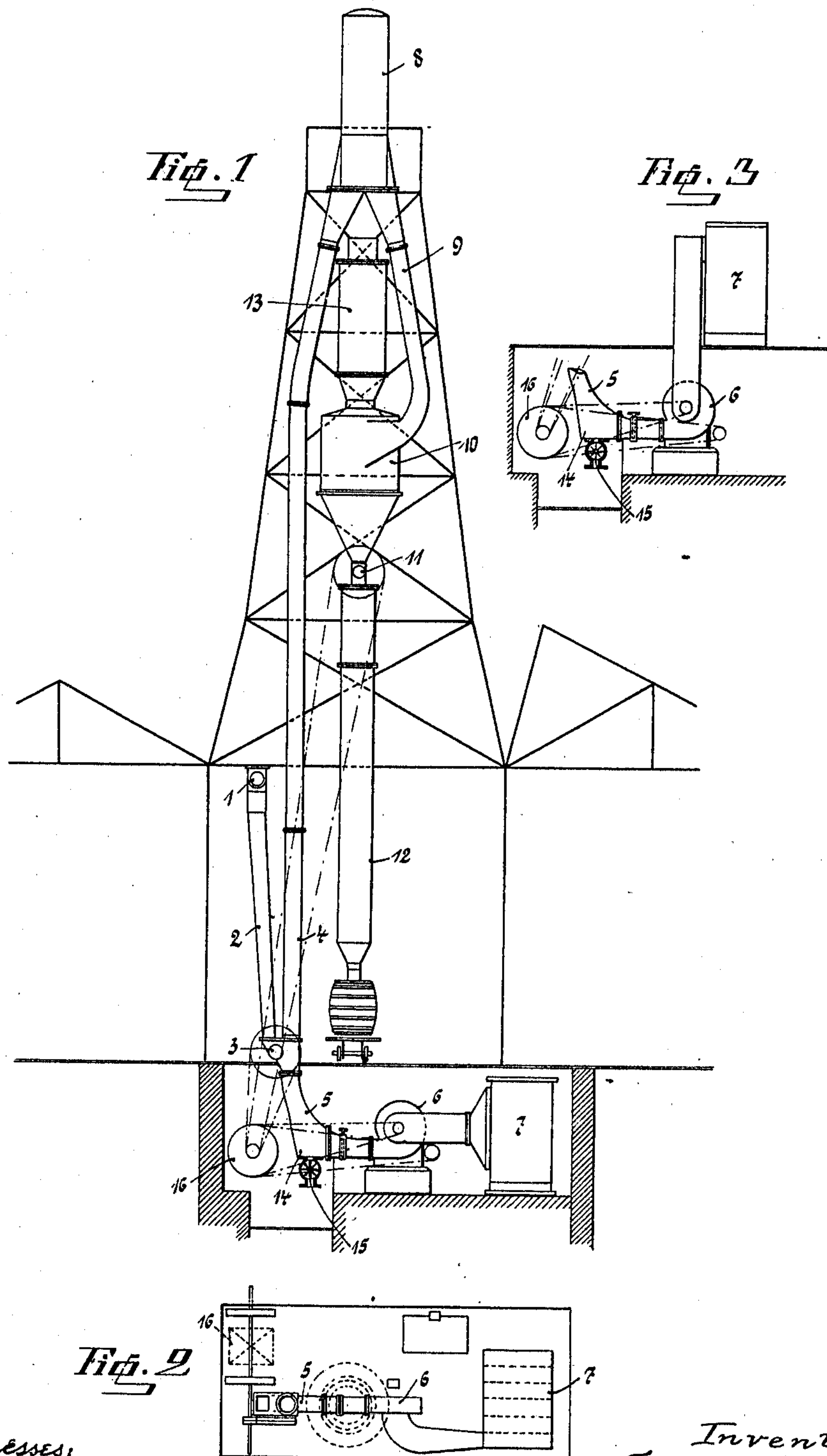


F. A. BÜHLER.
 APPARATUS FOR DRYING AND CONVEYING MOIST MATERIALS.
 APPLICATION FILED JAN. 27, 1911.

992,939.

Patented May 23, 1911.

3 SHEETS—SHEET 1.



Witnesses:
Charles H. H. H.
Chas. Black

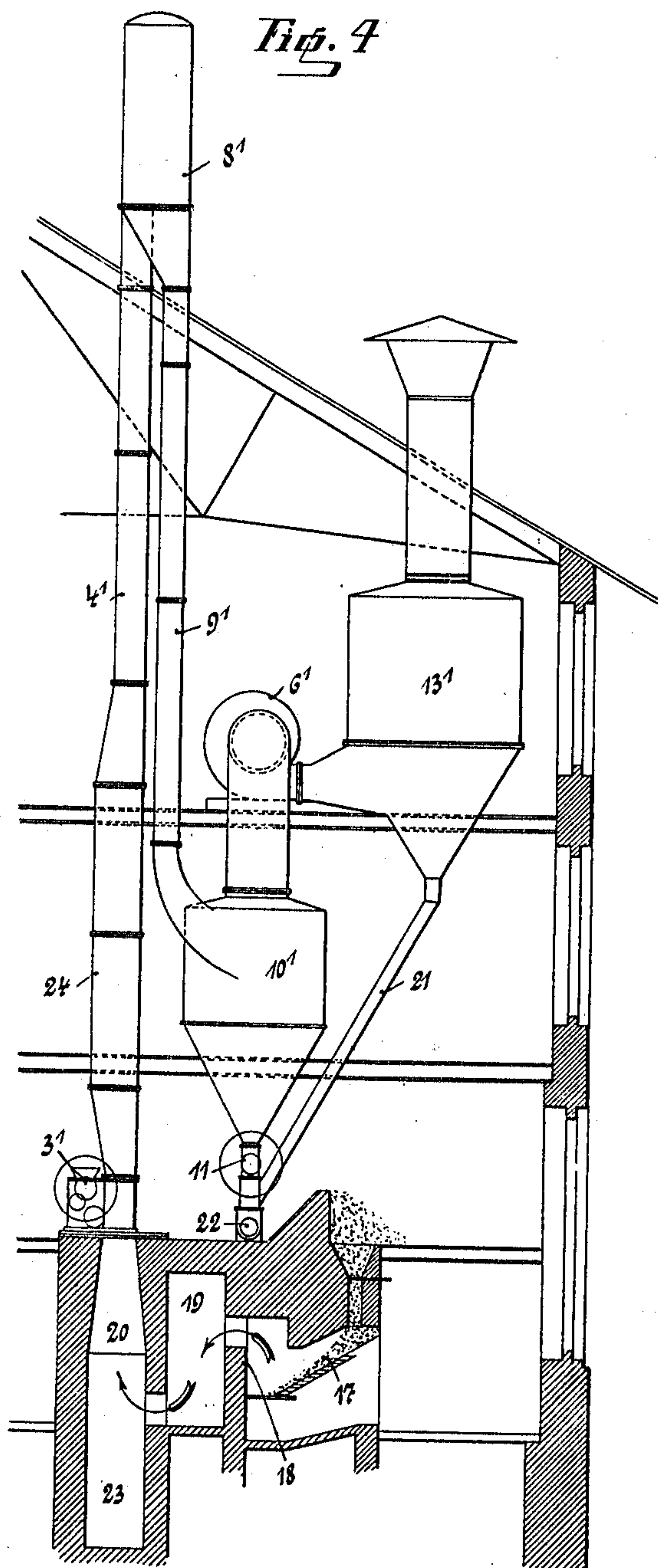
Inventor:
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3 SHEETS—SHEET 2.



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3 SHEETS—SHEET 3.

Fig. 5

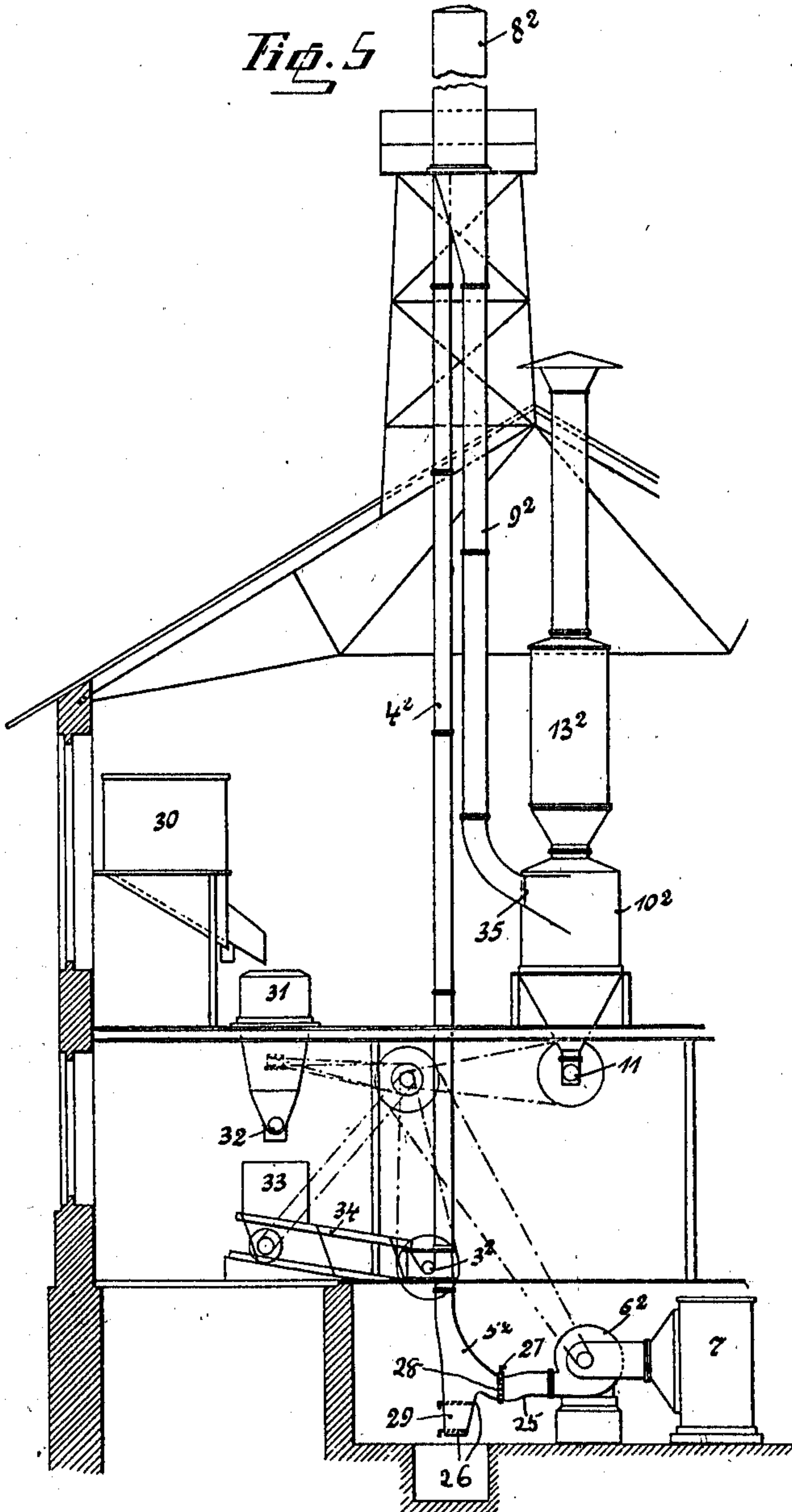


Fig. 7

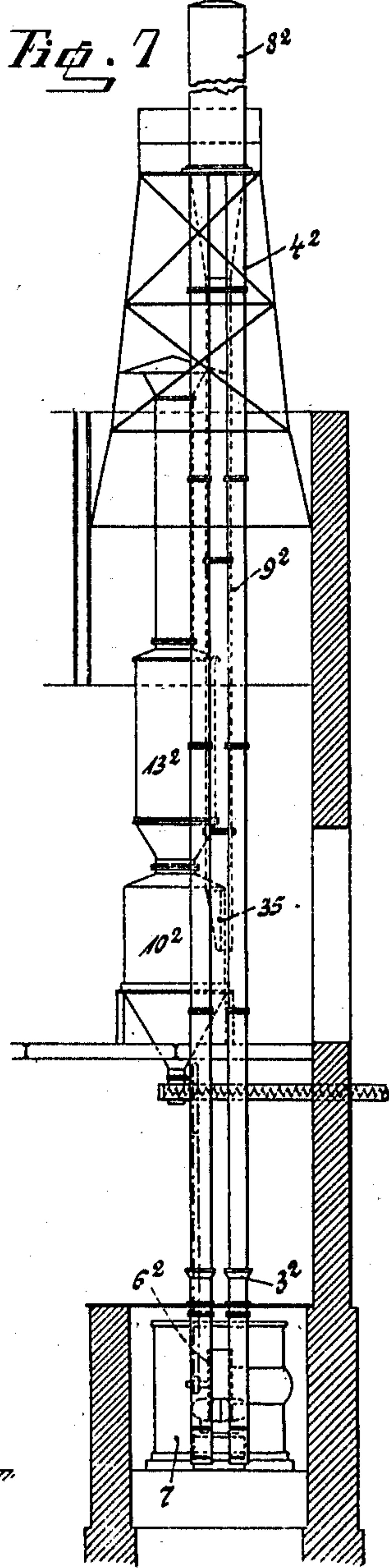
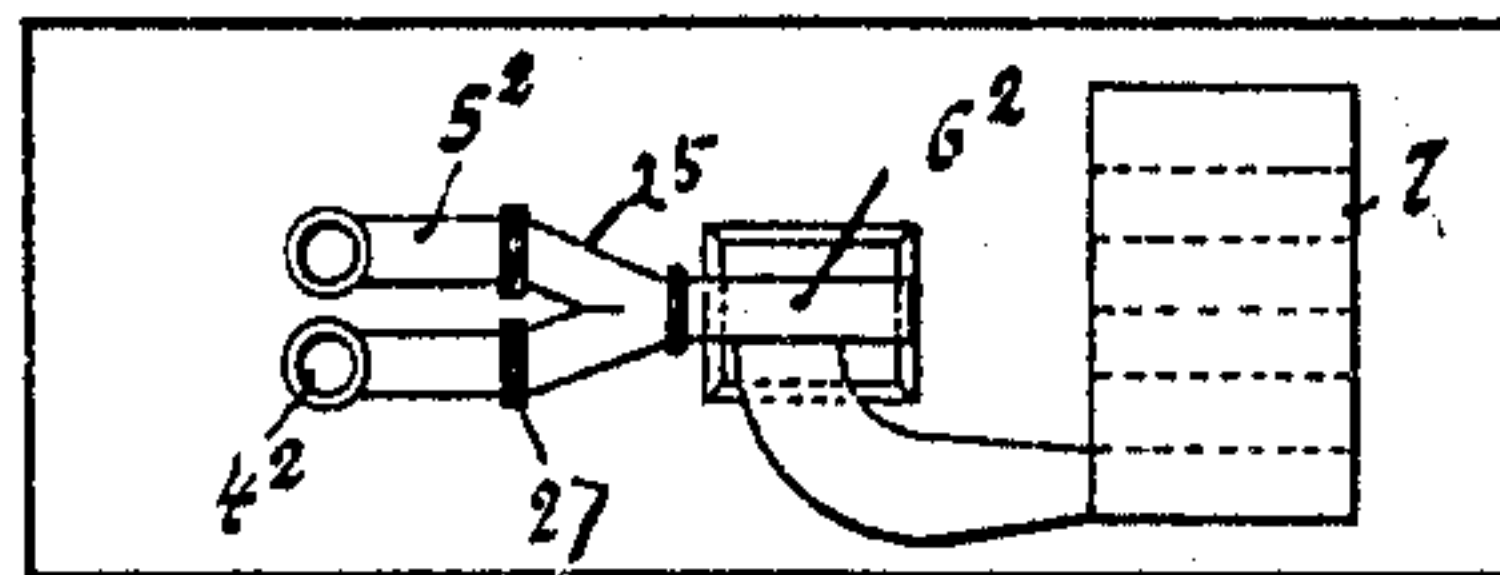


Fig. 6



Witnesses:
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UNITED STATES PATENT OFFICE.

FRIEDRICH ADOLF BÜHLER, OF GROSSLICHTERFELDE, NEAR BERLIN, GERMANY.

APPARATUS FOR DRYING AND CONVEYING MOIST MATERIALS.

992,939.

Specification of Letters Patent.

Patented May 23, 1911.

Application filed January 27, 1911. Serial No. 604,960.

To all whom it may concern:

Be it known that I, FRIEDRICH ADOLF BÜHLER, engineer, a citizen of the German Empire, residing at Grosslichterfelde, near Berlin, in the German Empire, have invented a new and useful Apparatus for Drying and Conveying Moist Materials; and I do hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to improvements in apparatus for drying and conveying moist materials, such for example as salts, and more particularly to that class of apparatus in which the materials are dried and conveyed by means of a current of warm air or gas. The construction of such apparatus as now in use is objectionable, because the energy imparted to the materials in the drying and conveying operation is used up by the current of the cooling medium which flows in a direction opposite to that of the materials. Therefore the energy required in the operation is comparatively large as compared to the actual effect, and furthermore more or less moisture is imparted to the dried materials by the cooling medium.

The object of the present improvements is to render the drying and conveying operation more effective. And with this object in view my invention consists in supplying the material into a drying tube or stack, bringing the same in contact with a current of warm or hot air, gas, or the like, and conveying the same into a baffle chamber within which the direction of the movement is reversed, whereupon the drying and conveying current and the material subjected to the operation are conducted downward in order to be separated within a separator. In this method of operation the energy required for moving the mass of material upward is balanced by the energy of the material which is moving downward, except as to the losses caused by friction and the differences in the levels of the inlet and outlet ends respectively, so that the energy required in the operation of the apparatus is comparatively small, and is great only when starting the apparatus, because then a large amount of material must be accelerated.

In order that my invention may more clearly be understood several examples embodying the same have been shown in the accompanying drawings in which the same

letters of reference have been used in all the views to indicate corresponding parts.

In said drawings—Figure 1, is a front elevation of the apparatus, Fig. 2, is a plan of the same, Fig. 3, is a partial view of an apparatus similar to that shown in Figs. 1 and 2, in which however the air heater is disposed at a different place, Fig. 4, is a front view of a modification of the apparatus, Fig. 5, is a front view of a further modification, Fig. 6, is a plan of Fig. 5, and Fig. 7, is a side view of the same.

Referring to the example illustrated in Figs. 1 and 2, the material to be dried and conveyed is supplied to a feeding device 3 by means of a worm conveyer 1 and a supply tube 2, and from the said feeding device it is uniformly conveyed into a drying tube or stack 4. The drying tube 4 rises from a tube 5 which is connected to a blower 6. The latter is connected with a heating apparatus 7 within which the gas or air is heated to a temperature suitable for the character of the goods or material to be dried. By means of the blower the gas or air is forced into the drying tube 4 where it carries along the material and throws the same into a baffle chamber 8. The latter is constructed in the form of a receptacle of suitable length and cross-section, and its diameter is larger than that of the tube or stack 4. Within the baffle chamber the direction of the current of air and suspended material is reversed or changed, whereupon the weight of the goods is caused to assist the conveying operation. Within the drying tube or stack 4 the material has been brought in thorough contact with the air or gas, and it has been completely dried therein, because, by reason of its weight, it has a smaller speed than the current of drying gas. Therefore constantly new particles of the drying agent are brought in contact with the material, and by reason of the relative speed of the air the particles are constantly revolved and whirled about. In the downward movement of the current of air and material the speed of the latter is greater, so that also in this case the goods are effectively dried. From the baffle chamber the material to be dried is conveyed through the tube 9 into a cyclone chamber 10 within which the air or gas is separated from the material. In old constructions the discharge end of the tube 9 is horizontal and of uniform cross-section throughout. But

in my improved construction it is tapered outward and bent so as to form a curved inlet by means of which the mixture of material and air is more easily separated.

5 From the cyclone chamber 10 the material is supplied to a discharging device 11 from which it may be conveyed to another place. If desired the material is distributed with-
10 way, and from which the material is filled into barrels or other receptacles. The drying agent escapes from the cyclone chamber through an air filter 13.

In the example described the tube 5 is not
15 constructed in the form of an ordinary curved tube of uniform cross-section, but it is tapered outward from both ends toward its central curved part, whereby a chamber 14 is formed. Within the latter the material
20 which descends downward from the inlet end of the tube and which is not carried upward by the current of air is gathered. Therefore the said material can not choke or obstruct the tube. Such an enlargement
25 of the tube 5 is particularly important in cases in which the material to be treated contains thick pieces. The material deposited within the tube is withdrawn therefrom through a discharging device 15, from
30 which it is again supplied to the feeding device 3.

The blower 6 by means of which the air is supplied from the heating apparatus 7 into the drying tube or stack 4 is disposed
35 within a pit together with the driving motor 16 and its belt gearing, while the other parts of the apparatus except the air heater 7 are suspended from a frame work. The air heater 7 may be disposed within the pit,
40 or on the floor of the plant, as is indicated in Fig. 3.

In the example shown in Fig. 4 fire gases are used for conveying and drying the material, which gases are drawn through the
45 apparatus by means of a blower 6'. The fire gases which come from the hearth 17 pass over the fire bridge 18 and into a chamber 19. From the latter they pass into a chamber 20 which is tapered inward at its
50 upper end and which carries the tube or stack 4'. By means of a feeding device 3' the material is supplied to the chamber 20 or the lower part of the stack 4', whereupon it is conveyed into the baffle chamber 8' by
55 means of the current of air produced by the blower 6'. From the baffle chamber 8' the mixture of gas and material descends into the cyclone chamber 10' through the tube 9'. After the air or the gas has passed
60 through the separator 10' it flows through an air filter 13' within which the dust is separated by means of a sieve and conveyed through a tube 21 to a discharge opening 22. In this example the chamber 20 is pro-
65 vided with a pit 23 within which the ma-

terial which has not been carried along is deposited so as to avoid choking the tubes or passages. From the said pit the material is withdrawn through an opening which is normally closed by a gate or valve. 70

The apparatus shown in Fig. 4 is suitable only for drying such materials as are not injured by being brought in contact with the fire gases from the hearth 17. To protect the blower 6' from injury by the said
75 gases it is disposed at the discharge end of the apparatus, and it acts by suction. In the example shown means are provided whereby irregularities in the operation are prevented which might be caused by ag-
80 glomerating material. For this purpose the stack 4' is formed, preferably at its lower part, with an enlarged portion 24. Within the said enlarged portion the agglom-
85 erating material is deposited without obstructing the cross-sectional area of the passage beyond what is allowable in a satisfactory operation. As the material de-
90 posited in the said enlarged portion is dried it breaks off and tends to drop downward. But it is broken up again by striking on the material which is being carried upward by the current of air, and it is carried upward by the latter. The feeding device which
95 may be supplied in any preferred way with the material to be dried is protected against the influence of the fire gases. Instead of using fire gases for drying the material as has been shown in Fig. 4, other gases may
100 be used. When using gas coal or other fuel high temperatures are available.

In the example illustrated in Figs. 5 to 7 the tubes 4² through which the material and the current of drying gas move upward are so constructed that they can be cleaned,
105 and the said tubes are connected to the blower 6² and the common baffle chamber 8² by means of a tube 25 having two branches. The tubes can be cleaned without stopping the operation of the apparatus. In the ex-
110 ample shown two tubes 4² for the ascending current of air and material are connected to the blower 8² by means of a V-shaped tube 25. Between the V-shaped tube 25 and the
115 curved tubes 5² gates or valves 27 are provided by means of which one of the conduits can be closed, or both can be thrown into operation. Preferably the curved tubes are bent downward, as is indicated by the
120 numeral 28, and each of the said curved tubes is provided with a pocket 29 which can be closed by means of two gates 26 in order to prevent the falling material from
125 being blown outward, when the latter is being removed. The material to be dried, for example salt, is supplied from a storing receptacle 30 to a centrifugal machine 31 wherein it undergoes a preliminary drying
130 operation. Thereupon it is conducted into a filling chamber 33 by means of a worm

32, and it is supplied to one of the feeding devices by means of an oscillating feed trough 34, by means of which any irregularities in the feed are balanced.

5 The remaining parts of the apparatus are similar to the corresponding parts used in the examples shown in Figs. 1 and 2. The material descending in the tube 9² passes through a laterally curved admission tube 10 35, the discharge end of which is of square cross-section, and into the separator or cyclone chamber 10². From the latter the air escapes through an air filter 13², while the dried material is removed from the cyclone 15 chamber at 11 by means of the separator. In each of the forms of my invention illustrated herein, the material to be dried and the drying agent travel upward in the stack (4, 4¹, 4²) which may be termed the ascending portion of a duct which also comprises the 20 chamber (8, 8¹, 8²) and the descending portion (9, 9¹, 9²) leading to the separator. Owing to the fact that the material and the drying agent travel downward in a portion 25 of this duct, the energy required for moving them through the duct is decreased.

I claim herein as my invention:

1. In an apparatus for conveying and treating materials, the combination with a 30 stack, of means to force a current of a treating gas upward through said stack, means to supply material to be dried, to said stack near the lower end thereof, a baffle chamber communicating with said stack at the upper 35 end thereof and adapted to reverse the current of treating gas and material ascending into the same from said stack, a tube connected with said baffle chamber and extending downward therefrom, and means to separately remove the treating gas and material 40 from said tube.

2. In an apparatus for conveying and treating materials, the combination with a 45 stack, of means to force a current of a treating gas upward through said stack, means to supply material to be treated, to said stack near the lower end thereof, a baffle chamber communicating with said stack at the upper 50 end thereof and adapted to reverse the current of treating gas and material ascending into the same from said stack, a tube connected with said baffle chamber and extending downward therefrom, and means to separately remove the treating gas and material 55 from said tube and means to cool the treated material after its removal from said tube.

3. In an apparatus for conveying and treating materials, the combination with a 60 stack, of a blower arranged to cause a current of treating gas to flow through said conveying tube, a baffle chamber communicating with said stack at the upper end thereof and adapted to reverse the current of treating 65 gas and material ascending into the same

from said stack, a tube connected with said baffle chamber and extending downward therefrom, and means to separately remove the treating gas and material from said tube, said blower being disposed at the discharge 70 end of the apparatus.

4. In an apparatus for conveying and treating materials, the combination with a stack, of a blower arranged to cause a current of treating gas to flow through said 75 conveying tube, a baffle chamber communicating with said stack at the upper end thereof and adapted to reverse the current of treating gas and material ascending into the same from said stack, a tube connected 80 with said baffle chamber and extending downward therefrom, and means to separately remove the treating gas and material from said tube, said blower being disposed at a point of the apparatus away from the 85 admission of treating gas.

5. In an apparatus for conveying and treating materials, the combination with a stack, of means to force a current of a treating gas upward through said stack, means 90 to supply material to be treated to said stack near the lower end thereof, said stack having its lower portion above the means to supply material to be treated constructed with an enlarged cross-section, a baffle 95 chamber communicating with said stack at the upper end thereof and adapted to reverse the current of treating gas and material ascending into the same from said stack, a tube connected with said baffle chamber and 100 extending downward therefrom, and means to separately remove the treating gas and material from said tube.

6. In an apparatus for conveying and treating materials, the combination with a 105 stack, of tubular connecting means secured to the lower end of said stack and having an enlarged portion adapted to gather material falling through said stack downward, means to remove such material from said enlarged 110 portion, means to cause a current of a treating gas to flow through said connecting means and stack upward, means to supply material to be treated to said stack near the lower end thereof, a baffle chamber communicating with said stack at the upper end 115 thereof and adapted to reverse the current of treating gas and material ascending into the same from said stack, a tube connected with said baffle chamber and extending downward 120 therefrom, and means to separately remove the treating gas and material from said tube.

7. In an apparatus for conveying and treating materials, the combination with a 125 stack, of means to force a current of a treating gas upward through said stack, means to supply material to be treated to said stack near the lower end thereof, a baffle chamber communicating with said stack at the upper 130

end thereof and adapted to reverse the current of treating gas and material ascending into the same from said stack, a separator for separating the material from the gas, a tube connected with said baffle chamber and extending downward therefrom and terminating with a curved portion into said separator, and means to separately remove said material and gas from said separator.

8. In an apparatus for conveying and treating materials, the combination with a plurality of stacks, of means to force currents of a treating gas upward through said stacks, means to supply material to be treated to said stacks, a baffle chamber communicating with both stacks at the upper ends thereof and adapted to reverse the currents of treating gas and material ascending into the same from said stacks, a tube connected with said baffle chamber and extending downward therefrom, means to separately remove the treating gas and material from said tube, and means to throw said stacks out of operation.

9. In an apparatus for conveying and treating materials, the combination of a stack having an inlet for the material to be treated, means for producing an ascending current of a treating agent in said stack to carry the material upward therein, a chamber connected with the upper end of the stack, a tube extending downward from said chamber and adapted to receive all the suspended material and the treating agent therefrom, and a separator connected with said tube, to separate the treating agent from the treated material.

10. In an apparatus for conveying and treating materials the combination of a duct having an ascending portion and a descending portion connected therewith, means for

supplying the material to be treated, to the ascending portion of said duct, means for producing in said duct a current of a treating agent which first ascends in one portion of the duct and then descends in the other, carrying all the suspended material along in each of said portions, and a separator to which leads the descending portion of the duct, to separate the treating agent from the treated material.

11. In an apparatus for conveying and treating materials, the combination of a continuous duct having ascending and descending portions, and an imperforate connection between them, means for supplying the material to be treated to one of said portions of the duct, a separator connected with the other portion of the duct, to separate the treating agent from the treated material, and means for producing in said duct, a current of a treating agent from the inlet portion to the separator.

12. In apparatus for conveying and treating materials, the combination of a duct having connected ascending and descending portions one of which terminates in a curve, a separator connected with the curved end of said portion, to separate the treated material from the agent employed to treat it, means for supplying the material to be treated, to the other portion of the duct, and means for producing in the duct, a current of the treating agent from the inlet to the separator.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

FRIEDRICH ADOLF BÜHLER.

Witnesses:

HEINRICH RANCHHOLZ,
WOLDEMAR HAUPT.

It is hereby certified that in Letters Patent No. 992,939, granted May 23, 1911, upon the application of Friedrich Adolf Bühler, of Grosslichterfelde, near Berlin, Germany, for an improvement in "Apparatus for Drying and Conveying Moist Materials," an error appears in the printed specification requiring correction as follows: Page 3, line 32, the word "dried" should read *treated*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of June, A. D., 1911.

[SEAL.]

C. C. BILLINGS,
Acting Commissioner of Patents.