To all whom it may concern:

Be it known that I, Paul D. Wright, a resident of Wilkinsburg, Allegheny county, Pennsylvania, and a citizen of the United States, have invented a certain new and useful Try-Rod or Stock-Level Indicator for Blast-Furnaces, of which the following is a specification.

Modern blast furnaces are charged with the materials forming the furnace burden by machinery from stock bins located at or below the level of the furnace base. The furnace is kept filled up as nearly as possible to a certain predetermined level known as the "stock line." The workmen in the absence of continual supervision are prone to allow the stock level to become lowered by carelessness in charging the stock into the furnace in sufficient quantities or with sufficient regularity.

On account of the irregularities in the rapidity of the reduction of the materials in the furnace the stock level or top of the furnace burden also is liable to become lowered below the stock line without the knowledge of the workmen even when the furnace is charged in accordance with the workmen's instructions.

One object of my invention is to provide novel means whereby the stock level or level at which the furnace burden is maintained within the furnace is indicated.

Another object of the invention is to provide improved means whereby the height of the stock level is determined and the indicated level is recorded continuously through predetermined time intervals.

Another object of the invention is to provide novel apparatus by which the stock level is indicated or recorded or is indicated and recorded at or adjacent to the base of the furnace, or other remotely located point.

A further object of the invention is to provide a stock level indicator having novel means whereby the try-rod forming part of the indicating apparatus is automatically maintained in position on top of the furnace burden, and the possibility of the try-rod becoming buried in fresh additions of the charged materials is avoided and prevented.

A still further object of my invention is the provision of a stock level indicator for blast furnaces having the novel combinations, constructions, and arrangements of parts, shown in the drawings to be more fully described hereinafter, and specifically covered by the appended claims.

The accompanying drawings forming part of this specification illustrate apparatus embodying the invention.

In the drawings Figure 1 is a vertical section of the upper part of a blast furnace, showing in elevation means for determining the level of the charge, for indicating the same at a point outside and away from the furnace top and for making a record of the same.

Fig. 2 is a face elevation of a recording means.

Fig. 3 is a similar view of an alternative style of indicating and recording means.

Figs. 4 and 5 are enlarged sectional views of details.

The invention is shown applied to a blast furnace having a refractory lining A, hopper B and a bell C which is lowered to open the furnace at its top in introducing the stock charged into the furnace and is lifted against its seat to close the furnace.

This is the style of furnace commonly used in making iron and the furnace is fed at intervals with charges of ore, coke and limestone forming the burden of such furnaces.

The invention is applicable also to blast furnaces used in other arts.

A device which I call a try-rod because it determines the level of the burden by a trial method, and which may be either in the shape of a rod or in various other shapes, determines the height of the charge E.

The position of the try-rod is indicated on an indicating scale F by a pointer G, carried on a cable H which runs over suitable guide pulleys and is connected to the upper end of the rod D. When an addition of stock is to be charged into the furnace the rod D is lifted, and thereafter the rod is lowered to determine the new level of the burden within the furnace. The rod has an enlargement J on its lower end adapted to hinder its penetration into the burden.

The bell C is operated through an upwardly extending rod K connected to an arm L of a lever L, M pivoted at a fixed point. The arm M is yodellingly connected through a spring N to a cable O which winds around a small drum or pulley P attached to a larger pulley or drum Q, around which is wound a cable R; the ends of the cables O and R being fastened to their respective drums. The cable R passes over a fixed
guide pulley S and thence to a slide T mounted on the rod D and normally resting on the top of the furnace. The rod D has a head U by which it is lifted when the slide T moves upwardly sufficiently. Between the slide T and the head U is a coil spring V which cushions the blow.

The charging bell C has a comparatively short movement. The differential pulleys, or drums P and Q shown, form one means which may be used to secure a greater lifting movement of the try-rod. The beam, or lever, L M has its arms of such relative lengths as to produce a similar increased movement of the try-rod. The loose connection between the cable R and the try-rod, or between the bell and the try-rod keeps the cables H and R taut on the drums at all times, and at the same time, permits the closing of the bell without causing the try-rod to drop too suddenly. This rod is of considerable length and weight and if it dropped suddenly it would drive itself for some distance into the stock in the furnace. The spring V cushions the lifting movement of the rod when the bell is opened. To prevent the rod D from moving down suddenly and driving itself into the stock in the furnace, I prefer to provide a special retarding device. Various styles of dash pots and similar devices may be used for this purpose. A suitable device is illustrated in Figs. 1 and 5. The end of the cable H passes over a guide pulley and carries a counterweight W of cylindrical shape, moving within a tank X of fluid. The counterweight is light enough to be over-balanced by the try-rod, and carries a check valve Y which slides up and down on the rod Z by which the cable H is fastened to the counterweight. The face of the valve Y may be roughened to cause the fluid to withdraw when the rod is falling and the counterweight rising through the fluid. There is also a restricted space around the counterweight through which the fluid passes. When the try-rod is lifted the counterweight falls freely through the fluid, the check-valve Y rising to open the central passage through the weight. Sometimes the charge in the furnace suddenly slips, through the breaking down of arches of the material forming the burden, and the level of the charge drops suddenly a considerable distance. In such a case the try-rod will descend at a moderate rate, owing to the braking effect of the counterweight, until it finds the new level.

For keeping a record of the levels in the furnace a recorder may be used of the style shown in Fig. 2. Disk a is rotated slowly and is marked by a pen b, dropped off a shaft g, which carries a drum h, around which are passed a few turns of the cable H; so that the radial movement of the pen is determined by the movement of the try-rod.

In place of the indicator F of Fig. 1 and the recorder a of Fig. 2, various other styles of indicators and recorders may be used. An electrical mechanism is shown in Fig. 3. The threaded shaft d is turned one way or the other as the try-rod is raised or lowered. In the constant voltage circuit the nut e on the threaded shaft carries a contact strip f, which is always in engagement with a terminal strip k. The contact strip k, as the nut is shifted to the right or to the left, makes and breaks contact with the individual contact pieces l, arranged at the opposite end of the circuit and separated from each other by resistance coils m. The circuit passes through k through a wire n, a battery o or other source of current, wire p, indicating voltmeter r and recording voltmeter s, to the contact pieces l. The two meters are calibrated to read directly in terms of furnace level. It will be noted that, with apparatus constructed in accordance with my invention, the try-rod is automatically maintained on top of the furnace burden at all times and notwithstanding that fresh additions of stock to the furnace burden are being made at frequent and short time intervals. It will also be noted that variations in the height of the stock level above as well as below the desired stock line will be indicated and recorded. This is of particular advantage as it informs the furnace superintendent of a material increase in the height of the stock level above the desired stock line and informs him whether the furnace is being charged at the desired frequent short time intervals and also when charged at the undesired long and correspondingly infrequent time intervals.

The invention is designed for blast furnaces, but there are certain features thereof which are applicable to other furnaces and various other vessels having a charge or content which varies in height.

Though I have described with great particularity of detail certain apparatus embodying my invention, yet it is not to be understood therefrom that the invention is restricted to the particular embodiments disclosed. Various modifications thereof in detail and in the shapes and arrangements of the parts may be made by those skilled in the art without departing from the invention.

I claim:

1. The combination with a blast furnace and mechanism for charging said furnace, of a try-rod adapted to be lowered on to the burden within the furnace, to determine the height thereof, and mechanism for operating said try-rod arranged to move and thereby automatically maintain the try-rod...
the height thereof, and means for determining the height thereof, a counterweight for said try-rods and means for retarding the upward movement of said counterweight and permitting a rapid downward movement thereof.

7. The combination with a furnace of a try-rod adapted to be lowered onto the burden within the furnace to determine the height thereof, a counterweight for said try-rod, means for retarding the upward movement of said counterweight and permitting a rapid downward movement thereof, and a charging bell for the furnace adapted when moving into position to lift said try-rod and when in closed position to permit descent of the try-rod.

8. The combination with a furnace of a try-rod movably into and out of engagement with the top of the furnace burden, means for automatically maintaining said try-rod in engagement with the top of the furnace burden, an indicator, and means operatively connecting said indicator to said try-rod.

In witness whereof I have hereunto signed my name.

PAUL D. WRIGHT.