Oct. 4, 1932. F. E. M. SCHENK 1,880,284

CONVEYER

Filed Aug. 16, 1929 6 Sheets-Sheet 1

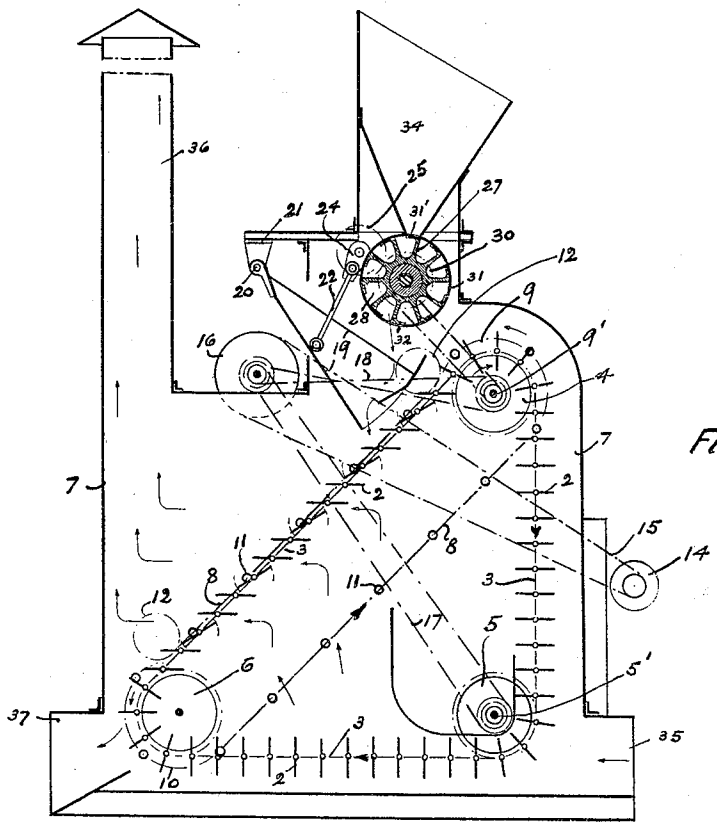


Fig. 1.

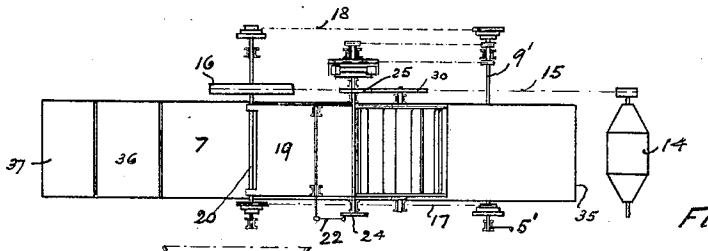


Fig. 2.

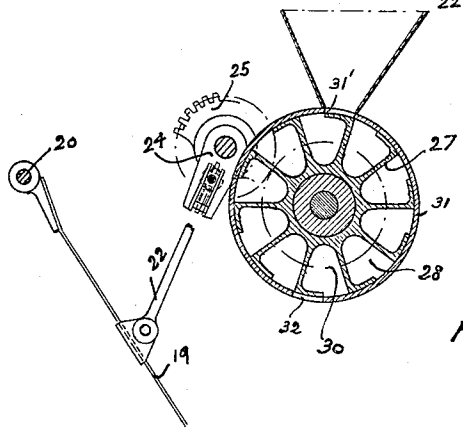


Fig. 3

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CONVEYER

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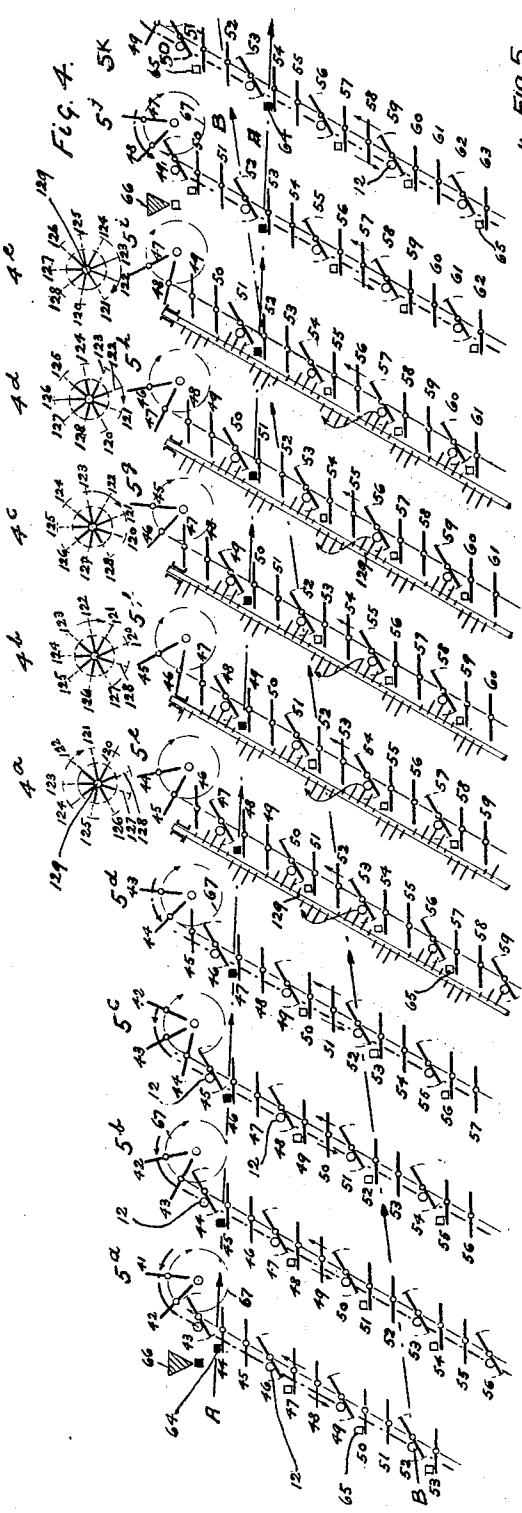


Fig. 4.

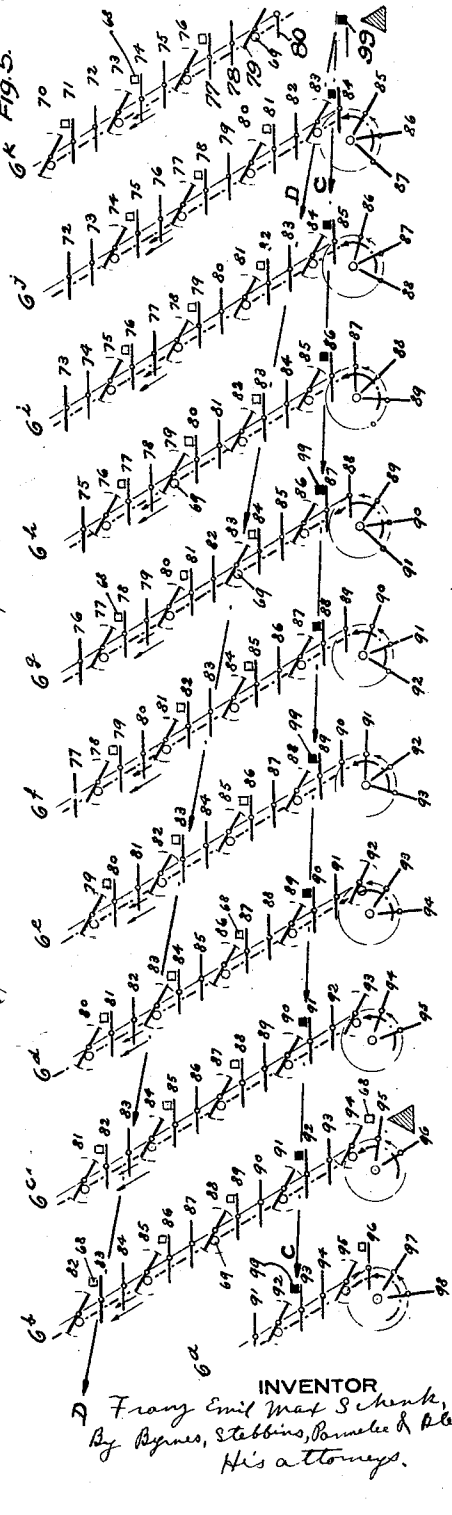


Fig. 5.

Fig. 6.

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CONVEYER

Filed Aug. 16, 1929 6 Sheets-Sheet 3

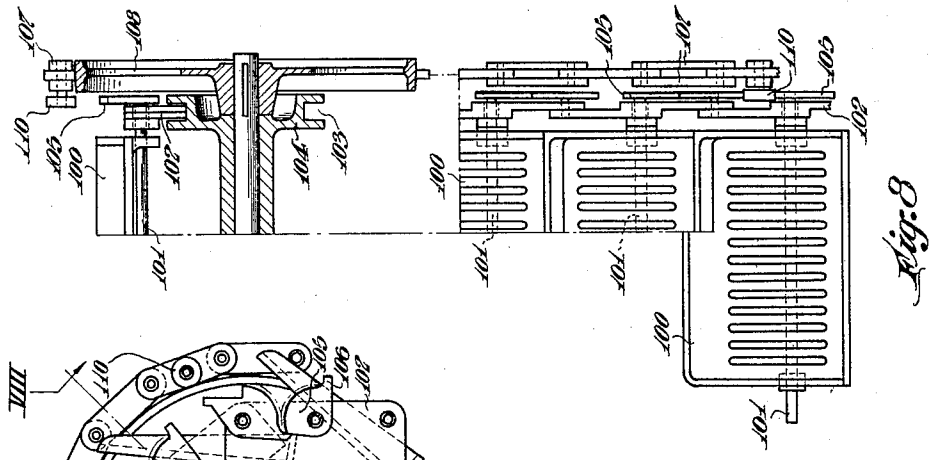


Fig. 8

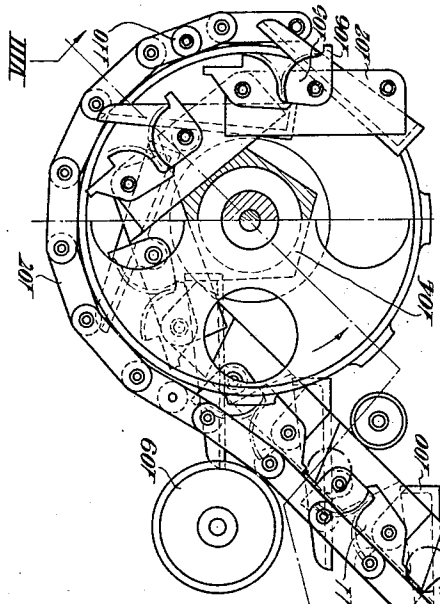


Fig. 7

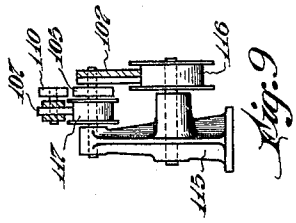


Fig. 9

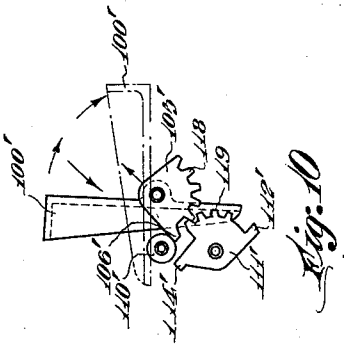


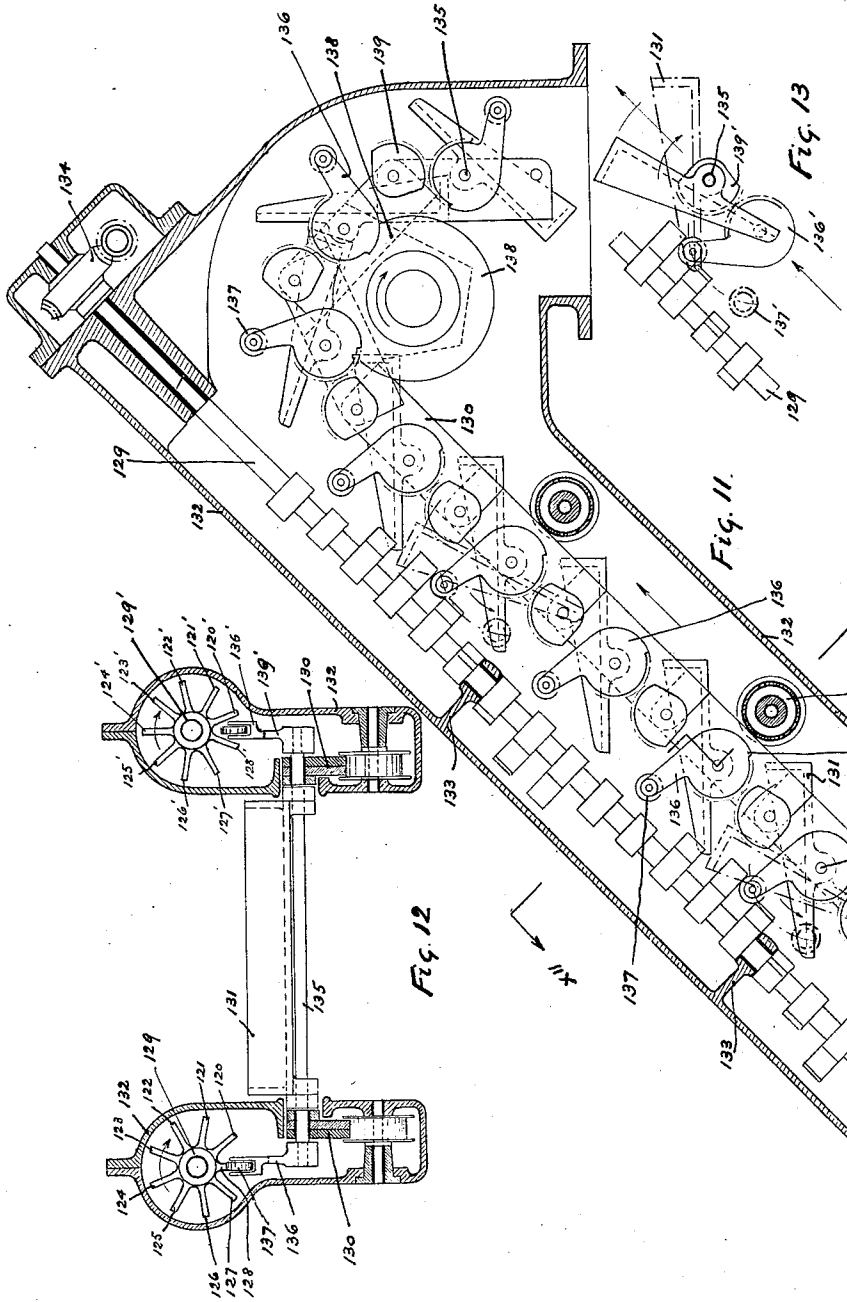
Fig. 10

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Oct. 4, 1932. F. E. M. SCHENK 1,880,284

CONVEYER

Filed Aug. 16, 1929 6 Sheets-Sheet 4



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CONVEYER

Filed Aug. 16, 1929 6 Sheets-Sheet 5

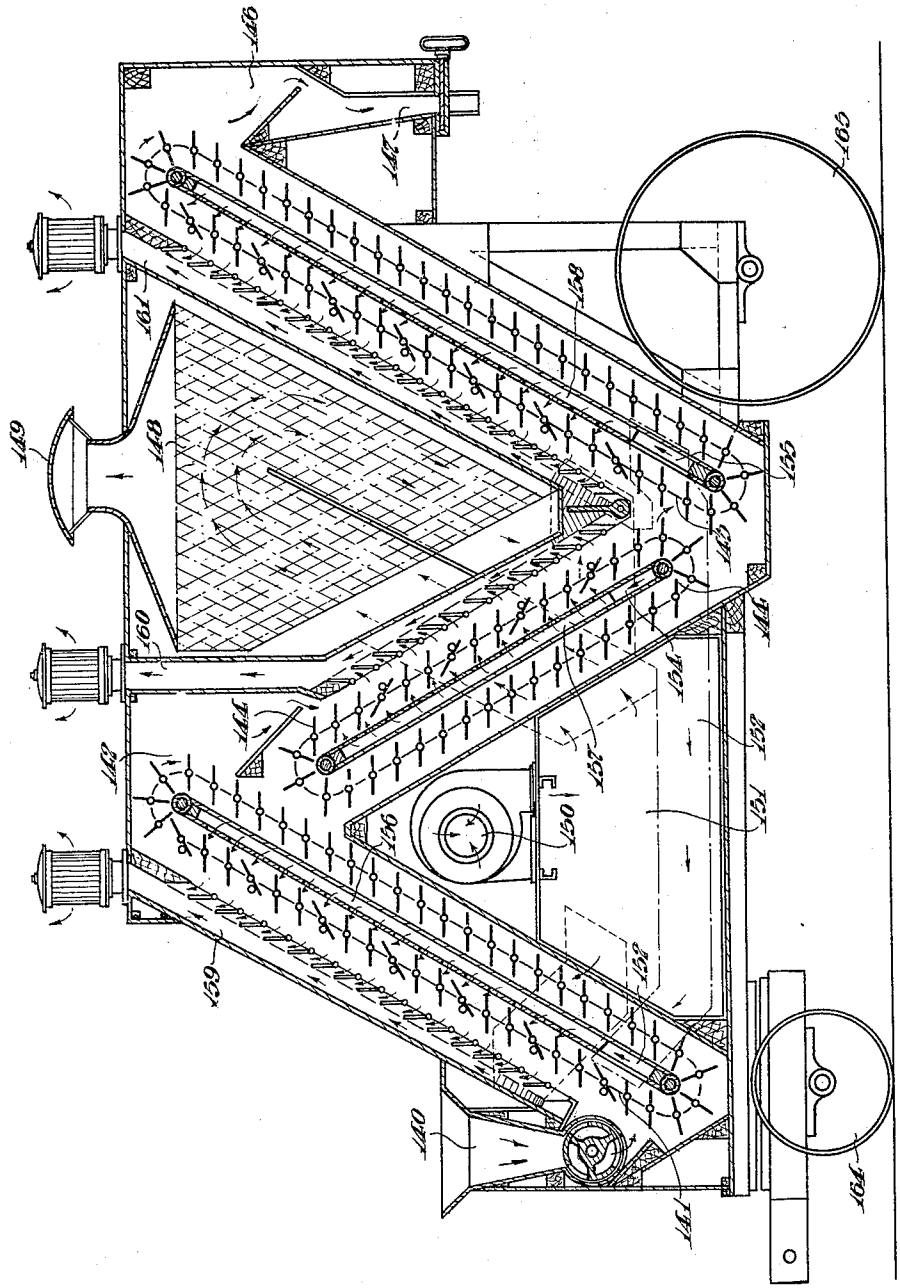


Fig. 11

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CONVEYER

Filed Aug. 16, 1929 6 Sheets-Sheet 6

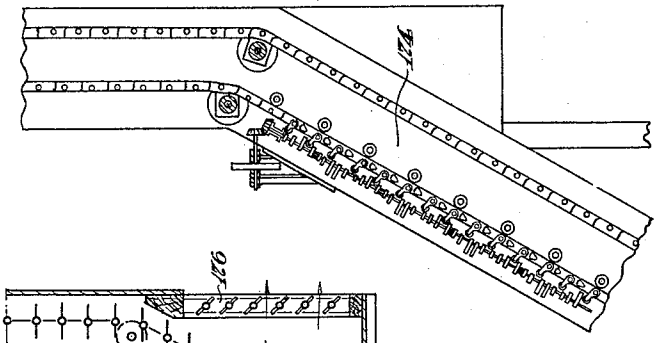


Fig. 16

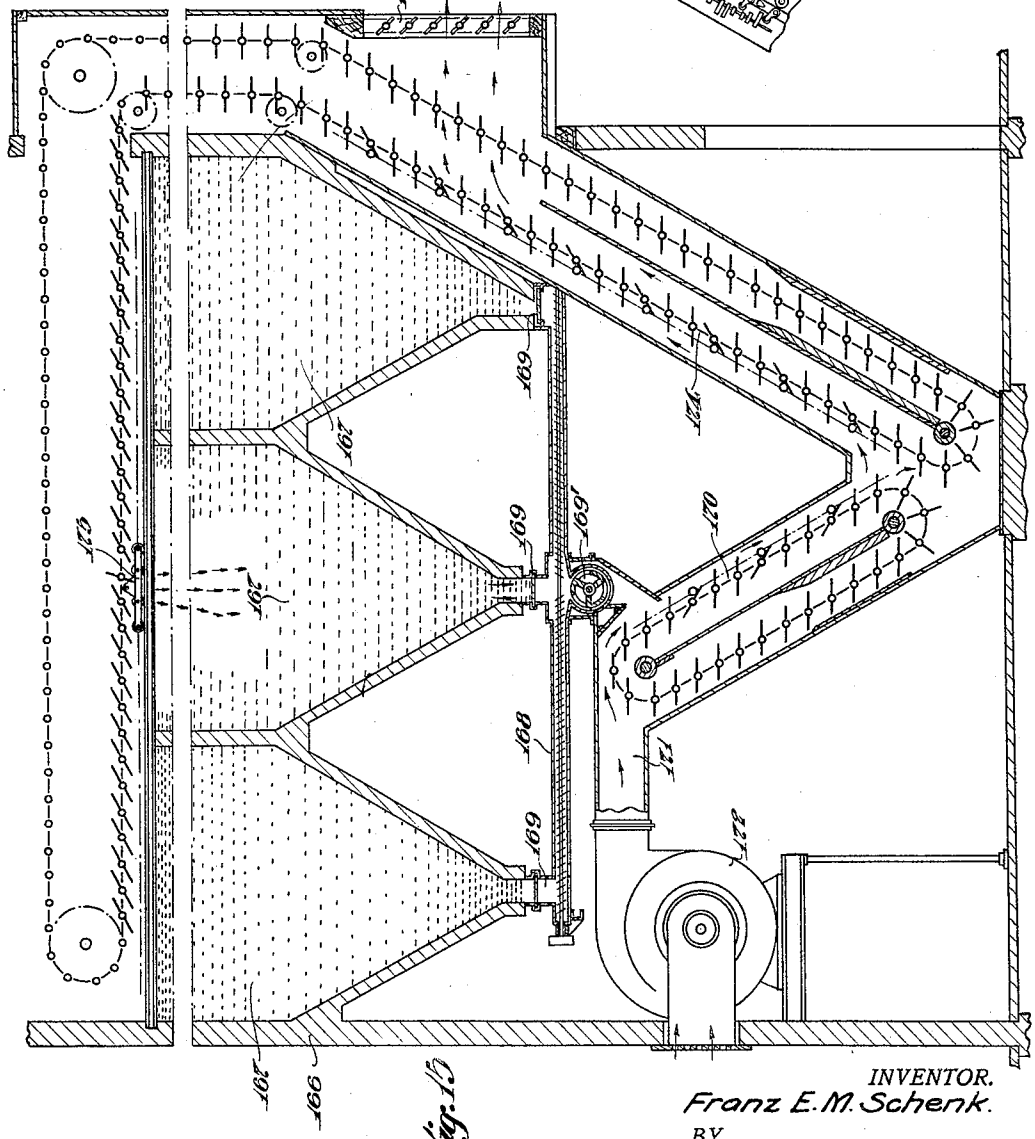


Fig. 15

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Patented Oct. 4, 1932

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UNITED STATES PATENT OFFICE

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CONVEYER

Application filed August 16, 1929, Serial No. 386,324, and in Germany October 30, 1928.

My invention relates to conveyers and more particularly to conveyers for moving material in a general direction by a series of steps of unequal magnitude whereby a series of movements somewhat resembling a cascade movement is obtained. The invention is applicable for mixing materials, for passing materials through drying devices, and for passing material through a furnace or the like where combustion or other chemical processes take place which require that the material be uniformly exposed to air or gases.

On the well-known chain grate type of drier, material is carried along on a conveyer in substantially an undisturbed position relative to the conveyer itself. As the material has little or no relative movement with respect to the conveyer, agitating and turning of the material on the conveyer is seldom obtained. As a result considerable time is needed to perform the desired transformation or treatment of large quantities of material. This is especially true where the size of the conveyer is limited, either by space or by an effort to reduce the cost of installation, with the result that when an attempt is made to move large quanities of material by the conveyer there follows imperfect treatment of the material. If the area of the drying conveyer is increased, in order to spread the material out in a thinner stream and thereby to expose a larger surface to air or other gases, the treatment becomes irregular, due to bare spots on the conveyer. In the case of combustion it is necessary to supply an excess of air to insure complete combustion of the fuel on the conveyer.

In drying devices, such as are now used for drying grains, a series of tiltable pans are mounted one above the other in a cascade arrangement so that as the pans tilt a continuous downward stream of material is obtained. Where a considerable number of tiltings are required it is necessary to provide a very high machine. The height of such a tilting conveyer prevents its use for combustion purposes in furnaces which have to be kept within definite dimensions and particular heights.

In mixing different kinds of material which is moving along a conveyer an unequal distribution of the ingredients is obtained unless the material is thoroughly agitated. This difficulty has led to the general use of mixing machines with conveyers disposed between the mixing machines and other machines in a process.

I provide a conveyer in which material is moved in opposite directions unequal amounts by alternately permitting the material to rest in or on a support such as a moving pan or a bar and periodically tripping the support to deposit the material onto a lower support by the influence of the force of gravity. The frequency with which the supports are dumped is controlled in accordance with the desired amount of agitation to be given the material in a given time and/or during its passage along a conveyer flight of a definite length. The material may be agitated either during a period of elevation from a feeding device to a receiving device, or the material may be agitated during a downward movement from a feeding device to a receiving device. The movement of the material along the conveyer somewhat resembles a cascade movement so that all parts of the material are brought to the surface and/or exposed to air or other gases. The conveyer may be used for mixing materials, for exposing material to air or gases, for heat-treating the material and/or for exposing material in a combustion chamber or chemical process.

With my invention it is possible to perform a large number of tilting operations in a conveyer of limited height. According to my invention the material can be dumped as often as desired, and can be either raised or lowered during the dumping operation.

In the case of material moving upwardly the lower supports are supplied with material. The material moves up a certain distance when it is dumped on the succeeding lower support. The ascending movement of the material while on any support is greater than the distance through which the material falls when it is dumped. This second support ascends a distance when it is dumped, permitting the material to fall on the third support. This operation is continued successively as the material moves upwardly

until it reaches the top of the conveyer flight when it is ejected from the machine. It is to be understood that more than one support may be dumped at the same time, thereby increasing the agitation of the material, if desired.

In lowering material, the material is fed onto the upper supports. The first support is raised a certain distance when it is tilted, and the material falls onto the support beneath it. By having the upward movements of the material less than the downward movements during the tilting operations, the material gradually works down the conveyer flight until it reaches the lowest support, when it is ejected from the machine.

The invention may be embodied in different forms of devices, for instance, pans or grates may be tilted by spur rollers engaging and riding over members connected to the grates or pans for tilting them, or cams carried by a shaft extending longitudinally of the flight may be utilized for successively engaging arms connected to the pans or grates for tilting them. Also by providing conveyer flights in series and consecutively moving material up and down the flights, a thorough mixing of material, or exposure of material to air or gases is obtained with conveyers of relatively short heights.

The accompanying drawings illustrate certain present preferred embodiments of the invention in which

Figure 1 is a schematic elevational view partially in section of a conveyer embodying my invention,

Figure 2 is a plan view thereof,

Figure 3 is an enlarged sectional view of the feeding mechanism therefor,

Figures 4*a* to 4*e* are diagrammatic views showing the operation of a tripping cam,

Figures 5*a* to 5*k* are schematic views showing the downward movement of material during the upward movement of a conveyer flight,

Figures 6*a* to 6*k* are schematic views showing the upward movement of material during the upward movement of a conveyer flight,

Figure 7 is an enlarged elevational view partially in section of a portion of a modified form of conveyer mechanism,

Figure 8 is a plan view thereof taken substantially along the section line VIII—VIII of Fig. 7,

Figure 9 is an elevational view of a portion of the mechanism, taken substantially along the section line IX—IX of Fig. 7,

Figure 10 is an elevational view partially in section, of a modified form of tripping mechanism,

Figure 11 is a longitudinal section view of a further modified form of conveying mechanism,

Figure 12 is a transverse view thereof taken along the section line XII—XII of Figure 11,

Figure 13 is a view of the tripping mechanism,

Figure 14 is a sectional view of a portable conveying device embodied in a drying mechanism,

Figure 15 is a similar view of another embodiment of the invention, and

Figure 16 is a diagrammatical view of a conveyer therefor.

Referring to Figures 1, 2, and 3, a conveyer embodying my invention comprises a plurality of rotatable material supports 2, mounted on endless chains 3 passing around a series of sprocket wheels 4, 5, and 6. The sprocket wheels 4, 5, and 6 are mounted in a frame 7 with the sprocket wheels 4 and 5 substantially in vertical alignment and the sprocket wheels 5 and 6 in horizontal alignment so that the flight of the conveyer chain between the sprocket wheels 4 and 6 extends at an angle to the horizontal. The supports 2 are diagrammatically illustrated in the form of bars which naturally assume a substantially horizontal position. The conveyer 3 moves in a clockwise direction and tends to lift material carried thereby from the sprocket wheel 6 toward the sprocket wheel 4.

An endless chain 8 arranged either on one side or on both sides of conveyer 3 passes around sprocket wheels 9 and 10 coaxially mounted relative to the sprocket wheels 4 and 6, respectively, but of sufficiently greater diameter so that lugs 11 on the chain 8 do not interfere with the supports 2 on the conveyer 3 as they pass over the sprocket wheels. The chain 8 runs in the opposite direction to the conveyer 3. Idling rollers 12, disposed between the sprocket wheels 9 and 10, force the chain 8 and lugs 11 carried thereby into the paths of the supports 2 so that as the conveyer 3 and chain 8 move in opposite directions the successive lugs 11 trip the supports 2. As shown in Figure 1, the lugs 11 are arranged to trip every third support.

The sprocket wheels 4, 5, 6, 9, and 10 are driven from a motor 14 connected by a chain or belt 15 with a pulley 16 mounted on the frame 7. A driving connection 17 is provided between the pulley 16 and the shaft 5′ for the sprocket wheel 5. A chain or belt connection 18 is provided between the pulley 16 and the shaft 9′ for the sprocket wheel 9, driving the chain 8. The connection 18 is reversed relative to the connection 17 so that the sprocket wheels 9 and 10 run in a reversed direction relative to sprocket wheels 4, 5, and 6.

Material to be conveyed and treated is periodically supplied to the supports 2 from a chute 19 which is pivotally mounted on a spindle 20 carried by a bracket 21 constituting a part of the frame 7. The chute 19 is con-

nected by a link 22 to a crank arm 24 connected with a segment gear 25, diagrammatically illustrated in Figure 3, for periodically engaging the crank arm 24 and lifting it. The segment gear 25 may be any one of a number of well known types and is driven by gear 30 from the shaft 9'. A feed wheel 27, having pockets 28 formed therein, is driven through a driving connection 29 and a gear 30 cooperating with the segment gear 25. A housing 31 for the feed wheel 27 is provided with an upper opening 31' and a lower opening 32. The opening 31' communicates with a hopper 34 from which material falls into successive pockets 28. The material in the hopper 34 may be of any character depending upon the process to which the conveyer is adapted. If the conveyer is used in a combustion chamber or in a chemical process, fuel or chemical compounds will be fed into the hopper 34. In case the conveyer is used in connection with a drying process the material to be dried is supplied to the hopper 34. In the case of a mixing operation the materials to be mixed are also placed in the hopper 34, which may be divided into several compartments.

In the operation of the device the feed wheel 27 is turned when the chute 19 is preferably in a lower position for depositing material on the supports 2 which are traveling upwardly. The chute is drawn upwardly by the operation of the segment gear 25 until the desired number of upper supports 2 are filled. Meanwhile the feed wheel 27 rotates to discharge successive batches of material through the opening 32. After the upper supports 2 are supplied with material, the segment gear 25 becomes disconnected to permit the chute 19 to fall by gravity to its lower position, illustrated in Figures 1 and 3. Preferably the feeding takes place from lower to upper supports, although it can be fed downwardly, if desired.

As the material starts to move upwardly with the conveyer 3, the supports 2 are engaged by the successive lugs 11 and the material is tripped to the succeeding supports in a manner more fully hereinafter described in connection with Figures 5*a* to 5*k*. The upward movement is slightly less than the downward movement. It is to be understood that the relative speeds of the conveyer 3 and chain 8 may be varied and the numbe rof lugs 11 may be varied so that the time during which material rests on any support 2 is varied, thereby controlling the number of dumping or tilting operations taking place between the application of material at the top of conveyer to the time it arrives at the bottom of the conveyer. This controls the amount of agitation given the material and also the surface exposure of the material to air or other gases passing through the housing 7. It is also to be understood that by supplying material at the lower sprocket wheel 6 the material can be raised toward the sprocket wheel 4 in a series of steps or motions in opposite directions of unequal magnitude. Regardless of whether the material is raised or lowered the invention contemplates the moving of the material in a general direction through a series of steps of unequal magnitude in opposite directions.

The housing 7 is provided with an opening 35 through which air or other gases are supplied which pass through the material falling between successive supports 2 and escape through a stack 36. An opening 37 is provided in the housing 7 opposite the sprocket wheel 6 for discharging material.

Referring to Figures 5*a* to 5*k*, inclusive, there are schematically registered nine stages in the movement of a unit 64 of material downwardly along a series of tiltable supports 41 to 63, inclusive, in accordance with the tilting of the supports by the lugs 12. The unit of material 64 is shown as a black square while preceding units and succeeding units are shown as open squares 65. The unit of material is deposited by a feeding mechanism 66 onto the support 44 in Figure 5*a*. The upwardly moving support 44 engages a downwardly moved lug 12 which tips it so that the unit is deposited upon the next lower support 45, as shown in Figure 5*b*. As shown in Figure 5*c*, the support 45 is engaged by the lug 12 which deposits the unit of material 64 onto the support 46. It is to be noted that the lug 12 is moved downwardly relative to the center of the sprocket wheel 67 over which the conveyer moves. Accordingly, the material moves downwardly over successive supports 44 to 54, inclusive, while actually only traveling downwardly a distance indicated by the line AA cutting across Figures 5*a* to 5*k*. The vertical distance between the center of the sprocket wheel 67 and the line AA in Figure 5*k* shows the actual downward movement of the unit of material 64 during the period when the support 49 has moved upwardly from its position in Figure 5*a* to its position in Figure 5*k*, which corresponds to the position of the support 42 in Figure 5*a*. The upward movement of a single support during the descending movement of the material is indicated by the line BB extending across Figures 5*a* to 5*k*, inclusive. In this construction the tilting movements of the supports occur at intervals such that the fall of the material at each tripping is greater than the elevation of the material between trippings.

Referring to Figures 6*a* to 6*k*, there is illustrated the operation of the supports in raising material. In these figures the supports are numbered successively from 70 to 98, inclusive. The unit of material 99 is deposited on support 84 intermediate Figures 6*j* and 6*k*. The unit of material is carried up-

wardly by the supports and successively deposited on adjacent lower supports by lugs 69 engaging the successive supports. The material is elevated by each support. The lugs 69 move in the same direction as the supports but at a higher speed and, accordingly, trip the supports for depositing the material on successive supports. The amount by which the material is raised by each support is slightly greater than the fall of the material between supports. Accordingly, the unit of material 99 advances along the line CC as the support 84 on which the material is originally deposited advances along the line DD. By comparing Figures 5*a* to 5*k* with Figures 6*a* to 6*k* the successive movements of a unit of material 64 being lowered are compared with those of the unit of material 99 being raised. In Figures 6*a* to 6*k* white squares 68 indicate units of material on the conveyer before and after the unit whose movement is indicated by the line CC.

Referring to Figures 7 to 10, inclusive, there is shown one form of conveyer mechanism. Supports 100 in the form of pans are swivelly mounted on shafts 101 between connecting side chains 102. The side chains 102 are made of a series of links in the usual form. The side chains 102 rest in a groove 103 in a sprocket wheel 104. As shown in Figure 7, the sprocket wheel 104 is preferably provided with a series of flat surfaces for engaging the links of the chain 102.

The shafts 101 are provided with cams 105 having ears 106 formed thereon. The ears 106 are normally disposed at substantially right angles to the direction of movement of the chain 102 in which position the pans 100 stand in substantially horizontal position for retaining material.

For tilting or dumping the pans 100 chains 107 are disposed on sprocket wheel 108 exteriorly of the chains 102. The diameters of the sprocket wheels 108 are in excess of those of the wheels 104 so that the chains 107 are clear of the pans 100 and chains 102 during the periods when they are traveling around the peripheries of the sprocket wheels. Rollers 109, only one of which is shown and corresponding to rollers 12 in Figure 1, are mounted for pressing the chains 107 into engagement with the chains 102 where rollers 110, carried by the chain 107, engage the ears 106 to rotate the cams 105 in a counter-clockwise direction to tilt the pans 100 into substantially a vertical position, as shown by the dotted line in Figure 7, to deposit material in the next successive pan 100. As shown by the arrows in Figure 7, the chains 102 are moving upwardly while the chains 107 are moving downwardly for tripping the pans. If desired, the pans may be returned to their horizontal, or material supporting, position under the influence of force of gravity.

If, however, a positive drive is desired, cams 111 are mounted on the chains 102 below the cams 105. Each cam 111 is provided with an extension 112 that underlies the lower edge of the adjacent cam 105 so that upon rotation of the cam 105 by the engagement of a lug 106 with a roller 110 the cooperating cam 111 is rotated in a clockwise direction until the roller passes over the cam 105 when the roller 110 engages a projection 114 on the adjacent cam 111 which is turned in a counter-clockwise direction until its projection 112 rotates the cam 105 to return the pan 100 to substantially horizontal position. The cams 111 also serve to keep the pans in alignment when they are on the back and bottom flights of the conveyer.

Referring to Figure 9, supporting brackets 115 may be provided with rollers 116 for supporting the chains 102 and with rollers 117 for supporting the chains 107, if desired.

Referring to Figure 10, a positive drive for the supports 100′ is given by providing teeth 118 on the periphery of each cam 105′ corresponding to the cams 105. Teeth 119 are also provided on the cams 111′. With this construction the movement of either cam 105′ or 111′ in accordance with movement of a roller 110′ positively moves the pan 100′ by reason of the meshing of the teeth 118 and 119.

Referring to Figures 11 to 13, 4*a* to 4*e*, and 5*e* to 5*i*, successive supports may also be tripped by means of one or more cam shafts, as is diagrammatically illustrated in Figures 4*a* to 4*e* and in Figures 5*e* to 5*i*. In Figures 4*a* to 4*e* the positions of a plurality of cams 120 to 128 mounted on a rotatable shaft 129 are shown in successive positions as the shaft rotates. The peripheral arrangement of the cams is indicated diagrammatically by the curling arrows 5*e* to 5*i*, inclusive. It is to be understood that insofar as the schematic operation of the conveyer, as illustrated in Figures 5*a* to 5*k*, it makes no difference whether the supports are tripped by lugs carried by a chain or by cams or by a rotating shaft. In either case the material is carried for a distance by a support which is tripped to permit the material to fall onto a succeeding support.

Referring to Figures 11 to 13, shaft 129 extends longitudinally of the conveyer, external of chains 130, carrying supports or pans 131. The shafts are supported in housings 132 by brackets 133 and are provided with a driving connection such as a worm gear 134.

For tilting the pans or supports 131 their supporting shafts 135 terminating in arms 136 carrying rollers 137, the rollers 137 engage with the successive cams 120 to 128, inclusive, for tripping the pans. It is to be understood that the number of cams on shaft 129 may be varied and that the speed of the shaft may be varied in accordance with the

desired movement of the conveyers. The chains 130 are supported by rollers 137 mounted in the frames 132 and the chains pass over sprocket wheels 138 corresponding to the sprocket wheel 104 of Figure 7. The chains 130 carry cams 139, which engage with notches 136'', formed in the bases of the arms 136 for preventing the backward rotation thereof to such extent that the rollers 137 cannot be engaged by the cams on the shafts 129. Generally one cam shaft 129 will be sufficient to trip the pans 131, the return motion of the pans to the normal material supporting position being effected by the force of gravity.

In case it is found necessary to force the pans back into their normal position after being tipped, which tipping is being accomplished by the cam shaft 129 in the manner described before, a second cam shaft 129' is being arranged on the other side, as is being illustrated in Fig. 12. Referring to Fig. 13, which illustrates the arrangement of arm 136' and cam 139', the position of these two parts is reversed, the cam 136' being rotatably attached to the chain 130, whereas the cam 139' is rigidly connected to shaft 135. Figure 13 shows how the pan 131, indicated in tilted position by full lines, is being tipped back to its normal material supporting position, indicated by dotted lines, by means of cams 120' to 128' on cam shaft 129', acting upon rollers 137' carried by arm 136'.

Referring to Figure 14, there is shown an application of the conveyer to a drying and cleaning device for grain. Grain is charged at an inlet 140 from which it is fed onto the conveyer 141. The conveyer 141 lifts the grain until it is discharged into a chute 142. A second conveyer 144 moves the material downwardly from the chute 142. At the lower end of the conveyer 144 the material is discharged onto a conveyer 145, which elevates and discharges it into a chute 146 from which it is discharged through a hopper 147 to the outside of the machine or sacks as desired.

During this up and down movement, the material is constantly being dumped in accordance with the characteristics of the conveyers heretofore described, whereby the material is agitated and exposed to numerous air currents. Assuming the several conveyers to be driven by a prime mover, such as a gasoline engine, the waste gases are conducted into a preheater 148 where the gases give up part of their heat and are discharged through a putted outlet 149.

A blower 150 forces air from the atmosphere into an air pocket 151 from whence it is blown through the preheater 148 and discharged into channels 152, 154, and 155 opening above the sprocket shafts of the conveyers 141, 144, and 145, respectively. The hot air flows from the outlets 152, 154 and 155 through chambers 156, 157, and 158, respectively. The latter chambers are provided with perforated tops through which warm air escapes across the path of the material being moved by the conveyers 141, 144, and 145, respectively. The hot air is collected in chambers 159, 160, and 161, associated with the conveyers 141, 144, and 145, respectively.

Accordingly grain traversing the drier is agitated during its movement along the several conveyers to expose large surfaces to the action of the warm air. The conveyer is mounted on wheels 164 and 165 for ease in transportation.

Referring to Figures 15 and 16, there is shown a storage warehouse or elevator 166, having a plurality of bins 167 in which grain or the like is stored. In order to prevent the grain from becoming musty it is necessary to clean and air it occasionally.

For this reason the bins 167 communicate with a horizontal extending conveyer 168, which is connected to the bins by gates or valves 169. The conveyer 168 moves the grain from the bins 167 to a central feed wheel 169' which in turn deposits the grain on a conveyer 170. The conveyers 170 and 174 are preferably cam controlled similarly to the conveyer shown in Figure 11 and as is illustrated in Figure 16. Air is forced into casing 171 for the conveyer 170 from a fan 172. The grain is deposited by the conveyer 170 on a conveyer 174 which extends upwardly and laterally of the bins 167 so that the grain may be returned through a tripper 175 to any bin 167. The air from the blower 172 after moving down the conveyer 170 moves up the conveyer 174 and out a port 176, so that the grain during its downward movement and upward movement is repeatedly agitated in the moving air column with the result that it is dried.

While I have shown several preferred embodiments of the invention, it is to be understood that it may be otherwise embodied and practiced without departing from the scope of the appended claims.

I claim:

1. In a conveyer, an endless chain, a plurality of supports pivoted thereto, and variable speed traveling means for dumping one support into another at such a rate that the material being conveyed may be caused to move generally in a selected direction in a series of alternate backward and forward steps.

2. A conveyer comprising loaded supports moving upwardly, and a traveling trip for repeatedly dumping the material in each of said supports into an adjacent support on said conveyer, whereby said material advances with a pilgrim-step motion.

3. In a conveyer, continuously moving supports, and means for repeatedly dumping each support into an adjacent one at a variable frequency, to cause the material carried

to move generally in a selected direction relative to the movement of the carriers.

4. In a method of handling granular material, the steps including repeatedly lifting discrete portions thereof through a predetermined distance and dumping said portions through a distance greater or less than said first-mentioned distance to effect a net downward or upward step-by-step movement of said portions.

5. In a method of handling granular material, the steps of raising and dumping discrete portions thereof repeatedly and controlling the direction of resultant movement of the material by varying the frequency of dumping relative to the rate of raising.

6. In a conveyer having a lifting flight, a plurality of supports pivoted thereto, and means for successively dumping a plurality of said supports simultaneously into the supports therebelow.

7. In a conveyer having a lifting flight, buckets pivoted on the conveyer, and movable means disposed substantially parallel to said flight for successively dumping a plurality of buckets on said flight simultaneously into the buckets therebelow.

8. Means for handling material comprising a conveyer having a lifting flight with buckets pivoted thereon, and means for causing a net upward or downward movement of material in the buckets on said lifting flight comprising a tripping chain moving downwardly parallel to said flight.

9. A material-handling means comprising a conveyer with a lifting flight having supports pivoted thereto and a tripping chain traveling downward along said flight for successively dumping a plurality of said supports simultaneously into the supports therebelow.

10. Material-handling apparatus comprising a lifting conveyer flight having supports pivoted thereon, and means for dumping each of said supports into the supports located below them on said flight with such frequency relative to the speed of the lifting flight as to cause material on said supports to have a predetermined net movement in a vertical plane.

11. In a method of handling material carried in supports pivoted to a lifting conveyer flight, the steps including repeatedly dumping a plurality of supports in said flight simultaneously into the supports therebelow.

12. The combination with a conveyer having a lifting flight with a plurality of supports pivoted thereto, of a traveling tripper extending along said flight for simultaneously dumping a plurality of buckets thereon into the bucket therebelow, and variable speed driving means for such tripper.

13. In a conveyer, a continuous chain disposed to form a lifting flight, buckets pivoted to said chain and a tripping chain traveling downward along said lifting flight for repeatedly dumping each of the buckets thereon into the bucket therebelow.

In testimony whereof I have hereunto set my hand.

FRANZ EMIL MAX SCHENK.