(No Model.)

2 Sheets—Sheet 1.

T. POORE.

ENDLESS CHAIN GRATE.

No. 334,047. Patented Jan. 12, 1886.

Fig 1.

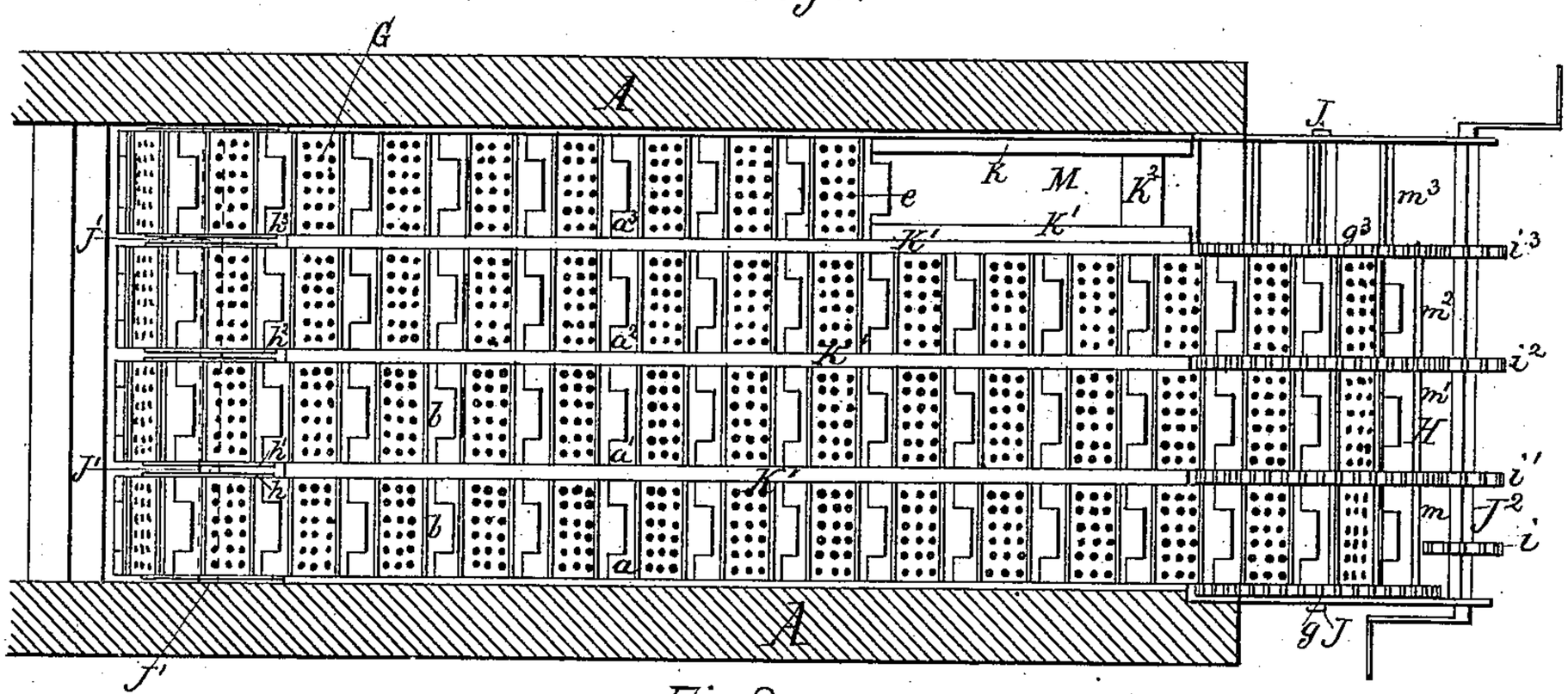


Fig 2.

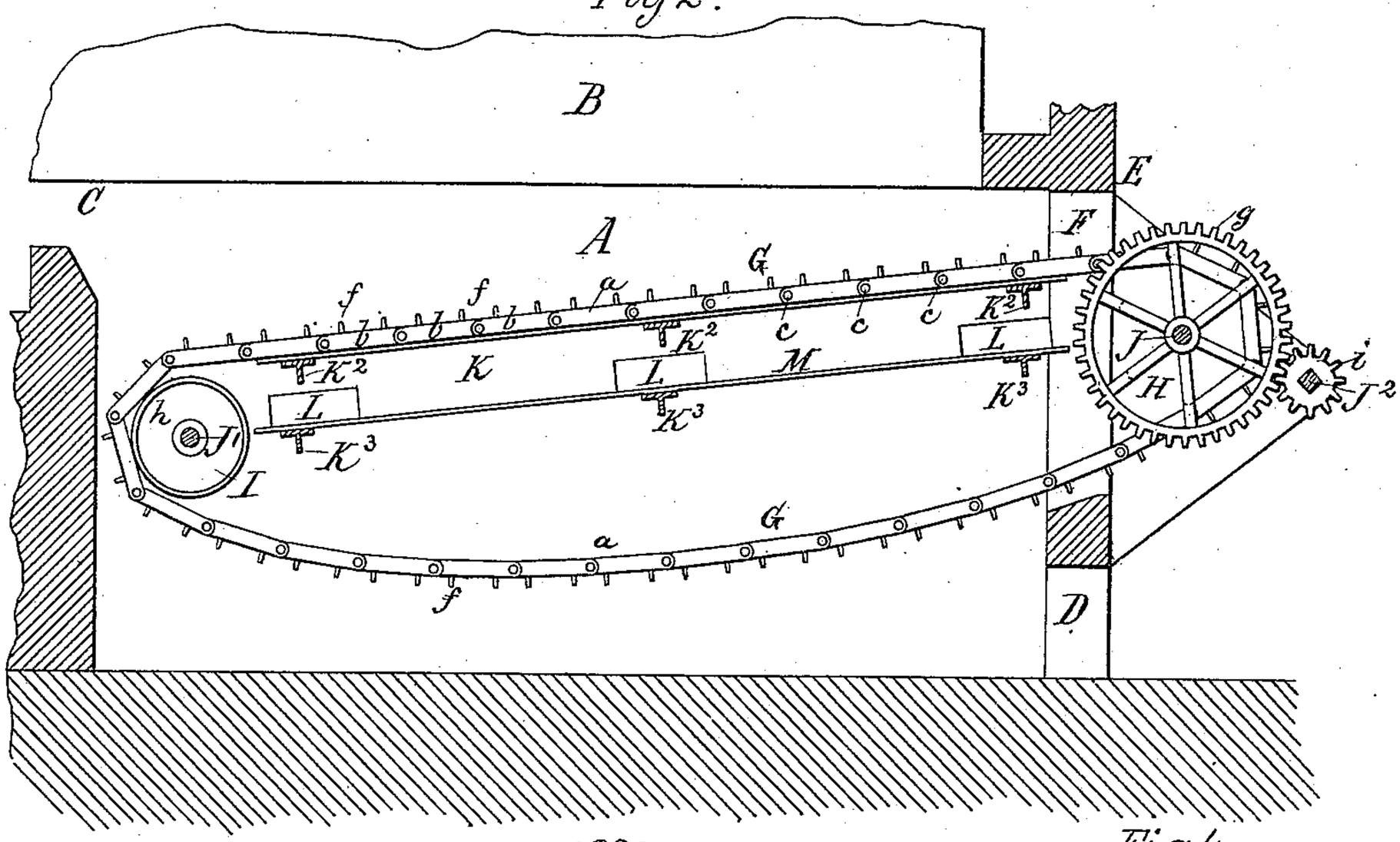


Fig 5.

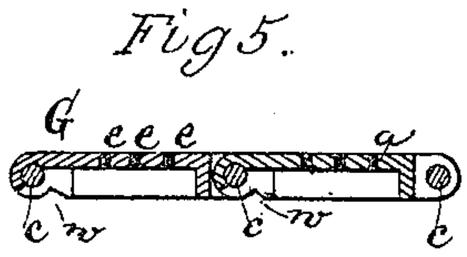


Fig 3.

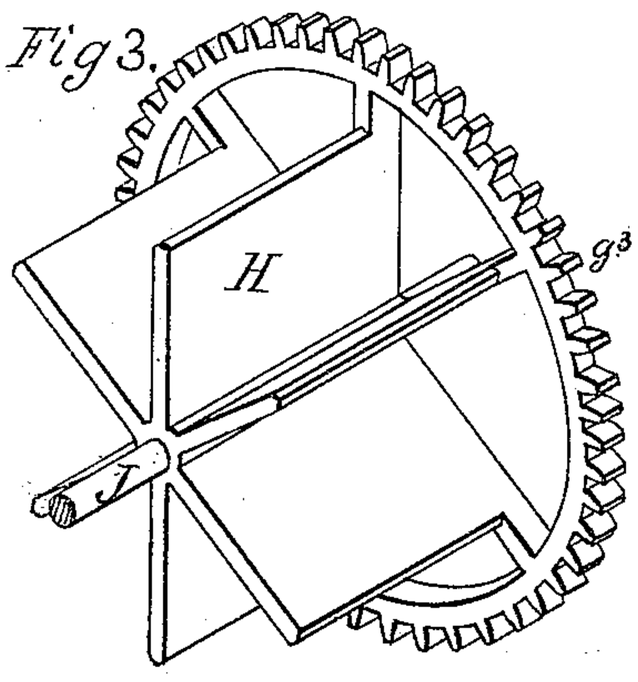
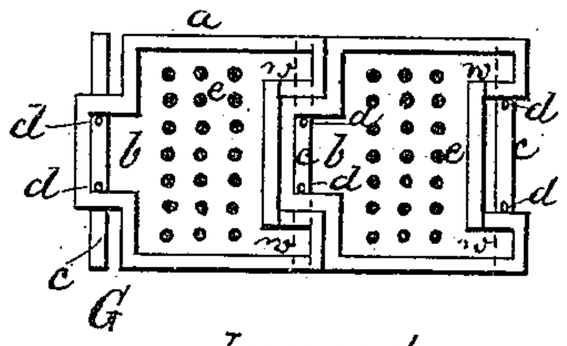


Fig 4.



Witnesses:
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B. C. Fenwick

Inventor:
Townsend Poore
by his attys
Fenwick and Lawrence

(No Model.) 2 Sheets—Sheet 2.

T. POORE.

ENDLESS CHAIN GRATE.

No. 334,047. Patented Jan. 12, 1886.

Fig 6.

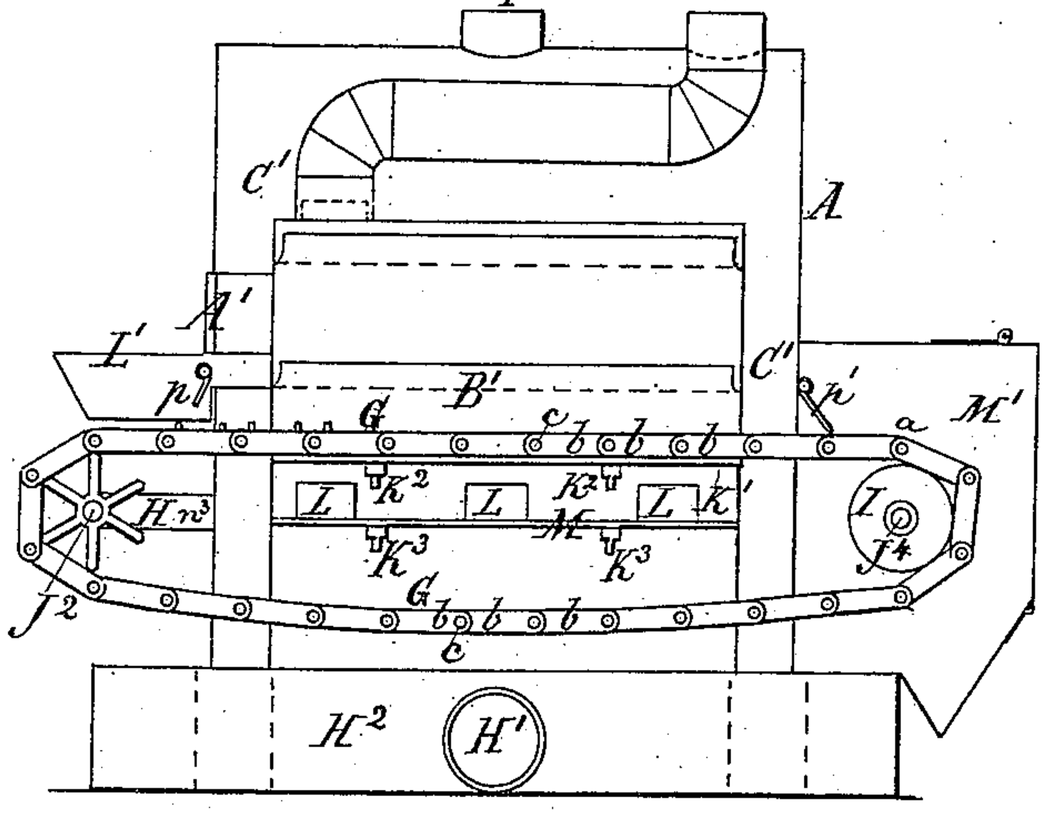


Fig 7.

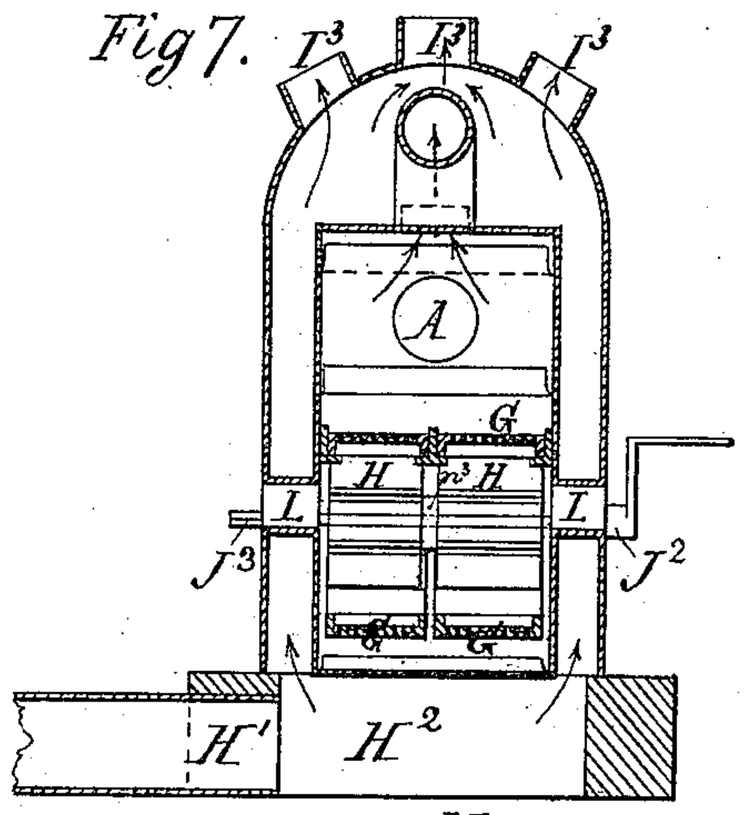
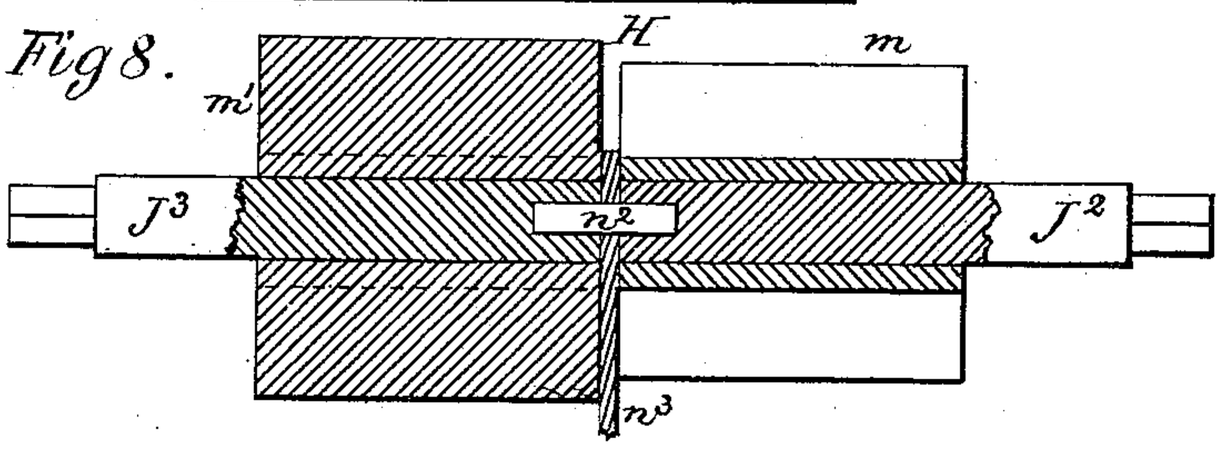


Fig 8.



Witnesses:
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BC Fenwick

Fig 9.

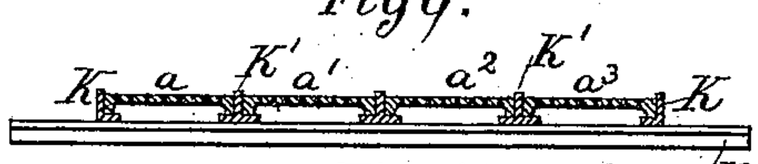
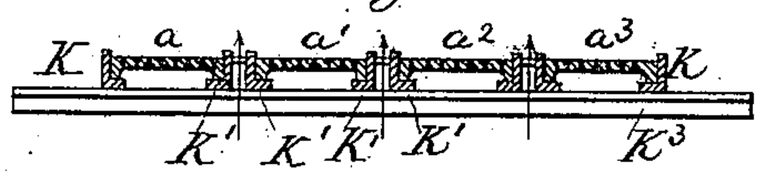


Fig 10.



Inventor:
Townsend Poore
by his attys
Fenwick and Lawrence

UNITED STATES PATENT OFFICE.

TOWNSEND POORE, OF SCRANTON, PENNSYLVANIA.

ENDLESS-CHAIN GRATE.

SPECIFICATION forming part of Letters Patent No. 334,047, dated January 12, 1886.

Application filed April 15, 1885. Serial No. 162,319. (No model.)

To all whom it may concern:

Be it known that I, TOWNSEND POORE, a citizen of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented new and useful Improvements in Endless-Chain Grates and Fire-Boxes therefor, of which the following is a specification.

The main object of my invention is to produce a grate and fire-box for either locomotive-boilers or stationary boilers or heating-furnaces or heating apparatus of every description to which the invention may be applied practically, and will serve for rendering more successful the attempts heretofore made to burn culm or the dust of anthracite coal or other similar fine hard fuel and bituminous coal.

Burning culm or dust of anthracite coal has proved a very difficult problem to solve, and it has not yet been accomplished as satisfactorily as desired by any device now in use; and at present this material is being used as fuel in a very disadvantageous and ineffectual manner, first, on account of the immense amount of partially-consumed culm wasted by being raked out from the larger number of boiler-furnaces necessarily used for producing steam with this fuel for driving machinery than are required when lump-coal is used; and, second, because of the great depth of the culm or fine-coal fires supported on the grates and the length of time the furnace-doors are required to be kept open to clean the fires and supply fresh fuel. A greater number of boiler-furnaces under the old mode are required for the use of culm or fine coal as fuel, because in order to produce a given amount of heat there must be the requisite weight in the fuel burned on each foot of fire-surface, and inasmuch as it is a fact that the finer the fuel the lighter it is in proportion to the bulk, and hence a requisite amount of this finer fuel must have about twice the amount of grate-area for a given depth of fire than is required for large or lump coal. The present furnaces are now made so large that the labor of manipulating them is so severe that the firemen make the fires far too deep, in order to avoid the labor of frequently raking them out and replenishing them with fuel. Fires which are deep do not admit the air through them as thoroughly as is necessary, and there is a large part of the fuel between the extreme top and bottom of the fire-bed which is but imperfectly utilized for heating the boilers, and this is of necessity raked out as waste along with a great quantity which is not burned at all.

With culm as fuel (as now practiced) clean fires are made under a portion of the boilers of a nest or system of boilers, and these fires are allowed to burn to just about or beyond their prime, or until the culm is not quite consumed and reduced to ashes. At this stage the doors are opened and the beds of these comparatively good fires are successively pushed to the rear of the fire-box, and about seven-eighths of the surface of the grate-bars is exposed, so that they may be thoroughly cleansed. The openings in the grate being usually so fine it is not practical to do this in any other way. After the bars have been cleaned the fire at the back is pulled forward and serves to kindle the fresh fuel, which is then applied, and by this mode other effective fires under the boilers first started are produced, and while several of the fires are being thus manipulated the other boilers of the nest or system, the fires of which have not as yet been raked back, serve for keeping up the steam, and these boilers are in turn cooled off and their fires manipulated in the same manner. The cooling down of the boilers and furnaces for cleaning the grates and replenishing them with fuel causes a great injury to boilers by reason of undue expansion and contraction under this system taking place, and while this is the case about twice as many boilers are necessary for a given sized establishment for burning culm as are required for burning ordinary lump-coal.

From practical experience in burning culm or anthracite dust, I have found that to burn the same properly and economically in all respects, so as to avoid waste, lessen labor, save expense, decrease the number of boilers for a given amount of work to be done, and avoid explosions or dangerous injury from undue expansion and contraction of the boilers, these kinds of fuel should be put into the furnaces without the admission of air above the

grate-bars, the fires should be cleaned without the admission of a large volume of air above or about them, the fuel should have a clean grate-surface and remain undisturbed until it is reduced to ashes, the fire should be kept thin, frequency of and the consequent increase of labor in applying fuel and removing ashes should be avoided, and also facilities should be afforded for renewing any part of the grate-surface, and this in every instance possible while the grate is in its place; and if these results can be accomplished successfully very great incidental advantages would be secured—viz., avoidance of leakage and explosions, as well as of the expense for repair of the boilers necessitated by the effects of great contraction and expansion of the boilers in cooling and reheating, due generally to the frequent opening and closing of the furnace-doors of ordinary culm-burning furnaces.

Having ascertained from practical experience that the leading idea in the burning of culm or anthracite coal dust is to have the combustion slow and thorough on a very large grate-surface, and to burn the same amount in weight in a given time for a given amount of work to be performed as is burned when lump-coal is used, I have devised the improved grate formed of two or more endless chains, and constructed and applied it in connection with an improved fire-box, as will be hereinafter described and specifically claimed, for accomplishing the objects hereinbefore mentioned, and thereby avoid the disadvantages heretofore experienced.

In the accompanying drawings, Figure 1 is a broken horizontal section of a boiler-furnace and a plan view of an improved sectional endless-chain grate, several chain-links being removed in order to show the girders. Fig. 2 is a broken vertical longitudinal section of a boiler-furnace and the improved grate. Figs. 3, 4, and 5 are views of details of the endless grate and supporting and operating parts. Fig. 6 is a side view illustrating the use of the invention in connection with a heating-furnace, one of the outer or inclosing walls of the furnace being removed to show the parts which are inclosed. Fig. 7 is a cross-sectional view of the heating-furnace and the improved grate. Fig. 8 is a modification of the spider, in cross-section, showing more plainly one of the shafts represented in Figs. 6 and 7, for supporting and propelling the sectional endless-chain grate. Fig. 9 is a detail sectional view showing the longitudinal girders in section and the transverse girders in elevation; and Fig. 10 is a similar view to Fig. 9, but illustrating the intermediate girders set apart, so as to allow air to pass up between them.

A in the drawings, Figs. 1 and 2, is intended to represent a suitable outer wall of a boiler or other furnace; B, a portion of a steam-boiler; C, the throat of the fire-bridge wall; D, the ash-pit doorway in the front wall, E, of the boiler-furnace; and F a feed-opening in the front wall and below the boiler, through which the fuel is fed into the fire-box. This opening may be provided with self-closing flap doors or valves so as to practically shut off too great amount of draft. In the space below the boiler the improved endless-chain grate G is arranged, as illustrated, its front end extending outside the front wall of the furnace, so that the fuel may be conveniently placed upon the same without opening doors, as in other furnaces. The grate which I employ differs from a single endless-chain grate of known construction in being made up of either two, three, four, or more narrow endless chains or sections, as indicated at a a' a^2 a^3, which can be moved separately alongside one another or all together, as desired. This grate also differs from known endless-chain grates in several peculiarities of construction and in its combination with novel parts of the furnace and with mechanism for operating its sections, as I shall now proceed to show.

Each of the chains forming the fire-bed or grate-surface is composed of links b, which are pivoted together by pins c, which are not riveted, but can be easily slipped in and out, so as to either unite or separate the links readily. The pivot-pins c are confined by cotters or key-pins d, passed transversely through so as to be readily removable when it is desired to withdraw the pins and separate the links. This construction is useful, for when a link or links are broken and new ones are to be inserted the operation can be conveniently performed while the chain-grate is in the furnace. The interlocking form of link shown is preferable to any other known to me, as it affords a perfect means for jointing the links, and also produces a practically continuous surface; but I may adopt any other suitable form, if found desirable. The chain-links are formed with angular depressions w on their under surface, so as to be positively caught and carried by a driving-spider, and are preferably perforated with either round, elliptical, or rectangular holes, e, so as to allow air to pass freely through them, as shown in Figs. 1, 4, and 5, and the working-surfaces of the links may be provided with ribs f, extending entirely across the respective sections of grate-surface, those of one section or endless chain being separated from those of another section or endless chain. These ribs are intended to insure the carrying of the mass of culm or fine coal along with a moving endless chain or section, or with the series of sections, if all are moved together. Instead of the projecting ribs, the links may be channeled or corrugated in a direction transverse of the movement of the chain, so as to produce a roughened surface which will take hold of the mass of fuel and insure its moving along with a grate section or sections; and such construction I regard an equivalent of the ribs. The links might be made with-

out ribs or channels or corrugations, and answer a useful purpose under some circumstances; but it is preferable to have their working-surfaces roughened for the purpose stated, and they will be formed of either metal, fire-brick, or any other suitable material.

The end supports for the endless chains comprise a sectional driving-spider, H, and a plain sectional drum, I, the spider being placed at the feeding end of the furnace and the drum near the fire-bridge wall, as shown. The spider is made of four separate sections, m m' m^2 m^3, which are provided, respectively, with a spur-wheel on one end, by which it is revolved. The spur-wheels are made fast to the sections, and are designated by letters g g' g^2 g^3 in the drawings. The respective spider-sections correspond in width with the respective endless chains or sections a a' a^2 a^3 of the grate G, and they are placed on a stationary shaft, J, supported suitably upon bearings projecting from the furnace-walls. When the spider-sections are in position on the shaft J, they are separated to the extent of the thickness of the spur-wheels g' g^2 g^3, and a like separation between the grate-sections a a' a^2 a^3 is made. The drum-sections h h' h^2 h^3 are separated to the same extent as the spider-sections m m' m^2 m^3, and they revolve loosely on a stationary shaft, J'. The spur-wheels g g' g^2 g^3 are geared with small pinions i i' i^2 i^3 on a square or other suitably-shaped shaft, J^2, which has round bearing-portions and is revolved by handles or otherwise suitably. The pinions i i' i^2 i^3 are made to slide on the shaft J^2, so as to be brought into or thrown out of gear with the spur-wheels g g' g^2 g^3, and when all the pinions are in gear with the spur-wheels g g' g^2 g^3 all the sections of the grate will move together; but if pinion i is out of gear with the spur-wheel g, as illustrated in Fig. 1, the endless-chain grate-section a will remain stationary and only the other sections, a' a^2 a^3, be moved; or if pinions i i' i^2 are out of gear only section a^3 of the grate will be moved; or if pinion i' is in gear and the others out of gear, only grate-section a' will be moved.

The advantages of the sectional endless-chain grate-bed are, easy movement of different portions of the mass of culm, ready breakage of clinkers by moving one section past another, and ready separation and convenient handling of parts for repairs. The plain drum I allows freedom of movement of the links under expansion and contraction, while the driving spider H, in connection with the depressions w on the under side of the chain-links, insures positive movement, by the spider-wings interlocking or taking hold of the shoulders formed by depressions w of the links.

When the endless-chain grate-bed, as ordinarily constructed, is formed of one wide endless chain, great labor is required to operate it and no facilities are afforded for breaking clinkers, and repair and handling such large parts is difficult, and for this reason it has not been successfully put into use.

For holding up that portion of the endless-chain section upon which the bed of fuel rests, longitudinal girders K K', of L and T or other suitable shapes, are provided, and these are supported by cross-girders K^2, of T or other suitable shape, fixed in the walls of the furnace. The girders K are affixed in position against the walls, while the girders K' are extended up between the grate-sections a a' a^2 a^3 and form a flush continuation of the fire-bed to within a short distance of the spider and the drum, as shown. Beneath the girders K K' another series of transverse T or other suitably-shaped girders, K^3, are set into the side walls, and upon these girders a sheet-iron platform or screen, M, is placed entirely across the fire-box, and extending nearly to the driving-spider and the drum, as shown, and on about the same plane with the top of this platform doors L are provided in the side walls of the furnace. The platform M serves for keeping ashes and hot coals which fall from the grate from lodging on the lower part of the same, also serving to form a shelter or screen from ashes and dirt to workmen who may be in the ash-pit repairing the grate, or taking out and putting in new links when the fire is burning. The doorways serve as entrances leading to the top of the platform, and through which implements may be inserted for the purpose of cleaning away ashes and débris which fall upon the platform from the grate. These doors answer also as draft-passages, and may be provided with regulating-slides for the admission of more or less air beneath the fire-bed. The platform M may be of flat or gable form, and if of gable form it may discharge ashes and refuse laterally on both sides into the ash-pit outside the grate.

In Fig. 10 I have shown that the intermediate supports may be formed of two L or other suitably-shaped girders, and this is done in order to allow air to pass up between the grate-sections to the upper part of the grate-surface.

In Fig. 8 I have shown that the driving-spider H can be constructed of two sections, m m', and these sections, respectively, may have a fast connection with short shafts J^2 J^3, which are fitted at their inner ends to revolve on short stud ends of a pin, n^2, which is firmly fixed in a plate or support, n^3, of the furnace-structure, and at their outer ends in suitable bearings of the furnace structure. When the spider H is thus constructed, the plain drum I will be formed of two sections on the same plan as the drum with four sections in Fig. 1, and these will revolve on a shaft, J^4. (See Fig. 6.)

In Figs. 6 and 7 a heating-furnace is represented, and this furnace comprises my improved sectional endless grate G, supported by girders K K' K^2, and provided with a platform or screen, M, supported by girders K^3,

and operated section by section or all together by the shafts J^2 J^3, or by the means shown in Figs. 1 and 2.

H′ is a cold-air-supply pipe passing into a pit of a foundation, H^2. At one end of the furnace a hopper, L′, for fuel, is provided and at the other a discharging-box, M′, for ashes, the latter having two doors—one for examining and cleaning the grate and the other for letting out the ashes.

C′ is the hot-air chamber, from which the pipes I^3 I^3 I^3 lead the heated air into the building. This hot-air chamber is provided with doors L L, which serve for admitting air, and also for admitting implements for cleaning ashes, &c., from the platform or screen M.

The fire-box B′ is made of cast-iron, and it comprises a door, A′, top, bottom, and three body-sections, which lap upon each other, this construction being for convenience of manufacture. The fire-box B′ is very much like those of other furnaces in use, except that it is rectangular.

At each end of the furnace hinged flap-plates *p p′* are applied, so as to practically close the furnace at both ends above the grate and still allow the mass of fuel to pass freely into and out of the fire-box without having large openings for air to pass through and interfere with the fire.

The bearings for the shafts shown in Fig. 8 may consist of suitable brackets tied together and resting on brick foundations of the furnace structure.

From the aforegoing description it will be seen that a practical means for keeping the furnace closed against an undue inrush of air while feeding the fuel to the fire-chamber is provided, and that the fire can be kept lively by moving the grate and discharging its ashes and spent fuel, and this while fresh fuel is being supplied and without checking the fire or cooling down the furnaces, so as to cause undue expansion and contraction; and, furthermore, that the millions of tons of culm or fine coal now almost regarded as "waste" can be utilized successfully as good fuel in both boiler-furnaces and furnaces employed for heating dwellings, which latter has not been deemed practicable until the application of the sectional endless-chain grate thereto was made by me.

I desire it to be understood that my inventions not relating specially to the sectional feature of the endless-chain grate may be found useful with an endless-chain grate not made in sections, and therefore I do not limit said features of invention always to a sectional endless-chain grate, but desire to cover the same by my patent for use with any kind of endless-chain grate.

The endless-chain sectional grate may be placed so as to revolve transversely of the furnace-flue or at right angles to the line of draft, and in that case the spider and the drum will be suitably placed on the sides of the fire-chamber, the spider being on one side and the drum on the other, and both suitably supported by bearings outside the walls of the furnace, and the ingress and egress passages of the grate-sections will have doors which can be closed and opened, as occasion requires, and also doors through which the draft for causing combustion can be admitted, as well as implements inserted for cleaning away the ashes and débris; but I do not claim under this application the specially-stated means whereby this transverse arrangement and working of the grate-sections is carried into effect, except so far as they are substantially the same in construction as those parts employed in a grate which moves longitudinally in the fire-chamber, as these means, in connection with the transverse grate, will be claimed under another application of mine for a patent; neither do I claim under this application the specifically-described heating-furnace and the means whereby the sectional endless grate is applied to it, except so far as these means are substantially the same as those parts employed in the grate which is shown applied to the boiler-furnace, as this furnace, in connection with said means is claimed under another application, No. 166,560, of mine for patent.

As indicating the state of the art, reference is made to English Patent No. 2,798 for 1877 and United States Patent No. 302,574. In the former of these patents the chains forming the grate or fuel-carrying bed are formed of links which are alternately placed vertical with respect to horizontal links, and these links are of necessity made quite narrow, and the vertical links travel in grooves of the supporting and driving rollers.

My flanged drums or spiders and plain drums or rollers, as also my endless-chain grate-section differs widely in construction and operation from the Patent No. 2,798, as fully appears from my specification.

In Patent No. 302,574 cotters are not employed for fastening the links upon their connecting-pins, and therefore it is necessary to adopt a different mode of construction from what is shown in my application in order to carry out the invention shown in Patent No. 302,574.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A grate for boiler-furnaces and heating structures, formed of two or more endless chains which are suitable supported in a fire-chamber, and can be operated separately or together, substantially as and for the purpose described.

2. A grate for boiler-furnaces, formed of two or more endless chains which are longitudinally separated by intermediate girders, K′, supported by girders K and K^3, and are operated either forward or backward separately or together by a driving sectional spider and sliding pinions at one end, and supported at

the other end by a plain sectional drum, substantially as and for the purpose described.

3. The combination, with an endless chain forming a grate-surface or fire-supporting bed for a boiler-furnace and heating structure, of a driving-spider, H, forming a flanged drum, and a plain drum, I, substantially as and for the purpose set forth.

4. The combination, with a grate formed of a series of endless chains suitably arranged and supported in a fire-chamber, of a series of sliding pinions on a shaft and a series of spur-wheels applied on a sectional spider, substantially as and for the purpose described.

5. The combination, with the T and L shaped longitudinal girders K K′, of the transverse girders K^2, fastened to the side walls, and the sectional endless-chain grate G, provided with a plain sectional drum, I, a sectional spider, H, and suitable mechanism for moving the sections of the grate separately or together, substantially as described.

6. The combination, with an endless-chain grate suitably arranged and operated in a fire-chamber, of the platform or screen M, supported by suitable girders, K^3, substantially as and for the purpose described.

7. The combination, with the fire-chamber of boiler-furnaces and heating structures provided with the draft and cleaning doors L, of the endless-chain grate, substantially as and for the purpose described.

8. The endless-chain grate formed of links pivoted together by pins *c*, provided with cotters *d*, substantially as and for the purpose described.

9. The endless-chain grate formed of links which are provided with angular depressions *w* on their under side, for the wings of the spider to catch upon, substantially as and for the purpose described.

10. The endless-chain grate formed of links provided with ribs *f* on their upper surfaces, substantially as and for the purpose described.

11. Sections, as *a a′* a^2 a^3, of an endless-chain grate guided by the horizontal flanges of T-shaped girders, and separated by the vertical web of said girders, said legs forming horizontal surfaces flush with the upper surface of the grate-sections, substantially as described.

TOWNSEND POORE.

Witnesses:
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