No. 753,696. PATENTED MAR. 1, 1904.

C. E. GEIGER.

FILTERING APPARATUS.

APPLICATION FILED JUNE 20, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

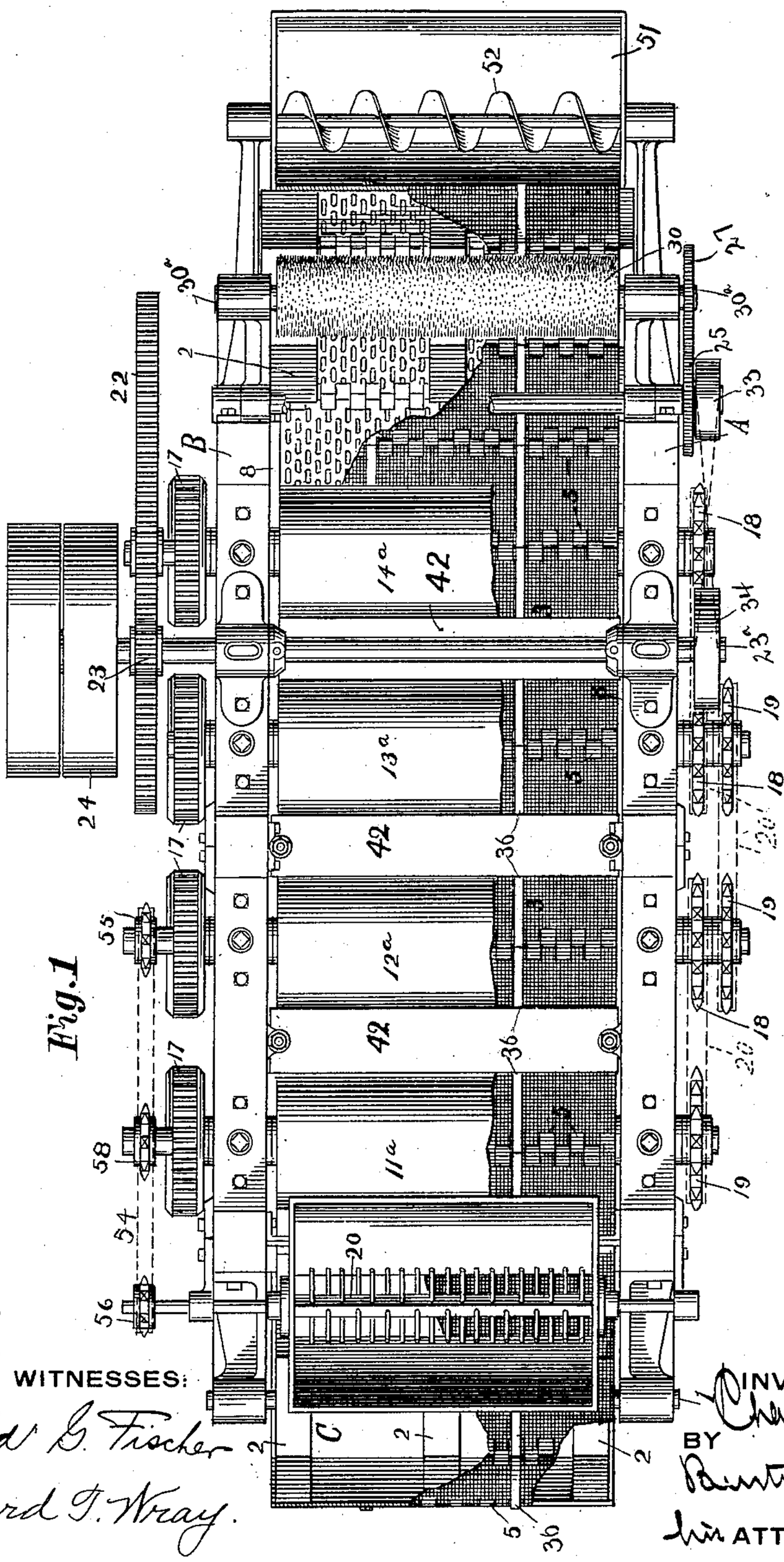

Fig. 1.

WITNESSES:

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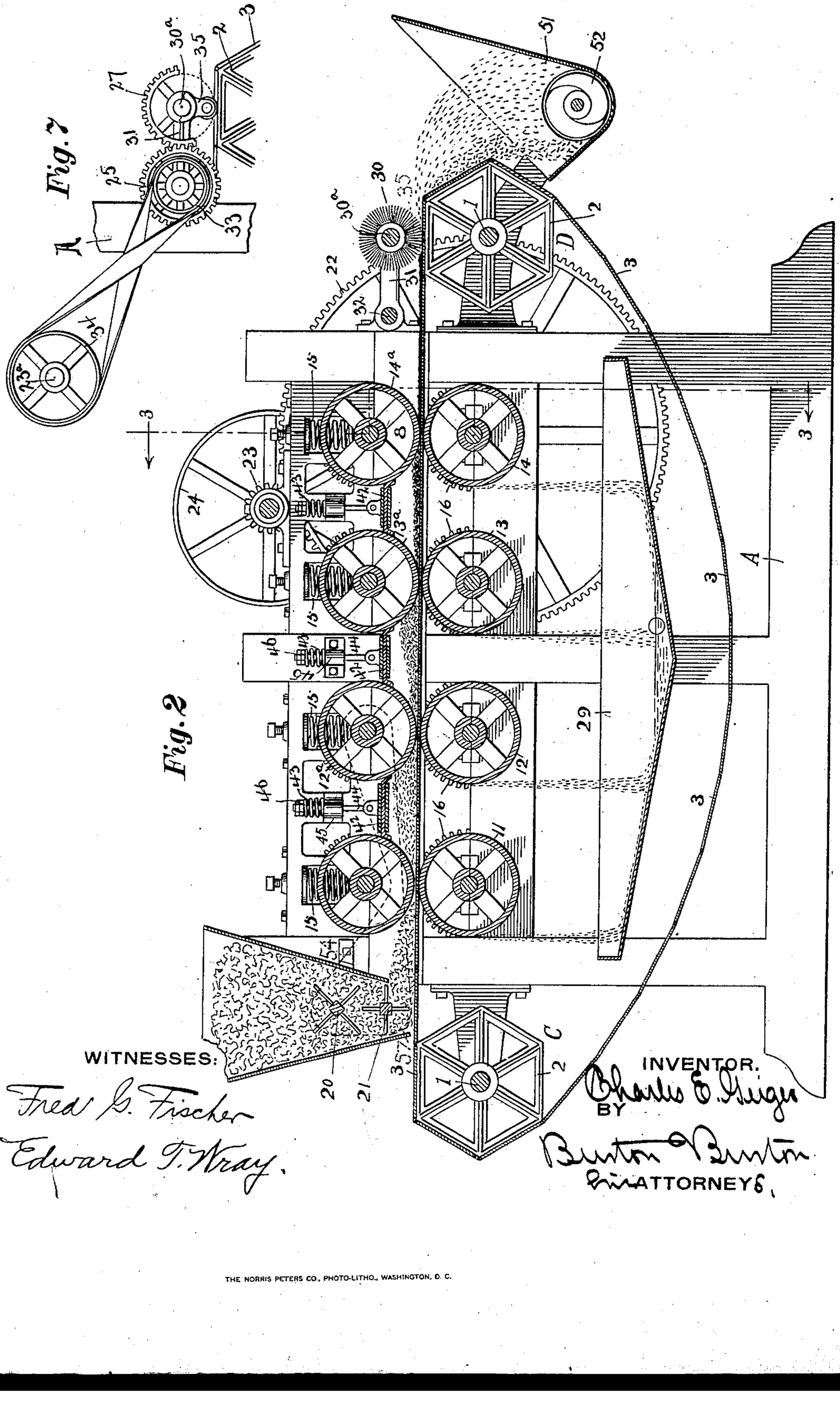
NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2



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NO MODEL. 3 SHEETS—SHEET 3.

Fig.6

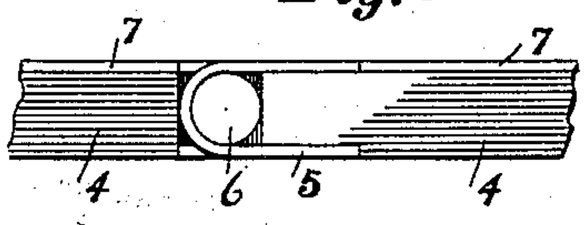


Fig.3

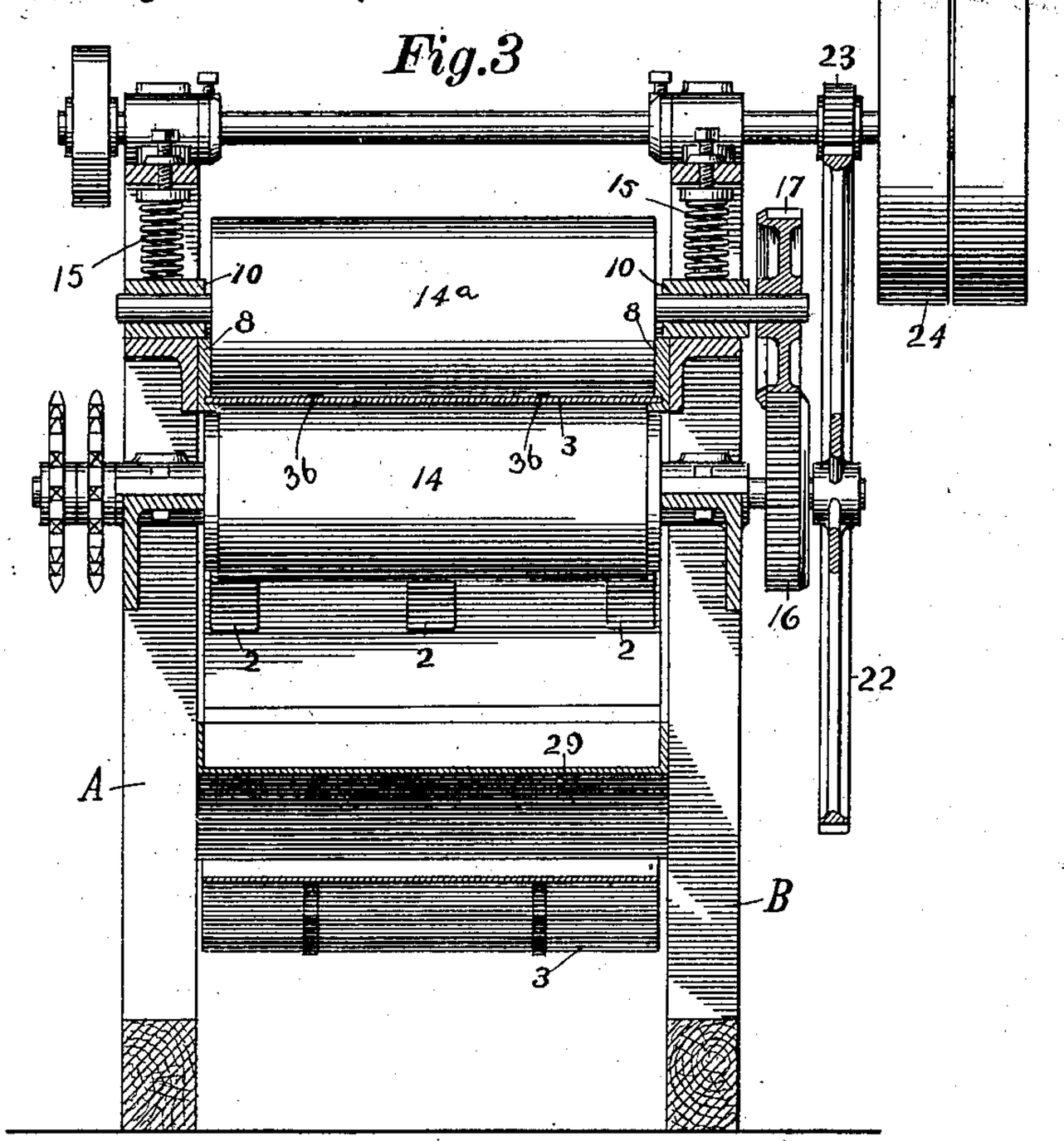


Fig.4

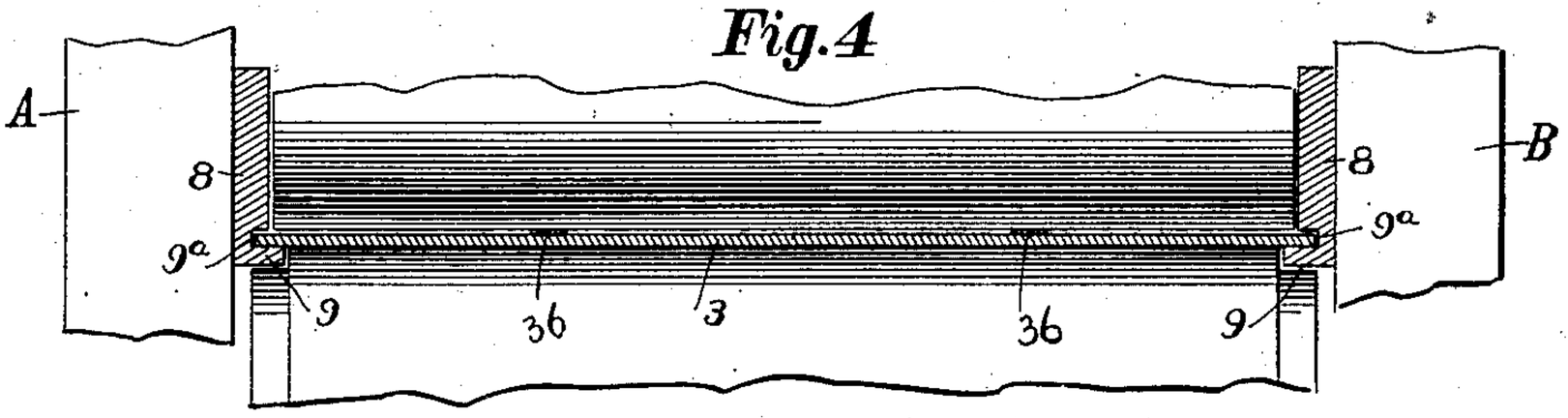
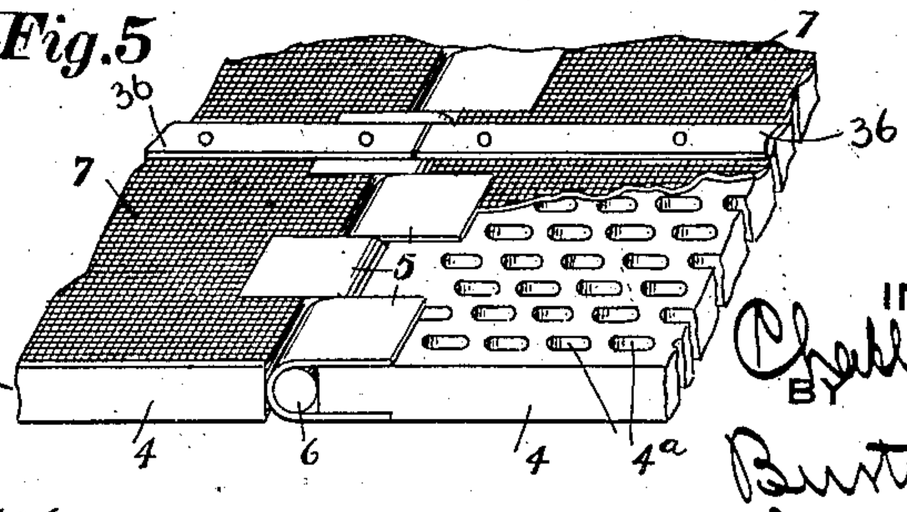


Fig.5



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No. 753,696. Patented March 1, 1904.

UNITED STATES PATENT OFFICE.

CHARLES E. GEIGER, OF LOUISVILLE, KENTUCKY, ASSIGNOR TO HIMSELF, W. E. KOOP, AND G. W. FISKE, PARTNERS DOING BUSINESS AS GEIGER, KOOP & FISKE, AND JOHN E. TURNEY, OF LOUISVILLE, KENTUCKY.

FILTERING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 753,696, dated March 1, 1904.

Application filed June 20, 1903. Serial No. 162,315. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. GEIGER, a citizen of the United States, residing at Louisville, in the county of Jefferson and State of Kentucky, have invented new and useful Improvements in Filtering Apparatus, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide an improved mechanism for separating by process of filtration the water or other liquid from a mixture containing both liquid and solid—such, for example, as "distillers' slop," so-called, and the corresponding material remaining as a residue of the grains in malting processes, commonly called "brewers' grains." It is not limited, however, to these substances, which are mentioned only as specimens.

It consists in the structures and features of construction which are specified in the claims.

In the drawings, Figure 1 is a plan view of my improved filtering apparatus. Fig. 2 is a longitudinal vertical section. Fig. 3 is a transverse section at the line 3 3 on Fig. 2. Fig. 4 is a detail section, on an enlarged scale, through the carrying-ply of the conveyer and the cheeks between which it travels, showing in elevation the wringing-rolls which embrace it. Fig. 5 is a detail perspective view of a piece of one of the rigid sections of the conveyer, showing the filtering-covering in part removed to disclose the perforated base. Fig. 6 is a detail side elevation of a portion of two of the rigid sections of the conveyer, showing the manner of securing them together. Fig. 7 is a detail showing the mechanism for operating the brush.

Essentially my filtering apparatus comprises an endless conveyer which is pervious, so as to operate as a filtering element, and which in its endless path of travel passes between successive pairs of rolls which operate as wringers to squeeze the water out of the substances which may be delivered onto the surface of the conveyer, causing it to pass through said pervious structure, leaving behind it as a deposit and ultimately as a cake or compact film on the surface of the conveyer the solid materials which it is desired to extract by the process.

Specifically the endless conveyer is made up of sections each of which is inflexible, such sections being hinged together, the conveyer being supported and carried around polygonal drums the sides of which correspond in width to the width of the hinged sections of the conveyer.

A further feature of the device consists in that the conveyer is actuated not by the drums by which it is carried, but by the wringing-rolls between which it passes and which by feeding the conveyer by their frictional grasp thereon squeeze out the water from the material to be filtered, which is deposited upon the conveyer at one end of its course.

In a suitable rigid structure comprising two side frames A and B, I journal the two polygonal carriers C and D, each of which comprise a shaft 1 and two or more polygonal spiders 2 2 2, rigid with the shaft, adapted to support the hinged sections of the endless conveyer at their ends and middle, respectively. About these two carriers the endless conveyer is extended, comprising hinged sections 3 3 3, &c., the width of each of which is substantially equal to the side of the polygonal spiders and comprises an iron or other metal plate or foundation element 4, which is perforated with comparatively large apertures 4ª. These plates are hinged together on their lateral edges in such a manner as to make a close joint between them, and this is most satisfactorily and conveniently done by rabbeting the said plates at their longitudinal edges and securing to them the U-shaped metal loops 5 5 5, &c., to constitute the opening element of the hinges between the adjacent plates, said loops being arranged on each of the two proximate edges of the adjacent plates, so that the loops upon one plate will enter the intervals between the loops of the other plate and make a close fit in such intervals through the loops of both plates. Thus interlaced, the pintle-rod 6 is inserted for completing the hinge and secures the two

plates together, with substantially no crevices for leakage at the joint thus formed between them.

The upper surface of the plates 4 is covered with finely-perforated sheet metal 7 or other equivalent filtering element, and though the perforated sheet metal is preferred wire-cloth or filtering fabric may for some purpose be employed. The thickness of the U-shaped loops 5 is enough less than the depth of the rabbets in which they are lodged at the edges of the plates to make the upper surface of the sheet-metal cover 7 flush with the surface of the loops constituting the hinge, so that the entire upper surface of the upper ply of the conveyer as it passes from carrier to carrier is substantially a smooth unbroken one except for guard-strips, hereinafter described.

At one end of the conveyer—that is, over one of the polygonal carriers—there is arranged a chute or descending conducting-flume through which the material to be filtered is to be delivered onto the upper surface of the endless conveyer as it passes up from its lower course around the carrier at that end. Sometimes—that is, for some materials—agitators 20 and 21, such as seen in Fig. 1, are employed in this flume to keep the material steadily discharging onto the conveyer. The upper ply of the conveyer runs throughout its entire course between two parallel cheeks 8 8, which constitute a part of the framework of the mechanism, being rigid with the side frames A and B, on which the polygonal carriers are journaled.

In order to make a substantial close joint or seam between the upper ply of the conveyer and these side cheeks, so that the upper ply of the conveyer forms the bottom of a close trough of which the cheeks form the sides, I form these cheeks with a ledge 9, on which the upper ply of the conveyer runs, the cheeks having also a groove 9^a leading in from the ledge and the conveyer-plates being wider than the rolls hereinafter mentioned, so that they extend into said grooves.

In the side frames A and B, underneath the conveyer, there are journally-fixed rolls 11 12 13 14, whose length at the operating cylindrical surface is the distance between the side cheeks measured from the proximate edges of the ledges of the said two opposite cheeks, so that the rolls support or take the weight of the conveyer over the full width of the same between said supporting-ledges. In vertical movable journal-boxes 10 10 10, &c., mounted and guided vertically in the cheeks, there are journaled directly over the rollers 11, 12, 13, and 14, respectively, counter-rolls 11^a, 12^a, 13^a, and 14^a, which are held pressed downward yieldingly toward said lower rolls, respectively, such pressure being effected by gravity, aided especially in respect to the advanced rolls by the springs 15 15, &c., operating upon the sliding boxes 10 10, &c. These upper rolls as to length extend fully between the two cheeks and are therefore a little longer than the lower rolls at their operating-surface, so that they overhang the ledges upon which the conveyer runs. The rolls of each pair are geared together, to wit, preferably by means of intermeshing gears 16 17 on the shafts of two rolls, respectively, at one end. The lower rolls of the several pairs are synchronously actuated by suitable connections, the driving power being communicated, primarily, to the lower roll 14 of the final pair, on whose shaft there is a large gear 22, which is driven by a pinion 23 on a shaft having any convenient means of receiving power, as a pulley or sprocket-wheel 24, to which a belt or chain extends from any source of power. A convenient means of connecting the lower rolls of the several pairs for synchronous actuation in the same direction of rotation comprises driving and driven sprocket-wheels 18 and 19, respectively, at the ends of the shafts opposite those having the gears 16 and chains 20, connecting them successively from the shaft of the last roll 14 back to the first roll 10. I do not limit myself to this or any particular means of thus connecting the rolls for synchronous connection.

When the material to be filtered is delivered from the flume onto the upper ply of the conveyer, it is carried thereby first toward and ultimately between the two rolls of the first pair 11 11^a. The upper roll of this pair may operate by gravity only for pressure upon the lower roll and might be lightened, even by counter-springs under its journal-boxes, so as to press with less than its normal weight on the material first entering from the flume, for the slop when first received and before it has parted with any considerable portion of its water cannot be squeezed to any considerable extent. It is nevertheless desirable that some pressure should be exerted to assist the filtration or force the water through the conveyer, not relying upon mere gravity drainage only; but in order that the material may not be positively held back and prevented from passing through between the rolls by reason of its sloppy condition I extend between the cheeks at the height at which the axis of the upper roll may stand when the rolls of this pair are separated from each other as much as they may be expected or desired to be separated a check-plate or cover 42 over the space between the upper rolls of the first and second pairs. This check-plate restrains the material from rising higher than the horizontal diameter of the rolls, as it might tend to do from the fact that the second pair of rolls will be set to exert more pressure than was exerted between the rolls of the first pair, since at this stage the material must be pressed a little drier than before. For a like purpose between the second and third and between the third and fourth upper rolls I locate similar check-plates 42. Preferably these

check-plates are upheld by springs 43, coiled around stems 44 44, with which the check-plates are provided at their opposite ends and which extend through boxes 45, secured to the side frames, the stems being provided with check-nuts 46 at the upper ends above the springs, as seen clearly in Fig. 2. The check-plates are also preferably attached to their said stems pivotally, and said plates being somewhat wider than the distance between the proximate rolls at their diametric plane and being at their edges beveled to seat upon the diverging curved surfaces of the rolls below that plane are held by the springs up against the rolls and by their pivotal attachment to their stems accommodate themselves to the slight rising and falling action of the rolls, which may vary from time to time, This construction causes these check-plates to make tight joints with the rolls, and so to effectively close at the top the space within which the material may accumulate between the rolls.

By the time the material has passed the third pair of rolls it will be reduced to a comparatively firm condition not liable to back up or accumulate in bulk, and usually the check-plate is not necessary beyond this point, and in passing out between the last pair of rolls the material is packed so firmly in a cake or film on the conveyer that the driving action is derived chiefly from the grip of the rolls of this pair upon the conveyer, although the upper roll itself does not actually reach or touch the conveyer at all, but grasps only the film of material which has been compacted by the roll. It will be understood, of course, that the rolls preceding the last pair operate on the conveyer with some driving force, which may be more or less according as the material is more or less compacted by the time it passes between these rolls. The first and second pair can scarcely be considered as driving the conveyer at all, since they operate substantially in the slop or mush, which has not as yet obtained sufficient cohesion to communicate any traction, but rather acts as a lubricant in which the rolls would slip even if they were close to the conveyer. Probably the certainty and apparent positiveness with which the rolls drive the conveyer under these circumstances are in some measure due to the fact that the material which is compacted by the rolls onto the conveyer is by that process forced into interstices or perforations of the perforated material which constitutes the filtering element, and thus positively grasps it with the full power of traction, which amounts to the sum-total of the resistance to the shearing of the total number of the little tentacles of the material which are forced into those perforations and which would have to be sheared off before the films could slip on the surface of the perforated cover of the plate; but with respect to the upper roll itself it is dependent entirely upon the frictional grasp of the smooth surface of the roll upon the compact material or the adhesion of such material to the roll. There is, however, to be considered the further frictional grasp of the lower roll upon the lower surface of the conveyer, both of such elements having smooth metal surfaces, which are pressed firmly together to the extent of the resistance of the compacted film to further compression. I do not, however, limit myself to driving the conveyer solely by friction of the rolls, as described. In treating slimy substances more positive means may be employed. The volume of material thus compacted on the conveyer is removed therefrom by a rotating brush 30, which is carried in bearing-arms 31 31, pivoted on a shaft 32, extending across the frame, said shaft having a pulley 33 for a belt extended thereto from the pulley 34 on the shaft 23^a of the pinion 23, and it has also a gear-wheel 25, which intermeshes with a gear-wheel 27 on the shaft 30^a of the wire brush 30. The brush operates on the conveyer preferably directly above the shaft 1 of the carrier at the discharge end of the machine, and in order that it may follow the rise and fall of the conveyer-sections as they pass onto the polygonal carrier the pivotal mounting of the brush, as above described, is important; but in order that the action of the brush on the conveyer-surface may be only as forcible as may be desired, so as to injure neither the brush itself nor the filtering-cover of the conveyer, I provide the shoes 35 35, extended down from the bearings of the brush-shaft and adapted to lodge upon the projecting periphery of the outer spiders 2 of the polygonal carrier. These shoes hold the shaft of the brush always at a uniform distance from the point of the spider, which is in line between the shaft of the brush and that of the spider, and thereby keep the operating-surface of the brush always operating uniformly upon the surface of the conveyer-sections as they pass onto the spider.

For the purpose of preventing the rolls from injuring the filtering-covering of the conveyer when the machine runs empty or becomes empty at any part, there may be provided upon the upper surface of each section of the conveyer above the filtering-covering 7 two strips 36 36 of metal whose thickness is not sufficient to prevent the rolls from thoroughly compacting the material on the conveyer for the purpose of forcing the moisture therefrom, as described, but which merely take the two surfaces—to wit, the roll and conveyer—out of contact.

The agitators 20 and 21 may be driven by a chain 54, which is actuated by a sprocket-wheel 55 on the rear end of the shaft of the roll 12^a and encompasses the sprocket-wheels 56 and 57 on the shafts of the agitator, respectively. A loose sprocket-wheel 58 on the shaft of the roll 11^a operates as guide-wheel for the chain, increasing the engagement with

the sprocket-wheel 56. The water which drains and is squeezed out through the upper ply of the conveyer is received in a drip-pan 29, from which it is drained by any convenient connections, and the material removed from the conveyer by the rotating brush 30 is received in pulverized or more or less comminuted condition in a trough 51, in which a spiral conveyer 52 or other suitable appliance operates to conduct it to the place of accumulation.

I claim—

1. A filtering-machine comprising an endless conveyer made up of rigid plates hinged together and perforated and covered with a filtering-surface element; carriers for such endless conveyer; a frame in which such carriers are mounted comprising cheeks between which the upper ply of the conveyer travels from carrier to carrier, such cheeks being formed with ledges preventing the sagging of the conveyer between carriers, and wringing-rolls in pairs, one above and one below the upper ply of the conveyer, such upper ply and the cheeks between which it moves constituting a trough in which the upper rollers of the several pairs operate.

2. A filtering-machine comprising an endless conveyer made up of rigid perforated plates hinged together and covered with a filtering-surface element; carriers by which such conveyer is sustained; a frame in which such carriers are mounted, comprising cheeks between which the upper ply of the conveyer travels; wringing-rolls in pairs, one of each pair being below and one above the upper ply of the conveyer, the upper rolls having vertical movable journal-boxes mounted in the cheeks; means for positively actuating both rolls of the several pairs and for pressing the upper rolls of one or more of said pairs yieldingly toward the conveyer, to cause the upper ply thereof to be grasped between the two rolls of such pair or pairs, the rolls of such pair or pairs constituting the means for actuating the conveyer in its endless path of travel between the cheeks and between the rolls.

3. A filtering-machine comprising an endless conveyer having a filtering-surface; polygonal carriers for such conveyer; a rotating brush extending transversely with respect to the direction of travel of the conveyer parallel with the axis of the polygonal carrier at the delivery side; arms having bearings for said brush pivoted at a line parallel therewith to adapt the brush to swing toward and from the axis of the polygonal carrier, and means for rotating the brush to clear the conveyer.

4. A filtering-machine comprising an endless conveyer, said conveyer consisting of rigid filtering elements hinged together; polygonal carriers for such conveyer; means for driving the conveyer thereby rotating the carriers; a brush extending across the conveyer above the polygonal carrier at the delivery side; arms in which the shaft of said brush is journaled; a counter-shaft parallel therewith at a distance back therefrom, on which said arms are fulcrumed, whereby the brush is free to oscillate toward and from the axis of the carrier; intermeshing gears on said counter-shaft and brush-shaft, and means for driving the counter-shaft to rotate the brush in a direction to clear the residual material from the conveyer.

5. A filtering-machine comprising an endless filtering-conveyer; polygonal carriers for the same; means for actuating the conveyer and rotating the carriers; a clearing-brush extending across the conveyer at the delivery side; bearings for the brush-shaft movable toward and from the axis of the polygonal carrier at the delivery side; means by which said bearings tend yieldingly to approach said axis, and a polygonal track on the carrier corresponding, side for side, with said polygonal carrier; the journal-bearings of the brush-shaft being stepped on said polygonal track to limit the approach of the brush to the carrier.

6. A filtering-machine comprising an endless conveyer made up of rigid perforated plates hinged together and provided with a filtering-surface; carriers for such conveyer; cheeks between which the upper ply of the conveyer travels, such cheeks being grooved to admit the edges of such upper ply, whereby said ply and the cheeks together constitute a substantially tight trough along the course of said upper ply from carrier to carrier; wringing-rolls in pairs, one below said upper ply and the other in the trough above said ply, the latter rolls being as to length fitted snugly between the cheeks, whereby they obstruct positively the passage through such trough and confine the material on the conveyer to passage between the rolls.

7. A filtering-machine comprising an endless conveyer; wringing-rolls between which such conveyer travels, said conveyer consisting of rigid filtering elements hinged together, the hinged connection between them being made by means of loops whose ends are lodged in rabbets in the surface of the rigid plates at their proximate edges, such loops alternating on the two elements on each hinge, and occupying each the interval between consecutive loops on the other element, and a pintle-rod extended through all the loops.

In testimony whereof I have hereunto set my hand, in the presence, of two witnesses, at Louisville, Kentucky, this 15th day of June, A. D. 1903.

CHARLES E. GEIGER.

In presence of—

ADOLPH ARMBRUST,

GEO. W. STEGO.