June 1, 1943. F. M. SMITH 2,320,755

REFINING APPARATUS

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Fig. 1.

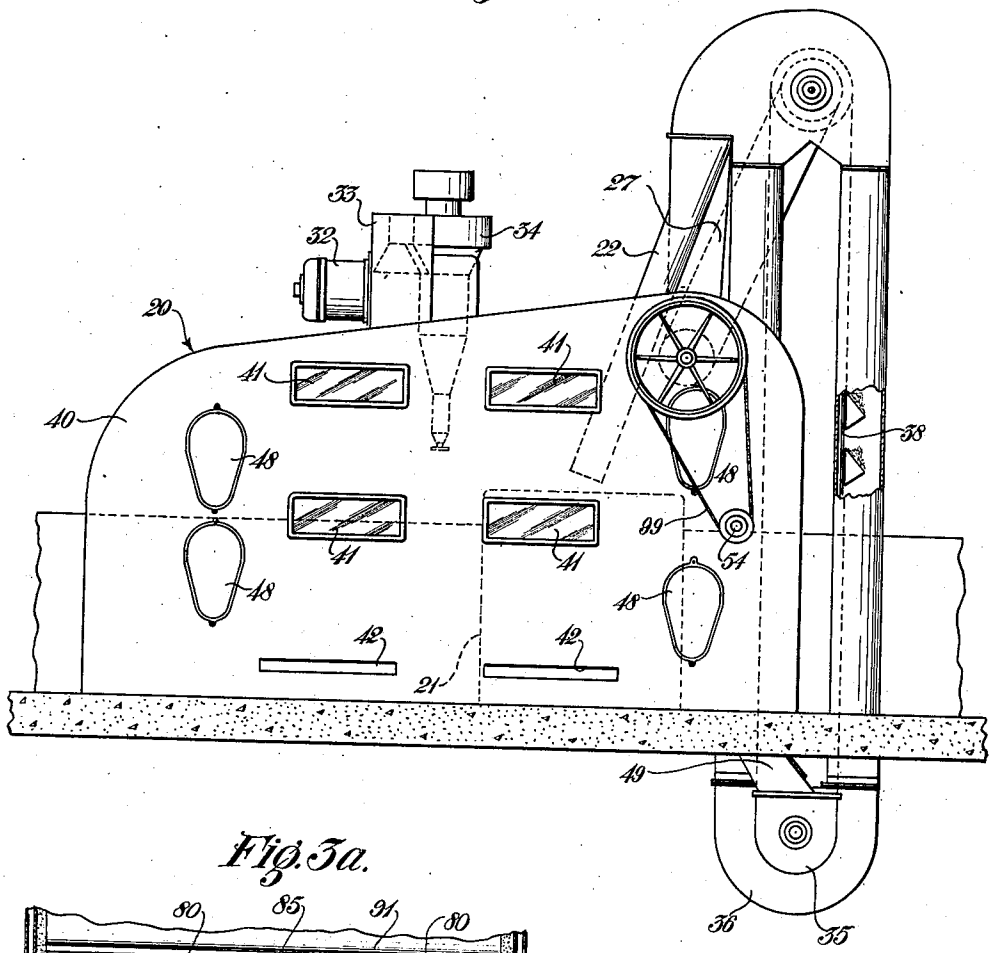
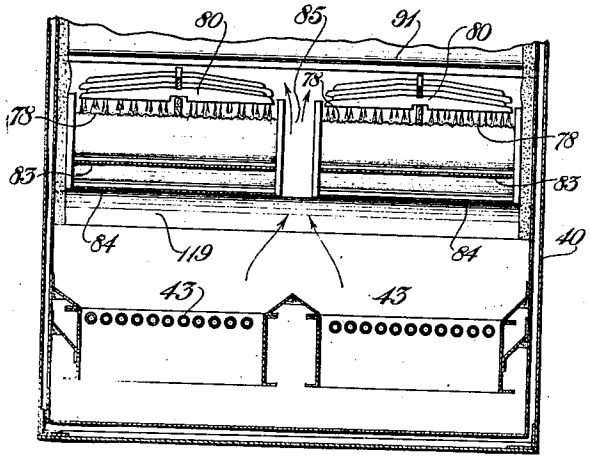


Fig. 3a.



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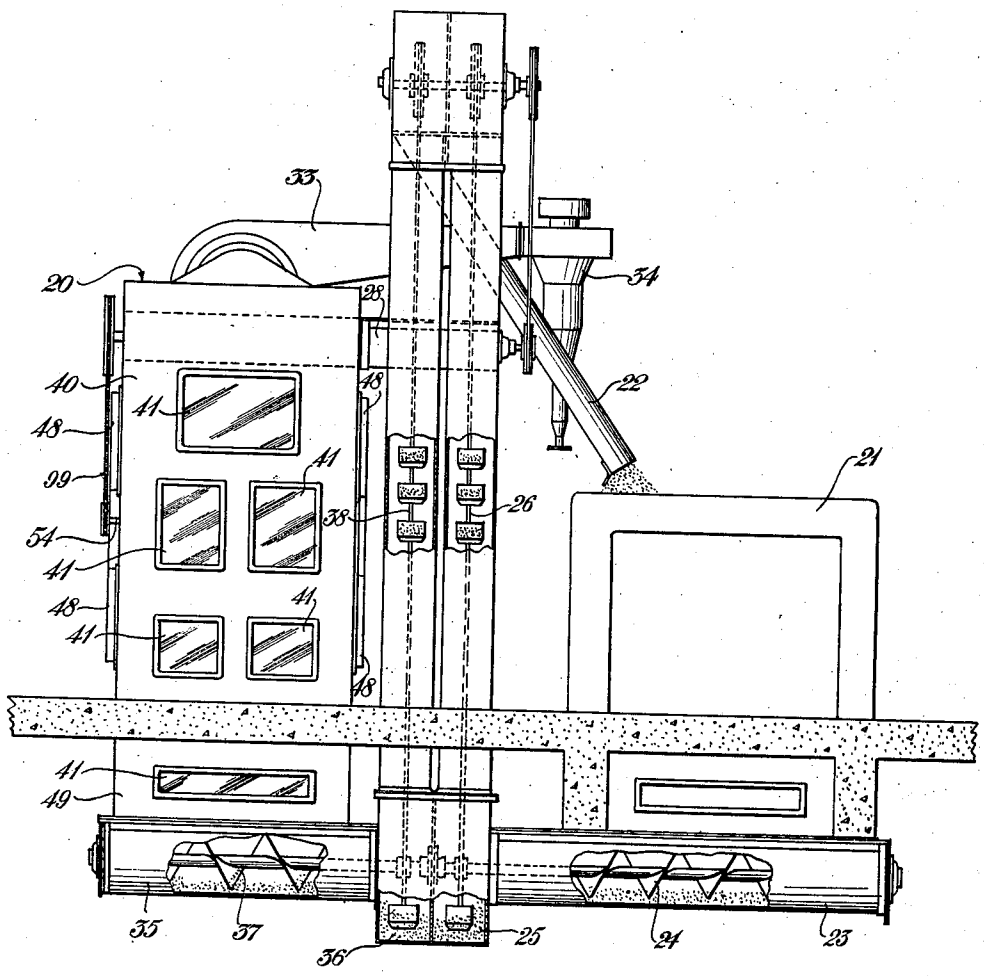
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REFINING APPARATUS

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Fig. 2.



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REFINING APPARATUS

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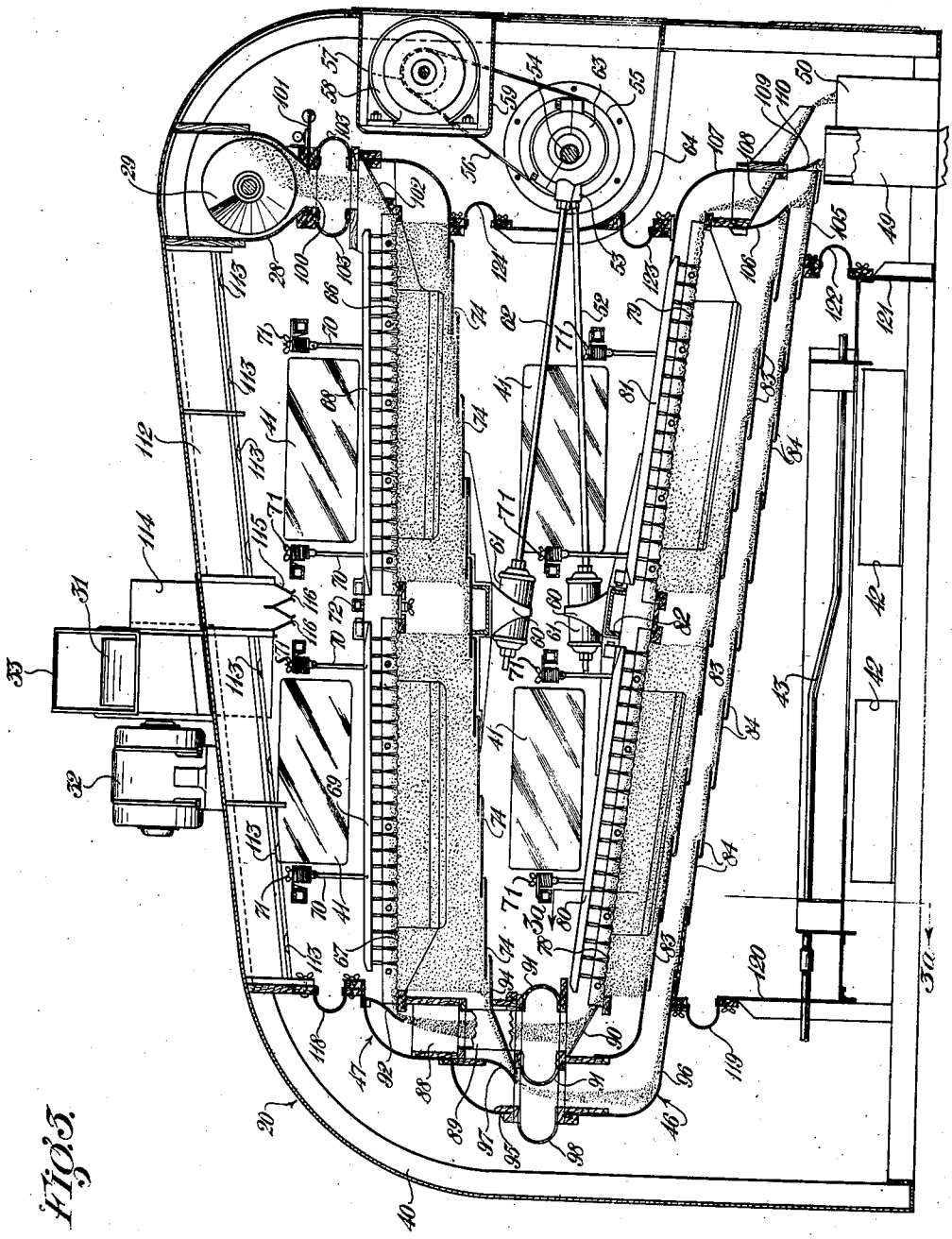


FIG. 3.

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REFINING APPARATUS

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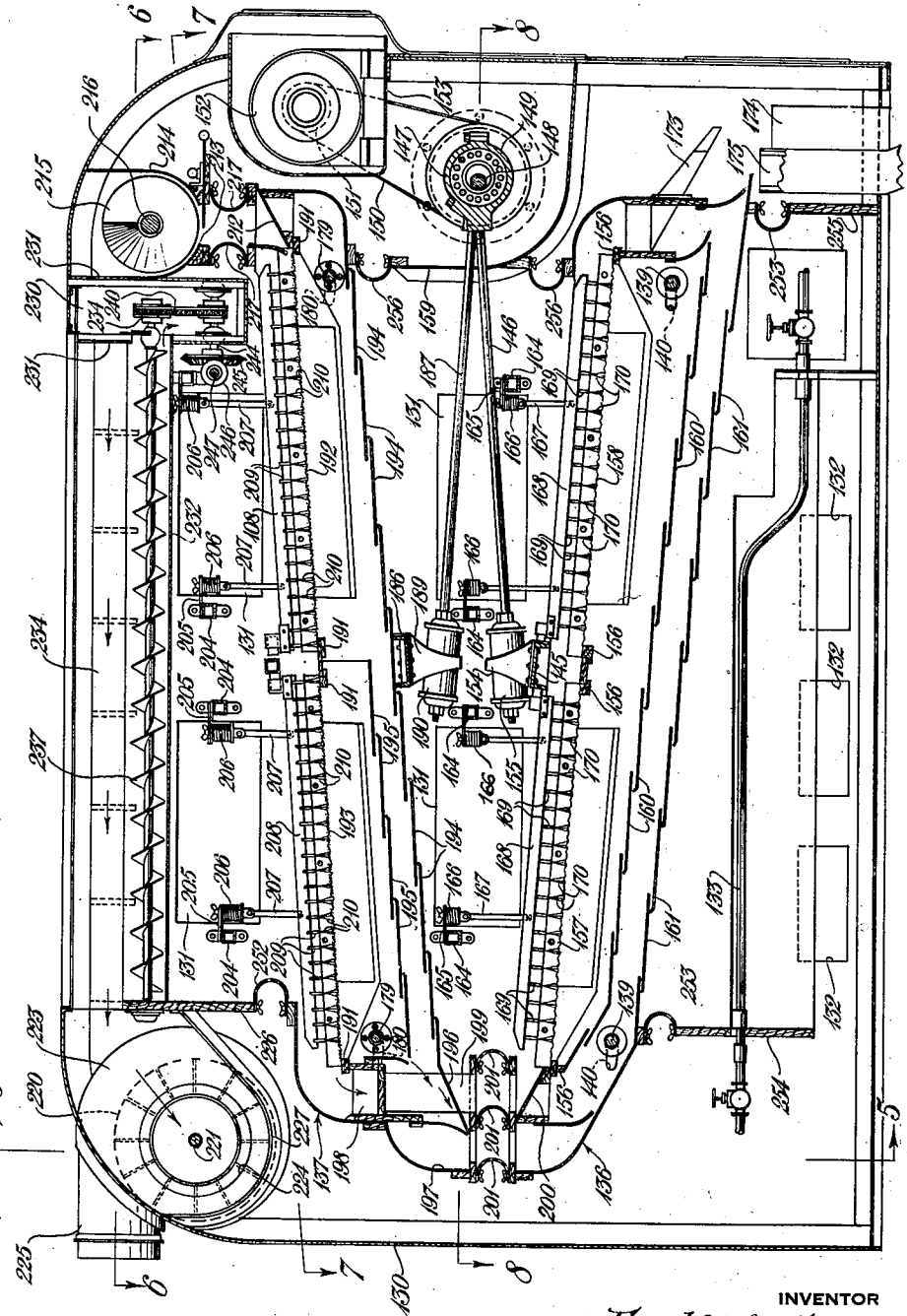


Fig. 4.

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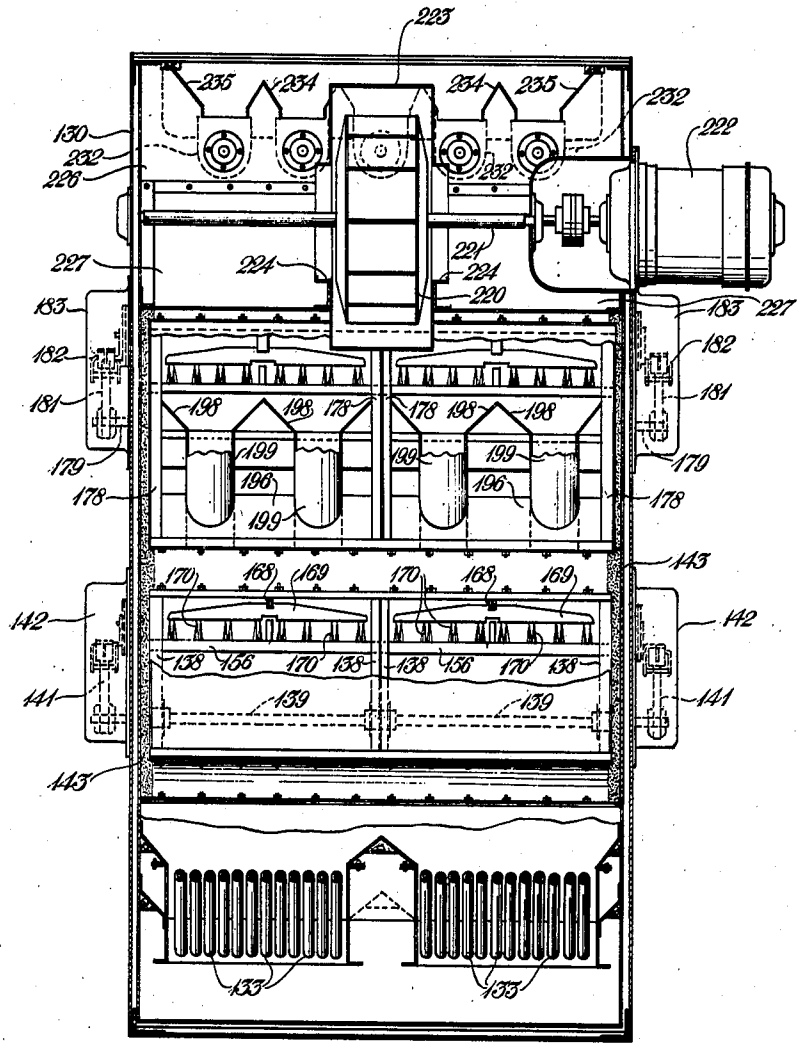
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REFINING APPARATUS

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Fig. 5.



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REFINING APPARATUS

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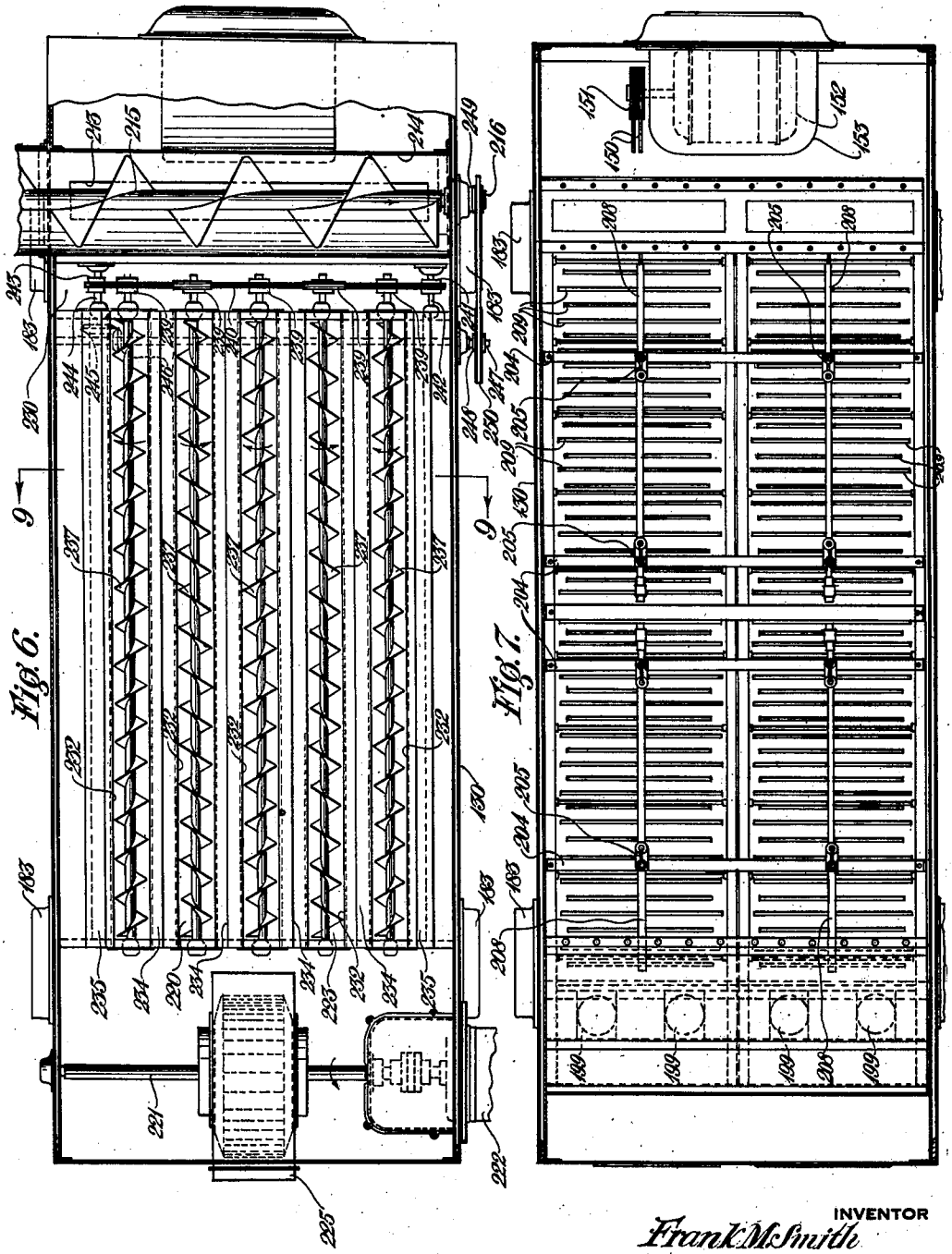


Fig. 6.

Fig. 7.

INVENTOR

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REFINING APPARATUS

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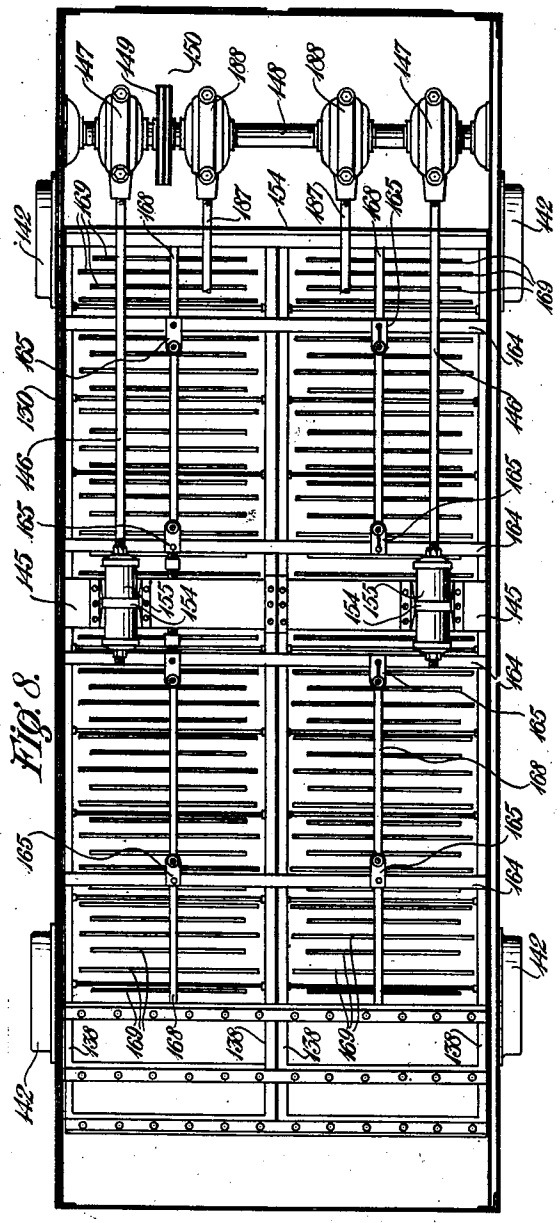


Fig. 8.

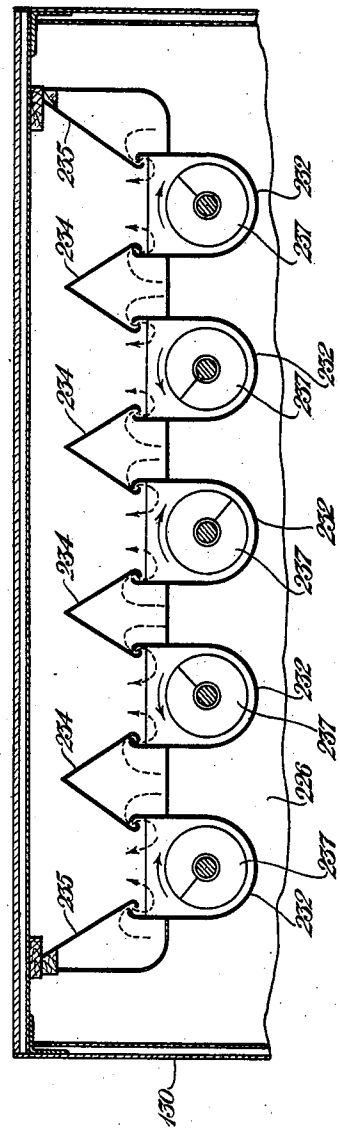


Fig. 9.

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REFINING APPARATUS

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FIG. 11.

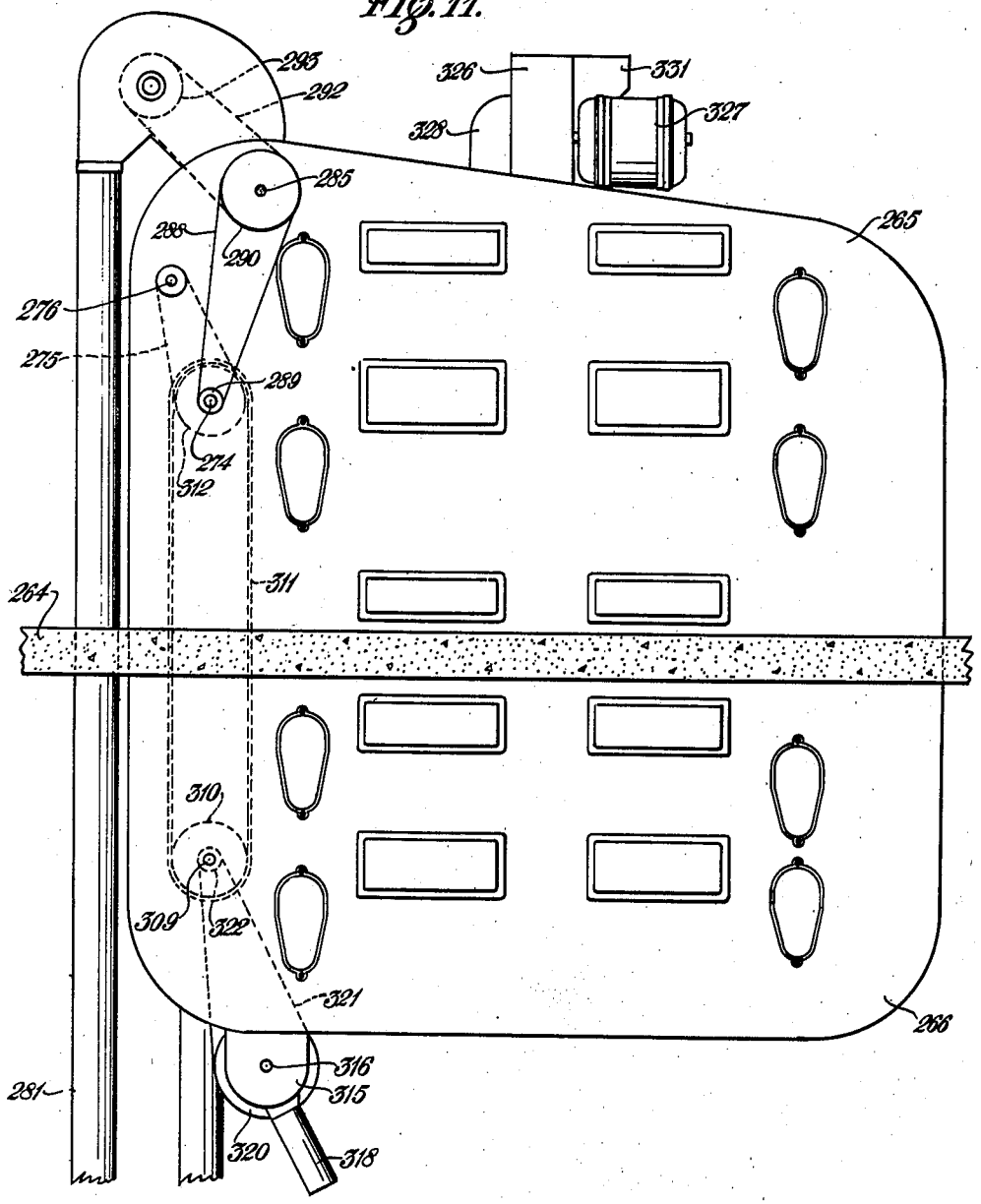
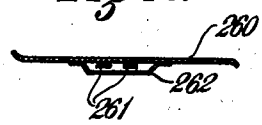


FIG. 10.



INVENTOR

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BY Clyde & Frye

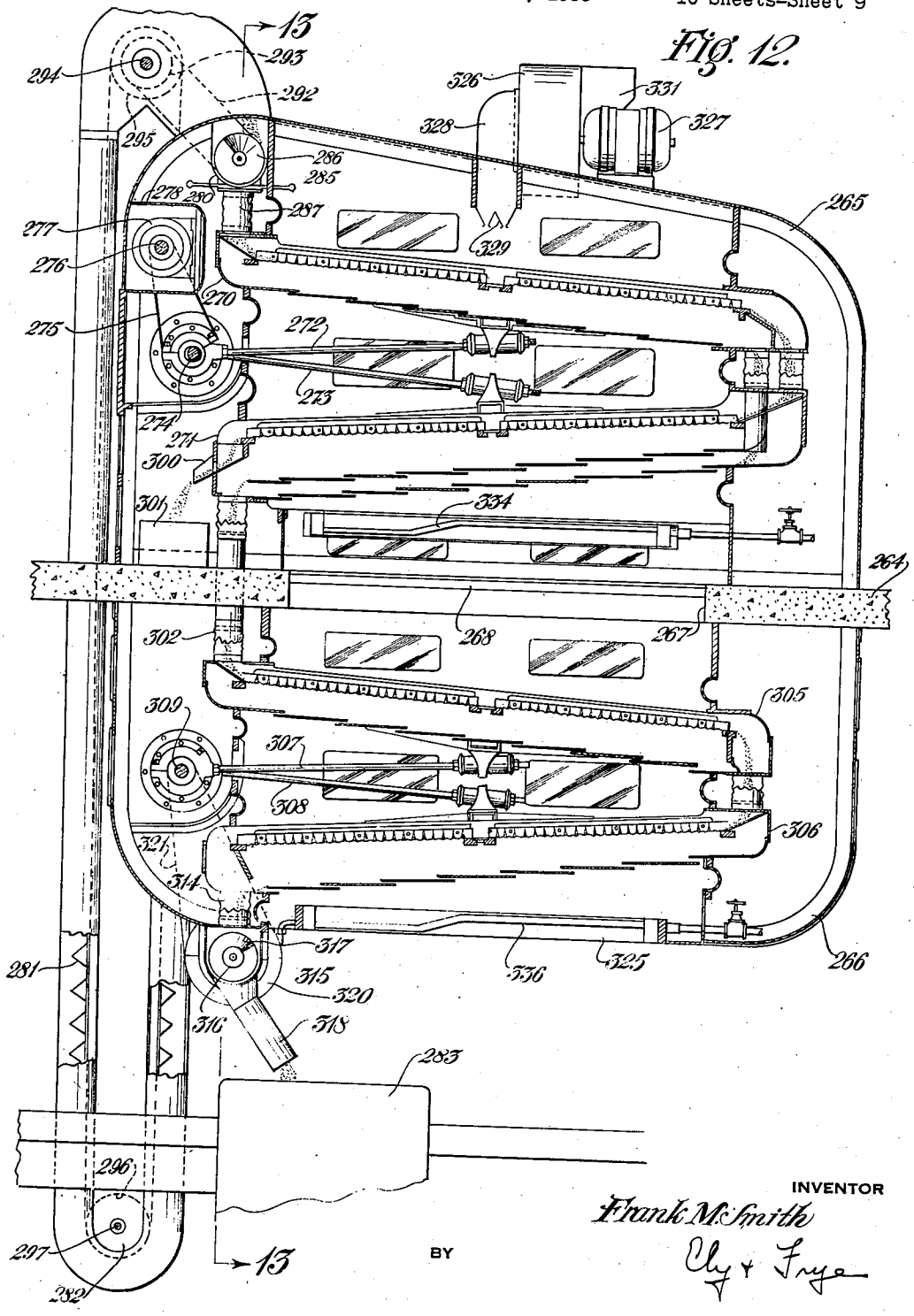
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June 1, 1943. F. M. SMITH 2,320,755

REFINING APPARATUS

Filed June 12, 1939 10 Sheets-Sheet 9

Fig. 12.



INVENTOR

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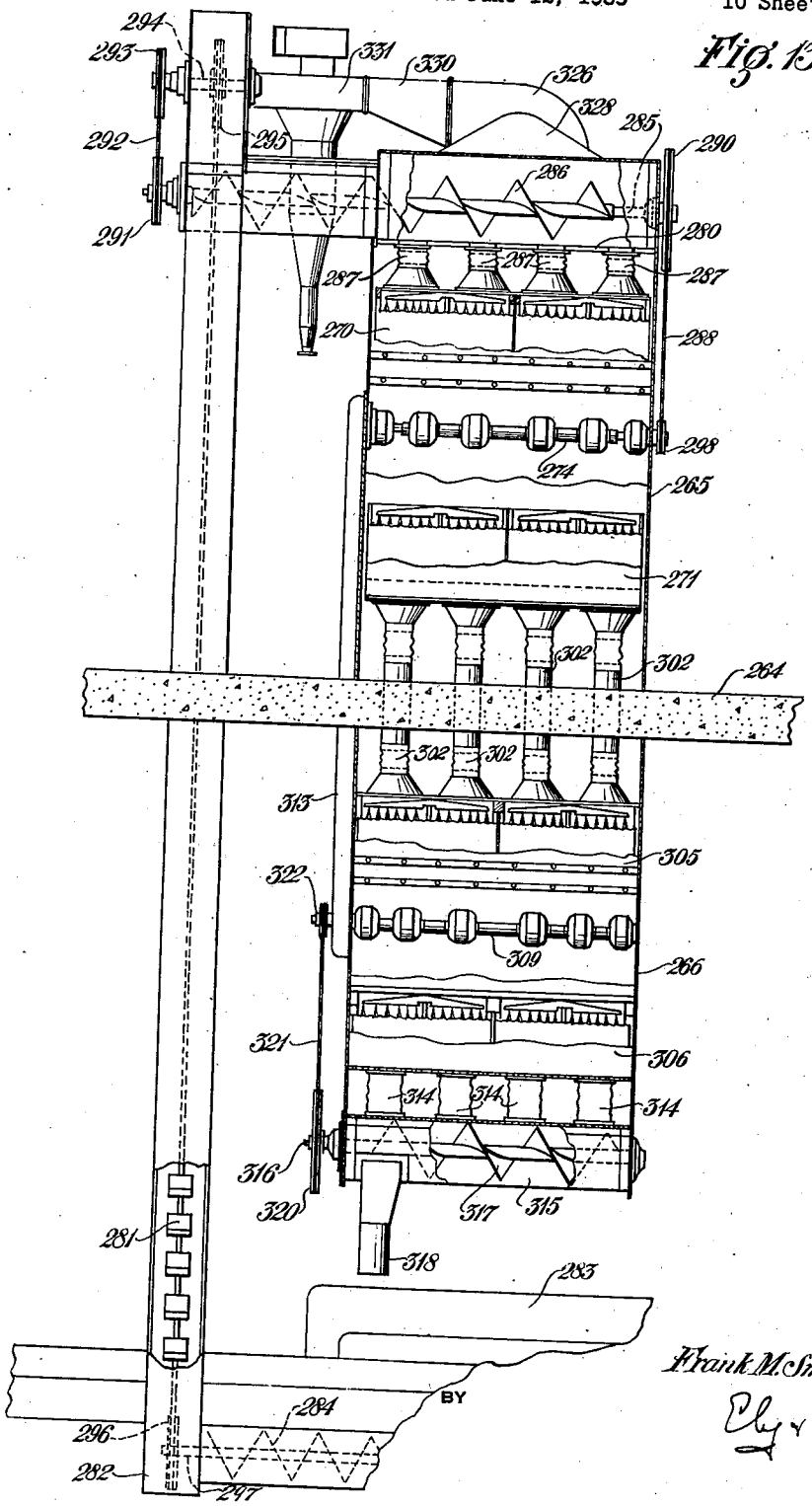
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June 1, 1943. F. M. SMITH 2,320,755

REFINING APPARATUS

Filed June 12, 1939 10 Sheets-Sheet 10

Fig. 13.



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Patented June 1, 1943 2,320,755

UNITED STATES PATENT OFFICE

2,320,755

REFINING APPARATUS

Frank M. Smith, Chicago, Ill.

Application June 12, 1939, Serial No. 278,600

7 Claims. (Cl. 209—21)

This invention relates to refining methods and apparatus, and more especially it relates to improved procedure and improved apparatus for refining pulverulent or granular material.

For the purpose of illustration, the invention is shown herein in its application to the refining of powdery starch. The refining of starch is of great utility in the candy industry where shallow wooden trays of powdered starch are impressed with intaglio designs and then used as matrices for the forming and aging of fondant centers, the latter subsequently being coated or covered with chocolate or other edible confection. The starch is used over and over, and each time after the candy centers are removed, the starch requires to be refined to remove therefrom any dirt, dust, wood splinters, and candy particles, and to reduce any starch lumps to particle size that is substantially uniform with the remainder of the starch, or to remove said lumps entirely. In the present invention the starch not only is refined, but is given the proper temperature and proper moisture content required for most efficient use in the manufacture of candies of various kinds and consistencies.

The chief objects of the invention are to provide in a superior manner for the cleaning, drying, and conditioning of pulverulent material; to provide apparatus for the foregoing purpose that will operate efficiently at relatively high speed so as to have a large capacity; to provide apparatus wherein the material being treated is concurrently screened and aerated; to provide apparatus of the character mentioned wherein the same medium is used for cooling the material that is used for heating and drying the same; to provide apparatus of the character mentioned wherein the escape of material is prevented, thus making for improved working conditions; and to provide connections between relatively moving elements within the apparatus, which connections do not require to be lubricated. Additional objects include the provision of apparatus that has few moving parts; that will have low maintenance cost; that will be noiseless in operation; that is readily synchronized to operate with a "mogul"; and that will be safe to operate. Other objects will be manifest as the specification proceeds.

Of the accompanying drawings:

Figure 1 is a side elevation of a starch handling apparatus comprising one embodiment of the invention;

Figure 2 is a front end elevation thereof as viewed from the right of Figure 1, parts being broken away to reveal a portion of the mechanism thereof;

Figure 3 is a vertical section of the refining and drying unit of the apparatus shown in Figures 1 and 2, and the work therein;

Figure 3*a* is a transverse vertical sectional detail taken on the line 3*a*—3*a* of Figure 3;

Figure 4 is a section similar to Figure 3 of an improved refining and drying unit constituting another embodiment of the invention;

Figure 5 is a section, on a larger scale, on the line 5—5 of Figure 4;

Figure 6 is a section on the line 6—6 of Figure 4;

Figure 7 is a section on the line 7—7 of Figure 4;

Figure 8 is a section on the line 8—8 of Figure 4;

Figure 9 is a section, on a larger scale, on the line 9—9 of Figure 6;

Figure 10 is a detail sectional view through a modified cascade plate such as is used on the vibratory structures of the refining apparatus;

Figure 11 is a side elevation of another embodiment of the refining and drying unit of the apparatus;

Figure 12 is a vertical longitudinal section therethrough; and

Figure 13 is a vertical transverse section through the refining unit taken on the line 13—13 of Figure 12.

Referring to the drawings, the complete apparatus shown in Figures 1 and 2 comprises a refining and drying unit, generally designated 20, and a "mogul" 21. The latter is an apparatus that is in common use in the candy industry, and since the present invention only indirectly relates thereto, only a brief description thereof need be given. Refined powdered starch is delivered to the top of the "mogul" 21 through a chute 22. Interiorly of the "mogul" the starch is deposited in trays and impressed with intaglio designs that subsequently are filled with fondant, the latter operation being effected after the trays are removed from the "mogul." After the fondant has "set" or aged, the trays, containing the starch and fondant pieces, are emptied within the "mogul" where separation of the starch and fondant pieces is effected, the latter then being removed therefrom for further treatment. The used starch from the trays, which at this time may be dirty and lumpy and contain particles of fondant, falls into a trough 23 in the bottom of the "mogul," in

which trough is a driven feed screw 24 that impels the starch longitudinally thereof out of the "mogul," and delivers it into a hopper 25. Operating within the hopper is a driven, endless, bucket elevator 26 that removes the dirty starch from said hopper, carries it to an elevated position, and dumps it into a chute 27 that extends downwardly to a trough 28 that extends to the interior of the refining unit 20, there being a driven feed screw 29, Figure 3, located in said trough for impelling the starch longitudinally thereof into said refining unit. The details of the refining unit presently will be described.

Dirt, dust, lint, and other lighter than air impurities in the starch are removed therefrom in the refiner 20 by means of air currents that are induced by means of a suction fan 31 in communication with the interior of the refiner at the top thereof, said fan being driven by a motor 32. Air withdrawn from the refiner by the fan 31 is discharged thereby into a duct 33 that extends to the usual cyclone separator 34 wherein the dirt and other foreign matter is removed from the air, the latter then passing to the atmosphere. The starch, after being refined in the apparatus 20, flows into a trough 35 at the bottom thereof, which trough extends to a hopper 36 exteriorly of the refiner, there being a driven feed screw 37 in said trough for impelling the starch longitudinally thereof to said hopper. Operating within the hopper 36 is a driven, endless, bucket elevator 38 that removes the refined starch from said hopper, carries it to an elevated position, and dumps it into the receiving end of the chute 22 hereinbefore mentioned, whereby it is returned to the "mogul" 21 for re-use as described. This cycle of use, followed by refining of the starch, is repeated as long as the apparatus operates.

Referring now to Figure 3 of the drawings, it will be seen that the refining unit 20 of the apparatus comprises a substantially closed housing 40 that is provided at suitable regions with glazed doors 41, 41 through which the operation of the refiner may be observed, and which provide access to the interior of the housing when necessary or desired. Adjacent the bottom of the housing the lateral walls thereof are formed with openings or ports 42, 42 through which air for refining the starch is drawn. Interiorly of the housing 40, near the bottom thereof, are heating coils 43 that are heated by means of steam supplied from any convenient source (not shown).

Positioned above the coils 43 is a vibratory structure generally designated 46, and positioned above the latter, in spaced relation thereto, a second vibratory structure designated 47, said structures being adapted to sift or screen powdered starch that passes therethrough and thereover as will be explained. For pendulously supporting said vibratory structures, portions thereof (not shown) project through apertures in the respective lateral walls of the housing and are engaged by flexible hangers (not shown) that are secured to the exterior of the housing, said hangers and apertures being enclosed by cover plates 48, 48, Figures 1 and 2, so that the housing is dust-proof. The vibratory structures 46, 47 extend transversely of the housing from one side thereof to the other, and suitable packing, such as woolskin (not shown) may be interposed between the sides of said structures and the lateral walls of the housing to prevent the passage of air therebetween. The ends of the vibratory structures are spaced somewhat from the end walls (front and rear) of the housing, and said structures are somewhat longitudinally inclined so that the starch will move longitudinally thereof toward their lower ends as the result of the vibration thereof. Thus, the starch is fed onto the upper structure 47 at the upper end thereof, whence it moves to the lower end thereof and passes therefrom onto the adjacent end portion of lower structure 46, which is the uppermost end of the latter. After traversing the length of the structure 46, the starch, now separated into refined stock and tailings, passes therefrom and falls by gravity, the refined stock into a chute 49 that extends to the trough 35 previously described, the tailings into a suitable receptacle 50 for subsequent disposal.

For effecting vibration of the vibratory structure 46, the framework thereof is connected to the free end of a pitman 52 that has its other end connected to an eccentric 53 mounted upon a driven shaft 54 that is journaled in the housing 40. The shaft 54 is provided with a pulley 55 that is connected by a belt 56 to a pulley 57 that is mounted upon the shaft of an electric motor 58, the latter being mounted in a dust-proof compartment 59 within said housing. The pitman 52 is connected to the vibratory structure 46 by means of a flexible connection that comprises a metal bracket 60 secured to the top of framework of the vibratory structure, and a flexible sleeve of rubber or other suitable material 61 carried by said bracket, the pitman 52 being secured in said sleeve. The arrangement is such as to enable the pitman to move angularly relatively of the bracket and frame-work, and the connection does not require lubrication such as might become fouled by the dust that is prevalent within the refiner. In like manner the framework of the upper vibratory structure 47 is provided at its bottom with an identical flexible connection to which is connected one end of a pitman 62, the other end of the latter being connected to an eccentric 63 on the shaft 54. The arrangement enables both vibratory structures 46, 47 to be reciprocated in a direction that is longitudinal with relation to the housing, whenever the motor 58 is in operation. The shaft 54 and eccentrics 53, 63 thereon are substantially enclosed by a wall 64 that is suitably apertured to enable the pitmans 52, 62 to extend therethrough.

The upper vibratory structure 47 comprises a pair of sieves or screens 66, 67 of which screen 66 covers substantially the upper end portion of the structure and screen 67 cover substantially the lower end portion thereof, the arrangement being such that the dirty starch fed into the refiner through trough 28 falls first onto screen 66. The screen 66 is of finer mesh than screen 67, being 24 to 28 meshes to the inch whereas screen 67 is but 20 to 22 meshes to the inch. The reason for the differential screen mesh subsequently will be explained. Vibration of structure 47 causes the starch, deposited thereon at the upper end thereof, to move longitudinally thereof to its lower end some of the starch sifting through the screen and falling therefrom. The starch on the screens 66, 67 contains many lumps too large to pass through the mesh, and to assist in breaking up such lumps, brush units 68 and 69 are positioned over the respective screens. The brush units 68 and 69 are pendulously supported above the screens on the free ends of a plurality of pivotally mounted arms 70, 70 that are swingable to a limited extent in the direction of the reciprocating movement of the vibratory structure. An abutment member

72 extends transversely of the housing between the adjacent ends of the brush units, said member serving to limit the swinging movement of said brush units, as has been found desirable. Adjustment means shown at 71, 71 is provided for positioning the brush units in optimum proximity to the screens, the ends of the bristles usually being about ¼ in. to ½ in. above the screen at the upper or receiving end of the structure, and somewhat closer at the lower or delivery end thereof. Preferably the bristle tufts of the brushes are arranged in transversely disposed rows with the tufts of adjacent rows in staggered relation to each other. The arrangement is such that as the vibratory structure 47 is reciprocated, the bristles of the brush units 68, 69 engage the starch on the screens 66, 67 and assist in breaking up any small lumps therein.

Also carried by the upper vibratory structure 47 are a plurality of plates 74, 74 that extend transversely of the structure from one side thereof to the other below the screens 66, 67. The plates 74 are arranged in imbricated or overlapping relation, and the series of plates is so inclined that powdery starch, dropping thereon from said screens, will flow by gravity to the lower end of the series of plates as the structure 47 is reciprocated. As shown in Figure 3, the uppermost margin of each plate 74 underlies the lowermost margin of the adjacent plate, said uppermost, underlying margins being upturned toward the overlying plate, but spaced therefrom sufficiently to permit the passage of air therebetween.

The lower vibratory structure 46 is essentially similar to structure 47, but is inclined in the reverse direction to the latter, its higher end being adjacent the lower end of structure 47. The structure 46 comprises screens 78, 79 of which screen 78, at the higher end thereof, is 20 to 22 meshes to the inch and screen 79, at the lower end thereof, is 24 to 26 meshes to the inch. Brush units 80, 81 are positioned above the respective screens 78, 79, said brush units being mounted in the same manner as brush units 68, 69, and serving the same function, there being an abutment or bumper 82 positioned between the adjacent ends of the brush units to limit the swinging movement thereof. Below the screens 78, 79 the structure 46 carries an inclined series of laterally overlapping plates 83, 83 that are identical to plates 74 of the structure 47. Below plates 83 and parallel thereto is a second series of overlapping plates 84, 84 that are identical with plates 74 and plates 83.

As is shown in Figure 3a, the lower vibratory structure 46 is centrally divided longitudinally to provide a flue 85 through which a portion of the heated air from coils 43 may ascend to the upper vibratory structure without being required to pass through the lower plates 83, 84 and screen 78.

At the lower or delivery end of the vibratory structure 47 is a covered trough 88 into which the unscreened starch falls as it passes off the delivery end of screen 67, and extending downwardly from trough 88 is a plurality of spaced apart tubular chutes, such as the chute 89, that remove the starch from said trough. Below the chutes 89, the vibratory structure 46 carries an inclined deflector plate 90 upon which starch from the chutes 89 falls, to be diverted thereby onto the upper end of screen 78. Flexible rubber walls 91, 91 span the space between the lower end of chutes 89 and the adjacent portion of structure 46, thus enclosing the space through which the starch falls, yet enabling relative movement between the structures 46, 47 due to reciprocation thereof. Preferably there is a flexible rubber apron 92 at the delivery end of the screen 67, the starch passing under said apron to flow into the trough 88. At the lower or delivery end of the series of overlapping plates 74 is a plate 94 onto which the screened starch flows from the lowermost plate 74, said plate extending between the several chutes, and being downwardly inclined, the delivery margin of said plate 94 being disposed in a covered spout 95, rearwardly of the rearmost flexible wall 91. Below the spout 95 the lower vibratory structure 47 is formed with a curved, downwardly inclined wall 96, the lower end of which overlies the uppermost plate of the lower series of plates 84. A flexible depending apron 97 rests against the lower end of plate 94, the sifted starch passing under said apron to flow into spout 95. A flexible rubber wall 98 connects the lower end of spout 95 to the adjacent wall of structure 46, thus enclosing the course of the starch that flows from said spout, said flexible wall enabling relative movement of the two vibratory structures. The arrangement is such that the unsifted starch from the screens of the upper vibratory structure 47 flows onto the screen 78 of the lower vibratory structure, the sifted starch from the plates 74 of the upper structure flowing onto the lower plates 84 of the lower vibratory structure.

As previously stated, the dirty starch is fed into the refiner 20 by the feed screw 29 operating within trough 28, said feed screw being driven from shaft 54 by means of an interposed sprocket chain 99, Figures 1 and 2. Interiorly of the refiner housing 40 the trough 28 is positioned above the uppermost or work-receiving end of the upper vibratory structure 47, the bottom of the trough having a longitudinally extending opening or slot 100 therein for the starch to fall through. Said opening 100 is provided with a slidably mounted closure member 101 by means of which the width of the opening may be varied. Below the trough 28 the upper end of the vibratory structure 47 is provided with an inclined plate 102 upon which starch falling from the said trough will strike, the lower margin of plate 102 being positioned at the upper end of screen 66 so that the starch flows onto the latter. Flexible rubber walls 103, 103 connect the bottom of trough 28, at each side of opening 100 therein, with the top of structure 47, thereby enabling relative movement of the trough and vibratory structure without interference to the flow of starch therebetween.

At the lower end of the lower vibratory structure 46, the end plate 105 of the lower series of plates 84 extends beyond the end plate of the series of plates 83, so that the screened starch falling from end plate 83 drops upon end plate 105. The lowermost or delivery margin of the latter is positioned over the open upper end of chute 49 previously described, with the result that the refined starch falling thereinto is conducted out of the refiner. A flexible apron 106 rests against the lowermost margin of the lower plate 83 so that the screened starch passes thereunder in flowing off said plate. A similar flexible apron 110 rests against the delivery edge of end plate 105. A delivery end of structure 46 also is formed with a covered trough 107 arranged to receive the tailings that flow thereinto from the lowermost end of screen 79, said trough 107 having an in-

clined bottom 108 that discharges into a downwardly inclined spout 109, the latter having its delivery end positioned over the receptacle 50 previously described.

Positioned in the top of the housing 40 is a duct 112 formed in the bottom of its structure with a plurality of inlet ports 113, 113 through which air, from the interior of the housing, is drawn. At its middle the duct 112 communicates with the intake side of suction fan 31 through the agency of a duct 114. At the juncture of ducts 114, 112, the bottom of the latter is formed with a depressed region 115 in the bottom of which are two normally closed valves 116, 116 that open when a determinate quantity of material rests thereon, said material being powdery material dropping from the stream of air that is moving into duct 114. There is a flexible rubber wall 118 between the lower end of duct 112 and the lower end of vibratory structure 47, and there is a similar flexible wall 119 between the upper end of vibratory structure 46 and the top of a low partition 120 at the adjacent end of the heating coils 43. There is a low partition 121 at the opposite end of said heating coils, and a flexible wall 122 connecting the top of said partition with the lower end of lower vibratory structure 46. The wall 64 that partly encloses the shaft 54 and eccentrics 53, 53 is connected by a flexible wall 123 to the top of adjacent lower vibratory structure 46, and is connected by flexible wall 124 to the bottom of adjacent upper vibratory structure 47. The function of the several flexible walls described is to confine the air current in the refiner so that it follows a determinate course.

In the operation of the refiner motors 32 and 58 are constantly driven, and the coils 43 are heated by the admission of steam thereto. Motor 32 drives suction fan 31 and thus creates a rising current of air that enters the housing 40 through the ports 42 near the bottom thereof, and immediately passes over coils 43 whereby it is warmed to the desired temperature, the air being withdrawn from the housing through duct 112. Motor 58 drives shaft 54, thereby rotating eccentrics 53 and 63, with the result that upper and lower vibratory structures 46, 47 are longitudinally reciprocated. Motor 58 also effects the rotation of feed screw 29, through the agency of drive-chain 99, so that dirty starch, delivered to trough 28 therefrom chute 27, is fed into the refiner, said starch falling through the slot 100 in the bottom of said trough and being diverted by the inclined plate 102 onto the receiving end of screen 66 of the upper vibratory structure 47. As the latter vibrates, the starch is caused to flow by gravity toward the lower end thereof, thus passing over screen 67. As the starch flows over said screens, the fine particles thereof sift through and fall onto the overlapped plates 74 therebeneath, and the inclination of said plates and the vibratory movement thereof causes the sifted starch to flow by gravity to the lower end of the series of plates, the starch cascading over the gaps that are present between the plates.

At the lower end of vibratory structure 47, the unscreened starch on screen 67 falls therefrom and passes through trough 88 and chutes 89, being diverted by inclined plate 90 at the bottom of the latter into the upper or receiving end of screen 78 of the lower vibratory structure 46. The screened starch from the plates 74 passes through spout 95 and flows onto the upper end of the series of overlapping plates 84. Vibration of structure 46 causes the unscreened starch to flow over screens 78, 79 to the lower end of the latter, the starch that sifts through the screens falling onto the overlapping plates 83. At the lower end of screen 79 the tailings flow through chute 109 into receptacle 50. The sifted starch on plates 83 flows therefrom onto end plate 105, where it mixes with the starch from plates 84 and passes into the chute 49 which removes it from the refiner.

As the starch moves along the vibrating screens 66, 67, 78 and 79, the reciprocatory swinging movement of the latter causes the starch on the screens to engage the bristles of the brushes 68, 69, 80 and 81, the latter thus serving to break up small balls of the starch. Furthermore, the staggered arrangement of the tufts of brush bristles causes the starch to be moved transversely back and forth on the screens, thus producing more effective screening and increasing the capacity of the refiner. The brushes are so set that they engage the starch but not the screens that carry the starch, the arrangement preventing the clogging of the screens by the forcing of starch therethrough.

As the starch is being subjected to the foregoing mechanical treatment, the suction fan is drawing air into the housing 40 through the openings 42 near the bottom thereof, which air moves upwardly within the housing and passes therefrom through the duct 112 in the top thereof. The air upon entering the housing first passes about the steam heated coils 43 and is warmed thereby to the temperature best suited for the drying of the starch. As the heated air moves upwardly from the coils 43 it passes between the plates 84 of the lower series of overlapping plates, and the plates 83 of series immediately above the latter. Since the screened starch is falling or cascading from each plate to the succeeding lower plate, the air current of necessity passes through falling powdery starch and aerates, dries, and heats the starch. Continuing its rise, the heated air moves counter to the sifted starch falling from the screens 78, 79, thereafter passing through the screens 78, 79 and brushes thereabove where it exercises a similar function upon any starch upon said screens. The rising air next encounters the plates 74, screens 66, 67, and brushes 68, 69 of the upper vibrating structure 47 where it picks up therefrom lighter particles, such as dust, lint, wood fibre and the like, and also initiates the aerating, drying, and heating of the starch. The arrangement is such that the sifted starch and the tailings are delivered into the chute 49 and receptacle 50 respectively, and the sifted starch is free of foreign particles and is dried and heated to the extent that it is ready for immediate re-use in the "mogul" 21 to which it passes. At the top of the housing, the air, laden with the lighter particles, passes into the duct 112 through the openings 113 in the bottom thereof, and is impelled by the fan 31 into the cyclone 34 where it is cleaned in the usual manner and discharged to the atmosphere. Particles dropped by the air current in ducts 112 and 114 collect in the depressed region 115 and periodically are dumped back into the refiner by the valves 116. Because the apertures 113 in the duct 112 are of smaller capacity than the capacity of the duct, the current of air is throttled or slowed down at these points, causing the air current to drop light particles of starch that it may be carrying. The several flexible transverse walls within the housing confine the starch and the air currents to a local

region, with the result that the housing is dust-tight, and the motor and other moving parts are not fouled by powdery material. Working parts that are exposed to dust, such as the flexible connections between pitmans 52, 62 and the respective vibratory structures, are so constructed as not to be susceptible to fouling by dust. The feature of having the screen 66 of finer mesh than the other screens is for the purpose of keeping the starch on the screen for a longer interval in order that it may be more widely distributed over the screen, whereby improved drying of the starch is effected. The relatively fine mesh of the screen 79 is for the purpose of retarding the air passing therethrough, there being relatively little starch normally on this screen.

Since the feed screw 29 and the eccentric shaft 54 are both driven by the same motor 58, it will be apparent that the vibratory cycle of the structures 46, 47 is in direct ratio to the speed of feed of starch into the refiner through trough 28, with the result that the apparatus readily may be speeded up or slowed down to handle various quantities of starch. Furthermore, the speed of the fan 31 may be regulated to control the flow of air through the refiner, and the temperature of the air also is controllable by means of the heating means described. The invention provides an improved apparatus in which starch is refined by heating, drying and aerating, and it also achieves the other objects set out in the foregoing statement of objects.

Referring now to Figures 4 to 9, inclusive, of the drawings, there is shown another embodiment of the invention that differs in some respects from that previously described, especially in the means for collecting the dirt-laden air and conducting it from the housing. This embodiment of the invention comprises a housing 130 which may have lateral walls of double thickness, including thermal insulation therein, if desired, for conserving the heat within the housing. The housing is provided with the usual glazed doors 131, 131, and adjacent its bottom is formed with openings or ports 132, 132 through which air for refining the starch is drawn into the housing. Interiorly of the housing, near the bottom thereof, are heating coils 133, 133 that are heated by steam supplied from any convenient source of supply (not shown).

Positioned above the heating coils 133 is a vibratory structure, generally designated 136, and positioned above the latter, in spaced relation thereto, is a second vibratory structure 137, said structures being substantially similar to the vibratory structures 46, 47 previously described, and for the same purpose. As is best shown in Figures 4, 5 and 8, the vibratory structure 136 is composed of two identical units disposed side by side, each of said units comprising vertically disposed lateral frame members 138, 138. All of said frame members are supported upon a pair of transversely disposed rods 139, 139 that are positioned at the opposite ends of the structure, and which extend through respective arcuate slots 140, 140 in the opposite lateral walls of the housing 130. Exteriorly of the housing the projecting ends of the rods 139 are attached to the free, lower ends of respective flexible hangers 141, preferably constructed of rubber, the upper ends of said hangers being fixedly secured to suitable brackets mounted upon the exterior of the housing. The hangers, and the slots 140 in the housing walls, are enclosed by cover plates 142, 142. Preferably layers of woolskin 143 are interposed between the lateral frame members 138 and the inner surface of the housing to prevent the passage of air and powdered starch therebetween.

For effecting vibration of the structure 136, the tops of the respective units thereof are provided with respective transversely disposed members 145 that are connected to the free ends of respective pitmans 146, 146, the other ends of the latter being connected to respective eccentrics 147, 147 that are mounted upon a driven shaft 148 that is journaled in the housing 130, at the front end thereof. The shaft 148 is provided with a pulley 149 that is connected by dual belts 150 to a pulley 151 upon the shaft of an electric motor 152, the latter being mounted within a dust-proof compartment 153 within the housing. Each pitman 146 is connected to the vibratory units of the vibratory structure 136 by means of a flexible connection that complises a metal bracket 154 secured to the top of frame member 145, and a rubber sleeve 155 carried by said bracket, the pitman being secured in said sleeve. The flexible connection is identical with that previously described, and possesses the same advantages as the other. The arrangement is such that the vibratory structure 136 is reciprocated in a longitudinal direction whenever the motor 152 is in operation. The shaft 148 and eccentrics thereon are enclosed by an apertured wall 159 substantially in the same manner as the similar elements of the previously described embodiment. The framework of the structure 136 also includes cross pieces 156, 156 that assist in supporting sieves or screens 157, 158, the said screens being in all respects similar to screens 78, 79 of the previously described embodiment of the invention. The framework of the structure 136 also carries two inclined series of overlapping metal plates 160, 161 that are substantially identical in structure and function to the plates 83, 84 previously described.

Positioned above the screens 157, 158 are the brush units that are provided for engaging the starch on said screens as the latter receiprocate. There are two screens 157 and two screens 158, and four brush units are provided, there being one for each of said screens. For supporting said brush units, four hollow supporting members 164, 164 are positioned above the brush units and extend transversely of the housing, the ends of said members being secured to the opposite lateral walls of said housing. Secured to each member 164 are two laterally projecting brackets 165, 165, and adjustably secured to the latter are respective resilient elements 166, usually consisting of coiled springs. Pendulously pivoted to each of the latter are respective swinging arms 167 that swing parallel to the reciprocating movement of the vibratory structure, there being two of said arms for supporting each brush unit. Each of said brush units comprises a centrally disposed, longitudinally extending member 168 to which two arms 167 are pivotally connected, said member 168 having a plurality of transverse, rib-like members 169, 169 secured to the under side thereof, said members 169 carrying downwardly projecting tufts of brush bristles 170. The transverse members 169 may be of two different lengths arranged in alternation, the longer carrying the greater number of tufts. The members 169 are so arranged relatively of each other that the tufts on each of them are in staggered relation to the tufts on adjacent members, as indicated in Figure 8. The function and advantages of the brush elements previously have been set forth.

In other respects the lower vibratory structure 136 is similar to the structure 46 previously described, the delivery end of the structure being provided with a spout 173 for receiving the tailings that drop from the delivery end of screen 158 and directing them into a suitable receptacle 174. The refined starch that flows from the delivery end of the lower overlapping plates 161 falls into the open end of a chute 175 that conducts it from the housing for subsequent use.

Referring now to the upper vibratory structure 137, it will be apparent from reference to Figure 5 that it comprises a pair of units arranged side by side and provided with lateral frame members 178, 178, the latter being supported at opposite ends of the structure upon transverse rods 179, 179. The rods 179 extend through arcuate slots 180, 180, Figure 4, in the lateral walls of the housing 130, being supported from their projecting end portions by flexible hangers 181. The upper ends of the latter are suspended from brackets 182, and the hangers and brackets are enclosed in suitable cover plates 183. The layers of woolskin 143 previously mentioned extend upwardly between the lateral frame members 178 and the inner surface of the housing.

For effecting vibration of the structure 137, the respective frame members of each unit thereof are connected to each other by respective transversely disposed members such as the member 186, Figure 4, located near the bottom of said frame members. Transverse members 186 are connected to the free ends of respective pitmans 187, the other ends of the latter being connected to respective eccentrics 188 that are mounted upon the driven shaft 148. The free ends of pitmans 187 are connected to the transverse members 186 of the vibratory structure by means of flexible connections, each of which comprises a bracket 189 and a rubber sleeve 190 identical with similar connections previously described. The arrangement is such that vibratory structures 136, 137 are reciprocated in unison. The framework of the structure 137 includes cross pieces 191, 191 that assist in supporting sieves or screens 192, 193, which screens are similar in all respects to screens 66, 67 of the previously described embodiment of the invention. The framework of the structure 137 also carries an inclined series of overlapping metal plates 194, 194 that are substantially similar in structure and function to the plates 74 of the first described embodiment. In addition to the plates 194, the structure 137 includes a second series of overlapping plates 195, 195 that are positioned above the plates 194, in spaced relation thereto, at the lower end region of the latter, the arrangement being such that the screened starch dropping through the screens 193 falls solely upon the plates 195. The lower or delivery end of the series of plates 195 is positioned above the lowermost plate of the series of plates 194 so that the starch from the upper series is delivered onto the lowermost plate of the lower series. The plate 194 at the delivery end of the lower series has a steeply inclined extension 196, the delivery end of the latter being positioned in a chute 197 at the lower end of structure 137. At the delivery end of screens 193 are the flared receiving ends 198 of four cylindrical vertical chutes 199, 199, which chutes extend downwardly through the inclined extension 196 of the overlapping plates 195, and discharge from the structure 137 laterally of the chute 197 that discharges the screened starch. The chute 197 is positioned over the inclined end-wall of the structure 136 so that starch discharged therefrom flows onto the upper end of lapped plates 161. Chutes 199 are positioned over an inclined plate 200 on structure 136 that is so positioned that unscreened starch falling thereonto flows onto the upper end of screen 157. Flexible walls of rubber 201, 201 connect the adjacent ends of structures 136, 137 and separate the respective passages for starch thereat.

Positioned above the screens 192, 193 are the brush units that engage the starch on said screens as the structure 137 is reciprocated, there being two brush units for the two screens 192 and two brush units for the two screens 193. For supporting said brush units, four hollow supporting members 204, 204 are positioned above the brush units and extend transversely of the housing, their ends being secured in the lateral walls of the housing. Brackets 205 secured to said supports have respective resilient elements 206 adjustably secured to them, said resilient elements having depending arms 207 pendulously secured to their lower ends, there being two arms 207 for each brush unit. Each brush unit comprises a centrally disposed, longitudinally extending member 208 to which two of the arms 207 are pivotally connected, said member 208 having a plurality of transverse rib-like members 209, 209 secured to the under side thereof, said members 209 carrying downwardly projecting tufts of brush-bristles 210. The ribs 209 may be of two different lengths and the bristle-tufts 210 thereon are in staggered relation in adjacent rows as previously described.

In other respects the upper vibratory structure 137 is similar to the vibratory structure 47 of the previously described embodiment of the invention. At its upper or work receiving end the structure 137 is provided with an inclined plate 212, the lower end of which is at the receiving end of the screens 192. The plate 212 is disposed below the slot 213 that extends longitudinally of a transverse trough 214 in the top of the housing, said trough having a feed screw 215 therein for impelling untreated or dirty starch into the refiner, said feed screw being mounted upon a driven shaft 216. The latter has driving connection (not shown) with the driven shaft 148. Flexible walls 217 connect the bottom of the trough 214 to the upper end of vibratory structure 137, thus providing a dust-proof passage for the starch issuing from the slot 213 of said trough.

For withdrawing air from the housing, an exhaust fan 220 is mounted in the top thereof, remote from the trough 214, said fan being carried upon a shaft 221 that extends transversely of the housing, a motor 222 being connected to said shaft exteriorly of the housing. The fan 220 is positioned centrally of the housing with relation to the lateral walls thereof, and is partly enclosed by a sheet metal casing 223, the latter having inlet openings 224 at each side thereof, concentric with the shaft 224, and having a discharge duct 225 that extends through the housing wall. Exteriorly of the housing the duct 225 connects with an air-cleaning and dust-recovery apparatus (not shown) similar to that previously described. Extending transversely of the interior of housing 130, near the top thereof adjacent fan casing 223 is a partition 226, and secured to said partition and to the adjacent end wall of the housing are sheet metal walls 227, 227 that extend from the lateral walls of the fan casing to the sides of the housing and thus provide chambers, of which the openings 224 of the fan

casing constitute respective outlets therefor. At the other end of the housing, in the top thereof and at the near side of trough 214, is a transverse chamber 230 that comprises sheet metal walls 231, 231. Supported by the partition 226 and the adjacent wall 231 of chamber 230 is a plurality, shown as five in number, of sheet metal troughs 232, 232, which troughs are horizontally disposed in spaced-apart parallel relation. The top of the partition 226 is cut away above the tops of the troughs 232, as best shown in Figure 5, to allow air to pass over said troughs and to move into the chambers at opposite sides of the fan casing 223.

Referring now to Figure 9 of the drawings, it will be seen that the upper margins of the troughs 232 are turned inwardly toward each other. Mounted above the spaces between the respective troughs 232 are deflector members 234, 234, which members have the shape of an acute angle in transverse section with the apex of the angle directed upwardly, the lateral marginal portions of the said members being bent inwardly toward each other, and positioned within the troughs 232, somewhat below the inturned upper margins of the latter. At the outside margins of the outermost troughs 232 of the series are inclined deflector plates 235 that are similar to deflector members 234 at their lower margins, but are not angular in section, the upper margins of plates 235 being secured to the top of the housing. The arrangement is such that the dust-laden air moving upwardly within the housing 130 passes into the space between the troughs 232 and the top of the housing by way of the narrow spaces or passages between the lower margins of the deflector members 234, 235 and the upper margins of the troughs, as indicated by broken-line arrows in Figure 9, which passages are arcuate as the result of the curved margins of the troughs and deflectors. The narrow, curved passages throttle the air streams and cause the latter to drop any starch particles that they may be carrying, the lighter dust particles remaining in suspension in the air so as subsequently to be removed therefrom exteriorly of the refiner.

The starch particles dropped by the air streams as described fall into the troughs 232, and for removing the particles from the latter, respective feed-screws 237 are positioned therein, said feed-screws being journaled at one end in the partition 226 and at their other ends in the near wall 231 of chamber 230. The feed-screws 237 are rotated in the proper direction to impel the starch particles in the troughs toward the chamber 230, the wall of the latter, at the ends of the troughs, being cut away or apertured to enable the starch to pass therethrough as indicated by the arrow in Figure 4. The starch that collects in the bottom of the chamber 230 may be removed therefrom through the side of the housing.

For driving the feed-screws 237, the shaft of each of them is provided with a sprocket 239, disposed within the chamber 230, said sprockets being interconnected by a sprocket chain 240 that passes over and under alternate sprockets. The sprocket chain 240 also is trained about an idler sprocket 241 mounted upon shaft 242 in one end of chamber 230, and about a driving sprocket 243 in the other end of chamber 230. The sprocket 243 is carried upon a short shaft 244 that is journaled in the opposite walls 231 of the chamber, said shaft extending through the chamber wall and carrying a bevel gear 245 on its end exteriorly of the chamber. The bevel gear 245 is meshed with a bevel pinion 246 that is mounted upon a shaft 247 extending transversely of the housing 130 and journaled in the opposite lateral walls thereof, said shaft having a projecting portion exteriorly of the housing upon which is mounted a pulley 248. The latter is connected to a driving pulley 249 of somewhat smaller diameter, that is mounted upon the exposed end portion of adjacent driven shaft 216, by means of a transmission belt 250, Figure 6. The arrangement is such that the feed screws 237 are driven whenever the infeed screw 215 is driven.

There is a flexible transverse wall of rubber 252 between the bottom of partition 226 and the top of vibratory structure 137. Similar flexible walls 253, 253 are positioned between the respective ends of the lower vibratory structure 136, and partitions 254, 255 at opposite ends of the heating coils 133. Other flexible walls, designated 256, are positioned between the apertured wall 159, and the adjacent frames of the upper vibratory structure 137 and lower vibratory structure 136.

This embodiment of the invention functions in substantially the same manner as the embodiment previously described, the principal difference residing in the improved construction of the means in the top of the refiner for separating starch particles from the heated air, the operation of which previously has been explained.

Referring now to Figure 10 of the drawings, there is shown a cascade plate 260, such as is used with the vibratory structures of any embodiment of the apparatus, said plate being of modified construction in that means is provided for individually heating it. To this end electrical heating units 261 are mounted upon the under side of the plate, said heating units being enclosed by means of a cover plate 262 so that none of the dust-laden air in the refiner comes into contact with the heating elements. It will be understood that the heated cascade plates 260 may be used on one or both vibratory structures in the refiners, and for one or both series of cascade plates on said vibratory structures. The arrangement provides means for obtaining greater heat within the refiners, and also for readily controlling said heat.

Referring now to Figures 11 to 13 of the drawings, there is shown another embodiment of the invention that is essentially the same as those previously described in the details of its various elements, but is arranged to deliver the refined starch in cool, dry condition, which condition is preferable in the manufacture of some kinds of confections. As shown in the drawings, the refiner is positioned partly above and partly below the floor of a building, said floor being designated 264. That portion of the refiner that is positioned above the floor is enclosed in a housing 265, and that portion that is positioned below the floor is enclosed in a housing 266, the latter being attached to the under side of said floor, which is the ceiling of the lower room. The interior of housing 265 connects with the interior of housing 266 through the agency of a relatively large opening 267 in the floor, said opening being provided with a grating or grille 268 if desired.

The starch refining mechanism in the upper housing 265 is essentially the same as that shown in Figure 5. Said mechanism comprises an upper vibratory structure 270 and lower vibratory structure 271, both vibratory structures compris-

ing screens, brushes, and overlapping cascade plates as previously described. The vibratory structures are vibrated by means of respective pitmans 272, 273 that are connected at one end to said structures, and at their other ends are connected to respective eccentrics carried upon a transversely disposed, driven shaft 274. The latter is connected by belt 275 to the shaft 276 of an electric motor 277 that is suitably enclosed in a dust-proof compartment 278 interiorly of the housing 265.

Dirty starch is introduced into the housing 265, from the exterior thereof through the agency of a trough 280 in the top of the housing. Exteriorly of the housing, the dirty starch is dumped into trough 280 from an enclosed endless bucket elevator 281 that extends through the floor 264 to a hopper 282, the latter being associated with a "mogul" 283 on the floor below. A feed screw 284, Figure 13, is provided for feeding the starch from the "mogul" 283 to the hopper 282. Within the trough 280 is a shaft 285 having a feed-screw 286 formed thereon, said feed screw being provided for impelling the starch longitudinally of the trough from the point where it is dumped thereinto by the elevator. A plurality of flexible, tubular chutes 287, 287 extend downwardly from the trough 280 and discharge onto the screen of the upper vibratory structure 270. The feed-screw-shaft 285 is driven by means of a transmission belt 288 that is trained about a pulley 289 mounted upon a projecting end of shaft 274, and a pulley 290 mounted upon a projecting end of shaft 285, remote from the elevator 281. The other end of shaft 285 carries a pulley 291 that is connected by a transmission belt 292 with a pulley 293, the latter being mounted upon a shaft 294 that carries a sprocket 295. Sprocket 295 carries the upper end of the endless conveyor 281, the lower end thereof being trained about a sprocket 296 carried by a shaft 297 in the hopper 282. Shaft 297 may be connected to or constitute a part of the feed screw 284 that impels starch from the "mogul" 283 to said hopper. The arrangement is such that the single motor 277 serves to drive the feed screw 284, elevator 281, feed screw 286, and shaft 274, the latter serving to effect reciprocation of the vibratory structures 270, 271.

At the delivery end of the lower vibratory structure 271, tailings from the screen thereof fall into a chute 300 that delivers them into a receptacle 301 within the housing, from which receptacle they are subsequently removed. The sifted starch from the cascade plates of the lower vibratory structure fall into a plurality of flexible chutes 302, 302 that extend downwardly through the floor 264 and discharge onto the receiving end of another refining mechanism located in the lower housing 266.

The starch refining mechanism in the lower housing 266 is essentially the same as that in upper housing 265, there being an upper vibratory structure 305 and a lower vibratory structure 306, the latter, however, having but one series of cascade plates as compared to the two series in the vibratory structure 271. Reciprocation of the vibratory structures 305, 306 is effected by means of respective pitmans 307, 308 that are connected at one end to said structures, and at their other ends are connected to respective eccentrics carried upon a transversely disposed shaft 309. Exteriorly of the housing 266, the shaft 309 is provided with a pulley 310, Figure 11, that is connected by a transmission belt 311 to a pulley 312 carried by the driven shaft 274 hereinbefore described, said pulleys 310, 312, and the belt 311 being protected by a casing 313 secured to the side of the housings 265, 266. At the delivery end of the lower vibratory structure 306, the refined starch is discharged into a plurality of flexible chutes 314, 314 that extend through the bottom of the housing and discharge into a trough 315 mounted below said housing. Extending longitudinally of the trough 315 is a shaft 316 that has a feed screw 317 formed thereon, said feed screw being adapted to impel the starch in the trough to one end thereof, where a downwardly extending delivery chute 318 is provided. The chute 318 discharges the refined starch into the top of the "mogul" 283 that is positioned therebeneath. For driving the shaft 316 and its feed screw 317, a projecting end of said shaft is provided with a pulley 320 that is connected by a transmission belt 321 to a pulley 322 mounted on the projecting end of driven shaft 309. The arrangement is such that the motor 277 drives all of the moving mechanisms of this embodiment of the invention.

The cleaning of the starch and the carrying off of the lint, dirt, and foreign matter therein is effected by an upwardly moving current of air in substantially the same manner as in the previously described embodiments of the invention. To this end the bottom of the lower housing 266 is formed with an inlet opening 325, Figure 12, of sufficient size to admit the amount of air required. The air current is induced by a suction fan (not shown) in a casing 326 atop the housing 265, said fan being driven by a motor 327. On its intake side the said fan communicates with the interior of the housing 265 through a duct 328, and interiorly of the housing are suitable baffles 329 that throttle the air current before it passes into duct 328, and thus causes said air current to drop its heavier particles, as previously described. At the discharge side of the fan is a duct 330 that discharges into a cyclone 331 wherein the dirt and dust is separated from the air current in the usual manner.

Located within the upper housing 265, over the opening 267 in floor 264, are pipe coils 334 through which heated fluid, such as steam, may be passed. The air current in passing the coils 334 becomes heated, and thus transfers the heat to the powdery starch as it moves through the latter, with the result that the starch is thereby dried and conditioned. Located within the lower housing 266, over the opening 325 in the bottom thereof, are pipe coils 336 through which cooling fluid, such as cold water, may be passed. The arrangement is such that air drawn into lower housing 266 is cooled below atmospheric temperature, and thus removes heat from the starch that is traversing the vibratory structures 305, 306, as it moves upwardly through the latter. The arrangement is such that the completely refined starch delivered from the chute 318 is in the cool condition best suited for the manufacture of certain kinds of candy.

Other modification may be resorted to without departing from the spirit of the invention, or the scope thereof as defined by the appended claims, which are not limited wholly to the specific construction shown, or exact procedure described.

What is claimed is:

1. Apparatus for refining pulverulent material, said apparatus comprising a pair of oppositely inclined vibratory structures disposed one above the other, each of said structures comprising a downwardly inclined screen and a downwardly inclined series of overlapped plates disposed below said screen and adapted to receive the material passing therethrough, means for leading material from the lower end of said upper screen to the upper end of said lower screen, an auxiliary series of overlapped plates associated with the lowest portion of said lower vibratory structure below the series of overlapped plates forming part of said lower vibratory structure, said series of overlapped plates being adapted to cascade material from the upper to the lower ends thereof, means for leading screened particles from the lower end of said upper series of overlapped plates to the upper end of said auxiliary series of overlapped plates, and means for passing a countercurrent of air through said vibratory structures to clean and dry the pulverulent material whereby said auxiliary series of overlapped plates aids in cleaning and drying the screened material.

2. In apparatus for refining pulverulent material the combination of a downwardly inclined screen, means for reciprocating said screen in the direction of its inclination, means for feeding material onto the upper end of said screen, brushes mounted above said screen to engage only with the material thereon, said brushes being adapted to move in the direction of reciprocation of said screen and being positioned closer to the discharge end thereof than to the feed end thereof, said brushes being arranged in rows of tufts extending transversely of said screen with the tufts in one row being staggered relative to the tufts in the adjacent rows, and means for limiting the movement of said brushes.

3. Apparatus for refining pulverulent material, said apparatus comprising a pair of vibratory structures disposed one above the other, each of said structures comprising a downwardly inclined screen and a downwardly inclined series of overlapped plates disposed below said screen with the upper end of the lower structure being adjacent the lower end of the upper structure, means for conducting material from the lower end of the upper screen to the upper end of the lower screen, and means for conducting material from the lower end of the upper series of overlapping plates to the upper end of the lower series of overlapping plates whereby a large vibratory area can be placed in a relatively small space, means for passing a current of air upwardly through the material being sifted by said vibratory structures, and a flue associated with the lower of said vibratory structures and being adapted to conduct a portion of the warm air to the upper of said vibratory structures without passing through the material being sifted on said lower vibratory structure.

4. Apparatus for refining cereal flour, said apparatus comprising a pair of vibratory structures disposed one above the other, each of said structures comprising a downwardly inclined screen and a downwardly inclined series of overlapped plates disposed below said screen with the upper end of the lower structure being adjacent the lower end of the upper structure, means for conducting material from the lower end of the upper screen to the upper end of the lower screen, and means for conducting material from the lower end of the upper series of overlapping plates to the upper end of the lower series of overlapping plates whereby a large vibratory area can be placed in a relatively small space, means for passing a current of air upwardly through the material being sifted by said vibratory structures, and a flue associated with the lower of said vibratory structures and being adapted to conduct a portion of the warm air to the upper of said vibratory structures without passing through the material being sifted on said lower vibratory structure.

5. Apparatus for refining pulverulent material, said apparatus comprising a downwardly inclined screen, means for arcuately reciprocating said screen, and bristle brushes positioned above and in spaced relation to the screen and engageable with the material thereon by reason of the reciprocation of the screen, said brushes comprising a plurality of transversely directed rows of tufts with the tufts of one row being staggered relatively to the tufts in the adjacent rows the arcuate reciprocation of said screen effecting a component of vertical movement tending to toss the pulverulent material vertically upon said screen and into a crushing engagement between said bristle brushes and said screen.

6. Apparatus for refining pulverulent material, said apparatus comprising a downwardly inclined screen adapted to progressively sift a portion of pulverulent material as it passes by gravity over said screen, a series of overlapping inclined spaced apart plates arranged underneath said screen and on which said material sifting through said screen falls, means whereby a current of heated air is passed upwardly through the falling materail, the material lying on said screen, and against said plates thereby heating all the pulverulent material, means for imparting reciprocal longitudinal motion to said screen and plates whereby the gravity flow of said material is assisted, and means for discharging the material that passes through said screen into one receptacle and the remainder of the material into another receptacle, means for subjecting the material that has passed through said screen to a current of cold air as said material approaches its receptacle, whereby said material is cooled and the material which has not passed through said screen is not cooled.

7. Apparatus for the continuous refining of pulverulent material, said apparatus comprising a housing, a downwardly inclined screen, means for delivering variable quantities of unrefined material onto said screen, means for controlling the quantity of said unrefined material delivered to said screen relative to controlled reciprocating motion of said screen whereby the speed of refining is regulated, means for imparting a reciprocating motion to said screen whereby the gravity flow of said material over said inclined screen is facilitated and sifting of said material is effected, brushing units positioned over and spaced apart from said screen but in contact with the said material on the screen, means for actuating said bushing units in a pendulous motion whereby small lumps in the pulverulent material is subjected to a downward pressure of brushes in said brushing unit, a series of inclined overlapping plates under said screen and upon which plates at least a portion of the sifted material falls, said plates being spaced apart sufficiently to permit the passage of air therebetween, means for vibrating said inclined plates whereby the

sifted material flows by gravity thereover, means for drawing air into said housing and upwardly through said refiner units the air being confined to a definite channel in its passage therethrough, heated units over which the in taken air is passed and heated to a predetermined temperature, exhaust means for drawing said heated air between said plates and through the falling sifted material whereby said plates are heated and the falling pulverulent material is aerated and the sifted material that is falling and lying on said plates is heated and dried, said air exhaust means being adapted to draw said heated air upwardly through the sifted material lying on said screen at a velocity of air flow sufficient to cause said air to blow material of low specific gravity upwardly separating it from the higher specific gravity material, a cleaning device and means for discharging the air which carries the low specific gravity material through said cleaning device whereby the low specific gravity material is removed therefrom and the air discharged to the atmosphere, means for delivering the sifted, aerated, dried and heated pulverulent material to one receptacle and the unsifted material to a separate receptacle.

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