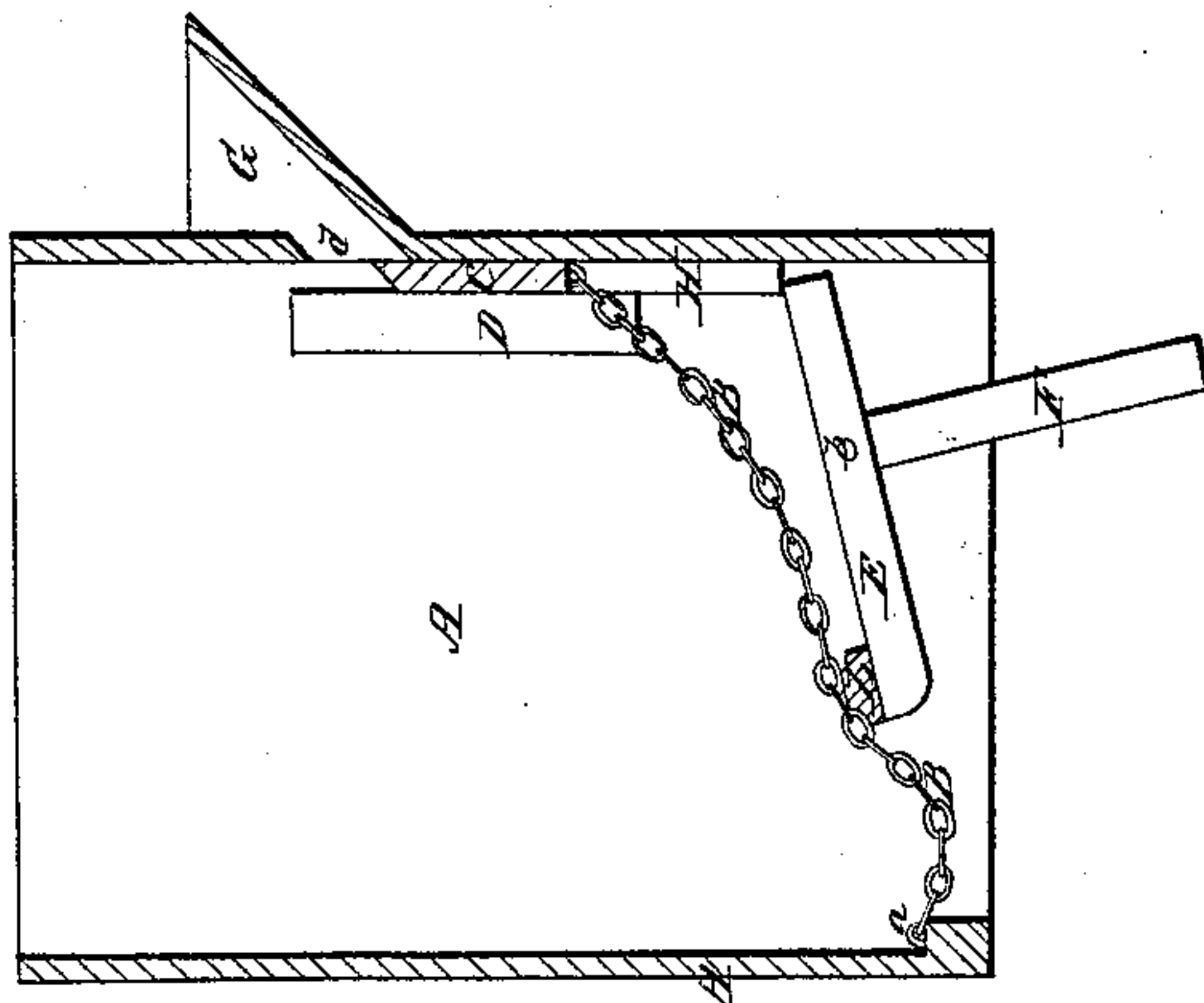


*E. Dugdale,*  
*Furnace Grate.*

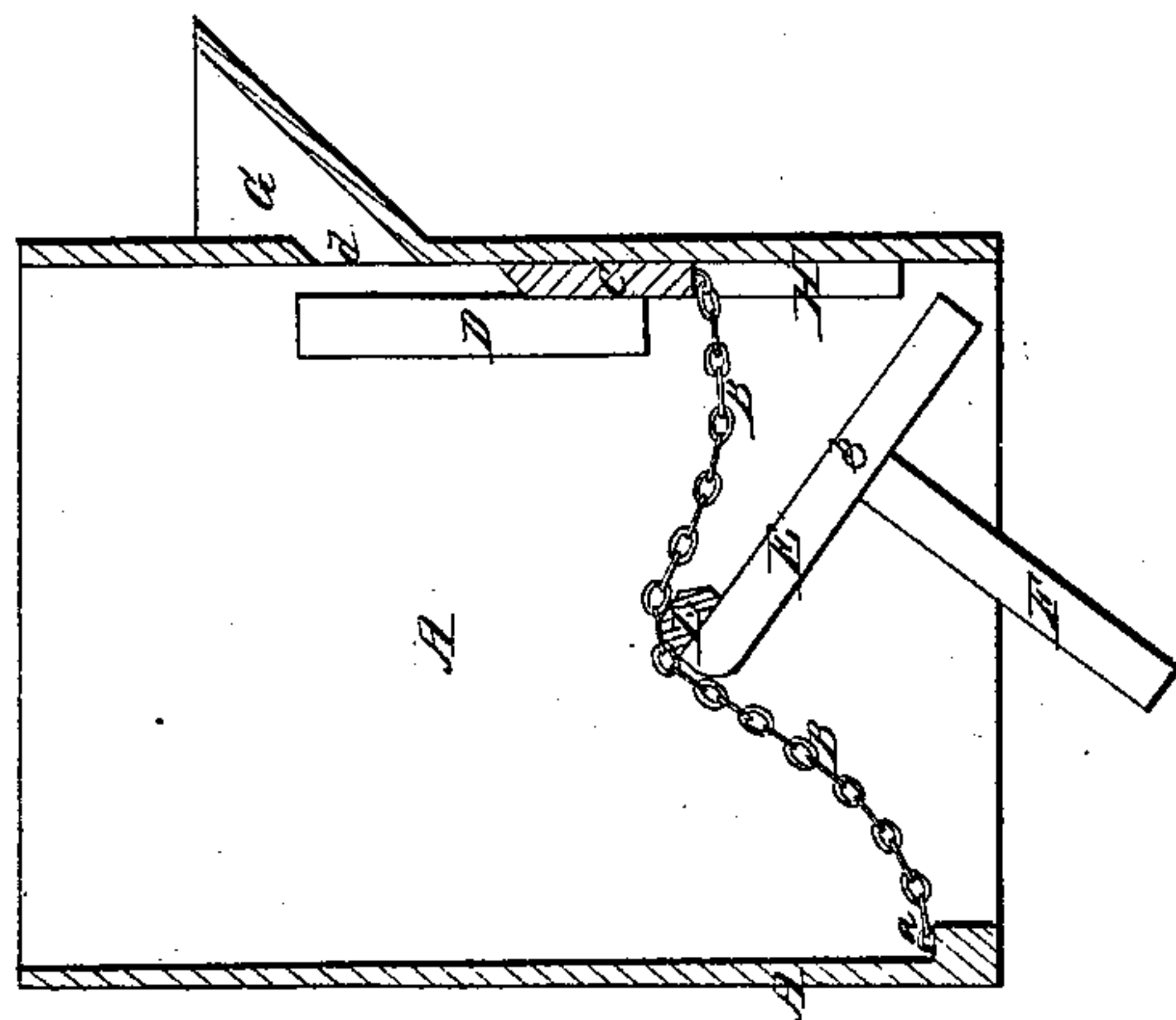
*N<sup>o</sup> 18,010.*

*Patented Aug. 18, 1857.*

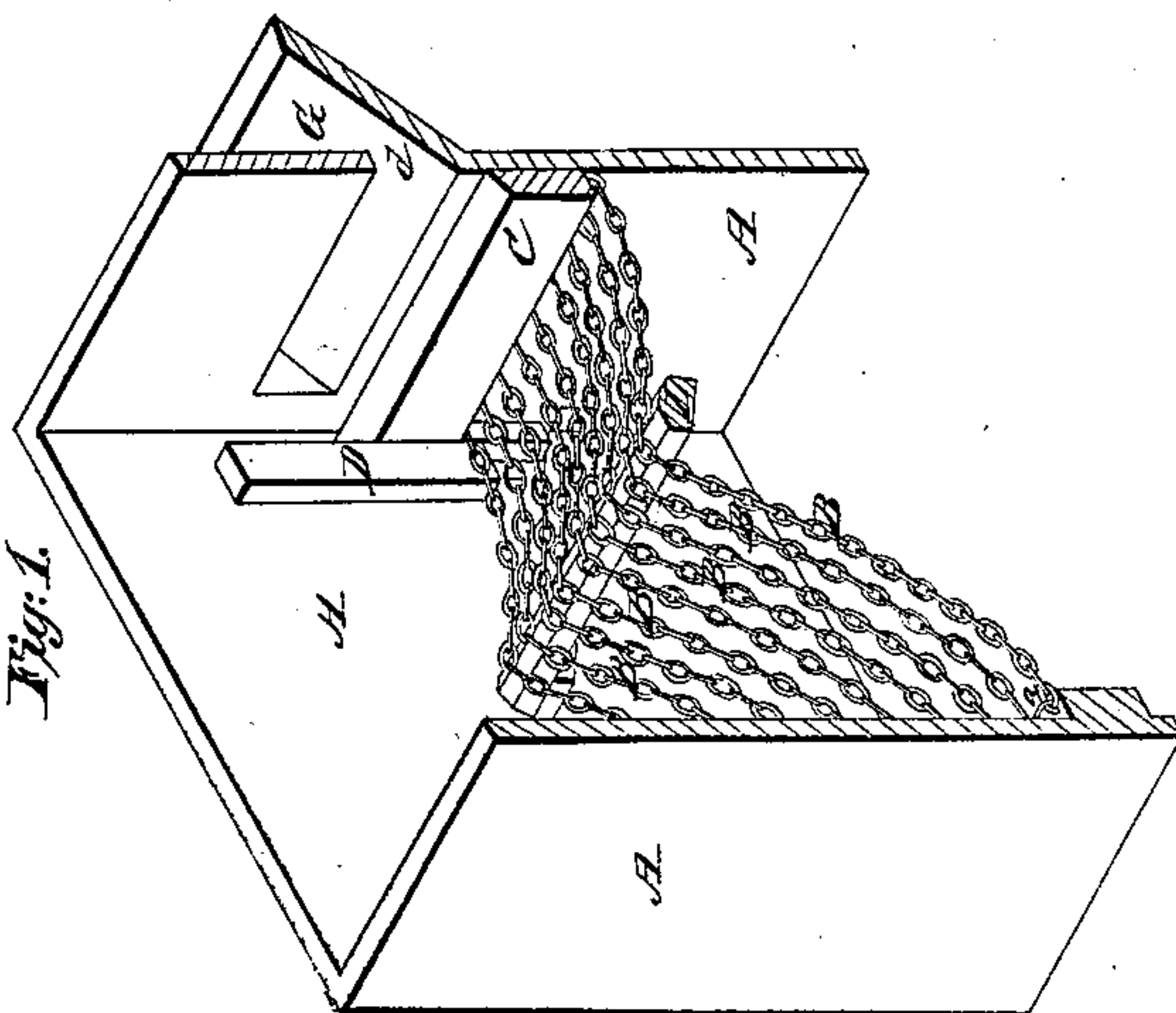
*Fig. 3.*



*Fig. 2.*



*Fig. 1.*



# UNITED STATES PATENT OFFICE.

EDWARD DUGDALE, OF BURLINGTON, NEW JERSEY.

## GRATE-BAR OF FURNACES.

Specification of Letters Patent No. 18,010, dated August 18, 1857.

*To all whom it may concern:*

Be it known that I, EDWARD DUGDALE, of Burlington, in the county of Burlington and State of New Jersey, have invented certain new and useful Improvements in Furnaces for Locomotives, Steam-Boilers, Heating Apparatus, and other Purposes; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 represents a sectional perspective of said furnace; Figs. 2 and 3 represent longitudinal vertical sections through the same.

The nature of my invention relates to the peculiar construction of the grate bars of a furnace in connection with the means of raising and lowering or shaking the same, to change the location of the fire, as well as to prevent what is termed the baking of the coal, and to sift out ashes, cinder, &c.

A represents a section of a locomotive fire box.

B, represents chains which are used in place of stiff grate bars, said chains being attached at one end *a* to the fire box, and the other end being secured to a slide C, which can be moved up and down within the ways formed by the sides of the fire box and the pieces D. The chains or flexible grate bars are supported on or about their center by a cross bar L, which passes through the entire width of the fire box. This cross bar is supported at its ends by means of a lever E, which can be made to swing on its fulcrum *b*, by applying power to arm F.

G represents a common feed hopper attached to the rear side of the fire box, and leading into said fire box, and the passage *d* can be opened or closed by means of the slide C, which can be operated by lever E, coming in contact with the sides H of said slide.

The operation of this apparatus is as follows:—The coal is thrown into the feed hopper G, and made to descend gradually down on the flexible grate bars, the hopper being constantly filled with coal prevents any air from entering the fire box above

the fire and the entire draft passes up from below keeping up the combustion while only a comparatively small quantity of coal drops down on the fire at a time. Thus a perfect combustion is kept up which produces very little or no smoke, thereby relieving the passengers from the smoke which results from the periodical feeding of the coal principally when any air can pass into the fire box above the fire. By operating arm F, of lever E, the flexible grate bars B, can be thrown into various positions as represented in Figs. 2 and 3, and it is obvious that when such a movement is produced the position of most every piece of coal is changed, thereby preventing said coal from baking while the ashes and cinder are removed by said movement, and a free draft of air from below is kept up without introducing any bar or breaker into the fire box. This arrangement also affords the means of shifting the mass of coal from one side of the furnace to the other. In Fig. 2 the greater mass of the coal which drops from the hopper will remain near the rear side of the fire box, while in Fig. 3, it will drop to the front thereof.

I am aware that turning or swinging grates have been used in stoves for the purpose of clearing the grates, but these work very imperfectly, chiefly when applied on a larger scale, besides having the inconvenience that coal will always be wedged in between the bearings, and the rim of said grates, which prevents them from being closed again.

I do not confine myself to the use of chains, as any flexible metal combination such as metal rope or linked rods may be used with the same advantage, nor do I confine the application of my invention to locomotive furnaces only, as it may be applied with equal success to the furnace of any steam boiler or any furnace in general.

Having thus fully described the nature of my invention, I would state that I am aware that shaking and hinged grates have been used, and that a fire box has been made to raise and lower so as to change its position in relation to the boiler. I am also aware that endless chains have been used for conveying coal into a furnace or fire box. I do not claim any of these things, but



What I do claim as new and desire to secure by Letters Patent is—

The flexible grate bars herein described, when used in connection with a raising and  
5 lowering, or shaking apparatus, so as to change the position of the fire, prevent the baking of the coal, and sift out the ashes

cinder, &c., as herein set forth and explained.

EDWARD DUGDALE.

Witnesses:

E. COHEN,  
EDM. F. BROWN.