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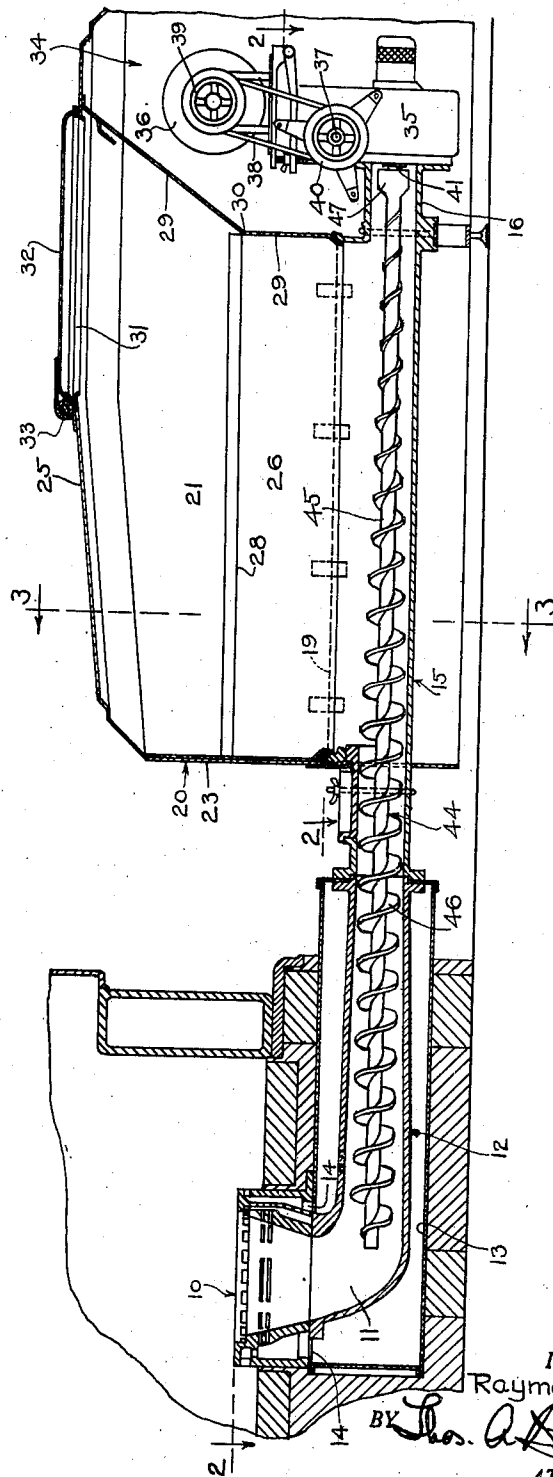
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2,127,018

FUEL FEED FOR STOKERS AND THE LIKE

Filed April 21, 1937

3 Sheets-Sheet 1



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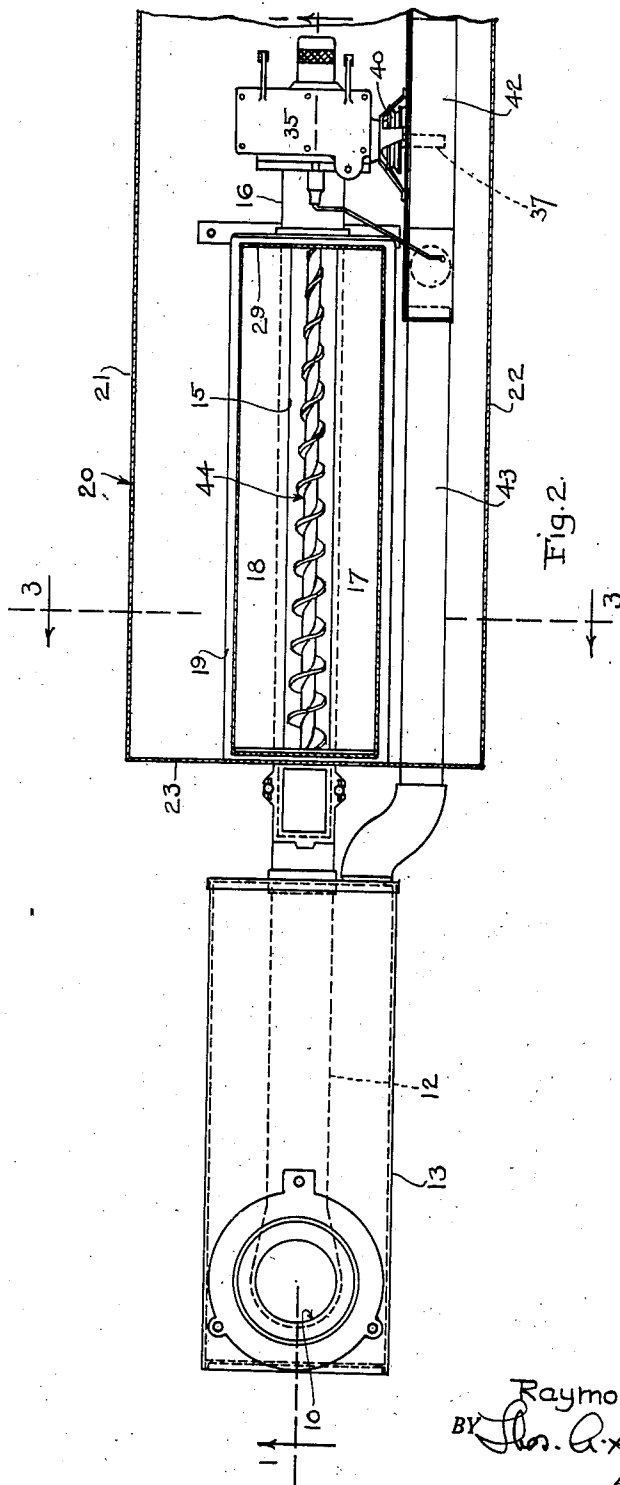
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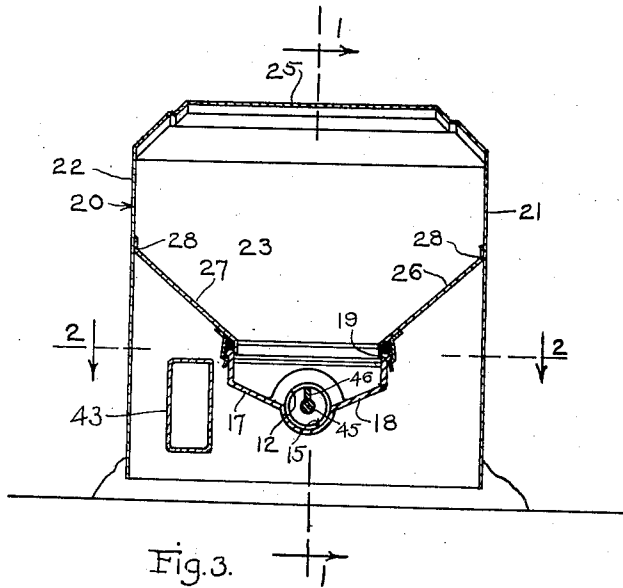
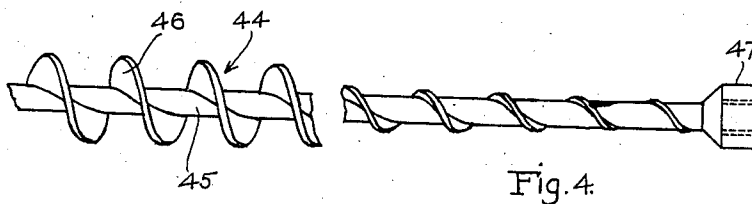
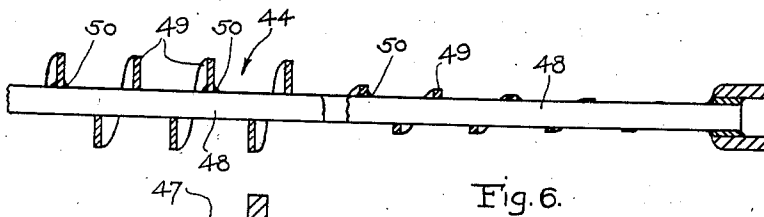
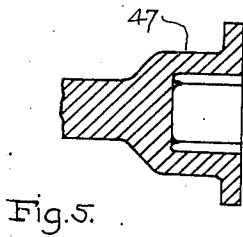
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FUEL FEED FOR STOKERS AND THE LIKE

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3 Sheets-Sheet 3



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FUEL FEED FOR STOKERS AND THE LIKE

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5 Claims. (Cl. 110—45)

This invention relates to improvements in underfeed stokers and the like. The invention concerns itself with the means for feeding the coal from the hopper to the fire pot; and especially the form and arrangement of the feed screw for such purpose.

In this type of device it has been found in the past that as the feed screw is rotated so as to advance the fuel, generally coal, into and along the throat leading to the fire pot, the coal contained in the hopper is subjected to a circulatory or flowing movement lengthwise of the hopper, instead of feeding uniformly and properly down into the screw without such movement. This has been due to the fact that it has been the custom to use a screw of uniform diameter and having uniform convolutions of equal depth throughout the length of that portion of the screw exposed to the coal in the bottom of the hopper. Under these circumstances the convolutions furthest from the fire pot will become at once filled with a full quantity of fuel, to be advanced as the screw rotates; and the same has been true of all the convolutions progressively throughout the length of screw exposed in the hopper. Since the forward convolutions of the same full size have also been completely filled with fuel there has not been space to accommodate the fuel advancing from behind (further from the fire pot) and driven forward by the convolutions located further back.

The above condition has resulted in "boiling" the fuel in the hopper: that is, as the screw has been rotated the fuel in the portion of the hopper closest to the throat has been caused to rise up due to delivery of excess fuel from the screw into such portion of the hopper, and such rising fuel has then flowed rearwardly in the hopper, again descending to the screw in such rearward portion of the hopper. This has caused a circulation of fuel in the hopper, up in the front end, then rearwardly, and then down in the rear end with a slow movement of flow. This has also resulted in a tendency for the screw to jam or clog and a tendency to unduly compress the fuel in the convolutions and hinder its advancement. All these factors have also resulted in increased friction in the fuel feed, and additional power losses due to the unnecessary circulation and "boiling" of the fuel in the hopper. These factors have caused substantial power losses and required additional motor capacity for driving the feed; and have also caused "segregation" of the fuel, that is, tendency to feed the finer material, leaving the larger or coarser material in the

hopper for subsequent feed, and also have caused "degradation" of the fuel, that is, tendency to break up the larger portions with creation of excess "fines".

The main object of the present invention is to overcome the above objectionable features by tapering the feed screw throughout all or a substantial portion of its length exposed to the fuel in the hopper; the convolutions commencing at a minimum diameter in that portion of the screw furthest from the throat and fire pot, and increasing in diameter as the throat is approached, so that the feeding capacity of the convolutions continually increases in the direction of feed. This makes it possible for the screw convolutions to pick up more and more fuel in the direction of feed, so that the fuel advancing from behind can be accommodated, together with additional fuel being withdrawn from those portions of the hopper closer to the throat. In other words, a uniformly distributed quantity of fuel may be withdrawn from the bottom of the hopper throughout its length, all such fuel being accumulated in the convolutions of constantly increasing size, and the fully loaded convolutions of maximum size delivering their full load of fuel uniformly into the throat. Thereby "boiling" is eliminated, the feeding capacity of the screw is maintained, and the power necessary for its operation is reduced and the "segregation" and "degradation" are reduced or eliminated, also a much longer hopper may be used, measured in the direction of feed, since the improved feed screw will take fuel from the full length of the hopper, even when same is much longer than it has heretofore been possible to use.

In connection with the foregoing, the specific form of tapered feed screw herein illustrated is one having its convolutions of the same form as produced by taking a feed screw having a core or shaft of uniform diameter, and having convolutions of uniform depth throughout its length, and cutting off the edge portions of the convolutions in a tapering degree so that said edge portions will contact the surface of a cone.

Specifically, also, it is an object of the invention to form the lower portion of the hopper on a cylindrical surface, the axis of the feed screw being parallel to and generally coinciding with the axis of the cylinder. With this arrangement the clearance between the edges of the convolutions is a maximum at the screw end furthest from the throat and decreases uniformly as the throat is approached. In this way particles of fuel of all sizes contained in the hopper may gain

access to any portion of the screw without crowding and jamming against the bottom surface of the hopper. This will avoid danger of stoppage by jamming and also will reduce friction losses with attendant reduction of power consumption.

Other objects and uses of the invention will appear from a detailed description of the same which consists in the features of construction and combinations of parts hereinafter described and claimed.

In the drawings:

Figure 1 shows a longitudinal section through a typical form of stoker embodying the features of my invention, being a vertical longitudinal section at the position of the feed screw;

Figure 2 shows a horizontal or plan view of the device of Figure 1, being substantially on the line 2—2 of Figure 1, looking in the direction of the arrows, with the hopper assembly removed;

Figure 3 shows a cross section on the line 3—3 of Figures 1 and 2 looking in the directions of the arrows;

Figure 4 shows an enlarged face view of the tapered portion of the feed screw in its relation to the lower portion of the hopper; and

Figure 5 shows a detailed section through the socket end of the feed screw showing the driving means therefor, and

Figure 6 shows an enlarged longitudinal section through a screw of modified form which is built up from a core and a separate thread welded thereto, being known as a "structural screw".

Referring to the drawings, I have therein shown the features of my invention as incorporated in a typical form of underfeed stoker construction. I wish it understood that I do not intend to limit the features of my invention thereto except as I may do so in the claims.

The stoker illustrated includes the fire pot 10 of upwardly tapering form, and mounted above the delivery end 11 of the fuel feed throat 12. The throat, 12 is encased throughout most of its length by the air box 13 which has the openings 14 for delivery of air to and around the fire pot in accordance with a well known type of construction.

The throat 12 extends back to a point of attachment to the hopper, presently to be explained, and a continuation 15 of the throat extends along beneath the hopper to the point 16 where a suitable connection is made to certain driving mechanisms, also to be referred to hereinafter. The portion 15 of the throat is of semi-circular or semi-cylindrical form with the upwardly slanting sides 17 and 18; and a flange 19 is carried around this portion of the throat member.

The hopper is designated in its entirety by the numeral 20. This hopper element is of generally rectangular form, having the side walls 21 and 22, and the back end 23 (the front end not shown in Figure 1), and the top 25; within this rectangular structure is the false structure having the sides 26 and 27 which register with the sides of the flange 19 of the throat portion 15, extending upwardly therefrom to the point 28 where said sides are tapered outwardly and upwardly to meet the top 25. The false structure also includes the false end wall or partition 29, whose lower portion extends straight up to the point 30 and then slants upward to meet the top 25. An opening 31 is formed in the top 25 in advance of the end wall 29, and a cover 32 is hinged at the point 33 to the top 25 so that when lowered this

cover closes the opening 31. The opening 31 is a filler opening for the hopper.

Within the member 20 and behind the partition 29 is a chamber 34 to accommodate the driving motor and various operating devices. These devices are contained within a housing 35 attached to the end of the throat portion 16; and the driving motor 36 is conveniently mounted on the housing. The driving motor drives a shaft 37 by the belt 38 and pulleys 39 and 40. This shaft 37 extends into the housing 35 and, through suitable gear and other drive and control devices it drives the stub shaft 41 in alignment with the throat, which stub shaft directly drives the feed screw, presently to be described.

The shaft 37 also extends sidewise to engage the hub of a fan within the fan housing 42, which fan delivers air for combustion to the flue 43 extending along beside the throat portion 15. The delivery end of the flue 43 connects to the air box 13 for delivery of air thereinto. Suitable damper devices may be provided in the flue 43.

The fuel contained within the hopper finds its way by gravity to the throat section 15, and is to be fed forward to and through the throat section 12 for delivery to the fire pot. Such feed is accomplished by the screw 44. Said screw includes the core portion 45 and the spiral thread 46, either cast as an integral unit or separately applied to the shaft or core. The thread convolutions lying within the throat section 12 are of uniform diameter the full size of the throat, with suitable allowance for such clearances as is needed to permit free rotation of the screw which clearance may increase slightly in the direction of feed so as to permit packing material to more easily free itself. This full size or depth of the convolution is carried back near to the point where the screw extends beneath the fuel hopper, being the open top portion 15 of the throat, and commencing substantially at that point the screw is of tapered diameter clear back to the back end of the open top portion 15. Such tapering of the screw is accomplished by so forming the thread that the pitch of the convolutions is constant but the diameter of the outside edge of the convolutions decreases, so that said outside edges lie substantially in the surface of a cone. This fact is readily seen from examination of the various figures. Such a screw can be formed by first forming the convolutions of the full diameter through the length of the screw, and then cutting off the edge portion of the tapered section, removing an increasing depth of the convolution progressively as the smaller diameter end is approached; or the screw can be initially formed of the desired form by casting or otherwise as by building up. It is noted in any case, however, that the axial distance between the convolutions remains constant.

The rear end of the screw core is provided with a socket 47 to receive the stub shaft 41 by which the screw is driven. This connection also serves to support the rear end portion of the screw above the semi-circular floor of the throat section 15 as well shown in Figure 1.

It is noted that, due to the fact that the semi-circular or semi-cylindrical floor portion is concentric with the axis of screw rotation, the taper of the screw flights establishes a progressively smaller clearance beneath and around the screw threads, so that the fuel can properly reach the screw at all points of its length. The fuel, being contained as a mass of particles or com-

minutions in the hopper constantly settles down on to the feed screw, and works beneath the screw. Then, as the screw is rotated these particles are taken between the convolutions of the screw, and feed towards the throat section 12 and into and along the same to the fire pot.

Consider a lamination of material lying against the screw core at the back, or small end of the screw. Due to the fact that the convolutions are of equal spacing lengthwise of the shaft, such lamination will be able to travel close to the core as it moves towards the throat section 12. When a turn of the screw has been completed, advancing this lamination one convolution, it will occupy a position where the screw thread projects beyond such lamination. Here another layer or lamination of material may be picked up by the screw, such new layer lying outside of and on the first layer. The rotation of the screw will carry both these superposed laminations along to the next position where a third lamination may be picked up, the action proceeding in this manner until finally the end of the hopper closest to the fire pot is reached at which point the full depth of convolution is completely filled with material to be advanced into the throat section 12. It is also noted that the pitch or axial distance between the flights of the screw contained within the throat or feed tube 12 is the same as the distance between the flights in the tapered portion of the screw so that the collected material contained in a flight of the tapered portion of the screw fully occupies and is properly accommodated within a flight of the screw within the throat.

The above analysis shows that with this tapered screw arrangement, with the convolutions of equal spacing along the screw core, makes possible a continual withdrawal of material from the bottom of the hopper, so that the material actually withdrawn comes uniformly from the entire length of the hopper and not merely or even chiefly from the back end of the hopper, farthest from the throat section 12. Due to this fact it is not necessary for the convolutions to "shed" portions of the material they were carrying in order to take on other portions, so the advancing movement of the fuel in the lower portion of the hopper above the screw does not occur. Such "shedding" action has heretofore caused the end-wise flowage of fuel in the lower portion of the hopper with accompanying upflow at the forward end of the hopper and return of the fuel towards the rear in the upper portion and descent of the fuel towards the screw at the rear end, farthest from the throat section 12. Consequently with my improved form of screw a much smoother feed of the fuel occurs and the power consumption is materially reduced, and the "segregation" and "degradation" are eliminated or greatly reduced. Also a much longer hopper may be used since the screw will withdraw the material uniformly from said hopper throughout the length of the screw taper.

In the modified form of screw shown in Figure 6, the same comprises a central core or shaft 48 of substantially uniform diameter, to which is applied a spiral thread section 49, the same being slipped over the shaft or core portion and then tack welded thereto at suitable spacings as shown at 50. The edge of such thread may then be cut down to establish the desired taper, either by turning in a lathe, or by cutting with a "cutting torch" or otherwise. By this "structural" form the thread may be made of one material, best

adapted to withstand erosion or wear, and the shaft or core may be made of another material, of proper toughness and strength to resist deflection and other forces.

By the term "stoker" as herein used, I contemplate any suitable form of mechanical solid fuel feeding device, or other device in which the features of my invention may be suitably used, as for example "overfeed" as well as underfeed stokers.

While I have herein shown and described only certain embodiments of the features of my invention, I do not intend to limit myself thereto except as I may do so in the claims to follow.

While in the drawings and specifications I have illustrated and described a semi-cylindrical bottom for the hopper, 20, still I do not intend to limit myself thereto, except as I may do so in the claims, but also contemplate other suitable forms of hopper bottom, as for example flat, curved, 20 semi-conical, and the like.

I claim:

1. In an underfeed stoker the combination with the fire pot and the feed throat connected thereto, and the fuel hopper, of a semi-cylindrical bottom for said hopper substantially co-axial with the feed throat, a feed screw extending longitudinally through the hopper bottom and co-axial with the semi-cylindrical hopper bottom and the throat, and means for rotating said feed screw, said feed screw comprising a core shaft portion of substantially uniform diameter throughout its length, together with a spiral thread projecting outwardly from said core shaft portion, said thread being of substantially uniform pitch throughout the full length of the screw including the feed throat and the hopper, the section of screw thread within the feed throat being of substantially uniform diameter throughout the length of the feed throat, and being of constantly and uniformly tapering diameter throughout the length of the semi-cylindrical hopper bottom with the small diameter of said taper at the rear end of the screw farthest from the feed throat, whereby the edge of said tapered screw thread lies substantially within the surface of a cone, and whereby the clearance between said tapered screw thread and the surface of the semi-cylindrical hopper bottom decreases uniformly as the feed throat is approached, and the diameter of the feed throat being such at all points that the clearance between the threads of the feed screw and the throat increases in the direction of coal feed substantially as and for the purpose set forth.

2. In an underfeed stoker the combination with the fire pot and the feed throat connected thereto, and the fuel hopper, of a semi-cylindrical bottom for said hopper substantially co-axial with the feed throat, a feed screw extending longitudinally through the hopper bottom and co-axial with the semi-cylindrical hopper bottom and the throat, and means for rotating said feed screw, said feed screw comprising a core shaft portion, together with a spiral thread projecting outwardly from said core shaft portion, said thread being of substantially uniform pitch throughout the full length of the screw including the feed throat and the hopper, the section of screw thread within the feed throat being of substantially uniform diameter throughout the length of the feed throat, and being of constantly and uniformly tapering diameter throughout the length of the semi-cylindrical hopper bottom with the small diameter of said taper at the rear

end of the screw farthest from the feed throat, whereby the edge of said tapered screw thread lies substantially within the surface of a cone, and whereby the clearance between said tapered
5 screw thread and the surface of the semi-cylindrical hopper bottom decreases uniformly as the feed throat is approached, and the diameter of the feed throat being such at all points that the
10 clearance between the threads of the feed screw and the throat increases in the direction of coal feed substantially as and for the purpose set forth.

3. In an underfeed stoker the combination with the fire pot and the feed throat connected thereto, and the fuel hopper, of a bottom for said
15 hopper, a feed screw extending longitudinally through the hopper bottom and co-axial with the throat, and means for rotating said feed screw, said feed screw comprising a core shaft
20 portion, together with a spiral thread projecting outwardly from said core shaft portion, said thread being of substantially uniform pitch throughout the full length of the screw including the feed throat and the hopper, the section
25 of screw thread within the feed throat being of substantially uniform diameter throughout the length of the feed throat, and being of constantly and uniformly tapering diameter throughout the length of the hopper bottom with the small diameter of said taper at the rear end of the screw
30 farthest from the feed throat, whereby the edge of said tapered screw thread lies substantially within the surface of a cone, and the diameter of the feed throat being such at all points that the clearance between the threads of the feed
35 screw and the throat increases in the direction of coal feed substantially as and for the purpose set forth.

4. In an underfeed stoker the combination with the fire pot and the feed throat connected thereto, and the fuel hopper, of a curved bottom for
40 said hopper, a feed screw extending longitudinally through the hopper bottom and co-axial with the throat, and means for rotating said feed screw, said feed screw comprising a core shaft
45 portion together with a spiral thread projecting

outwardly from said core shaft portion, said thread being of substantially uniform pitch throughout the full length of the screw including the feed throat and the hopper, the section
5 of screw thread within the feed throat being of substantially uniform diameter throughout the length of the feed throat, and being of tapering diameter throughout the length of the hopper bottom with the small diameter of said taper at the driven end of the screw, whereby the edge
10 of said tapered screw thread lies substantially within the surface of a tapering body of circular cross section at all points throughout its length, and the diameter of the feed throat being such at all points that the clearance between
15 the threads of the feed screw and the throat increases in the direction of coal feed substantially as and for the purpose set forth.

5. In an underfeed stoker the combination with the fire pot and the feed throat connected
20 thereto, and the fuel hopper, of a bottom for said hopper, a feed screw extending longitudinally through the hopper bottom and co-axial with the throat, and means for rotating said feed
25 screw, said feed screw comprising a core shaft portion together with a spiral thread projecting outwardly from said core shaft portion, said thread being of substantially uniform pitch throughout the full length of the screw including the feed throat and the hopper, the section
30 of screw thread within the feed throat being of substantially uniform diameter throughout the length of the feed throat, and being of tapering diameter throughout the length of the hopper bottom with the small diameter of said taper at the rear end of the screw farthest from the feed
35 throat, whereby the edge of said tapered screw thread lies substantially within the surface of a tapering body of circular cross section at all points throughout its length, and the diameter of the feed throat being such at all points that the
40 clearance between the threads of the feed screw and the throat increases in the direction of coal feed substantially as and for the purpose set forth.

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