(No Model.) 3 Sheets—Sheet 1.

T. MURPHY.

SELF FEEDING FURNACE.

No. 587,678. Patented Aug. 3, 1897.

Fig. 1

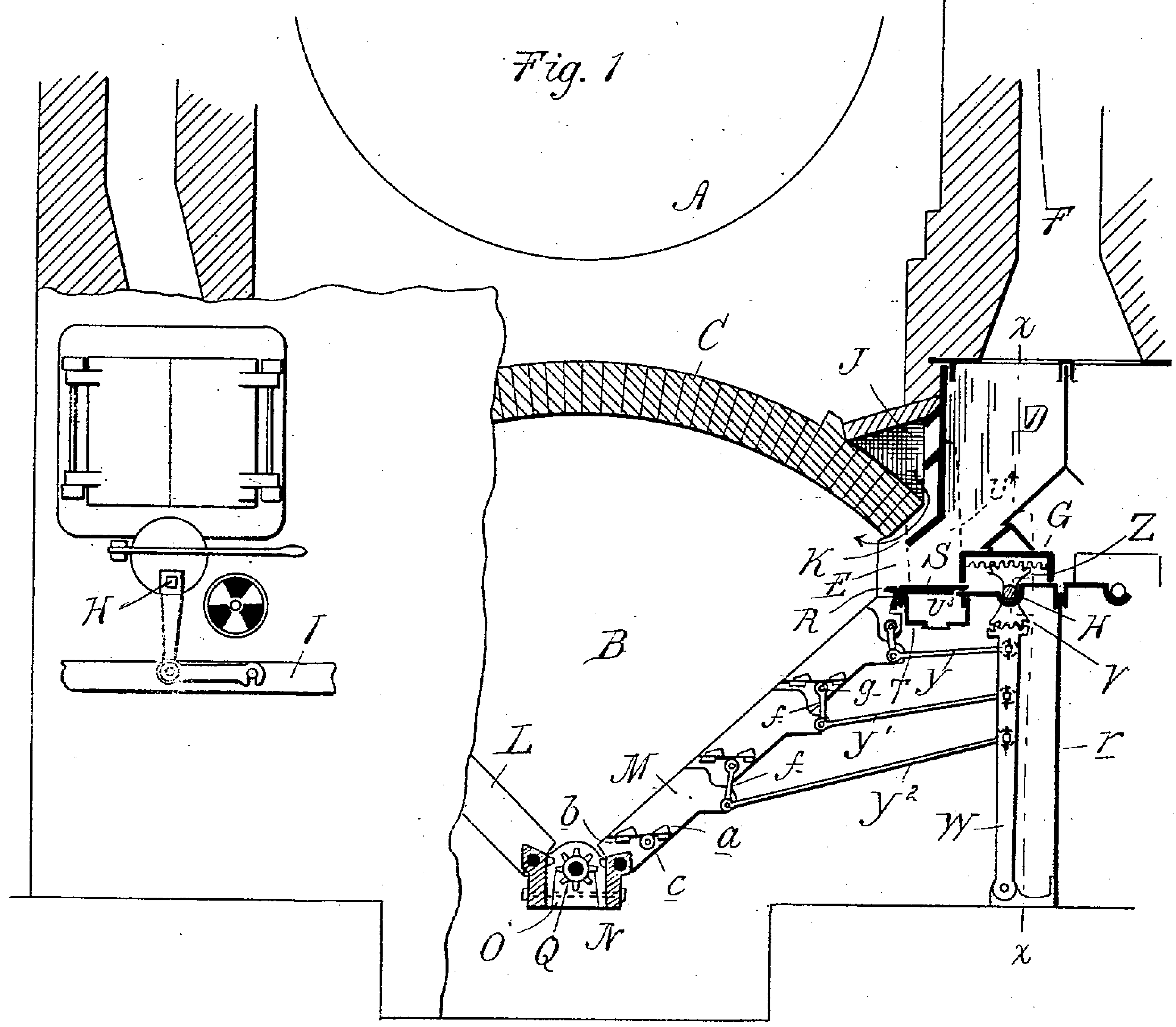
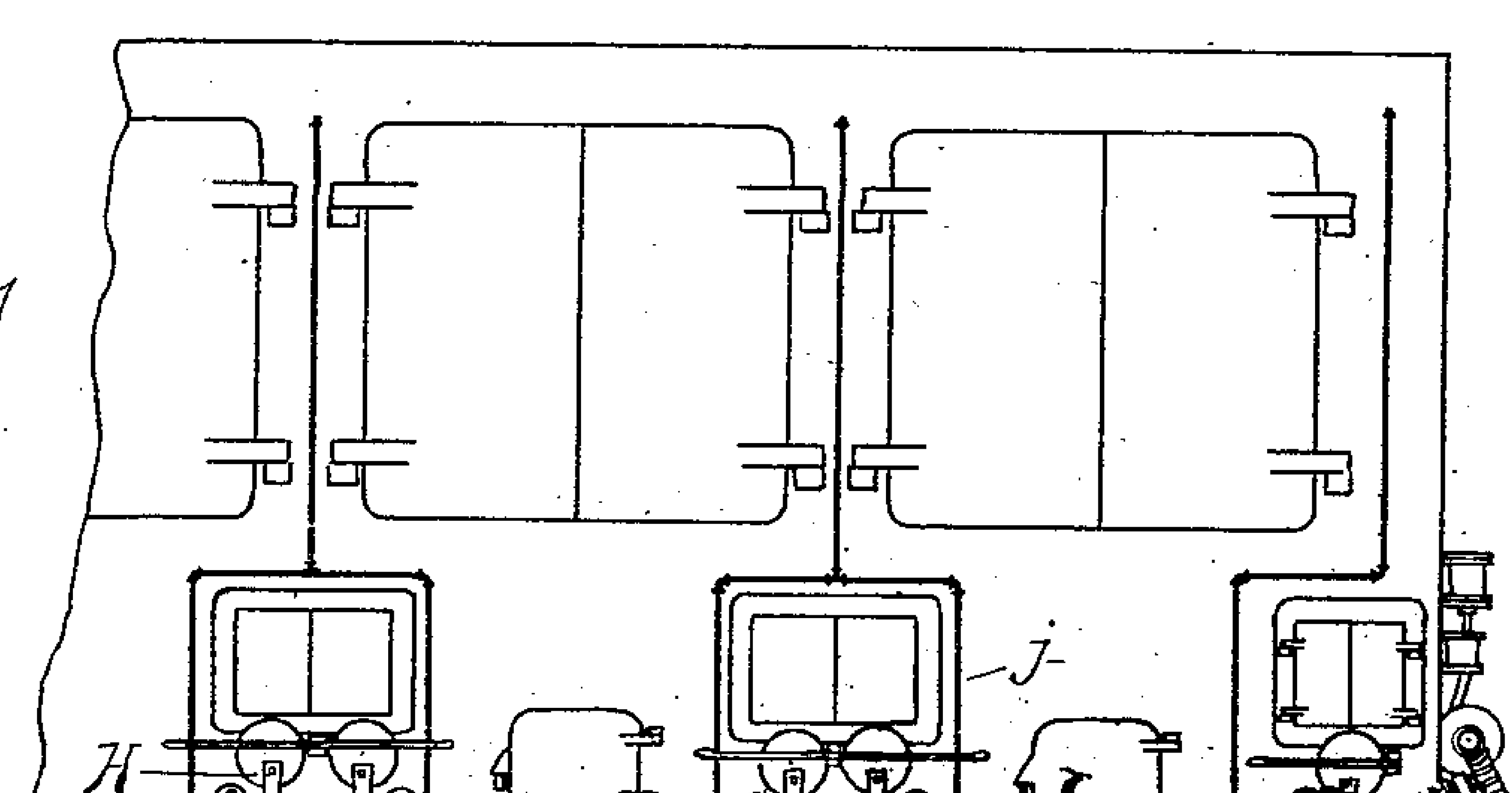


Fig. 11



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(No Model.) 3 Sheets—Sheet 2.

T. MURPHY.

SELF FEEDING FURNACE.

No. 587,678. Patented Aug. 3, 1897.

Fig. 2.

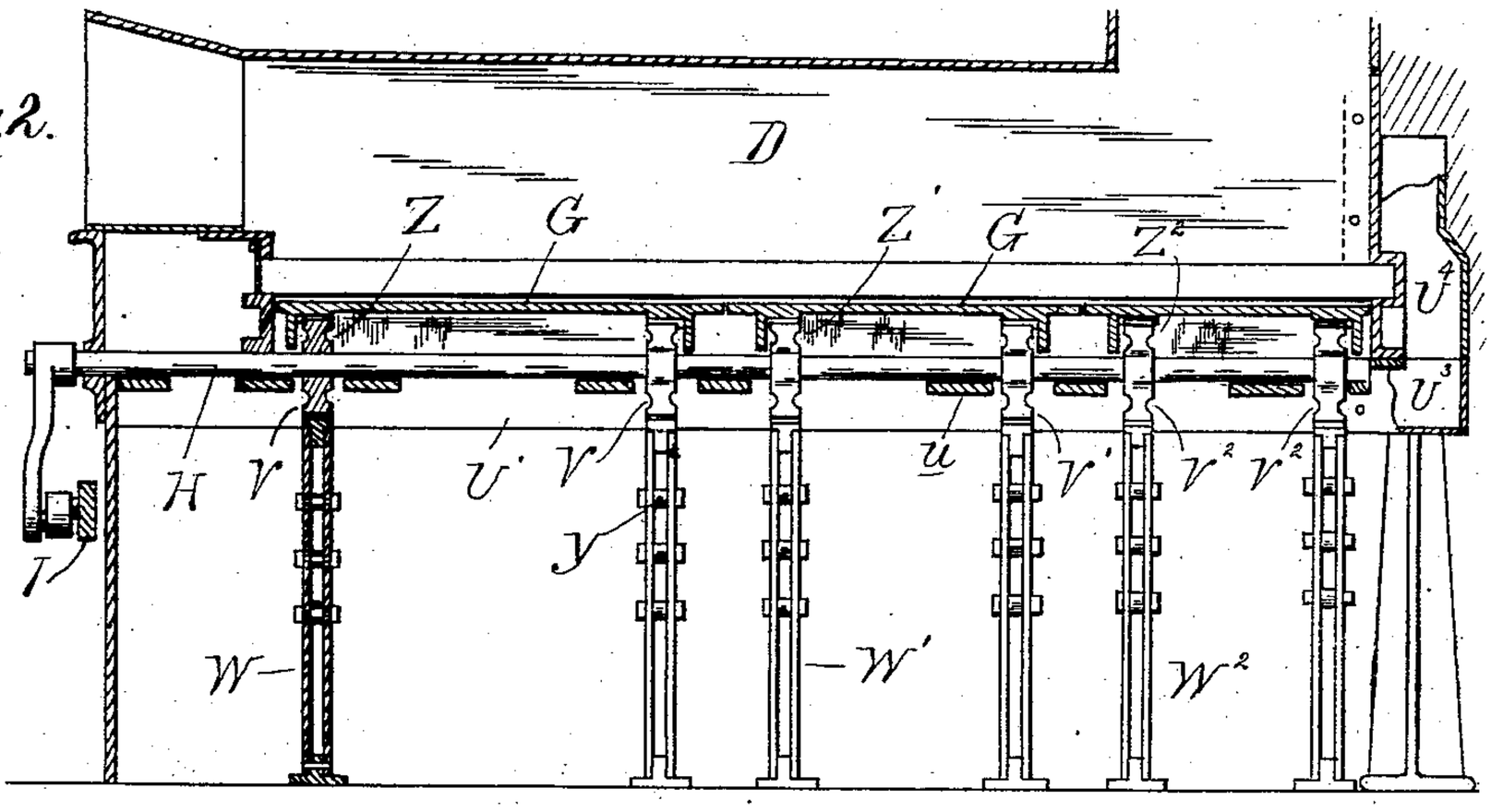


Fig. 9.

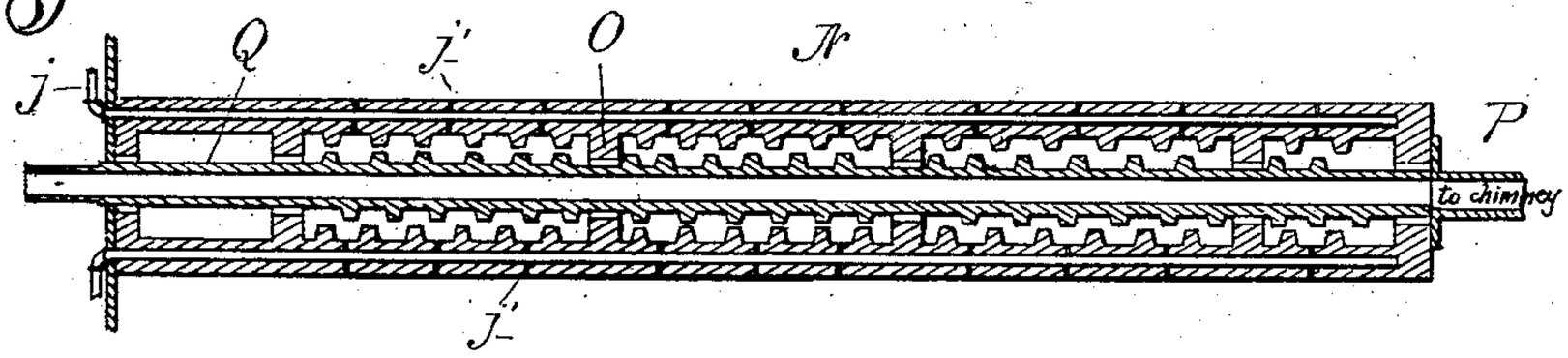
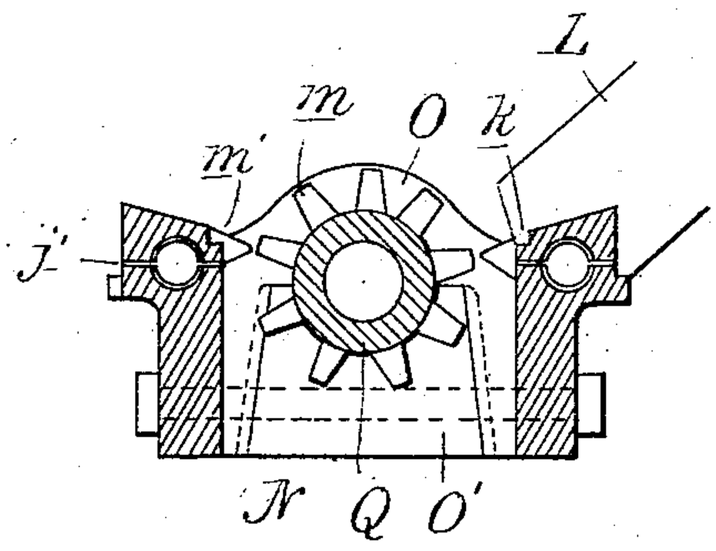


Fig. 10.



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(No Model.) 3 Sheets—Sheet 3.

T. MURPHY.

SELF FEEDING FURNACE.

No. 587,678. Patented Aug. 3, 1897.

Fig. 3.

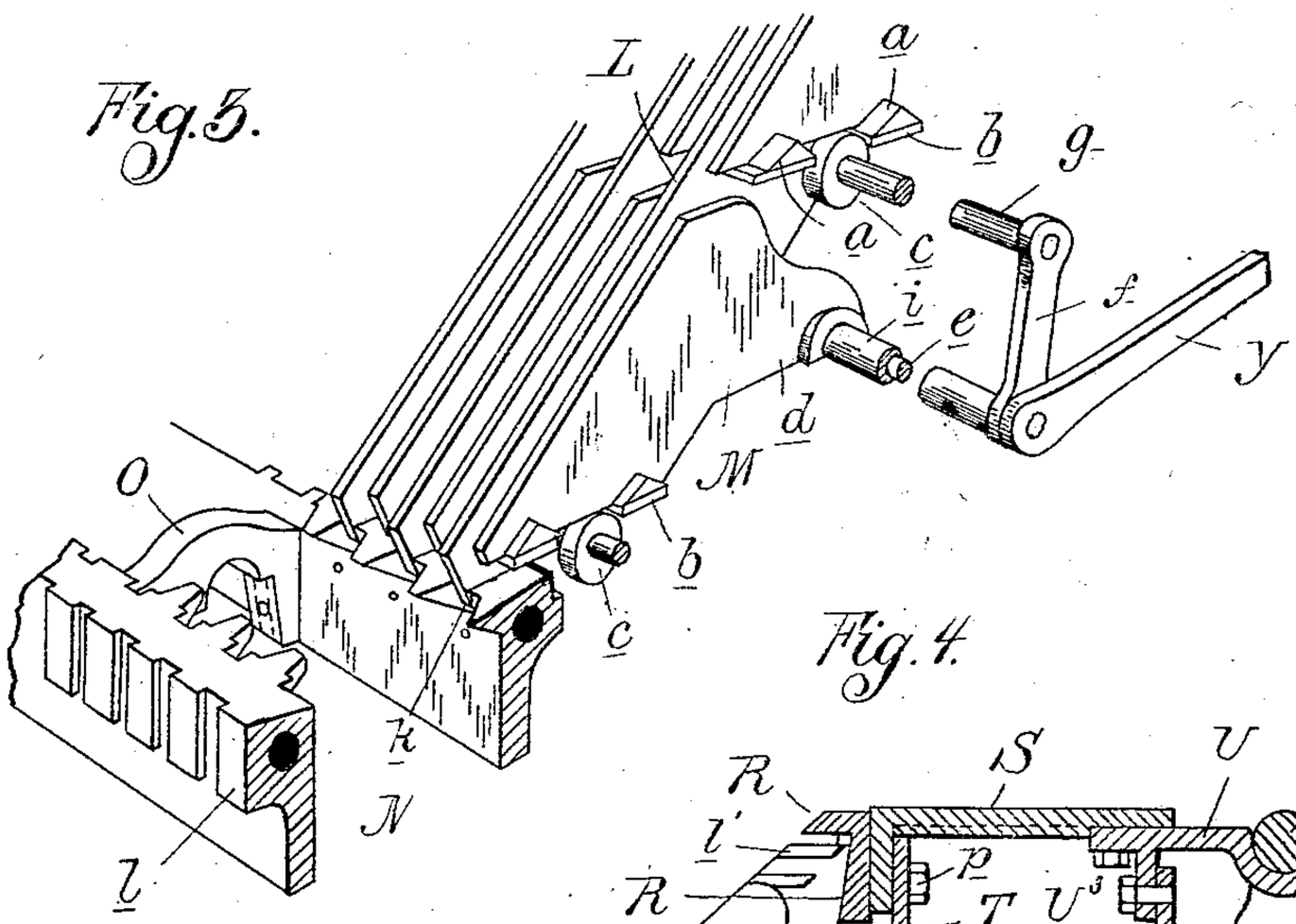

Fig. 4.

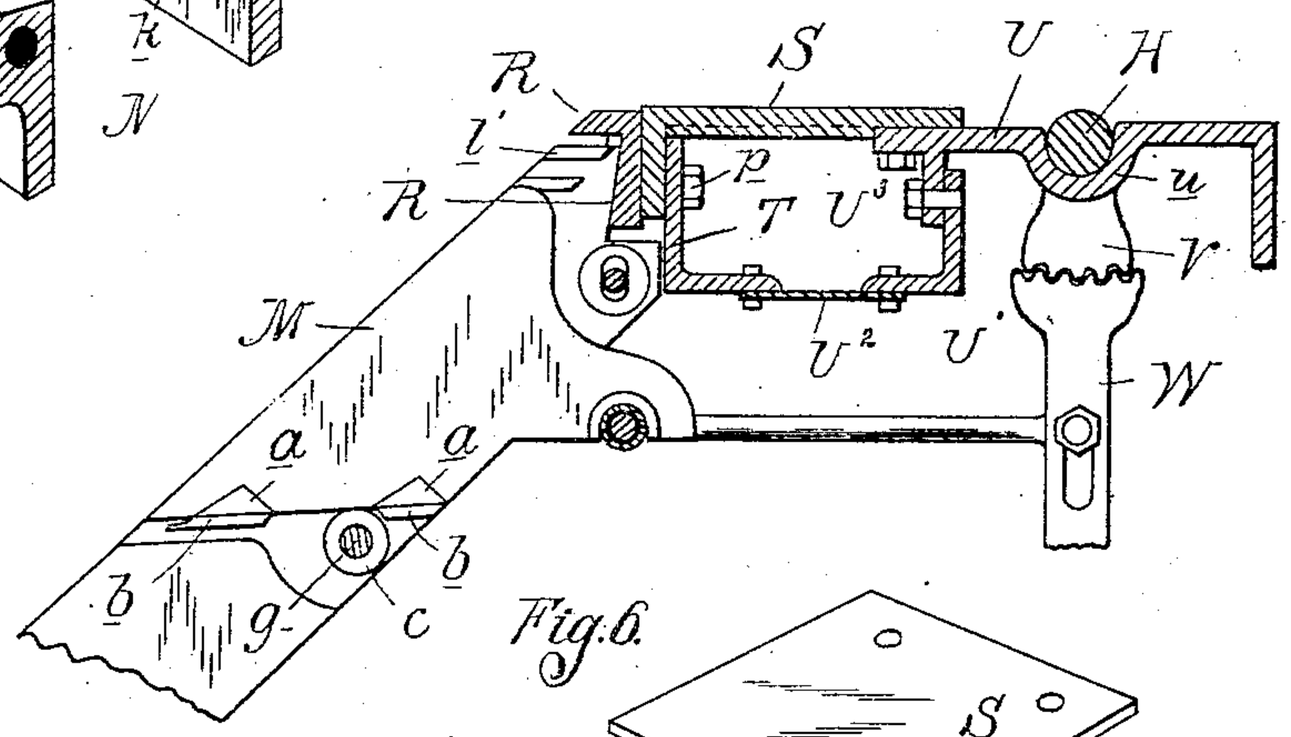

Fig. 6.

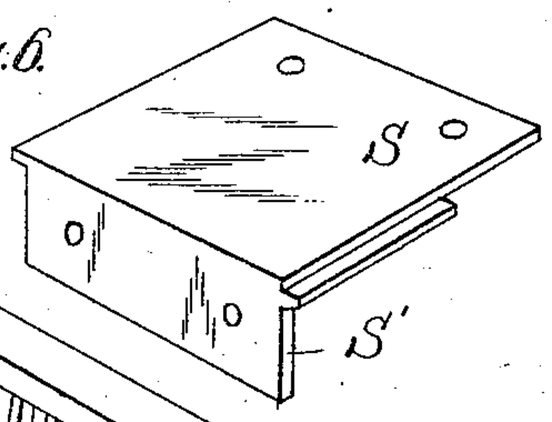

Fig. 7.

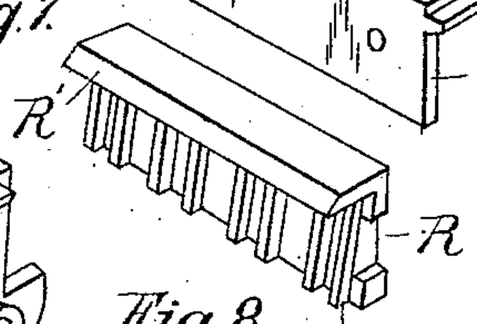

Fig. 5.

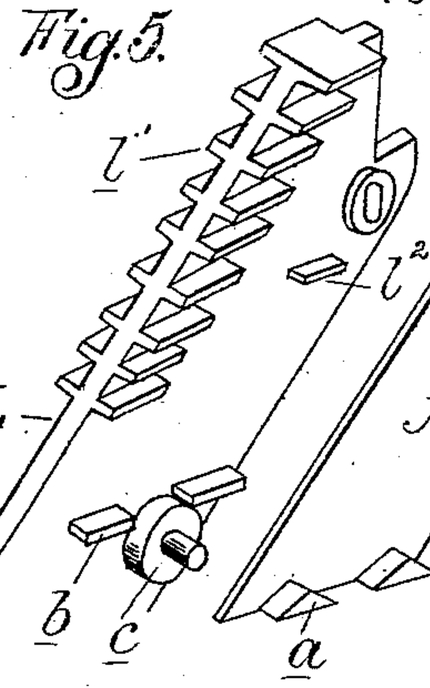

Fig. 8.

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UNITED STATES PATENT OFFICE.

THOMAS MURPHY, OF DETROIT, MICHIGAN.

SELF-FEEDING FURNACE.

SPECIFICATION forming part of Letters Patent No. 587,678, dated August 3, 1897.

Application filed August 24, 1896. Serial No. 603,771. (No model.)

To all whom it may concern:

Be it known that I, THOMAS MURPHY, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Self-Feeding Furnaces, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates more particularly to steam-boilers and other furnaces of the self-feeding smokeless type, in which the grate-bars are arranged either in two rows on the opposite sides or in front of the furnace-chamber and incline downwardly toward the center or toward the rear, the fuel being introduced at the top and fed down toward the middle or rear, in which there is a device for mechanically removing the clinkers.

The object of my invention is to improve the mechanical devices for feeding the fuel and removing the clinkers with a view of obtaining greater efficiency and, further, to safeguard against the destructive influence of the high heat, which is the most difficult factor to deal with in this class of furnaces, and to this end I have devised an improved fuel-feeding device including a new form of grate, which devices embody the new idea of feeding the fuel to each part of the furnace exactly in the relative proportions to the degree of combustion which takes place therein; further, in the provisions which are made to lessen the liability of damage to the parts exposed to the heat and to facilitate repairs where such damage should occur.

Further, my invention comprises certain improvements in the devices for removing the clinkers, all as more fully hereinafter described, and shown in the accompanying drawings, in which—

Figure 1 is a cross-section through a furnace embodying my improvements, said furnace being represented as one of a battery of like furnaces. Fig. 2 is a vertical section on line *x x* in Fig. 1. Fig. 3 is a sectional perspective of a portion of the grate. Fig. 4 represents, on a larger scale, a portion of Fig. 1. Figs. 5, 6, 7, and 8 are detached perspective views of parts of the grate as indicated by the letters of reference. Fig. 9 is a horizontal section through the clinker-bar and its bearer. Fig. 10 is a cross-section thereof. Fig. 11 is a front elevation of the furnace.

In the said drawings my improvements are shown in connection with a smokeless furnace, shown and described in my Letters Patent Nos. 316,461 and 316,462, dated April 28, 1885, in which A represents a steam-generator; B, a combustion-chamber; C, the fire-arch of the combustion-chamber.

D is the fuel-magazine, located in the sides of the combustion-chamber and provided with discharge-openings E and supply-chutes F.

G are coal-pushers reciprocatingly actuated by the rock-shafts H to feed the coal from the magazine into the grate.

I is a reciprocating bar for imparting motion to the rock-shafts H, and J the air-ducts for supplying heated air through narrow passages K to the burning fuel upon the grate, all these parts being substantially constructed and arranged to operate as described and shown in the above-mentioned Letters Patent, except as to the parts hereinafter described.

My improved grate forms the usual doubly-inclined grate-surface composed of stationary grate-bars L and alternate movable grate-bars M.

The movable grate-bars M are sectional bars arranged in tiers, the drawings showing three tiers, the bars on which alternate with the stationary bars, so that one bar of each tier moves in the spaces between two stationary bars. These movable bars are supported in position by the stationary bars, and to this end they are provided with laterally-projecting lugs *a*, which rest upon the lugs *b* upon the sides of the stationary grate-bars L. Instead of the lugs *a b*, however, friction-rollers *c*, secured in the intervals between the stationary bars, may be used to support the movable bars upon. In the drawings I show both means, as I preferably use them both, so that while the rollers relieve the friction the lugs prevent the possible tipping of these bars.

Each movable grate-bar is further supported in position by means of a rearwardly-extending arm terminating in a hook *d*, engaging with the swinging bars *e*, which is suspended by means of links *f*. As will be seen in Fig. 11, each tier of movable grate-bars is

arranged in several independent groups, the drawings showing three for each, the bars of each group being shown hooked upon separate swing-bars *e*. The links which support these swing-bars are pivotally suspended from the stationary bars by means of bars *g*, and they are provided with the sleeves *i* for the hooks *d* to engage upon.

The stationary grate-bars are supported at their inner ends upon a grate-bearer N, which is composed of two longitudinal bars united at distances apart by means of yokes O and supporting in the space between them a clinker-bar Q, which rests upon movable bearing-blocks O', bolted in between underneath the yokes.

The clinker-bar is provided on the outside with teeth *m*, which extend spirally around the bar, and the approximate inner edges of the bearers are provided with similar teeth *m'* to aid in crushing the clinkers when the clinker-bar is rocked and also for preventing coal from falling through when starting the fire.

The stationary grate-bars extend with their lower ends over the top of the longitudinal bars of the grate-bearer, and they are formed with hook-shaped bearings *k*, which engage upon the top of said bearer to hold the grate-bars against longitudinal displacement, and lugs *l*, cast in the bearer, serve to space the grate-bars at fixed distances apart.

The stationary grate-bars are cast thin, and upon their sides along the upper portion they are provided with short horizontal flanges *l*, arranged in the form of steps, which, while permitting the free passage of the air between the grate-bars, intercept the fine fuel from falling through and thus adapt the grate to the use of slack coal or culm. A few similar flanges *l* may be provided along the under edge of each grate-bar to form, in connection with the flanges *l*, guides to keep the movable grate-bars in position between the stationary grate-bars.

The upper ends of the stationary grate-bars abut against a wedge-shaped compensating plate R, which forms an inclined abutment to permit the bars to expand more readily with the heat, and upon this abutment ribs *n* are cast to serve as spacing-lugs for the bars. This compensating plate is not fastened in position, so that it is free to move up and down with the expansion of the grate-bars.

The plate R is provided with a lip R', which projects over the top of the grate-bars to prevent fuel falling between the grate-bars and allowing free passage of air to keep plate R cool. At the same time it forms a removable part of the coking-plate S.

The dead-plate or coking-plate S, instead of being made in one piece the whole length, as heretofore, is made in sections, joined at the edges by lap tongue and groove, and the compensating plate R is constructed in similar sections, and by forming the coking-plate sections with flanges S', I secure them to a supporting-beam T by means of bolts *p*. Oblong openings in the plates R allow the latter to move up and down on the bolt-heads.

Along the other edge the dead-plate S rests upon a cast-iron bed-plate U, to the under side of which is bolted the L-beam U', so arranged as to make in connection with the L-beam T and the intermediate plate U'' an air-chamber U^3, and air-chamber U^4, communicating therewith, is formed at the rear end of the magazine and leads into the air-flue J, from which it is fed through the passages K into the furnace. As the front end of air-chamber U^3 is open a current of air will be induced to flow through the air-chambers U^3 U^4 and keep the parts cool, while at the same time heated air is introduced into the furnace.

The iron bed-plate U is centrally slotted with the exception *u*, which support the rock-shaft thereon. The latter is provided with segmental gears V, V', and V^2, which engage with corresponding segmental gears formed at the ends of the vibrating levers W, W', and W^2. The latter are pivotally secured at their lower ends and are connected by rods Y, Y', and Y^2 with a swing-bar *e*, upon which the movable grate-bars are hooked, all so arranged as to impart a horizontally-reciprocating motion to the movable grate-bars by the motion of the rock-shaft.

The swing-bars *e* of the corresponding groups in each tier of movable grate-bars are connected to the same pair of vibrating levers, and there are as many pairs of levers as there are groups in each tier, but it will be seen that the amplitude of motion imparted to the groups connected to the same pair of levers is not the same, as the rods Y are connected higher up on the levers than the levers Y', while the rods Y^2 are connected below the rods Y. Thus the groups of grate-bars actuated by the same pair of levers have a differential feed. Provision is also made to adjust the points of connections of the rods Y Y' Y^2 with the levers W W' W^2 higher or lower for the purpose of adjusting the feed.

Furthermore, I prefer to impart a differential movement to the vibrating levers themselves by making the segmental gears V V' V^2 of different radius, the length of radius increasing from front to rear for each pair of levers, so that in the rear the movable grate-bars feed relatively faster than those in front. In connection with this differential feed of the movable grate-bars there are as many separate coal-pushers provided as there are groups of movable grate-bars of each tier, and these coal-pushers are differentially moved by means of segmental gears Z Z' Z^2 of different radii, increasing in length from front to rear. There are two of these segmental gears attached to the rock-shaft for each coal-pusher, and these engage with the racks formed on the under side of the coal-pushers, which have the form of a rectangular box open at the bottom. In this manner

the movement of the rock-shaft imparts a differential reciprocating movement to the coal-pushers, which feeds the coal correspondingly faster—that is, in larger quantity—at the rear than in front, corresponding to the differential feed motion of the movable grate-bars.

The parts being thus constructed and arranged as shown and described, they are intended to operate as follows: The reciprocating bar I (the speed of which can be regulated reciprocatingly) actuates the movable grate-bars and the coal-pushers in a manner to feed the coal just in proportion to the proper requirements of the furnace, it being well known that the heat, and consequently the combustion, is more intense toward the rear of the furnace, and by thus accommodating the feed to the natural condition of things the fuel is consumed with much greater economy in the production of heat and in the better prevention of smoke by maintaining an even thickness of coal over the grate-surface. At the same time it will be seen that the fire may be regulated within much larger limits, as the varying requirements for steam may permit. Thus the fuel fed may be cut down to a lower limit without depriving any part of the grate of an adequate supply of fuel to maintain proper thickness and proper combustion, or the furnace may be pushed to its highest duty without choking the fire by feeding too much coal in front and at top of grate-bars, and thus producing smoke by incomplete combustion. A differential feed based on the natural requirements or capacity of the grate in different parts of the furnace is thus an important improvement in self-feeding smokeless furnaces.

While I have shown and described differentially-movable groups of grate-bars in each tier, I claim equally as well a construction in which all the movable bars in each tier are hooked upon a single swing-bar, extending from front to rear, and in which the differential movement is brought about by imparting to the rear end a larger movement than to the front end, in the same manner as is described for differentially moving the groups.

By effecting the perfect crushing and removal of the clinkers the effective grate-surfaces are much increased, and as the movable grates push the refuse directly upon the clinker-bar there is no chance for the clinkers to form a bridge between the ends of the grate-bars.

If the clinker-bar should need to be replaced, it can now be removed from the under side, which is the most accessible part of the furnace. At the same time, the yokes being cast in one piece with the grate-bearer, the heat is conducted away from them by the larger body of the bearer, and so the yokes which hold the clinker-bars in position are prevented from burning out, while no cap or separate piece could withstand the heat.

The destructive effect of the heat upon the parts is further lessened by having the coking-plate S kept cool by a circulation of air underneath it, and by dispensing with all brickwork underneath, and in building a battery of boilers I merely divide the furnaces off by a thin iron partition *r*, as shown in Fig. 1, which partition may be bolted in between the bed-plate U of the adjacent furnaces. This gives ample space underneath the magazine and grates to have easy access to all parts, (there being a convenient door in the furnace-front,) and the construction is purposely devised to permit the renewal of any part from such space. This is greatly facilitated by having the dead-plate and other parts constructed in sections, aside from the economy it affords, and it will be noted that the bolts and other connections are removed from the influence of any direct heat upon them.

The function of the lateral flanges upon the upper portions of the stationary grate-bars is also very important, as they virtually constitute a variable extension of the coking-plate. Thus as long as the fuel is merely coking it will lodge upon the flanges and prevent fine coal from falling through into the ash-pit; but as soon as the fuel is coked and catches fire it will allow air to pass. These flanges should not extend farther down the bar than about one-third of its length, so that the full supply of air can be freely passed between the bars for the remaining two-thirds of their length.

I have not herein claimed the subject-matter relating to the hollow grate-bearers and clinker-bars, having made the same the subject-matter of a separate application filed June 8, 1897, and bearing the Serial No. 639,824.

What I claim as my invention is—

1. In a furnace, the combination of a grate-bearer having a central longitudinal slot, a clinker-bar supported in said slot and removable bearing-blocks secured in said slot from the under side of said grate-bearer to support the clinker-bar.

2. In a furnace, the combination of a grate-bearer composed of two longitudinal bars united at intervals by yokes, a clinker-bar and removable bearing-blocks bolted in from below said yokes and forming in connection with the yokes bearings to hold the clinker-bar in position.

3. In a furnace the combination of a grate-bearer formed with two parallel sides, and with a central, longitudinal opening between the same, a clinker-bar freely supported in said opening between the sides, and a V-shaped grate formed of inclined grate-bars, having their lower ends supported upon the opposite sides of said grate-bearer and provided with inwardly-inclined lower ends extending over the opening in the grate-bar whereby a contracting throat is formed between said inner ends which enlarges into the opening of the grate-bearer.

4. In a self-feeding furnace, a bank of inclined grate-bars composed of inclined fixed grate-bars extending the whole length of the bank and inclined movable bars of shorter length, arranged in two or more independently-movable tiers, each tier extending through a portion of the length of the fixed bars, with the bars of each tier alternating with the fixed bars.

5. The combination in a self-feeding furnace of a bank of inclined grate-bars composed of fixed inclined bars extending the whole length of the bank and inclined bars of shorter length, movably supported between the fixed bars and arranged in two or more tiers, one below the other, each tier extending through a portion of the length of the fixed bars, and with the bars of each tier alternating with the fixed bars, and means for imparting motion to each tier, differentially with every other tier whereby each lower tier moves faster than the one above it.

6. In combination in a self-feeding furnace of a bank of inclined grate-bars composed of inclined fixed bars extending the whole length of the bank, and inclined bars of shorter length movably supported between the fixed bar and arranged in two or more tiers, each tier extending through a portion of the length of the fixed bars and with the bars of each tier alternating with the fixed bars, and means for imparting motion to each tier of movable bars differentially with each other tier, and differentially also to the bars (or group of bars) in each tier whereby each tier moves faster than the one above it and also the bars of each tier (or groups thereof) move at relatively different speed.

7. In a self-feeding furnace, a V-shaped grate formed of two oppositely-inclined banks of grate-bars, each composed of inclined fixed bars and inclined movable bars arranged alternately with the fixed bars in two or more independent movable tiers, collectively extending the length of the fixed bars, means for reciprocatingly actuating each tier of movable bars, to impart differential motion to the bars of each tier (or groups thereof) and a feed-hopper, one for each bank of grate-bars, for supplying fuel thereto, said feed-hopper having differential fuel-feeding devices to correspondingly feed the fuel faster to the faster-moving bars of the grate.

8. In a self-feeding furnace, the combination of the fuel-magazine located in the sides of the furnace, and provided with differential fuel-feeding devices, adapted to feed the fuel relatively faster in rear than in front of the furnace, and a V-shaped self-feeding grate having differential feeding devices for feeding the fuel faster in rear than in front of the furnace correspondingly with the fuel-feeding devices of the magazine.

9. In a self-feeding furnace, the combination of a V-shaped grate composed of alternating fixed and movable grate-bars and with the movable grate-bars arranged in separate tiers, each composed of one or more independently-movable groups, fuel-magazines located in the sides of the furnaces and communicating with the grates, fuel-pushers in each magazine corresponding with the groups of movable grate-bars and actuating devices whereby the fuel-pushers and groups of movable grate-bars are differentially actuated to feed the fuel.

10. In a self-feeding furnace, the combination of an inclined series of fixed grate-bars, one or more series of shorter movable grate-bars arranged in tiers one above the other between said fixed bars and alternating therewith, a rock-shaft and separate actuating connections between said rock-shaft and the movable grate-bars in each tier, said actuating connections imparting a differential feed.

11. In a self-feeding furnace, an inclined grate composed of alternate fixed and movable grate-bars, the movable grate-bars being arranged in separate tiers, one above the other and each comprising one or more independently-movable groups, a fuel-magazine having separate fuel-pushers corresponding to the groups of movable grate-bars, a rock-shaft, separate actuating connections between the rock-shaft and each of the fuel-pushers, and separate actuating connections between said rock-shaft and the groups of movable grate-bars, said actuating connections imparting a differential motion.

12. In a self-feeding furnace, the combination of the fixed grate-bars, the movable grate-bars provided with rearwardly-extending hooks, the swing-bars engaging with the hooks of the movable bars and connecting them in separate groups, the fuel-magazine provided with fuel-pushers corresponding to the groups of movable grate-bars, the rock-shaft having differential actuating connection therewith, and separate connections from said rock-shaft with each group of movable grate-bars, for imparting a differential movement to said groups.

13. In a self-feeding furnace, the combination of the fuel-magazines supported on bed-plates in the side walls of the furnace, the rock-shafts supported in bearings in said bed-plate, reciprocating coal-pushers provided with actuating differential gear connections with the rock-shaft, the grate composed of fixed grate-bars and movable bars arranged in tiers, the vibrating levers below the bed-plates having differential gear connections with the rock-shafts and connecting-rods for said levers with the tiers of movable grate-bars arranged to impart a differential reciprocating motion to said movable bars.

14. In a self-feeding furnace, the combination with the fuel-magazines in the side walls, and the coal-pushers for feeding the fuel, of the coking-plates constructed in independent sections and forming the top of an air-flue extending back of the fuel-magazine and into the air-feeding devices of the furnace.

15. In a self-feeding furnace, the combina-

tion of a fuel-magazine located in one side of the furnace and provided with a plurality of independently-reciprocating coal-pushers for feeding the fuel into the furnace, a grate composed of alternating fixed and movable inclined grate-bars and actuating devices for said coal-pushers and movable grate-bars, said actuating devices being arranged to impart a differential motion to said coal-pushers and grate-bars, for feeding the fuel faster in rear than in front of the furnace.

16. In a self-feeding furnace-grate composed of an inclined row of alternating fixed and movable grate-bars, the combination of the movable grate-bars formed with rearwardly-projecting hooks and with a sliding foot or base at the lower end, antifriction-rollers mounted between the stationary grate-bars and supporting the foot of the movable grate-bars, one or more swinging bars suspended from the stationary grate-bars and with which the hook of the movable bar engages, and actuating connections for reciprocating the swinging bar or bars.

17. In a self-feeding furnace inclosed in brick walls and having side-feeding fuel-magazines and a V-shaped grate between the same, of fuel-magazines supported longitudinally in the sides of the furnace free and clear of the brickwork to form an open space beneath the magazines for the access of the air and for the removal of the coking-plate, the latter being constructed in removable sections.

18. In a self-feeding furnace, the combination with the stationary inclined grate-bars supported at the lower end by a grate-bearer, of the compensating plate R forming a vertically self-adjusting abutment for the support of the upper end of said grate-bars.

19. In a self-feeding furnace, the combination with a V-shaped grate composed of alternating fixed and movable grate-bars and the grate-bearer supporting the lower ends of the fixed grate-bars, of fuel-magazines supported in the sides of the furnace and provided with coking-plates extending into the furnace and the compensating plates interposed between the coking-plates and the upper end of the grate-bars and having a lip projecting over the upper edges of the grate.

In testimony whereof I affix my signature in presence of two witnesses.

THOS. MURPHY.

Witnesses:
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P. M. HULBERT.