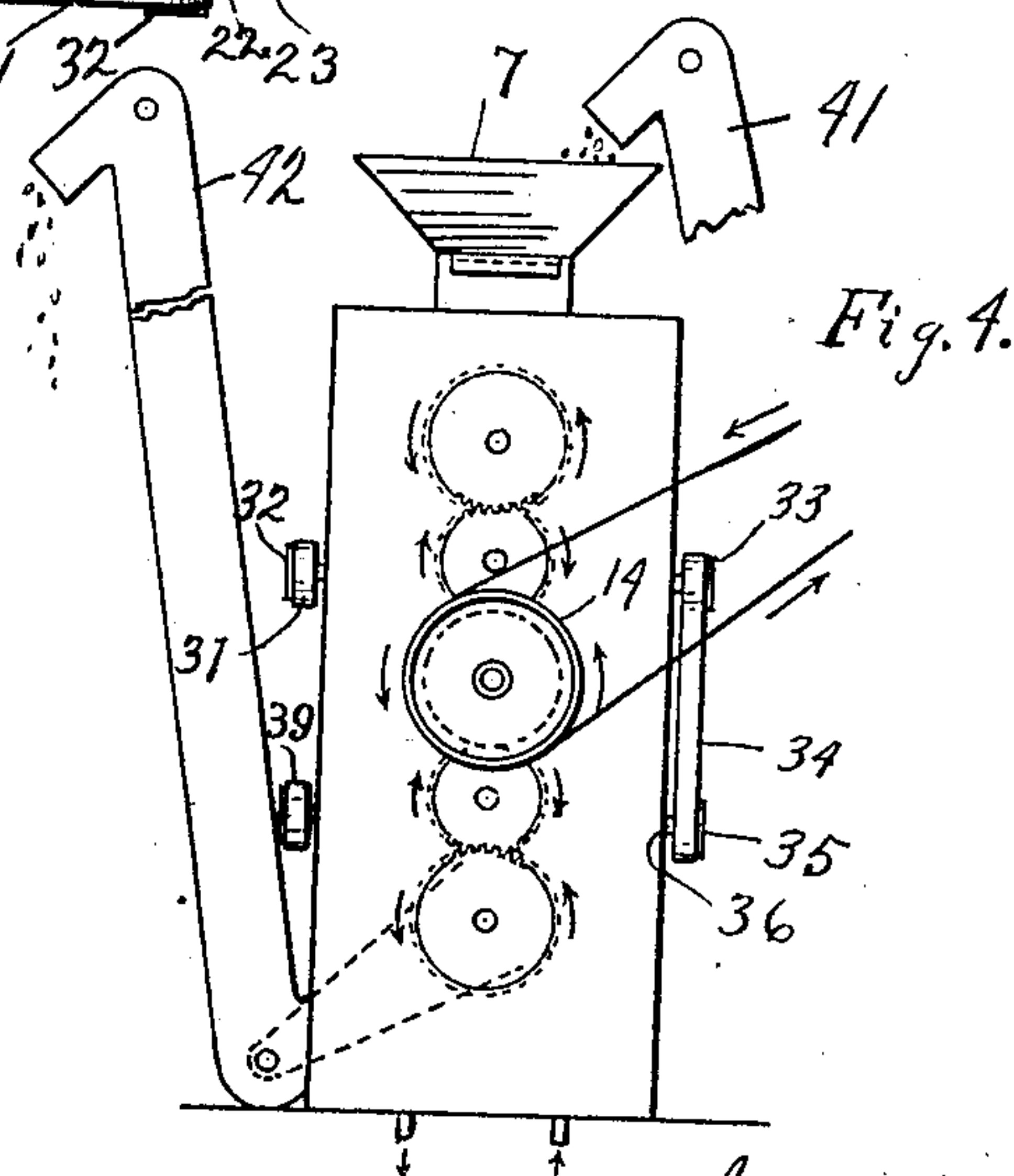
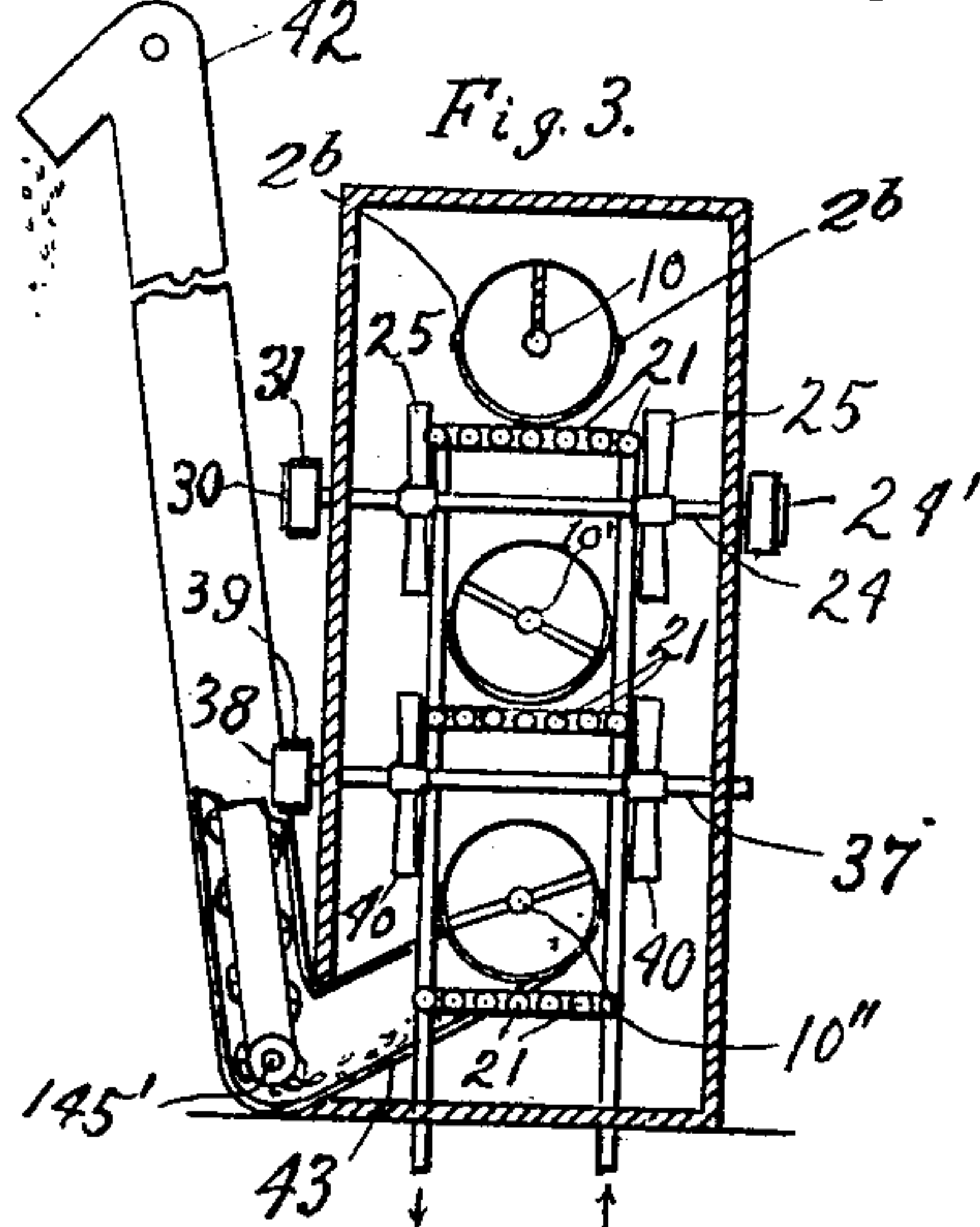
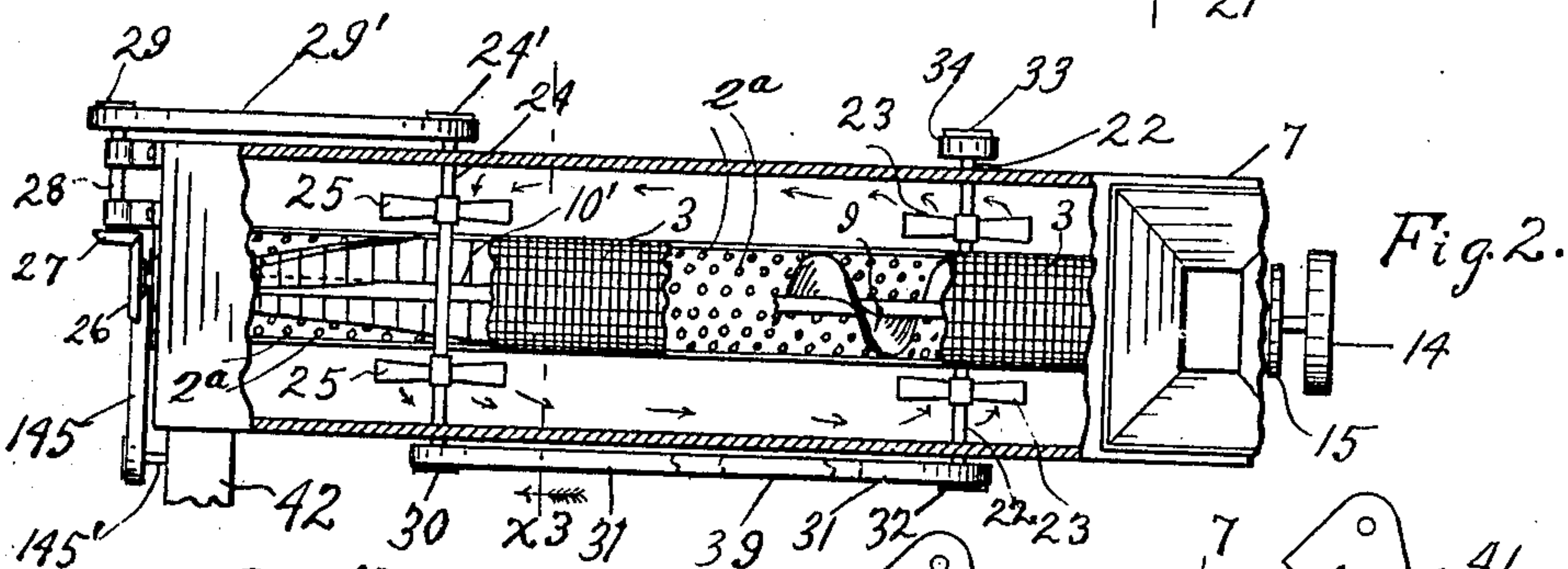
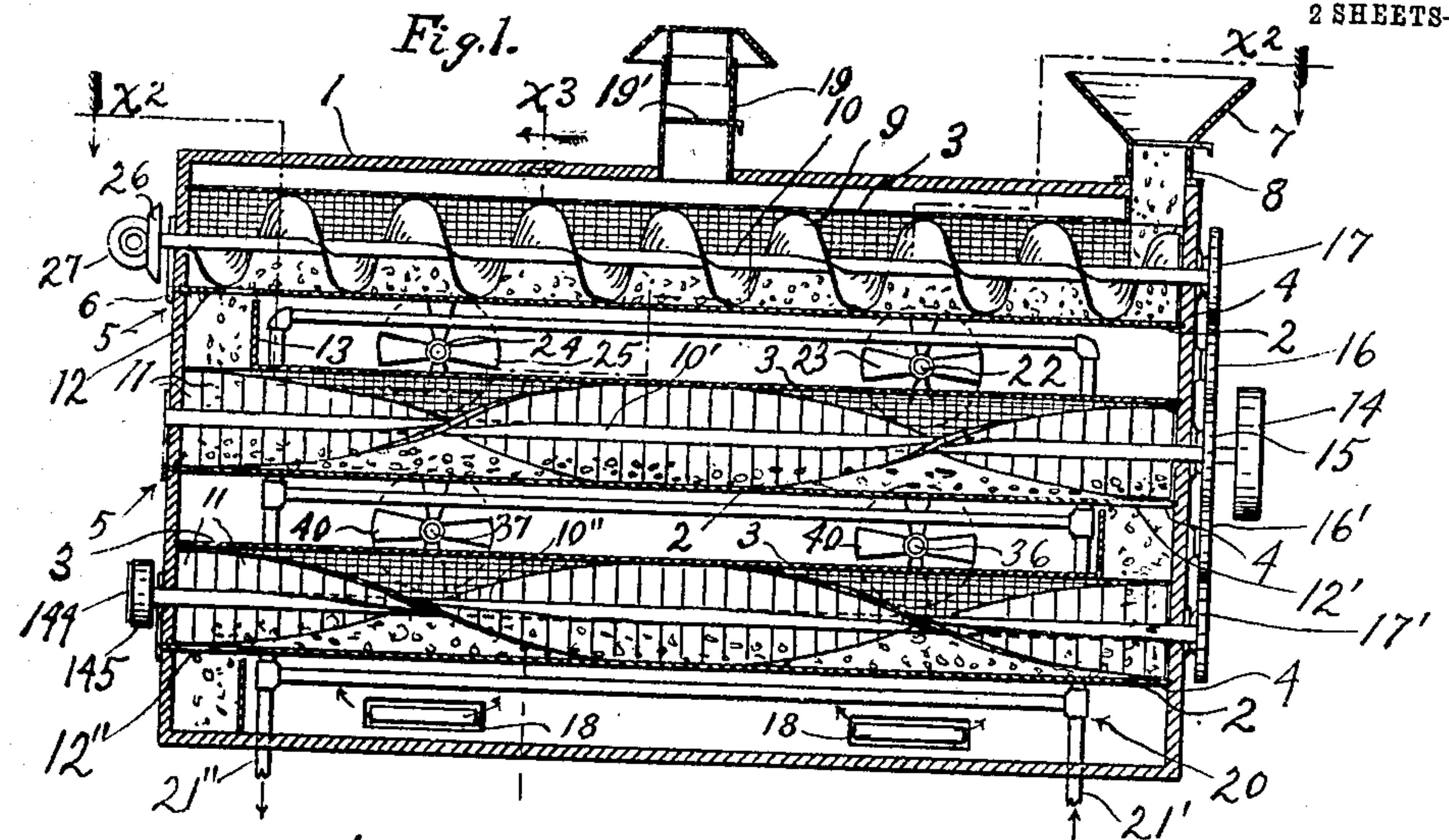


920,050.

R. GRAUER.
 DRYING APPARATUS.
 APPLICATION FILED FEB. 14, 1908.

Patented Apr. 27, 1909.

2 SHEETS—SHEET 1.



Witnesses:
 Meta Sands
 John W. Hinton.

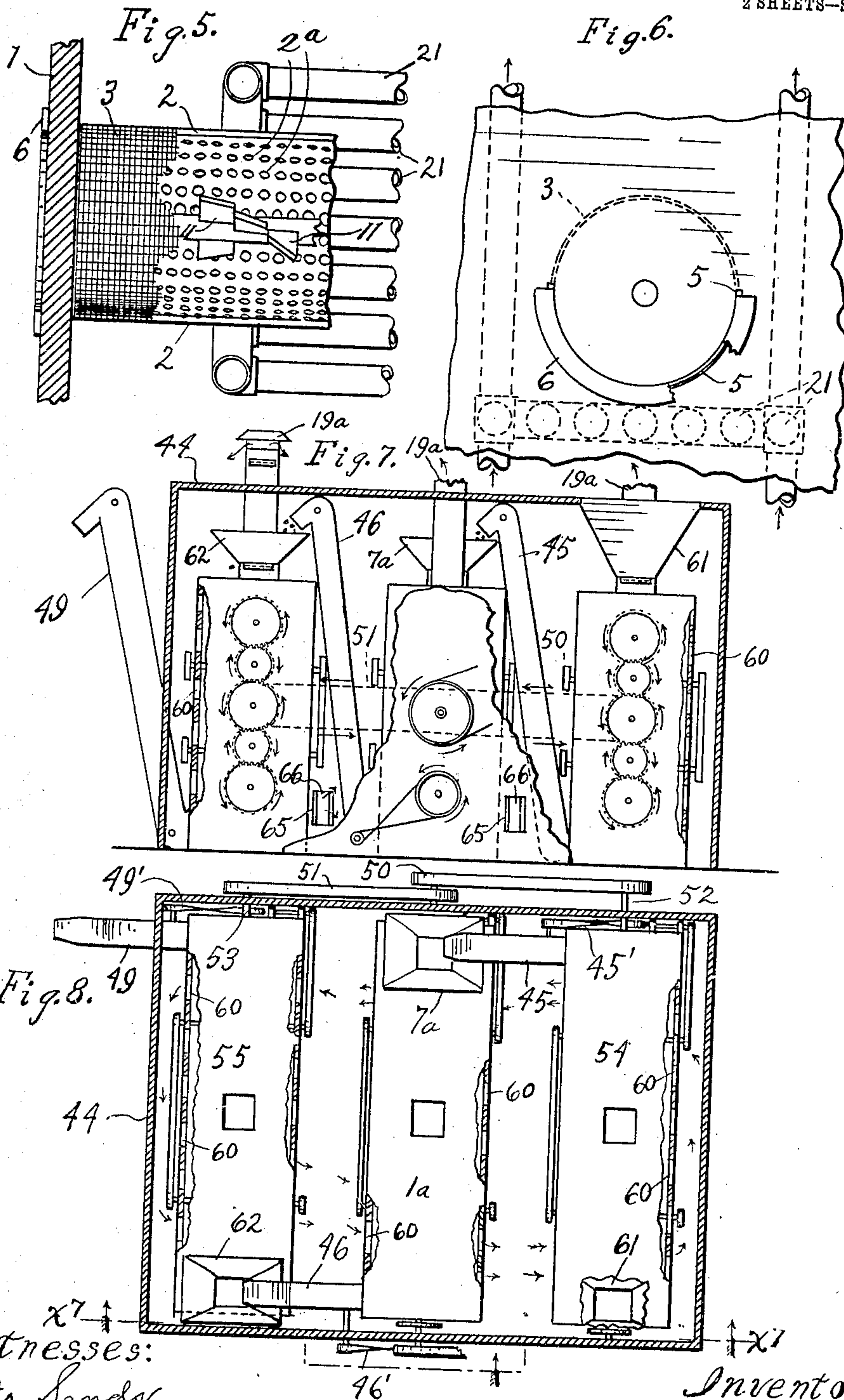
Inventor:
 Robert Grauer
 By Albert H. Merrill
 his Atty.

920,050.

R. GRAUER.
 DRYING APPARATUS.
 APPLICATION FILED FEB. 14, 1908.

Patented Apr. 27, 1909.

2 SHEETS—SHEET 2.



Witnesses:

Meta Sands
 Solara Soime Newton

Inventor:

Robert Grauer
 By Albert H. Merrill
 his atty.

UNITED STATES PATENT OFFICE.

ROBERT GRAUER, OF LOS ANGELES, CALIFORNIA.

DRYING APPARATUS.

No. 920,050.

Specification of Letters Patent.

Patented April 27, 1909.

Application filed February 14, 1908. Serial No. 415,989.

To all whom it may concern:

Be it known that I, ROBERT GRAUER, a subject of the Emperor of Austria-Hungary, and a resident of Los Angeles, California, have invented new and useful Drying Apparatus, of which the following is a specification.

Objects of this invention are to provide a drier having improved means for advancing a suitably prepared moist material across a heated area of air, and at the same time, agitate the material in such a manner as to accelerate the drying thereof; to provide improved means for supporting and progressively advancing said material during the drying thereof in such a manner as to allow the hot air to penetrate to every portion of the material; to provide means adapted to operate upon the material to move it forward in the best manner when it is in the most moist condition, and in combination with said means, different means better adapted to move the material forward after it has become partly dried; to provide improved means for removing and cleaning the means for supporting the material; and to provide improved means for supporting and confining the material in a manner allowing the heated air to have ready access there-through.

A further object is to provide a compact apparatus whereby the material will be compelled to move a long distance over the supporting means, and the said supporting means still be confined to a comparatively small compact case.

Another object of the invention is to provide improved means for automatically advancing the material being operated upon, from one series of driers to another adjoining series of driers until the material is sufficiently dried.

Other objects and advantages may hereinafter appear.

This drying apparatus is well adapted for drying fruit and other vegetable matter, and may also be used for drying other substances.

Referring to the accompanying drawings which illustrate the invention, Figure 1 is a longitudinal mid-section of a set of the driers. Fig. 2 is a plan view of the set of driers shown in Fig. 1, upper parts being broken away to show underlying parts, the line X—2 of Fig. 1 indicating the line of section. Fig. 3 is a cross-section of Figs. 1 and 2 on line X—3 thereof. Fig. 4 is an end elevation of one set of the drying elements. Fig. 5 is an

enlarged plan section of a portion of one of the drying troughs, showing, in addition to the trough, a fragment of the stirring means and of the heating means. Fig. 6 is a fragmental elevation of a portion of the out-side of the case, looking toward the left of Fig. 5 and showing an end of one of the drying troughs. Fig. 7 is a longitudinal section on line X—7 of Fig. 8, of a drying apparatus comprising a series of the driers illustrated in Figs. 1 to 4. Fig. 8 is a plan of Fig. 7, the ventilators and top wall of the main case being removed.

Referring in detail to the drawings: 1 is a case or box forming a drying chamber, wherein is mounted a series of superposed troughs 2, preferably having curved or segmental bottoms with perforations 2^a as best shown in Figs. 2 and 5. Said troughs are each provided with a screen or perforated cover 3 as best shown in Fig. 3 where 2^b designates offset lower edges of the covers for holding said covers in place. Said troughs are removably mounted in the casing 1, being desirably seated in seats 4 at one end of the casing and extending outside the casing at the other end through segmental grooves or openings 5. This construction makes it possible to pull the troughs out from the left end of the case, as shown in Fig. 1, for the purpose of cleaning the troughs to clear the perforations therethrough. The protruding ends of the troughs may each be provided with a flange 6 which the operator may take hold of when withdrawing the trough. The covers 3 are desirably permanently fastened within the case by any suitable means, said covers preferably forming arches over the tops of the troughs, thereby forming elongated chambers sufficiently large to receive stirring and advancing means which will hereinafter be described.

Feeding means, desirably a feeding hopper 7, is provided on top of one end of the case; said hopper discharging through a chute 8, into one end of the initial or upper-most trough 2. In said initial trough is mounted a spiral blade 9 on a shaft 10 extending longitudinally of said upper trough. Upon the shafts 10', 10'', of the lower troughs are mounted spirally-arranged series of flattened stirring arms 11. Said flattened stirring arms 11 are of such length that their outer ends move close to the bottom of the trough when said shafts 10', 10'' are rotated, each arm being so inclined with relation to the

length of the trough, as to move the material progressively forward along its course when the shafts are rotated from right to left. At the end of the casing opposite the hopper 7, the upper trough is provided with a discharge opening 12 in its bottom; said opening discharging through a chute 13, into the adjacent end of the next lower trough. At the other end of said lower trough is a discharge opening 12' for discharging into the lower trough shown in Fig. 1.

14 designates a driving pulley fastened directly to the middle shaft 10'. 15 is a cog-wheel made fast to the said shaft 10 as shown in Fig. 1. 16, 16' are idle cog-wheels meshing respectively with the upper and lower sides of cog-wheel 15 and communicating motion from said cog-wheel. The idler 16 turns the upper cog-wheel 17 for driving upper shaft 10, and the idler 16' meshes with cog-wheel 17' for driving the lowermost shaft 10''. It will be seen that this system of gearing for driving shafts 10, 10' and 10'' will, if the stirring arms and the spiral blade are properly inclined with relation to the troughs, feed the material in the upper trough from the right to the left side of the case, thence through discharge opening 12 back to the right side of the case through the middle chamber, thence through discharge opening 12' back to the left end of the case through the lower chamber. Said lower chamber is provided at its left end with discharge opening 12'' which may discharge material into another part of the drying apparatus, as will be hereinafter described. The spiral blade 9 is adapted to receive and positively move moist material directly from the hopper and move said material on to the left end of the upper chamber, the current of hot air drying said material sufficiently by the time it reaches the left end of the chamber and falls into the next lower chamber or tube so that the inclined stirring arms 11, although not so positive in their action when the material is in a wet or sticky state, may be safely relied upon to move the material further along its course after the material has become somewhat dry in the elongated upper chamber.

The object of employing separate stirring arms, as shown in detail in Fig. 5, instead of a continuous spiral blade, is to more effectually separate and mix air with the particles of the material being dried as it progresses along the elongated lower chambers.

18 designates air dampers for admitting air to the bottom of the main drying chamber 1.

19 designates a covered ventilator on top of the drying chamber. Ventilator having desirably a damper 19' to regulate the escape of air and moisture therethrough.

20 designates piping containing steam or hot air supplied from any suitable source (not shown) for heating the air inside the

drying chamber, to cause the desired evaporation of moisture from the material being dried.

A series of horizontally-arranged pipes 21 are desirably disposed parallel to and underneath each of the elongated drying chambers to cause a volume of heated air to pass directly up through the heated perforated bottoms of said drying chambers.

21' are vertically-arranged pipes forming the necessary means for conducting air to one end of the horizontal series of pipes and 21'' are similarly disposed outlet pipes at the other end of said series of pipes. Near one end of the main drying chamber is a horizontal cross-shaft 22, provided near each side of the drier with one or more fans 23, the vanes of which are so set as to create a circulation of air, as indicated by the small arrows in Fig. 2. Near the other end of the drying chamber is a similar shaft 24 having like fans 25 thereon. The longitudinal shaft 10 of the drier is provided with a beveled cog-wheel 26 meshing with pinion bevel 27 on shaft 28, carrying a pulley 29, and by means of belt 29' rotating pulley 24' to turn shaft 24. Shaft 24 is provided at the other side of the case with a pulley 30 for driving belt 31 thus to rotate pulley 32 and shaft 22, so that all the four fans 23 and 25 are thus rotated, causing a circulation of air as indicated by small arrows in Fig. 2. Shaft 22 carries pulley 33 from which a belt 34 extends downward to a lower pulley 35 (see Fig. 4), thus to drive lower fan shafts 36 and 37 through a pulley 38 and belt 39. The driving connections last described serve to rotate the four lower fans 40, to cause a circulation of air throughout the lower portion of the apparatus in a manner similar to that caused by the four upper fans already described.

Each series of elongated drying chambers may be provided with a feeding elevator 41 delivering into the hopper 7, and a discharge elevator 42 to receive material in a more or less dry condition as delivered through lower discharge opening 12'' (see Fig. 1 for location of said discharge opening).

43 designates an inclined lower chute or trough for delivering the material from the lower elongated chamber, as shown in Fig. 3.

The left end of shaft 10'' is projected outside of case 1 and provided with a pulley 144 for driving belt 145 (see Figs. 1 and 2), said belt turning shaft 145' and thereby operating elevator 42 to raise the material delivered through opening 12''.

In Figs. 7 and 8, sets of superposed troughs 2 are shown arranged in juxtaposed series; said series being confined within a large box or case 44, and elevators 45 and 46 being used to transfer from one set of driers to the next set within the casing, while elevator 49 is used to discharge to the outside of the casing.

When the apparatus is thus assembled in

juxtaposed series, the shaft 10' of the middle series may be provided at one end outside of the case, with two belt pulleys over which pass the inner ends of belts 50 and 51. The outer end of belt 50 rotating shaft 52 and the outer end of belt 51 rotating shaft 53; said shaft 52 operates the interior mechanism of the right-hand series of drying apparatus shown in Figs. 7 and 8, inclosed in case 54 and the shaft 53 likewise operating the mechanism contained in the left-hand case 55. The arrangement of spiral blades and stirring arms and of wheels, shafts, etc. for driving them, is not explained in detail as to Figs. 7 and 8, as such construction is merely a duplication of that already described and will be therefore readily understood, without further detailed description.

Elevators 45, 46 and 49, as shown in Fig. 8, are driven by twisted belts 45', 46' and 49', in order to give said elevators the proper direction of movement, the arrangement of driving means for elevators 45 and 49 being a duplication of the means illustrated in Figs. 7 and 8 for operating elevator 46.

While the apparatus is well adapted for the drying of fruit which has been previously sliced to the proper thinness, it is also adapted to dry various other moist materials when reduced to a sufficient fineness to be handled by the conveying apparatus described. The stirring arms are not arranged to form a spiral with a continuous edge, but, as clearly shown in detail in Fig. 5, the ends of said arms are radially spaced apart so that as the material is operated upon, the particles thereof are separated from each other by adjacent arms and are therefore more thoroughly dried by the current of air circulated by the fans as already described.

The middle box 1^a and also the boxes 54 and 55 at each side thereof, are provided with perforated walls as shown where the walls are broken away and sectioned in Figs. 7 and 8, 60 indicating the perforations through the walls in said views. The material being dried is moved progressively through the succession of boxes shown in Figs. 7 and 8, being first fed into the hopper 61 of box 54. From box 54 the material is conveyed by elevator 45 to hopper 7^a of box 1^a. From box 1^a material is elevated by elevator 46 to hopper 62 of box 55, being delivered from said box to the outside of main case 44 by elevator 49. The fans at the ends of each of said boxes circulate the air through the perforations of the walls as indicated by small arrows in Fig. 8, thus making a complete circulation of air throughout the whole of the main case 44. This construction makes a better circulation of air, with less power than could be obtained if each of the smaller boxes had a separate and independent circulation of air therein, because the fans in the arrangement shown, combine

their power, and the current moves through a larger cycle, and is less hindered in its circulation through the apparatus. 65 designates openings near the bottom of the main case 44 for admitting air to the interior of the apparatus when assembled within said main case. 66 are dampers for controlling the entrance of air through said openings 65. The ventilators, 19^a, protrude through the top of the main case as shown, but the elevators 45 and 46, are confined within said main case so that the material being dried is not exposed to the outer atmosphere during its passage through the main case.

It will be seen that an improved system of circulating air through material being dried results from assembling the troughs having perforated sides one above the other and mounting transverse fan-carrying shafts between said troughs, because the trough next above and next below each shaft receives practically as strong a current of air as though the shaft and its fans were provided in combination with a single trough only. By this invention, therefore, a plurality of troughs are simultaneously subjected to a current of air which would be expended on a single trough if the drying apparatus were otherwise constructed. However, this invention is an improvement over other devices of its class in an important respect even when the fans are used in connection with a single trough, for the reason that on account of the air being admitted transversely to the body of material in the trough and the fans producing a transverse current of air against the troughs simultaneously with the stirring of the material therein, a more complete aeration of the material being operated upon results than can be obtained by any construction which merely passes the air over the top of the material.

By locating blowing fans 23 and 25 at different points with respect to the length of the troughs and mounting said fans in position to blow air transversely through the perforated walls of the troughs, thus blowing the air in reverse directions at different points along the length of the troughs, a circulation of air is caused entirely within the case. This arrangement causes the air to take up as much moisture as possible before escaping through ventilator 19 at the top of the apparatus.

It is to be understood that, while I have described what I at present consider the best embodiment of the invention, I do not limit myself to the exact construction shown, but may adopt various modifications within the scope of the claims without departing from the spirit of the invention.

I claim:—

1. In drying apparatus, in combination, a case forming a drying chamber, a trough

therein having a curved perforated bottom, a shaft above said bottom, extending longitudinally thereof, stirring means carried by said shaft adapted to advance material
5 along said trough, a semi cylindrical screen above said trough and inclosing said stirring means, the lower portion of said screen resting upon the upper edge of said trough and means for rotating said shaft to move
10 material along said trough.

2. In drying apparatus, a trough having walls perforated to allow air to pass transversely through said trough, fans located at different points with respect to the length
15 of said trough, said fans being adapted to blow air transversely through said trough, and means for rotating said fans to direct currents of air through said trough in reverse directions.

20 3. In drying apparatus, a trough having a curved perforated bottom, a shaft over said trough extending lengthwise thereof, a series of spirally-arranged radial flattened arms carried by said shaft, the ends of said
25 arms being turned axially to an angle with relation to the length of said trough, said arms being ranged around said shaft in advance of each other to leave air spaces between the ends of said arms, means for
30 rotating said shaft, and means to cause a current of air to pass transversely through perforated bottom of said trough.

4. In drying apparatus a trough having perforated sides to allow air to pass transversely through the body of material in said
35 trough, means for producing a current of air and directing the same transversely against said trough, stirring means for stirring the material in said trough and means for simultaneously operating said stirring means and
40 said means for producing the air current.

5. In drying apparatus, a series of superposed approximately horizontal troughs, feeding means to deliver material to one end
45 of an upper trough, discharge means at the other end of said trough to allow material to be fed to a second trough there beneath, there being a plurality of troughs beneath the upper trough having discharge openings
50 to provide for material being fed through the troughs in reverse directions, an elevator for raising material from the lowermost trough of the series, another series of troughs likewise constructed to receive material from said elevator, a separate case for
55 each series of troughs, means in each separate case for circulating air through the material in the troughs, a main case including both the first-mentioned cases and means
60 for discharging material from the last set of troughs to the outside of main case.

6. In drying apparatus, a case, a succe-

sion of boxes within said case, means for feeding material to the first of said boxes and progressively through the other boxes
65 to the last of the succession, means for discharging material from said last box to a point outside said case, fans at the end of each of said boxes nearest one wall of said case, said fans cooperating to create a draft
70 in the same direction, fans at the other end of said boxes cooperating to create a draft in the opposite direction, and means for operating all of said fans, said boxes having perforated walls to allow the air to circulate
75 therethrough.

7. In drying apparatus, a main case, a plurality of boxes within said main case, drying apparatus in each of said boxes, means for feeding material to one of said boxes, means
80 for progressively moving said material from said feeding means through all said boxes within the main case, means for discharging the material from the last of said plurality of boxes through which the material is passed,
85 and means within each of said boxes for creating a draft of air, said boxes having perforated walls to cause the current of air created by one of the boxes to circulate through the other boxes.
90

8. In drying apparatus a case, a plurality of superposed troughs mounted therein said troughs having perforated sides to allow air to pass transversely through bodies of material in said troughs, one or more shafts be-
95 tween said troughs extending transversely thereto, fans mounted on said shafts, stirring means to stir the bodies of material in said troughs and means for simultaneously operating said stirring means and rotating
100 said shafts to cause a current of air to pass transversely through said troughs.

9. In drying apparatus in combination a case, a substantially horizontal trough there-
105 in having perforated sides, means in said case near one end of said trough for producing a current of air and directing the same transversely against one side of said trough, means in said case near the other end of said
110 trough for producing a current of air and directing the same against the other side of said trough, means for feeding material to one end of said trough, and stirring means to stir material in said trough and move the material therealong.
115

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses at Los Angeles, in the county of Los Angeles and State of California, this 8th day of February 1908.

ROBERT GRAUER.

Witnesses:

ALBERT H. MERRILL,
FLORA H. FOSS.