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FUEL AGITATOR FOR STOKER HOPPERS

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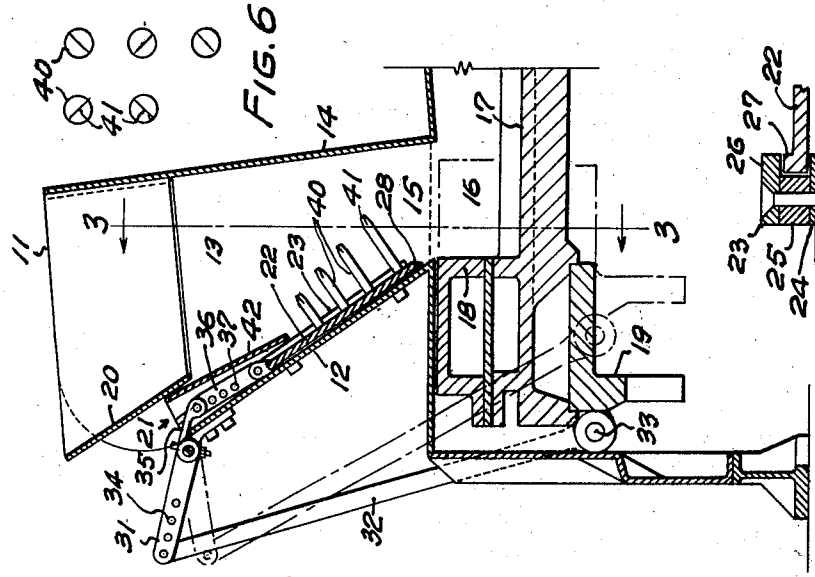

FIG. 6

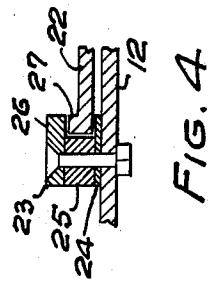

FIG. 4

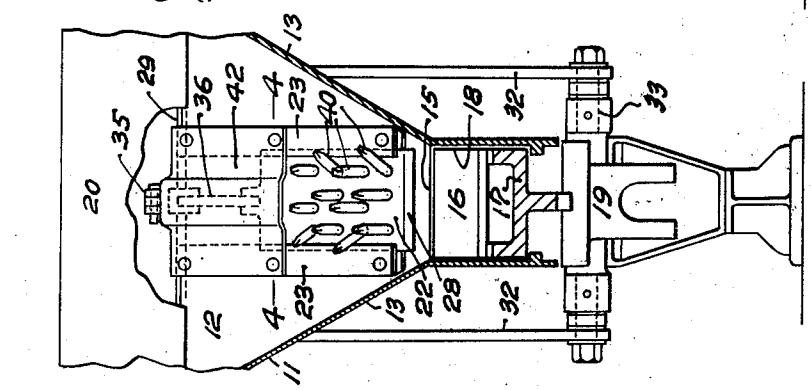

FIG. 2

FIG. 3

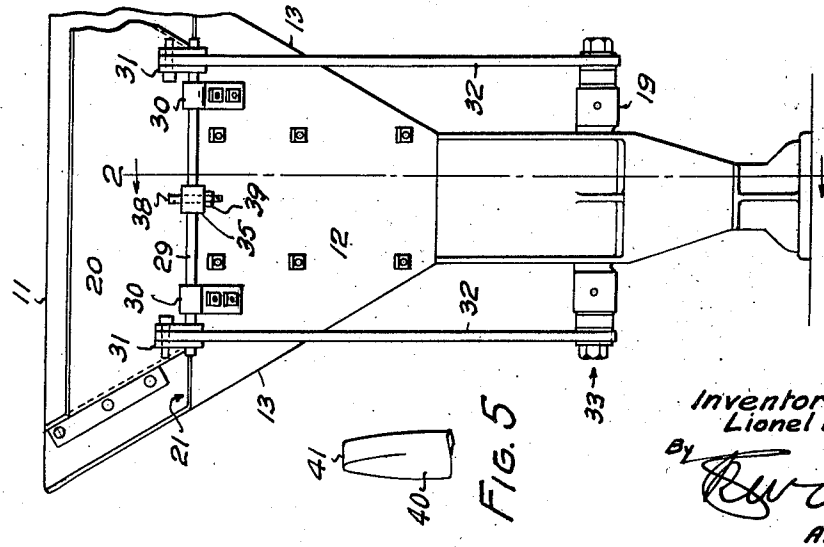

FIG. 1

FIG. 5

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FUEL AGITATOR FOR STOKER HOPPERS

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13 Claims. (Cl. 222—243)

This invention relates to improvements in agitators for the contents of hoppers, such as those of mechanical stokers, and the primary object of the invention is to provide means for breaking up agglomerations of comminuted material in a hopper and for ensuring a uniform discharge from the hopper. A further object is to provide means for so controlling downward movement of material in a hopper as to prevent jamming of a material feeding element at the hopper outlet during its feeding movement; and as to ensure the feeding of a full charge of material to said element during its charge receiving movement. A still further object is to provide an agitator so constructed and arranged that it will require only a small amount of power for its operation. Another object is to provide simple, durable and inexpensive means as aforesaid which may be installed in existing hoppers quite as well as in new construction. Various other objects and the advantages of the invention may be ascertained from the following description and the accompany drawings.

To facilitate explanation, the invention will be hereafter described in its application to a mechanical stoker. In the operation of mechanical stokers in which fuel drops through a chute into a downwardly tapering hopper, considerable difficulty is occasioned by the packing or wedging of the fuel in the hopper, due to the momentum of the falling fuel and to the tapering of the passage through the hopper, which results in an irregular discharge from the hopper and sometimes complete stopping of the discharge. This is particularly the case if wet or sticky fuel of small particle size is being fed. Further difficulty is encountered at times because of the presence of strongly coherent masses of fuel or of agglomerations thereof, such as result from freezing of wet or sticky fuel, which masses are too large to pass down to the hopper outlet and substantially or completely stop the discharge of fuel from the hopper. Such fuel masses, even if small enough to pass the hopper outlet, are frequently too large to fall free of the hopper and are caught between the rear edge of the hopper mouth and the rearwardly moving fuel feeder block, thus imposing undesirable, and sometimes damaging, stress in the stoker mechanism and needless expenditure of power. As the feeding of fuel by the stoker cannot be readily observed, it is necessary to agitate the fuel in the hopper frequently, or substantially continuously, to break up masses or agglomerations of fuel and ensure a proper and uniform discharge of fuel from the hopper. Various mechanical devices for this purpose have been proposed but for one reason or another these have not proved entirely satisfactory and, in consequence, the usual method of agitation is hand poking by means of a poker introduced at the top of the hopper. In a continuously operating plant of any considerable size this necessitates the services of at least one man per working shift, that is, at least three men per 24-hour day. The resulting labour cost largely offsets the theoretical cost saving of mechanical stoking as compared with manual stoking.

The present invention provides power operated mechanical means for automatically and effectively agitating fuel in a stoker hopper in suchwise that agglomerations of fuel in the hopper, whether introduced as such or due to packing of fuel in the hopper, are broken up and a uniform discharge of fuel ensured; the said means operating also to prevent passage from the hopper of fuel agglomerations or

lumps so large as to be caught between the edge of the hopper mouth and the fuel feeder block.

Broadly speaking, the invention consists in an agitator plate reciprocable up and down in close proximity to the inner surfaces of an inclined wall of a stoker hopper, said plate having projecting therefrom into the hopper a series of tines; and driving connection between said plate and any suitable moving part of the stoker.

In greater detail, the invention consists in the features and combinations of features herein disclosed, together with all such modifications thereof and substitutions of equivalents therefore as are within the scope of the appended claims.

In the accompanying drawings which illustrate that embodiment of the invention now preferred but to the details of which and to the particular form of stoker shown, the invention is not limited:

Fig. 1 is an elevation of the front of a conventional stoker, illustrating the application of the invention thereto;

Fig. 2 is a vertical, longitudinal, sectional view of the stoker, on the line 2—2 of Fig. 1, illustrating the invention and its application to a stoker;

Fig. 3 is a vertical, transverse, sectional view of the stoker, on the line 3—3 of Fig. 2, still further illustrating the invention and its application to a stoker;

Fig. 4 is a fragmentary sectional view, on an enlarged scale, at the line 4—4 of Fig. 3, showing a detail of the agitator mounting;

Fig. 5 is an elevation, on an enlarged scale, of the tip of one of the agitator tines; and

Fig. 6 is a diagram illustrating the arrangement of the tips of the tines.

Referring more particularly to the drawings, **11** designates the feed hopper of a conventional mechanical stoker having a rearwardly and downwardly inclined front wall **12**, downwardly converging side walls **13** and a rear wall **14**. The lower edges of the walls define a discharge opening **15** leading to a fuel measuring chamber **16** formed by the side walls of the stoker body, the sliding bottom **17** and the feeder block **18** which is fixed to the front end of the sliding bottom. The sliding bottom and the feeder block thereon are reciprocated forwardly and rearwardly by a cross-head **19**, or equivalent, of form suitable to the motive power of the stoker. In the upper part of the hopper, a shield **20** is provided, having front and side walls substantially paralleling the adjacent hopper walls and spaced inwardly therefrom to define a poking slot **21** at the front and sides of the hopper.

An agitator plate **22** is slidably mounted within the hopper, substantially parallel with one of the inclined walls thereof, preferably the front wall **12**, by means of parallel guides **23** fixed to the inner surface of the hopper wall and extending substantially from top to bottom thereof. As shown in Fig. 4, each guide comprises a spacer strip **24** to project between the hopper wall and an edge portion of the plate **22** for elimination of friction between them; a filler strip **25** slightly thicker than the edge portion of the agitator plate and located outwardly of the plate; and a cover strip **26** overlying the edge portion of the plate and retaining the same in proper relation to the hopper wall. To minimize entrance of grit into the guides, the inner or rear surface of the agitator plate may be provided with projecting flanges **27** engaging the cover strips so as to locate the contacting surfaces of the plate and strips above the main surface of the plate. The width of the agitator plate is preferably approximately the same as the width of the hopper discharge opening **15** but may be as much more as less as is desired. The length of the plate **22** is preferably such that it may extend from the bottom of the hopper approximately half way to the top thereof, but may be more or less. The lower edge portion **28** of the agitator plate is

bevelled on its rear surface to reduce resistance to plate movement downwardly between the hopper wall and fuel in the hopper.

Any suitable means is provided to transmit power to the agitator plate to reciprocate the same. Preferably, this means is a movement transmitting connection between a moving part of the stoker and the plate and is adapted to move the plate in synchronism with movements of the feeder block. In stokers of the general type illustrated, in which the feeder block is reciprocated by a cross-head, it is most convenient to connect the movement transmitting means of the plate to the stoker cross-head, but it will be understood the invention is not thus limited as the connection may be to some different type of stoker element, such as a rotating shaft and through the intermediary of a crank, cam or eccentric. Obviously the plate may be powered by means entirely separate from the stoker.

A plate reciprocating means suitable for the type of stoker illustrated comprises a transverse rock shaft **29** mounted at approximately the level of the upper edge of the hopper wall, and outwardly thereof, by means of bearings **30** fixed to the outer surface of the hopper wall. Arms **31** are each fixed at one end to said shaft, toward the ends thereof, and project away from the hopper. These arms **31** are pivotally connected to the upper ends of links **32**, the lower ends of which are pivotally connected to the cross-head **19**, or equivalent reciprocating element of the stoker, by means of studs **33** rigidly mounted in the cross-head. The arms **31** are formed with a plurality of apertures **34** for the pivotal connection of the links **32** at any one of a plurality of points in the lengths of the arms so that the extent of oscillation of the arms and the shaft may be varied. An arm **35** is fixed to the shaft **29** in the vertical plane of the longitudinal axis of the agitator plate and projects a short distance into the hopper. The free end of this arm is pivotally connected to the upper end of a link **36**, the lower end of which is pivotally connected to the upper edge of the agitator plate. The link **36** is provided with a series of apertures **37** for pivotal connection to the plate whereby the length of the link between the arm **35** and the plate **22** may be varied to adjust the plate upwardly or downwardly in the hopper. The arm **35** may be fixed to the shaft **29** by means of a tapered shear pin **38** passing through both the arm and the shaft and threaded at its smaller end to co-operate with a nut **39** seating against the arm, whereby the pin may be retained in place and may be tightened to take up wear. The arms **31** may be fixed to the shaft in the same manner as the arm **35**, or in any other manner desired. It will be seen that the arms **31** and **35** and the shaft connecting them constitute a lever fulcrumed intermediate its ends and having one arm connected to the agitator plate and the other arm connected to an actuating means, the shaft being, primarily, merely the pivotal mounting of the lever.

The agitator plate **22** carries a plurality of tines **40** rigidly mounted thereon and projecting into the hopper at an upward inclination. These tines are preferably arranged in vertical rows, as shown in Fig. 3, and increase in length from top to bottom of the rows so that each lower tine projects inwardly of the hopper beyond the tine next above it, as shown in Fig. 2. In the outermost rows, alternate tines may stand approximately normal to the plate while the remaining alternate tines are directed outwardly, or laterally, as shown in Fig. 3, so that, while the roots of the tines are in a single row at each side of the plate, the tips of the tines are in two laterally spaced rows. The plate and tines may be regarded as constituting a rake and the inclination of the tines as aforesaid increases the reach of the rake beyond the width of the plate. The tips of all tines lie substantially in a single plane inclined with respect to the plane of the plate **22** and nearer horizontal than the plane of the plate. The inclination of the plate and the lengths of the tines are

so related that as the plate is moved up and down in its plane, the tip of each tine traces a path different from that traced by the tip of any other tine. The tips of the tines are wedge shaped, as shown in Fig. 5, and the apex edges **41** of alternate tines in a row are inclined oppositely to the apex edges of the remaining alternate tines of that row, and preferably oppositely to the apex edges of the tines at the same level in adjacent rows, as shown in Fig. 6. As will be seen, the tines project into the path of fuel moving down through the hopper to such an extent that the unobstructed path through the hopper is smaller than the hopper outlet.

In the upper part of the hopper, a cover plate **42** extends from one to the other of the guides **23** and from a level below the upper edge of the plate **22** upwardly into the space **21** between the shield and the hopper wall and prevents material in the hopper from contacting the upper edge of the agitator plate and the link **36** and arm **35** and also prevents the material from entering the guides above the plate **22**.

While the agitator of this invention has been illustrated as mounted on the front wall of a hopper, it will be understood that, if desired, an agitator may be mounted on either or each of the side walls and that a plurality of similar agitators may be mounted, one on the front wall and one on either or each of the side walls.

In the operation of a stoker, the hopper is periodically filled with fuel, either by hand or by descent through a chute. The fall of the fuel into the tapering hopper tends to cause the fuel to pack or wedge in the hopper and form a bridge or arch, especially in the lower part of the hopper, which must be broken to permit descent of the fuel forming such bridge and the fuel above it. In the lower part of the hopper, the material rests on the plate **22** and the tines **40** are buried in the material. The movement of the plate operates to loosen an end of any bridge which may form, so that the bridge collapses. In addition, the tines **40**, some of which will be buried in the bridge, will, by their movement, further break the bridge so that the fuel will descend uniformly to the hopper outlet. It frequently happens that an agglomeration of fuel, larger than the hopper outlet or larger than the charging chamber **16** beneath the hopper, will enter the top of the hopper and become wedged part way down in the hopper with, to some extent, the same effect as a bridge of the fuel. Such an agglomeration will be supported on the tips of the tines **40** so that some passage for fuel remains between the agglomeration and the plate **22**. As the agitator moves up and down, the tines tear at the surface of such an agglomeration along a multitude of paths lying in planes parallel to the plane of agitator movement and thus break up the agglomeration. As the plane containing the tips of the tines is inclined to the planes of their movement, the tines operate, during their upward movements, to lift the agglomeration so that it does not become wedged in the hopper; and also operate to rotate the agglomeration and, in time, tear at substantially the entire outer surface if the agglomeration should persist for a sufficient time. As the tines move up and down in contact with the fuel, the lateral inclinations of the surfaces of their wedge-form tips produce lateral thrustings of the fuel which facilitate its downward movement and offset any tendency of tine movement to cause a packing of fuel in the vertical direction. With tines of suitable length, formed and arranged as described, agglomerations of fuel will, at the least, be reduced to such size that they will enter easily into the charging chamber **16** of the stoker and will not be caught between the rear edge of the hopper outlet and the rear end of the feeder block **18** during its rearward movement.

In the normal operation of a stoker, with fuel in free flowing condition in the hopper, there is considerable weight of fuel resting on the feeder block during its rearward movement. According to this invention, the move-

ment of the agitator is synchronized with the movement of the feeder block, the agitator moving upwards during rearward movement of the feeder block and tending to lift the fuel in the hopper so as to partially relieve the downward pressure on the feeder block; and moving downward during forward movement of the feeder block so as to urge fuel downwardly into the chamber **16**.

While the invention has been described in its application to a mechanical stoker, it will be obvious that its use is not thus limited and that it may be applied to facilitating movement through a hopper, of comminuted or granular material other than fuel.

Having thus described my invention, I claim:

1. A material agitator for hoppers comprising an agitator plate of a width approximating the width of the hopper outlet, means for mounting said plate on the inner surface of an inclined wall of a hopper for edgewise sliding movement up and down in constant close proximity to and parallelism with said wall, tines arranged in a plurality of horizontally spaced vertical rows projecting from said plate into the hopper for agitating material in the central portion of the hopper, and means for moving said plate upwardly and downwardly.

2. A device according to claim 1 in which the tines are wedge-shaped at their free ends and the apex edges of the tine ends are inclined in the transverse direction of the plate.

3. A material agitator for hoppers comprising an agitator plate, means for mounting said plate on the inner surface of an inclined wall of a hopper for edgewise sliding movement up and down in close proximity to and parallelism with said wall, tines projecting from said plate into the hopper for agitating material in the hopper, and means for moving said plate upwardly and downwardly including a rock shaft to traverse said inclined hopper wall adjacent and externally of the upper edge of the wall, means for mounting said rock shaft on the hopper, a lever fixed at one end to said shaft, a link pivoted at one end to said lever and adapted to be connected at its other end to a powering element for movement in its longitudinal direction, a second lever fixed at one end to said shaft and adapted to project into a hopper, and a link connecting said second lever and said plate.

4. A device of the class described comprising, in combination, a hopper having an inclined wall, and an outlet, and an agitator plate mounted on the inner surface of said hopper wall for sliding movement upwardly and downwardly in a plane parallel with the hopper wall, tines spaced vertically of said plate and also transversely thereof through a distance approximating the width of the hopper outlet and projecting from said plate into the hopper means to prevent material in the hopper from entering between the plate and the adjacent hopper wall, and means for moving said plate upwardly and downwardly.

5. A device according to claim 4 in which the free ends of some at least of the tines are disposed at a distance from the opposite wall of the hopper which is materially less than the distance between said walls at the outlet of the hopper whereby said tines overhang the outlet of the hopper to a material extent at all times.

6. A device according to claim 4 in which the tines are arranged in vertical rows, the lengths of the tines increasing from the upper end of each row to the lower end thereof and the tips of the tines lying in a plane inclined more nearly to horizontal than the inclination of the plate whereby upon movement of the plate the tip of each tine will trace a path different from the path traced by the tip of any other tine.

7. A material agitator for a hopper comprising a plate, means for mounting said plate on a hopper wall in an inclined position, means for moving said plate up and down in the plane of its inclination, tines fixed to said plate to project into the central part of a hopper and inclining upwardly toward their free ends, said tines being disposed at different elevations and each lower tine being longer than the tine next above it, the lengths of the tines being such that the tips thereof occupy a common plane inclined more nearly to horizontal than the plane of the plate.

8. A device according to claim 7 in which the tines are arranged in at least three vertical rows and in the two outermost rows each alternate tine is laterally inclined away from the other outermost row while the remaining alternate tines of said rows stand approximately normal to the plate.

9. A device according to claim 7 in which the tips of the tines are wedge-shaped, the apex edges of the wedge-shaped tips being laterally inclined.

10. A material agitator for hoppers comprising an agitator plate; means for mounting said plate on the inner side of an inclined hopper wall for edgewise sliding movement up and down in slightly spaced relation to and parallelism with said wall, comprising continuous guide members for the side edges of said plate and a stationary cover plate for the upper portion of said agitator plate to prevent entry of material from the hopper into the space between the agitator plate and the hopper wall; tines projecting from said plate into the hopper for agitating material therein; and means for moving said agitator plate upwardly and downwardly.

11. A device of the class described comprising the combination with a hopper having an inclined wall and a reciprocating material-feeding element at the outlet of the hopper; of an agitator plate mounted on the inner surface of said inclined hopper wall for sliding movement upwardly and downwardly; continuous guide members for the side edges of said plate fixed to the hopper wall; a cover plate for said agitator plate fixed to the hopper wall and extending from a level below the upper edge of the agitator plate to substantially the upper edge of the inclined hopper wall, said guide members and cover plate serving to exclude material in the hopper from the space between the agitator plate and the hopper wall; tines projecting from said agitator plate into the hopper; and means for moving said agitator plate upwardly and downwardly.

12. In a stoker hopper, an agitator slidably related to a wall of the hopper for movement upwardly and downwardly, comprising a plurality of tines projecting into the hopper and located at a plurality of points spaced in the height and width of the hopper, said tines being arranged to support an agglomeration of material in the hopper above the said hopper wall and being of lengths sufficient to support an agglomeration of material at such distance from said hopper wall as to permit passage of unagglomerated material between the agglomeration and the hopper wall at substantially a normal rate of flow of material through the hopper; and means to move said agitator upwardly and downwardly.

13. In a stoker hopper, an agitator slidably related to a wall of the hopper for movement upwardly and downwardly, comprising a plurality of tines arranged at a plurality of points spaced in the height and width of the hopper and projecting toward an opposite wall of the hopper, the lengths of some at least of said tines being such that the agitator will support an agglomeration of material too large to pass freely through the hopper outlet and at such distance from the hopper outlet as to leave the same unobstructed for passage of unagglomerated material at substantially a normal rate of flow of such material through the hopper; and means for moving said agitator upwardly and downwardly.

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