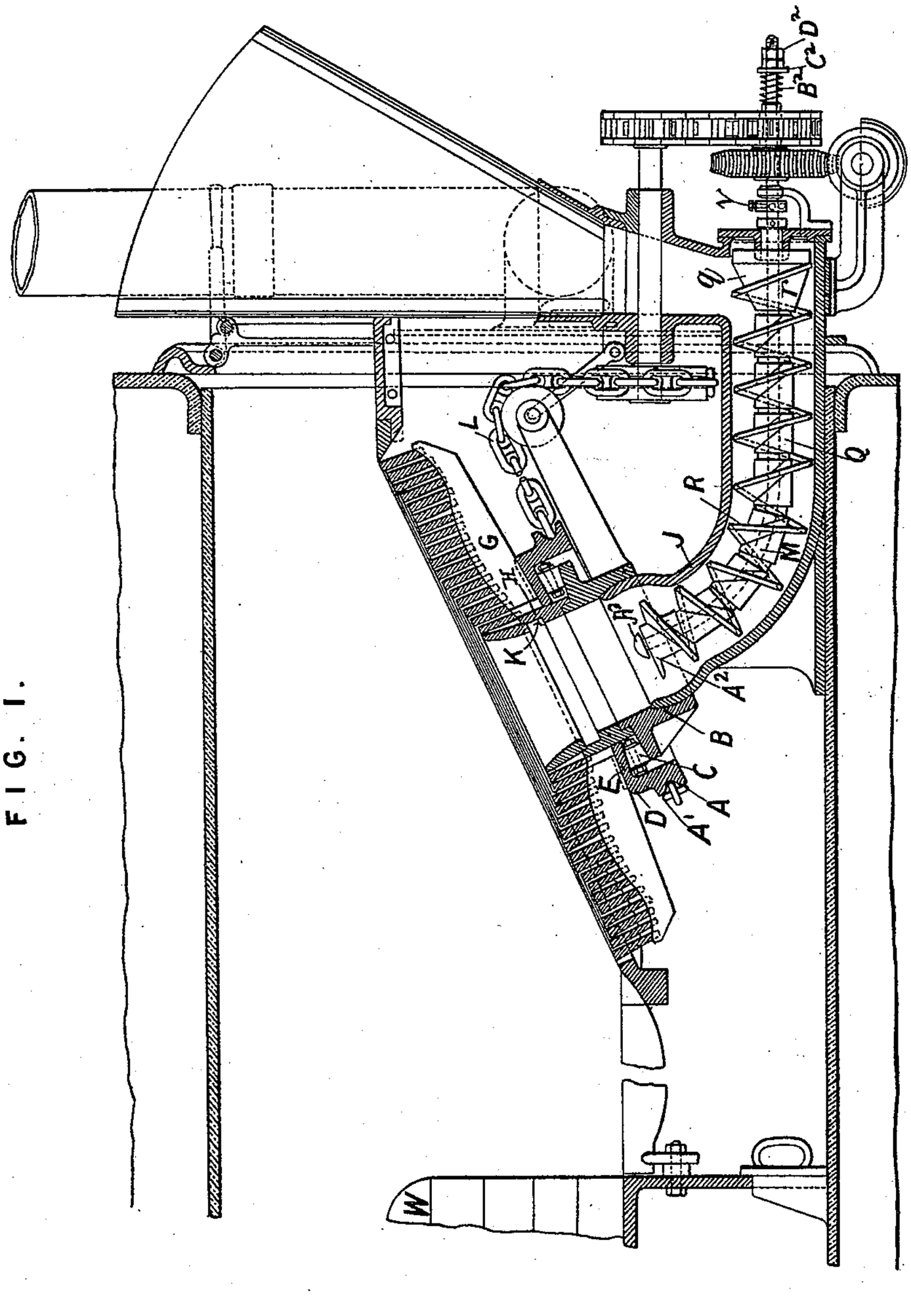
(No Model.) 3 Sheets—Sheet 1.

L. HOPCRAFT.

FURNACE FIRE GRATE.

No. 450,018. Patented Apr. 7, 1891.

FIG. I.



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(No Model.) 3 Sheets—Sheet 2.

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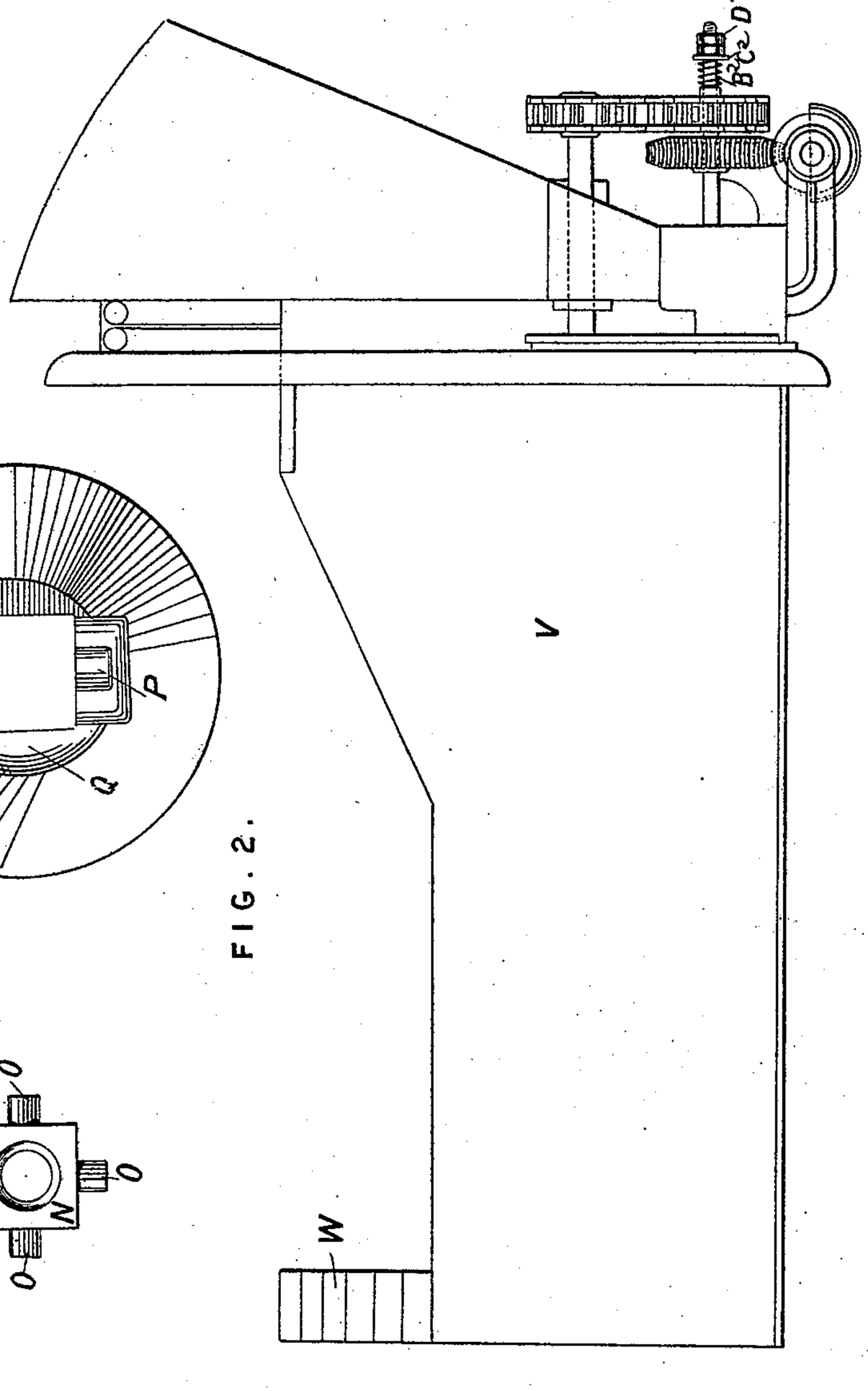

FIG. 2.

FIG. 4.

FIG. 3.

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FIG. 6.

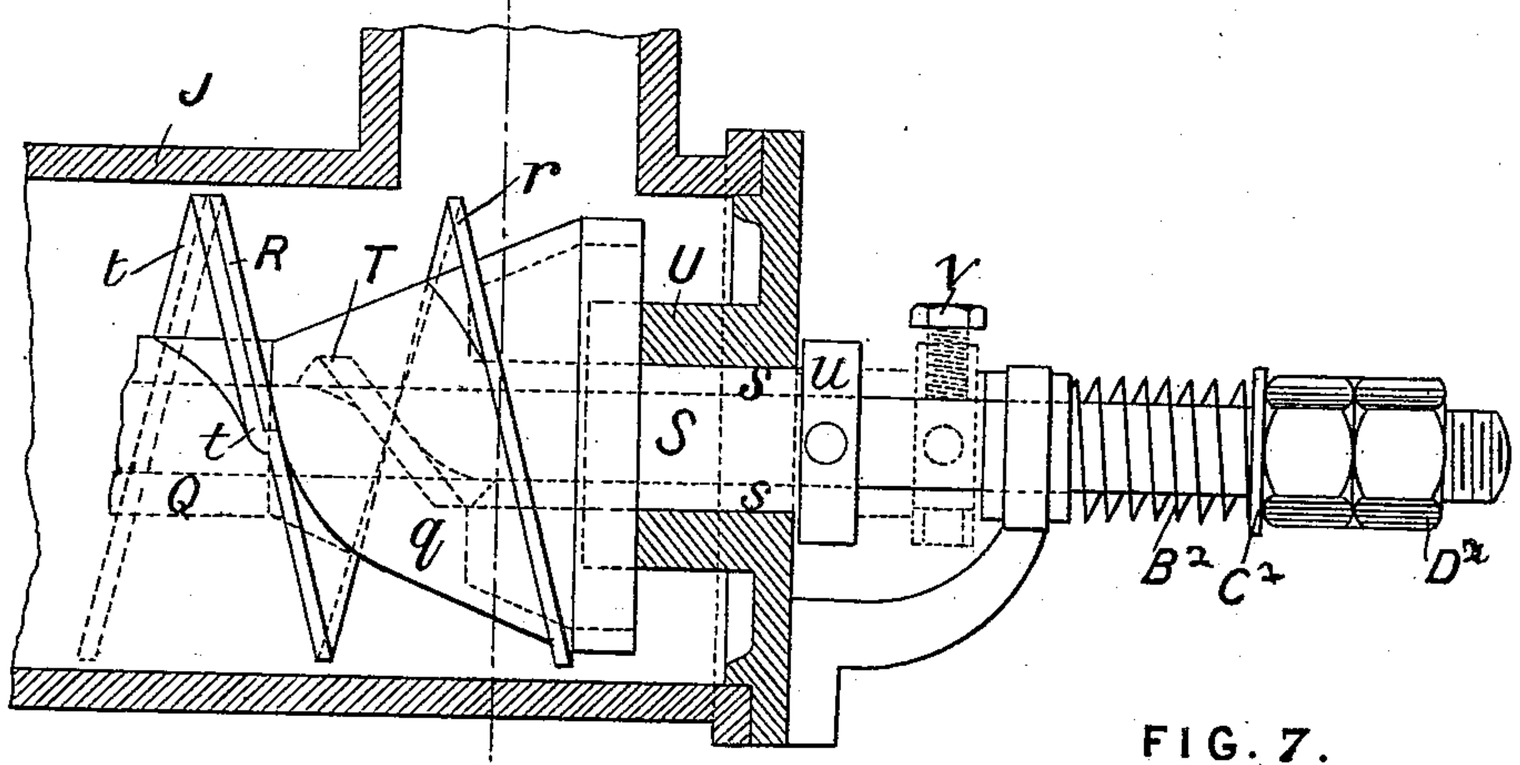
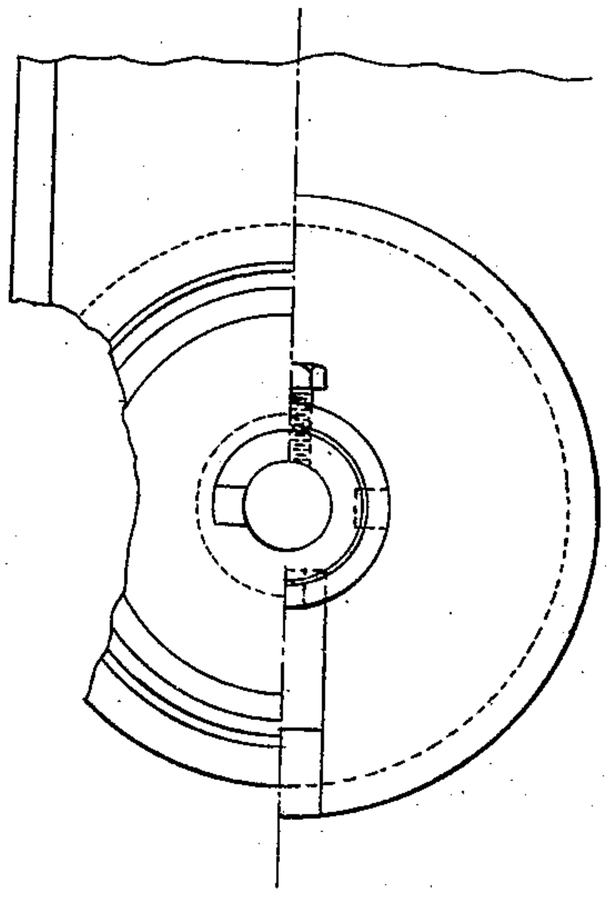


FIG. 7.



X

FIG. 5

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UNITED STATES PATENT OFFICE.

LEWIS HOPCRAFT, OF LONDON, ENGLAND, ASSIGNOR TO THE HOPCRAFT FURNACE COMPANY, LIMITED, OF SAME PLACE.

FURNACE FIRE-GRATE.

SPECIFICATION forming part of Letters Patent No. 450,018, dated April 7, 1891.

Application filed December 26, 1889. Serial No. 335,060. (No model.) Patented in England February 13, 1889, No. 2,581.

To all whom it may concern:

Be it known that I, LEWIS HOPCRAFT, engineer, a subject of the Queen of Great Britain, residing at No. 26 West Bank, Stamford Hill, London, in the county of Middlesex, England, have invented new and useful Improvements in and Relating to Furnace Fire-Grates, (for which I have obtained British Letters Patent No. 2,581, dated February 13, 1889,) of which the following is a specification.

This invention comprises certain improvements on the invention for which Letters Patent were granted to me numbered 404,706 and dated June 4, 1889.

The improvements consist, first, in the construction of the radial arms for carrying the circular bars; second, of means for tilting the grate independently of the worm-conveyer tube; third, in the construction of the worm conveyer and the tube, so that the fuel may be fed in any desired direction instead of vertically or horizontally only, as heretofore; fourth, in means for regulating the feed of the fuel, and, fifth, in providing an outer case, so that the furnace complete may be fitted into or withdrawn from an internally-fired boiler when desired.

In order that my invention may be more fully understood and carried into practice, I will now proceed to describe the same with reference to the accompanying drawings, in which similar letters indicate corresponding parts throughout.

Figure 1 is a longitudinal section of a furnace fire-grate constructed according to this invention. Fig. 2 shows the whole arrangement provided with an outer casing ready for fitting into an internally-fired boiler. Fig. 3 is an enlarged plan of one of the gimbals used in the screw conveyer and Fig. 4 is an enlarged plan of one of the sections of the screw conveyer. Fig. 5 is an elevation of a radial arm. Fig. 6 is a partly-sectional elevation of the screw conveyer, and shows the arrangement adopted for regulating the feed; and Fig. 7 is a section on the line *x x*, Fig. 6.

The radial arms G are vertically sinuous or sinuous only on their upper surfaces, as shown in Figs. 1 and 5, and the fire-bars when placed thereon conform to the wavy shape of the radial arms, the sinuosities of each of which said radial arms corresponds to that of the others, so that when in position on the radial arms each fire-bar is level.

The radial arms G rest upon a ring E, fixed to the tube H. (See Fig. 1.) This ring is made with a shoulder D, inclosing an annular space, as shown in Fig. 1, within which are any suitable number of conical rollers C, running in suitable bearings formed on a loose ring A′. The trunnion-ring B is fitted on the top of the screw-conveyer tube J and does not rotate. The upper end of the said screw-conveyer tube J is made of a globular shape, and the lower part of the trunnion-tube B, which fits thereover is made of a similar shape, the two forming a joint for the purpose of altering the inclination of the grate when desired. The outside of the trunnion-tube B is provided with trunnions A^2, working in fixed bearings carried by suitable brackets or standards formed on the screw-conveyer tube J, so as to support the tube B and prevent it turning on a vertical axis. A groove A is made in the outer circumference of the ring E, within which works a chain L for rotating the grate; but other means may be adopted if found convenient.

The screw conveyer is constructed so as to convey the coal in any desired direction and is provided with means for regulating the supply of coal to the furnace. I construct the screw conveyer in sections and string them loosely upon a non-rotatable rod or bar M, (shown in dotted lines in Fig. 1,) curved to the shape of the direction in which it is desired to convey the coal, so that the said rod or bar M is always central in the conveyer-tube J. Onto the upper end of the said rod M is affixed a head A^3, which rests against the last section of the screw and keeps it in position. The other end of the rod M passes through the center of the worm-actuating shaft S and is produced outward and provided with a spiral or other spring B^2, bearing against a washer C^2 with adjusting locknuts D^2. (See Fig. 1.) The tension of the spring therefore tends to pull the rod forward out of the tube J, causing the head A^3 to bear against the last section, thus compressing all the sections and so keeping the gimbals in their places. Between each two

sections I place a loose gimbal or universal joint N, provided with two pairs of trunnions O, each pair being at right angles to the other pair. (See Fig. 3.) One pair of trunnions takes into recesses or bearings P in one section and the other pair of trunnions into bearings in the next section. Each section of the worm conveyer is constructed in the form of a boss or collar Q, with a screw wing or blade R (see Fig. 4) constructed thereon in such a manner that when fitted together the wings or blades are continuous and form an Archimedean screw around the bosses or collars, as shown in Fig. 1.

To regulate the feed of the conveyer, I construct the boss or collar *q* of the first section, or the section immediately under the hopper, in the form of a truncated cone with a blade or wing *r*, which only extends the same distance from the center of the boss as the wings or blades on the other sections, as shown in Fig. 1 and in detail in Figs. 6 and 7. Thus as the boss or collar *q* becomes thicker the wing or blade *r* becomes correspondingly less, and will therefore take up and feed along a smaller quantity of coal at its thicker than it would at its thinner end. The first or conical section is provided with a sleeve *s*, riding loose on the shaft S, which said shaft S is rigidly affixed to the boss Q of the second section. This shaft S is provided with a pin or thread T, extending partly round its circumference and of the same pitch as the pitch of the Archimedean screw. This said pin or thread T works in a corresponding groove formed on the inside of the boss *q* of the first section. The wing *r* is prolonged beyond the end of the boss *q* and is provided with a small shoulder or bend *t*, and then continued so as to lie parallel with and close against the under side of the wing R of the second section. By this arrangement as the first section is moved away from the second there will be no gap in the Archimedean screw. The first section is actuated as follows: The sleeve *s* terminates in a collar *u* with a suitable number of holes around its circumference, into which the end of a "tommy" or lever may be placed and provided with a set-screw *v*. Fig. 6 shows the conical section close up to the next section, so as to feed the smallest amount of coal possible. To alter the feed, I turn the collar *u* by means of a tommy or hand-lever. The groove on the boss *q* works over the thread T, formed on the shaft S, and the continuation of the wing *r* works along and under the wing R on the second section until the desired thickness of the cone is beneath the hopper, when I fix it by means of the set-screw *v*. The other extreme position of the collar *u* is shown by the dotted lines in Fig. 6. There is an annular recess in the base of the cone, into which takes the boss U on the cover of the conveyer tube J.

When it is desired to fit the furnace fire-grate in an internally-fired boiler, I construct a casing V smaller in size than the furnace-tube, so that it may easily slide therein without jamming against the plates, rivets, or other projections, and within this casing I build the furnace-bridge W and fit together the various parts forming the furnace-grate, as shown in Fig. 2. The casing V is then, with the furnace-grate therein, placed in position in the furnace-tube and secured by means of suitable flanges constructed or formed on or affixed to the casing V, whereby the said casing may be bolted to the boiler-plates.

What I claim is—

1. In combination with a central rotating cylinder or tube H, the sinuous radial arms G for carrying the concentric fire-bars, and a suitable feeding device for conveying the fuel to the fire-bars, substantially as and for the purposes set forth.

2. A screw conveyer constructed in sections fitted together by gimbals or universal joints N, working on a central rod M, bent to the required shape, substantially in the manner described and illustrated.

3. The feed-regulating device consisting of a conical section with a prolonged wing or blade *r* and a thread T, working in a corresponding groove formed in the boss *q* and actuated by the sleeve *s* and collar *u*, substantially as and for the purpose hereinbefore set forth and illustrated.

4. A casing V, in which the various parts of the furnace-grate are fitted together, and a bridge W built therein for expeditiously fitting the furnace fire-grate into internally-fired boilers, substantially as and for the purpose hereinbefore set forth.

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