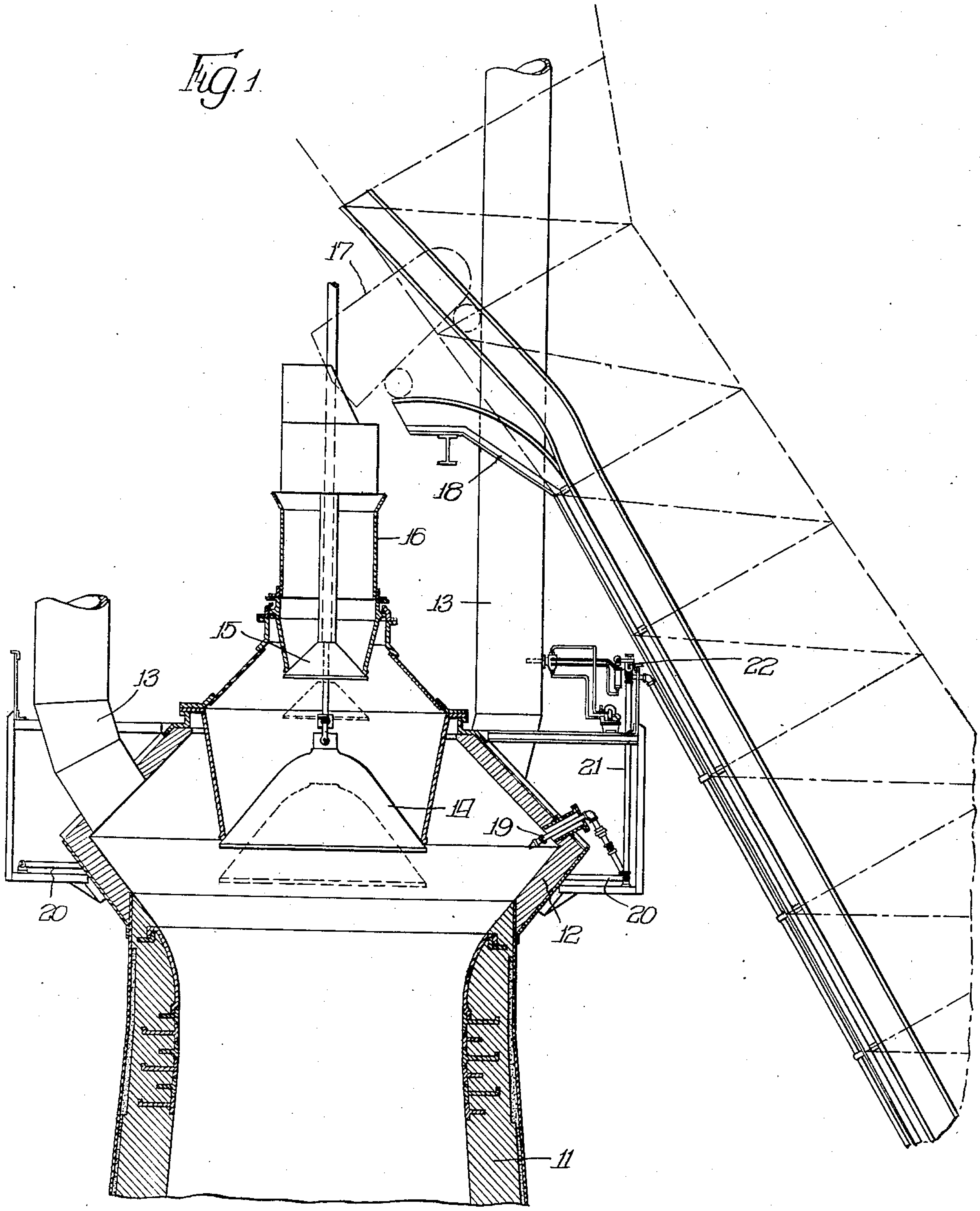
Feb. 14, 1933. H. A. BRASSERT 1,897,750

METHOD OF BLAST FURNACE OPERATION

Filed Sept. 18, 1931 2 Sheets-Sheet 1

Fig. 1



Inventor:
Herman A. Brassert,
By Wilkinson Husley Byron & Knight
Attys.

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Filed Sept. 18, 1931 2 Sheets-Sheet 2

Fig. 2.

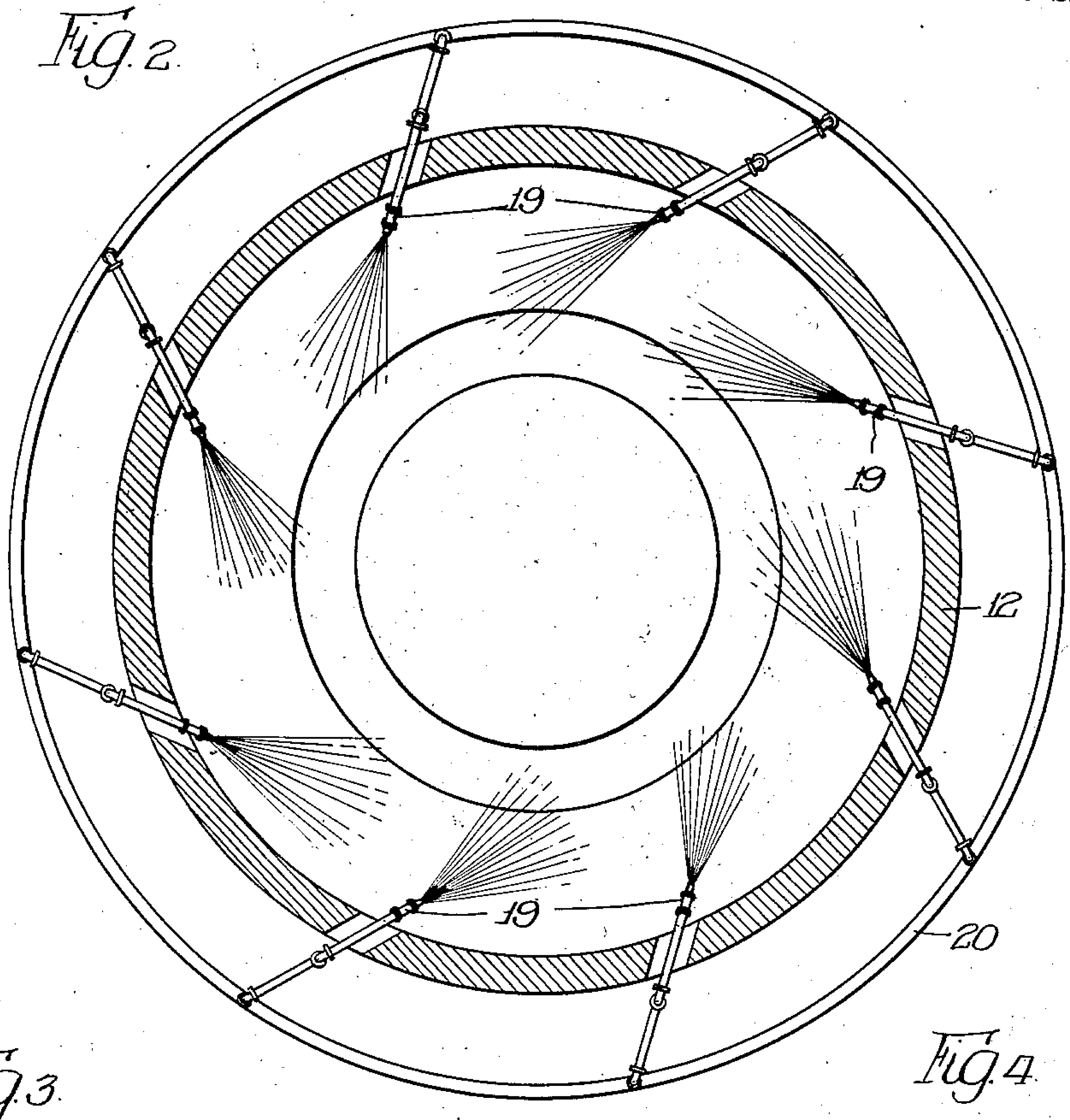


Fig. 3.

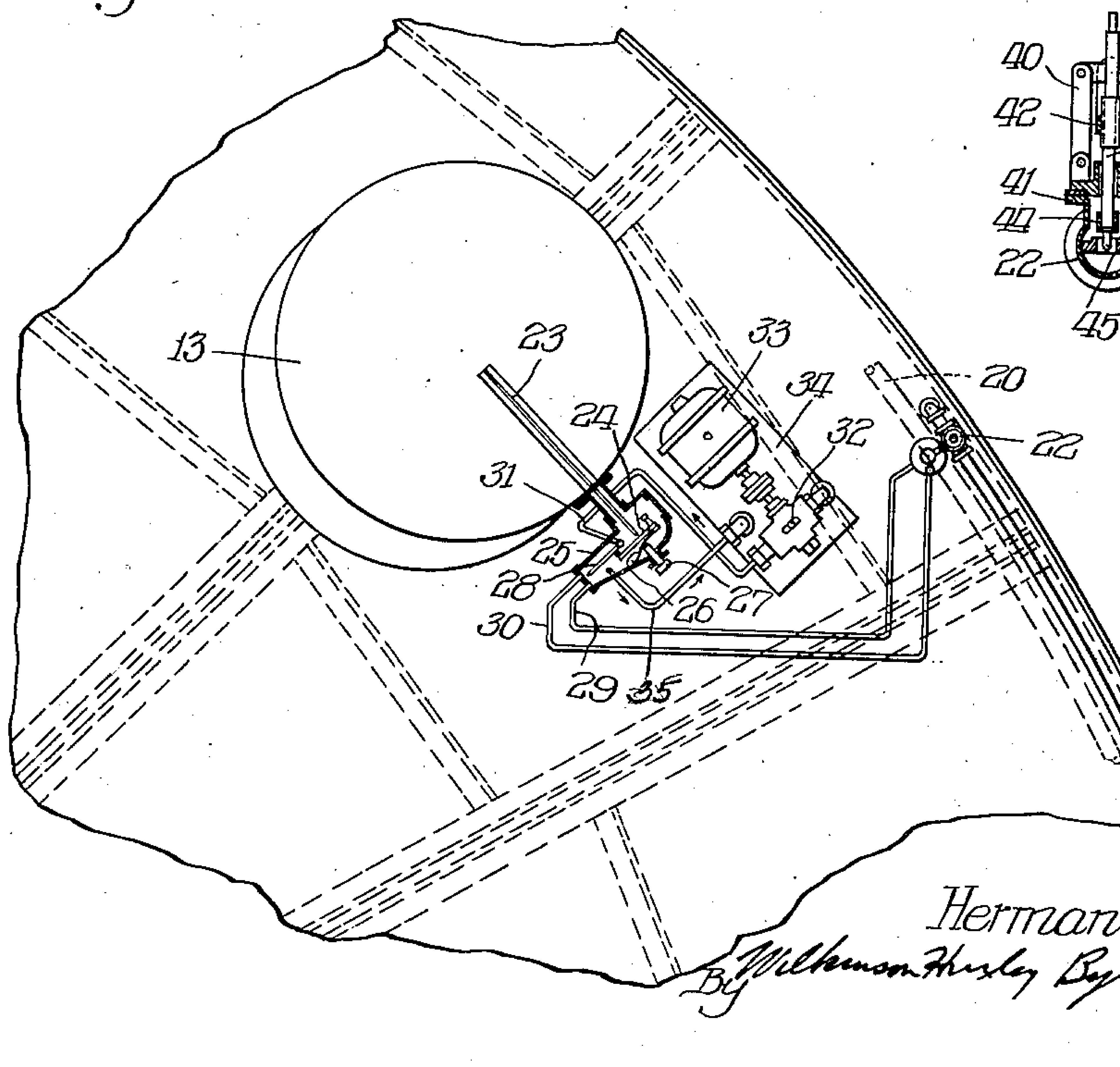
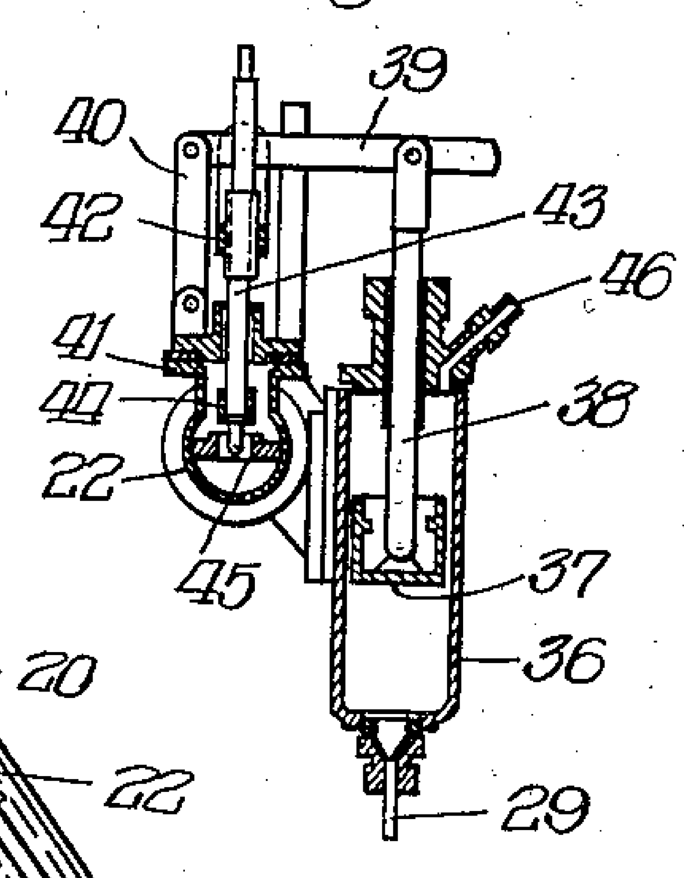


Fig. 4.



Inventor:
Herman A. Brassert,
By Wilkinson Huxley Byron + Knight
attys.

Patented Feb. 14, 1933

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UNITED STATES PATENT OFFICE

HERMAN A. BRASSERT, OF CHICAGO, ILLINOIS, ASSIGNOR TO H. A. BRASSERT & COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

METHOD OF BLAST FURNACE OPERATION

Application filed September 18, 1931. Serial No. 563,601.

This invention relates to a new and improved method of blast furnace operation, and more particularly to a method for maintaining a substantially uniform top temperature both as to gases and as to the upper layers of stock.

One of the chief defects in blast furnace operations comes from the fact that due to variation in the quality of the raw materials and their distribution in the furnace, and due to changes in the heat and moisture of the blast and other variables, the melting zone and the zones of reduction above are not maintained in the position established in normal efficient practice; and that by an extension of the melting zone upward into the reduction zone and a simultaneous rise in stack temperature, the relative position of the zones of direct and indirect reduction changes, unbalancing these important reactions and leading not only to uneconomic operations from the point of view of heat economy but often to hanging and slipping of the furnace. The flue dust losses which are concurrent with such irregularities are one of the greatest sources of monetary losses in furnace operations and can be greatly decreased if it is possible to maintain the correct temperatures throughout the furnace stock.

With modern hot blast equipment it is possible to maintain the blast at a substantially even temperature, it is also possible to compensate for irregularities in the moisture of the blast by a corresponding increase or decrease in blast temperature; or the moisture can be entirely eliminated through treating the blast by well known methods, but it is not possible to so control the physical and chemical quality of the raw materials that the heat reactions in the furnace will be uniform at all times. These irregularities will often cause an uneven distribution of the gases through the stack, including channeling of excessive quantities of gases through certain sections, for instance, up on the walls. This causes local rises in temperature, increasing the amount of flue dust in those regions by sweeping a portion of the fines up with the gas stream ascending with abnormally high velocities.

I find that this condition can be counteracted and largely prevented if we can succeed in keeping the top temperatures of the furnace uniform, not only in respect to that of the gases but also to that of the materials in the top layers. Attempts have been made to accomplish this by adding varying amounts of water to the stock and the practice is old and well known to add a certain amount of water to the ores before they are hoisted to the top of the furnace. This particularly applies to fine ores which are wetted down for the purpose of preventing the fines from blowing over and making flue dust.

This method has the disadvantage of being irregular and subject to the whim of the operator and furthermore, fulfilling its purpose in only a very limited manner by reason of the inability to uniformly distribute the water throughout the ore. It carries no possibility of uniform control of the top temperature. This control of the top temperature which is so important in order to avoid the aforesaid irregular operations, I obtain by injecting a measured amount of water into the furnace top below the main charging bell in such a manner as to distribute it evenly over the entire charge and automatically controlling the amount of this water by the top temperature. In this manner I not only maintain a uniform temperature of the top gases but I also maintain a uniform temperature of the upper layers of the stock, the effect of which is carried down to the lower zones with the result that I obtain progressively uniform zones of reduction and finally a uniform melting zone.

It is an object of the present invention to provide a new and improved method of blast furnace operation.

It is a further object to provide a method of this character in which the top temperatures may be maintained substantially uniform both as to gases and as to the top layers of stock.

It is an additional object to provide a method for accomplishing this result, which operation is controlled automatically by the top temperatures.

It is also an object to provide a method of this character which is carried out by the use of cooling fluids, such as water or other cooling mediums which are injected into the upper portion of the furnace.

Other and further objects will appear as the description proceeds.

I have shown a preferred embodiment of apparatus for carrying out my improved method in the accompanying drawings in which—

Figure 1 is a fragmentary vertical section showing the top of a blast furnace with my invention applied thereto.

Figure 2 is a transverse section through the plane of the nozzles of Figure 1.

Figure 3 is a fragmentary plan view showing the control apparatus, and

Figure 4 is a fragmentary section through the fluid supply valve and control cylinder.

In the drawings the blast furnace is shown as having an upper outwardly flaring portion 12 leading to the offtakes 13. The furnace is shown as provided with usual charging apparatus including the lower bell 14, upper bell 15, hopper 16, skip 17 and skip hoist 18.

A plurality of tangentially located nozzles 19 are provided extending into the upper flaring portion of the furnace. These nozzles are all fed with fluid from a circular header 20 which is fed through pipe 21 from valve 22. These nozzles are adapted to discharge fluid into the upper portion of the furnace to cool both the gases and the upper layers of material.

The automatic control provided comprises the heat responsive control member or bar 23 extending into the offtake 13, as shown on Figure 3, so that it is affected by the heat of the gases passing up through the offtake. The inner end of the bar 23 engages a pivoted arm 24 in housing 25, this arm 24 being held against the bar by spring 26, the tension of which may be adjusted by screw 27. The arm 24 is connected by a link with the pivoted nozzle 28 which is directed toward the two outlet pipes 29 and 30. The pipe 31 leads to nozzle 28 from the oil pump 32 which is driven by motor 33 and fed from oil reservoir 34. The oil return pipe 35 leads from housing 25 to the reservoir 34.

The control cylinder and valve are shown in Figure 4, where cylinder 36 contains the piston 37 connected by piston rod 38 to the arm 39. This arm is connected by link 40 to the valve housing 41 and is also connected to yoke 42 which is connected to valve stem 43. The valve 44 is adapted to co-act with the valve seat 45. The cylinder 36 has the connection 46 to connect pipe 30 at its upper end and at its lower end is connected to pipe 29.

In the operation of the control device, as the bar 23 expands upon the temperature rising in the offtake 13, it swings the arm 24 in a counter clockwise direction against the tension of spring 26. The connecting link also causes the nozzle 28 to be swung in the counter clockwise direction. The major pressure from the oil flowing from nozzle 28 is thus directed into pipe 29 and consequently into the lower portion of cylinder 36 against the under side of piston 37. This pressure forces the piston 37 upwardly and through piston rod 38, arm 39, yoke 42 and valve stem 43, it lifts valve 44 from valve seat 45. This permits a flow of cooling fluid through pipe 21 to header 20 and thus through nozzles 19 by which it is sprayed into the top of the furnace.

Similarly when the gases in the offtake 13 become cooled, the bar 23 shrinks, the arm 24 is forced in a clockwise direction by spring 26, the nozzle 28 is swung in the clockwise direction and the heavier oil pressure is transmitted through pipe 30 to the upper side of piston 37 and the valve 44 is forced down against its seat 45, thus cutting off the flow of cooling fluid.

It will be understood that the particular type of control which has been shown is to be taken as illustrative only as my invention may be carried out in other ways and by other forms of control and I contemplate such changes and modifications as come within the spirit and scope of the appended claims. While ordinarily water will be the fluid used for discharge through the nozzles, it may be found advisable to inject a certain amount of gas togethei with the water in order to increase the kinetic energy or centrifugal force of the revolving gases. This is for the purpose of causing the dust to separate itself from the path of the gases in accordance with the Eichenberg system for the prevention of flue dust.

I claim:

1. The method of blast furnace operation which comprises injecting a cooling medium into the top of the furnace and controlling the injection of said medium by means responsive to the temperature of the gases at the top of the furnace.

2. The method of blast furnace operation which comprises spraying water at a plurality of points into the top of the furnace and controlling the water spray automatically by means responsive to the furnace top temperatures.

Signed at Chicago, Illinois, this 15th day of September, 1931.

HERMAN A. BRASSERT.