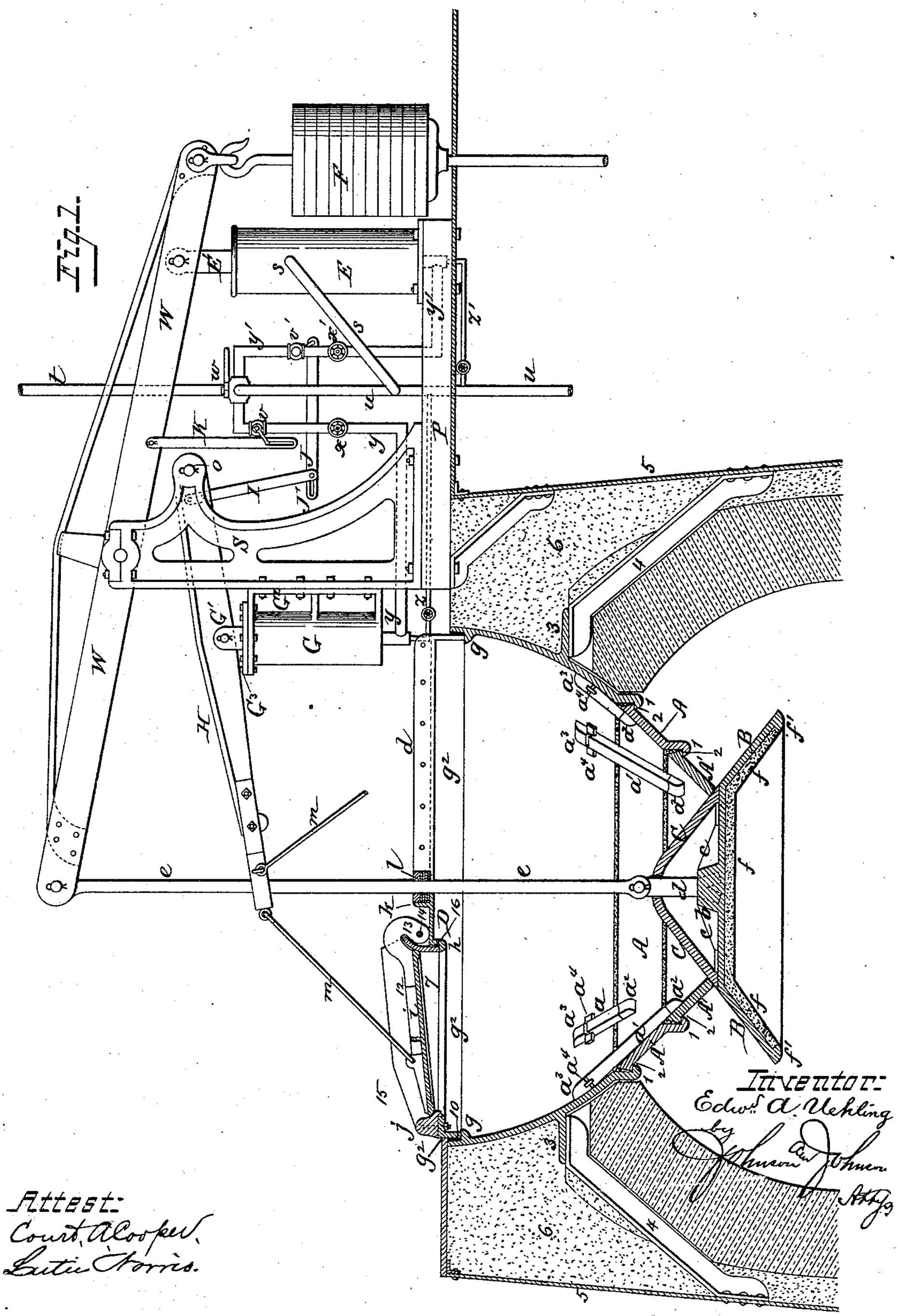
(No Model.) 3 Sheets—Sheet 1.

E. A. UEHLING.

GAS SEAL FOR BLAST FURNACES.

No. 305,983. Patented Sept. 30, 1884.

Fig. 1.



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E. A. UEHLING.

GAS SEAL FOR BLAST FURNACES.

No. 305,983. Patented Sept. 30, 1884.

Fig. 2.

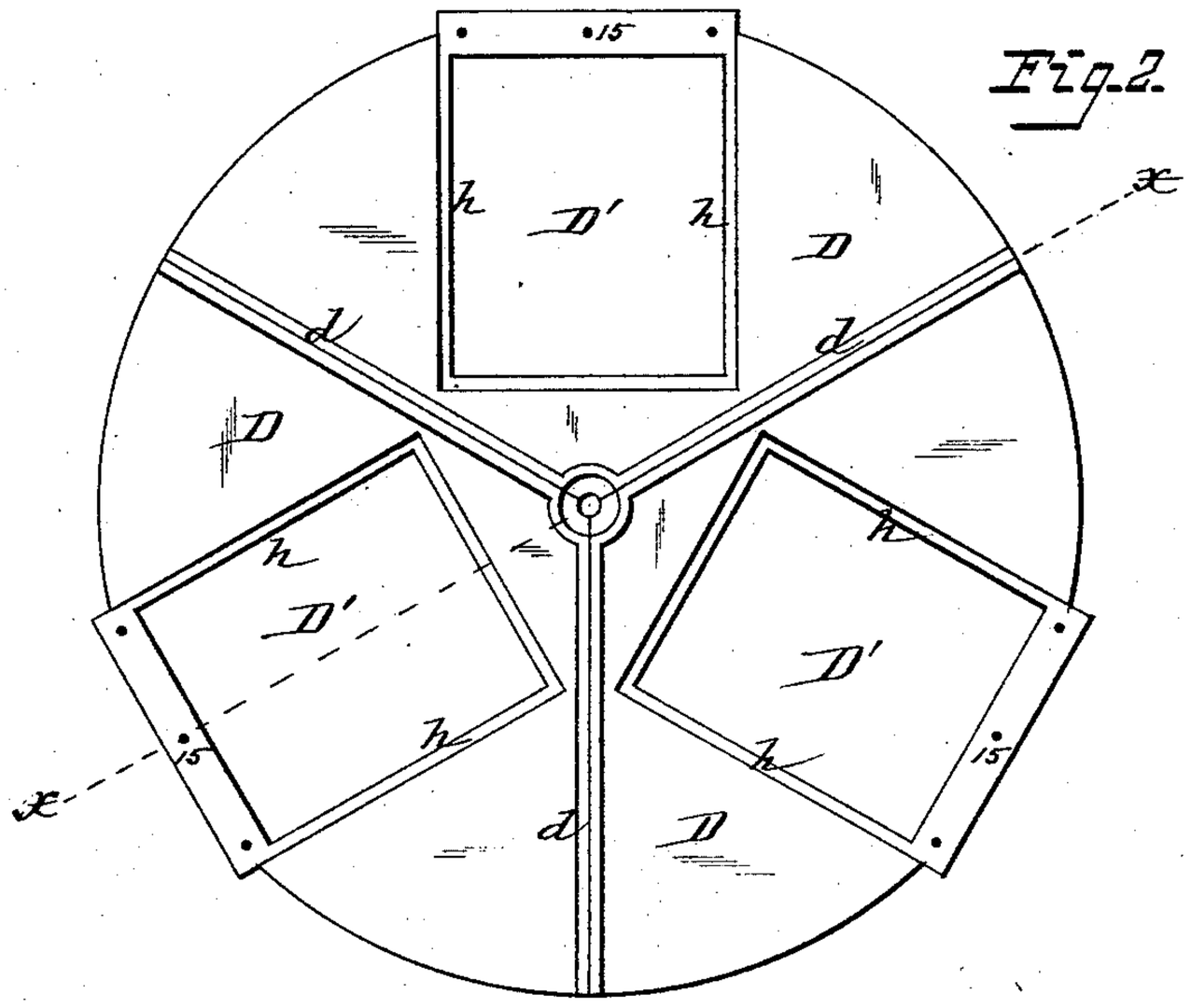


Fig. 3.

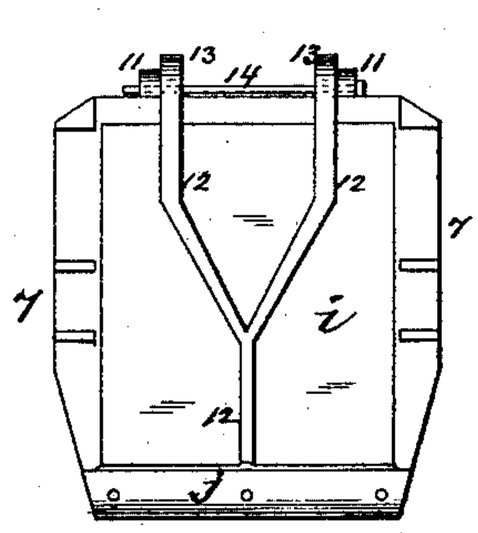


Fig. 4.

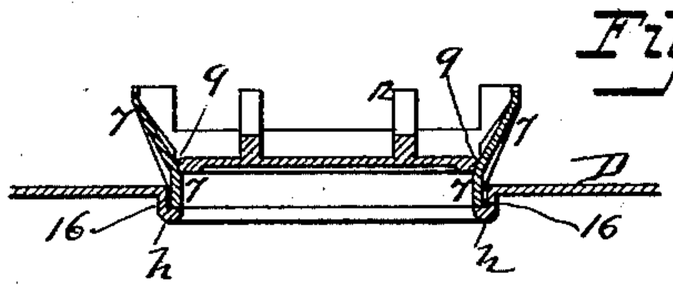


Fig. 5.

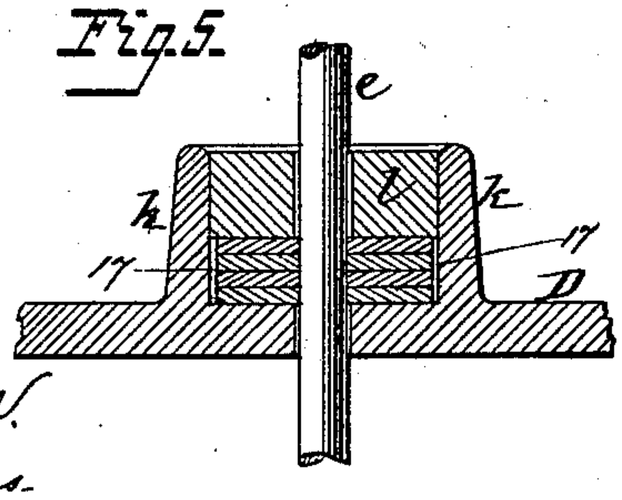
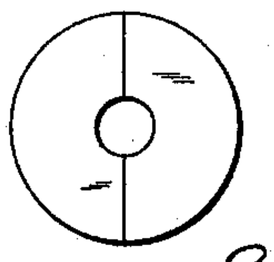


Fig. 6.



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(No Model.) 3 Sheets—Sheet 3.

E. A. UEHLING.

GAS SEAL FOR BLAST FURNACES.

No. 305,983. Patented Sept. 30, 1884.

Fig. 7.

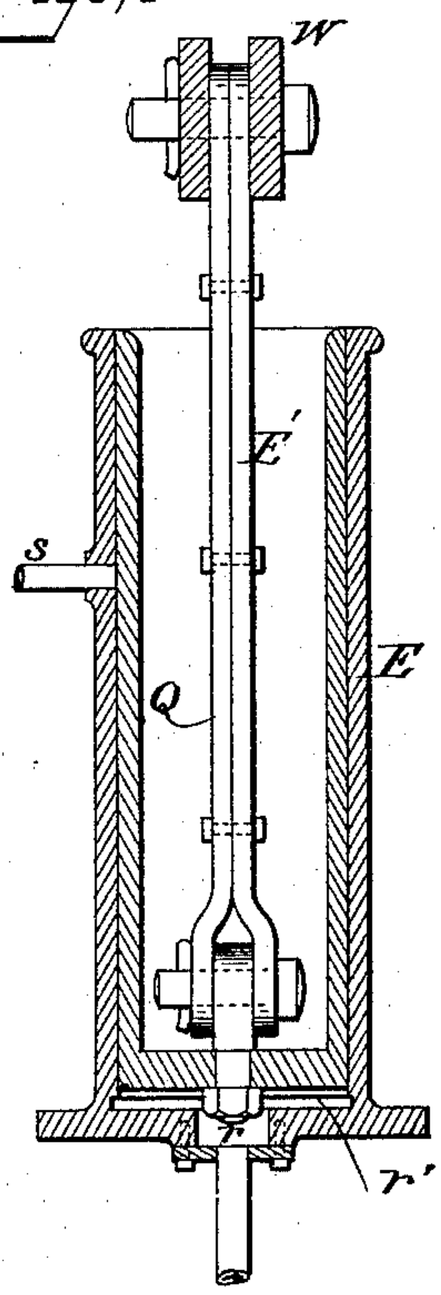


Fig. 8.

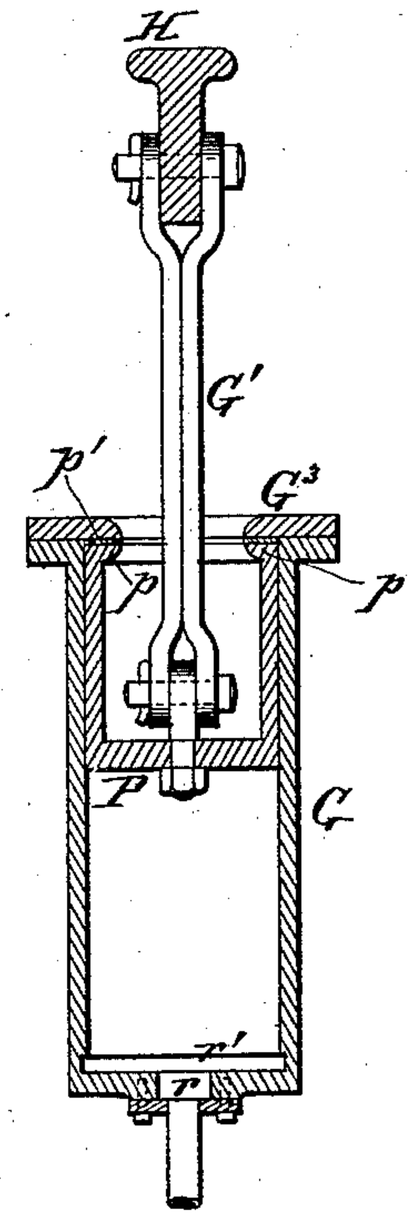
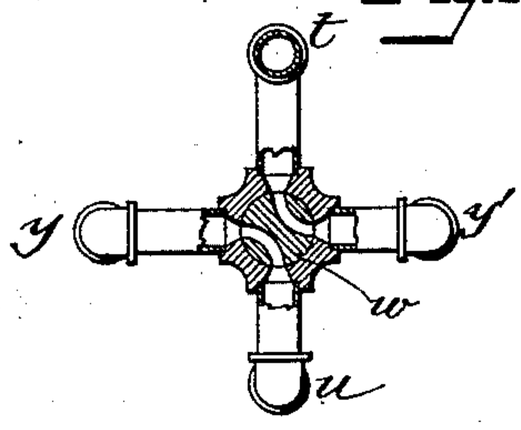


Fig. 9.



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UNITED STATES PATENT OFFICE.

EDWARD A. UEHLING, OF BETHLEHEM, PENNSYLVANIA.

GAS-SEAL FOR BLAST-FURNACES.

SPECIFICATION forming part of Letters Patent No. 305,983, dated September 30, 1884.

Application filed April 18, 1884. (No model.)

To all whom it may concern:

Be it known that I, EDWARD A. UEHLING, a citizen of the United States, residing at Bethlehem, in the county of Northampton and State of Pennsylvania, have invented new and useful Improvements in Gas-Seals for Blast-Furnaces, of which the following is a specification.

My invention relates to the hopper-charging device and gas-seal of blast-furnaces, in which the hopper is closed by a bell or cone, and wherein the hopper is sealed by a cover provided with charge-openings, which latter are automatically closed and opened, as in a patent granted to me February 27, 1883, for gas-seal for blast-furnaces.

The objects of my said invention are to so construct the hopper and bell that the best possible intermingling of the stock is secured, and that they may be easily constructed and repaired; to so shape and connect the different parts that the joints are rendered perfectly gas-tight, and to provide for the automatic opening and closing of the bell and sealing-lids, so that the motion of the one is controlled by that of the other in such a manner that the furnace is never open to the atmosphere, thus effectually preventing the escape of gas. The lower end of the hopper is constructed of two or more lip-rings, instead of one, as is usual, secured together and to the body of the hopper by packed joints, and held in position by wedged struts, which can be easily removed, if necessary. The bell is constructed in two sections with a dividing web. The lower section is lined with fire-proof material to protect it against the occasional excessive heat when the stock runs so low as to become incandescent. The lower edge of the bell is provided with a heavy flange which supports the lining and also greatly strengthens the bell. The upper section or apex of the bell which closes the hopper-opening is thus doubly protected against overheating, and warping is entirely prevented. The hopper is formed with an interior flange around its inner wall below the edge to receive the top plate or cover and form a wall packing-joint therefor. Hopper-shaped or outwardly-flaring frames are placed in openings in the hopper-cover to receive the sealing-lids, and act as conduits to the entering stock and prevent the scattering of the same, provision being made for sealing the hopper-frames and the charging-lids to prevent the escape of gas at the joints of these parts. Two single-acting cylinders with suitable connecting-pipes, valves, &c., are used in connection with pivoted walking-beams, attached by suitable connections to the bell and feeding-doors, whereby the operation of opening and closing of the feeding-lids and bell may be performed automatically and at regular intervals by the action of air, steam, and water pressure.

Referring to the accompanying drawings, Figure 1 represents a vertical section of my automatic gas-seal for blast-furnaces, the operating mechanism being shown in elevation, the bell and one of the charging-lids being shown closed, that being the position of the charging-lids just before the bell opens, the section being taken through one of the lids only of the hopper-cover. Fig. 2 represents a plan view of the lid or cover of the hopper, showing the feeding-openings therein and the cover constructed of sections. Fig. 3 represents a plan view of one of the feeding-lids and the hopper-frame into which it fits. Fig. 4 represents a vertical transverse section through one of the said feeding-lids, its hopper-frame, and a portion of the hopper-cover. Fig. 5 is a detached enlarged section through the stuffing-box of the hopper-top for the bell-rod. Fig. 6 is an enlarged detached plan view of the weighted ring employed to hold the packing in the box shown in Fig. 5. Fig. 7 represents a section of the cylinder and piston which operates the bell, showing the construction of the same. Fig. 8 represents a similar view of the cylinder and piston which operates the feeding-lids, and Fig. 9 is a detail in illustration of the operation of the four-way cock which admits and cuts off the supply of steam to the cylinders.

The primary features of my invention relate to the construction of the hopper, its bell and cover, together with the feeding-lids, so as to prevent the escape of gas. This portion of the invention will therefore be described first. Following this, the means for automati-

cally operating the gas-seal will be described, then details of construction of the several parts employed to effect the desired result.

It is necessary, in the class of furnaces to which my invention appertains, that the size of the bell should be in proportion with the dimensions of the furnace for which it is fitted, in order to properly spread the stock in the latter. In order to do this, it has universally been the practice to increase the opening at the bottom of the hopper with the size of bell required for the furnace. Thus every increase in the size of the bell required by an enlargement of the furnace would be accompanied by a proportionate widening of the bottom of the hopper. The result of this mode of construction was that many disadvantages were experienced, which became more serious as the size of the furnace was increased. First, the bell and lip-ring became so large and ponderous that they were difficult to construct and to handle; second, the seat of the lip-ring became so extended that warping occurred more readily and was proportionately more serious; third, the bell, because of its greatly increased size, protruded so far up into the hopper that the stock, when dumped around it, would slide into the furnace without proper intermingling.

The foregoing defects are obviated in the hopper, of which Fig. 1 represents a sectional view, and the construction of which will now be explained.

To make the discharge-opening as small as the nature of the stock will permit, the lower part of the hopper is made of two lip-rings, A and A′, instead of a single ring. These rings are held in position each by three or more struts, *a* and *a′*, which rest against lugs a^2, cast upon the inner surface of the rings, and are keyed fast against other lugs, a^3, cast upon the inner walls of the main hopper-section. The lower lugs are made with a concave seat, into which the struts are made to fit. The upper lugs and also the upper ends of the struts are provided with key-seats, into which wedges are driven, as shown at a^4, making a solid fastening for the rings crossing their joints. Should the bell, from wear or any other cause, become leaky so that it must be repaired, this can be done very easily and quickly and at comparatively small expense, because only the apex and small lip-ring need be removed and replaced. Besides the advantage of having only small weights to handle, the great annoyance of having it to do over an open furnace, as is necessary in the ordinary construction, is also avoided, since the lower section or apron of the bell can be drawn up and fastened so as to make a joint with the second lip-ring, thus rendering one of the most trying and difficult operations comparatively easy.

Another advantage derived by constructing the discharge end of the hopper of two or more rings, as above set forth, is that they are easily constructed and handled and not liable to become easily warped, which would not be the case were a single ring of large size employed.

To support the rings in position, a seat-lip, as at 1, is formed around the lower edge of the hopper-body, upon which the seat-lip 2 of the top ring A rests.

At the bottom edge of the ring A a similar seat-lip is formed, upon which rests the ring A′, which has a similar seat-lip. By this means the rings are supported in position, and, as before explained, securely locked together and to the hopper-body by the struts *a a′*. The top edges of both the rings A and A′ are made beveled or flare upward, so that the edge of each ring will form a V-shaped opening or space into which a packing or filling is interposed to make a gas-tight joint at their seats. The bell is made in two parts, the apex C, which serves as a valve for the smallest hopper-ring, and is regulated in size by the latter, and a lower section, which forms an apron, B, whose office is to spread the stock, and is made as large as the size of the furnace demands to serve also as a seal in case it becomes necessary to remove the apex and smaller lip-ring for repairs. This apron B is provided with a boss, *b*, strengthened by radial ribs *c*, into which boss is cast or otherwise securely fastened a hanger, *d*, which passes with an easy fit through the apex C and connected to the connecting-rod *e*, by which both are suspended from the walking-beam W in the usual manner of suspending the single bell.

Upon the interior of the apron B is a fire-proof lining, *f*, to protect it against the action of the heat from the furnace. The lining is held in place by the flange *f′*.

By forming the bell as above explained—that is, of two members, C and B, with an interposed dividing suspending plate or web—a much stronger structure is made and more secure bearing provided for the hanger than to form the bell of a cone-shaped shell, as is usual, with the hanger secured at its apex. The quick destruction of the bell is therefore prevented and the destroyed part need only be renewed instead of the whole bell being removed, as is now necessary.

Other important advantages are derived from constructing the bell in the manner herein described. First, the parts which require machine-fitting—viz., the apex C and lip-ring A′—are reduced in weight from twenty-five to seventy-five per cent. from those of ordinary form; second, the fire-proof lining and the apex being independent of the apron, reduces the chances of warping, which is the main cause of leakage, to a minimum; and it is evident that this bell, because of its fire-proof lining, will resist heats, without injury, which would completely destroy an ordinary bell; and, third, in reducing the opening of the hopper as much as is consistent with the free discharge of the stock (varying with the nature

of the latter between thirty and forty inches) the entire contents of the hopper must drop on the apex of the bell, thereby securing the best possible intermingling and distribution of the stock. The hopper is supported by a flange, 3, which is formed thereon, and rests on a sufficient number of braces, 4, which are riveted to the outer shell of the stack 5. The flange 3, instead of being near the top, is some distance below the same, which has the advantage that the upper portion of the usual lining may be dispensed with and the space filled with loam or crushed cinder, as shown at 6, Fig. 1. The hopper is also provided with a lip, *g*, around the inside near its top edge, upon which rests the cylindrical angle-flange g^2 of the cover D, as shown. This cover is formed of two, three, or more sections, according to the size of the furnace, bolted to each other by angle-flanges *d*, which also act to increase the strength and rigidity of the same. Each section of the cover D has a charge-opening, D′, around which is formed a depressed lip, *h*, as shown in Figs. 1 and 4, upon which lip rests a frame, 7, within which the hinged lid *i* that closes the charge-opening is received and rests. The diameter or size of the cover D relatively to the opening in the hopper-top is such that space, as at 10, is formed between the cover, angle-flange g^2, and wall of hopper, into which a filling is placed, as shown, thus closing the joint gas-tight at the supporting-wall flange *g*.

The frames 7, provided to receive the charging-lids, are made hopper-shaped, or with outwardly-flaring sides, to prevent the scattering of stock while being dumped into the hopper, and a beveled seat, 9, is formed therein, upon which rests the beveled edges of the lid *i*.

By forming the seat for the lid beveled, as shown, no particles of stock can lodge upon it, therefore the close and tight shutting of the charging-lids is always assured.

The fronts of the hopper-frames are made very heavy, as shown at *j*, to enable them to resist the blows of the filling-barrows, which strike at this point while being dumped, and upon the back of the frame lugs 11 are formed, to furnish hinge-bearings for the charging-lids. Upon the top of the lids strengthening-ribs 12 are formed, which terminate in curved ends 13.

To complete the hinge between the lid and its frame, a pintle, 14, is inserted through the lugs 11 and curved ends, 13, of the ribs of the lids. The frames 7 are bolted to the corner D at the front only, as shown at 15, Figs. 1 and 2, and they are made of a size relatively to the openings D′, that along the sides and inner ends thereof a space is formed between the frame and the depressed wall of the opening, as seen at 16, Figs. 1 and 4, into which is packed suitable material to make a gas-tight joint, the same as the space 10, between the hopper-wall and its cover, as before explained.

From the center of the cover D projects a cylindrical collar, *k*, shown enlarged in Fig. 5, to form a packing-box around the rod *e*, which rod passes loosely through the cover, as shown. In the bottom of the box is placed several layers, 17 of asbestus board or other fire-proof material, which fit closely to the rod *e*, but has considerable play in the box, and upon this packing is placed a heavy piece of metal, *l*, which fits closely to the box, but has sufficient play for the rod *e* to hold the packing 17 in place, and this weight *l* is made in half-sections, as shown in Fig. 6, so that it can be readily removed when a new packing is required.

The before-described mode of constructing the hopper and covering makes, with the lids down, a perfect gas-tight seal.

The mechanism for automatically operating the bell and seal will now be explained. For operating the bell, the usual walking-beam, W, of proper strength and rigidity, is employed, mounted on a standard, S, and connected to the bell by the rod *e*. Standing on a bed-plate, P, with the standard S, is a cylinder, E, the connecting-rod E′ of which is connected with the beam W near its inner end, by which the movement necessary to open the bell is given to the beam. From the extreme end of the walking-beam are suspended balance-weights F, sufficiently heavy to overbalance the bell, plus the weight of the stock supported thereon when the hopper is charged. The charging-lids *i* are operated through the rods *m* by the lever H, which lever is pivoted to the standard S, at *o*, and connected with the connecting-rod G′ of the cylinder G, as shown in Figs. 1 and 8. This cylinder G is securely bolted to the standard S by a flanged web, G^2, or otherwise, as desired.

Both of the cylinders E and G for operating the bell and lids are single-acting in action, and only operate to open the bell and the hinged lids; the closing of the same being effected by the gravity of the lids and the counterpoise-weight F acting to bring up the bell after the pressure in the cylinder has been exhausted.

In Figs. 7 and 8 enlarged sectional views of the cylinders are shown, which exhibit the construction of the same and their mode of operation. These cylinders are formed integral with the bottom heads, centrally through which an opening, *r*, is made to serve as a recess for the nut at the bottom of the piston, as well as an inlet for the steam. At the bottom of the cylinders a recess, *r*′, is formed around the same for clearance. The pistons of both cylinders are shown in their normal positions of rest in these figures between the cycles of motion, and, as shown, they are both open at the top. The piston P of the cylinder G is formed with a rim, which projects over the inner surface of said piston, as shown at *p*, Fig. 8, for the double purpose of arresting the piston in its upward motion, and to ena-

ble it to make a steam-tight joint at this point with the open top of the cylinder, and as a further means to prevent leakage, for this cylinder is charged with steam at full pressure while at rest. The joint between the piston-head and head G^3 of the cylinder is packed by a packing of suitable material, as shown at p', Fig. 8.

The cylinder E, Fig. 7, is provided with a hollow piston, Q, of the full length of the cylinder minus the clearance. This secures the advantage that the bearing-surfaces of the cylinder and piston protect each other against dust and grit during their normal position, in which they persist at least ninety-five per cent. of the time. This cylinder is formed with an outlet at *s*, connected with the exhaust-pipe *u*, Fig. 1, which limits the upstroke by allowing the steam to escape, as shown, as soon as the end of the piston reaches this point.

In constructing the mechanism so as to make the cylinders single-acting great simplicity results. Cylinder-heads, piston-rods, and stuffing-boxes are avoided, and the pistons being made of such liberal lengths no packing-rings are required.

The steam-connections for supplying the steam or other power to and exhausting the same from the cylinders, as shown, consists of the following parts:

t is the supply-pipe leading from the boiler, and *u* the exhaust-pipe.

v and *v'* are valves for automatic regulation, operated by the beams W and H, and *x x'* are hand-valves, by which the speed of the action of the pistons in the respective cylinders G and E are governed. The valves *x x'* are interposed between the automatic valves *v* and *v'* and the cylinders G and E, and they are intended to perform a very important function, that of regulating the supply of steam to the cylinders, and thereby governing the speed or degree of rapidity in opening and closing the lids and bell to any desired degree, no extra attention being required on the part of the generally unskilled attendant. Without these valves the throttle-valve must be very carefully handled when high-pressure steam is the motive power, or else it acts too vigorously. With them the tension of any fluid can be easily and nicely controlled.

w is a four-way hand-cock (shown in section in Fig. 9) for supplying and cutting off the steam alternately to the respective cylinders.

y and *y'* are supply-pipes leading from the four-way cock *w* to the cylinders G and E, respectively. Each cylinder is provided with drip-pipe and valves, as thown at *z z'*, connected with the exhaust-pipe *u*, as shown.

To effect the automatic operation of the valves *v* and *v'* by which the supply of steam to the cylinders is admitted or cut off, a bar, I, is rigidly fastened to the lever H near its inner end and connected by a pin in the slotted end J' to a rod, J, which is attached to and operates the valve *v'*; and to the beam W a rod, K, is fastened, having a slot at its lower end, which engages with the valve *v*. The slots formed in the end of the rods J and K are provided, so that the valves are moved only at the end of the movements of the levers or beams H and W, as will be seen.

Having now fully described the steam-connections, the mode of action will be explained as follows, viz: In the normal position for charging the hopper the lever H is up, the lids *i* are raised, and the bell closed, live steam being turned into cylinder G, with the valve *v* open and valve *v'* closed. Turning the four-way cock *w* into the position shown in Fig. 9, live steam enters the pipe *y'*, leading to the cylinder E, but is arrested by the valve *v'*, which is closed, while cylinder G exhausts through the open valve *v*, allowing the beam H to fall and take the position shown in Fig. 1 and the lids to close. At the moment that this will have occurred the rod I, connected to said lever H through its connecting-bar J, will have opened the valve *v'* and permitted the steam to flow through valve *x'* and pipe *y'* into cylinder E, and raise the piston thereof, which, acting upon the rear end of the beam W, lifts the same and causes the bell to be lowered and permit the discharge of the stock into the furnace. As the beam W approaches the end of the upward movement the rod K, pivoted thereto, comes into play and acts to close the valve *v*. As soon as the charge has dropped into the furnace the four-way cock *w* is turned back, so as to open communication between inlet-pipe *t* and pipe *y* of cylinder G and pipe *y'* and exhaust *u*. By this means live steam is permitted to enter pipe *y*, leading to cylinder G, but is arrested by valve *v*, which has been closed by the upstroke of the beam W and the exhaust-passage from *y'* to *u*, having also been established by the same movement of the four-way cock *w* that supplies live steam from pipe *t* to pipe *y*, the cylinder E is exhausted, which relieves the pressure upon the cylinder therein and permits the weight F to bring the bell up to its seat. At the instant this is effected the rod K, descending with the beam W, acts upon the valve *v* and opens the same, permitting steam to flow to the cylinder G and lift its piston, and through its rod raise the lever H and open the lids *i*, thereby returning the parts to their normal position. The operation above explained is thus seen to be entirely automatic, which has the great advantage that no valve can be displaced and that the seal cannot be neglected. The bell cannot leave its seat before the lids are down, and the lids cannot open before the bell is up. Thus the furnace can at no time be left open to the atmosphere, hence positively avoiding the loss of heat and gas, which is the most apparent objection to the gas-seal.

I claim—

1. The charging-hopper of a blast-furnace

having its discharging end composed of two or more removable hopper-sections united to each other and to the fixed hopper-section, in combination with a bell having an area adapted to form a seal with the lower end of either of said hopper-sections, as may be required, whereby the discharging capacity of the hopper may be increased or diminished, substantially as herein set forth, and for the purposes specified.

2. In a blast-furnace feeding device and gas-seal, the combination of a feeding-hopper having two or more removable hopper-sections secured together and to the hopper with sealed joints, to form a single receiving and discharging hopper, with a bell adapted to form a seal with either of said hopper-sections when required, and mechanism for supporting and operating the same, substantially as herein set forth.

3. The combination, in a blast-furnace feeding device and gas-seal, of a feeding-hopper with a bell composed of two separate sections divided by a horizontal partition, and both suspended by the bell-operating rod, substantially as described, for the purpose specified.

4. The combination, in a blast-furnace feeding device and a gas-seal, of a feeding-hopper having two or more removable hopper-sections secured together and to the hopper with sealed joints and their walls in the same plane, with a bell composed of renewable sections, substantially as described, for the purpose specified.

5. The discharging-hopper of a blast-furnace composed of a fixed section and two or more movable ring-sections, forming the discharging end, said removable sections being countersunk seated upon each other and upon the fixed hopper-section, and a bell adapted to close said discharging end when said discharging end is formed by either section of said hopper, substantially as herein set forth.

6. The combination, with the feeding-hopper of a blast-furnace, of a gas-sealing bell or cone composed of two sections, the lower section having a dividing crown or web, and lined with a fire-proof material, and the upper section supported upon the crown, substantially as described, for the purpose specified.

7. In a blast-furnace feeding device, a charging-hopper composed of a fixed upper section and two or more renewable ring-sections, the latter united by sealed joints, and terminating with curved or beveled lower edges adapted to form a sealing-joint, combined with a sealing bell or cone having a base diameter greater than that of the discharge-opening of either of said ring-sections; substantially as described, for the purpose specified.

8. The charging-hopper of a blast-furnace composed of a fixed section and two or more removable sections forming the discharging end, joined and supported upon each other by countersunk seats, in combination with fastening-bars arranged to cross the joining edges of the several sections, and a bell or sealing cone arranged to seal the hopper from below, whereby the removable hopper-sections are supported and held in proper relation against the closing pressure of the bell, substantially as set forth.

9. In a blast-furnace, in combination with a hopper, a bell for closing the discharge-opening of the same, composed of two separate sections, with an interposed uniting-plate, and lined in the bottom with fire-brick, substantially as and for the purpose described.

10. The combination, in a blast-furnace, with the hopper and bell, of the lip-rings A A′, lugs a^2 a^3, struts a a', and wedges a^4, substantially as and for the purpose described.

11. In a blast-furnace, the combination, with the hopper having the flange g below the top edge thereof, of the cover D, composed of several sections united together, and formed with charging-openings D′, having depressed lips h around the same, and suitable hinged lids and holding-frames therefor, substantially as and for the purpose described.

12. In a blast or similar furnace, the combination, with the hopper and cover D, having the charging-openings D′ therein formed with depressed lip-flanges h, of the frame 7, made hopper-shaped, and the hinged lid fitting within said frame, substantially as described.

13. In a blast-furnace, the combination, with the cover D, having the charging-openings D′ formed with depressed lip-flanges h, of the hopper-shaped frame 7, to receive the lids i, made to form a space around the said frame between the walls of said opening for packing, substantially as described.

14. In a blast-furnace, the combination, with the frame 7, having a beveled seat, 9, formed therein, of the lids i, having beveled edges to fit said seat, substantially as and for the purposes described.

15. The combination, with the hopper and its cover, having the charging-openings D′, of the frame 7, for seating the sealing-lids formed at its front with an enlargement or projecting rib, j, to receive the blow of the filling-barrows, substantially as described.

16. The combination, in a charging apparatus for blast-furnaces, of the charging-hopper, the sealing-bell and its operating-rod, with a hopper-cover having confined packing-rings adapted to move sidewise with said rod and maintain a gas-tight joint therewith, substantially as herein set forth.

17. In a blast-furnace, the combination, with the single-acting cylinders G and E and weight F, of the beams W and H, the bell and the lids, and suitable pipe-connections to properly supply and exhaust the steam from the cylinders, substantially as and for the purpose described.

18. In a blast-furnace, the mechanism for effecting the automatic operation of opening and closing the seats, consisting of the single-

acting cylinders G and E, weight F, beams W and H, pipes *y*, *y'*, *t*, and *u*, four-way cock *w*, valves *v* *v'*, and hand-valves *x* *x'*, together with the slotted rods J K and connection I, all arranged and adapted for operation substantially as described and shown.

19. The combination, in a gas-seal for blast-furnaces, of the steam-cylinder E, closed at one end only, having the end inlet and side exhaust-pipes *y'* and *s*, with a piston which is substantially the same length as the cylinder, the piston-rod, the beam W, and the bell of the charging-hopper, substantially as herein set forth.

20. In a blast-furnace, the piston G, for operating the sealing-lids formed with a single head, combined with a piston having a top flange, *p*, and packing *p'* at the open top of said cylinder, the connecting-rod G', and the beam H, and the hinged lids, substantially as described.

21. The combination, in a blast-furnace, with the two single-acting cylinders and suitable interposed inlet and exhaust connections, substantially such as described, of the hand-valves *x* and *x'*, interposed between the respective cylinders upon their supply-pipes, and the automatic valves *v* and *v'*, whereby the amount of steam admitted to the cylinders may be regulated to any desired degree and the quick or slow action of the pistons of said cylinders correspondingly effected.

22. The cover of a charging-hopper of a gas-seal for blast-furnaces having one or more charging-openings formed with depressed surrounding ledges, in combination with an open fixed hopper-frame seated with a sealed joint upon said frame-ledge, and a hinged lid adapted, when closed, to form a sealed joint upon the inner walls of said open hopper-frame, substantially as described, for the purpose specified.

23. The combination, with the charging-hopper of a blast-furnace, of a top plate or cover for said hopper, provided with a fixed charging-hopper frame, and a hinged lid closing with gas-tight joints therein, substantially as described, for the purpose specified.

24. The combination, in a charging apparatus for blast-furnaces, of the charging-hopper, with a cover therefor having a countersunk sealed joint within said hopper-walls, and one or more charging-hopper frames having countersunk sealed joints with said cover, and a hinged lid adapted to close upon the inner beveled walls of said charging-hopper frame, substantially as herein set forth.

25. The cover of the charging-hopper of a blast-furnace seated upon an interior wall-ledge, *g*, of said hopper with a sealed joint, and having one or more charging-hopper frames seated upon countersunk ledges with sealed joints, hinged lids for said charging-frames, having beveled seats, and a packing for the bell-rod, having freedom for side movement with the rod in its box, whereby every joint of the cover is sealed against the escape of gas, substantially as herein set forth.

26. The combination of the charging-hopper, its cover, the sealing-bell, and its operating-rod, of a blast-furnace, with a cover-packing for said rod composed of rings of asbestus or similar sheet-packing, a divided weight for holding it in place, and a confining-cup within which said packing has freedom for side movement produced by the lateral deflections of said bell-rod, substantially as herein set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

EDWARD A. UEHLING.

Witnesses:
MAUNSEL WHITE,
ARNON P. MILLER.