United States Patent

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[73] Assignee **United States Steel Corporation**
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[54] **MECHANISM FOR MEASURING LOADS ON PINCH ROLLS OF CONTINUOUS-CASTING MACHINE**
4 Claims, 2 Drawing Figs.

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[51] **Int. Cl.** **B22c 19/04**
[50] **Field of Search** ..... 164/4, 82, 273, 274, 282, 150, 152, 153, 154; 72/(Inquired); 226/25, 26

[56] **References Cited**

UNITED STATES PATENTS

3,047,915	8/1962	Barnard et al.	164/282X
3,338,297	8/1967	Foldessy	164/282X

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ABSTRACT: A mechanism for measuring line loads at the pinch rolls of a continuous-casting machine. Pinch rolls are supported on load cells which are connected to a recorder. Load cells measure weight at pinch rolls, which weight varies inversely as the line load enables operator to control force on slab and prevent overloading at the pinch rolls.

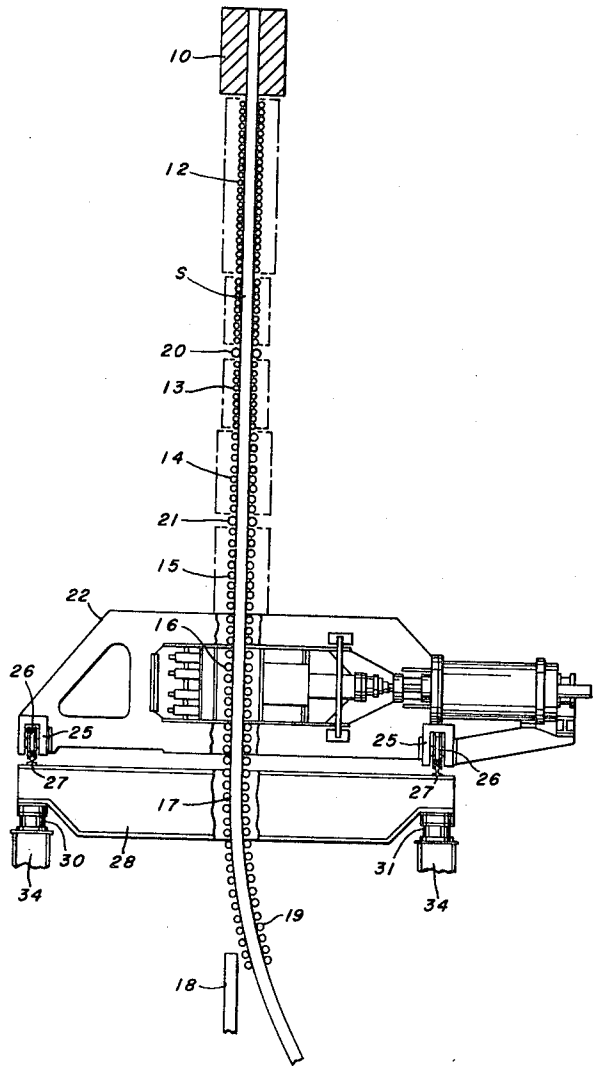

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FIG. 1.

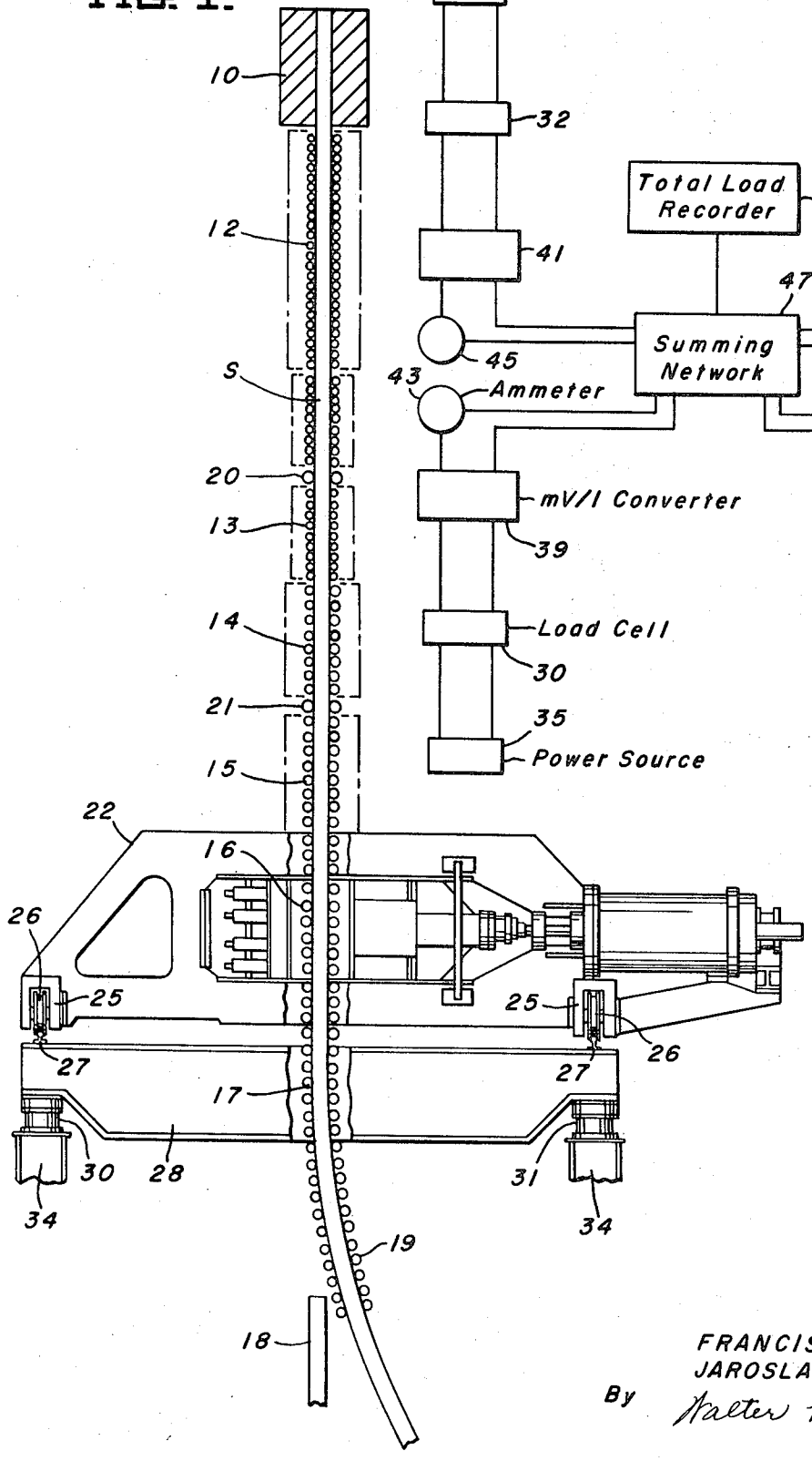

FIG. 2.

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MECHANISM FOR MEASURING LOADS ON PINCH ROLLS OF CONTINUOUS-CASTING MACHINE

SPECIFICATION

This invention relates to an improved mechanism for measuring line loads at the pinch rolls of a continuous-casting machine and to a method of preventing overloading at the pinch rolls.

The form of continuous-casting machine in which our mechanism and method are used includes a water-cooled mold open at both ends, trains of vertically spaced opposed pairs of guide rolls below the mold, a set of power-driven pinch rolls below the guide rolls, and a curved casting guide below the pinch rolls. Before a casting operation begins, a starter bar is inserted upwardly through the pinch rolls and guide rolls to the mold. A stream of molten metal is poured through the mold into contact with the top of the starter bar, which descends through the guide rolls and pinch rolls ahead of the resulting slab. As the slab passes the guide rolls, water sprays are applied to its surface to aid in solidifying it. Initially the leading end of the slab attaches itself to the top of the starter bar, but the starter bar is disconnected as the slab reaches the pinch rolls. At first the pinch rolls restrain descent of the starter bar, but after the slab is part way through the guide rolls, the pinch rolls propel the starter bar and slab. After the starter bar is disconnected, bending rolls within the casting guide bend the slab 90° so that it travels horizontally from there on for further processing. Reference can be made to Foldessy, U.S. Pat. No. 3,338,297 for a more complete showing of such a machine, although our invention is not limited to use with the particular machine.

In a continuous-casting operation, the "line load" refers to the resistance to slab movement offered by the guide rolls, pinch rolls and bending rolls as the slab travels from the mold through the curved casting guide. The pinch rolls must overcome the line load to propel the slab. The line load is inversely related to the weight at the pinch rolls.

The line load or weight at the pinch rolls should follow a pattern during a rolling cycle. Before a starter bar is inserted, the weight represents only the dead weight of the rolls and associated parts, typically 600,000 to 800,000 pounds. When the starter bar is inserted, its weight is added to the roll weight, typically another 50,000 to 75,000 pounds. As pouring begins and the pinch rolls restrain the solidifying slab, the weight continues to increase and typically may reach a maximum of 800,000 to 900,000 pounds. The weight diminishes as the starter bar is disconnected, and drops below the dead weight of the rolls, etc. as the rolls propel the slab. The minimum weight or maximum line load occurs while the leading end of the slab is being threaded through the casting guide below the pinch rolls. Thereafter the slab enters a set of drag or straightening rolls which relieve the pinch rolls of part of the line load. If the weight at the pinch rolls drops below some critical limit, typically in the range of 300,000 to 500,000 pounds, the pinch rolls are overloaded. The foregoing FIGS. of course vary widely, depending on the size of casting machine and slab.

An object of our invention is to provide a mechanism which affords a continuous indication of the line load at the pinch rolls by measuring the weight thereof.

A more specific object is to provide a load-measuring mechanism which includes electrically connected load cells mounted under the pinch rolls to measure the weight thereof throughout a casting operation and thereby furnish a continuous indication of the line load.

A further object is to provide a method of detecting imminent overloading of the pinch rolls through measurement and observation of the weight thereon, and warning of possible trouble.

In the drawing:

FIG. 1 is a diagrammatic side elevational view of a portion of a continuous-casting machine equipped with our load-measuring mechanism; and

FIG. 2 is a schematic wiring diagram.

FIG. 1 shows a continuous-casting machine which includes an open ended mold 10, four trains of vertically spaced idler guide rolls 12, 13, 14 and 15 below the mold, power-driven pinch rolls 16 below the guide rolls, a casting guide 17 below the pinch rolls, and a starter bar 18. The casting guide is equipped with bending rolls 19. Preferably the machine has an upper set of power-driven guide rolls 20 between the two trains of idler guide rolls 12 and 13, and a lower set of power-driven guide rolls 21 between the two trains of idler guide rolls 14 and 15, as shown and claimed in an application of the present coinventor Gallucci Ser. No. 699,150, filed Jan. 19, 1968. The pinch rolls 16 are supported in a frame 22 preferably constructed as shown and claimed in another Gallucci application Ser. No. 707,638, filed Feb. 23, 1968. Both said applications are assigned to the same assignee as the present application. In other respects the foregoing parts can be of known construction, for example as shown in the aforementioned Foldessy patent. The machine of course includes other conventional parts which we have not shown, since they are not involved in the present invention. A slab S is shown descending through the machine.

The pinch roll frame 22 includes trucks 25 at opposite ends and flanged wheels 26 journaled in the trucks. The wheels ride on transverse rails 27 which are supported on beams 28. This construction enables the pinch roll assembly to be moved bodily out of the machine for maintenance, as explained more fully in the second-mentioned Gallucci application. Beams 28 also afford support for a number of the bending rolls 19 at the entry end of the casting guide.

In accordance with our invention, we support beams 28 on four load cells 30, 31, 32 and 33 located beneath opposite ends of each beam. FIG. 1 shows the two load cells 30 and 31, but the other two are shown only in the schematic wiring diagram of FIG. 2. The load cells are supported on structural members 34 of the building structure for the casting machine. As FIG. 2 shows, we connect the four load cells to power sources 35, 36, 37 and 38 respectively and to millivolt-to-current converters 39, 40, 41 and 42. We connect the output terminals of the converters to individual ammeters 43, 44, 45 and 46 and to a summing network 47. We connect the latter to a "-total load" recorder 48. The individual instruments per se are known devices available commercially; hence we have not shown them in detail. One example of a suitable load cell is the 500,000 pounds capacity vertical load cell supplied by Revere Corporation of America, Catalog No. C45975. One example of a suitable converter is that supplied by Taylor Instrument Company as the "Potentiometer Transmitter, Model 760T." One example of a suitable recorder is that supplied by Leeds and Northrup as the "Speedomax W." The technique for adding electric signals in the summing network is well known to those skilled in the art. Reference can be made First a printed publication "Control Engineers Handbook," First Edition, by John G. Truxal, published by McGraw-Hill Book Company, copyright 1958, for an explanation.

The four load cells individually register the weight at the ends of beams 28. The dead weight includes the pinch roll frame 22, pinch rolls 16 and other parts of the pinch roll assembly, the supporting trucks 25, beams 28, and the bending rolls 19. When the starter bar 18 is inserted through the pinch rolls at the start of a casting operation, its weight also is included. As pouring starts, and the pinch rolls restrain the slab, the weight increases over the dead weight. The weight drops when the starter bar is disconnected, and continues to drop as the pinch rolls commence to propel the slab. At this stage the pinch rolls tend to crawl up the slab and the weight is less than the dead weight. The less the weight, the greater the line load.

The individual ammeters 43, 44, 45 and 46 indicate the weight at each corner of the pinch roll assembly and enable the operator to correct for unevenness later during maintenance periods. The recorder 48 indicates the total weight at the pinch rolls. This is a measure of the line load or the net force up or down which the pinch rolls exert on the slab. With this information, the operator knows when to speed up or slow down the pinch rolls and other driven rolls to maintain the

proper force on the slab without tearing its surface. If the weight drops too low, it is an indication the pinch rolls are on the verge of becoming overloaded, and the operation can be stopped.

While we have shown and described only a single embodiment of our invention, it is apparent that modifications may arise. Therefore, we do not wish to be limited to the disclosure set forth but only by the scope of the appended claims.

We claim:

1. In a continuous-casting machine which includes an open ended mold, trains of vertically spaced opposed pairs of guide rolls below said mold, a set of power-driven pinch rolls below said guide rolls, a frame in which said pinch rolls are journaled, and a curved casting guide below said pinch rolls, the improvement comprising a plurality of load cells on which said frame is supported for measuring the weight at said pinch rolls, and indicating means connected with said load cells to show the load pattern on said pinch rolls during a casting cycle.

2. A structure as defined in claim 1 further comprising a pair of beams on which said frame rests, there being four load cells each located under a different end of one of said beams.

3. A structure as defined in claim 2 further comprising a summing network to which said load cells are connected, said indicating means including a recorder connected to said amplifier.

4. A structure as defined in claim 3 in which said indicating means further comprises individual ammeters connected to the respective load cells for showing the weight measured by each one.