H. SNYDER & J. T. HUME.

MECHANICAL STOKER.

APPLICATION FILED JAN. 10, 1903.

943,712.

Patented Dec. 21, 1909.

7 SHEETS—SHEET 1.

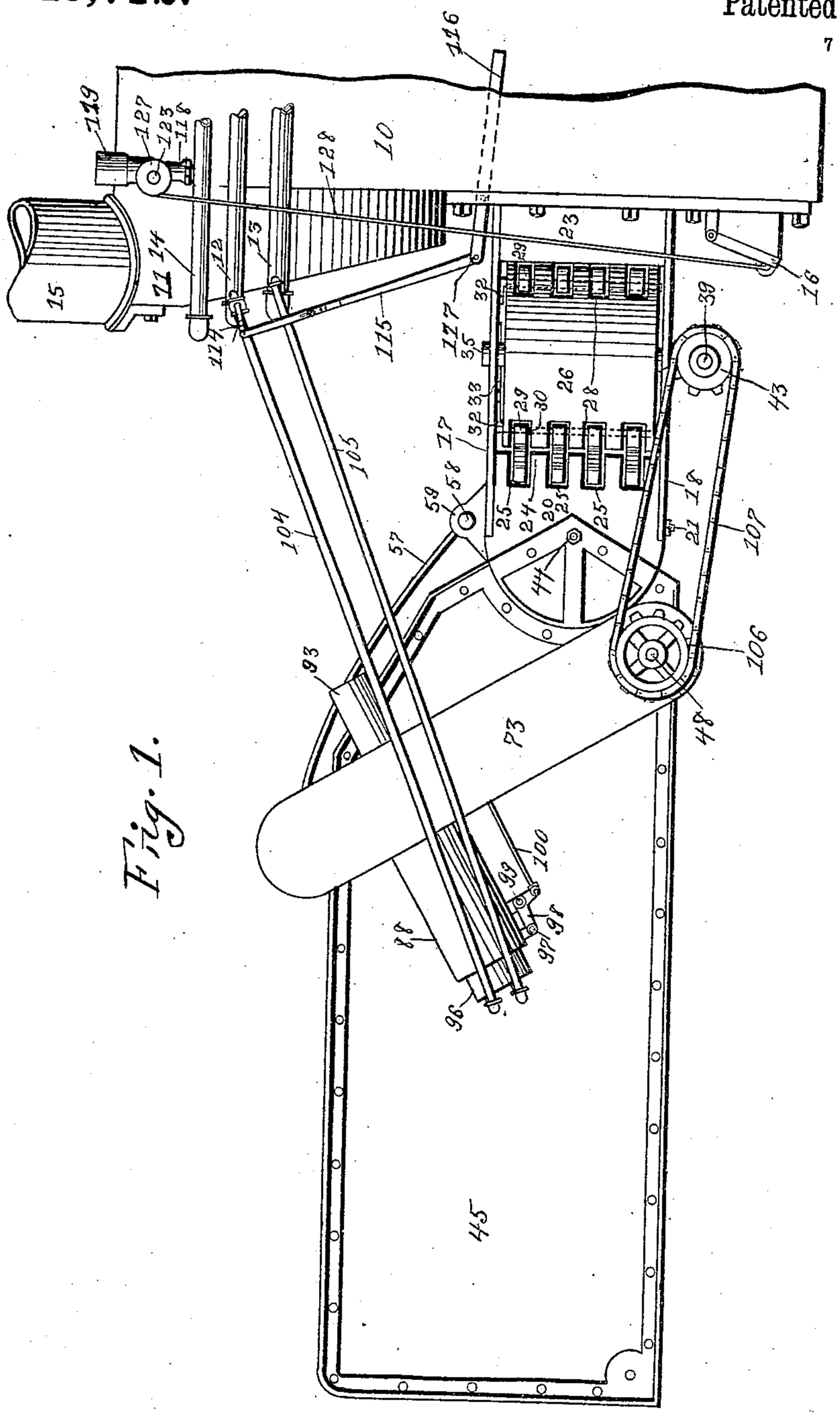

Fig. 1.

Witnesses:-
L. L. Leibrock.
S. F. Christy.

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and J. T. Hume.
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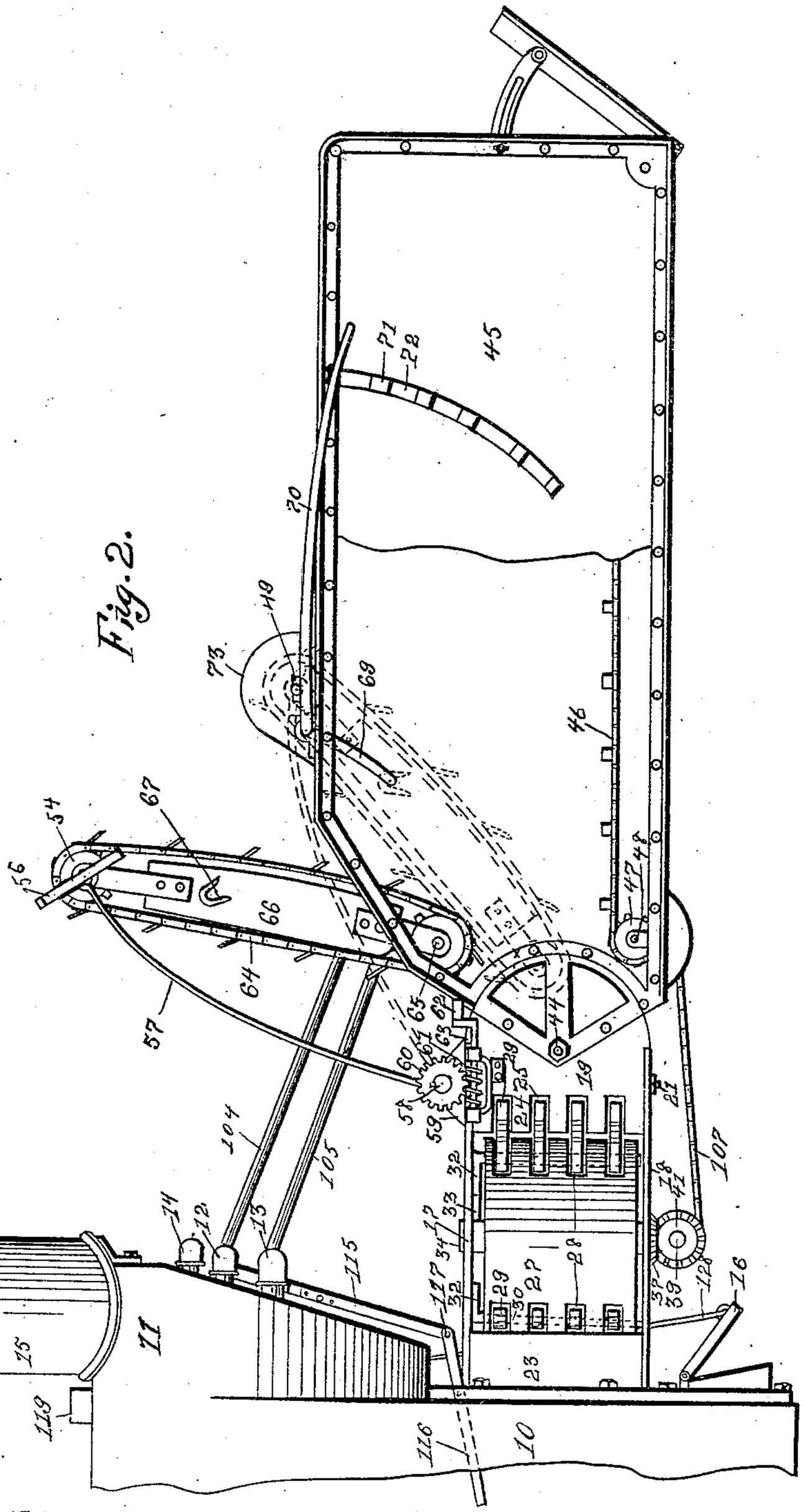
7 SHEETS—SHEET 2.

Fig. 2.



Witnesses:-

L. L. Leibrock.

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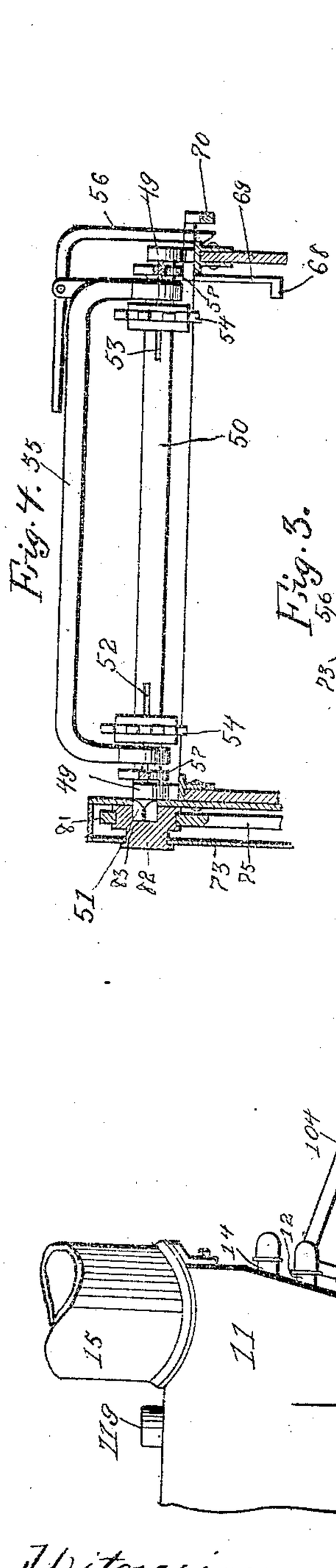

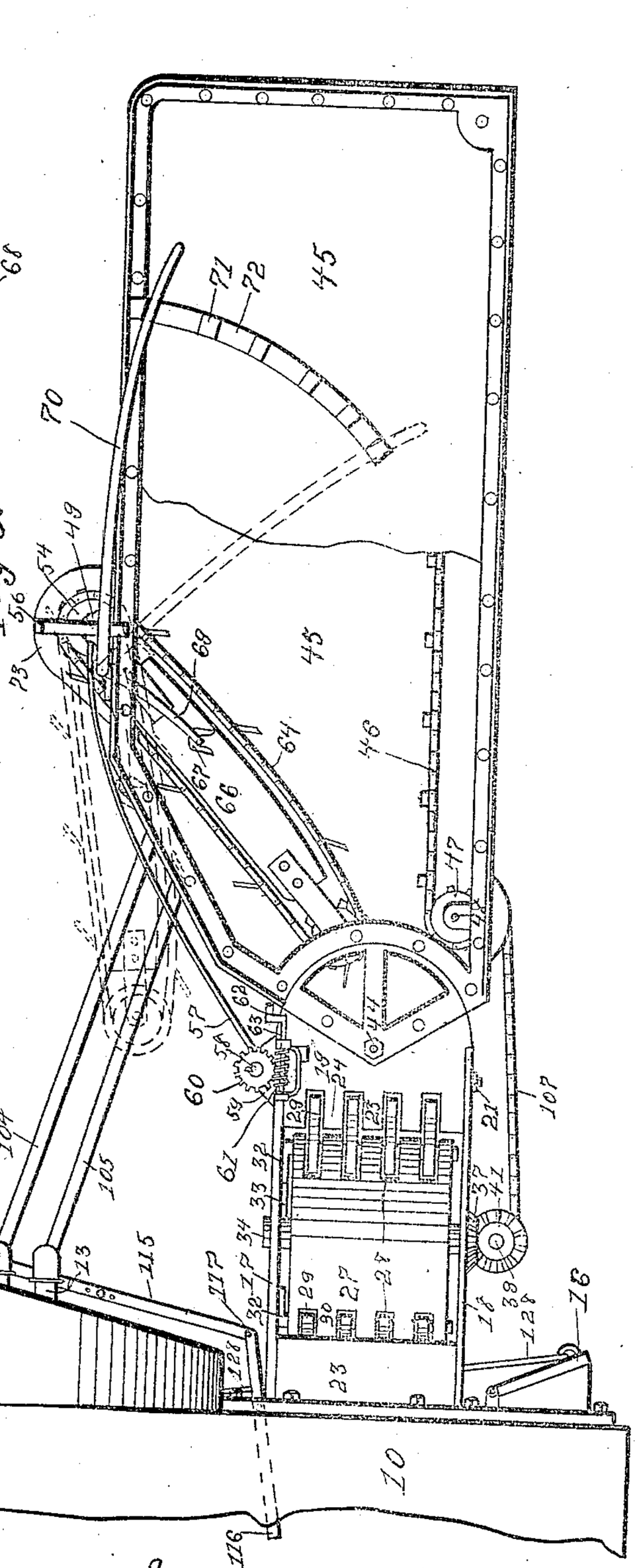

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A. G. Hague

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7 SHEETS—SHEET 4.

Fig. 7.

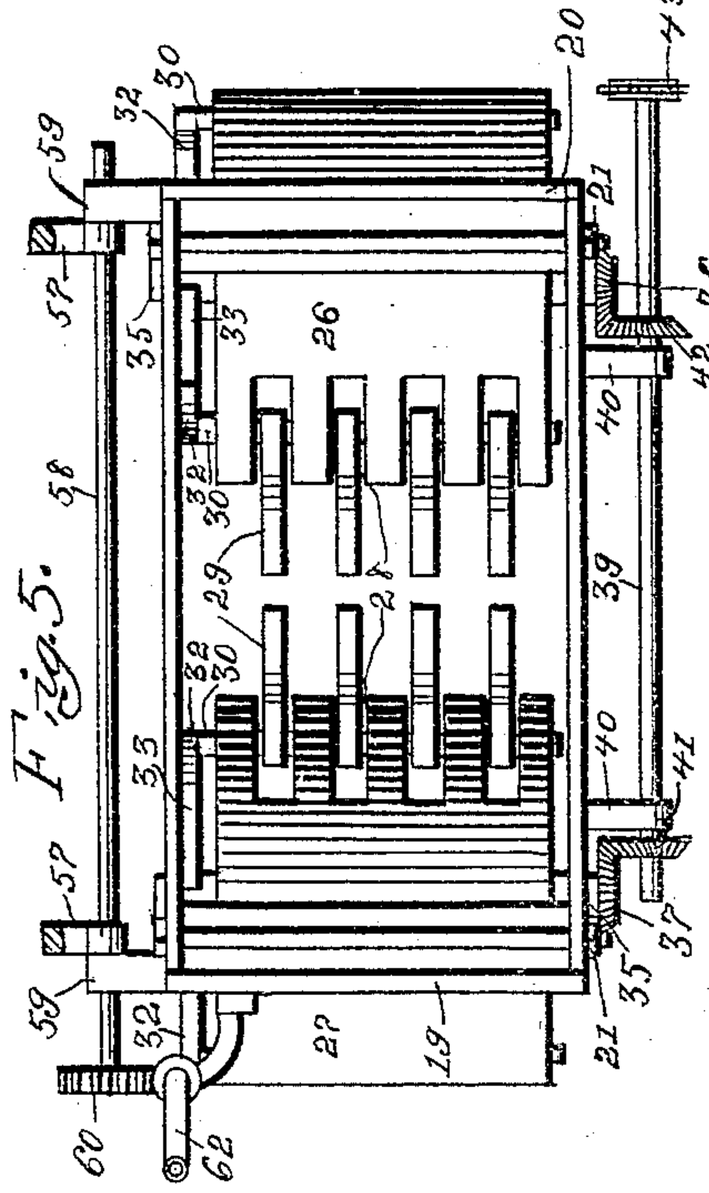

Fig. 5.

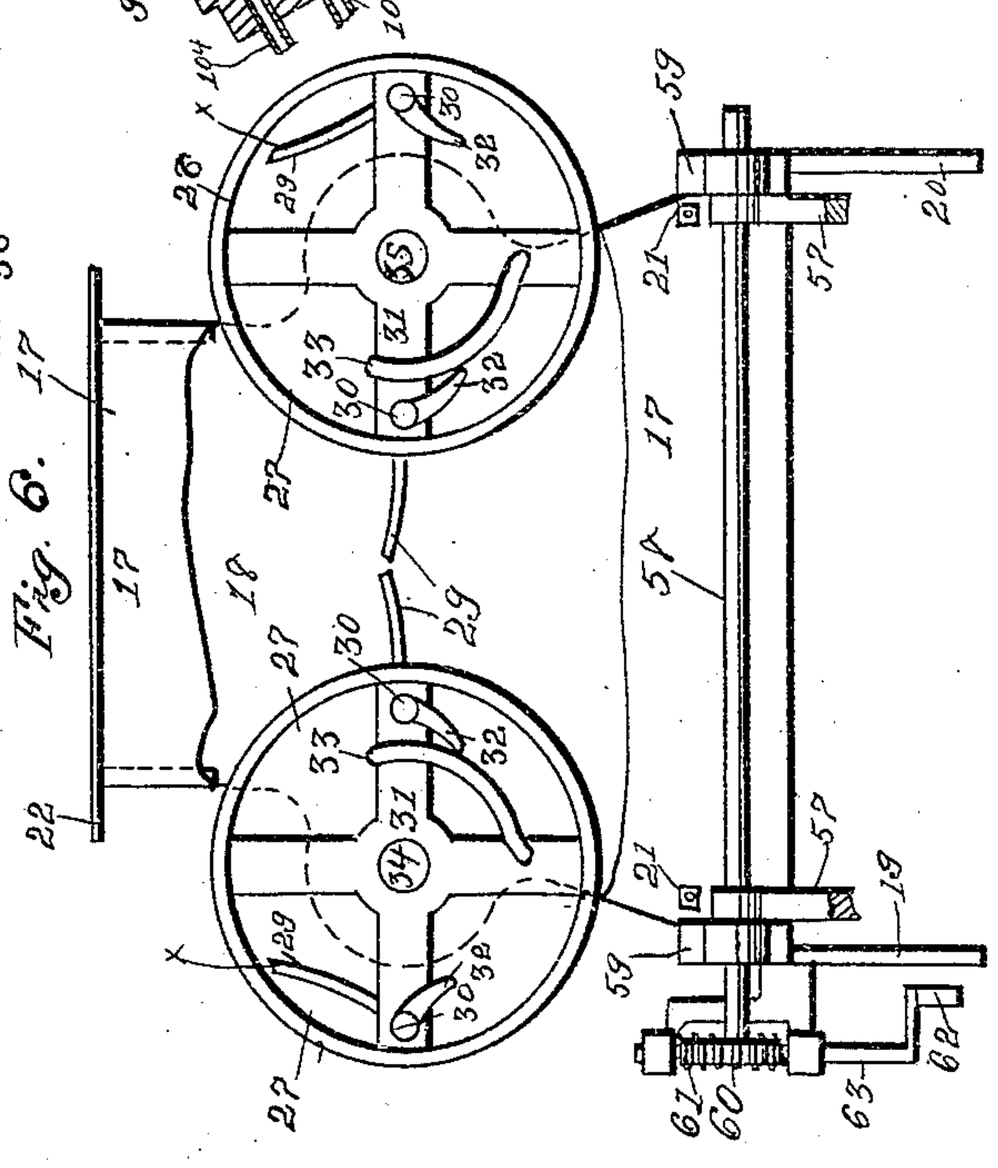

Fig. 6.

Witnesses:-

L. F. Leibrock.

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MECHANICAL STOKER.

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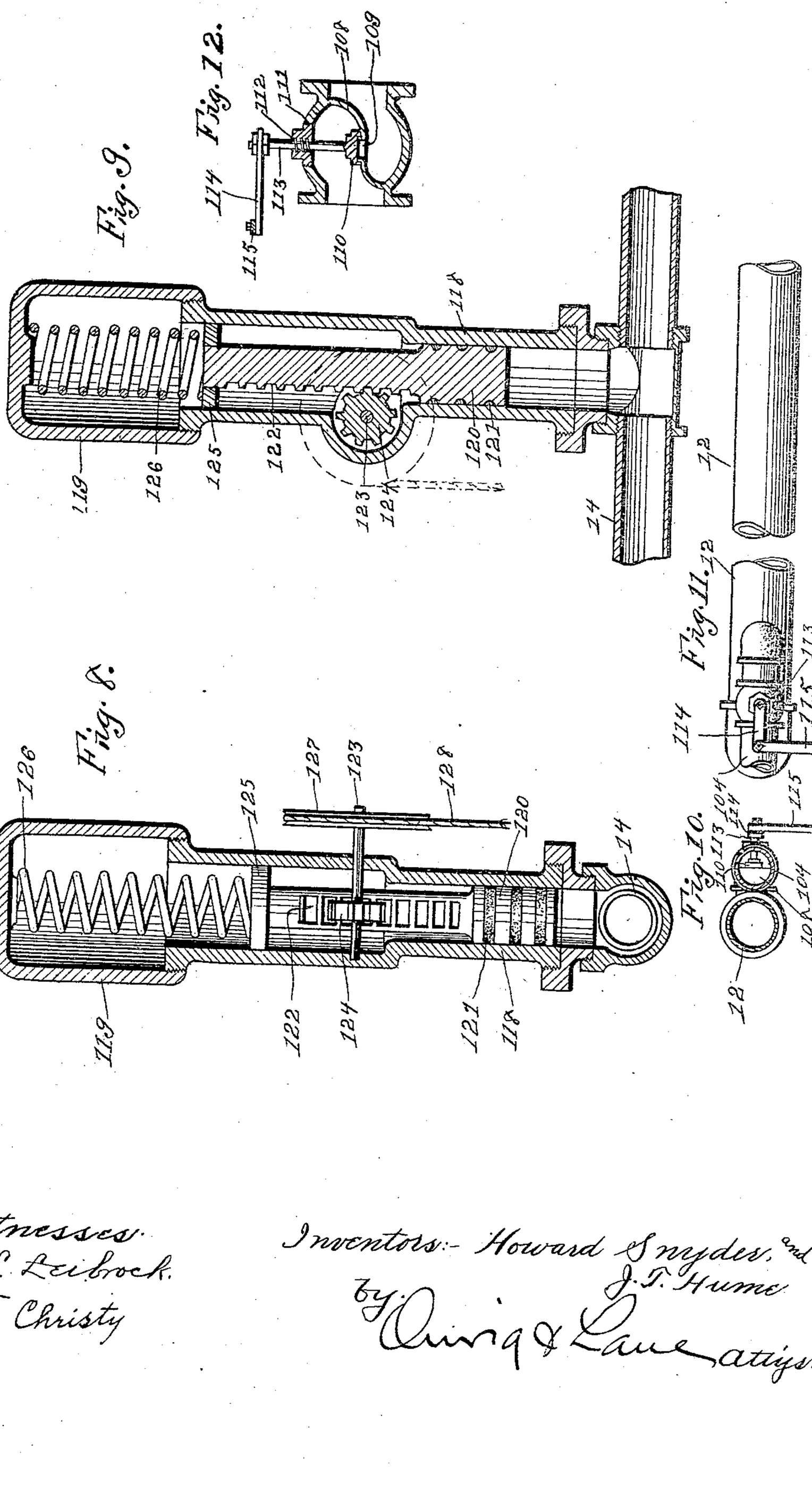
7 SHEETS—SHEET 5.



Witnesses.
L. L. Leibrock.
S. F. Christy

Inventors:- Howard Snyder, and
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7 SHEETS—SHEET 6.

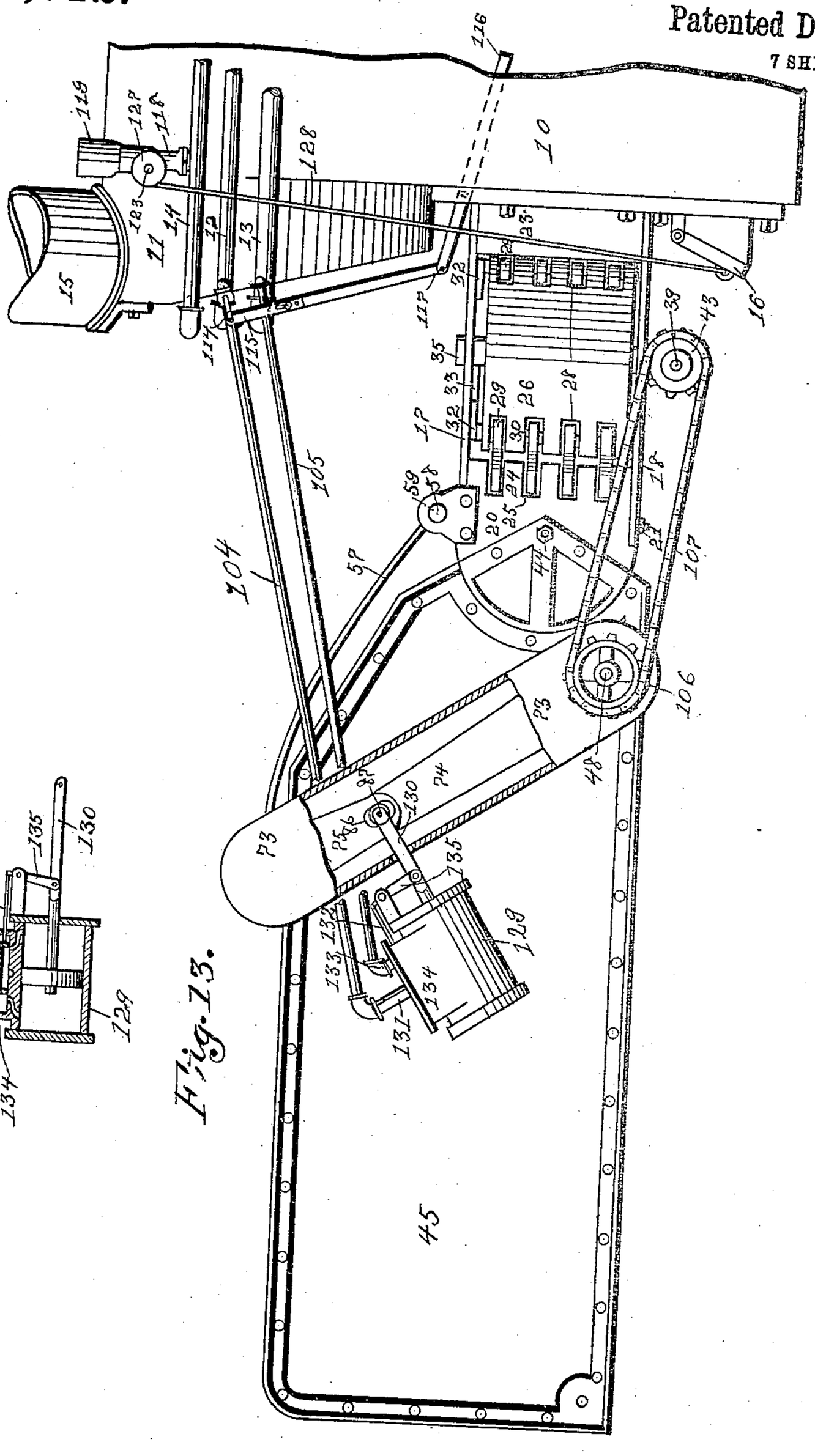

Fig. 13.

Fig. 14.

Witnesses:—
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H. SNYDER & J. T. HUME.

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APPLICATION FILED JAN. 10, 1903.

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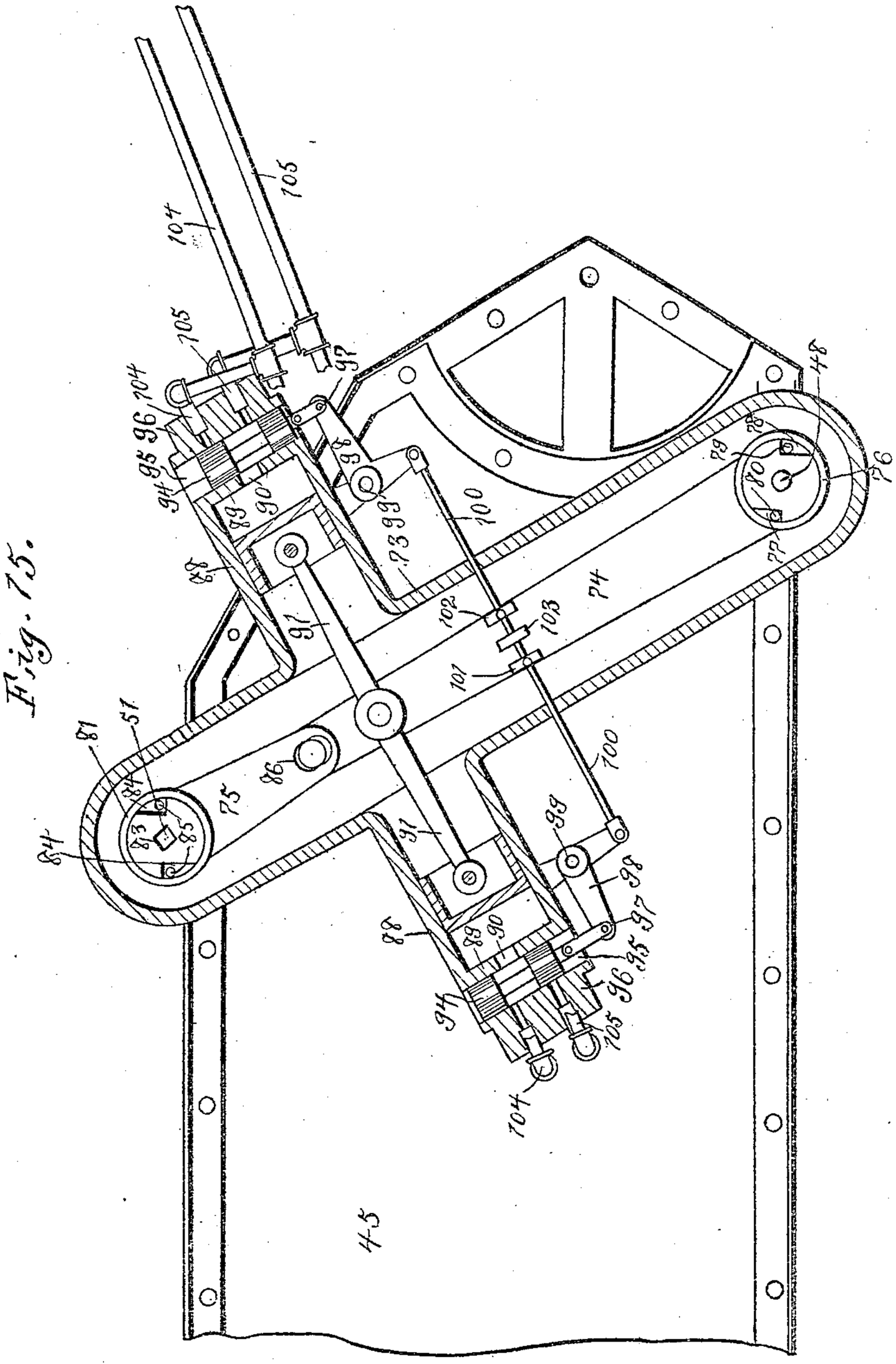
7 SHEETS—SHEET 7.

Fig. 15.



Witnesses:-
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UNITED STATES PATENT OFFICE.

HOWARD SNYDER AND JOHN T. HUME, OF NEWTON, IOWA.

MECHANICAL STOKER.

943,712. Specification of Letters Patent. Patented Dec. 21, 1909.

Application filed January 10, 1903. Serial No. 138,586.

To all whom it may concern:

Be it known that we, HOWARD SNYDER and JOHN T. HUME, citizens of the United States, residing at Newton, in the county of Jasper and State of Iowa, have invented certain new and useful Improvements in Mechanical Stokers, of which the following is a specification.

The objects of our invention are to provide a stoker which can be attached to the ordinary straw burning engine or furnace and which is designed to be driven by steam generated in the main boiler of the engine or furnace through an independent engine, and also to provide means whereby the pressure of the steam in the main boiler or furnace can be regulated automatically.

A further object is to provide a series of conveyers which will operate to throw the straw from the casing, which we have provided, into the fire box of the engine or furnace. These conveyers are to be driven preferably by an independent engine obtaining its power from the steam in the main boiler.

A further object is to provide means for automatically shutting off the supply of steam from the main boiler and thus preventing this steam from passing into the independent engine which drives the mechanism operating the conveyers.

A further object is to provide means whereby the draft of the furnace can be regulated and thus prevent the steam from attaining a pressure above a certain predetermined amount.

A further object is to provide means for throwing out of operation the driving mechanism of the conveyers when the straw in the fire box has attained a certain predetermined height, and further to provide a frame which is to be attached near the mouth of the fire box of the engine or furnace, so arranged that the ends of its sides which are away from the engine are farther apart than that portion of its sides which is nearest the engine; in other words, it is our object to provide a frame, the sides of which flare outwardly from their points of attachment to the engine, and to provide means for crowding the straw into a fire box which has a comparatively small mouth.

A further object is to provide means for raising and lowering the floating feeder, which is in the straw retaining casing, upwardly and to a sufficient height to allow the operator to have access to the mouth of the fire box with comparative ease. The material object of our invention, however, is to provide a driving mechanism whereby straw or other substance can be fed into the fire box of the ordinary straw burning furnace or engine at any desirable rate and in any desirable amounts.

Our invention consists in certain details in the construction, arrangement and combination of the various parts of the device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in our claims and illustrated in the accompanying drawings, in which—

Figure 1 shows a side elevation of our mechanism looking at the right side of the casing. This view also shows a portion of the engine and the way of attaching the casing to it. Fig. 2 is a side elevation of the device attached to the engine looking at the left side of it. We have also broken away, in this view, a portion of the straw receiving casing to show the conveyers in this casing. Fig. 3 is a side elevation of the device with a portion of the side of the straw receiving casing cut away to show the conveyers in their position. We have also shown, in dotted lines, the lower end of the floating feeder raised by means of the lever attachment. Fig. 4 is a cross sectional view of the upper portion of the straw receiving casing cut through said casing in front of the points of attachment of the floating feeder to the casing. Fig. 5 is a rear elevation of the toothed wheels which are mounted adjacent to the mouth of the fire box and outside thereof. This view also shows a portion of the mechanism whereby said wheels are rotated. Fig. 6 is a top or plan view of the supporting frame referred to in the short description of Fig. 5, a portion of the top of said frame being broken away to illustrate the toothed wheels and the way in which they are operated in said frame, and also shows in dotted lines the shape of the top portion which is broken away. This view makes clear the way in which the sides of the frame flare outwardly from their point of attachment to the engine. This view also shows the rounded portion of the frame against which the forward portion of the straw receiving casing is designed to rest. The worm gear arrangement, whereby the floating feeder is raised and lowered is also shown. Fig. 7 is a longitudinal, vertical sectional view of the preferable form of

independent driving engine and also shows the oscillating bars whereby the conveyers are operated. Fig. 8 is a vertical, sectional view of that portion of the damper regulator which is attached to the supply pipe and shows the rope which is attached to said device broken away. The lower end of this rope is designed to be attached to the damper in front of the ash pit. This sectional view is taken looking from the rear of the engine forwardly. Fig. 9 is a vertical sectional view of the same cut through the portion referred to in the short description of Fig. 8 except that this section is taken looking at the right side of the engine. This view shows clearly the way in which the draft regulator is attached to the supply pipe. Fig. 10 is a cross sectional view of the supply pipe cut through said pipe immediately at the rear of the point of attachment of the shut off valve which regulates the amount of straw to be driven into the fire box. This view is looking from the rear end of the engine forwardly and shows the auxiliary pipe which is attached to the main supply pipe and connects it with the independent engine for driving the conveyers. Fig. 11 is a side elevation of the main supply pipe showing the way in which the auxiliary supply pipe for feeding the independent engine is attached to the main supply pipe and shows the top portion of the means for operating the shut off valve. Fig. 12 is a sectional view of the shut off valve for regulating the supply of steam for driving the independent engine. This section is cut through the auxiliary supply pipe in a line substantially parallel with the under surface of said pipe. Fig. 13 shows a side elevation of the stoker attached to the rear portion of the engine. This view is the same as Fig. 1 except that a modified form of the independent engine is used to operate the oscillating shafts. A portion of the protector for the oscillating shafts is broken away to illustrate the position of these shafts in said protector clearly. Fig. 14 is a sectional view of the independent engine referred to in the short description of Fig. 13. Fig. 15 shows a modified form of the independent engine.

Similar numbers refer to similar parts throughout the several views.

Engine.—The engine with which our stoker is used has the ordinary straw burning fire box. The engine is also provided with the ordinary pipes. We have designated the body portion of this engine by the numeral 10, its boiler by the numeral 11; one of the supply pipes through which the driving mechanism is supplied with steam by means of the numeral 12. The numeral 13 indicates the ordinary exhaust pipe of the engine and the numeral 14 indicates another supply pipe which is above the supply pipe 12, all of which are attached to the engine. Near the rear end of the engine there is the ordinary fire box and ash pit. The smoke stack 15 of the engine is attached at the rear end of the engine as is customary in the most preferable form of straw burning furnaces and engines. We have provided the ordinary damper 16 on the outside of the ash pit and beneath the mouth of the fire box as is customary in engines of the class referred to.

Supporting frame.—Attached to the mouth of the fire box and surrounding it is the frame comprising a top portion 17 and the bottom portion 18. These top and bottom portions are held in position relative to each other by the sides 19 and 20, which are held in position relative to the top portion 17 by means of the bolts 21, one of said bolts 21 being on each side of the top and bottom portions and extending through them. The top and bottom portions 17 and 18 are also firmly attached to each other at their forward ends by the plate 22. The plate 22 is attached to the rear of the engine and outside of the mouth of the fire box so that an opening in this plate forms an opening into the fire box, each of the sides 19 and 20 having substantially semi-circular rear end pieces hereinafter referred to. Each of these sides is also divided into two portions, a forward portion 23 which is attached to the plate 22 and also the top portion 17 and the bottom portion 18, and the rear portion 24 which is the one having the substantially semi-circular rear end. Said portion 24 is firmly mounted between the top and bottom portions 17 and 18. At the forward edge of each of the portions 24 we have provided a series of slots 25 substantially equi-distant from each other.

Toothed wheels.—Mounted between the top and bottom portions 17 and 18 of the supporting frame are the drums 26 and 27, each of these drums having a series of slots 28 in its periphery designed to admit the pivotally mounted teeth 29 between the edges of these slots. Passed through each of the drums 26 and 27 are the pivots 30. The teeth 29 are mounted on said pivots 30 in such a way that these teeth can be made to swing on their pivots and when in one position they will be on the interior of the periphery of the drum and in the other position they will be outside the periphery of the drum and substantially in line with the diameter of the drums drawn through these pivotal points 30. Mounted firmly on the upper portion of each of these pivots 30 and above the upper supports 31 of each of the pivots is the lug 32. It is to be understood in this connection that the teeth 29 are attached to the pivots 30 and that one tooth is provided for each of the slots 28.

Attached to the top portion 17 of the supporting frame and extending downwardly therefrom are the curved guides 33 designed to be engaged by the lugs 32 as the drums 26 and 27 rotate on their pivots 34 and 35. These drums, it is understood, are designed to be rotated in a horizontal plane and in opposite directions in such a way as to draw the straw which has been forced against them inwardly in a direction toward the fire box of the engine, and as the lugs 32 engage the guides 33 when the drum rotates, the pivots 30 will be rotated a slight distance and will accordingly force the teeth 29 partially outside of the periphery of the drums and into the position shown in Fig. 6 of the drawings. As soon as one of the lugs 32 engages a guide 33, the teeth will be thrown out from the interior of the drum as has been above intimated and will be drawn through the slots 25, as clearly shown in Fig. 1 of the drawings. The teeth referred to in this connection are those shown in Fig. 1 farthest away from the engine. The teeth 29 which are shown nearest the engine in Fig. 1 are in their position on the interior of the drum, the slots 25 allowing the teeth to pass through them and to draw the straw which is to be forced against these drums toward the fire box of the engine. The teeth 29 will be maintained in their position, as the drums are rotated, outside of the periphery of the drum by means of the guides 33 until that portion of the teeth outside of the drum engages the rear portions 23 which are a part of the sides of the frame, and as these drums are rotated when the teeth 29 strike these sides 19 and 20, they are forced inwardly to the position indicated by the letters *x* in Fig. 6 of the drawings.

Mounted on the lower ends of the pivots 34 and 35 are the beveled gear wheels 36 and 37 respectively. Mounted substantially parallel with the bottom 18 of the frame is the driving shaft 39 supported by the lugs 40. This shaft has the beveled gear wheel 41 mounted on the left end of it in mesh with the beveled gear wheel 37 and placed so that their point of mesh is on the inside of the pivot 35. We have also mounted on this shaft 39 the beveled gear wheel 42 in mesh with the gear wheel 36. On the opposite end of the driving shaft 39 from the beveled gear wheel 41 we have provided the sprocket wheel 43, said sprocket wheel being designed to be connected with the other driving mechanism by means of a sprocket chain as hereinafter more fully brought out.

Straw receiving casing.—Pivotally attached to the rear portion 24 of the supporting frame by means of the pivots 44 is the straw receiving casing comprising the sides 45. Said sides are held firmly in position relative to each other and are substantially parallel with each other. These sides are preferably made of some thin metallic substance. Forming the bottom of the straw receiving casing is the conveyer 46 having sprocket chains therein designed to pass over the sprocket wheels 47 which are mounted on the shaft 48, said sprocket wheels 47 being firmly mounted on said shaft. The shaft 48 extends a considerable distance outside of the right side 45 of the casing for purposes hereinafter made clear. Rotatably mounted on top of the sides 45 of the straw receiving casing by means of the supporting lugs 49 is the supporting and driving shaft 50. Said supporting and driving shaft 50 has a squared end 51 on the right side of the casing. This squared end projects a slight distance over the right side 45 of the casing. We have also provided two slots 52 and 53 in said supporting shaft 50 so arranged that the sprocket wheels 54 which are mounted on said shaft at each end thereof may be keyed to said shaft 50 and they may maintain their position relative to the sides 45 of the casing when the shaft is moved crosswise of the casing.

The object of moving the shaft 50 out of engagement with the mechanism which is to drive it is to enable the operator to raise the shaft 50 upwardly and forwardly. We have provided a handle 55 attached to the shaft 50 which will enable the operator to more easily raise it when desired. The handle is so mounted on the shaft 50 as to allow it to rotate freely and slide longitudinally of it. We have also pivotally attached to the handle 55 the hook catch 56, the hook portion of said catch being designed to hook over the top portion of the left side of the casing 45 and hold the shaft firmly in position when held to the casing while it is being rotated. When it is desired to raise the shaft 50 the operator simply has to draw the shaft toward the left side of the casing a slight distance, throw the hook portion of the catch 56 out of engagement with the side of the casing and raise upwardly on the handle and the shaft 50 will take the position shown in Fig. 2 of the drawings, on account of this shaft being mounted on the arms 57, which are secured to a shaft 58, extending across the top portion 17 of the supporting frame and near its rear end. This shaft 58 is rotatably mounted on said top portions 17 by means of the boxes 59.

At one end of the shaft 58 and preferably at the left end we have mounted the gear wheel 60, said gear wheel being in mesh with the worm gear wheel 61 which is rotatably mounted on the front portion 24 of the side 19. I have also provided a crank 62 at the rear end of the shaft 63 upon which the worm gear wheel 61 is mounted. It will be readily seen that by turning the crank 62 in one direction the worm gear wheel will be

rotated in such a way as to raise the rear ends of the arms 57 upwardly and forwardly, and when the crank is turned in the opposite direction the worm gear wheel will be rotated in such a way as to allow the rear ends of the arms 57 to move downwardly and rearwardly. By this means we provide a device whereby the shaft 50 may be easily raised and lowered relative to the casing and maintained at any desirable position.

Mounted on the shaft 50 and operated by means of the sprocket chains 64 which pass over the sprocket wheels 54 is a floating feeder, said floating feeder having a shaft 65 at its lower portion upon which sprocket wheels are mounted to act with the sprocket wheels 54 when the floating feeder is in operation. We have provided connecting pieces between the shafts 65 and 50 which we have designated by the numeral 66. Extending outside from the connecting piece 66 which is nearest the left side of the casing is a loop 67, said loop being designed to be engaged by an inwardly extending projection 68 mounted on the inner portion 69 of the lever which is designed to raise the forward end of the floating feeder. This lever is constructed as follows: The portion 68 is attached to the inner lower end of the portion 69, said portion 69 extending downwardly from the upper inner portion of the left side of the casing 45. This lever has its bearing on top of the casing 45 in front of the lug 49 which supports the shaft 50; extending rearwardly and on the outside of the casing is the body portion 70 of the lever. It will be clearly seen that as the rear end of this body portion 70 is pushed downwardly into its dotted position shown in Fig. 3 of the drawings, the forward end of the floating feeder will be raised to the position shown in dotted lines in Fig. 3 of the drawings. The floating feeder can be maintained at any desirable position by placing the body portion of the handle against any one of the projections 71 of the sector 72 which is attached to the outside of the left side of the casing 45. It will be readily seen that when the straw which is in the straw receiving casing passes between the conveyer 46 and the floating feeder, if the bundle is large, the lower end of the floating feeder will be raised upwardly and downwardly without obstruction, and it will be noted that by means of the raising device attached to it, the floating feeder can be placed at any desirable position relative to the casing so that easy access may be had to the mouth of the fire box. It will also be seen that when the worm gear is used for raising the floating feeder the lever for raising the forward end of said feeder will in no way obstruct the raising by the worm gear. Neither will the raising by means of the lever affect in any way the worm gear or any of its attachments used for raising the entire floating feeder formed between the sides of the casing.

Oscillating shafts and driving mechanism.—Firmly attached to the right side of the straw receiving casing and near the front end thereof in such a way that the squared end 51 of the shaft 50 enters it at its top portion and the shaft 48 passes through it at its lower portion is the protector 73 having two sides and two edge portions designed to incase between said side and said edge portions the oscillating shafts 74 and 75, the shaft 74 has a circular ring 76 at its lower extremity designed to admit the shaft 48 so that the inner portion of the circular ring 76 engages the outer portion of the shaft 48. We have cut notches 77 and 78 in the shaft 48 to provide for the admission of the rollers 79 and 80, said rollers 79 and 80 being designed to fit in the notches and provide for a roller clutch so that as the ring is rotated in one direction the rollers will wedge between the shaft 48 and the interior of the ring 76 and thus rotate the shaft 48 in such a direction as to cause the portion of the conveyer 46 which is above it, to move forwardly and the portion of the conveyer 46 which is below the shaft 48 to be drawn rearwardly, thus causing the straw which is upon the conveyer 46 to be thrown in a direction toward the engine. When the ring 76 rotates in the opposite direction the shaft 48 will not be rotated. At the upper portion of the protector 73 and pivotally and slidingly attached to the upper portion of the oscillating shaft 74 is the second oscillating shaft 75. This shaft 75 is designed to be oscillated at the same time as the shaft 74. At the upper portion of said oscillating shaft 75 we have provided the ring 81 which is constructed in the same manner as the ring 76 on the shaft 74.

Mounted between the sides of the protector 73 and inside of the ring 81 is the circular nut 82, said circular nut 82 having a squared opening 83 in its central portion. We have also provided notches 84 in the outer periphery of said circular nut so arranged as to admit the rollers 85 between the outer surface of the notches 84 and the inner surface of the ring 81. On account of the ring 81 being firmly attached to the upper end of the oscillating shaft 75 when the shaft is moved forwardly, at its lower end, the ring will be rotated and will wedge the rollers 85 between the ring 81 and the circular nut 82 so as to drive said nut in such a way as to drive the shaft 50, the squared end of which is placed in the squared opening 83 so that the floating feeder which is mounted upon said shaft 50 will be driven so as to force the straw which is beneath it downwardly onto the conveyer 46 and forwardly into the frame at the front of the fire box. It will be clearly seen that as the upper end

of the oscillating shaft 74 and the lower end of the oscillating shaft 75 is moved forwardly, the shaft 50 and the shaft 48 will be rotated in opposite directions. By the construction of the circular ring 81 and the circular nut 83 the squared end 51 of the shaft 50 may be inserted into the opening 83 or it may be readily drawn from said opening, and of course, when the squared end 51 of the shaft 50 is out of engagement with the circular nut 82 the shaft will not be driven even though the shafts 74 and 75 are oscillating.

We have pivotally and slidingly attached the upper end of the shaft 74 to the lower end of the shaft 75 by cutting a slot 86 in the lower end of the shaft 75 and placing a pin 87 on the upper portion of the shaft 74 and through the slot 86 so that the shafts can oscillate freely relative to each other.

Preferably attached to the rear side of the protector 73 and opening into it is the cylinder 88, said cylinder having a bottom portion 89 with the opening 90 in its central portion. On the interior of the cylinder 88 we have provided the reciprocating piston 91 designed to move longitudinally of said cylinder and fit tightly on its interior. This piston 91 is attached at its upper forward portion pivotally to the oscillating shaft 74 so that as the piston rises and falls on the interior of the cylinders 88 the shafts 74 and 75 will be oscillated.

We have provided a helical spring 92, said spring being designed to assist in pushing the piston downwardly after it has reached its upper limit of movement. We have provided a forwardly extending circular projection 93 for the protector 73 to provide a space on the interior of it to allow the helical spring 92 to operate in. Beneath the bottom 89 of the cylinder we have provided a circular cut-off valve 94, said valve being so arranged as to slide longitudinally of the opening 95 which is beneath the bottom portion 89. The portion 89 forms the top portion of the opening 95 and the portion 96, through which the supply and exhaust pipes enter the opening 95, forms the bottom portion of the opening 95. Attached to the valve 94 by means of a connecting piece 97 is the lever 98 pivotally attached to the lower side of the cylinder 88 by means of the pivot 99. Attached to the outer end of this lever is the rod 100, said rod extending beneath the cylinder 88 and the lower edge of the protector 73 to a position outside of the oscillating shaft 74. Mounted on this oscillating shaft 74 and around the rod 100 are the limiting stops 101 and 102, the limiting stop 101 being on the lower edge of said shaft. Mounted on the rod 100 is the lug 103, said lug being on that portion of the rod 100 which is between the limiting stops 101 and 102 so that as the piston moves forwardly on account of the steam entering the supply pipe 104, and the upper end of the shaft 74 moved upwardly until the lug 103 engages the limiting stop 101 the valve 94 is drawn downwardly in such a way as to close the opening of the supply pipe. The steam then passes out through the exhaust pipe 105 and the piston moves downwardly assisted by the helical spring 92. As the piston moves downwardly the lug 103 engages the stop 102 and forces the valve into the normal position shown in Fig. 7 of the drawings and allows the steam to come through the supply pipe and again force the piston upwardly, thus causing the piston to reciprocate and the shafts 74 and 75 to oscillate. The supply pipe 104 is connected with the supply pipe 12 from the main boiler of the engine. The exhaust pipe 105 is connected with the exhaust pipe 13 of the main engine.

It is desirable in the use of stokers of this class to advance the straw very slowly, and to accomplish this result the straw advancing mechanism is operated intermittently: that is, the straw advancing mechanism is driven so as to advance the straw a slight distance and then to stop momentarily and to drive again for a short distance and another momentary stop take place and so on.

The sprocket chain.—The shaft 48 which has been referred to above extends transversely of the lower end of the protector 73. Mounted on that portion of the shaft 48 which is outside of the protector is the sprocket wheel 106. Connecting the sprocket wheel 106 and the sprocket wheel 43 is the sprocket chain 107 so adjusted that as the sprocket wheel 106 is rotated the sprocket wheel 43 will be rotated in the same direction. It will be seen in this connection that as the shaft 48 upon which the conveyer 46 and the sprocket wheel 106 are mounted is rotated in such a way as to force the straw toward the engine, the drums 26 and 27 which are mounted in the frame adjacent to the engine will be rotated in such a direction to take the straw which has been forced forwardly by the conveyer 46 and throw it inwardly and forwardly between them and force this straw into the engine fire box on account of the way in which the gear wheels 36 and 42 and the gear wheels 37 and 41 are mounted on the shaft 39 upon which the sprocket wheel 43 is also mounted. Thus the driving mechanism which is connected with the mechanism on the interior of the protector 73 will operate all of the mechanism used in forcing the straw from the straw receiving casing into the fire box.

The feed regulator.—Adjacent to the point where the auxiliary supply pipe 104 is connected with the main supply pipe of the engine 12, we have a shut off valve in the auxiliary pipe 104. This valve is of the ordi-

nary construction as shown clearly in Fig. 12 of the drawings and comprises the partition 108 having an opening 109 in its central portion. There is a cap 110 designed to fit tightly over the opening 109 and has a rod extending outwardly from it and through one side of the valve. This side 111 of the valve chamber is provided with a screw threaded portion 112 to coact with the screw threaded portion of the rod 113. As this rod is rotated in one direction the cap will move away from the opening 109 and as it is rotated in the opposite direction, the cap 110 will fit down closely over the opening 109. On account of the partition 108 being cast integral with the interior of the sides of the valve, when the cap 110 is over the opening an absolute shut off will be provided. In order to provide an automatic arrangement with which the steam from the main supply pipe 12 of the engine can be shut off from passing through the pipe 104 into the independent engine, we have attached to the upper outer end of the rod 113 the arm 114 substantially at right angles to the rod 113. This arm 114 when in position extends a slight distance rearwardly from the rear end of the engine as shown in Fig. 1 of the drawings. Pivotally attached to the rear of said arm 114 and extending downwardly therefrom is the adjustable arm 115. Pivotally attached to the lower end of said arm 115 and to the rear end of the engine is the rod 116 which is pivoted at 117 to the adjustable arm 115 and extends forwardly into the fire box of the engine, and on account of its being pivotally attached to the rear of the engine when the forward end of said rod 116 is moved upwardly, the rod 115 will be drawn downwardly and consequently draw the rear end of the arm 114 downwardly thus causing the rod 113 to be rotated in such a direction as to force the cap 110 over the opening 109 and shut off the steam supply from the main supply 12 into the independent engine; so that when the straw which is in the fire box reaches the rod 116, which can be adjusted at any predetermined height in the fire box by adjusting the rod 115, the steam will be shut off from the independent engine and thus prevent any more straw being fed into the fire box of the engine until a portion of the straw in the fire box has been consumed, and the forward end of the rod 116 falls to a normal position causing the valve in the supply pipe 104 to be thrown open and the mechanism for feeding the straw to be thrown into full operation.

Draft regulator.—Mounted on the steam pipe 14 of the engine and preferably extending upwardly from it we have provided a device for regulating the draft so that when the steam in the boiler has a certain predetermined amount of pressure the damper 16 which is normally held open will be allowed to drop downwardly and close, thus lessening the amount of draft through the fire box. In order to accomplish this result automatically we have provided the following described mechanism. Attached to the supply pipe 14 is the cylinder 118, the top portion of said cylinder being slightly larger than the bottom portion thereof, the top portion 119 being screwed to the lower portion of said cylinder. In the lower portion of this cylinder and slightly above its point of attachment is a piston having the grooved lower portion 120; the grooves contain packing 121 so that the piston will fit tightly in the cylinder and no steam will be allowed to escape between the outside of the piston and the inside of the cylinder. Forming the upper portion of the piston in place of the ordinary piston rod is a rack 122.

Extending across the central portion of the cylinder and mounted in its sides is the wheel bearing shaft 123, said shaft having mounted on that portion of it, which is between the inside portions of the cylinder, the pinion 124 designed to coact with the rack 122 so that as the pinion 124 is rotated the shaft 123 will be rotated by the piston being raised or lowered, the piston rising to rotate the shaft in one direction and falling to rotate the shaft in the opposite direction. Mounted on top of the rack portion 122 is the plate 125. Mounted above said plate 125 inside of the cylinder and connected with the top portion 119 is the helical spring 126. This spring 126 is designed to hold the piston normally at its lower limit of movement. When, however, the steam in the boiler attains a certain pressure the piston will be forced upwardly and thus the spring 126 will be compressed.

Mounted on that portion of the shaft 123 which is outside of the cylinder 118 is the grooved wheel 127. Attached to the said grooved wheel and extending downwardly from it and attached to the damper 16 is the rope 128. This rope is so attached to the wheel 127 as to hold the damper 16 in a raised position when the piston is at its lower limit of movement. Then as the piston rises on account of the pressure of steam being sufficient to force it upwardly, the wheel will be rotated slightly and allow the damper 16 to be in a closed position as shown in Fig. 1 of the drawings, In this connection, it may be well to state that the spring may be of any desired material and may have any desired tension, so that the pressure of the steam will be great or small to force the piston upwardly as the tension of the spring is great or small.

The independent engine modified.—We have also provided a modified independent engine, the piston rod of which may be connected with the oscillating shafts 74 and 75.

This engine, however, is not connected in any way with the protector 73 except by its piston. This modified form of engine is of the ordinary construction and as a detailed sectional view of it is shown in Fig. 14 of the drawings, a full description of this is deemed unnecessary. Suffice it to say that this engine has a cylinder 129, a reciprocating piston 130 to operate in said cylinder, a supply inlet 131, said supply inlet having two openings diverging from the main opening and one leading into one end of the cylinder and the other leading into the other end of the cylinder, and a slide valve 132 to allow the steam to pass first, into one of the diverging openings and then into the other alternately. This engine also has an exhaust 133. The slide valve 132 is operated backwardly and forwardly in the valve chamber 134 by being pivotally connected with a portion of the engine and with the piston rod by means of the connecting lover 135. The supply and exhaust pipes of this independent engine are designed to be connected with the steam supply of the main engine.

We have also provided a second modification to the independent engine which is used for driving the straw advancing mechanism. This engine is shown in Fig. 15 of the drawings and in place of the spring 92 which is shown in Fig. 7 of the drawings we have used a second piston and also provided a cylinder corresponding to the cylinder 88, a piston corresponding to the piston 91, a slide valve corresponding to the slide valve 94, and also provided steam supply and exhaust pipes to the second cylinder, and also provided means for operating the second slide valve so that there is a positive drive on the oscillating shafts 74 and 75. We have used the same numerals on the second cylinder and its attachments as were used on the first cylinder, as the parts are constructed exactly alike throughout. It will be seen that in this modified form that the oscillating bars will be driven in both directions, and a much more positive movement of these bars is had than by the use of the spring 92. As the operation of this modified form in Fig. 15 is so similar to the form shown in Fig. 7, a further description of it is deemed unnecessary.

In practical operation.—In practical operation and assuming that our device is operatively attached to the ordinary straw burning furnace. He then rotates the drums 26 and 27, causing the conveyer 46 to force the straw forwardly and against the rear portion of the wheels 26 and 27, which the operator rotates by hand, for forcing the straw forwardly into the fire box, and sets fire to it, causing it to heat the water in the boiler. When sufficient steam pressure has been generated in the boiler of the main engine to cause the reciprocating piston 91 in the independent engine to oscillate the shafts 74 and 75 and drive the conveyers, the lever 70 is released to its normal position Fig. 3 of the drawings, whereupon the device is in position for operation and the straw will be fed from the straw receiving casing into the fire box of the engine mechanically.

The worm gear attachment for throwing the floating feeder into an elevated forward position relative to the casing, as shown in solid lines in Fig. 2 of the drawings is only designed to be used when the device needs repairing or has become clogged in any way.

When the straw reaches a certain height in the fire box, the forward end of the rod 116 is raised and this effects a shutting off of the supply of steam from the main supply pipe 12 into the independent engine in the manner above indicated. When the pressure of the steam in the boiler reaches a certain point the piston of the damper regulator allows the damper to be closed, and thus check the draft and prevent the straw from burning too rapidly.

The oscillating bars in the driving mechanism cause the shafts 48 and 50 to be rotated in opposite directions and therefore drive the floating feeder and the conveyer so as to force the straw toward the fire box of the engine. The floating feeder is driven in such a way as to throw the straw forwardly and downwardly between the floating feeder and the conveyer 46 and against the drums 26 and 27. As the oscillating shafts 74 and 75 are moved upwardly and forwardly on the shafts 48, and the circular nut 82, the rollers mounted adjacent to said shaft 48 and said circular nut 82 will be wedged between the parts in such a way as to drive this shaft and the circular nut. When the oscillating bars 74 and 75 are drawn downwardly and rearwardly, the nuts 82 and 48 maintain their position, and do not rotate. Thus it will be seen that upon every oscillation of the shafts 74 and 75, the floating feeder and the conveyer 46 will be driven but a slight distance and the straw will be fed from the straw receiving casing into the fire box of the engine very slowly even though the oscillating bars move rapidly.

Having thus described our invention, what we claim and desire to secure by Letters Patent of the United States therefor is—

1. The combination of a straw burning engine, wheels mounted adjacent to the mouth of the fire box of the engine having a number of series of slots in the periphery of them, pivots rotatably mounted in the wheels adjacent to each series of slots, teeth mounted on said pivots capable of swinging outwardly and partially through the slots, means for rotating the wheels, means for

rotating the pivots to swing said teeth outwardly and inwardly through the slots as the wheels are rotated, for the purposes stated.

2. The combination of a straw burning engine, wheels mounted adjacent to the fire box of said engine having slots in their peripheries, teeth mounted on the inside of said wheels and adjacent to said slots, means for swinging said teeth outwardly and inwardly through said slots in such a way that straw or other substance will be drawn between them and thrown rearwardly as the wheels are rotated in opposite directions, means for rotating said wheels in opposite directions, for the purposes stated.

3. The combination of an engine, a frame attached near the fire box thereof, wheels having slots in their peripheries, pivots in said wheels adjacent to said slots, teeth on the pivots adapted to swing through the slots, a lug attached to each of said pivots, projections on the frame for engaging each of said lugs as the wheels are rotated and so arranged as to throw the teeth to their outer limit of movement relative to the wheels and maintain the teeth in that position until the rear portions of the frame engage the teeth and throw them to their inner limit of movement.

4. The combination of a straw burning engine, a frame attached to the engine and near the fire box thereof, sides in said frame flaring outwardly from their points of attachment to the engine, wheels rotatably mounted in said frame and in each side thereof, means mounted on the frame for rotating the wheels in opposite directions and in a horizontal plane, pivots mounted in the wheels, teeth mounted on said pivots, means for rotating the pivots to swing the teeth partially outside the periphery of said wheels as the teeth move toward each other in the rotation of the wheels.

5. The combination with a straw burning engine, a frame, sides flaring outwardly from their points of attachment to the engine, toothed wheels mounted at the opposite sides of the frame having slots in their peripheries, pivots mounted in the wheels adjacent to the slots, teeth mounted on the pivots, a lug on the top portion of each of said pivots, a substantially semi-circular projection attached to the lower portion of the top of said frame to engage said lugs as the wheels are rotated and to act in throwing the teeth outwardly through said slots and maintain them at their outer limit of movement throughout a part of each rotation of the wheels, rear portions in said sides to engage said teeth and force them inside the wheels as the wheels are rotated, for the purposes stated.

6. The combination of a frame attached near the mouth of a straw burning engine, vertical shafts rotatably mounted on the opposite sides of said frame, wheels on the lower ends of said shafts and below the frame, a horizontally mounted shaft beneath the frame, gear wheels on said horizontally mounted shaft in mesh with the gear wheels on the vertical shaft and between them, a sprocket wheel on the horizontal shaft, means for rotating the sprocket wheel and causing the vertical shafts to rotate in opposite directions, toothed wheels mounted on the vertical shafts which are rotated when the vertical shafts rotate, said toothed wheels being designed to coact with each other in advancing straw or other substance, for the purposes stated.

7. The combination of an engine, a straw receiving casing mounted near the engine, a floating feeder in the casing, means for raising said floating feeder out of the casing, for the purposes stated.

8. The combination of an engine, a straw receiving casing mounted near the engine, a floating feeder mounted in the straw receiving casing, means for raising said floating feeder out of the casing and maintaining it in a raised position, for the purposes stated.

9. The combination of an engine, a straw receiving casing mounted near the engine, a floating feeder mounted in the straw receiving casing, means for raising said floating feeder out of the casing and maintaining it in a raised position, and means for driving the floating feeder.

10. The combination of an engine, a straw receiving casing mounted near said engine, a conveyer at the bottom of said casing, a floating feeder mounted above the conveyer, means for raising and lowering the floating feeder relative to the casing, for the purposes stated.

11. The combination of an engine, a straw receiving casing mounted near said engine, a conveyer at the bottom of said casing, a floating feeder mounted above the conveyer, means for raising and lowering the floating feeder relative to the casing, and maintaining it at any desired position relative to the casing.

12. The combination of an engine, a straw receiving casing mounted near said engine or furnace, a conveyer at the bottom of said casing, a floating feeder mounted above the conveyer, means for raising and lowering the floating feeder relative to the casing, and means for driving the conveyer and floating feeder, for the purposes stated.

13. The combination of an engine, a straw receiving casing mounted near said engine or furnace, a conveyer at the bottom of said casing, a floating feeder mounted above the conveyer, means for raising and lowering the floating feeder relative to the casing and maintaining it at any desired position relative to the casing, and means for driv-

ing the conveyer and floating feeder, for the purposes stated.

14. The combination of a straw burning engine, a frame, a straw receiving casing pivotally mounted on said frame, a conveyer forming the bottom of said straw receiving casing, a floating feeder mounted above said conveyer and between the sides of said casing, means attached to said frame and to the floating feeder for raising and lowering the floating feeder relative to the straw receiving casing, and a driving mechanism connected with the conveyer and floating feeder, for the purposes stated.

15. The combination of a straw burning engine, a frame, a straw receiving casing pivotally mounted on said frame, a conveyer forming the bottom of said straw receiving casing, a floating feeder mounted above said conveyer and between the sides of said casing, means attached to said frame and to the floating feeder for raising and lowering the floating feeder relative to the straw receiving casing, a driving mechanism connected with the conveyer and detachably connected with the floating feeder.

16. An engine, a casing mounted near said engine, a floating feeder mounted in said straw receiving casing, means for raising and lowering the forward end of the floating feeder relative to the bottom of the casing, for the purposes stated.

17. In a device of the class described, the combination of an engine, of a casing mounted near said engine, a floating feeder mounted in said casing, means for raising and lowering the forward end of said floating feeder and supporting the lower forward end of the feeder at any desired position relative to the bottom of the casing, for the purposes stated.

18. The combination of a straw burning engine, a frame mounted near the mouth of the fire box of the straw burning engine, a casing pivotally mounted on said frame, a floating feeder mounted in said casing, means for driving said floating feeder, and means for raising and lowering the forward end of the floating feeder, for the purposes stated.

19. An engine, a straw receiving casing mounted in operative relation to the fire box thereof, a floating feeder, means for adjusting the floating feeder so that easy access may be had to the interior of the casing.

20. The combination of a straw receiving casing mounted near the fire box, a straw burning engine, a floating feeder mounted in said casing, means for supporting the lower forward end of the feeder and for raising and lowering said lower end, means for raising and lowering the entire floating feeder relative to the casing, for the purposes stated.

21. The combination of a straw receiving casing mounted near the fire box, a straw burning engine, a floating feeder mounted in said casing, means for supporting the lower forward end of the feeder and for raising and lowering said lower end, means for raising and lowering the entire floating feeder relative to the casing, and means for driving the floating feeder, for the purposes stated.

22. The combination of a straw receiving casing mounted near the fire box, a straw burning engine, a floating feeder mounted in said casing, means for supporting the lower forward end of the feeder and for raising and lowering said lower end, means for raising and lowering the entire floating feeder relative to the casing, and a conveyer mounted in said casing and partially beneath said floating feeder, means for driving said conveyer and the floating feeder so as to advance straw or other substance which is between them, for the purposes stated.

23. The combination of a straw receiving casing mounted near the fire box, a straw burning engine, a floating feeder mounted in said casing, means for supporting the lower forward end of the feeder and for raising and lowering said lower end, means for raising and lowering the entire floating feeder relative to the casing, and a conveyer mounted in said casing and partially beneath said floating feeder, means for driving said conveyer and the floating feeder so as to advance straw or other substance which is between them, and means for holding the floating feeder in position relative to the straw receiving casing, for the purposes stated.

24. The combination of a straw burning engine, a frame mounted near the fire box of said engine, a casing mounted on said frame, a conveyer forming the bottom of said casing, a floating feeder mounted above said conveyer, a lever mounted on said casing and connected with the floating feeder for raising and lowering the forward end of the floating feeder, a sector attached to the outside of said casing having projections on said sector for engaging the lever, for the purposes stated.

25. The combination of an engine, a frame mounted near the fire box of the engine, a straw receiving casing, a conveyer forming the bottom of said straw receiving casing, a floating feeder above the conveyer, a lever mounted on the casing and detachably connected with the floating feeder for supporting the lower end of the floating feeder and for raising and lowering said lower end and maintaining it in a raised or lowered position, for the purposes stated.

26. The combination of a straw burning engine, a straw receiving casing attached to said straw burning engine near the fire box thereof, straw advancing conveyers for taking the straw in the receiving casing and

driving it into the fire box of the engine, an independent engine for driving said conveyer, a steam supply pipe connecting the independent engine with the boiler of the main engine, and a steam exhaust pipe connecting the independent engine with the exhaust of the main engine, for the purposes stated.

27. The combination of a straw receiving casing mounted in operative relation to the fire box of the straw burning engine or furnace, a conveyer forming the bottom of said casing, a floating feeder mounted above said conveyer, shafts extending across the casing for driving the conveyer and the floating feeder, oscillating shafts connected with the ends of said shafts for rotating them at each oscillation of the oscillating shafts, and an independent engine for driving the oscillating shafts.

28. The combination of an engine, a straw receiving casing mounted near the fire box of the engine, a conveyer forming the bottom of said casing, a floating feeder mounted above said conveyer, a rotating shaft for driving the floating feeder, a rotating shaft for driving the conveyer, two oscillating shafts connected with said rotating shafts and with each other, a ratchet device between the rotating shaft which drives the floating feeder and one of said oscillating shafts, a ratchet device interposed between the rotating shaft which drives the conveyer and the other of said oscillating shafts, and an independent engine connected with one of said oscillating shafts for driving them, for the purposes stated.

29. The combination of an engine, a straw receiving casing mounted near the fire box of the engine, a conveyer forming the bottom of said casing, a floating feeder mounted above said conveyer, a rotating shaft for driving the floating feeder, a rotating shaft for driving the conveyer, two oscillating shafts connected with said rotating shafts and with each other, a ratchet device between the rotating shaft which drives the floating feeder and one of said oscillating shafts, a ratchet device interposed between the rotating shaft which drives the conveyer and the other of said oscillating shafts, an independent engine connected with one of said oscillating shafts for driving them, steam pipes connecting the independent engine with the main engine, and means for automatically shutting off the steam supply from the main engine into the independent engine, for the purposes stated.

30. The combination of a straw burning engine, a straw receiving casing mounted near the mouth of the fire box of said engine, a floating feeder mounted in said casing, means for raising and lowering the forward end of the floating feeder relative to the casing, a rotating shaft for supporting said floating feeder, an oscillating shaft, a ratchet device interposed between the rotating shaft and the oscillating shaft, and means for oscillating the oscillating shaft.

31. The combination of a straw burning engine, a fire box in said engine, an independent engine, pipes for connecting the boiler of the main engine with the independent engine in such a way that the steam from the main engine will drive the independent engine, a pivotally mounted rod extending partially inside the fire box of the engine, a shut off valve in the supply pipe between the main engine and the independent engine, a rod for connecting the rear end of the pivoted rod and the shut off valve so that when the material in the fire box of the engine reaches a certain predetermined height the steam supply from the boiler of the main engine into the independent engine will be shut off and a fuel feeding mechanism operated by the independent engine, for the purposes stated.

32. The combination of an engine, an independent engine, pipes connecting said engines for allowing the steam from the boiler in the main engine to pass into the independent engine, means attached to the main engine for shutting off the supply of steam from the main engine into the independent engine when the fuel in the fire box of the main engine reaches a certain predetermined height and a fuel feeding mechanism operated by the independent engine, for the purposes stated.

33. The combination of a main engine, means for forcing straw into the fire box of the main engine, an independent engine for driving said means, said independent engine being controlled by the rise and fall of the straw in the fire box of the main engine, for the purposes stated.

34. The combination of an engine, means for forcing straw into the fire box of said engine, an independent engine for driving said means, and means for controlling the speed of the independent engine by the flow of the straw.

35. The combination with a straw burning engine, a straw feeding mechanism for said straw burning engine, an independent engine for driving said straw feeding mechanism, and means operated by the straw for controlling the independent engine.

36. The combination of a straw burning engine, a straw feeding mechanism for said straw burning engine, an independent engine for driving said straw feeding mechanism, and means regulated by the flow of straw from the feeding mechanism for controlling the driving speed of the independent engine, and a damper regulator attached to said engine or furnace, for the purposes stated.

37. The combination of a straw burning

engine, a mechanism for feeding straw into the fire box of the engine, oscillating bars for driving said feeding mechanism, an independent engine for operating said oscillating bars, means controlled by the height of the fuel in the fire box of the engine or furnace for controlling the driving speed of the independent engine.

38. The combination of a main engine having a fire box and a boiler therein, a mechanism for feeding straw into the fire box of said engine, an independent engine for driving said mechanism, means for regulating the driving speed of the independent engine by the flow of the straw into the fire box of the engine, a damper regulator for regulating the draft in the fire box of the engine for determining the pressure of steam in the boiler of the engine, substantially as and for the purposes stated.

39. A straw advancing mechanism adapted to be connected with an engine or furnace comprising two wheels designed to be rotated in the same horizontal plane, having a series of slots in the periphery of each of them, teeth pivotally mounted inside of said wheels capable of being swung outwardly through said slots, means for rotating the wheels in opposite directions and means for swinging said teeth outwardly and inwardly through the peripheries of said wheels as the wheels are rotated in opposite directions to advance material between them.

40. In a device of the class described two wheels designed to be rotated in the same horizontal plane, having a series of slots in the periphery of each of them, teeth pivotally mounted inside of said wheels capable of being swung outwardly through said slots, and means for swinging said teeth outwardly and inwardly through the peripheries of said wheels as the wheels are rotated in opposite directions, a main engine or furnace adjacent to the fire box of which said wheels are mounted, and an independent engine for rotating said wheels in opposite directions.

41. In a device of the class described two wheels designed to be rotated in the same horizontal plane, having a series of slots in the periphery of each of them, teeth pivotally mounted inside of said wheels capable of being swung outwardly through said slots, and means for swinging said teeth outwardly and inwardly through the peripheries of said wheels as the wheels are rotated in opposite directions, an independent engine or furnace adjacent to the fire box of which said wheels are mounted, an independent engine for rotating said wheels in opposite directions, and means operated by the flow of straw between said wheels for controlling the operation of said independent engine.

42. An engine, a straw advancing mechanism for said engine, means for intermittently driving the straw advancing mechanism, and an independent engine for driving said means.

43. An engine, a straw receiving casing mounted in operative relation thereto, a floating feeder mounted in the casing, an independent engine for driving said floating feeder, and means for adjusting the floating feeder so that easy access may be had to the interior of the casing.

44. An engine, a straw receiving casing mounted near said engine, a conveyer at the bottom of said casing, a floating feeder mounted above the conveyer, straw advancing toothed wheels mounted between said casing and the fire box of said engine, and an independent engine for driving said conveyer, the floating feeder and said toothed wheels.

45. An engine, a straw receiving casing mounted near said engine, a conveyer at the bottom of said casing, a floating feeder mounted above the conveyer, straw advancing toothed wheels mounted between said casing and the fire box of said engine, an independent engine for driving said conveyer, the floating feeder and said toothed wheels, and means for automatically controlling the operation of the independent engine.

46. The combination of an engine, a straw receiving casing mounted in operative relation thereto, a floating feeder in the casing, means for raising said feeder out of the casing, and an independent engine for driving said floating feeder.

47. An engine, a straw receiving casing mounted near the engine, a floating feeder mounted in the straw receiving casing, means for raising said floating feeder out of the casing and maintaining it in a raised position, means for operating the floating feeder intermittently, and an independent engine for driving said means.

48. An engine, a straw receiving casing mounted near said engine, a conveyer at the bottom of said casing, a floating feeder mounted above the conveyer, means for operating said floating feeder and conveyer intermittently, an independent engine for driving said means, and means for automatically controlling the operation of the independent engine.

49. An engine, a straw receiving casing mounted near said engine, a conveyer at the bottom of said casing, a floating feeder mounted above the conveyer, means for operating said floating feeder and said conveyer intermittently, an independent engine for driving said means, means for automatically controlling the operation of the independent engine, and toothed wheels driven by said independent engine mounted between the straw receiving casing and the main engine.

50. An engine, a straw receiving casing

mounted near said engine, a conveyer at the bottom of said casing, a floating feeder mounted above the conveyer, means for operating said floating feeder and said conveyer intermittently, an independent engine for driving said means, means for automatically controlling the operation of the independent engine, toothed wheels driven by said independent engine mounted between the straw receiving casing and the main engine, and means for raising and lowering said floating feeder relative to said conveyer.

51. An engine, a straw advancing mechanism for said engine, means for intermittently driving the straw advancing mechanism, an independent engine for operating said means, and means for automatically controlling the speed of the independent engine.

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Witnesses:
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