No. 684,052. Patented Oct. 8, 1901.

# H. S. FARQUHAR.

## APPARATUS FOR REMOVING SNOW FROM THOROUGHFARES.

(Application filed June 22, 1901.)

(No Model.) 5 Sheets—Sheet 1.

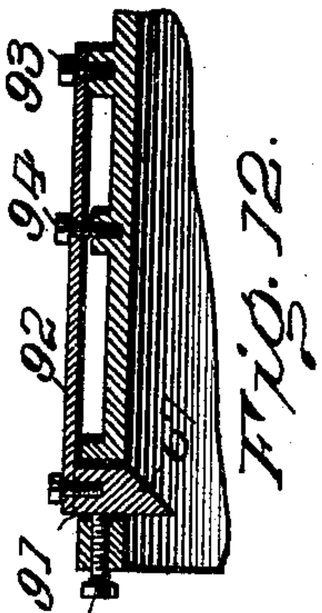


Fig. 11.

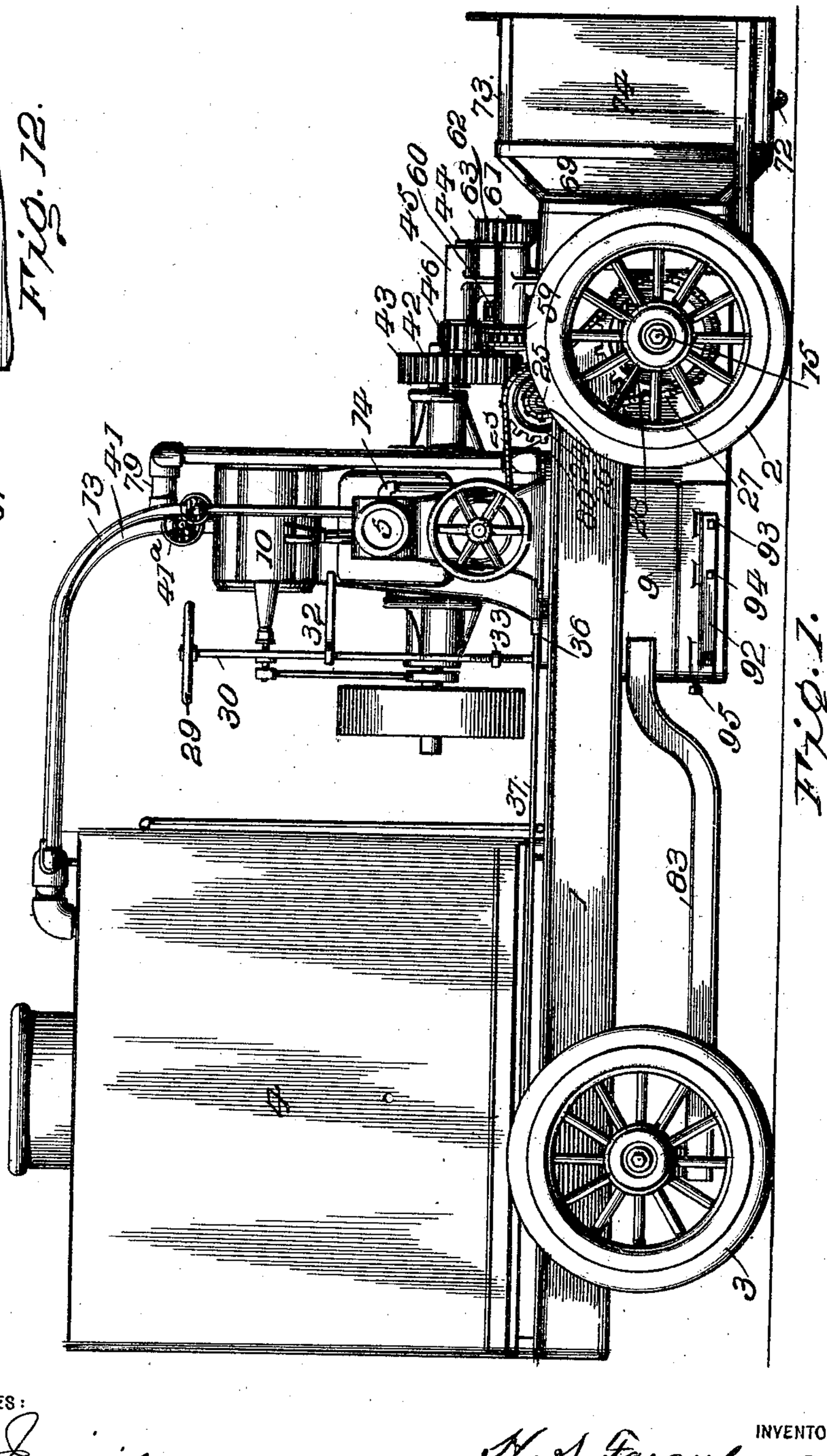


Fig. 1.

WITNESSES:

Jno. Ennis

W. G. Williams.

INVENTOR

H. S. Farquhar

BY

Wm. C. Dewey Sutine

ATTORNEY.

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# H. S. FARQUHAR.

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(No Model.) 5 Sheets—Sheet 2.

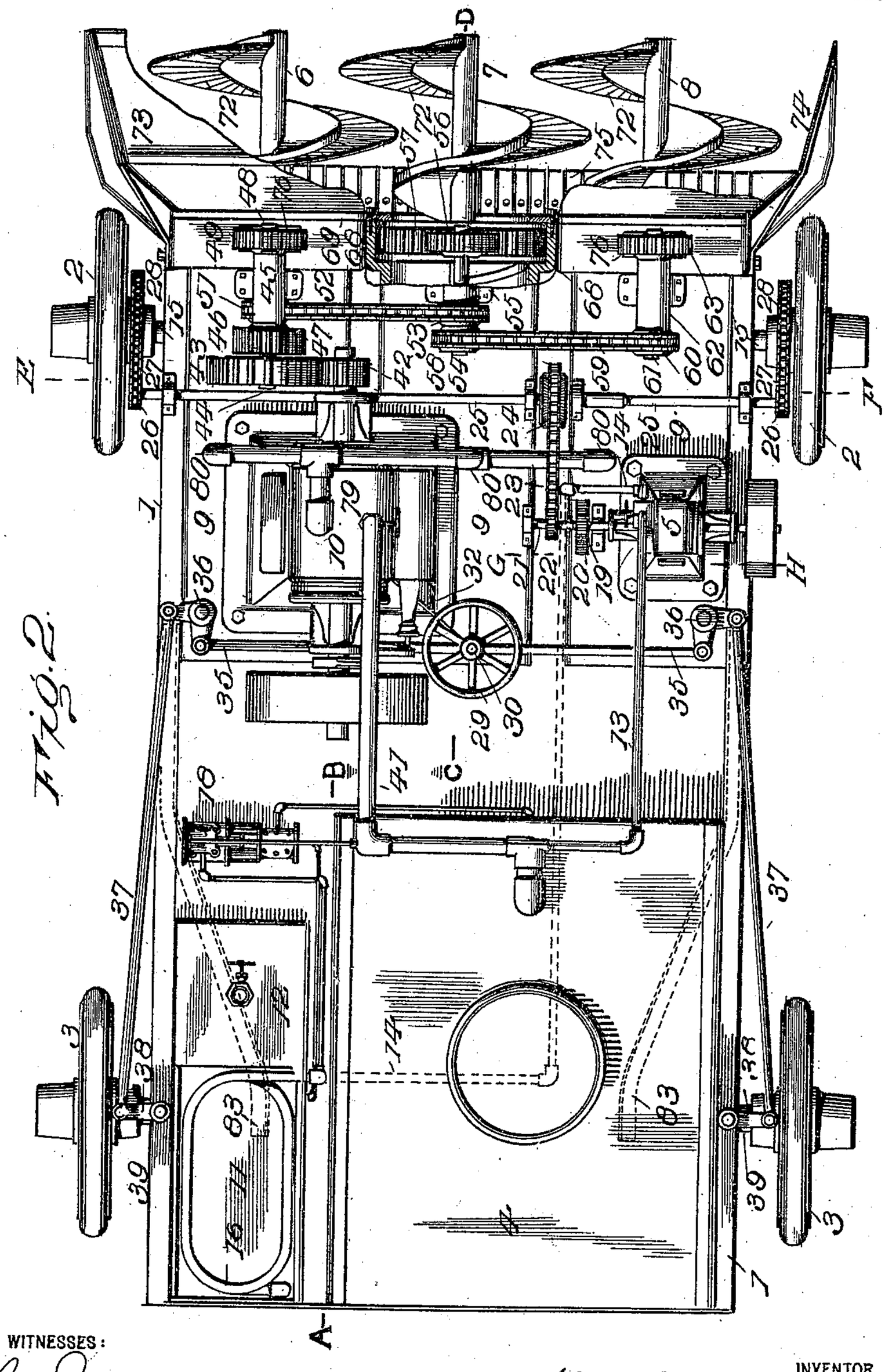


Fig. 2.

WITNESSES:

Jno. Immisch

H. G. Williams.

INVENTOR

H. S. Farquhar

BY

Wm. C. R. W. Saire

ATTORNEY.

No. 684,052. Patented Oct. 8, 1901.

# H. S. FARQUHAR.

## APPARATUS FOR REMOVING SNOW FROM THOROUGHFARES.

(Application filed June 22, 1901.)

(No Model.) 5 Sheets—Sheet 3.

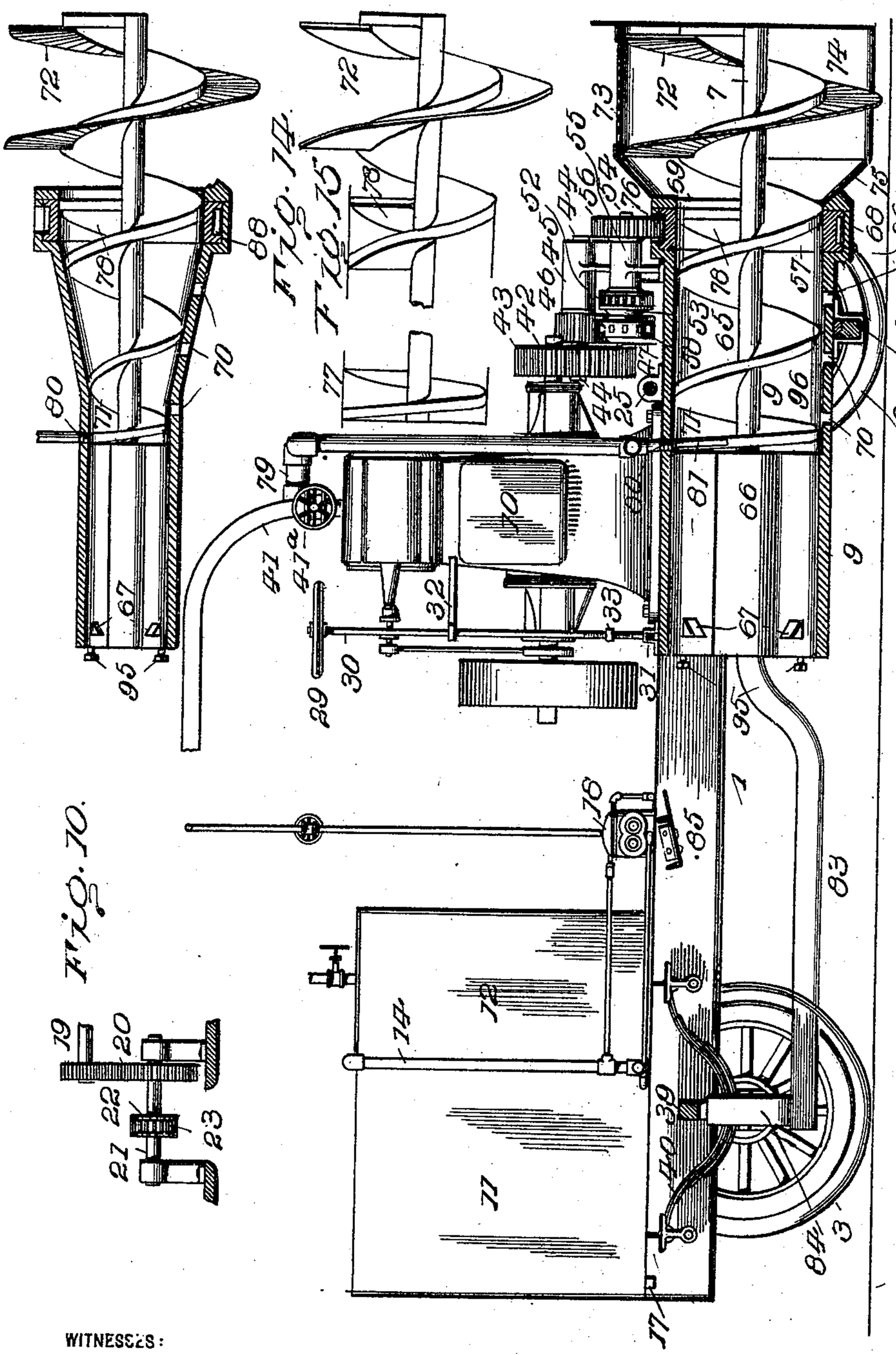


Fig. 3.



Fig. 10.

WITNESSES:

Jno. Imirie

H. G. Williams.

INVENTOR

H. S. Farquhar

BY

Wm. C. R. W. Entire

ATTORNEY.

No. 684,052. Patented Oct. 8, 1901.

# H. S. FARQUHAR.

## APPARATUS FOR REMOVING SNOW FROM THOROUGHFARES.

(Application filed June 22, 1901.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 4.

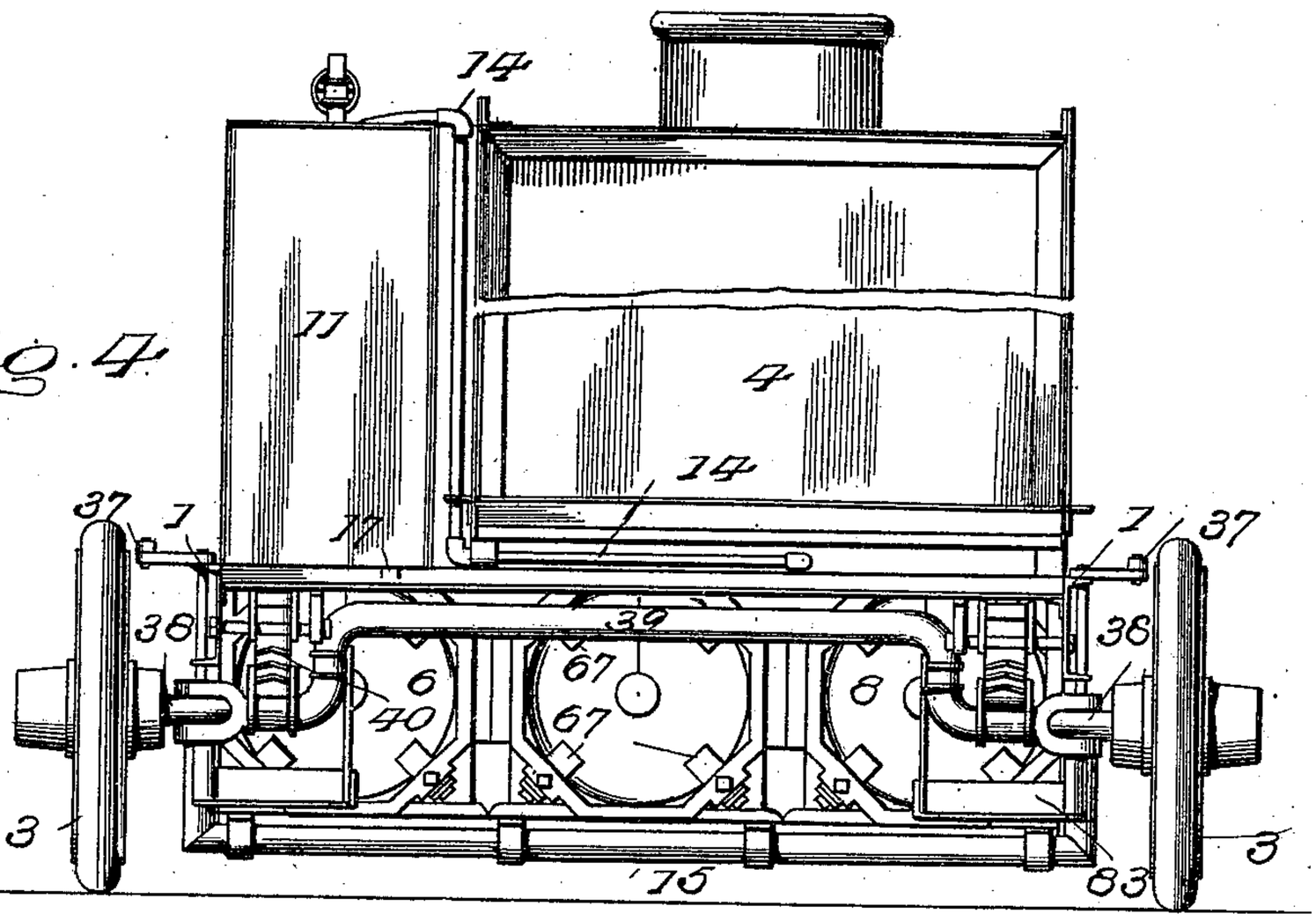
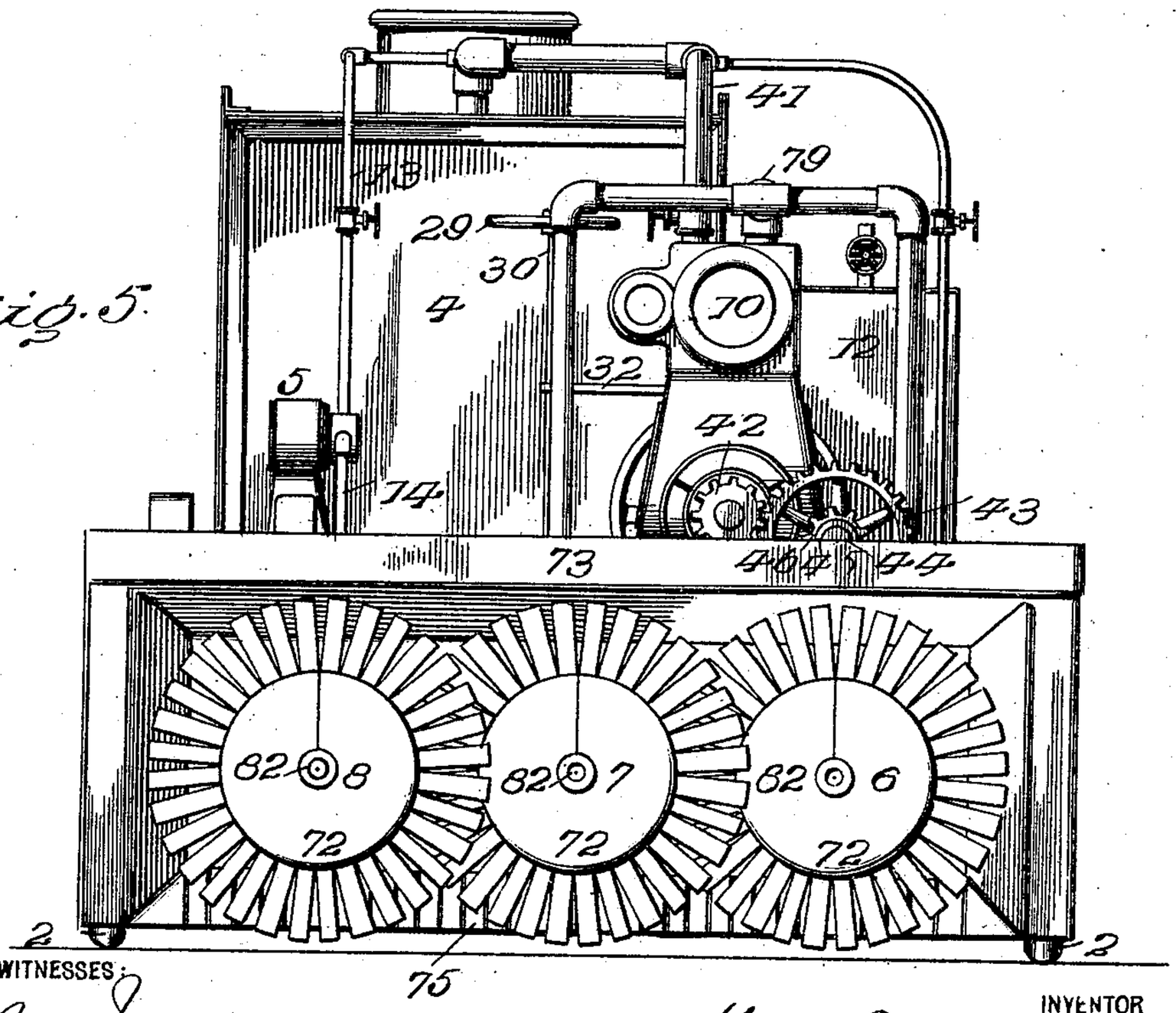



Fig. 5.




WITNESSES:

Jno. Ennis

H. A. Williams.

INVENTOR

H. S. Farquhar

BY

Wm. C. R. W. Fritze

ATTORNEY.

No. 684,052. Patented Oct. 8, 1901.

# H. S. FARQUHAR.

## APPARATUS FOR REMOVING SNOW FROM THOROUGHFARES.

(Application filed June 22, 1901.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 6.

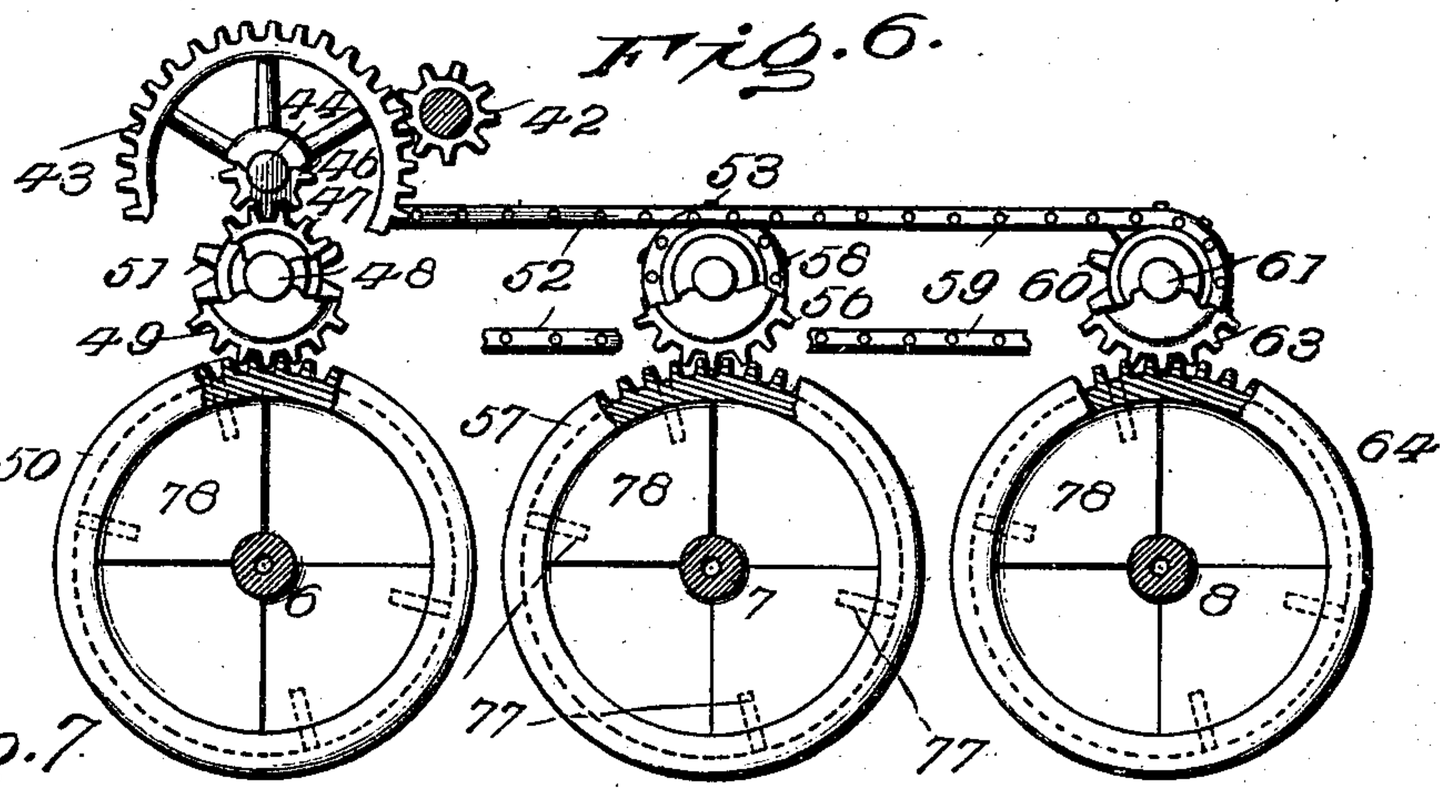



Fig. 7.

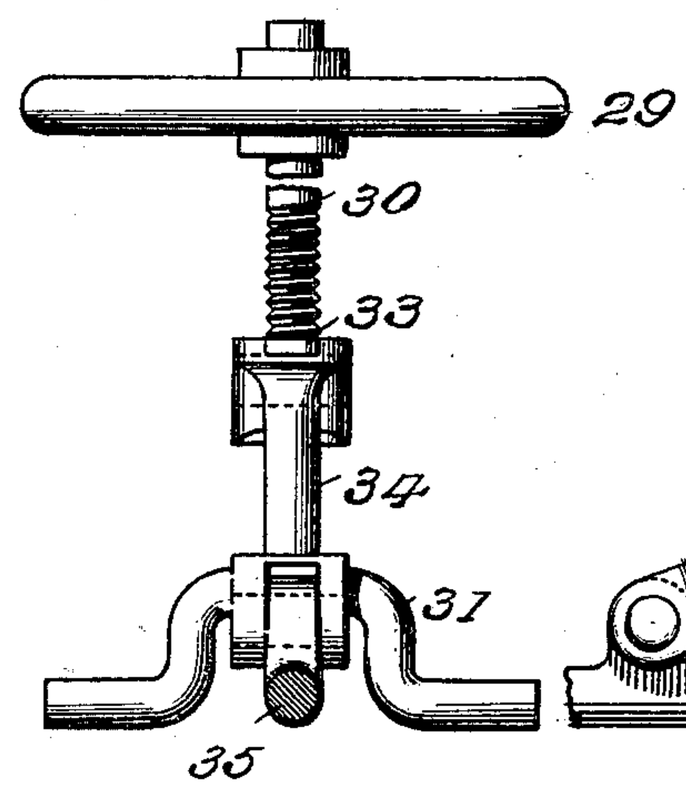



Fig. 8.

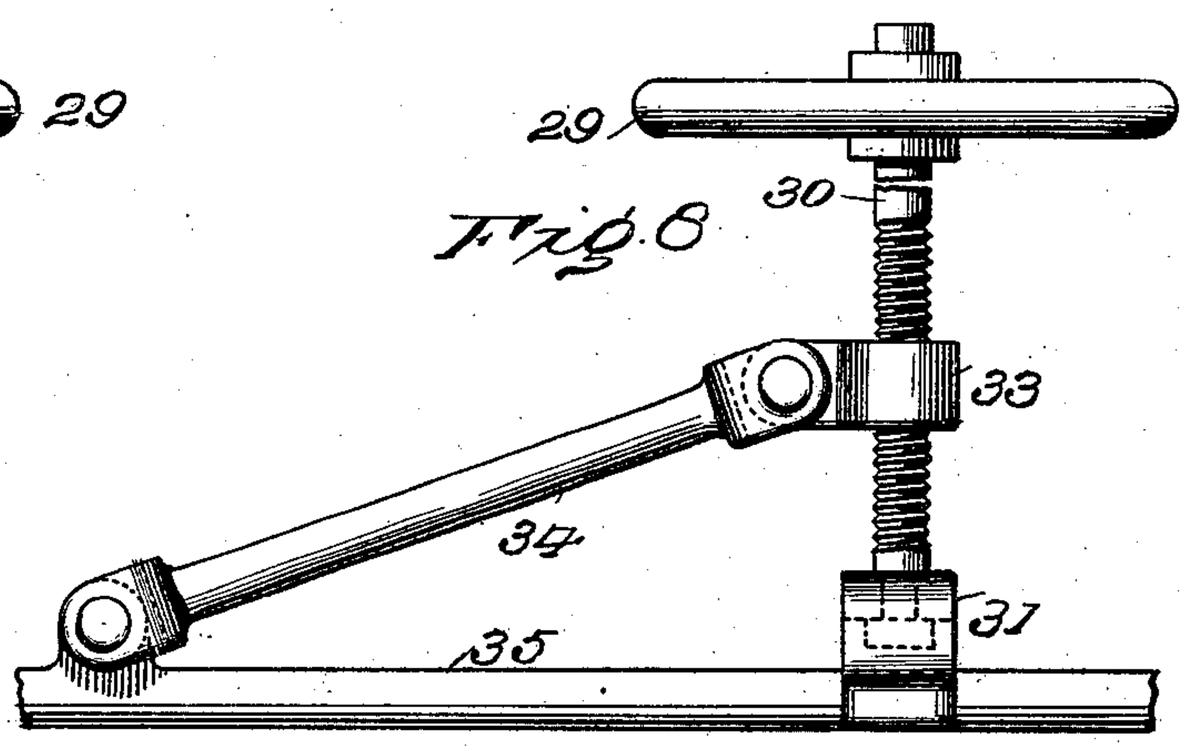



Fig. 9.

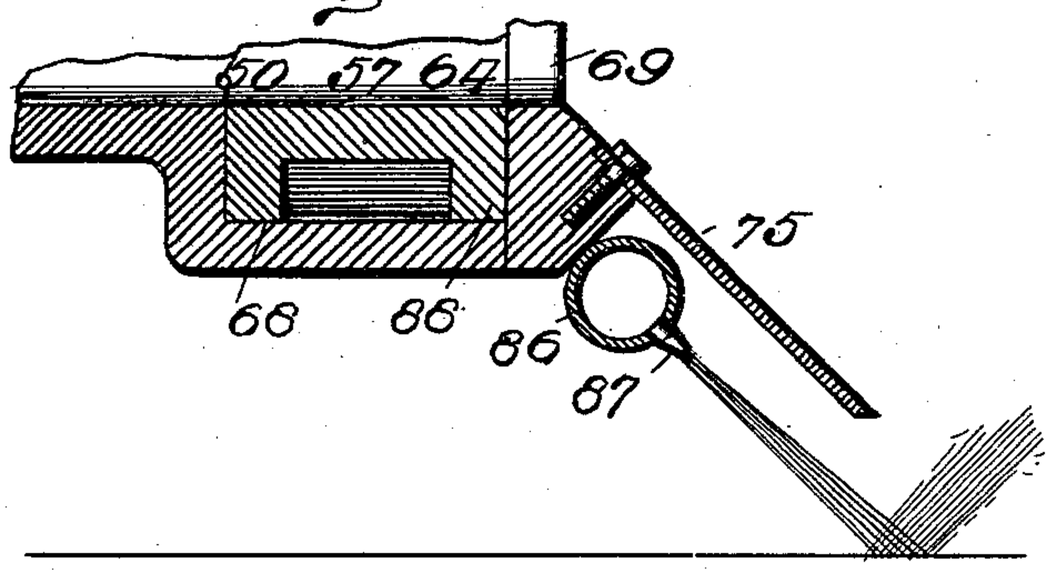
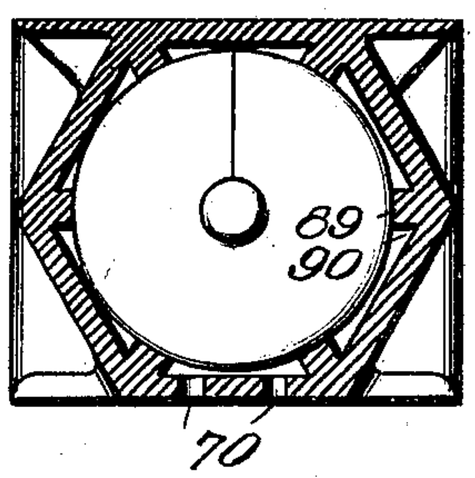



Fig. 13.




WITNESSES:

Jno. Imrie

H. G. Williams.

H. S. Farquhar. INVENTOR

BY

Wm. O. Duvall & Sons ATTORNEY.

# UNITED STATES PATENT OFFICE.

HENRY S. FARQUHAR, OF SAN FRANCISCO, CALIFORNIA.

## APPARATUS FOR REMOVING SNOW FROM THOROUGHFARES.

SPECIFICATION forming part of Letters Patent No. 684,052, dated October 8, 1901.

Application filed June 22, 1901. Serial No. 65,666. (No model.)

*To all whom it may concern:*

Be it known that I, HENRY S. FARQUHAR, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Apparatus for Removing Snow from Streets and Thoroughfares; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to certain new and useful improvements in apparatus for removing snow from highways and other localites.

Under all ordinary conditions snow occupies space enormously disproportionate to the amount of water involved in its formation, and consequently its removal is necessarily slow and expensive.

My invention has for its objects to provide a machine or apparatus adapted to collect and remove the snow from the surface of the highway or other locality, then to compress the same to eliminate a large proportion of the constituent water and other fluids, and to compact the residuum into blocks of convenient size and shape for subsequent disposal, thus reducing both its bulk and weight.

With these ends in view my invention consists in the improved apparatus hereinafter and in detail described.

In order that those skilled in the art to which my invention appertains may know how to make my improved apparatus and to successfully operate the same, I will proceed to describe its construction and operation, referring by numerals to the accompanying drawings, in which—

Figure 1 shows a side elevation of my improved apparatus. Fig. 2 shows a plan view of the same; Fig. 3, a vertical longitudinal section of the apparatus, taken on the line A B C D of Fig. 2. Fig. 4 shows a rear elevation of the apparatus. Fig. 5 shows a front elevation of the apparatus. Fig. 6 shows a vertical detail section, taken on the line E F of Fig. 2, looking toward the front of the apparatus, of the gearing for driving the compressor-screws. Figs. 7 and 8 show details of the steering-post and part of the steering-gear. Fig. 9 shows a detail of the picking-up device. Fig. 10 shows a view of a portion of the gearing for propelling the apparatus, taken on line G H of Fig. 2, looking toward the front end of the apparatus. Figs. 11 and 12 show details of the resistance-lugs. Fig. 13 shows a cross-section of a modified form of the compression-chamber, and Figs. 14 and 15 show modifications of the compressor.

Similar reference-numerals denote like parts in the several figures of the drawings.

1 designates the frame or platform of the apparatus, and 2 the front or driving and 3 the rear or steering wheels on which the frame is mounted; 4, the steam generator or boiler mounted on the frame; 5, the engine for propelling the apparatus; 6 7 8, the snow-compressor screws; 9, the three compression-chambers, one for each screw; 10, the compressor-engine for rotating said compressor-screws and connected therewith by suitable gearing, hereinafter described; 11, a feed-water tank provided with a snow-melting coil, and 12 the fuel-supply tank or receptacle.

The steam generator or boiler 4 is mounted on and at the rear end of the frame 1, and at one side thereof and for the generation of steam it is provided with a suitable burner supplied with hydrocarbon fuel from the supply tank or receptacle 12, which is placed alongside and toward the front end of the steam-generator and in front of the feed-water tank 11. Mounted on the platform 1 and near the front end and on the same side as the steam-generator 4 is a small engine 5 for propelling the machine forward or backward, supplied with steam from the generator through the steam-pipe 13. The exhaust from said engine 5 is conveyed through a pipe 14, passing under the frame 1 to a point alongside the feed-water tank 11 and then upward and connects with one end of a snow-melting coil 16, placed in the said feed-water tank 11. The lower end 17 of said coil passes through the bottom of the tank and is open to the atmosphere for the escape of the exhaust. While the apparatus is in operation feed-water is obtained by depositing snow into the feed-water tank, where the heated exhaust-pipe melts it and reduces it to water. A boiler feed-pump 18 is suitably placed on the frame

and is connected with the feed-water tank and steam-generator, respectively.

Fixed on one end of the driving-shaft of the engine 5 is a pinion 19, which meshes with a gear 20 on an auxiliary shaft 21. A sprocket-wheel 22 is also mounted on this shaft 21 and is connected by a sprocket-chain 23 with a suitable compensating gear 24 on an additional auxiliary shaft 25, suitably journaled on and extending across the frame 1 and beyond each side thereof. On each end of the shaft 25 is fixed a sprocket-wheel 26, which in turn is connected by a sprocket-chain 27 with a suitable sprocket-wheel 28, fixed on the hub of the respective driving-wheels 2, loosely mounted on the ends of the axle 15. It will thus be seen that by this gearing motion is transmitted by the engine 5 to the forward or driving wheels 2. The rear or steering wheels 2 are controlled by a suitable hand-wheel 29, having a position above the center of the frame ahead of the steam-generator 4. This hand-wheel 29 is fixed on the upper end of a vertical shaft 30, journaled at its lower end in a support 31, (see Fig. 7,) fastened on the upper frame, and near its upper end is a brace 32, fastened to the frame of the engine 10. The shaft 30 is screw-threaded above the support 31, and on the screw-thread works a nut 33, pivoted to the upper end of an inclined connecting-bar 34, (see Fig. 8,) the lower end of which is pivoted to a projection on a laterally-movable shifter-bar 35, extending crosswise of the frame 1. The opposite ends of this shifter-bar 35 are pivoted each to one arm of a bell-crank lever 36, respectively pivoted on the top and near each side of the frame 1. The other arm of each bell-crank lever 36 is connected by a longitudinal rod 37 with the free end of the lever-arm of a steering-knuckle 38, vertically journaled in a clevis, one at each end of the axle 39. This axle 39 is provided with suitable springs 40, which carry the rear end of the frame 1. Mounted loosely on the spindles of the steering-knuckles 38, respectively, are the steering-wheels 3. It will be seen that by the turning of the hand-wheel 29 either in one direction or the other the nut 33 will be either raised or lowered, and by means of its various connections the steering-wheels will be turned about the vertical journal of the steering-knuckle 38 and the direction of motion of the apparatus thereby changed.

The compressor-engine 10 for driving the compressor-screws is connected by a steam-pipe 41, provided with a suitable throttle-valve $41^a$, with the steam-generator 4. A pinion 42 (see Fig. 6) is fixed on one end of the longitudinal driving-shaft of the compressor-engine 10 and meshes with a gear-wheel 43 on a parallel shaft 44, journaled in and near the top of the bearing-block 45, mounted on the frame 1 and above one of the compression-chambers 9. A pinion 46 (see Figs. 2 and 6) is also fixed on the shaft 44 between the gear 43 and the bearing-block 45 and meshes with a gear-wheel 47, fixed on one end of a second shaft 48, also journaled in the bearing-block 45, but below the shaft 44, already mentioned. A pinion 49 is fixed on the opposite end of the shaft 48 and meshes with a spur-ring 50, provided with teeth on its external face. The axis-line of this spur-ring extends longitudinally of the apparatus and at the same time also forms the center line of one of the compression-chambers 9, and the respective compressor-screw 6 and the said spur-ring 50 are fastened to the circumference of said compressor-screw, as will be hereinafter described. A sprocket-wheel 51 is also mounted on the lower shaft 48 between the gear 47 and the bearing-block 45 and is connected by a laterally-moving sprocket-chain 52 above the compressor-chambers with a sprocket-wheel 53, fixed on and near one end of a shaft 54, journaled in a second bearing-block 55, mounted above the second one of the compression-chambers 9. A pinion 56 is fixed on the opposite end of the shaft 54, last mentioned, and meshes with the teeth of a second spur-ring 57, having a like relation to the second compression-chamber 9 and its respective compressor-screw 7 as the spur-ring 50, previously mentioned, has to the first one of the compression-chambers 9 and the compressor-screw 6. A second sprocket-wheel 58 is fixed on the shaft 54, last mentioned, outside of the sprocket-wheel 53, previously described, and is connected by a sprocket-chain 59 with a sprocket-wheel 60 on one end of a shaft 61, journaled in a third bearing-block 62 above the third one of the compression-chambers 9, and this shaft, like the last two described, has fixed on its opposite end a pinion 63, which in turn, like in the previous instances, meshes with the teeth on a spur-ring 64, having a like relation to the third one of the compression-chambers 9 and its respective compressor-screw 8 as the spur-rings previously described have to their respective compression-chambers and the respective screws.

The three compression-chambers 9 are parallel to each other and on the same horizontal plane and are located between the side bars of the frame. These compression-chambers are bolted together and to the said side bars, and their exterior upper faces together form part of the platform 1. The interior cross-section of each of the compression-chambers 9 is round for a portion of its length from front to rear, as shown at 65, and the remainder or the back end 66 is octagonal, with the opposite sides thereof parallel. Four resistance-lugs 67 extend through the walls of each of the compression-chambers and at a point near the rear end and at right angles to the face of a like number of sides of the octagonal portion of said compression-chambers. These resistance-lugs 67 (see particularly Figs. 11 and 12) work loosely in the openings 91 and are held in place by the springs 92, which are fastened to the compression-cham-

ber by means of the screws 93. The screws 94 are to increase the tension of the springs 92. Set-screws 95 are provided to rigidly fix the depth of the resistance-lugs 67. As these lugs are adapted to be projected to a greater or less extent within the exit-opening of the compressors, it follows that the area of such exits may be accordingly varied. The front end of each compression-chamber has a counterbore 68, wherein the respective spur-rings 50 57 64 are located and which are confined in place by a suitable flat plate 69, having a hole for each compression-chamber 9 and registering with the bore of the respective spur-rings 50 57 64. The bores of the said spur-rings, respectively, are of the same diameter as the round portion 65 of the compression-chambers. Suitable channels 96 and drain-holes 70 (see Fig. 3) are provided in the bottom of the forward portion 65. Compressor-screws 6 7 8, having hollow blades, are respectively mounted in each compression-chamber 9 and loosely turn in the round bore only of the forward portion 65 and extend back to but not into the rear or octagonal portion of said compression-chamber. These screws 6 7 8 extend through the respective spur-rings and for one and one-half turns beyond or in front of the compression-chamber and the main frame of the apparatus, and each is straight and of an equal diameter throughout; but its last turn 71 is of a diminishing pitch, while the other turns are all of the same pitch. A series of flat resilient blades 72 are fastened to the rear face of one turn of the respective screws 6 7 8 and extend radially therefrom and beyond the circumference of the screws 6 7 8, and consequently during rotation describe a circle of larger diameter than that of the screws and while describing said circle come into close proximity to the surface to be cleared of snow. A suitable hood 73, open at the front, extends crosswise of the frame and is fastened to the front end thereof and extends forward. The top of this hood takes in all three of the compressor-screws 6 7 8 and extends beyond the gage-line of the wheels, and its opposite sides or ends 74 extend downward, with their lower edges near the ground. An inclined bottom, consisting of a series of resilient pick-up blades 75, (see Figs. 3 and 9,) is provided for a portion of the said hood 73 and extends from one side to the other thereof. This inclined bottom rises toward the rear and terminates on the same plane as the bottom of the bore of the compression-chambers. The rear ends of said blades are fastened to the front plate 69. The top portions of the counterbores of the respective compressor-chambers 9 have openings 76, (see Fig. 2,) through which the pinions 49 56 63, respectively, mesh with the respective spur-rings 50 57 64. The longitudinal length of each of the respective spur-rings is equal to one-quarter of a full turn of the thread of the screws or to one-quarter the pitch of the compressor-screws. The bore of these spur-rings fits the arc described by the threads or blades of the screw and are fastened to the blades (see Fig. 6) by means of pins or screws 77, passing through the ring and into the blade of the screw. In view of the spur-rings taking in only one-quarter of a turn of the screw a second blade or thread 78, consisting only of a quarter-turn one hundred and eighty degrees apart from the other or main thread, but of the same pitch, is provided where the respective screws 6 7 8 pass through the spur-rings, to which they are also fastened. By the construction above described it will be seen that the spur-rings will drive or rotate the compressor-screws. The exhaust-pipe 79, (see Fig. 3,) leading from the compressor-engine 10, has three outlets 80, opening to the interior of the respective compression-chambers 9 at the rear end of the round portion 65. The last turn of each of the respective hollow compressor-screws 6 7 8 is provided with a hole 81 on its periphery, extending into the hollow blade of the screw. Once in every revolution of the screw the hole 81 in the blade allows a portion of the exhaust-steam to enter the hollow screw. A vent-hole 82 (see Fig. 5) is provided in the front end of the core of each of the screws 6 7 8 and serves as an exhaust. The three compressor-screws 6 7 8 all rotate in the same direction and with the same speed and are set the same, so that there is no possibility for collision between the resilient blades of one screw with the resilient blades or main blades of either of the other two screws. The front axle 15 between the side bars of the frame is depressed, so as to pass under the compression-chambers, while the rear axle 39 is bent upward between the side bars of the frame to increase the clearance between it and the surface passed over.

Two guide-bars 83, one at each side of the machine, are provided. The front end of one of the guide-bars is fastened to the outside of one outside compression-chamber and the front end of the other guide-bar is fastened to the outside of the other outside compression-chamber and each has a downward bend near its front end and then extends backward on a horizontal plane somewhat above the surface of the highway. These bars for a portion of their length back of the downward bends converge toward each other, and near their rear end are each bent so as to become parallel, in which relation they terminate at a point below the rear axle 39 and from which they are supported by suitable hangers 84.

A rearwardly-inclined breaker-bar 85, a short distance back of the rear end of the compression-chamber 9, extends crosswise of the apparatus from one side of the frame 1 to the other and is fastened thereto. The front or higher edge of this bar 85 lies in a plane just above the top of the bore of the compression-chamber 9 and the rear edge lies in a plane below the same, as clearly shown at Fig. 3.

A steam-pipe 86, (see Fig. 9,) suitably connected with the steam-generator or with the exhaust from the engines, extends across the apparatus under the inclined bottom of the hood 73 and is provided with a longitudinal series of jet-nozzles 87, inclining downward and forward, to direct a jet of steam against the surface of the highway just ahead of the lower and forward edge of the said inclined bottom 75. The steam-pipe 86 may be slightly turned on its axis to throw the point of impact between the steam-jet and the surface of the highway either ahead or back of the point referred to above.

Having described the several parts of my invention, the operation is as follows: When the apparatus has been put in service after steam has been gotten up, it is propelled forward by means of the front or traction wheels 2 into the snow-bank or the snow on the surface to be cleaned, and the compressor-engine 10 also having been started the rotation of the three compressor-screws cuts into the mass of snow and forces the part of snow taken by the blades backward and up over the inclined bottom 75 into the three compression-chambers 9 and continues to force it backward through and to the rear end of the octagonal section, which has been temporarily closed, so as to start a banking of the snow in said octagonal section. As soon as this begins to take place compression will also begin to take place and the mass become more compact. As soon as a certain degree of compression is obtained, the rear end may be again opened, and the resistance-lugs 67 will then begin to perform their function of forming a resistance to the longitudinal rear movement of the compressed mass in the octagonal section of the compression-chamber. As the rotation of the compressor-screws continues and the apparatus also moves forward and more snow is forced into the compression-chamber the retarding action of the resistance-lugs becomes greater until the compressed mass has become practically solid and practically no more compression can take place in the mass. When this state has been reached and the force continues and further compression is attempted, the resistance to backward movement of the compressed mass by the resistance-lugs is overcome by grooves being cut along the sides of the compressed mass, where the resistance-lugs previously bound it, due to a shearing action between the mass and said resistance-lugs. It will be seen that the ultimate amount of compression will always depend upon how far the resistance-lugs project into the octagonal section of the compression-chamber, or the softer the block the deeper the groove and the harder the block the less the groove.

The compressor-screws 6 7 8 for their length (except the last turn 71, the turn of diminishing the pitch) each act as pushers or feeders of the snow to the said last turn, which, due to its diminishing pitch, causes the maximum amount of compression of the snow. Some compression will, however, take place during the act of pushing. The fluids eliminated or expelled during compression escape to the atmosphere through holes 70, previously referred to, in the bottom of the round section of the respective compression-chambers 9. The pitch of the blades of the last turn 71 of the compressor-screws continues to diminish until the end of said turn and the end of the compressor-screw, at which point it is lost entirely, and the pitch-line of the blade becomes tangent to a line at right angles to the axis of the compressor-screw. By making the last turn of the compressor-screw of a diminishing pitch the pressure upon the mass increases as its density increases and its bulk diminishes. This is especially desirable, as the snow in its loose form may be materially compressed with a comparatively slight pressure and small expenditure of power over an extended range of movement, while when it becomes denser more power but less movement is required, and at the final end, where maximum compression is required, the minimum movement of the mass is necessary. It will be noticed that no shaft-bearings for the compressor-screws are provided and that the bearings are on the circumferential faces of the blades and on the spur-ring. Attention is also called to the boxed form of teeth for the spur-ring, whereby the circumferential bearing of said ring is on the faces of the end walls 88 of the spur-ring. This is a well-known form of gear, and by its use in this instance wear on the faces of the teeth of said spur-ring is diminished. The object of providing no shaft-bearings for the compressor-screws is to avoid any impediment to the movement of the snow before it reaches the resistance-lugs.

The flat resilient blades extending from the blades of the first turn of the compressor-screws are provided to practically form cutters when frozen snow is encountered and to force the snow thus severed backward to the compression-chambers to be acted upon by the main blades of the compressor-screws. The object of making the blades of the compressor-screws hollow and discharging the exhaust-steam from the compressor-engine therein is to utilize the heat of the said steam to warm the blades, and to thus melt a small portion of the snow in contact with their surfaces, whereby a film of moisture will be formed thereon, which film will act as a lubricant and allow the snow to better slip on the blades, and said blades will at the same time present a clean or smooth surface for incoming snow, and in addition the blades form a partial surface condenser for said exhaust-steam.

The steam-jet nozzles 87 are provided, so that jets of steam may be delivered therefrom and onto the highway just ahead of the inclined pick-up blades in cases of very light snow or to keep pushing ahead that portion

of the snow which might pass under the inclined pick-up blades 75 and which would otherwise be left upon the highway.

In the modified form of compression-chamber shown in cross-section in Fig. 13 the compression-chamber instead of having a round cross-section, as heretofore referred to, is made hexagonal and has ribs 89 in the interior between each adjacent pair of interior faces of the hexagon. The interior edges of these ribs are all equidistant from the axis-line of the chamber and serve as bearings for the circumferential faces of the blades of the respective compressor-screws 6 7 8. The circle described by the diameter of the compressor-screws leaves a small channel 90 between each side of said ribs and the adjacent face of the interior of the hexagonal compression-chamber. The objects to be gained by a compression-chamber thus formed are twofold: First, it prevents the possibility of the screw becoming choked and consequent twirling around of the material confined between the blades, which would result in the screw not feeding or pushing the snow backward, and, second, the grooves or channels 90, formed between the ribs 89 and faces of the chamber, allow the fluids eliminated or ejected by compression free exit to the atmosphere.

In Fig. 14 a modified form of compressor-screw and compression-chamber is shown. In this form the compression-chamber and the compressor-screw are tapered for a portion of their lengths. The main body of the compressor-screw is of equal diameter from the rear edge of the spur-ring forward. From the spur-ring back to the front end of the one turn of diminishing pitch it is tapered and of the same pitch as the front end first referred to and has its small diameter where the one turn of diminishing pitch begins, when it again becomes straight and so continues to the end of the compressor-screw. The bore of the compression-chamber is made to coincide with the taper of the screw from the spur-ring to the point where the diminishing pitch begins on the screw, and from this point and continuing to the rear end of the chamber it is straight and with its diameter equal to that of the compressor-screw where the turn of diminishing pitch occurs. By making the compression-chamber and its screws as described a wider path may be cleared in one passage of the apparatus, and in cases where the apparatus is used upon a medium depth of snow the rear end of the compressor-screw for the full diameter of the chamber will have the tendency to always be full, with a body of snow to be acted upon by the turn of diminishing pitch of the compressor-screw. As the snow is compressed and forced rearward, after passing the resistance-lugs the rear end of the compressed mass contacts with the inclined breaker bar or plate 85, and owing to its inclined position it is obvious that the compressed mass or block is forced downwardly or below its path through the compressor, and consequently it will be broken at a point somewhere near to the near terminus of the compressor and the severed portion will fall to the ground and be deflected toward the longitudical center of the machine by the inclined bars 83 and out of the path of the rear steering-wheels 3. The cross-section formation of the severed blocks causes them to remain at a state of rest after the machine has passed beyond them, when they may be readily moved to any given locality upon the highway or loaded into carts for transportation. It will be readily understood that by reason of the pressure applied in the manner stated for compressing the snow—viz., the sliding movement—the pushing devices do not have to overcome the action exerted by a vacuum, as would be the case where the compression was by a reciprocating piston or plunger.

Many changes may be made in the mere detail of construction without departing from the spirit of my invention, the genus of which rests in the broad idea of automatically gathering the snow, expelling a portion of the fluid constituents, continuously compressing the same, and breaking the continuous compressed mass into any approximately predetermined lengths, and in this last-mentioned step while I prefer to break the mass by causing it to be deflected out of the plane of its travel through the compressors it will be understood that it may be broken by a reciprocating plunger or knife, if thought desirable.

What I claim as new, and desire to secure by Letters Patent, is—

1. In an apparatus for removing snow from streets, &c., the combination of a snow-gathering device, compressing devices for forming the snow into a continuous compressed body and forcing the same in compressed condition in a straight line, and means for separating the continuously-moving compressed mass into suitable lengths for handling and removal, substantially as hereinbefore set forth.

2. In an apparatus for removing snow from streets, &c., the combination with a movable platform or vehicle, of snow-gathering devices for transferring the snow from the surface to compressing devices, means for automatically and continuously compressing the snow and forcing the compressed snow in a right line, and means for separating the continuously-moving compressed mass into suitable lengths for handling and subsequent transportation, substantially as set forth.

3. In an apparatus for removing snow from streets, &c., in combination with means for gathering the snow from the surface, and a polygonal compression-chamber; a circular screw and surrounding chamber, intermediate of the gathering device and the compression-chamber, substantially as and for the purpose hereinbefore set forth.

4. In a snow-cleaning apparatus a compression-chamber arranged horizontally and in

alinement with snow-feeding devices, and open at one end to receive the snow from the delivery devices and also open at the opposite end to discharge the compressed snow, substantially as hereinbefore set forth.

5. In a snow-cleaning apparatus, a snow-compression chamber provided at its discharge end with means for controlling variations of pressure applied to the snow, substantially as and for the purpose set forth.

6. In a snow-cleaning apparatus, in combination with a compression-chamber and means for compressing the snow therein and forcing the same continuously out of said chamber, means for varying the area of the exit-opening of the compression-chamber, substantially as and for the purpose set forth.

7. In a snow-cleaning apparatus, a compression-chamber provided at its discharge end with spring detents or retarders provided with tension-regulating devices, substantially as and for the purpose set forth.

8. In a snow-cleaning apparatus, a screw for conveying and compressing the snow, located within a surrounding chamber, and having peripheral bearings within said chamber, substantially as and for the purposes set forth.

9. The compression screw or pusher having all its blades except its final rear one, of equal pitch, and the rear final blade of diminished pitch, whereby the pressure exerted upon the mass of snow is increased at the time that the snow has become dense and its bulk reduced, substantially as hereinbefore set forth.

10. In a snow-cleaning apparatus a combined snow pusher and compressor having its final blade with a pitch-line tangent to a line at right angles to the axis of the compressor and pusher whereby the compressed mass of snow is readily released as hereinbefore fully set forth.

11. In a snow-cleaning apparatus provided with a steam-generator, the screw compressor and pusher having hollow blades provided with steam inlet and outlet passages; and steam-controlled connections between the generator and the hollow blades, substantially as and for the purposes set forth.

12. In a snow-cleaning apparatus, the snow compressor and pusher, and snow-gathering device formed integral and adapted to revolve, upon a common axis, substantially as described.

13. In a snow-cleaning apparatus, in combination with a continuously-operating compressing mechanism a stationary inclined breaker device arranged to intersect the path of the moving compressed snow, substantially as and for the purpose set forth.

14. In a snow-cleaning apparatus, in combination with the gathering device and compression-chambers, an inclined pick-up in advance of the compression-chambers, and consisting of a plurality of parallel inclined resilient bars or blades, substantially as and for the purpose set forth.

15. In a snow-cleaning apparatus pushing and compressing screws having peripheral spurs, adapted to mesh with driving-pinions, in combination with suitable means for operating the driving-pinions, substantially as and for the purpose set forth.

16. In a snow-cleaning apparatus, the combination with snow gathering and compressing mechanism, means substantially as described for delivering jets of steam below, and in advance of the gathering device, substantially as and for the purpose set forth.

17. In a snow-cleaning apparatus, in combination with snow-gathering, and snow compressing and pushing devices, retarders at or near the exit of the conveyer, to produce density or uniformity of compression, substantially as set forth.

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

HENRY S. FARQUHAR.

Witnesses:

DAVIS MURDOCK,

JOAQUIN M. BUCKLEY.