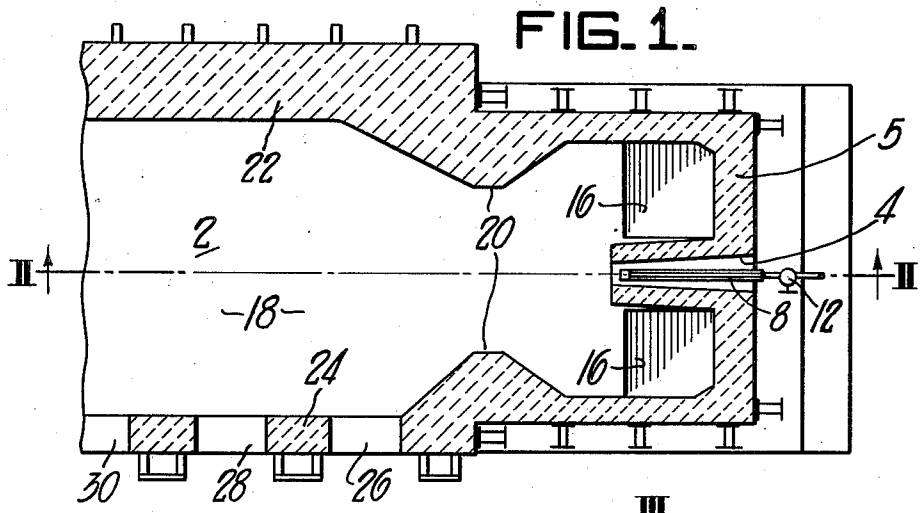
May 29, 1951 F. H. BARNES ET AL 2,554,609

METHOD OF OPERATING OPEN HEARTH FURNACES

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FIG. 1.



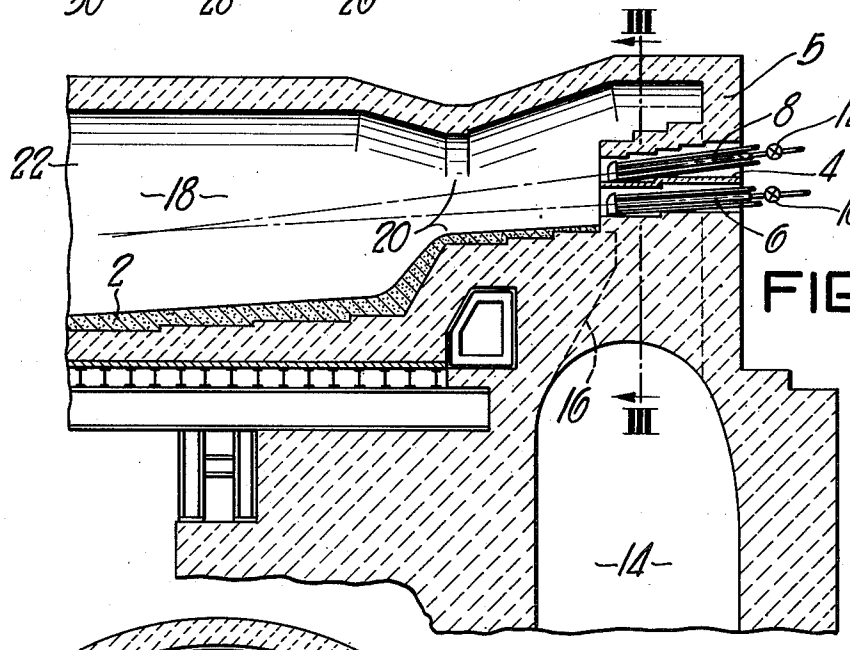


FIG. 2.

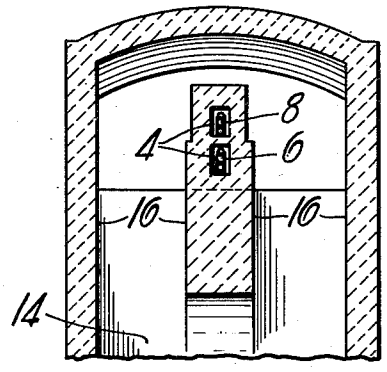


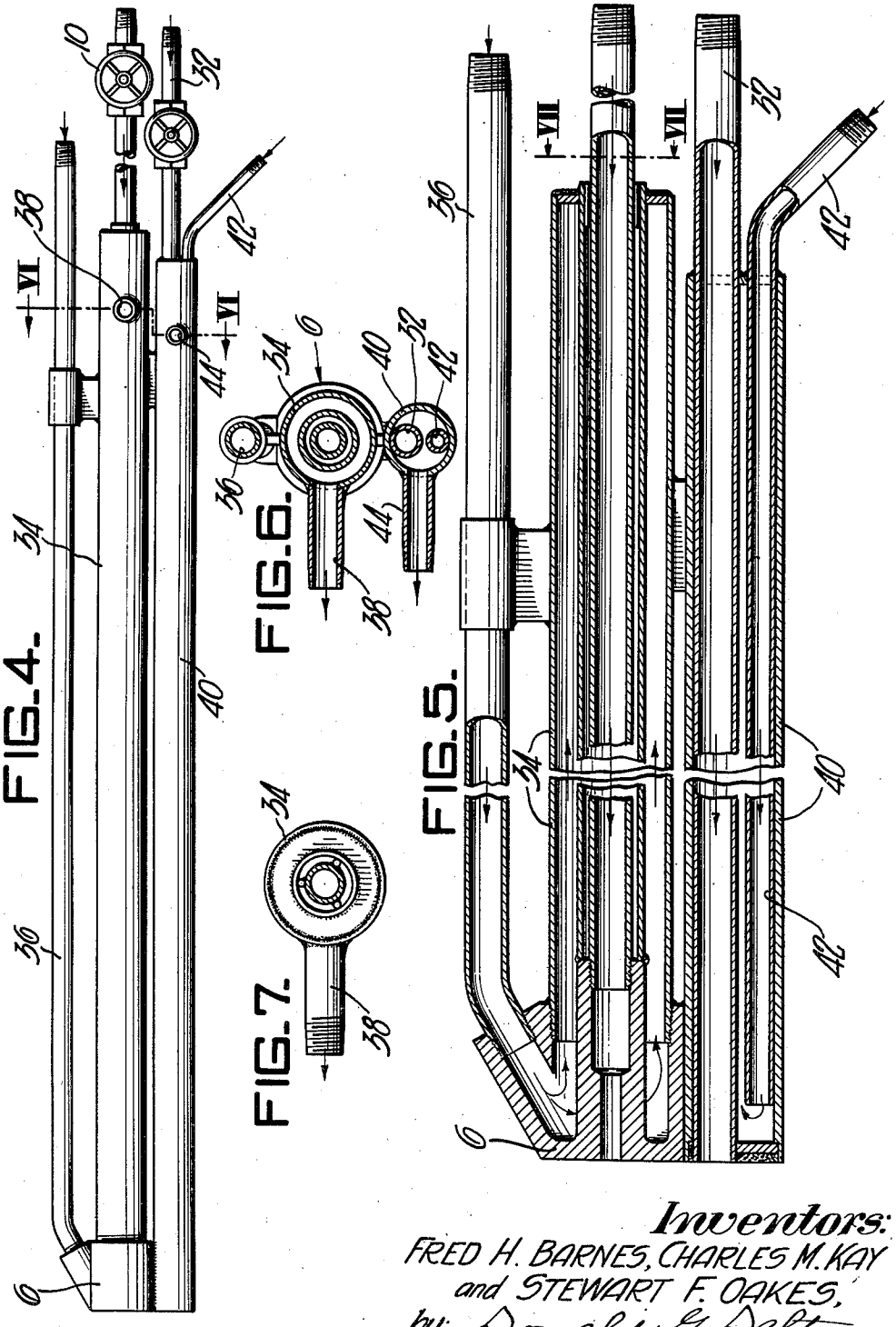
FIG. 3.

Inventors:
FRED H. BARNES, CHARLES M. KAY
and STEWART F. OAKES,
by: Donald G. Dalton
their Attorney.

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Inventors:
FRED H. BARNES, CHARLES M. KAY
and STEWART F. OAKES,
by: Donald G. Dalton
their Attorney.

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2,554,609

METHOD OF OPERATING OPEN-HEARTH FURNACES

Fred H. Barnes, Charles M. Kay, and Stewart F. Oakes, Worcester, Mass., assignors to The American Steel and Wire Company of New Jersey, a corporation of New Jersey

Application January 10, 1948, Serial No. 1,577

4 Claims. (Cl. 75—43)

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This invention relates to a method of operating open hearth furnaces and more particularly to operating such furnaces when they are using scrap metal as part of the charge. In the operation of such furnaces, scrap is first charged into the furnace and melted down, after which cold or hot iron or both are added and the entire charge refined. Various types of fuel, such as gas, oil and tar, are used in heating the furnace. In some instances a combination of gas and oil or tar is used. This invention relates to those furnaces in which oil or tar are used separately or in combination with gas and for the purpose of this application, any fuel made up in whole or in part of a liquid will be termed "liquid fuel." In heating the charge, the heat is supplied alternately from each end of the furnace and ordinarily a single burner is used at each end of the furnace. In some instances where gaseous fuels are used, two burners may be used at each end of the furnace, but these are commonly low pressure burners firing in approximately a horizontal plane at an angle to the longitudinal center line of the furnace. The amount of heat required varies at different stages of the heat. The desired characteristics of the flame are also different at various stages of the heat. When using a single liquid fuel burner it is difficult to obtain the desired concentration of heat at all times and it is also difficult to maintain the correct flame characteristics. During the melting down period a sharp, short intense luminous flame is preferable while during the refining period a longer luminous flame is preferred. In using a single burner the volume of fuel is such that the combustion is somewhat delayed because the fuel and air do not mix readily, and as a result, the melting down of the scrap charge is delayed because the maximum flame temperature is not obtained wih the desired speed.

Due to normal furnace construction and the relative position of the bridge walls and burners, it has been difficult to provide the air in a manner to obtain combustion of the liquid fuel close to the entrance end of the furnace when using a single burner at top capacity. As a result, a considerable amount of fuel burns near the exit end of the bath or may even burn as it leaves the furnace through the downtakes. We have found that by introducing compressed air directly below the fuel stream the speed of combustion is increased with an accompanying increase in melting rate and fuel efficiency. It has been suggested that air be introduced around the

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periphery of the fuel outlet, but this does not act to supply the combustion air in the desired manner.

It is an object of this invention to provide a method of firing an open hearth furnace in which compressed air is introduced into the furnace directly beneath the fuel stream in a furnace having either a single or double burner.

This and other objects will be more apparent after referring to the following specification and attached drawings, in which:

Figure 1 is a horizontal sectional view taken at the burner ports;

Figure 2 is a sectional view taken on the line II—II of Figure 1;

Figure 3 is a sectional view taken on the line III—III of Figure 2;

Figure 4 is an elevation of the lower burner and auxiliary air supply;

Figure 5 is a longitudinal section through the lower burner and auxiliary air supply;

Figure 6 is a sectional view taken on the line VI—VI of Figure 4; and

Figure 7 is a sectional view taken on the line VII—VII of Figure 5.

Referring more particularly to the drawings, the reference numeral 2 indicates the hearth of an open hearth furnace. The ends of the furnace are the same and therefore only one end is shown in the drawings and will be described herein. A pair of burner tunnels 4 are provided through the end wall 5 and two liquid fuel burners of conventional design are located therein. The lower burner 6 is arranged approximately on the center line of the furnace with its axis arranged at an angle to intersect the surface of the charge. Directly above the burner 6 is the burner 8 which is arranged at a steeper angle than burner 6 so that its extended axis will intersect the extended axis of burner 6 at a point beyond the point of intersection of the axis of burner 6 with the charge. As is usual, the liquid fuel is atomized with steam or air and the flow of the mixture of steam or air and fuel to burners 6 and 8 is regulated by means of valves 10 and 12, respectively. Air for combustion is supplied from a checker chamber 14 through the air uptakes 16 and flows into the melting chamber 18 of the furnace around the streams of fuel from burners 6 and 8. The mixing of the fuel and air is accelerated as it passes through the restricted passageway or throat 20. The furnace is provided with the usual back wall 22 and front wall 24 having door openings 26, 28 and 30 therein. The opening 30 is on the center line of

the furnace and two openings similar to openings 26 and 28 are located on the opposite side of the center line.

As best shown in Figures 4 through 7, compressed air is introduced into the furnace through a pipe 32 located directly beneath and substantially parallel to the burner 6. As is usual, water is supplied to the water jacket 34 of the burner 6 through the water inlet 36, the water being discharged from the jacket 34 through the pipe 38. The compressed air pipe 32 is preferably surrounded by a pipe 40 which acts as a water jacket and, as shown, is welded to the burner 6. Water is introduced into the pipe 40 through the inlet pipe 42 and is discharged through the pipe 44.

The furnace is operated as follows:

Metal scrap is charged into the furnace, burners 6 and 8 are started in operation and compressed air is introduced through the pipe 32. The air from the checker chamber 14 flows upwardly through the uptake 16 around the streams of fuel flowing from the burners. The streams of fuel flowing from the burners flow longitudinally into the chamber 18 with the stream from the burner 6 being directed downwardly at an angle to impinge on the charge and the stream from the burner 8 being directed above the first stream downwardly at an angle to impinge on the charge at a point beyond the point of impingement of the first stream on the charge. The center lines of the streams of fuel intersect at a zone between one-third and one-half the length of the furnace (as measured between the burner tips at each end of the furnace) from the burners. In the furnaces in which the method is being used, this zone includes doors 28 and 30 and the space therebetween. Because of the bulkiness of the scrap charge it is advantageous to have the two flames impinge on the charge at different positions and at different angles.

In the furnaces in which the method is being used we have found that the compressed air being delivered to the furnace should have a minimum pressure of 30 pounds per square inch, but better results are obtained when the pressure is increased to 100 pounds per square inch or more. At 100 pounds per square inch pressure and one inch diameter opening, 1600 cubic feet of air per minute is introduced at a temperature of approximately 200° F. The compressed air supplied may be 2 to 20% by weight of the total combustion air being supplied. By supplying air in this manner, combustion starts at the burner tip and progresses gradually until it strikes the charge with the greatest amount of heat being concentrated downwardly on the charge where it is most useful. The advantages of the compressed air are greatest during the melting period, but some advantages accrue at other times.

While we have shown and described the invention relating to supplying compressed air beneath the lower burner of a pair of burners, many of the advantages of the use of the compressed air are obtained when using a single burner. If desired, compressed air can also be used to advantage beneath the top burner. We have found that it is advantageous to provide from 30 to 75% of the fuel through the top burner and the remaining fuel through the lower burner. As compared to the single burner previously used, about 25% more fuel may be used efficiently with the double burners. On single burners about 3.05 pounds of steam are consumed per gallon of oil fired whereas the total steam consumption is about 3.5 pounds per gallon of oil fired when two burners are used, this being approximately a 15% increase per gallon of oil. Due to the increase in fuel consumption, approximately 1290 pounds of steam is consumed per hour with double burners as compared to 920 pounds on a single burner, this being an increase of approximately 40%. During the refining period, the top burner 8 is shut off and only the lower burner 6 is used. This is necessary because the large amount of heat liberated through the use of the two burners and increased fuel will overheat the roof and walls if there is an insufficient amount of cold charge available to absorb the heat input. Preferably during the refining period the compressed air is shut off and only the lower burner 6 is used.

It will be understood that the furnace will otherwise be operated in the manner normal to such furnaces, that is, it will be reversed at intervals and on each reversal the burners and the air on one end will be shut off and the burners and the air on the other end turned on.

While one embodiment of our invention has been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

We claim:

1. In the method of making steel in the melting chamber of an open hearth furnace which includes the step of charging metal scrap into the furnace, the improvement in the melting step thereof comprising projecting a stream of liquid fuel from a burner into one end of and longitudinally of said chamber, said stream being directed downwardly at an angle to impinge on said charge, introducing a stream of compressed air at a pressure of at least approximately 30 pounds per square inch into said chamber directly below and substantially parallel to said stream of fuel, said stream of compressed air being substantially the only compressed air introduced adjacent said stream of fuel, and flowing into said chamber a stream of preheated air around said streams.

2. The method of burning fuel in the melting chamber of an open hearth furnace which includes the steps of charging metal into the furnace, projecting a stream of liquid fuel from a burner into one end of and longitudinally of said chamber, said stream being directed downwardly at an angle to impinge on said charge, introducing a stream of compressed air into said chamber directly below and substantially parallel to said stream of fuel, said stream of compressed air being substantially the only compressed air introduced adjacent said stream of fuel, and flowing into said chamber a stream of preheated air around said streams, said compressed air constituting approximately between 2% and 20% by weight of the total amount of combustion air supplied.

3. The method of burning fuel in the melting chamber of an open hearth furnace according to claim 2 in which a second stream of liquid fuel is directed into said chamber above the first stream downwardly at an angle to impinge on said charge at a point beyond the point of impingement of the first stream on the charge, and supplying from 30% to 75% of the fuel through the top burner, and the remainder through the bottom burner.

4. The method of burning fuel in the melting chamber of an open hearth furnace which includes the steps of charging metal into the furnace, projecting a stream of liquid fuel from a burner into one end of and longitudinally of said chamber, said stream being directed downwardly at an angle to impinge on said charge, introducing a stream of compressed air at a pressure of at least approximately 30 pounds per square inch into said chamber directly below and substantially parallel to said stream of fuel, said stream of compressed air being substantially the only compressed air introduced adjacent said stream of fuel, and flowing into said chamber a stream of preheated air around said streams, said compressed air constituting approximately between 2% and 20% by weight of the total amount of combustion air supplied.

FRED H. BARNES.
CHARLES M. KAY.
STEWART F. OAKES.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,513,828	Kernohan et al.	Nov. 4, 1924
1,554,251	Schieldrop	Sept. 22, 1925
1,736,675	Steese	Nov. 19, 1929
1,830,574	Thwing	Nov. 3, 1931
1,860,045	Mambourg	May 24, 1932
1,907,140	Bartholomew	May 2, 1933
1,955,589	Leahy	Apr. 17, 1934
1,964,544	Trinks	June 26, 1934
2,025,165	Henry	Dec. 24, 1935
2,233,916	Creighton	Mar. 4, 1941
2,310,454	Mulholland	Feb. 9, 1943
2,362,085	Morgan	Nov. 7, 1944
2,385,261	Crowe	Sept. 18, 1945
2,412,579	Hauzvic	Dec. 17, 1946
2,417,951	Schwartz	Mar. 25, 1947
2,446,511	Kerry et al.	Aug. 3, 1948
2,466,258	Morgan	Apr. 5, 1949
2,484,272	Crowe	Oct. 11, 1949

OTHER REFERENCES

Open Hearth Proceedings, 1944, pages 126, 127, and 129.

Open Hearth Proceedings, 1947, pages 73, 74, and 82, published by the A. I. M. E., New York, N. Y.

Blast Furnace and Steel Plant, Jan. 1948, page 66, published by Steel Publications, Pittsburgh, Pa.