

April 28, 1925.

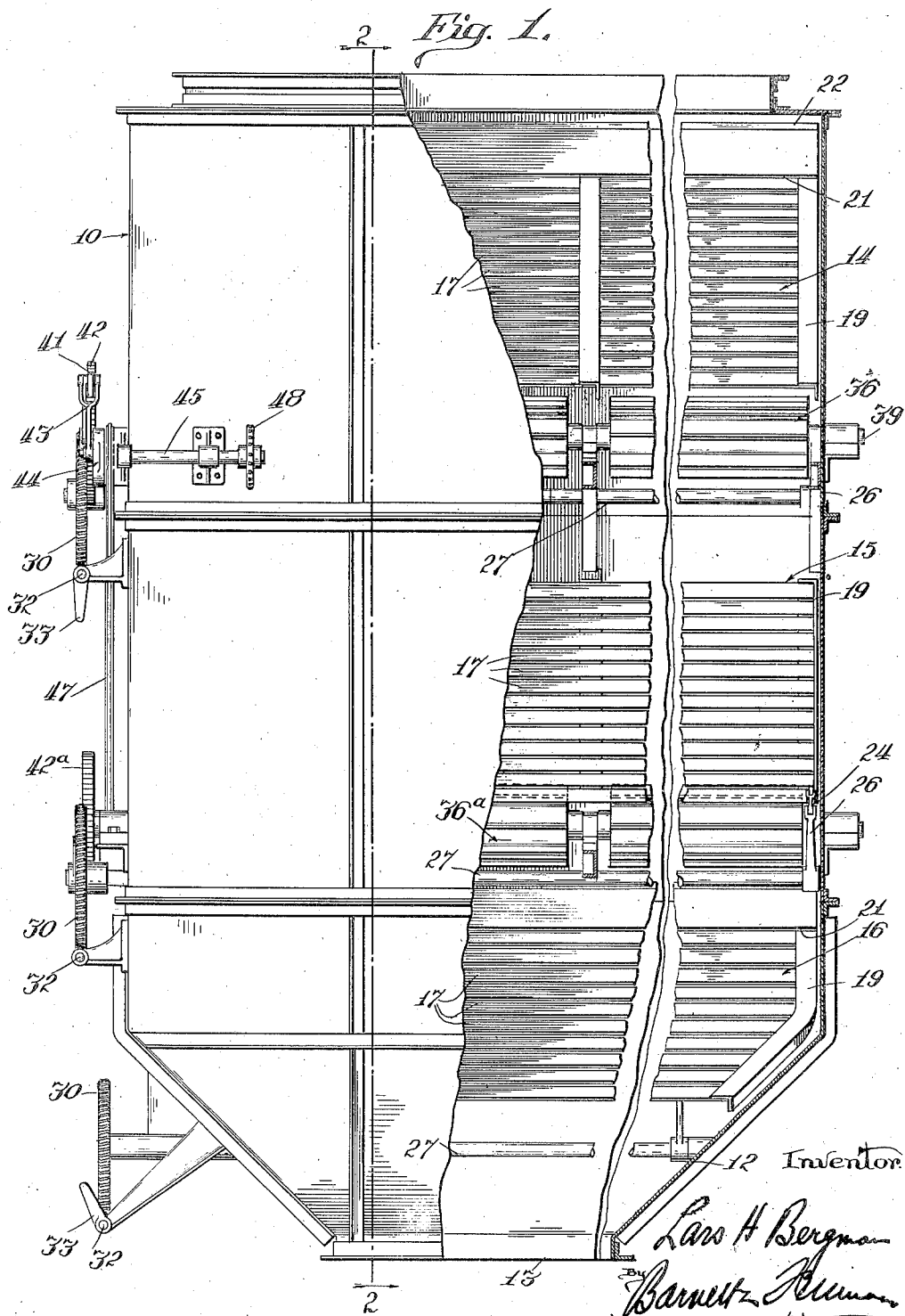
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L. H. BERGMAN

DRYING APPARATUS

Filed Oct. 13, 1923

3 Sheets-Sheet 1



April 28, 1925.

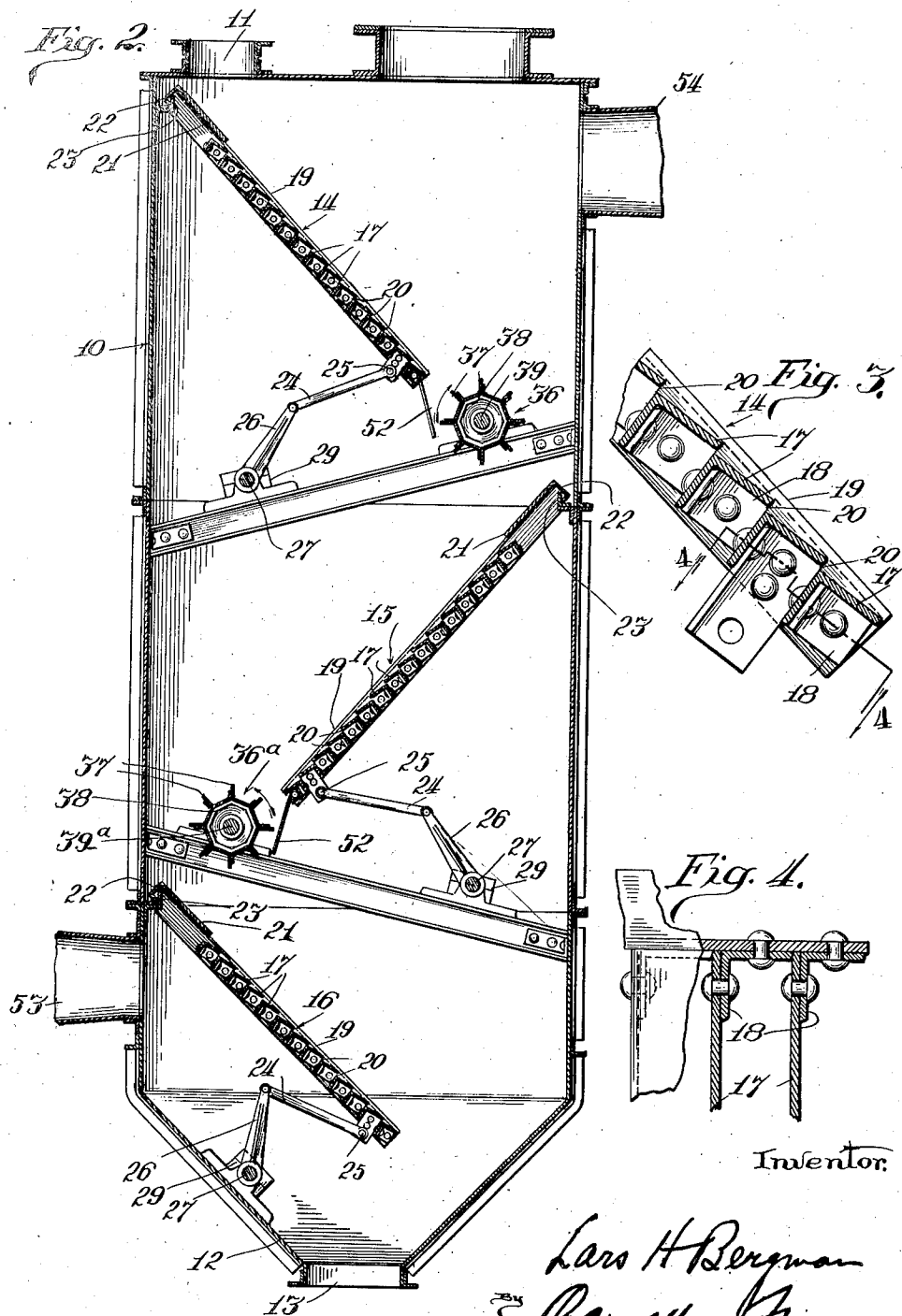
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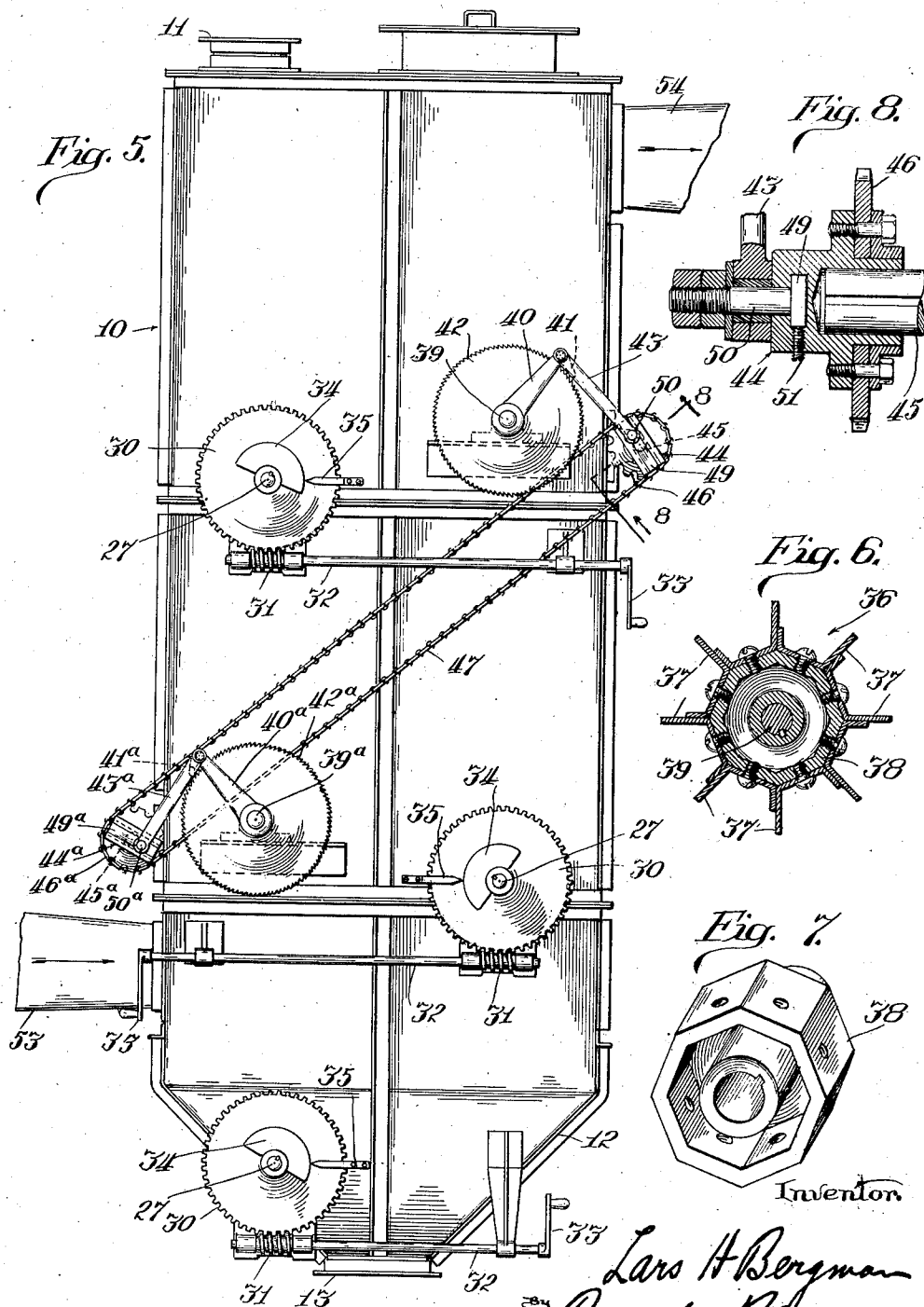
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UNITED STATES PATENT OFFICE.

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DRYING APPARATUS.

Application filed October 13, 1923. Serial No. 668,333.

To all whom it may concern:

Be it known that I, LARS H. BERGMAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Drying Apparatus, of which the following is a specification.

My invention relates to drying apparatus and has for its object to provide an efficient and economical means for drying material such as comminuted coal.

The invention consists of a drying tower having certain improved arrangements, constructions and combinations of parts and devices whereby the material to be dried may be introduced into the tower at the upper end thereof and passed by gravity over a plurality of heated inclined chutes in opposition to a draft of heated air.

One of the specific objects of my invention is to provide an arrangement and construction of inclined chutes whereby the inclination of the chutes may be varied so as to control the velocity of the material and thereby increase or diminish the period during which the material is subjected to the drying influence of the heated air, and to provide the inclined chutes with air passages so arranged as to permit the heated air to thoroughly permeate the material.

Another specific object of the invention is to provide improved agitating and forwarding devices at the discharge end of certain chutes, which devices receive the material from said chutes and deliver it intermittently to the upper end of the adjacent lower chute and thereby prevent the fine particles of material from collecting at the discharge and receiving ends of the chutes in a manner to interfere with the proper movement of the material.

The invention has for further objects such other new and improved arrangements, constructions and combinations of parts relating to drying apparatus as will be hereinafter described and claimed for carrying out the above stated objects and such other objects as will appear from the following description.

A preferred embodiment of the invention

is illustrated in the accompanying drawings, wherein like characters of reference designate corresponding parts, and wherein—

Fig. 1 is a side view, partly in section, of my improved drying apparatus.

Fig. 2 is a vertical section taken on line 2—2 of Fig. 1, looking in the direction indicated by the arrow.

Fig. 3 is a fragmentary sectional view of one of the chutes forming a part of my improved drying apparatus.

Fig. 4 is a detail sectional view taken on line 4—4 of Fig. 3.

Fig. 5 is a side view in elevation of my improved drying tower looking towards the left side of Fig. 1.

Fig. 6 is a cross section of one of the mixing and forwarding members employed in my apparatus.

Fig. 7 is a view, in perspective, of one element embodied in the mixing and forwarding member shown in Fig. 6, and

Fig. 8 is a sectional view, taken on line 8—8 of Fig. 5, illustrating the construction of part of the mechanism for driving the mixing and forwarding members.

The preferred construction of drying apparatus consists, preferably, of a closed drying tower 10 having an inlet port 11 at its upper end and formed at its lower end with a hopper shaped bottom portion 12 provided with a discharge port 13.

The tower 10 may be of any suitable height and encloses one or more inclined chutes over which the material slides by gravity from the inlet port to the discharge port. In the drawings the apparatus is illustrated as being provided with three chutes: a top chute 14, an intermediate chute 15 and a bottom chute 16. Each of the chutes is made up of a plurality of angle bars 17 arranged parallel to each other and secured by means of attaching angles 18 to side members 19. The angle bars 17 are arranged with respect to each other so as to provide a stepped or cataract configuration in cross section; the webs of the angle bars, which provide the surface over which the material slides, being spaced away from the adjacent angle bar so as to provide an

air passage 20 between each pair of angle bars.

The upper end of each chute is rigidified by a relatively wide plate 21 and a cross channel member 22. The chutes are arranged in staggered relation to each other and are hinged at their upper ends to the side walls of the tower so that the inclination of each chute may be varied by moving its lower end toward or away from the wall to which it is hinged. This hinged connection between the chutes and the tower is preferably effected by hooking the channel member 22 of each chute over an associated supporting angle 23 secured to the side wall of the tower.

The desired angular positions of the chutes are maintained by means of separately adjustable mechanism connected with the lower end of each chute. This mechanism is substantially the same for each chute and consists, preferably, of link members 24 secured at 25 to opposite sides of the chute, and connected to associated levers 26 secured to a shaft 27. The shaft 27, in each case, is supported in bearings 29 secured to the sides of the tower and is rotated by means of a gear 30, on the outside of the tower, which meshes with a worm 31 on a shaft 32. The shaft 32 is supported in suitable bearings and may be rotated in either direction by means of crank 33.

In order to give a visual indication of the degree of inclination of each chute, a dial 34 is secured to the outer end of each shaft 27 so as to cooperate with a pointer 35 secured to the wall of the tower.

In order to maintain a substantially uniform distribution of material upon the chutes and thereby effect a thorough mixing and drying of the material, mixing and forwarding devices comprising wheels 36 and 36^a are arranged adjacent the discharge ends of the upper and the intermediate chutes. These mixing and forwarding wheels are so constructed and operated that they receive a quantity of material from the discharge end of one chute, turn it over and discharge it upon the upper end of the chute immediately below it. This device in addition to breaking up the cohering particles of material, operates to forward the material, thereby preventing an undesirable collection of material at the point of transfer from one chute to another.

The mixing and forwarding wheels are each made up of a plurality of channel bars 37 secured to octagon-shaped hubs 38 so that their outwardly projecting flanges provide pockets to receive the material. The wheels 36, 36^a are secured to shaft 39, 39^a and are operated intermittently by means of arms 40, 40^a mounted to oscillate upon the outer ends of the shafts 39, 39^a respectively, and are provided with pivoted dogs 41, 41^a

which engage the teeth of ratchet gears 42, 42^a secured to the shafts 39, 39^a. The arms 40, 40^a are oscillated by means of links 43, 43^a which connect the outer ends of the arms with adjusting crank members 44, 44^a supported on shafts 45, 45^a. The crank devices 44, 44^a are secured rigidly to sprockets 46, 46^a respectively. These sprockets are connected by means of a link belt 47 and are operated simultaneously by means of a suitable driving connection with a sprocket 48 secured to a shaft 45. With the above construction the amount of movement of the mixing and forwarding wheels may be varied by shifting the crank supporting slides 49, 49^a within the retaining members 44, 44^a, so as to shift the position of the crank pins 50, 50^a with relation to the shafts 45, 45^a. When the crank pins above described have been properly adjusted, they may be held in their adjusted position by means of set screws 51 (Fig. 8).

The lower ends of the chutes 14 and 15 are preferably provided with pivoted aprons 52 adapted to permit the chutes to be adjusted relatively close to the forwarding device so as not to form objectionable spaces between the discharge ends of the chutes.

Heated air is introduced into the tower 10 through a pipe 53 near the bottom of the tower and is passed upwardly through the air passages 20 of the chutes and is exhausted through pipe 54 near the top of the tower.

In operation, the material is first comminuted to a relatively fine product and is then introduced into the drying tower through the inlet port 11. The material then slides over the inclined chute 14 and is received by the mixing and forwarding wheel 36. This wheel intermittently delivers the material to the upper end of the chute 15, the material being spilled out of the channel-shaped pockets of the wheel in a thin stream upon the upper end of the chute 15. The material then slides down the chute 15 and is delivered by means of the mixing and forwarding wheel 36^a to the upper end of the chute 16, from which chute it is delivered into the hopper shaped bottom of the tower. The heated air heats the chutes, over which the particles of material slide, and passes through the openings 20 between the angle bar 17 of the chutes. The heated air thereby permeates the material as the latter flows in thin streams over the cascade configuration of the chutes and also passes through the thin film of material as it is spilled out of the pockets of the forwarding wheels 36, 36^a. The forwarding wheels in addition to distributing the material over the entire width of the next chute below, breaks up the cohering particles of material so that each particle of the material will come into contact with the

heated surfaces of the chutes and with the heated drafts of air.

If the material is of such character as to be dried quickly, one or more of the chutes may be adjusted at a suitable angle to increase the velocity of the material. If the material requires a longer period to be properly dried, one or more of the chutes may be adjusted to retard the velocity of the material.

While I have described my invention in one specific embodiment, it will be obvious that various features of construction illustrated in the drawings may be varied without departure from the spirit of my invention. I, therefore, do not wish to be limited to the exact structure shown and described except insofar as specific limitations may appear in the appended claims.

I claim:

1. In apparatus for drying comminuted material, the combination with a closed tower adapted to receive material at the upper end and discharge it at the bottom thereof, of means for passing heated air through the tower in opposition to the movement of the material, inclined chutes over which said material slides by gravity, and means for separately varying the inclination of each of said chutes to vary the velocity of said material comprising, in each case, a shaft, arms fixed on said shaft, links connecting said arms with one of said chutes, a gear fixed to the shaft, a transverse shaft, a worm on said transverse shaft adapted to mesh with said gear, and means for operating said transverse shaft.

2. In apparatus for drying comminuted material, the combination with a closed tower adapted to receive material at the upper end and discharge it at the bottom thereof, of means for passing heated air through the tower in opposition to the movement of the material, inclined chutes hingedly supported at their upper ends to the sides of the tower and provided with a surface of stepped configuration over which the material slides by gravity, and means for supporting the lower ends of the chutes adapted to be separately adjustable to vary the inclination of the chutes so as to vary the velocity of the material.

3. In apparatus for drying comminuted material, the combination with a closed tower adapted to receive material at the upper end and discharge it at the bottom thereof, of means for passing heated air through the tower in opposition to the movement of the material, inclined chutes hingedly supported at their upper ends to the sides of the tower, and consisting, in each case, of a plurality of angle bars spaced apart one above another to provide a series of cascades over which the material slides by gravity and to provide an air passage between each pair

of cascades, whereby the heated air permeates the material as it passes over said chutes, and means for supporting the lower ends of said chutes adapted to be separately adjustable to vary the inclination of the chutes so as to vary the velocity of the material.

4. In apparatus for drying comminuted material, the combination with a closed tower adapted to receive material at the upper end and discharge it at the bottom thereof, of means for passing heated air through the tower in opposition to the movement of the material, inclined chutes arranged one above another over which the material slides by gravity, and a mixing and forwarding wheel adapted to receive the material from the discharge end of one chute and deliver it to the upper end of another chute.

5. In apparatus for drying comminuted material, the combination with a closed tower adapted to receive material at the upper end and discharge it at the bottom thereof, of means for passing heated air through the tower in opposition to the movement of the material, inclined chutes arranged one above another, over which the material slides by gravity, and an intermittently movable mixing and forwarding wheel adapted to receive the material from the discharge end of one chute and deliver it to the upper end of another chute.

6. In apparatus for drying comminuted material, the combination with a closed tower, adapted to receive material at the upper end and discharge it at the bottom thereof, of means for passing heated air through the tower in opposition to the movement of the material, inclined chutes arranged one above another, over which the material slides by gravity and intermittently operated mixing and distributing wheels adapted to receive the material from the lower end of a chute and deliver it to the upper end of an adjacent lower chute.

7. In apparatus for drying comminuted material, the combination with a closed tower adapted to receive material at the upper end and discharge it at the bottom thereof, of means for passing heated air through the tower in opposition to the movement of the material, inclined chutes arranged one above another, over which the material slides by gravity, mixing and distributing wheels formed with a plurality of pockets adapted to receive the material from the lower end of a chute and deliver it to the upper end of an adjacent lower chute, and intermittently operated mechanisms for operating said mixing and distributing wheels comprising a ratchet gear operatively connected with each of said mixing and distributing wheels, oscillating ratchets engaged with said gears, and crank mechanism operatively connected with each of

said ratchets and adapted to impart oscillating movement thereto, said crank mechanism consisting in each case of a sprocket, a crank pin support provided with a slot and a crank
5 pin adjustably supported in said slot.

8. In apparatus for drying comminuted material, the combination with a closed tower adapted to receive material at the upper end and discharge it at the bottom

thereof, of means for passing heated air 10 through the tower in opposition to the movement of the material, an inclined chute in said tower formed with a series of steps providing cascades over which the material slides, and means for varying the inclina- 15 tion of said chute.

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