No. 842,437. PATENTED JAN. 29, 1907.

G. W. TICE.

THRESHER AND CLEANER.

APPLICATION FILED NOV. 23, 1905.

5 SHEETS—SHEET 1.

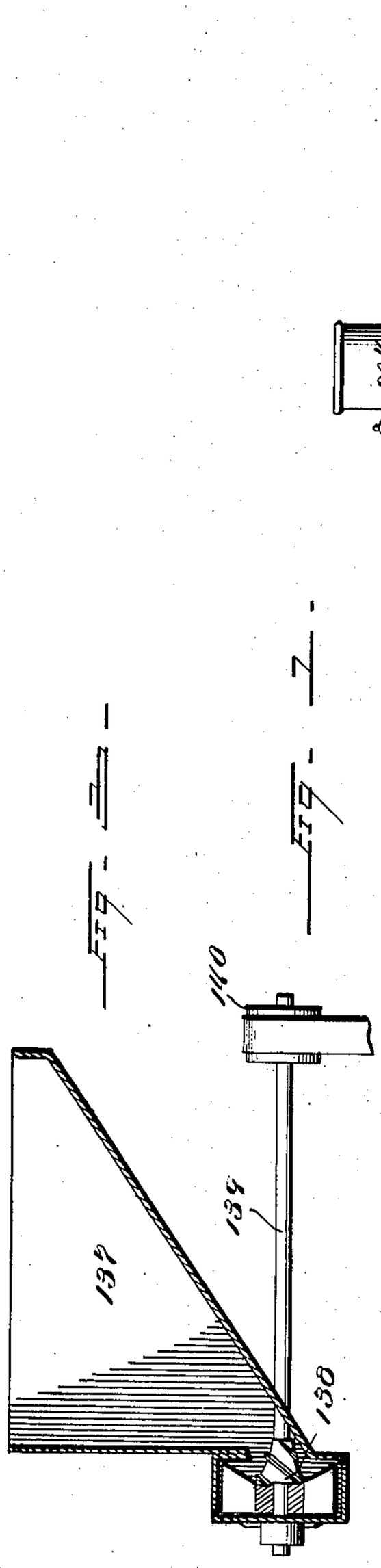

FIG. 3.

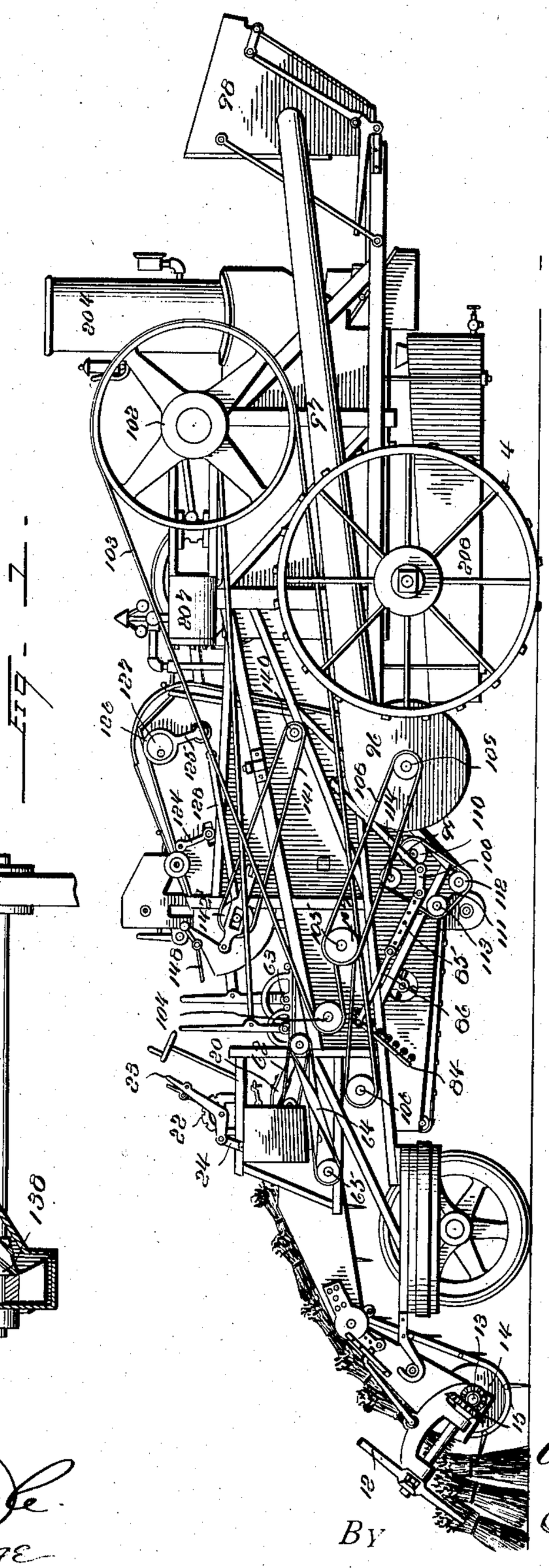

FIG. 1.

WITNESSES:

W. F. Robe.

Alfred T. Page

INVENTOR

George W. Tice,

By E. B. Stocking

Attorney

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5 SHEETS—SHEET 2.

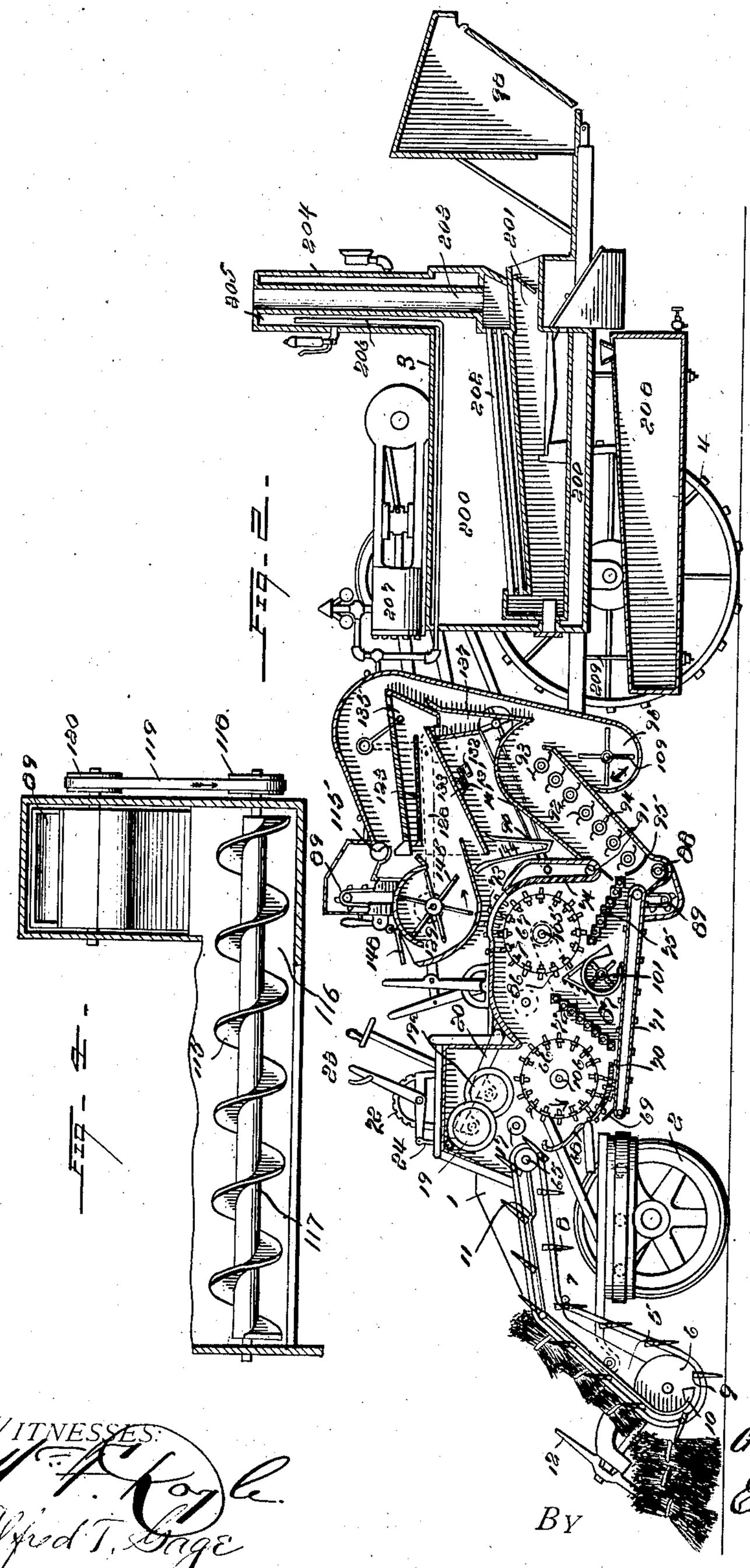

FIG. 2.

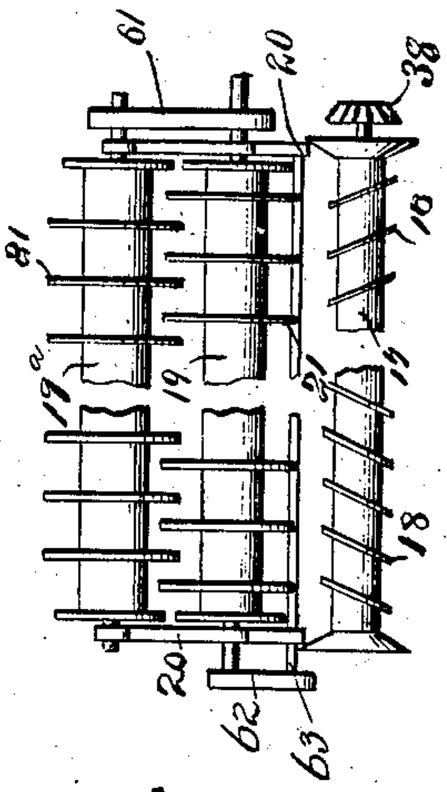

FIG. 17

FIG. 3.

WITNESSES:

H. F. Coyle.

Alfred T. Dage

INVENTOR

George W. Tice,

By E. B. Stocklup

Attorney

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5 SHEETS—SHEET 3.

FIG. 2.

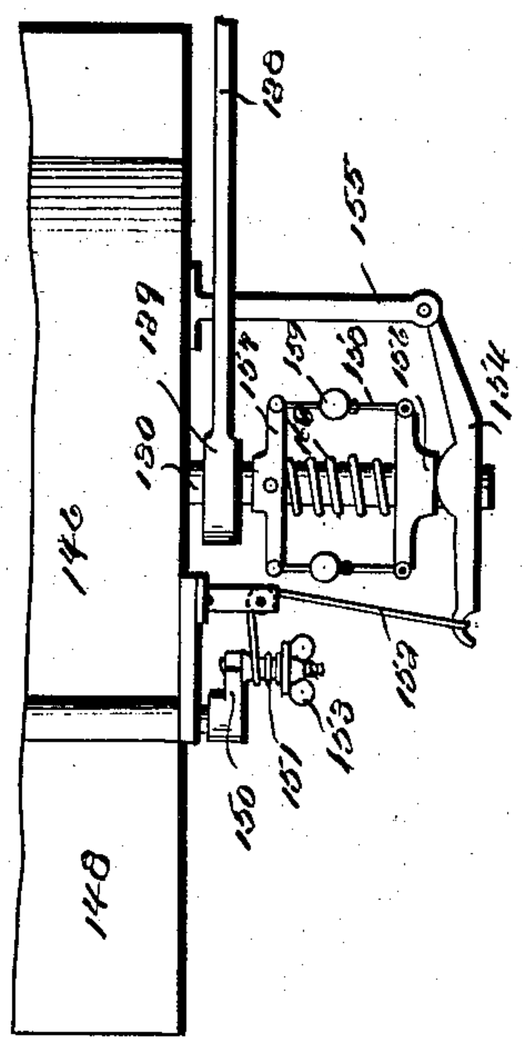

FIG. 3.

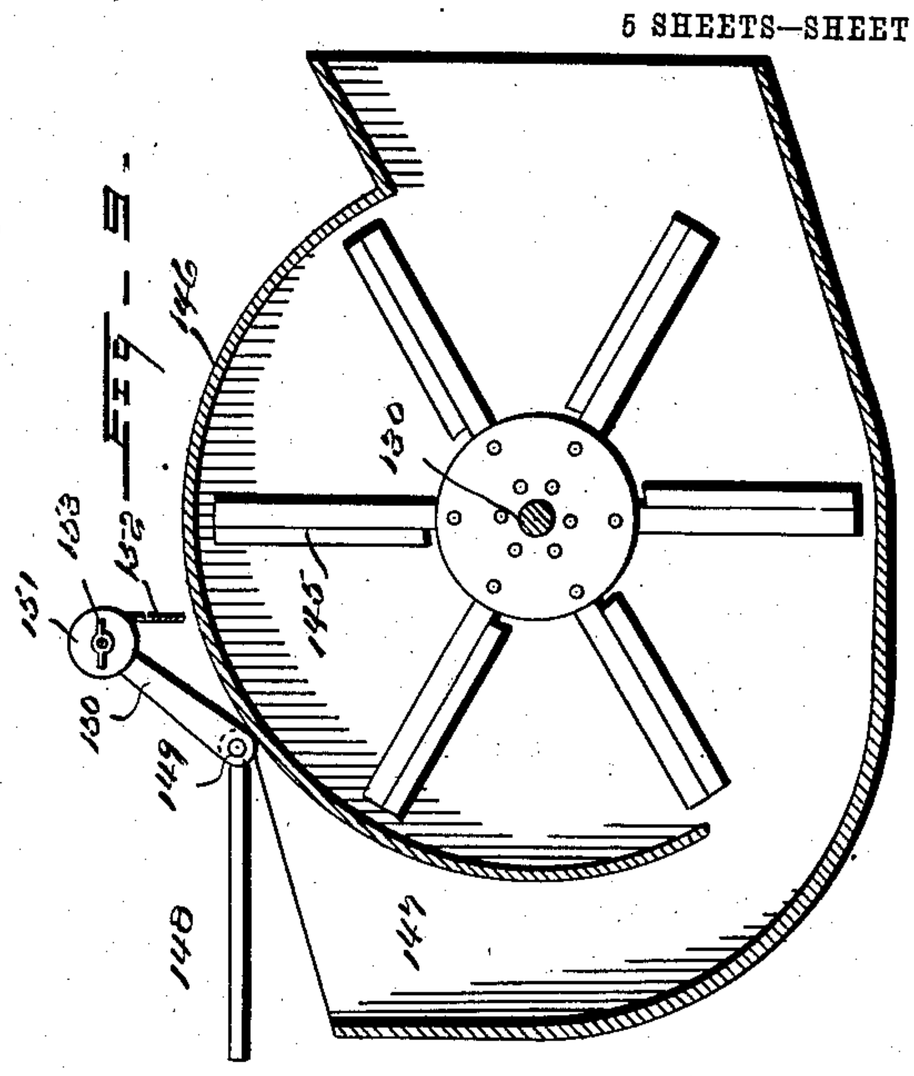

FIG. 4.

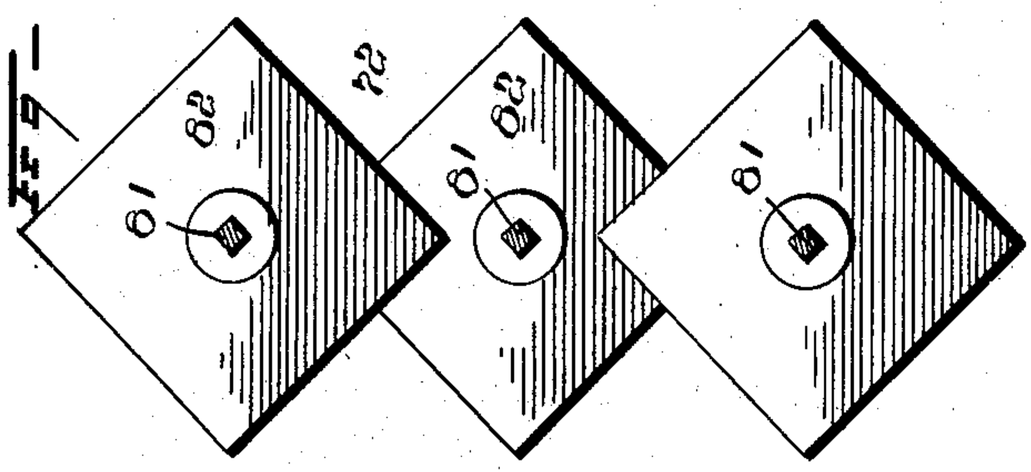

FIG. 5.

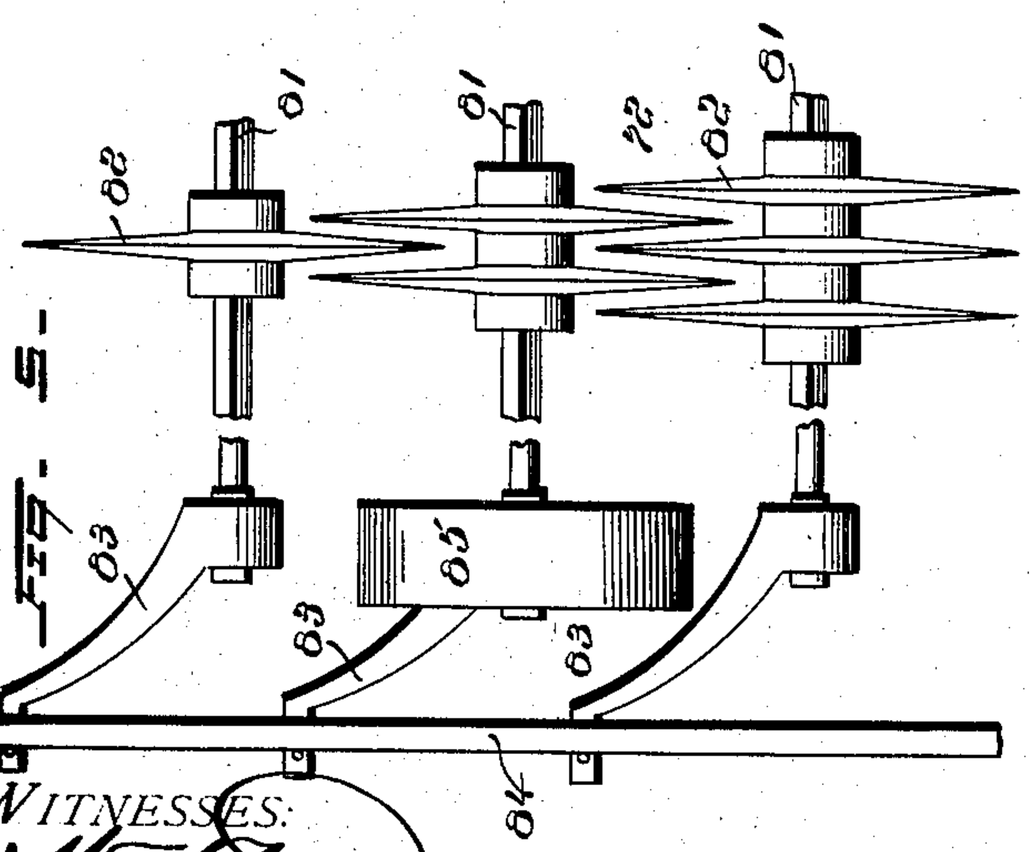

FIG. 6.

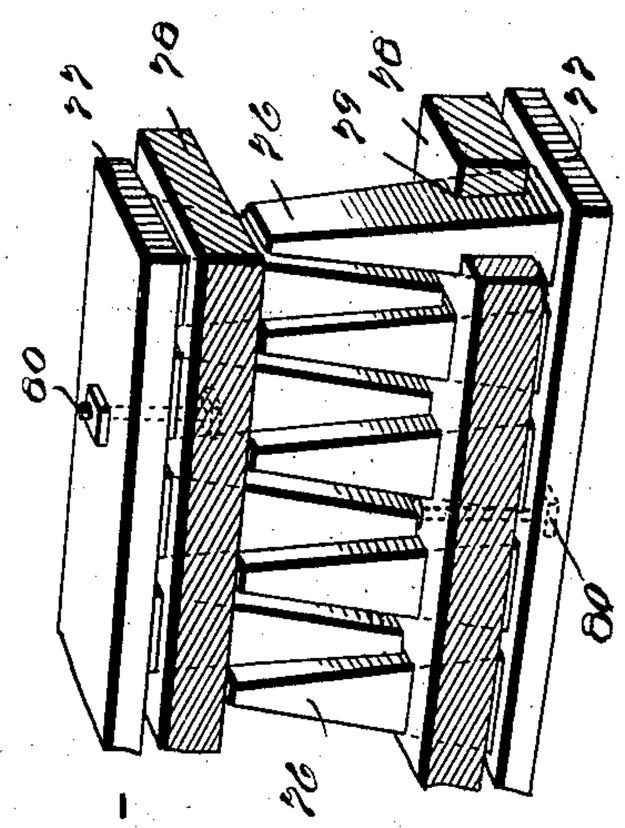

FIG. 7.

WITNESSES:

W. F. Cook.

Alfred T. Gage

INVENTOR

George W. Tice,

BY E. B. Stocking

Attorney

No. 842,437. PATENTED JAN. 29, 1907.

G. W. TICE.

THRESHER AND CLEANER.

APPLICATION FILED NOV. 23, 1905.

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Fig. 10.

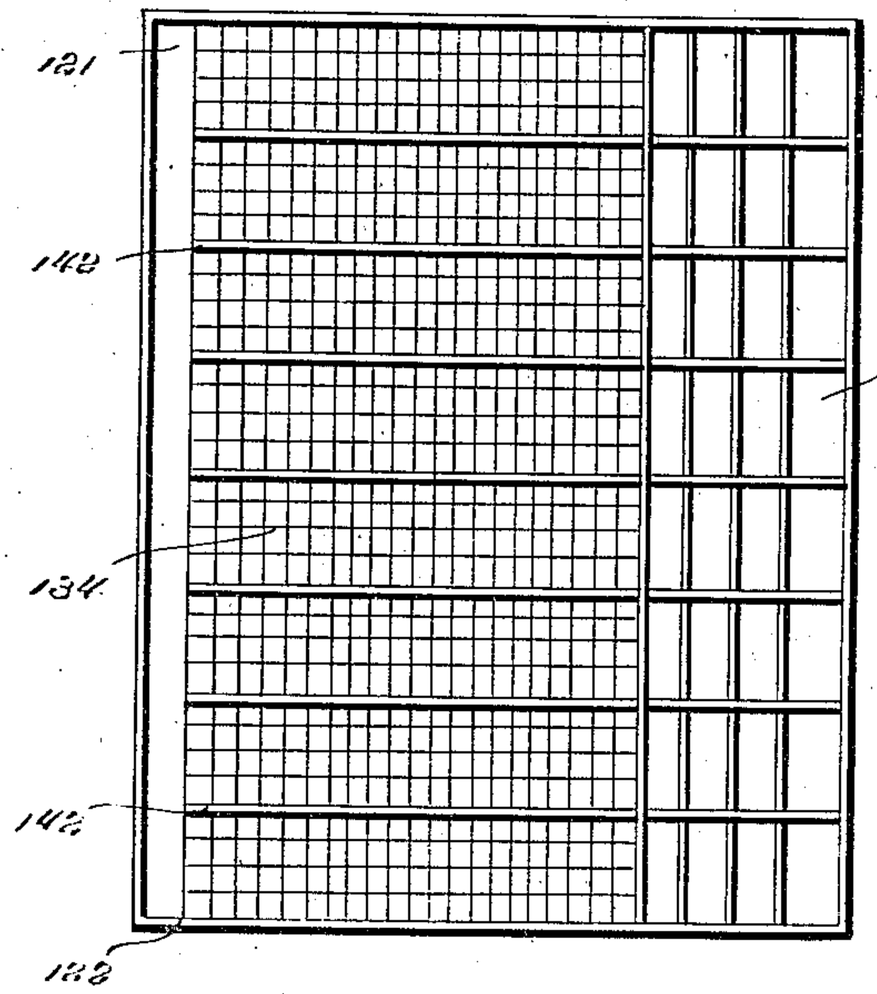


Fig. 14.

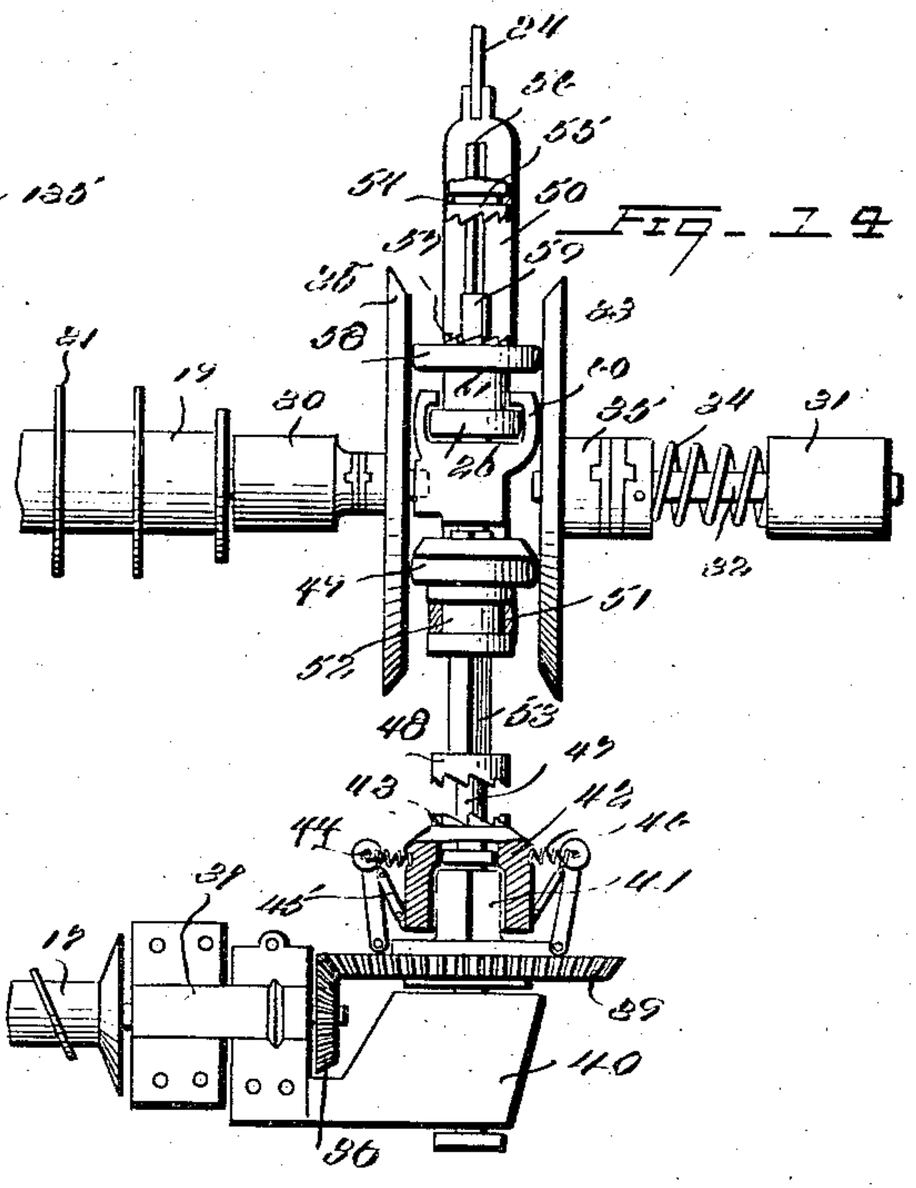


Fig. 11.

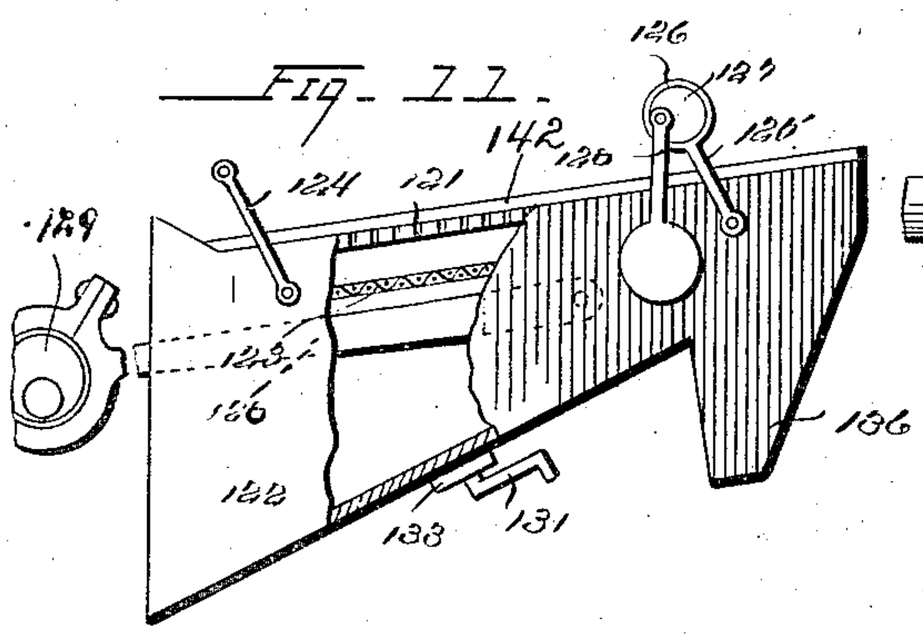


Fig. 12.

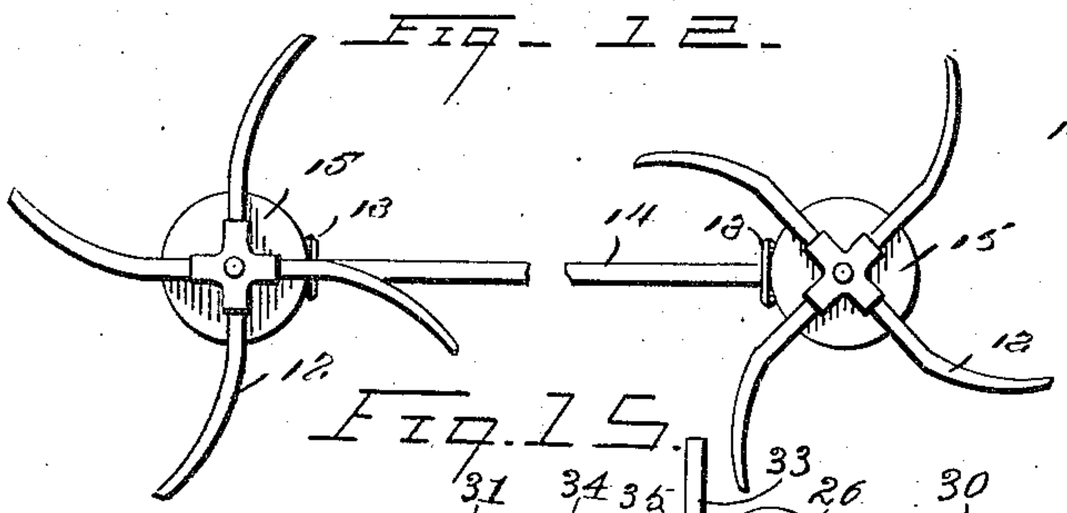


Fig. 15.

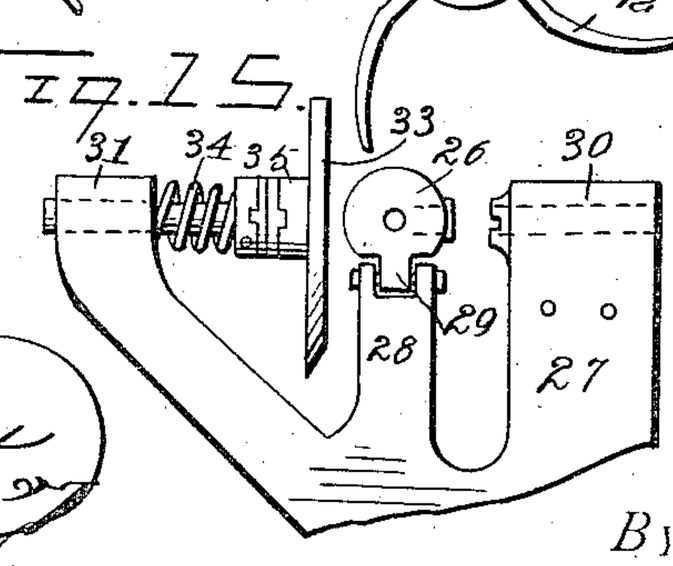
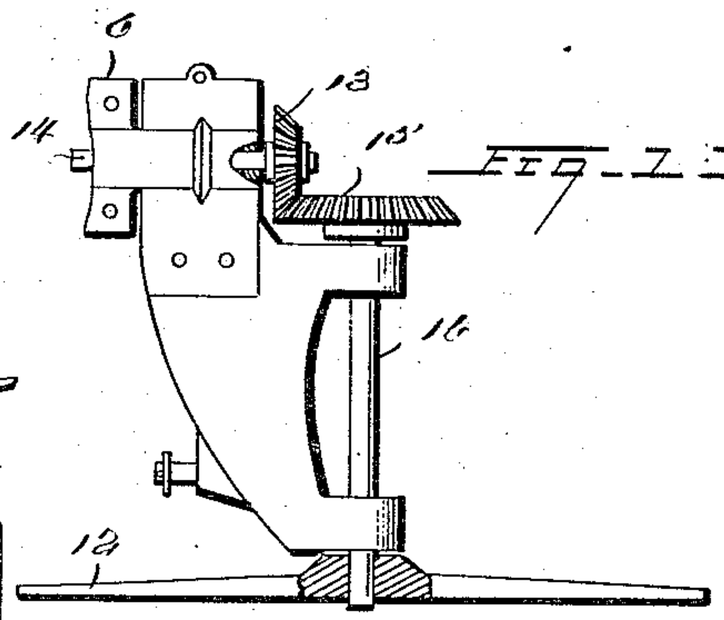


Fig. 13.



WITNESSES:

[illegible]

Clyde A. Bridge.

INVENTOR

George W. Tice

By E. B. Stocking

Attorney

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G. W. TICE.

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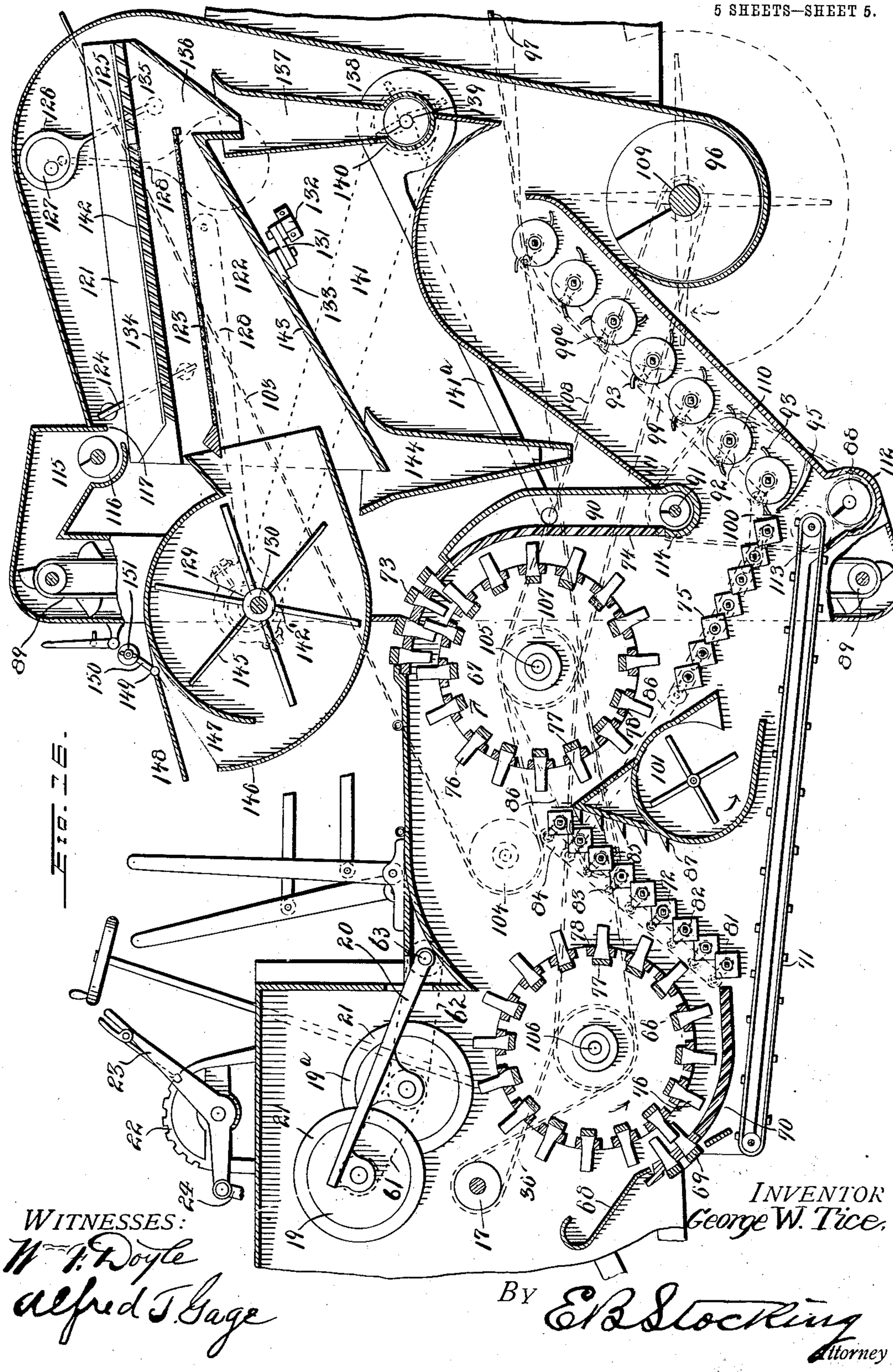

FIG. 15.

WITNESSES:

W. F. Doyle

Alfred T. Gage

INVENTOR

George W. Tice,

BY E. B. Stocking

Attorney

UNITED STATES PATENT OFFICE.

GEORGE W TICE, OF RILEY CENTER, MICHIGAN, ASSIGNOR OF ONE-HALF TO ALLEN K. TICE, OF LARIMORE, NORTH DAKOTA.

THRESHER AND CLEANER.

No. 842,437. Specification of Letters Patent. Patented Jan. 29, 1907.

Application filed November 23, 1905. Serial No. 288,763.

To all whom it may concern:

Be it known that I, GEORGE W. TICE, a citizen of the United States, residing at Riley Center, in the county of St. Clair, State of Michigan, have invented certain new and useful Improvements in Threshers and Cleaners, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to a threshing and cleaning machine, and particularly to a portable structure of this character having a traction-engine in connection therewith.

The invention has for an object to provide an improved construction and arrangement of threshing-cylinders and conveying means both for the straw and grain between the cylinders and away from the same, together with an improved construction and arrangement of driving-mechanism for the several parts.

Other and further objects of the invention will be hereinafter set forth, and the novel features thereof defined in the appended claims.

In the drawings, Figure 1 is a side elevation of the machine. Fig. 2 is a longitudinal vertical section thereof. Fig. 3 is an enlarged vertical cross-section of the hulling-hopper. Fig. 4 is a vertical cross-section of the conveyer from the elevator to the chaffing-screen on line 4 4, Fig. 16. Fig. 5 is a plan of the revolving feeding-grates. Fig. 6 is a detail side view of said grates. Fig. 7 is a detail perspective of the threshing-teeth. Fig. 8 is a plan of the regulating mechanism for the cleaning-fan. Fig. 9 is a vertical section through said fan. Fig. 10 is a plan of the chaffing-screen. Fig. 11 is a side elevation showing the mounting thereof. Fig. 12 is an elevation of the rolls for feeding bundles to the conveying-rakes. Fig. 13 is a detail plan of this device with parts in section. Fig. 14 is an elevation, with parts in section, of the driving mechanism for the band-cutters and spreader-rolls. Fig. 15 is a detail elevation of the supporting-frame for these parts. Fig. 16 is an enlarged section through the thresher and cleaner. Fig. 17 is a detail elevation of the band-cutter rolls and the cooperating spreader-roll.

Like numerals of reference refer to like parts throughout the several views of the drawings.

The numeral 1 indicates the frame of the machine, which may be of any suitable character, and is supported at the feeding end by means of a traction-wheel 2 and provided at the opposite end with the engine 3, provided with the traction-wheels 4.

When the machine is to be used for the purpose of feeding bundles tied in the usual manner, the construction and arrangement of parts shown in Fig. 2 is provided, or if the machine is to be used as a harvester the attachment shown in Figs. 17 and 18 is applied. In the former arrangement a depending frame 5 is provided, having at its lower end a bearing-wheel 6, over which the belt 7 of the feeder-rakes passes. These rakes 8 are pivotally mounted upon this belt or carrier and provided at their inner ends with an arm 9, adapted to engage the rake-trip 10, which extends upward along the ascending portion of the apron. The rakes are thus thrown into a position obliquely to the apron and held there during the travel of the rakes in contact with the trip and until they reach the deflected portion 11 thereof, when they are released from their trip and permitted to fall, so that the bundle or material carried thereby is free to be received into the machine. For the purpose of directing these bundles upon this apron or rake the reels 12 are provided, as shown in Figs. 12 and 13, and geared to operate together by means of a pinion 13, carried by the outer end of the shaft 14, upon which the bearing-pulley 6 is mounted. This gear meshes with a coöperating gear 15, disposed at the inner end of the shaft 16, carrying these rolls, as shown in Fig. 13.

The bundle delivered from the pivoted rakes is received by the spreader-roller 17, which is provided with plates 18, disposed spirally or diagonally to the longitudinal axis of the roller, so as to feed the grain longitudinally of the roller to spread a layer of equal thickness after the cutting of the bands thereon and before its introduction to the threshing-cylinders. This band-cutting is accomplished by means of the rollers 19 and 19ª, mounted in a pivoted arm 20, above the spreader-roller and each provided with peripheral blades or other knives 21, disposed in lines overlapping each other, as shown in Fig. 19. The bundle-spreading roller is adapted to be driven at a more rapid speed

than the band-cutting rollers in any desired manner—for instance, as shown in Fig. 14. This is accomplished by an adjustment of the arm 20, carrying these rollers by any suitable means—for instance, the segment 22 and ratchet-lever 23, having a link connection 24. The band-roller has secured thereto a friction-disk 25, which is also pivotally mounted in the boxing 26. This boxing is carried from the machine-frame by the supporting-frame 27, having an arm 28 extending therefrom and provided with a pivotal connection 29 for the boxing. (See Fig. 15.) At one end of the frame a bearing 30 is provided for the shaft of the roller 19, and at the opposite end a bearing 31 is provided for the shaft 32, carrying the friction-disk 33, which is held under spring tension by means of the spring 34, disposed between the hub 35 of said disk and the bearing 31. The feeder-roll 17 is driven in any desired manner—for instance, by means of the crossed belt 36, (shown by dotted lines in Fig. 16)—and has an extended shaft mounted in bearings 37 and provided with a bevel-gear 38, meshing with a coöperating pinion 39, supported in the bearing 40. This pinion is provided with an angular hub 41, over which the correspondingly shaped collar 42 is adapted to slide, and is provided upon its upper face with a clutch member 43. This collar and clutch are lifted upward in the rotation of the pinion by means of the weighted arms 44, connected by links 45 with the collar 42 and normally restored by means of springs 46. The pinion 39 is freely rotatable upon the lower end of the shaft 47, and this shaft has secured thereto a clutch-face 48, adapted to coöperate with the member 43 and is provided at its upper end with a friction driving-wheel 49, adapted for movement longitudinally upon the shaft 47. This wheel 49 is mounted in a frame 50, connecting with the adjusting-lever 23. This frame 50 is provided with a yoke 51, embracing the hub 52 of the friction-drive 49, which is slidingly mounted upon the angular portion 53 of the shaft 47. The frame is also provided with a yoke 54, embracing the clutch member 55, disposed upon the upper angular end 56 of the shaft 47. When the parts are raised in position by means of this frame, the clutch 57, carried by the power-transmitting wheel 58, which is slidingly mounted upon the circular portion 59 of the shaft 47, is brought into contact with the clutch 55 to reverse the direction of the drive. It will also be observed that the boxing 26 is provided with a socket 60, in which the hub 61 of the power-transmitting wheel 58 is adapted to seat, so that these parts may be shifted to vary the position of the driving-wheel and power-transmitting wheel relatively to the centers of the friction-disks 25 and 33. By this means the cutter-roll 19 is driven from the spreading-roll, and its associate roll 19ª is driven therefrom by means of the pulley 61, as shown in Fig. 19. From the opposite end of the shaft of the roll 19ª a belt 62 extends to the pivotal point 63 of the arm 20. This pivot is provided with a driving-pulley, from which the belt 64 extends to a pulley upon the shaft 65 for driving the upper end of the rake-belt, as shown in Fig. 1, whereby the motion of this rake-belt is controlled relative to the drive of the cutter-rolls and spreader. With this construction it will be seen that in the operation of feeding the material to the machine the volume fed will be in proportion to the spaces between the feeding and spreading rolls, and should a larger volume than intended pass between said rolls it will raise the frame carrying the cutting-rolls while maintaining the same driving relation to the mechanism hereinbefore described.

Should the volume fed be so large as to entirely withdraw the friction drive-roll from contact with its disks, this would cause the disks, and also the shaft of the cutter, to stop and free the connections hereinbefore described and also the feeding-belt, while the spreading and feeding rolls will continue their operation until the volume of feed be reduced, so as to permit the parts to regain their initial operation. Should the volume be great enough to raise the parts carried by the cutting-roll 19 sufficiently to engage the clutch members 55 and 57, the driving action would be reversed for both the rakes and cutting-knives, thus throwing back the surplus material, while the parts would return to their ordinary operation as soon as restored to their normal position.

The foregoing construction provides means for automatically governing the feed to the threshing-cylinders. With the ordinary system and construction of threshing-cylinders it is not possible under many conditions to perform this class of work with one cylinder, because in certain localities the size of the grain and seeds is very uneven, and a single cylinder set or adjusted with its threshing-teeth close enough to its concave to thresh out the finer grains will crush or crack the coarser ones, and if set apart sufficiently to prevent crushing the fine grain will not be threshed, but will pass out with the straw, thus causing waste and loss. This objection is obviated in the present construction by the use of two threshing-cylinders 66 and 67. The material is fed from the apron 68 beneath the first of these cylinders, which is provided with a coöperating concave 69, carrying the threshing-teeth and beyond said concave with the screen 70, adapted to discharge grain passing therefrom upon the apron 71, mounted beneath said screen, as shown in Fig. 2. The material is carried upward from the first cylinder by means of a series of

grates or conveyers 72, as shown in detail in Figs. 5 and 6, and received upon the upper cylinder 67, where it is carried into contact with the teeth of its concave 73 and passes downward over the screen 74, finally resting upon the series of grates 75 similar in construction to the grates 72.

The teeth 76 for each of the threshing-cylinders and their concaves are similarly constructed and arranged, as shown in Fig. 7, these teeth being angular and wedge-shaped, so as to rest at their base upon a supporting-plate 77. They are firmly held in this position by means of a clamping-plate 78, having beveled or inclined apertures 79 therein, through which the small ends of the teeth pass and by which these teeth are held in position by the bolts 80 or other securing means extending through the clamping-plate 78 and base-plate 77. It will be seen that by this arrangement of parts the teeth are rendered readily removable and reversible, while when clamped in position they are not liable to accidental disconnection from the cylinder, as frequently occurs with teeth threaded therein.

The grate 72 comprises a series of angular shafts 81, to which the rectangular plates 82 are secured so as to rotate therewith, said plates being overlapped, as shown in Figs. 5 and 6. Each of the shafts 81 is provided with a crank-arm 83, journaled at its outer end in a connecting-bar 84, so that the arms rotate in unison; one of said arms being driven by means of a pulley 85, secured upon the shaft thereof and driven by a belted connection 86, as shown by dotted lines in Fig. 16. The grate 72 communicates motion through its bar 84 to the grate 75, which is provided with a similar bar 85, Fig. 1, and a connecting pitman 86, so that these grates rotate in unison. The grate 72 in its rotary movement feeds the straw, which is a lighter substance than the grain, up to the second threshing-cylinder, while the grain passes therethrough and contacts with the deflecting-apron 87, by which it is carried downward to the apron 71 and from it discharged upon the conveyer 88, which in turn delivers the grain to the elevator 89. It will be observed that the first threshing-cylinder is an "undershot" cylinder and is adapted to receive thereon the larger-size grain, while the smaller grain will be threshed by the second cylinder, which is an "overshot" cylinder, and the straw carried from this cylinder with the grain is thrown against the screen 74, so that a certain portion of the threshed grain passes down into the receiving-chamber 90, which is provided with the conveyer 91, adapted to discharge into the elevator 89. The straw after passing over the grate or conveyer 75 is thrown upon the straw-conveyers 92, each of which is provided with arms 93 and are rotatably mounted so as to carry the material upward upon the bottom board 94, upon which they operate. At the lower end of this board a guard-rack 95 is provided in order to prevent the fall of straw into the conveyer 88, while the upper end of the straw-conveyer discharges into the fan 96, which communicates, by means of a conduit 97, Fig. 1, with the fuel-box 98, disposed adjacent the fire-box of the engine. The straw-conveyers 92 are operated by means of a connecting-bar 99, pivotally secured to the arms carried by the axis of the conveyers, said bar being connected by the link 100 with the bar 85 for operating the grate 95. The straw in its passage over the grate 75 is in fine particles, owing to passing through the two threshing-cylinders, and to prevent this fine material from mixing with the grain a blast-fan 101 is disposed at the rear of the grate 75, so as to carry this light material off of the grates out into the straw-conveying chamber while the action of this fan is supplemented by the suction of the fan 96.

The parts hereinbefore described may be driven by any desired connection—for instance, the driving-wheel 102, provided upon the engine, from which the belt 103 extends over the idler or belt-tightener 104, thence over the shaft 105 of the threshing-cylinder 67, and thence over a pulley secured upon the shaft 106 of the threshing-cylinder 66, from whence it returns to the driving-wheel 102. The shaft 105 is provided with a supplemental driving-pulley 107, from which power is conveyed by a belt 108 to the shaft 109 of the fan 96. The shaft of one of the straw-conveyers 92 is provided with a pulley 110, from which the belt 111 extends over the driving-pulley 112 for the conveyer 88 and over the pulley 113 for the apron 71, thence over the pulley 114 upon the shaft of the conveyer 91 in the chamber 90, said parts being driven by motion acquired from the straw-conveying members.

The separated grain is delivered from the elevator 89 to the cleaning mechanism, as shown in Fig. 16, and distributed equally over the cleaning-screens regardless of the angle or inclination of the machine. This is accomplished by means of the screw conveyer 115, mounted in a casing 116, which casing is provided with an opening 117 in its lower side portion. This conveyer 115 may be driven by a pulley 118, connected by belt 119 with the driving-pulley 120 at the upper end of the elevator, as shown in Fig. 4. The grain is delivered from this screw conveyer upon the chaffing-screen 121. (Shown in Figs. 10 and 11.) This screen is mounted in a casing 122, which also contains cleaning-screen 123, such casing being pivotally mounted by means of the link 124, pivoted thereto and to the frame of the machine at one end of the casing and at the opposite end by means of the link 125, pivoted to the casing 122 and having a collar 126 surrounding an eccentric 127, which produces a rising-and-falling

movement of the screens in their travel. The eccentric is also provided with a depending weighted arm 128, which maintains this end of the casing in normally level position. The casing 122 is reciprocated longitudinally by means of a pitman 128, connected to an eccentric 129 upon the driving-shaft 130 of the cleaner-fan. This casing is also given a lateral or side movement during its reciprocatory travel by means of the crank-arm 131, pivoted to the frame of the machine at 132 and to the screen-casing at 133.

The chaffing-screen 121 is provided with a surface 134 of proper mesh for the passage of the grain therefrom to the cleaning-screen 123 beneath the same and at its outer end is provided with a portion 135 of wider mesh, through which any unhulled grain or unthreshed heads will pass by means of the chute portion 136 into the hopper 137, as shown in detail in Fig. 3. This hopper communicates at its lower portion with the huller-blades 138, driven by shaft 139, carrying driving-pulley 140, which is connected by belt 141 with a similar pulley 142′ upon the shaft 130 of the cleaner-fan. The grain hulled by these blades passes downward through the chute 141ª, from whence it is discharged into the chamber 90 and then returned to the elevator 89 for a subsequent cleaning action. The chaffer-screen 121 is provided with a series of parallel ribs 142, raised above the surface thereof, which tend to prevent any lateral movement of the grain in the shaking of the screen, and thus insure an even feed over the screen and deposit upon the cleaning-screen 123. The material passing from this latter screen falls upon the board 143, from whence it is directed into the delivery-chute 144.

The blower 145 (shown in detail in Figs. 8 and 9) is disposed within a casing 146, which is provided with an air-intake 147 at one side thereof, having a valve 148 pivotally mounted at 149 and provided with an operating-lever 150, carrying at its end a winding-spool 151, from which the connecting-cord 152 extends. This spool is adapted to be rotated for the purpose of lengthening and shortening the cord 152 and is held in its adjusted position by means of the thumb-nut 153, so that it is in fixed relation to the arm 150 while the parts are in operation. This cord extends to a lever 154, which is pivotally mounted upon a bracket 155, and is adapted to engage the movable member 156, carried by a governing mechanism upon the shaft 130. This mechanism comprises a fixed member 157, having a link connection 158 with the movable member 156. These links are provided with governor-weights 159, which in their outward movement retract the member 156 and place spring 150, disposed upon the shaft 130, under proper tension. When this spring is distended, as shown in Fig. 8, the valve 148 is held in open position; but as the speed of the fan increases, and consequent blast of air becomes greater, the retraction of the member 156 slacks the connection with the valve 148, causing the same to gradually close, so as to positively deliver an even current of air for the full width of the cleaning-screens. This automatic regulation of the air-inlet to the fan permits the proper amount to be fed to the cleaner under the varying conditions of slow and fast threshing, as an increase in the speed of the fan reduces the air-opening, while a decrease thereof increases the capacity of its opening.

Any suitable form of engine or motor may be used for driving the parts described, and a preferable form is illustrated herein in Fig. 2, comprising the engine, having a water-space 200, surrounding the fire-box 201, from which the fire-tubes 202 extend to the stack 203, which is inclosed within the casing 204 to form a steam-dome 205, from which the steam is taken by means of the pipe 206 to the engine 207, the driving-shaft of which is provided with the main driving-wheel 102. (Shown in Fig. 1.) Beneath the engine a suitable water-tank 208 may be supported by means of hangers 209.

The grain is fed by the band-cutting rollers and separating-roller from either of the devices hereinbefore described to the threshing-cylinders, the first of which threshes the large grain, which passes through the screen to the conveying-belt beneath the same, while the remaining smaller grain not acted upon by this cylinder is carried through the next threshing-cylinder, the teeth of which are set to properly thresh the small grain and avoid injury to the large grain before feeding to this cylinder. A portion of the grain removed by this cylinder is carried directly through the screen at the back thereof, while the straw with the remaining grain falls upon the conveyers, the former being carried by the straw-conveyer and thence by the fan to the fire-box, while the grain passes downward through the grates and conveyers to the elevator, by which it is carried upward and deposited upon the movable cleaning and chaffing screens. These screens are under the constant action of the air-blast from the fan, which communicates with the interior casing thereof, and the straw, hulls, or other material which is carried off of the screens is conveyed downward to the fan of the straw-conveyer, which assists the cleaning-fan by creating a suction-draft therefrom. The material passing from the chaffing-screen is also received upon the cleaner-screen, from which it is delivered into the delivery-chute, while the material which passes off of the cleaner-screen, as well as the unhulled material from the chaffing-screen, is carried by gravity into the hulling-blades, from which it is returned to

the conveyer for a repetition of the cleaning action.

It will be seen that the construction and arrangement of parts hereinbefore described provides means by which the bundles are cut and spread, so as to provide a most desirable feed to the thresher, while these threshing-cylinders are constructed and arranged to secure a most desirable action, and the conveying grates or disks between the threshers permit the escape and delivery of any separated grain.

It will also be seen that the construction of the straw-conveyers permit the flow backward of any grain escaping therefrom, while the upward feed of the straw is continued until it is received by the conveying-fan therefor.

The screw conveyer by which the grain is fed from the elevator to the cleaning-screen provides for the even feed thereon, while the reciprocatory movement of this screen, combined with the vertical movement at one end due to the eccentric connection and the lateral movement thereof, produces the most efficient screening action, as the grain is thoroughly agitated on the surface of the screen, while the automatic regulation of the air-blast through this screen prevents excessive blast thereon, by which the grain might be carried away with the refuse, and maintains a constant pressure during the separating action.

Having now described my invention and set forth its merits, what I claim, and desire to secure by Letters Patent, is—

1. In a machine of the class described, a threshing-cylinder having a coöperating concave, a screen beneath said cylinder, a secondary threshing-cylinder, a conveyer-grate disposed beneath said cylinders, a conveyer-grate at the discharge from said secondary cylinder, a straw-conveyer disposed at the discharge from said last-mentioned grate, and a conveyer-belt extending beneath said screen and both conveyer-grates.

2. In a machine of the class described, a threshing-cylinder, having a coöperating concave, a screen beneath said cylinder, a conveyer disposed beneath said screen, a secondary threshing-cylinder, a conveyer-grate disposed beneath said cylinders and discharging upon said conveyer, a conveyer-grate at the discharge from said secondary cylinder, straw-conveying rakes disposed at the discharge from said last-mentioned grate, and a fan disposed at the front of said last-mentioned grate to force air therethrough.

3. In a machine of the class described, a plurality of threshing-cylinders each adapted to thresh grain of different sizes, means for feeding material from one of said cylinders to the other, a screen beneath one of said cylinders, a vertically-disposed screen at the rear of the other cylinder, and a conveying-belt extending beneath both of said cylinders.

4. In a machine of the class described, a threshing-cylinder in combination with a coöperating concave at its upper portion, means for feeding material to said cylinder, and a vertically-disposed screen at the discharge side of the cylinder comprising a prolongation of the concave.

5. In a machine of the class described, a primary undershot threshing-cylinder in combination with a secondary overshot cylinder, means for feeding material from one of said cylinders to the other, a screen disposed beneath the primary cylinder, a conveying-belt beneath said screen, and a conveying-chamber having a screen-wall at the rear of the secondary cylinder.

6. In a device of the class described, a threshing mechanism, means for conveying the grain therefrom, a straw-conveyer extending from said threshing mechanism, a suction conveying-fan communicating with said straw-conveyer, a cleaner having a closed casing communicating with said fan, a cleaner-fan having communication with the straw-conveying fan through said casing, a huller mechanism disposed in communication with said cleaner-fan, and means to return the material from said huller to said cleaner.

7. In a machine of the class described, a threshing mechanism, means for conveying the grain therefrom, an elevator, a straw-conveyer extending from said threshing mechanism, a suction conveying-fan communicating with said straw-conveyer, a cleaner disposed at the upper end of said elevator and having a casing communicating with said fan, a cleaner-fan having communication with said straw-conveying fan through said casing, a huller mechanism disposed in communication with said cleaner, means to return the material from said huller to said elevator, and means for automatically controlling the air-inlet to said cleaner-fan to regulate the blast thereto.

8. In a machine of the class described, a plurality of threshing-cylinders, a conveying-reel disposed between said cylinders, a vertically-disposed screen at the discharge from the last cylinder, and a conveying-belt disposed beneath said reel.

9. In a machine of the class described, a primary undershot and secondary overshot threshing-cylinder, a conveying-reel between said cylinders, a secondary conveying-reel disposed beneath the discharge from the overshot cylinder, a conveying-belt disposed beneath both of said cylinders, a straw-conveyer disposed at the discharge of the secondary reel, and means for simultaneously operating said reels and straw-conveyer.

10. In a machine of the class described, a plurality of threshing-cylinders, a conveying-grate disposed between said cylinders, a secondary conveying-grate disposed at the discharge from the last cylinder, a conveying-belt disposed beneath both of said cylinders, a straw-conveyer disposed at the discharge of the said secondary grate, means for simultaneously operating said reels and straw-conveyer, means to drive an air-blast through the secondary grate, and a suction-fan disposed in communication with said straw-conveyer.

11. In a machine of the class described, a plurality of threshing-cylinders, a conveying-grate disposed between said cylinders, a secondary conveying-grate disposed at the discharge from the last cylinder, a conveying-belt disposed beneath both of said cylinders, a straw-conveyer disposed at the discharge of the secondary grate, means for simultaneously operating said reels and straw-conveyer, means to drive an air-blast through the secondary grate, a suction-fan disposed in communication with said straw-conveyer, an elevator from said endless conveyer, a cleaner in communication with said elevator and with the suction-fan of the straw-conveyer, and a cleaner-fan communicating with said cleaner and suction-fan.

12. In a machine of the class described, two series of grates each series consisting of a plurality of rotating grates each having arms extending from the journals thereof, a bar connecting the bottom grate of each series of grates, and a pitman extending between the bars of each series.

13. In a machine of the class described, two series of grates each series consisting of a plurality of rotating grates each having arms extending from the journals thereof, a bar connecting the bottom grate of each series of grates, a pitman extending between the bars of each series, a rotary toothed straw-conveyer comprising a series of fingers having independent shafts each provided with lever-arms extending therefrom and connected to a universal driving-bar, and a link connection between said bar and the bar of a series of grates.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE W TICE.

Witnesses:

JOHN LOWN,

C. W. JOCELYN.