To all whom it may concern:

Be it known that I, Edwin E. Slick, a citizen of the United States, residing in the borough of Westmont, in the county of Cambria and State of Pennsylvania, (whose post-office is Johnstown, Pennsylvania,) have invented certain new and useful Improvements in Blast-Furnace Operation; and I hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in blast furnace operation, with special reference to a method of charging the stock, whereby certain cleavage lines and arrangements of minor concentrations are produced in the charge whereby all, or the major portion of the cross section of the material in the blast furnace stack, is more uniformly subjected to the reducing action of the gases and fuels. Under certain prior conditions of the arrangement of bells and hoppers of blast furnaces, the stock is distributed in layers, that is, with a large part of the fines in one place and a large part of the coarse material in other places, in such a way that the gases passing therethrough follow the lines of least resistance and a so-called chimney is formed through the charge, with the result that a blast furnace does not produce an output corresponding to its size or desired capacity.

By means of my invention these difficulties are obviated and I obtain a distribution of the stock such that the largest possible proportion of the cross section of the blast furnace is operative in all parts, without the tendency to the formation of deposits on the walls, or a local chimney through the charge, and my arrangement also prevents hanging, slips and scaffolds.

My arrangement is also such that lines of cleavage are formed in the various layers of stock so that when the layers below settle, due to the operation of the furnace, the charge above them gradually breaks on its cleavage lines, allowing the whole mass to settle uniformly and thereby preserve the desired arrangement.

In carrying out my invention I preferably discharge the stock into the top of the blast furnace in such a way that it is deposited in a plurality of mounds of slight elevation, arranged in various suitable ways, taking care, however, not to provide unbroken or concentric rings of coarser particles. The material being deposited in a plurality of mounds causes the larger pieces of the coke, flux and ore to roll down the surfaces of these mounds and to be segregated in the small or minor valleys between the mounds. This causes the stock to be distributed throughout the cross section of the furnace with reasonable uniformity but at the same time a plurality of cleavage lines are formed, due to the coarser particles of material. The result of this is such that when the lower layers of the stock settle, due to the operation of the furnace, the smelting of the ores, the burning of the coke and the fusing of the flux, the portion of the charge above them gradually breaks on its plurality of cleavage lines allowing the whole mass to settle uniformly and thereby preserve the desired arrangement, whereby the entire section of the furnace is operative in all its parts without any tendency to the formation of irregularly located local chimneys, and the arrangement also prevents the serious troubles due to the hanging of the charge and the slippage of large quantities of same into the white hot cavities formed, with disturbing and destructive effects which is the result when other methods are used.

The result of the actual operation of my method has shown that the stock was distributed in three directions, part going outwardly toward the walls of the furnace, another part going almost vertically downward from the skirt of my distributor and another part going inwardly, the whole forming a plurality of mounds, the finer materials being generally at the tops of the mounds and the coarser materials at the bases thereof, or in the minor valleys between the mounds, and some in the center of the furnace.

The charging of materials into a blast furnace in the manners previously used results in the formation of one or more approximately concentric rings of material with the larger particles of coke, ore and flux forming a cylindrical column in the center of the furnace or thereabout, with the result that when smelting a charge so arranged, a local chimney or stack is formed up through this coarser material which smelts more rapidly than the other more compact portions surrounding the same and
the approximately cylindrical column of stock settles down and produces a large cavity in the charge. On account of the circular and strong arched form of the materials surrounding this opening, these outer materials do not settle until a large approximately cylindrical cavity has formed, after which they finally break and fall in large masses into the cavity with destructive and disturbing effects. These are known as "slips," which are produced by the scaffold or hanging portions of the cylindrical walls falling into the cavity. All this is obviated by my method of blast furnace operation, which divides the charge into a plurality of columns separated by the cleavage lines as previously described, whereby the stock settles uniformly and quietly at all times in all parts of the furnace.

Having thus given a general description of my invention, I will now, in order to make the matter more clear, refer to the accompanying sheet of drawings which form part of this specification and in which like characters refer to like parts.

Figure 1 is a vertical transverse sectional elevation of the top portion of a blast furnace showing the application of my invention, this being taken on the lines 1—1 of Figs. 2 and 3.

Fig. 2 is a top plan view of the surface of the materials after they are charged into the furnace, showing the conformation or the manner in which they are distributed.

Fig. 3 is a top plan view of the distributor forming part of the apparatus used in my method.

Referring now to the characters of reference—

1 indicates the top of the furnace generally, 2 the upper or receiving hopper, and 3 the lower or charging hopper. 4 represents a small distributing bell, and 5 is the large charging bell. A small bell seat is indicated as 6; 7 indicates a seal ring for the large charging bell, while 8 indicates my distributor in general. 9 are the fingers of my distributor, 10 the openings in, or spaces between the same, and 11 indicates the top flange of the distributor. A flanged shelf upon which the hopper 3 rests is indicated as 12. 13 indicates inner flanges for securing together the sections of the distributor; 14 are bolt holes in the flanges 13, while 15 indicates bolts for attaching together the sections of my distributor. 16 is a vertical central rib on each section of the distributor, 17 are the integral brackets connecting the top flange 11 and the sides of the distributor. 18 indicates holes through the top flange 11, while 19 indicates rods for securing the distributor to the top of the furnace. Small mounds of material are indicated as 20, the central portion of these mounds being formed of the finer materials and the outer portions in the valleys 21 between the mounds being composed of coarser materials, which latter form predetermined cleavage lines throughout the stock, which lines extend downwardly through the body of the same, thereby separating the charge into a plurality of small columns, which columns are preferably not ring shape or circular.

The central low portion of the charge is indicated as 22, which also is composed of coarser materials, and 23 are the intermediate high points of the mounds between the low parts or valleys 21 and the central low portion 22.

In the charging of blast furnaces, successive quantities of coke, ore and limestone are fed therein through the distributing and charging bells. When the receiving hopper has obtained a charge, the charging bell is lowered, whereupon the material slides down on the surface of said bell and portions impinge against the fingers 9 of my distributor. This deflects those portions of the charge toward the center of the furnace, while those portions which pass between the fingers continue in their travel outwardly toward the walls of the furnace. A cross section of an actual arrangement of materials which have been charged by my method is as shown in Fig. 1, and an actual plan view of the same is illustrated in Fig. 2.

It will be noted from Fig. 2 that there are certain locations where the layers of material are of greater coarseness than at others, and this, together with the dome-like form of the deposits, forms cleavage or breaking lines which will allow the stock to settle quietly and regularly as the portions below it move downwardly.

The dotted lines in Fig. 1 represent the lower positions of the bells. The lower charging bell may be so adjusted as to be moved downwardly, more or less, than as indicated by dotted lines, in order to adjust the distribution of the material.

Although I have shown and described my improvements in considerable detail, I do not wish to be limited to the exact and specific details shown and described, but may use such substitutions, modifications or equivalents thereof as are embraced within the scope of my invention, or as pointed out in the claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. The method of operating blast furnaces which consists in discharging the materials into the top portion thereof, causing a portion of the material to be discharged in a plurality of streams toward the sides of the furnace and other portions to be discharged in a plurality of streams toward the center of the furnace, thereby forming a plurality of streams in the furnace.
rality of columns separated by the coarser materials, whereby the stock settles and smelts uniformly.

2. The method of operating a blast furnace, which consists in charging the stock into the upper portion thereof, causing a portion of the same to be discharged toward the outside walls of the furnace, other portions of the same to be discharged toward the center of the furnace, thereby forming a plurality of mounds on the upper surface of the stock, the centers of said mounds being composed of finer materials and the valleys between them of coarser materials, thereby providing a plurality of columns extending downwardly through the charge, separated by numerous channels and lines of cleavage, whereby the stock settles and smelts uniformly.

3. The method of operating a blast furnace which consists in charging the stock into the upper part thereof, causing a plurality of portions of the same to be discharged toward the side walls of the furnace, another plurality of portions of the same to be discharged toward the center of the furnace and other portions to be discharged more directly downward, thereby forming a plurality of columns in the stock, separated by irregular and predetermined lines of cleavage, whereby the gases pass upwardly through all portions of the charge and the charge smelts and settles uniformly in all portions of the furnace.

In testimony whereof I hereto affix my signature in the presence of two witnesses.

EDWIN E. SLICK.

Witnesses:
A. Dix Tittle,
Elmer E. Werry.