unlike other elevation indication systems that do not provide an obvious indication that the system is not functioning, this system is fail-safe. In cable 34 should become disconnected or broken, spring motor 42 would immediately wind cable 34 onto drum 30 providing an obviously erroneous indication of maximum height.

Controller 50 may be programmed to control motor 20 by actuating the acceleration and deceleration controls of motor 20 in response to a preset number of pulses for desired heights or ranges. The controller may also be used for repetitive spotting of spreader bar 24 at any desired height.

While one embodiment of my invention has been shown and described, it will be apparent that other adaptations and modifications may be made to my invention.

I claim:

1. A crane hoist height signal system for a crane having a hoist block comprising
 - a cable having one end attached to the hoist block,
 - a revolving drum mounted on the crane and attached to the other end of the cable for winding and unwinding the cable as the hoist block is raised and lowered,
 - a shaft attached to the drum to revolve with the drum,
 - a constant torque spring motor attached to the shaft for continuously applying a force to the drum tending to wind the cable onto the drum,
 - a pulse generator attached to the shaft for providing a first type pulse for each predetermined increment of winding the cable and a second type pulse for each predetermined increment of unwinding the cable and
 - means connected to said pulse generator for adding the first type pulses and subtracting the second type pulses from a predetermined total correlated with a selected hoist block height thereby providing a pulse total representative of the hoist block height.
2. A system according to claim 1 which includes means connected to said means for adding and subtracting pulses for displaying the pulse total representative of the hoist block height.
3. A system according to claim 1 which includes a crane hoist motor mounted on the crane and means connected to said motor and said means for adding and subtracting pulses for controlling said motor in response to the pulse total representative of the hoist block height.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,863,772

Dated February 4, 1975

Inventor(s) George F. Schwartz

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 13, "calbes" should be -- cables --;

line 14, after "arrangement." "cables"
should be deleted.

Signed and sealed this 13th day of May 1975.

(SEAL)

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks