No. 616,101. Patented Dec. 20, 1898.

J. M. HARTMAN.

BLAST FURNACE ACCESSORY.

(Application filed Dec. 14, 1896.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 2.

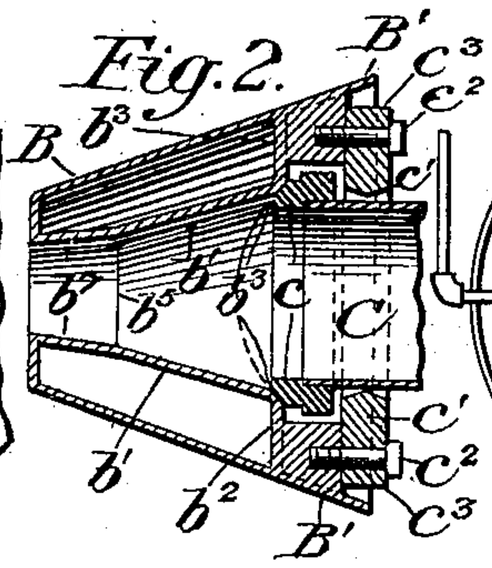


Fig. 3.

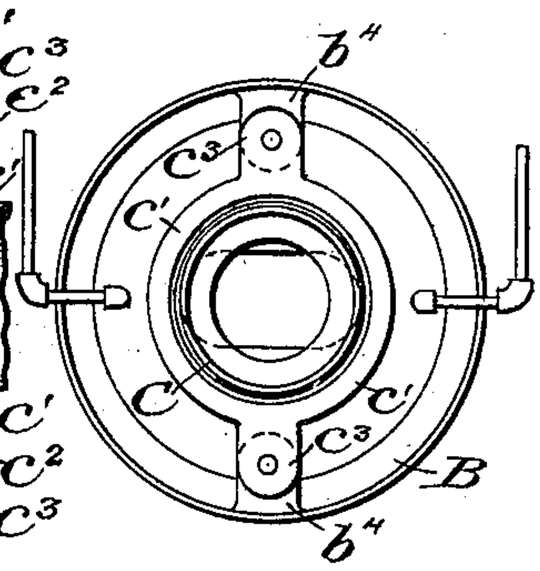


Fig. 4.

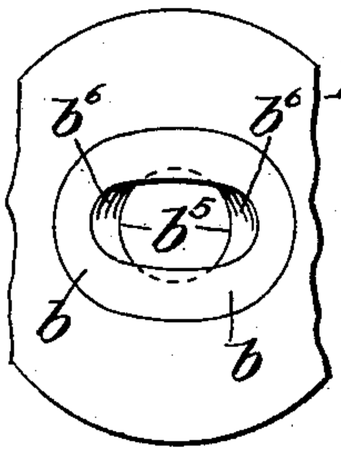


Fig. 5.

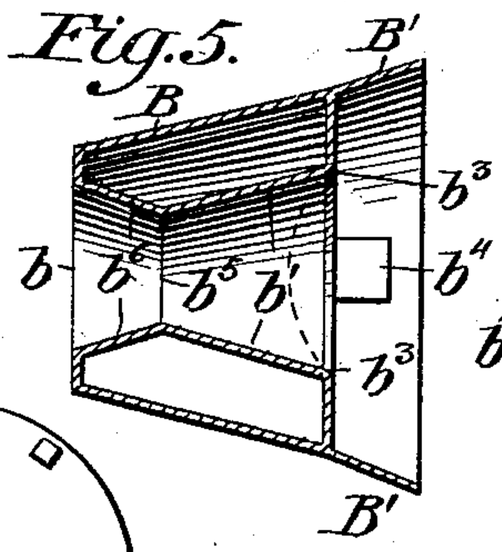


Fig. 6.

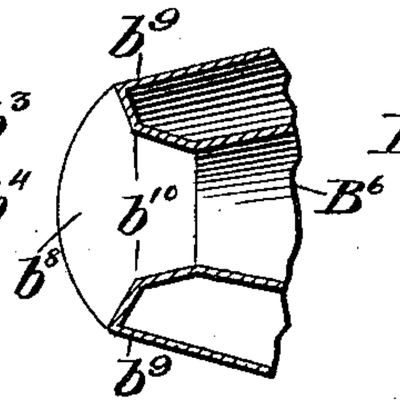


Fig. 7.

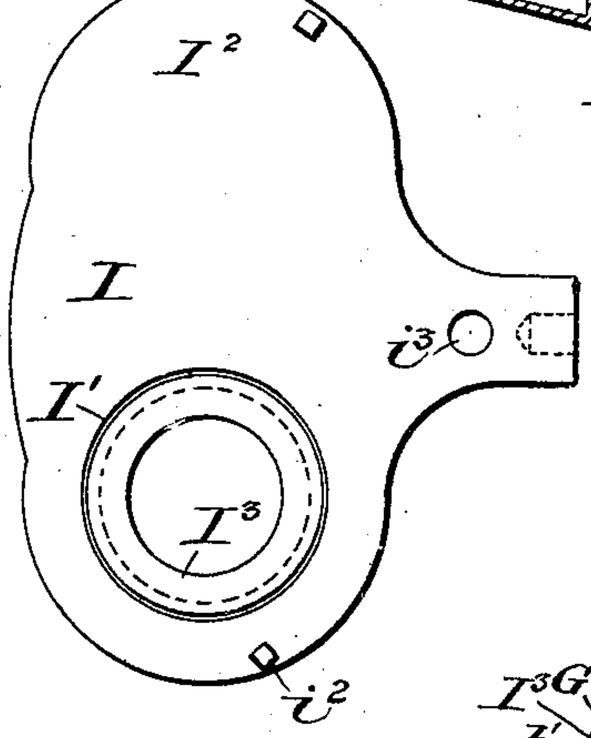


Fig. 10.

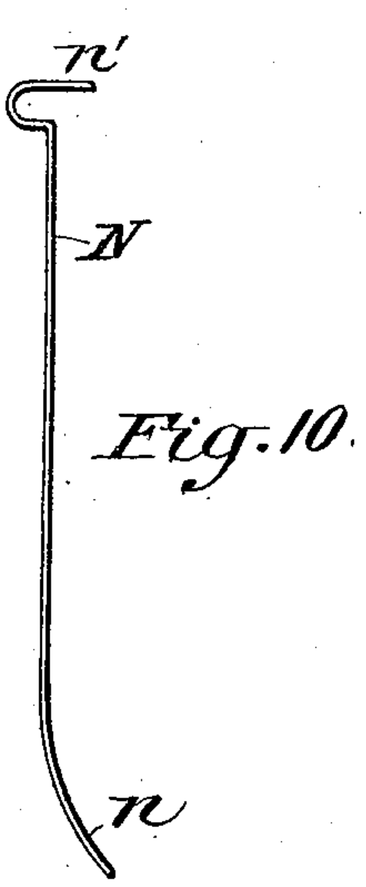
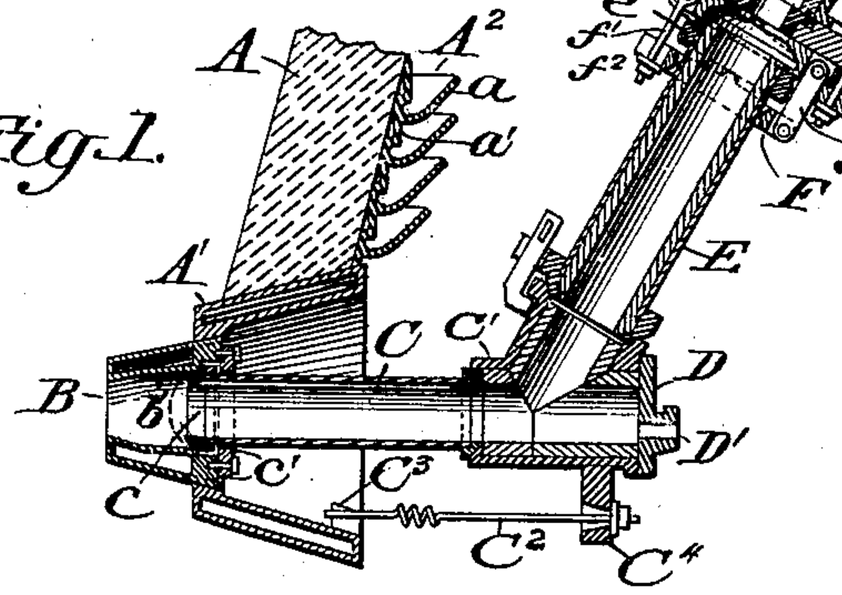


Fig. 1.



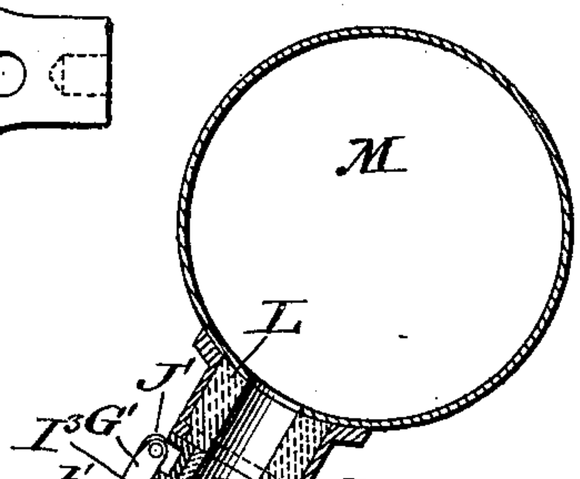


Fig. 8.

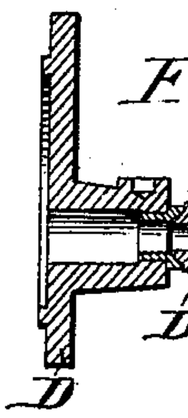
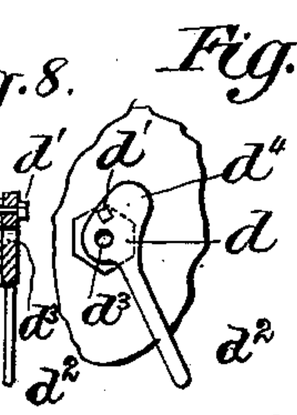


Fig. 9.



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No. 616,101. Patented Dec. 20, 1898.

J. M. HARTMAN.

BLAST FURNACE ACCESSORY.

(Application filed Dec. 14, 1896.)

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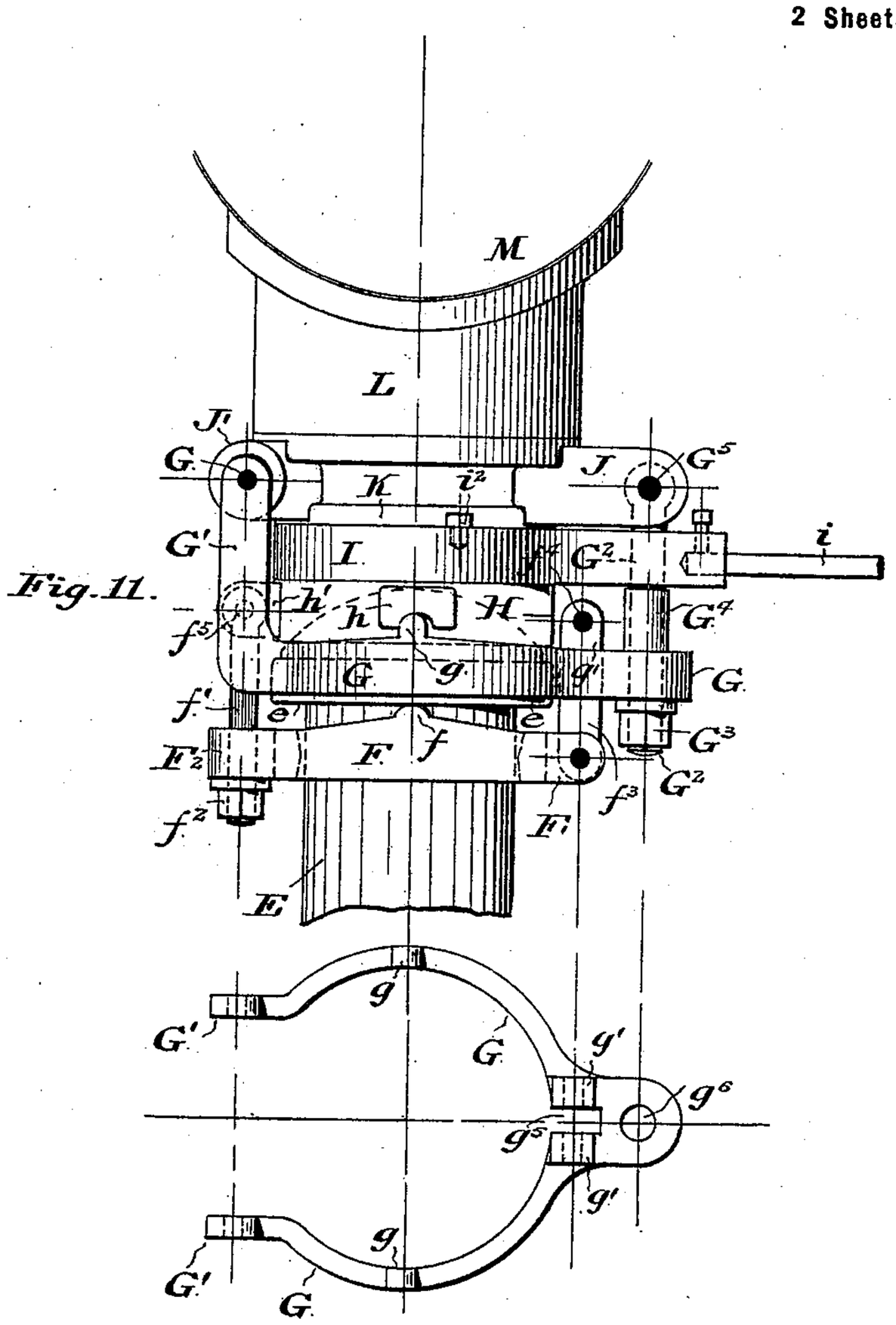

Fig. 11.

Fig. 12.

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UNITED STATES PATENT OFFICE.

JOHN M. HARTMAN, OF PHILADELPHIA, PENNSYLVANIA.

BLAST-FURNACE ACCESSORY.

SPECIFICATION forming part of Letters Patent No. 616,101, dated December 20, 1898.

Application filed December 14, 1896. Serial No. 615,562. (No model.)

To all whom it may concern:

Be it known that I, JOHN M. HARTMAN, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Blast-Furnace Accessories, whereof the following is a specification, reference being had to the accompanying drawings.

Among the important purposes of my invention are the following: the even and uniform distribution of the blast across the crucible of the furnace by definite lateral dispersion and the avoidance of dead-spaces of relatively low and irregular combustion, economy in the construction of the twyer itself and the facilitation of handling the same when removal of a twyer and insertion of a new one become necessary, the ready and efficient control of the blast in the twyer-pipe, and facilitation of the handling of the twyer-pipe and adjacent parts, whereby great economy of time and labor is effected in the various manipulations which are incident to blast-furnace practice.

Other and minor features, to which my invention is addressed, will be adverted to in the general description.

In the accompanying drawings, Figure 1 is a general view representing in vertical section a portion of the furnace-wall, the twyer, twyer-stock, and adjacent parts, the plane of section running through the axis of the twyer. The scale of the remaining figures is enlarged. Fig. 2 is a section on the same vertical plane as Fig. 1 through the twyer itself, showing the adjacent end portion of the twyer-pipe. Figs. 3 and 4 are respectively rear and front views of the twyer. Fig. 5 is a horizontal axial section through the twyer. Fig. 6 is a partial horizontal section through a twyer, having a modified form of nose. Fig. 7 is a plan view of the valve which is placed in the twyer-stock to control the blast. Fig. 8 is a vertical central section through the eyepiece at the rear end of the twyer-pipe elbow. Fig. 9 is a rear view in elevation of said eyepiece. Fig. 10 is a view in elevation of the bar with which the nose of the twyer is cleared. Fig. 11 is a view, on a still more enlarged scale, of the adjusting and securing devices adjacent to the valve in the twyer-stock. Fig. 12 is a top or plan view of a bridle which forms part of said adjusting devices.

Referring to the general view of Fig. 1, A represents the furnace-wall, in which the water-cooled twyer-breast A′ is inserted in the usual manner. For a short distance above the region of the twyers the bosh-jacket A^2 of the furnace is constructed of metal having a higher conducting power than iron—such, for instance, as bronze—said jacket being provided with external open water-troughs *a* surrounding the furnace. As this bosh is not claimed herein, further description is deemed unnecessary.

The twyer B is formed with a double shell for internal water circulation and fits snugly within the breast A′; but instead of constructing the double shell in the usual manner by carrying the same throughout that portion of the twyer which is seated in the twyer-breast I terminate the inner shell at a point substantially in the same plane as the inner extremity of the twyer-breast by placing the annular rear wall b^2 of the shell at this point and then project the outer face of the shell rearwardly, as indicated at B′, so as to fit metal and metal against the twyer-breast and afford the necessary support. This rearward projection B′ is efficiently cooled by contact with the water-cooled surface of the breast A′, and thus not only is the metal of the twyer economized, but by shortening the twyer itself in the described manner the blast is not required to travel over so long a water-cooled surface as would be the case were the inner shell projected rearwardly to the same distance as the outer one and the joint with the twyer-pipe formed at that point.

Hitherto it has been customary to employ in blast-furnaces twyers with round openings at the ends. Under these circumstances the air enters in a stream having a minimum of external surface and is projected forcibly toward the center of the furnace, the only dispersion occurring through accidental causes. As the temperature of the burning fuel when the furnace is working properly is over 4,000°, while that of the entering blast is, say, 1,200°, a localized cooling action necessarily follows, which retards combustion and increases the

friction of the blast. Sometimes when a large piece of fuel descends in front of the twyer-nose the air cools it, so that the combustion is very slow, and the blast is liable to be diverted upward, raising the zone of maximum combustion to a point high above the twyer zone, and thus producing irregular working and favoring the formation of sticky cinder, which pastes the fuel together. Furthermore, even under the best conditions with the old form of twyer when the air is forced without irregular diversion directly inward toward the center of the furnace there are dead-spaces between the twyers, where the action of the blast is relatively inefficient, giving rise to difficulties somewhat similar to those just described. I have found that by giving to the nose of the twyer a configuration which will uniformly and definitely disperse the blast in a lateral direction not only will a greater operative surface of blast be afforded, but regular and mellow combustion will be insured to the highest extent, while at the same time the blank spaces on each side of the twyer will be reduced to a minimum. I accomplish this by laterally elongating the opening at the nose of the twyer, as indicated at b in the front view of Fig. 4, and giving to the inner shell an outward flare at each side from a point near the nose to the exit, as shown at b^6 in Figs. 4 and 5.

To maintain the air-pressure down to the very moment of exit, the internal configuration of the passage adjacent to the nose should be such that there shall be no substantial increase of the area until the point of exit is reached. I prefer to accomplish this in the manner indicated in Figs. 2, 4, and 5, where it will be seen that down to a region indicated by the line b^5 the inner shell b' of the twyer converges toward the nose with the usual taper, or approximately conical form. From this region the sides b^6 flare outwardly, as stated, while at top and bottom the convergence continues, preferably, at a less obtuse angle to the axis, as indicated at b^7. By properly proportioning the converging pitch of the top and bottom with relation to the diverging pitch of the sides at the nose the total area of exit may be maintained without substantial increase, and thus the full blast-pressure will be delivered. Another method of accomplishing this result is indicated in the partial horizontal section, Fig. 6, where the front end of the twyer, B^6, is shown. Here the top and bottom portions b^8 of the double shell are projected beyond the side portions b^9, the inner shell at the sides having the configuration shown at b^{10}.

As at present constructed, twyers are difficult to manipulate when it is necessary to remove and replace them. The work is conducted in a contracted space. There is but little to take hold of, and the parts are usually very hot. It is of course undesirable that the twyer should be rigidly attached to the twyer-pipe, since under the method of construction now almost universal an oscillating joint is required between the twyer and the twyer-pipe. I have, however, provided a means whereby the twyer may be loosely secured to the front end of the twyer-pipe, so that during the act of removal and insertion the twyer-pipe may serve as a handle, thus rendering manipulation very easy, while at the same time the oscillating joint is in no wise impaired. To accomplish this result, I provide at the butt of the twyer (preferably on the inside of the projection B′) blocks b^4, which may be two in number and diametrically opposite, as shown. These blocks form seats for screws c^2, which pass through lugs c^3 upon a collar c'. The twyer-pipe C is of considerably smaller diameter than the opening of the collar c', so as to pass loosely through the same; but the front end of said twyer-pipe C is provided with a rigidly-attached ring c, whose front periphery is faced to form an oscillating joint, with a corresponding face b^3 on the butt of the twyer. The external diameter of this ring c is greater than the opening of the collar c'; but the depth of the ring is such that when said collar c' is secured to the blocks b^4 by means of the screws c^2 the collar fails to clamp the ring, and the twyer is thus connected to the twyer-pipe, so that it cannot drop off from the end thereof, but at the same time is held loosely thereon. By this means the twyer-pipe can be utilized to thrust the twyer into position or remove it, and the twyer can also support the twyer-pipe while the latter is being adjusted, the collar connecting the parts to the necessary extent; but when the twyer and twyer-pipe are brought home to their final positions (by means of the usual spring-rod C^2, engaging at one end with the lug C^3 upon the twyer-breast and at the same time with the lug C^4 upon the elbow C′) the oscillating joint under yielding tension is formed and maintained in the usual manner.

At the rear end D of the elbow C′ is the usual "eyesight" D′, (see Figs. 8 and 9,) which may be of any of the well-known constructions; but to save the glass of the eye-piece and permit it to be readily cleaned or replaced I mount said glass d^3 in a swinging cap d, pivoted at d' to the tubular eyesight D′ and provided with a blank or imperforate extension d^4 and handle d^2. Thus when not in use the glass d^3 may be swung clear to one side of the tube D′ and the aperture covered by the blank d^4. The glass is not only protected when not in use, but when swung clear of the eyesight may be cleaned on its inner surface.

To clear the nose of the twyer from obstructions, such as are due to the backing in of cinder, &c., I provide a rod N. (See Fig. 10.) This rod has its front end portion n curved to such an extent that when the point is in contact with the outwardly-flaring nose of the twyer the

back of the curve abuts against the opposite inner wall of the twyer, thus bringing the curved front extremity into forcible contact with the flaring side thereof. To indicate to the workmen the position of the curved end, I prolong the handle, as shown at n', in the same direction as the curved extremity n and preferably to about the same extent. I do not in this application claim the rod, but have deemed it expedient to describe the same as specially useful in connection with the twyer, which forms the subject-matter of certain of my claims herein.

The leg-pipe E of the twyer-stock is connected in the usual manner at its lower end to the elbow C′ by an oscillating joint, and is also provided at its upper end with a rigidly-attached collar e, whose periphery is faced to form an oscillating joint with an independent ring H correspondingly faced on the side proximate to said collar e, but having its other face flat to form a close joint or seat for the transversely-swinging valve I.

Upon the nozzle L, attached to the bustle-pipe M, is an annular facing-piece K, whose end surface forms the other seat for the valve I. This valve I consists of a flat plate having a large opening I′ in one portion and an imperforate extension or blank I^2 in its other portion. It is adapted to be swung transversely to the axis of the twyer-stock upon a pivotal point at i^3 by means of a handle i, a stop i^2 being provided to limit the movement at the point corresponding with the open position. As the construction of this type of valve is well understood, it need not be further described.

Heretofore it has been usual to control the blast by means of reducers placed in the twyer or other point in the line of piping, but to insert and remove the same has always been a matter of some difficulty, owing to the inaccessibility of the position where the reducer was placed. By my present invention I provide a seat for a reducer, such as I^3, in the opening I′ of the valve itself, thus enabling said reducer to be inserted or removed without difficulty or loss of time, it being merely necessary to swing the valve I shut, thus exposing the opening I′, then insert or remove the reducer, and swing the valve back again into its open position.

The leg-pipe E, ring H, and valve I are supported from the nozzle L by means of the following group of devices:

The facing-piece K of the nozzle is provided on opposite sides with laterally-projecting pairs of lugs J and J′, only one lug of each pair of course being visible in the views shown in Figs. 1 and 11. To the lugs J′ are pivotally attached at G^6 the L-shaped arms G′ of a yoke G. (Shown in plan view in Fig. 12.) The length of the arms G′ is such that said yoke underhangs the ring H, and the sides of the yoke are provided with lugs g, which engage beneath the laterally-projecting blocks h, extending outward from the ring H at points diametrically opposite. The points of contact between said lugs g and said blocks h are in axial plane with the leg-pipe E and nozzle L. The front end of the yoke (or portion farthest from the arms G′) is extended outward and provided with a slot g^5 and a hole g^6. Through this hole a bolt G^2 extends upwardly, passing through a hole i^3 in the swinging valve I, (of which it constitutes the pivot,) and thence to a point between the pair of lugs J upon the piece K, where it is supported by a transverse pin G^5. Said bolt G^2 is threaded at its lower end and provided with a nut G^3, which bears against the under side of the yoke G. The portion of the bolt G^3 which is intermediate between the yoke G and the valve I is provided with a sleeve G^4, loosely fitting thereon and abutting against the yoke on the one end and the surface of the valve I on the other end, so as to make a lower bearing-surface for the valve at its pivotal point.

It will be seen that by means of the parts as thus far described the valve I is pivotally supported in position between the facing-piece K of the nozzle and the ring H, the respective faces of which form the valve-seats, and that by screwing the nut G^3 home the yoke G will force the ring H tightly against the valve I and hold both ring and valve firmly in position upon the nozzle, while by loosening said nut G^3 the parts will separate sufficiently to permit play of the valve and the latter can swing transversely upon the bolt G^2 as a pivotal point.

In order to hold the leg-pipe E and its collar e properly in position against the ring H, I provide a second yoke F, which embraces the leg-pipe. Said yoke is suspended at one side by means of a link f^3, which is pivotally attached at one end to the projection F′ of the yoke F, thence passed upward through the slot g^5 in the yoke G, and is secured at its upper end by a transverse pin f^4, supported in a pair of lugs g', which project upwardly from the upper face of the yoke G adjacent to the slot g^5. The other end of the yoke F is provided with an extension F^2, through which is passed a bolt f', having a nut f^2 upon its threaded lower end to abut against the extension F^2, while the upper end of said bolt f' is pivoted at f^5 between a pair of lugs h', extending outwardly from the ring H at a point between the arms G′ of the yoke G. The lower yoke F is provided with upwardly-projecting lugs f, diametrically opposite to one another and in a plane axial with the leg-pipe E, said lugs f bearing against the under surface of the collar e. Thus when the nut f^2 is screwed home upon the bolt f' the yoke F, by means of the lugs f, forces the collar e, and consequently the leg-pipe E, upward into close contact with the ring H. By this method of attachment the oscillating joint at the upper end of the leg-pipe E is insured, and the

ring H can be maintained in tight contact with the valve I even when the leg-pipe E is entirely removed. So, also, the joint between the valve and the seats or faces upon the parts K and H can be loosened to permit the shifting of the valve without loosening the joint between the collar *e* of the leg-pipe E and the ring H. If, then, it is necessary to remove the twyer-pipe C or the leg-pipe E, blast need not be shut off from the furnace generally, since the valve I can be closed and clamped in position by means of the main yoke G, the secondary yoke F being swung clear to permit the detaching of the desired parts, and on the other hand the valve I can be shifted without such loosening of the twyer-stock generally as will disarrange its joints.

Referring to that portion of my invention which consists in the peculiar configuration of the twyer-opening, I wish it to be understood that I do not broadly claim the flattened or elongated aperture. If the aperture should lack the outwardly-flaring configuration of the sides, the result which I contemplate would not be obtained, since the air-current would be directed radially inward in practically the same manner as is the case with a circular aperture, excepting in so far as the cross-section of the current itself would be varied. The object of my invention being to effect lateral dispersion of the blast, I limit my claims touching this part of the subject-matter to a device embodying substantially the features of construction above described which are adapted to that particular end.

Having thus described my invention, I claim—

1. The combination, with the twyer-breast; of a water-cooled twyer formed with a double shell, the inner shell of said twyer terminating in a plane which coincides substantially with the front end of the breast, and the outer shell of said twyer projecting rearwardly and forming a support in the breast in rear of the water-cooled shell of the twyer, substantially as set forth.

2. The combination, with the twyer having on the internal periphery of its butt a face adapted to form an oscillating joint; of the twyer-pipe having a rigidly-attached projecting ring upon its front end, said ring being faced in correspondence with the periphery of the twyer to form an oscillating joint therewith; a collar fitting loosely upon the twyer-pipe but engaging behind said ring; and means substantially as set forth for securing said collar to the twyer, whereby the twyer may be held upon the front end of the twyer-pipe with a loose fitting connection, substantially as set forth.

3. A twyer, for blast-furnace use, having a laterally-elongated opening at its front end, the internal shell of said twyer converging forward to a point near the nose, thence flaring outwardly at the sides, but converging at the top and bottom toward the nose, whereby a laterally-dispersed discharge is effected, without substantial increase of the area of the passage, as and for the purposes specified.

4. The combination with the twyer-pipe elbow C′ and its apertured end plate D, of an eyesight-tube D′ projecting from the aperture in end plate D, and a swinging cap *d* pivoted to the outer end of pipe D′ and having a glazed opening d^3 and a blank extension d^4 both adapted to register with the open end of the tube D; said glazed opening lying beyond the exterior of tube D′ when the blank d^4 closes the tube D′ to permit the glass to be cleaned; substantially as described.

5. The combination, with the leg-pipe of the twyer-stock and with the nozzle at the upper part of said stock; of a valve pivoted to swing transversely to the stock, said valve having an opening and a blank space; a seat for said valve on the nozzle; an independent ring adapted to form the opposite seat for said valve; a yoke adapted to clamp said ring against said valve; and means substantially as set forth for securing said yoke in position.

6. The combination, with the nozzle at the upper part of said twyer-stock and with the leg-pipe having at its upper end a face adapted to form an oscillating joint; of a valve pivoted to swing transversely to the twyer-stock, said valve having an opening and a blank space; a seat for said valve on the nozzle; an independent ring, one of whose faces is adapted to form the opposite seat for said valve, and the other of whose faces is adapted to form an oscillating joint with the upper end of said leg-pipe; a yoke adapted to clamp said ring against said valve; means substantially as set forth for securing said yoke; a secondary yoke adapted to maintain the upper end of said leg-pipe in contact with the other face of said ring to form an oscillating joint therewith; and independent means for securing said secondary yoke, substantially as set forth.

7. The combination, with the nozzle at the upper part of the twyer-stock and with the leg-pipe, having at its upper end a face adapted to form an oscillating joint; of a valve pivoted to swing transversely to the twyer-stock, said valve being provided with an opening and a blank space; a seat for said valve on the nozzle; an independent ring adapted to form the other seat for said valve, said ring being provided with laterally-projecting blocks; a yoke underhanging said ring and provided with lugs bearing against said blocks, said yoke having L-shaped arms at one end and a slotted projection at the other end; a bolt adapted to secure said yoke, said bolt running through the valve and forming the pivot thereof; supports upon the nozzle for said arms and said bolt; a secondary yoke adapted to engage behind a projection upon the leg-pipe; a link supporting said secondary yoke

at one end, said link passing through the slot of the other yoke and being pivotally attached to the projecting end portion thereof; and an independent bolt supported upon the ring and adapted to secure said secondary yoke, substantially as set forth.

8. The combination, with the twyer-stock; of a transversely-swinging valve having an opening and a blank space; and a reducer adapted to be maintained in the opening of said valve, substantially as set forth.

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