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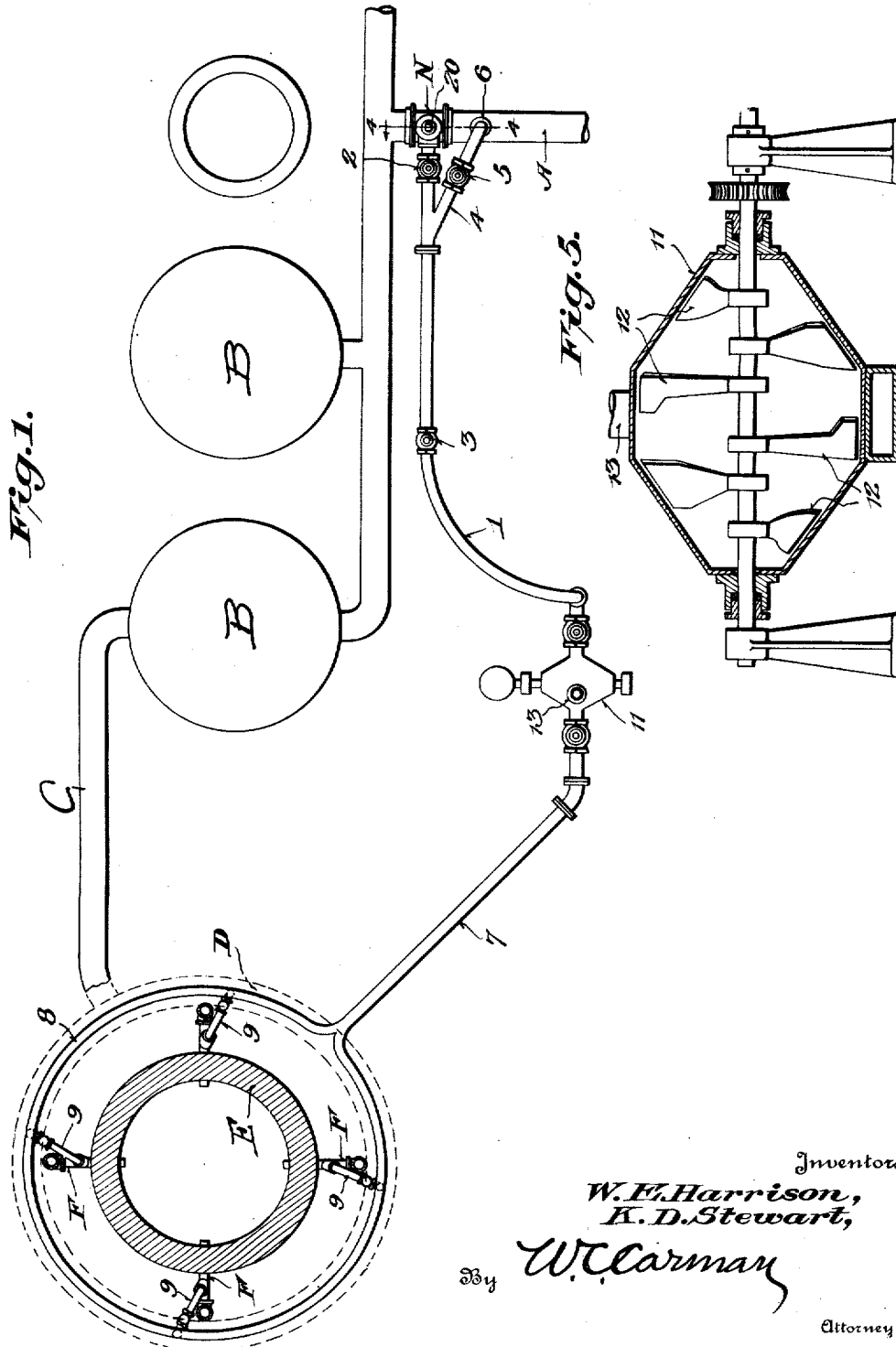
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W. E. HARRISON ET AL

CHARGING SYSTEM FOR BLAST FURNACES

Filed Feb. 24, 1921

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

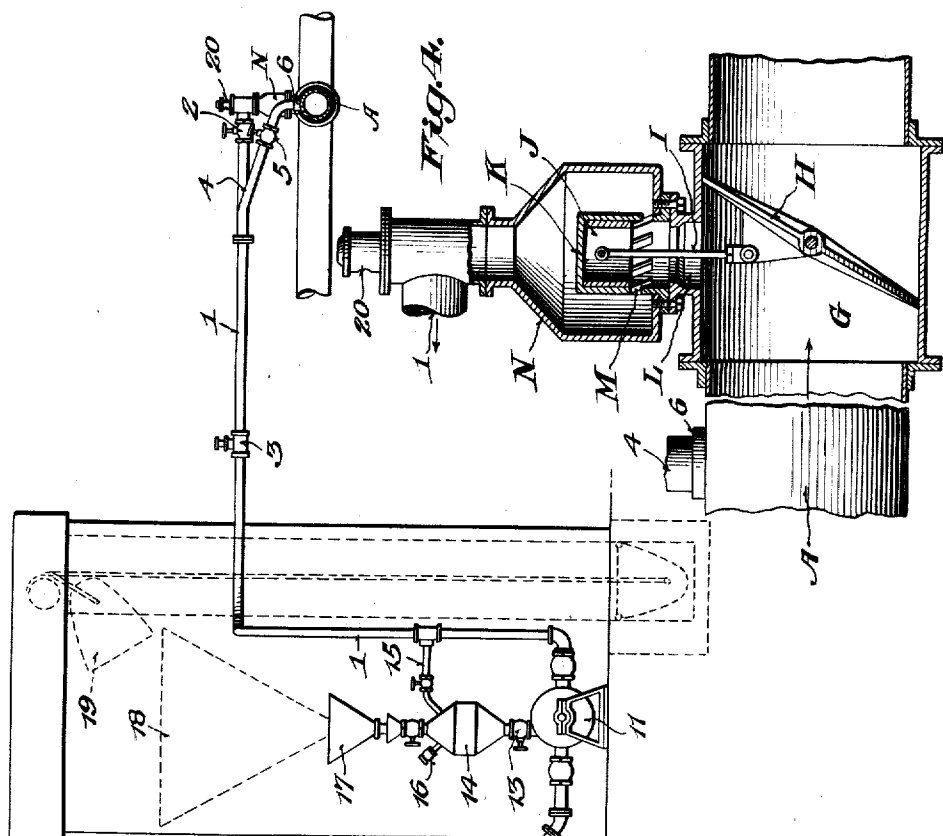


Fig. 2.

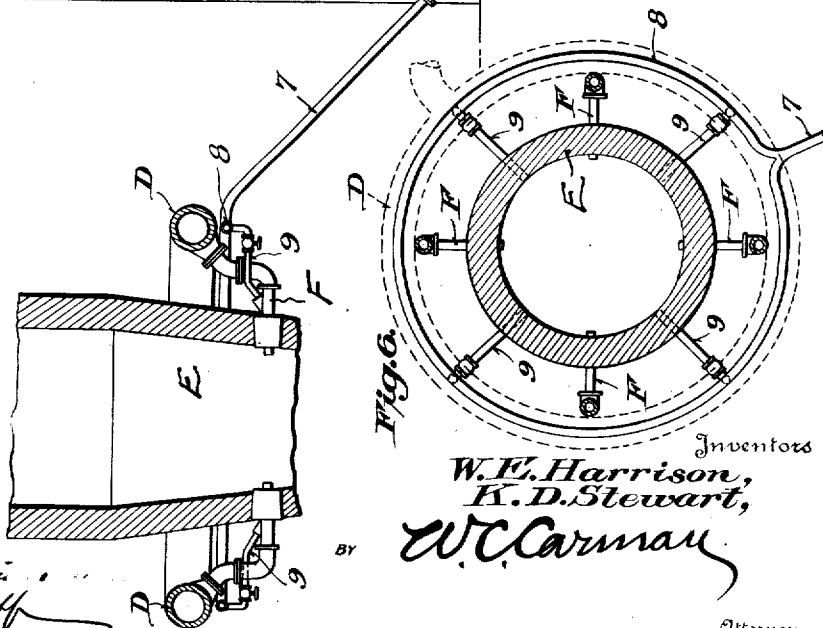


Fig. 6.

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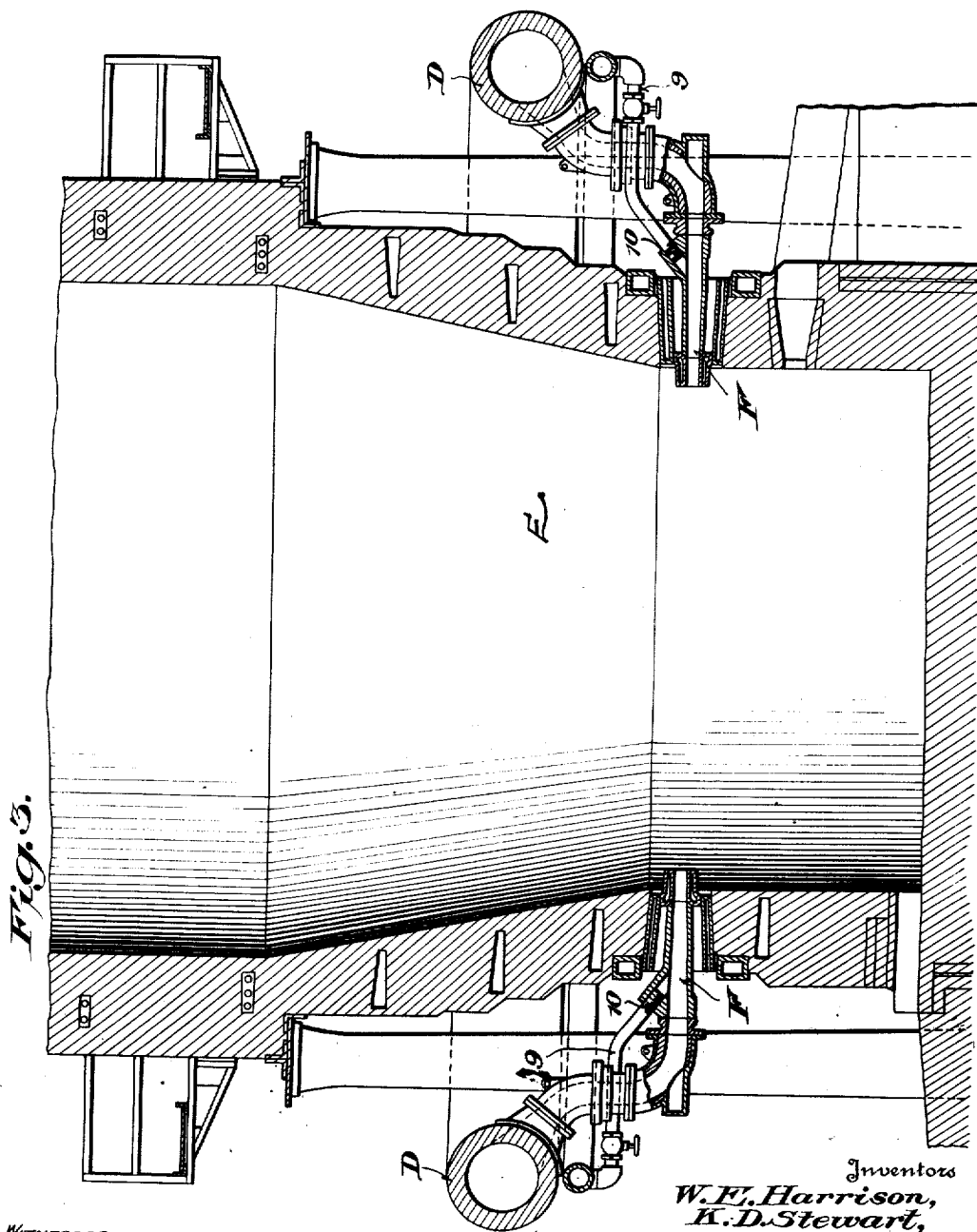
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CHARGING SYSTEM FOR BLAST FURNACES

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

WILLIAM E. HARRISON AND KENNETH D. STEWART, OF YOUNGSTOWN, OHIO.

CHARGING SYSTEM FOR BLAST FURNACES.

Application filed February 24, 1921. Serial No. 447,497.

To all whom it may concern:

Be it known that we, WILLIAM E. HARRISON and KENNETH D. STEWART, citizens of the United States, residing at Youngstown, in the county of Mahoning and State of Ohio, have invented certain new and useful Improvements in Charging Systems for Blast Furnaces, of which the following is a specification.

This invention relates to a novel charging system for blast furnaces and possesses special utility in providing for returning "flue dust" to the furnace at a point below the regular charge of constituent elements in process of reduction, in such manner that it will mingle directly with the molten metal at the bottom of the furnace.

Accordingly a primary object of the invention is to provide a blast furnace with an equipment which may be employed economically and in a practical manner to very effectually utilize the downcomer or flue dust resulting from the operation of blast furnaces, also to provide an equipment of that kind which is available as a charging system to inject other ingredients, when desired or required, into the furnace, through or adjacent the blow pipes or tuyères.

As is well known by those familiar with the operation of blast furnaces, the various substances entering into the composition of iron are introduced into the furnace stack at the top, and are held in suspension by the hot blast (hot air introduced into the furnace near its lower end) aided by the inwardly inclining furnace wall until they reach the molten stage, and in this molten condition the metal drops down, against this air pressure, to the bottom of the furnace stack.

During this process, large quantities of the finer portions or particles of the ingredients are blown upwardly in the stack, and escape through pipes known as "downcomers", in the form known as "flue-dust". This flue-dust is heavily laden with pure iron, estimated between 55 and 60%, and the loss of this, of course, results in a very heavy economic waste. Under the present methods of operation, this dust is sometimes taken to a sintering plant where it is re-sintered, and then again introduced into the furnace with other material. This,

however, is an expensive operation, and even at that, inevitably results in more or less loss or waste of iron.

As stated above, the primary object of our invention is to provide means by which this flue-dust may be returned to the furnace stack in dust form, in such manner that instead of mixing with the regular unreduced charge at the top, it will immediately mingle with the already molten metal at the bottom of the furnace, so that practically the entire percentage of the iron therein will be recovered.

While the primary object of this invention, as stated above, is the return of flue-dust to the furnace stack, it may also be used with great advantage when desired to inject an additional portion of some certain constituent element which enters into the composition of iron. For instance, if the iron, in its molten condition, indicates too high a degree of silicon, it becomes necessary to introduce an additional amount of lime, which may be injected by means of our invention, in such manner as to bring it into immediate contact with the molten mass at the bottom of the furnace stack. Or, if too low in silicon, too much lime, it becomes necessary to introduce dolomite, or other ingredients. If too high in sulphur, coke is introduced in the same manner.

Again, if the furnace is working "limey", using trade parlance, it is often necessary to introduce a charge of sand, which is now done from the top, requiring twelve or fourteen hours to work its way through the charge in the furnace, whereas, with our invention, this sand may be introduced beneath the regular furnace charge, thus producing almost immediate results in the change of the condition of the furnace. Should the furnace get cool, requiring an additional amount of coke, this may be immediately introduced below the charge in contact with the hot blast, and immediate results obtained.

With these and other objects in view, as the nature of the invention is better understood, the same consists in the novel construction, combination and arrangements of parts hereinafter more fully illustrated, described and claimed.

The primary features of the invention are

susceptible of a variety of structural changes and modifications, but preferred and practical forms of the invention are shown in the accompanying drawings, in which—

5 Figure 1 is a diagrammatic plan view of the general arrangement of the invention in combination with the stoves and furnace.

Figure 2 is a diagrammatic side elevation of the arrangement shown in Figure 1.

10 Figure 3 is a vertical sectional view of the lower end of the furnace illustrating one means for introducing the dust charge into the furnace.

Figure 4 is an enlarged detail vertical sectional view taken on the line 4—4 of Fig. 1 showing the valve in the cold air blast line.

Figure 5 is a detail vertical sectional view of the charge receiver illustrating the agitating means therein.

Figure 6 is a more or less diagrammatic horizontal sectional view of a furnace showing a modified arrangement for introducing the charge into the furnace.

25 Similar reference numerals designate corresponding parts throughout the several figures of the drawings.

The general construction of a blast furnace includes a cold air pipe A, leading 30 from the blowing engine to the heating stoves B into which the air passes, and from which it is discharged in its heated state through the supply pipe C to the bustle pipe D surrounding the furnace stack E at a 35 point well below the longitudinal or vertical center of the stack. Communicating with the bustle pipe D are a plurality of blow-pipes F, the inner ends of which enter the furnace stack wall, and communicate with 40 the furnace interior through the usual tuyères and through these blow pipes the hot air passes from the bustle pipe into the furnace stack. This is known as the hot-blast".

The usual blast furnace equipment ordinarily includes means for heating the cold 45 air before it is discharged into the furnace through the blow pipes and tuyères. Certain parts of said air supplying and air controlling means are utilized for the purposes of the present invention and referring 50 thereto, the cold air pipe A has included therein a valve casing G in which is mounted a butterfly valve H having a rod or equivalent operating connection I with a piston 55 valve J which slidably fits within a ported valve cage K surmounting the valve casing G and in communication with the same and the air pipe A through the open throat L. The shell or wall of the said valve cage K 60 is provided with a plurality of air ports M which are controlled and regulated by the piston valve J, the operating rod or stem I of which is so connected with the butterfly valve H that when the latter is open for 65 the passage of air into the heating stoves the

piston is automatically drawn to its lower position covering or closing the air ports.

Conversely, when the valve H is closed against passage of the air into the heating 70 stoves, the piston is automatically forced upwardly uncovering the air ports. This apparatus is known in furnace practice as a snort valve and Fig. 4 of the drawing illustrates a standard form thereof.

The present invention proposes to utilize 75 the air discharged through the uncovered air ports and to that end provides the receiving chamber N which is in the form of a hood surrounding the valve cage K and providing a coupling between the air pressure 80 supply pipe 1, of the present charging system, and the cold air blast pipe A of the usual equipment. Adjacent the receiving chamber N for the cold air blast, the air pressure supply pipe 1 is preferably fitted 85 with a suitable controlling valve 2 and at a point beyond the said controlling valve has fitted therein an automatic relief valve 3 of any suitable type which may be adjusted or set to operate according to any pre- 90 determined pressure. Furthermore, the air pressure supply pipe 1 has connected therewith between the valves 2 and 3 one end of a by-pass 4 provided with a suitable controlling valve 5 therein and whose other end 95 is connected as at 6 with the cold air blast pipe A at a point between the butterfly valve and the source of air supply so that air pressure is available from the blast pipe A at all times regardless of whether the but- 100 tterfly valve H is open or closed.

The air pressure supplying means described which includes the pipe 1 and its connections respectively with the butterfly 105 valve controlling device, and with the valved by-pass 4, is associated with the feeding means which supply the flue-dust, or other elements to the delivery pipe 7, which delivers the said flue-dust or other elements to an annular distributing pipe surrounding 110 the blast furnace below the bustle pipe D and which distributing pipe is provided with a plurality of valved charging nozzles 9, each of which nozzles preferably is connected as at 10 with one of the blow pipes F 115 of the hot blast so that the flue-dust or other elements may be introduced into the furnace directly through the blow-pipe.

The feeding means referred to, therefore, 120 is operated in conjunction with the air pressure supplying means and in turn provides the supply or charge which is to be forcibly delivered through the delivery pipe 7. The said feeding means may be of any suitable construction or character according to the 125 purpose intended, but for illustrative purposes, there is shown in the drawings one type which may be resorted to: This primarily includes a charge receiver 11 which may be said to be introduced into the air 130

pressure line and is in communication with both the source of feed as well as with the delivery pipe 7. The said charge receiver 11 may be of any suitable form of construction but in order to adapt it for all kinds of substances which it may be desired to introduce into the furnace, the same is in the form of a closed casing or drum having the pipes 1 and 7 respectively connected with opposite sides thereof and accommodating a rotary agitator or beater device 12 which will serve as a mixer or stirrer for any mixture of elements constituting the charge. The flue-dust or other substance or substances are introduced conveniently into the top of the receiver 11 through a valved feed connection 13 which in turn may communicate with the bottom of what may be termed a feeder drum 14 having a valved pressure pipe connection 15 with the air pressure supply pipe 1 and an adjustable relief valve 16 connected with the top part thereof. A supply of the flue-dust or other substance is preferably measured into the said drum 14 by a measuring scale 17 (diagrammatically indicated), and the said scale is fed by a supply hopper 18, in turn being charged with the flue-dust or other substance by a feeding device 19 which may consist of a bucket elevator or equivalent mechanism. In the operation of the feeding means, flue-dust or other substance may be allowed to freely run from the supply hopper 18 directly into the charge receiver 11 and there picked up by the blast of air and blown through the delivery pipe 7, the distributing pipe 8 and the charge nozzles 9 into the furnace. In cases where a mixture is employed, or there is a tendency to cake or clog, the air pressure pipe 15 serves to break that up and forcibly feed the charge receiver 11, and in the event of the valved connection 13 being throttled, the relief valve 16 will relieve back pressure in the drum.

A modification of the invention is suggested in Figure 6 of the drawings, wherein the charging nozzles 9 of the distributing pipe 8 are shown disassociated from the hot blast pipes of the furnace and enter the furnace through separate apertures, but within the circular plane, or adjacent the circular plane, of the said hot blast pipes.

It should be noted that the ordinary equipment for a blast furnace as hereinbefore referred to, includes the cold air blast pipe leading to the heating stoves and it also includes the butterfly valve, the valve cage K and the piston J, the said valve device ordinarily being used to permit air to escape to the atmosphere when the butterfly valve cuts off the supply of cold air to the stoves. However, as that operation would be liable to reduce the pressure in the by-pass pipe 4 to too low a point, the receiving chamber N is placed about the said

cage K so that the air which ordinarily escapes to the atmosphere at that point is trapped and directed into the air pressure supply pipe 1 should it be desired to augment the pressure obtained through the by-pass 4. In connection with this part of the apparatus, the receiving chamber N may be provided with an adjustable relief valve 20 of any suitable and approved type.

From the foregoing, it is thought that the construction, operation and advantages of the hereinbefore described system will now be apparent to those skilled in the art, and it will also be understood that changes in the form, proportion and minor details of construction may be resorted to without departing from the spirit of the invention or the scope of the appended claims.

We claim:

1. A charging system for blast furnaces including a cold air blast pipe for the furnace, a delivery pipe having communication with the furnace interior at the plane of or adjacent the hot blast, a receiver for the charge in communication with said delivery pipe, and an air pressure supply pipe having valved communication with the cold air blast pipe for the furnace.

2. A charging system for blast furnaces including a cold air blast pipe for the furnace, a delivery pipe having communication with the furnace interior at the plane of or adjacent the hot blast, a receiver for the charge in communication with said delivery pipe, an air pressure supply pipe having valved communication with the cold air blast pipe for the furnace, and also having a by-pass connection with said cold air blast pipe.

3. A charging system for blast furnaces including a cold air blast pipe leading to the air heating stoves and having a cut off valve, a delivery pipe having communication with the furnace at or adjacent the hot blast, a receiver for the charge in communication with said delivery pipe, an air outlet valve on the cold air blast pipe having an operating connection with said cut off valve, and an air pressure supply pipe having its receiving end in communication with the discharge from said air outlet valve of the cold air blast pipe.

4. A charging system for blast furnaces including a cold air blast pipe leading to the air heating stoves and having a cut off valve, a delivery pipe having communication with the furnace at or adjacent the hot blast, a receiver for the charge in communication with said delivery pipe, an air outlet valve on the cold air blast pipe having an operating connection with said cut off valve, and an air pressure supply pipe having its receiving end fitted with a drum communicating with the discharge from said air outlet valve.

5. A charging system for blast furnaces including in combination, the air supply line for the furnace, a valved outlet positioned in said air supply line, a charging line communicating with the furnace at or adjacent the plane of the hot blast and communicating with the outlet valve of the said air supply line, and means for feeding a charge to said charging line.
6. A charging system for blast furnaces including in combination, a main air supply line for the furnace, a combination valve and outlet positioned in said main air supply line, a charging line communicating with the furnace at or adjacent the plane of the hot blast and communicating with the outlet valve of the air supply line, and means for feeding a charge to said charging line.
7. A charging system for blast furnaces including in combination, the main air supply line for the furnace, a snort valve in said main air supply line, a charging line communicating with the furnace at or adjacent the plane of the hot blast and communicating with the outlet of said snort valve, and means for feeding a charge to said charging line.
8. A charging system for blast furnaces including in combination, the main air supply line for the furnace, a snort valve in said main air supply line, a charging line communicating with the furnace at or adjacent the plane of the hot blast, and means connecting the outlet of said snort valve with said charging line.
9. A charging system for blast furnaces including in combination, the main air supply line for the furnace communicating with the tuyères, a charging line communicating with the furnace at or adjacent the plane of the hot blast and means located in said main air supply line for intercepting the current of air passing therethrough and diverting a portion of the same through said charging line.
- In testimony whereof we hereunto affix our signatures.
- WILLIAM E. HARRISON.
KENNETH D. STEWART.

5. A charging system for blast furnaces including in combination, the air supply line for the furnace, a valved outlet positioned in said air supply line, a charging line communicating with the furnace at or adjacent the plane of the hot blast and communicating with the outlet valve of the said air supply line, and means for feeding a charge to said charging line.
6. A charging system for blast furnaces including in combination, a main air supply line for the furnace, a combination valve and outlet positioned in said main air supply line, a charging line communicating with the furnace at or adjacent the plane of the hot blast and communicating with the outlet valve of the air supply line, and means for feeding a charge to said charging line.
7. A charging system for blast furnaces including in combination, the main air supply line for the furnace, a snort valve in said main air supply line, a charging line communicating with the furnace at or adjacent the plane of the hot blast and communicating with the outlet of said snort valve, and means for feeding a charge to said charging line.
8. A charging system for blast furnaces including in combination, the main air supply line for the furnace, a snort valve in said main air supply line, a charging line communicating with the furnace at or adjacent the plane of the hot blast, and means connecting the outlet of said snort valve with said charging line.
9. A charging system for blast furnaces including in combination, the main air supply line for the furnace communicating with the tuyères, a charging line communicating with the furnace at or adjacent the plane of the hot blast and means located in said main air supply line for intercepting the current of air passing therethrough and diverting a portion of the same through said charging line.
- In testimony whereof we hereunto affix our signatures.
- WILLIAM E. HARRISON.
KENNETH D. STEWART.

Certificate of Correction.

It is hereby certified that Letters Patent No. 1,567,642, granted December 29, 1925, upon the application of William E. Harrison and Kenneth D. Stewart, of Youngstown, Ohio, for an improvement in "Charging Systems for Blast Furnaces," were erroneously issued to the inventors, said "Harrison and Stewart," whereas said Letters Patent should have been issued to *W. E. Harrison*, said Harrison being assignee of the *entire interest* in said invention, as shown by the record of assignments in this office; and that the said Letters Patent should have been read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23d day of February, A. D. 1926.

[SEAL.]

WM. A. KINNAN,
Acting Commissioner of Patents.

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[SEAL.]

WM. A. KINNAN,
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