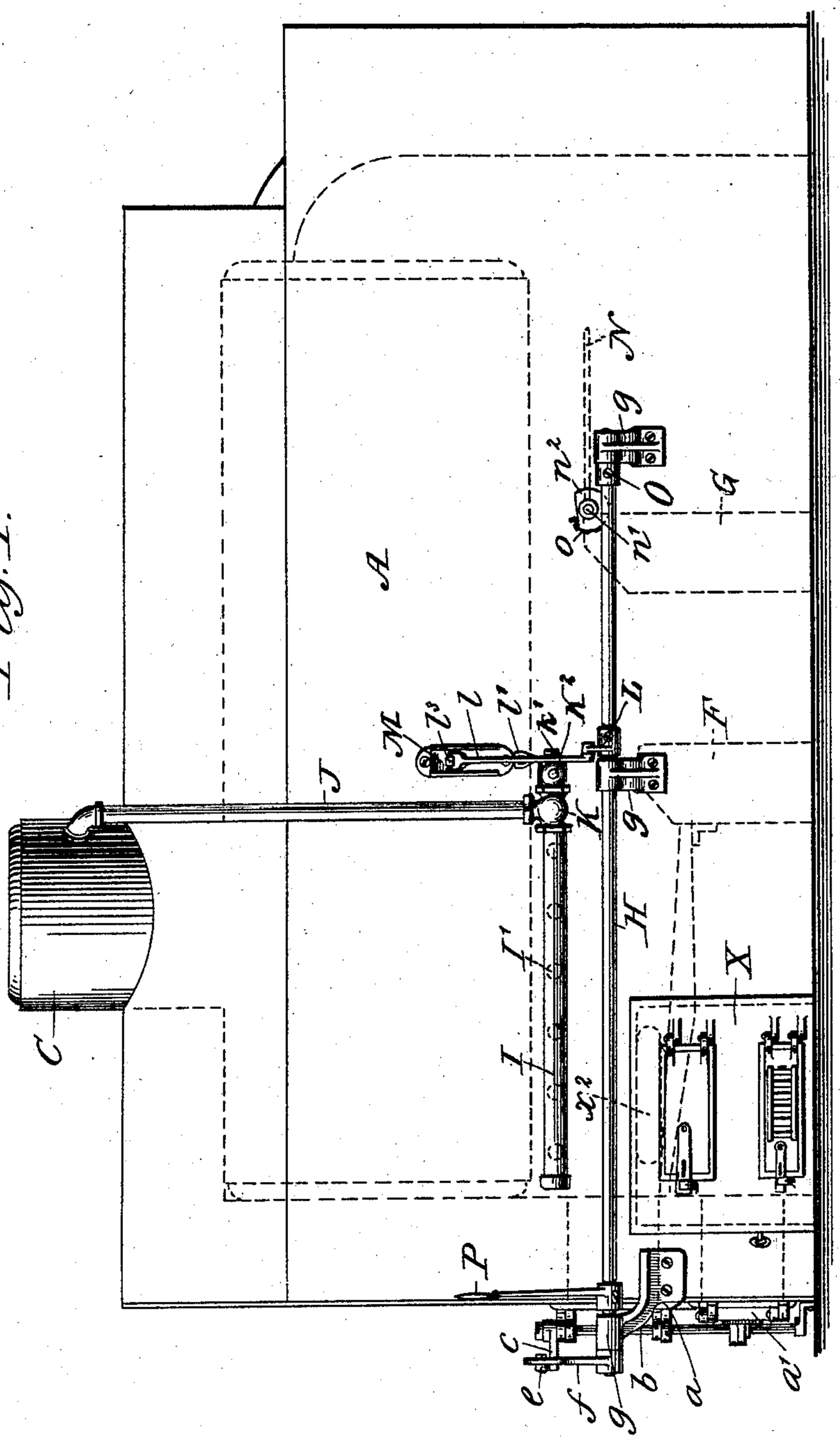
(No Model.) 4 Sheets—Sheet 1.

H. P. K. PECK.

FURNACE FOR CONSUMING SMOKE.

No. 580,712. Patented Apr. 13, 1897.

Fig. 1.



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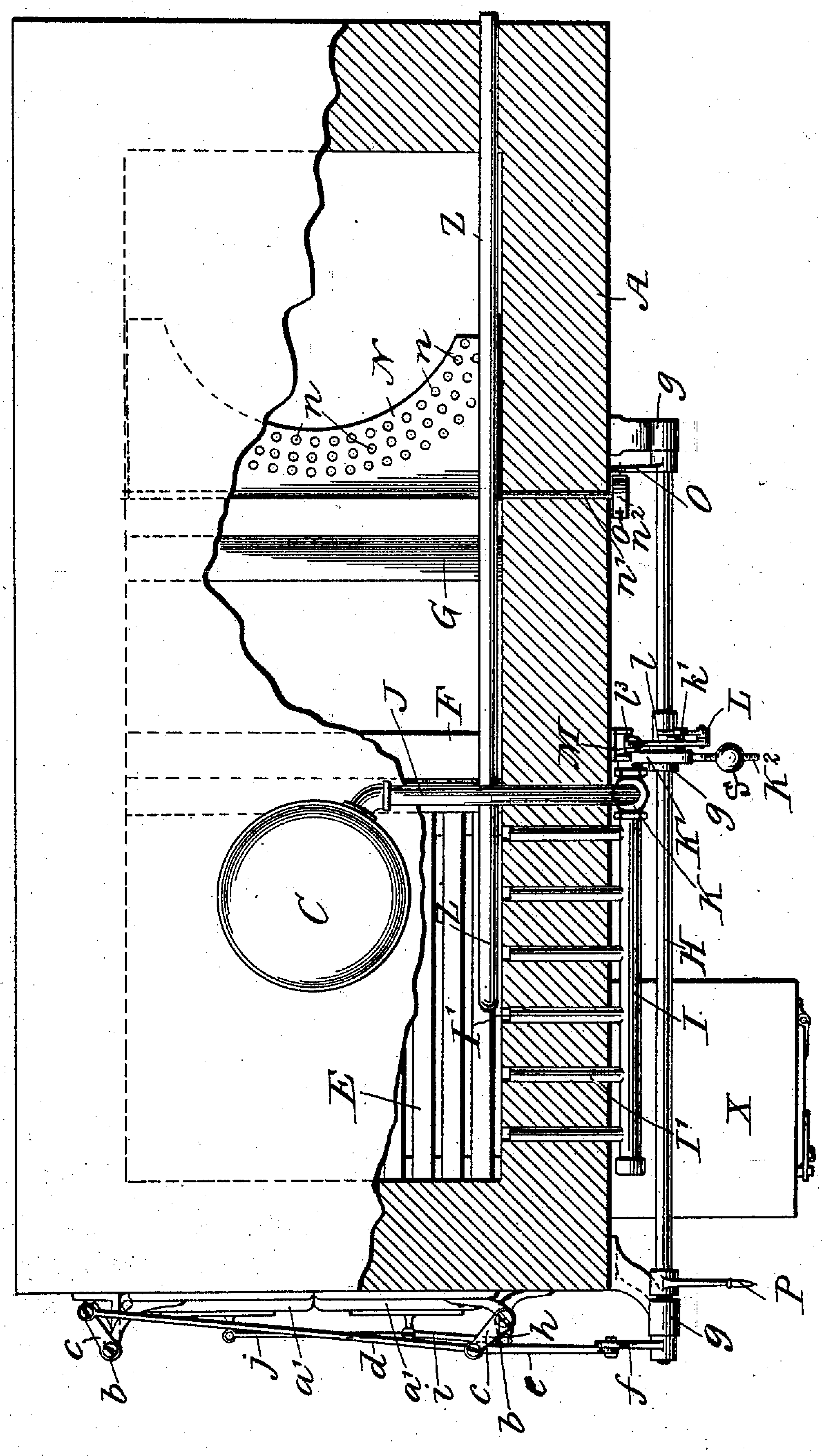
H. P. K. PECK.

FURNACE FOR CONSUMING SMOKE.

No. 580,712. Patented Apr. 13, 1897.

Fig: 2.



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H. P. K. PECK.

FURNACE FOR CONSUMING SMOKE.

No. 580,712. Patented Apr. 13, 1897.

Fig: 3.

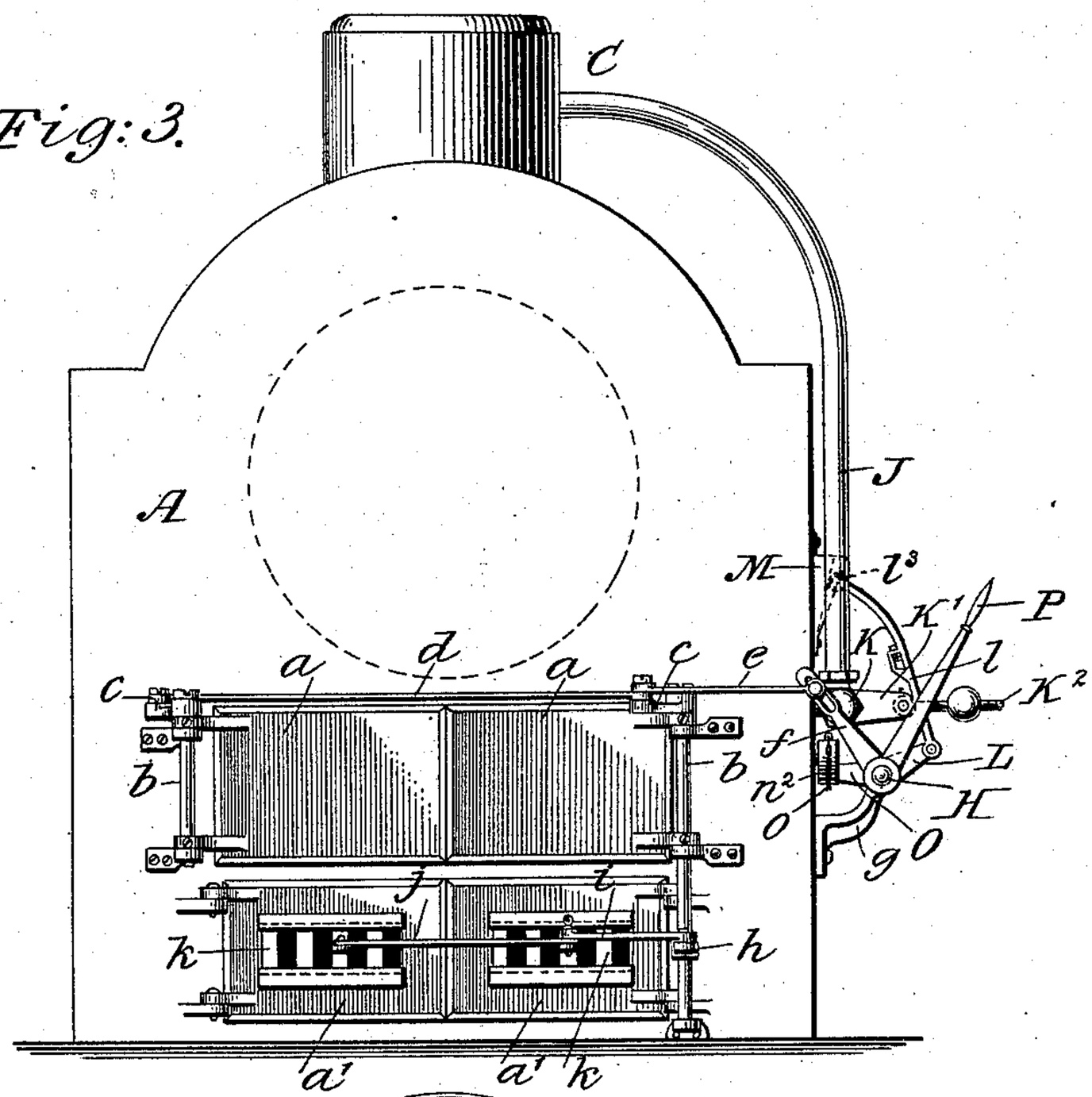
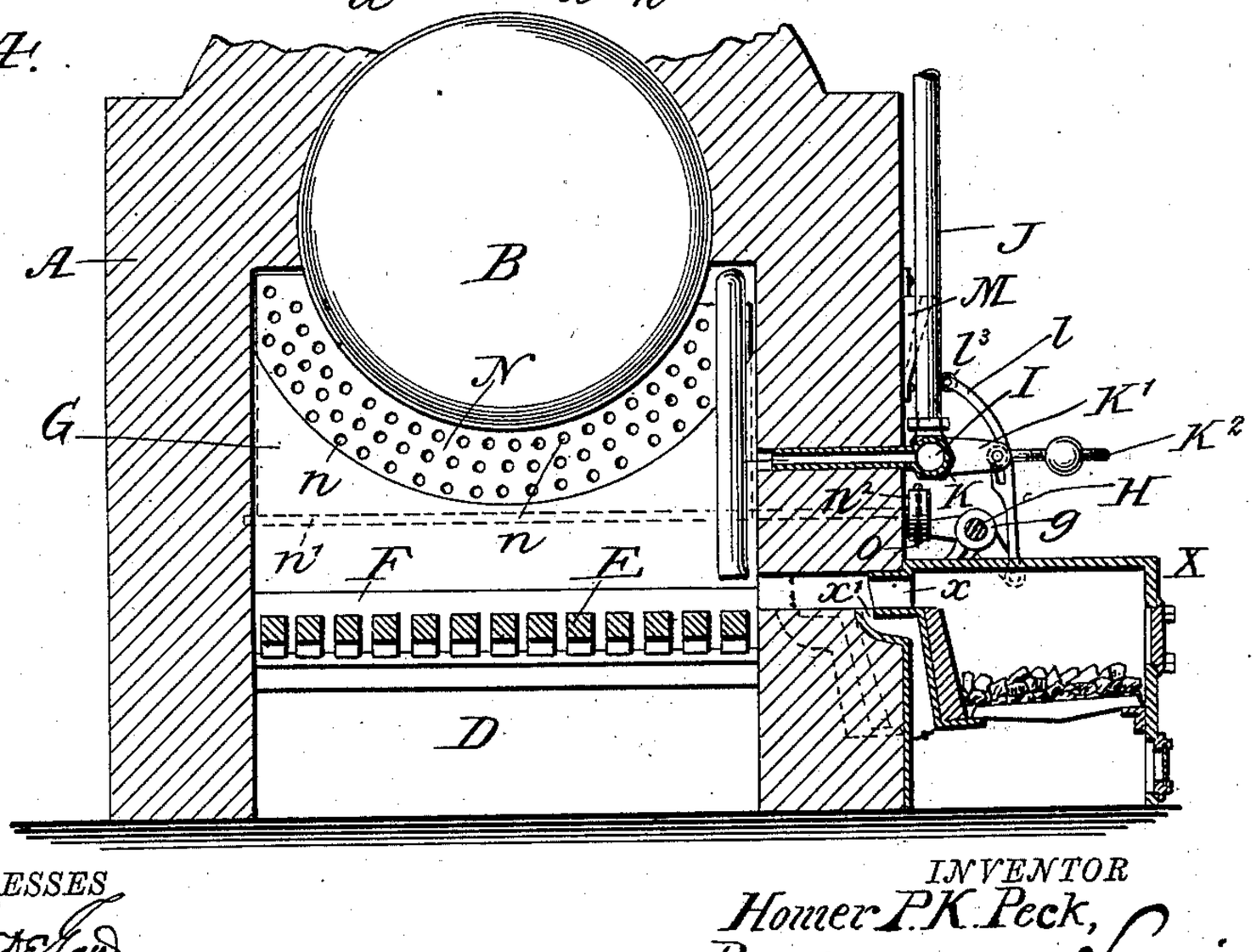


Fig: 4.



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H. P. K. PECK.

FURNACE FOR CONSUMING SMOKE.

No. 580,712. Patented Apr. 13, 1897.

Fig: 5.

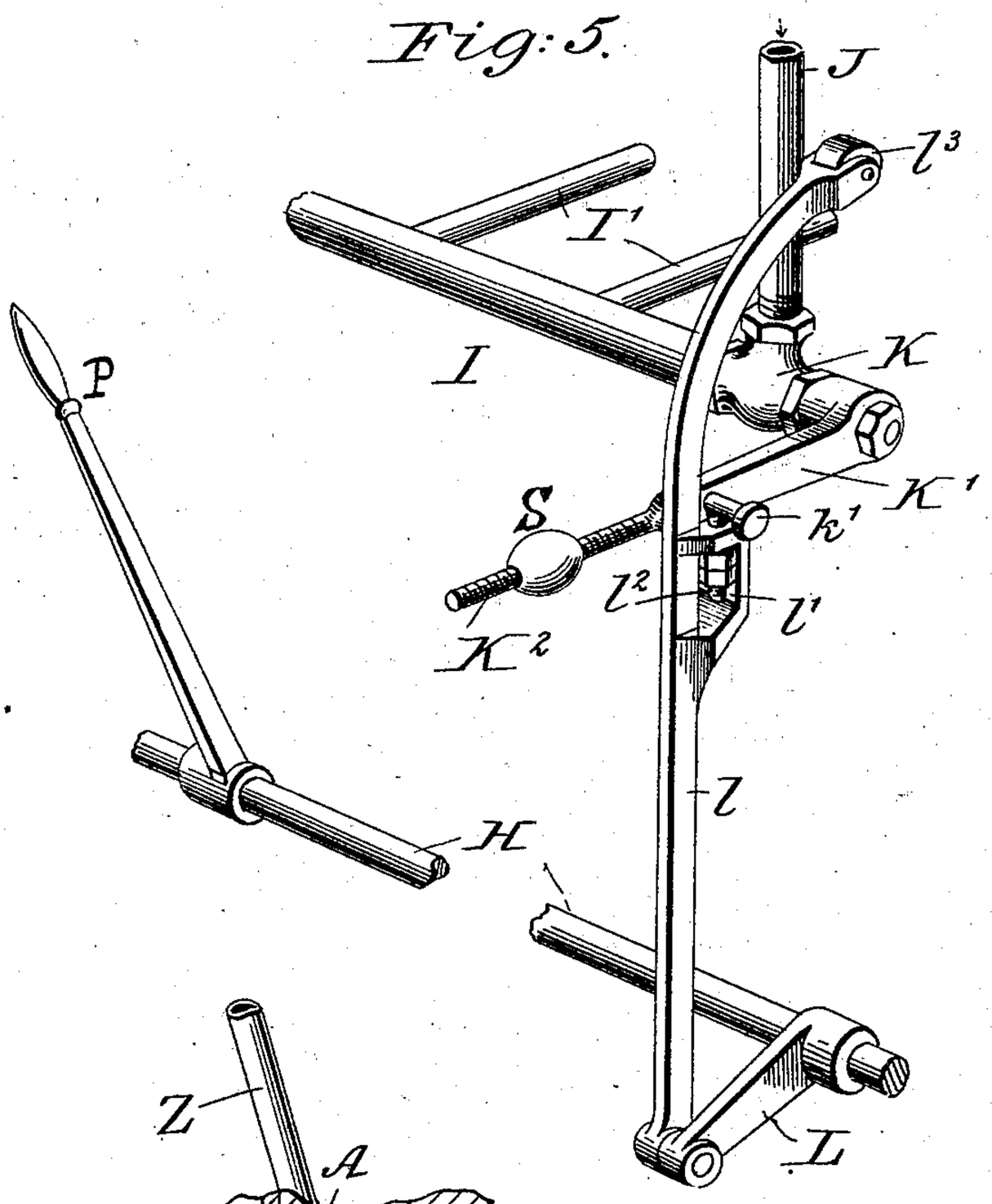


Fig: 6.

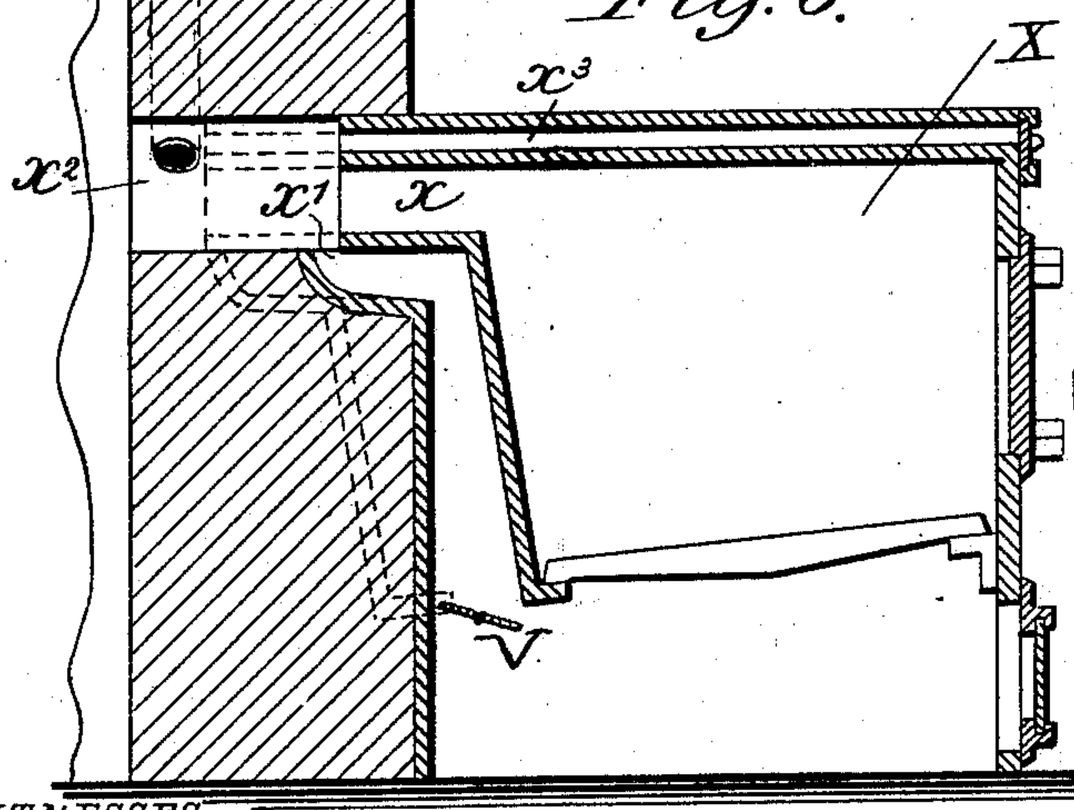
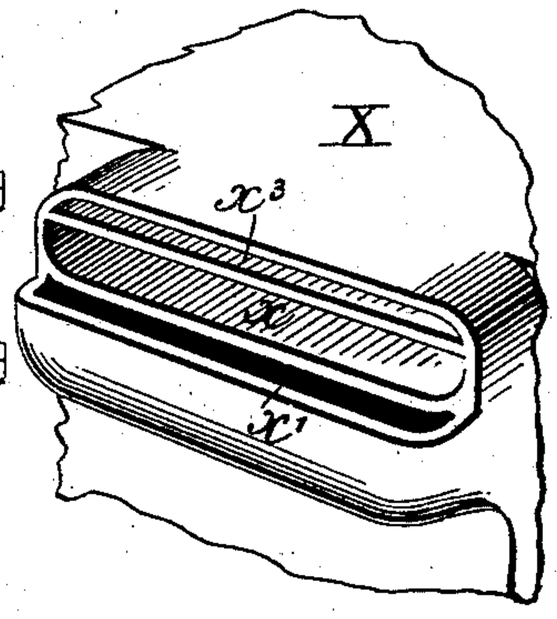


Fig: 7.



WITNESSES

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UNITED STATES PATENT OFFICE.

HOMER P. K. PECK, OF TENAFLY, NEW JERSEY.

FURNACE FOR CONSUMING SMOKE.

SPECIFICATION forming part of Letters Patent No. 580,712, dated April 13, 1897.

Application filed December 7, 1896. Serial No. 614,814. (No model.)

To all whom it may concern:

Be it known that I, HOMER P. K. PECK, a citizen of the United States, residing at Tenafly, in the county of Bergen and State of New Jersey, have invented new and useful Improvements in Furnaces for Saving Fuel and Consuming Smoke, of which the following is a specification.

This invention comprises devices and mechanism for the introduction, regulation, and control of dry steam, heated and common air, and for commingling thereof with the smoke and other volatile products of burning fuel in the body or fire-chamber of a furnace; also, in combination with said devices, the use of a perforated adjustable diaphragm to prevent the escape of said products of combustion from the fire-chamber and thereby assure their entire combustion under the boiler and therefore prevent their admission, as such, to the flues of the boiler.

One branch of the invention relates to the introduction to the fire-chamber of heated air in conjunction with the heat generated and air heated by an auxiliary coke-furnace connected with the main furnace, and in such relation at the side thereof as to cause the hot air drawn through a pipe or chamber located along the side of the furnace-boiler to commingle as it enters the furnace with jets of steam and with the smoke and gases evolved from the fuel used in the main furnace and thereby cause complete combustion thereof, principally under the front portion of the boiler. The heat generated by the coke-furnace and the hot air heated thereby will, together with the volume of hot air drawn through a hot-air pipe situated along the side of the boiler and over the burning fuel, form a sufficient body of hot air to mingle with the inflow of small jets of steam and become diffused with the smoke, &c., evolved from the fuel to effect the entire combustion thereof without introducing drafts of cold or common air for this purpose over the grate and burning fuel.

In the accompanying drawings, Figure 1 represents a side elevation of the organized invention, exhibiting in outline and dotted lines an incased boiler and some of the interior parts of the main furnace. Fig. 2 is a plan view with part of the casing broken away. Fig. 3 is a front elevation showing the boiler-dome and steam-conducting pipe. Fig. 4 is a transverse vertical section taken through the rear portion of the auxiliary furnace. Fig. 5 exhibits a perspective view of the operating mechanism. Fig. 6 is a vertical sectional view of the auxiliary or coke-furnace, showing its hot-air passage or chamber. Fig. 7 is a perspective view of the flues of the auxiliary furnace, which enter the casing of the main furnace.

A denotes the furnace and boiler casing; B, the boiler; C, boiler-dome; D, ash-pit; E, grate-bars; F, front bridge-wall; G, rear bridge-wall; H, rock-shaft; J, steam-supply pipe; I, branch steam-pipe; I′, small steam pipes or nozzles which inject small jets or spray; K, stop-cock of steam-pipe; K′, actuating-arm of stop-cock; K^2, extension of same with screw-thread and adjustable weight; L, fixed arm on rock-shaft to act on stop-cock arm K′ through hinged bent arm *l;* M, cam-block secured to and inclining from boiler-casing (shown in dotted lines in Figs. 3 and 4) to cause release of the bent arm from the stop-cock arm; N, adjustable perforated diaphragm; O, fixed arm on rock-shaft to raise the diaphragm to nearly a vertical plane under the boiler; P, operating hand-lever on rock-shaft; *a a*, furnace-doors; *a′ a′*, ash-pit doors; *b b*, hinge-rods of furnace-doors; *c c*, arms attached to hinges of furnace-doors; *d*, rod connecting said arms *c c* with furnace-doors *a a* by pivots; *e*, pitman-rod pivoted to arm *c* on furnace-door and connecting by pivot with slot in fixed arm *f* on rock-shaft H; *f*, said fixed arm on rock-shaft that operates furnace-doors *a a* through connecting-arms C and rod *d; g*, brackets supporting rock-shaft; *h*, fixed arm on lower portion of door-hinge pivot to actuate ash-pit-door dampers *k* through connecting-rods *i j*, which are detachable.

l denotes a bent hinged arm pivoted to fixed arm L on rock-shaft to act upon arm K′ to open stop-cock K; *k′*, a stud on arm K′, against which bent hinged arm *l* rides; *l′*, an open slot in a projection on bent arm *l*, in which is an adjustable set-screw to regulate the extent of opening of stop-cock K; l^2, said set-screw to adjust extent of said movement of stop-cock arm K′, which actuates stop-cock;

l^3, friction-roller in end of bent arm l, that works on inclined plane or cam-block M; n, perforations in diaphragm; n', hinge-rod connected rigidly to diaphragm N, located in rear of bridge G; n^2, segmental pulley on which chain o works, connecting it with arm O on rock-shaft H; X, auxiliary furnace; x, its combustion-chamber flue; X', hot-air exit-flue; X^2, flue-space communicating with main furnace above its grate, into which hot air, through pipe Z, is discharged; X^3, hot-air chamber formed between two upper plates of furnace X; Z, hot-air induction-pipe communicating with flue-space X^2 and having its outer open end outside the furnace-casing.

In order to completely consume the smoke and other combustible products that evolve from the use of bituminous fuel which is fed to a furnace at intervals of time in the usual way and to utilize them for heating purposes, it is of prime importance that the supply of oxygen to support combustion be fully adequate at all times and that provision should be made to increase its supply as exigencies occur, as in the case while each replenishing feed of fuel is being reduced to coke and to an incandescent glow. To meet these conditions, it has been the custom to introduce superheated steam to the furnace-fire after each fresh supply of fuel is placed thereon without deeming it of value to employ means of enlarging and augmenting the air-draft of the furnace at the time when such increase is especially required, except such increase is admitted directly through the furnace-doors. In some instances dampers have been employed in the furnace-doors, through which air-draft is admitted, but it is evident that this method tends to drive the smoke and gas emitted from the fresh fuel rearward. Hence its escape unconsumed by reason of the chimney-draft. In cases where the air-feed has been accelerated and its volume enlarged by the use of a blower directing the supply up through the grate and burning fuel at the time of the ingress of steam to the fire-chamber and while the fresh fuel is emitting smoke, soot, and gas, better results have been obtained; yet the effect is in some degree to drive those combustible unconsumed products to the rear, and thence to the final exit of the chimney. Besides, the effect of cold-air drafts directed over the fuel and necessarily under the front portion of the boiler causes what are called "cooling-drafts," which diminish the degree of heat of the boiler and correspondingly affect the quantity of steam produced.

The object of this invention is to furnish a combination of devices and mechanism greatly simplifying the apparatus heretofore introduced of analogous kinds, intended to effect the principal ultimate purpose desired, and to provide means of avoiding the inefficiencies and objections mentioned, and to greatly economize in the use of fuel, and capable of use by unskilled workmen.

Observation and experience have proven that the failures of means and methods devised to completely consume the smoke and gas evolved from burning bituminous fuel in furnaces have resulted from the fact that when fresh supplies of such fuel are cast upon the grate of burning coals the heat is diminished thereby for the reason that the fresh replenishing supply tends to smother the fire, causing inadequate generation of heat at the precise period of time when the smoke is being emitted in the furnace. This inefficiency of heat will be rectified by the use of the auxiliary furnace, because it will supply an adequate extra volume of pure caloric that enters the main furnace, together with highly-heated air and steam, at the time of the emission of the smoke, soot, and gas from the replenishing feeds of fuel cast into the furnace, and thus create an intense heat therein, assuring the complete consumption of the combustible products evolved.

The organization herein more fully explained will, it is believed, greatly advance the art in this class of inventions.

From the foregoing description of parts and their connections it will be understood that the hand-lever P in actuating rock-shaft H will move with it the several arms fastened thereon—namely, arm L, which is hinged to bent arm l, that acts against a stud k' on arm K', connected with stop-cock K, thereby opening the same for the admission of steam through pipes J and I, thence through jet-nozzles I' to the fire-chamber. The set-screw l^2 may be so adjusted that after having acted on stud k' and turned the stop-cock to the desired extent for admission of steam the further movement of arm l will cause friction-roll l^3 to traverse cam-block M and thereby release the stop-cock arm K', leaving the stop-cock free to be closed by the gravity of the weight s on the screw-threaded extension thereof, K^2.

The pivot-rod N', which serves as the hinge of diaphragm N, is rigidly secured thereto, and the normal position of diaphragm N is horizontal behind bridge-wall G. Attached to the projecting end of pivot-rod N' is a segmental pulley N^2 with a chain o fastened thereto, having its other end secured to arm O on rock-shaft H, and by the rocking of said shaft in the right direction said arm acts on chain o and raises the diaphragm up to near a vertical plane, closing the flue-space between the bridge G and boiler B, which greatly checks the egress of the smoke, &c., at the time and directly after fresh fuel is supplied to the burning fuel and while the dry steam and highly-heated air are being fed to the furnace to assure the burning of the volatile products of the fuel and more rapidly reduce the fuel to an incandescent glow.

The arrangement of the apparatus is such, as hereinbefore partly set forth, that no cold-air drafts are admitted to cool the boiler and cause greater consumption of fuel necessary,

and the use of a blower to satisfactorily do the work of generating a stated quantity of steam is not required.

The projecting end of the hinge-rod *n'* may be provided with a small chain and weight (not shown in the drawings) to cause a gradual return of the diaphragm to its normal horizontal position, as it will return to said position by its own gravity, being inclined rearward when standing up in the flue-draft under the boiler, and it is apparent that when the rock-shaft is reversed the arm O on shaft H will be carried with it, and therefore its chain will become slackened, leaving the diaphragm free to fall to its horizontal place. The counteracting-weight connected to the outer end of the hinge-rod will not be sufficient to prevent the diaphragm from gradually opening the flue-space by its descent, but will in some degree continue while it descends to retard the passage of smoke and gas until the ignition thereof is well established.

While it is true that the holes through the diaphragm N will permit the less dense products of combustion to slowly pass and thus prevent total check-draft, yet the denser soot-laden smoke will be retained to be consumed under the front of the boiler, and the gases that have passed beyond the diaphragm will be quickly inflamed, as the heat increases in the fire-chamber of the furnace and is carried rearward to the exit-flues of the boiler after the diaphragm has commenced its descent.

The fixed arm *f* on the rock-shaft serves to open and close the furnace-doors *a a*, having a connecting rod or pitman *e* hinged by pivot and slot to it and to the arm *c*, secured to the hinge-rod *b* of the door nearest the rock-shaft, and a similar arm *c* is fastened to the other door, and the two arms *c c* are pivotally connected together by rod *d*, so that the movement of hand-lever P to the right will cause the rock-shaft H to act through arm F, which in turn acts upon pitman-rod *e* and connecting-rod *d*, hinged, as aforesaid, to arms *c c* on doors *a a*, thus operating to open doors *a a*, and the reverse movement of the rock-shaft will act through the same connections and close said doors, which remain open only time for each feeding of fuel. The fixed arm *h*, fastened to the right-hand hinge-rod *b*, that extends down past the ash-pit doors *a' a'*, is connected by pivot to rod *i*, having its other end pivoted to a stud on the sliding damper *k*, and another pivoted rod *j* is similarly attached to the other damper *k* of the other door *a'* of the ash-pit and to the pivot-stud on the right-hand damper. These rods are removable to allow the doors *a' a'* to be opened to remove ashes; also to allow their adjustment by hand to particularly regulate the air-draft under the furnace-grate when deemed desirable.

It will be observed that whenever the furnace-doors *a a* are being opened by means of the mechanism described for the supply of fuel the sliding dampers in the ash-pit doors *a' a'* will be closed and the air-draft through them will be cut off, and on closing the furnace-doors *a a* said dampers will be opened unless the connecting-rods *i j* are detached, and at or about the same time the furnace-doors are opened the same movement of the rock-shaft will, through its connections, elevate the perforated diaphragm, as shown in Fig. 4, and the reverse movement of the rock-shaft that closes the doors *a a* will open the steam stop-cock K, but neither the stop-cock nor the diaphragm N will be acted upon to restore them to their normal condition by their connection with the rock-shaft, as these movements are effected by adjustable counteracting-weight, as before specified. Consequently the amount of steam to be admitted may be graduated in quantity and gradually diminished as may be found desirable, and the time required to entirely close the steam stop-cock and also to lower down the diaphragm to its horizontal plane will be determined by the engineer or other attendant of the furnace, who can adjust the weights.

The coke-furnace X may be set well into the brick casing A, as indicated by dotted lines in Figs. 4 and 6, and the air chamber or flue X^3 may have a damper at the front to admit air thereto, and in passing to the main furnace it will become heated and increase the volume of hot air introduced through pipe Z, which, together with the injected steam, mingle with the dense volume of smoke, &c., as aforesaid. Instead of coke anthracite coal or other fuel may be used in this auxiliary furnace.

The discharging end of pipe Z is preferably located in the flue X^2 of the auxiliary furnace, as seen in Fig. 6. The air-draft under the coke-furnace grate should be nearly closed off after the body of coke thereon has been brought to a bright glowing condition, thereby greatly economizing its use, and thereupon the damper V, Fig. 6, may be opened to permit the air that enters under the grate to rise up through flue *x'* and become heated before reaching the common exit-flue x^2.

It should be stated that the arms attached to the rock-shaft may be made adjustable thereon, so that some interval of time may occur between their several functions, and thereby the operations of doors and dampers and of the steam stop-cock and diaphragm may be accomplished as successive steps instead of being simultaneously effected.

It is apparent from the foregoing description that a sufficient supply of hot air and dry steam may be drawn into the main furnace and in a varying volume as required for different states of the burning fuel to effectively create the necessary combustion of the fuel and also to consume the smoke and other evolved products that are inflammable without the use of the ordinary cold-air drafts through the doors of the furnace or ash-pit. The coke-furnace X may be dispensed with, but its use will effect saving of fuel, and its auxiliary services are deemed to

be of decided importance. In its management not more than ten bushels of coke per day need be used, and this amount should be divided in only four or five feeds, because the body of coke of two bushels after being brought up to the incandescent state in the coke-furnace may be kept for several hours in that glowing state by shutting off nearly all air-draft, yet its heat-radiating effect continues with little diminution. The benefit of this inexpensive coke-furnace, of a capacity to burn two or three bushels at a time, (being only five feet in length and two feet broad and deep,) will greatly reduce the quantity of fuel required to be used in the main furnace, while the main object of consuming the smoke and gases will be especially promoted thereby.

The reason for introducing the drafts of hot air and sprays or jets of steam at the side of the fuel-chamber above the grate of the furnace is to cause a revolution thereof, together with the smoke, &c., to mix them while in motion transversely to the flue-exit leading under the boiler to the chimney, and thereby retard their passage and assure the prime purpose of consuming them before being drawn off by the combustion-flue and chimney-draft.

The forcible discharge of the jets of steam into the furnace in conjunction with the feed of heated air naturally tends to increase and accelerate the ingress of the air during the time the steam is being injected into the furnace.

It will be observed by reference to Fig. 2 that the arm *c*, secured to the left-hand furnace-door, is V-shaped, and that the branch of it to which rod *d* is pivoted projects rearward and occupies a position reverse to that of the arm *c* on the right-hand furnace-door. This reverse position of the arms *c c* in respect to each other causes the furnace-doors to be opened in opposite directions (as is usual) by means of the direct drawing action of the pitman-rod *e*, and the reverse movement of rod *e* will close said doors, as has been stated.

It will be noticed that the necessary functions herein described to attain the important result desired are produced by the employment of an organization of few simple parts, homogeneous in their combination and operations, and consequently neither governing nor regulating appurtenances, termed "cataracts," "dash-pots," or other complex and cumbersome appendages, are required as auxiliary means of effectively working the actuating mechanism herein described.

Having described my invention, I claim and desire to secure by Letters Patent—

1. The combination with a furnace for consuming smoke and gas evolved from the burning fuel used therein, of an auxiliary furnace at the side of the main furnace and having a flue communicating therewith, hot-air and steam induction pipes and flues arranged at one side of the fuel-combustion chamber, and in such relation to each other that the steam and air thus introduced will commingle with hot air generated and discharged by the auxiliary furnace, and together be diffused with the combustible elements emitted from the fuel and cause ignition of said elements before they can be drawn off and escape from the furnace through the boiler-flues and chimney-draft.

2. The main furnace in combination with the auxiliary furnace having flues communicating with the fire-chamber of the main furnace for the admission thereto of heat generated by the auxiliary furnace, and air heated thereby, and air-draft-heating flues above and at the rear of the auxiliary furnace as described.

3. The adjustable perforated diaphragm, located behind the rear bridge-wall in combination with a furnace provided with steam and hot-air-induction tubes for consuming hydrocarbon gas emitted from burning fuel, as set forth.

4. The rock-shaft H provided with a hand-lever, and arms *f*, L, and O, connected to and in combination, respectively, with mechanism for operating the main furnace-doors, the steam-pipe stop-cock hinged adjustable diaphragm and the ash-pit dampers, as set forth.

5. The bent arm hinged to arm L on the rock-shaft H, having a set-screw to act on the stud attached to the stop-cock arm and open the stop-cock; and a friction-roller to traverse an inclined plane or cam, to release the stop-cock arm so that the stop-cock will be closed by means of the gravity of the adjustable weight on the extension of said arm, as described.

6. The air-draft-heating flues above and at the rear of the auxiliary or coke furnace, in combination with the common exit-flue of said furnace, to conduct heated air to the main furnace fire-chamber, as specified.

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

HOMER P. K. PECK.

Witnesses:
GEO. W. REA,
VINTON COOMBS.