Aug. 30, 1927. 1,641,018

T. THURCHAK

SMOKE WASHER

Filed April 2, 1923 6 Sheets-Sheet 1

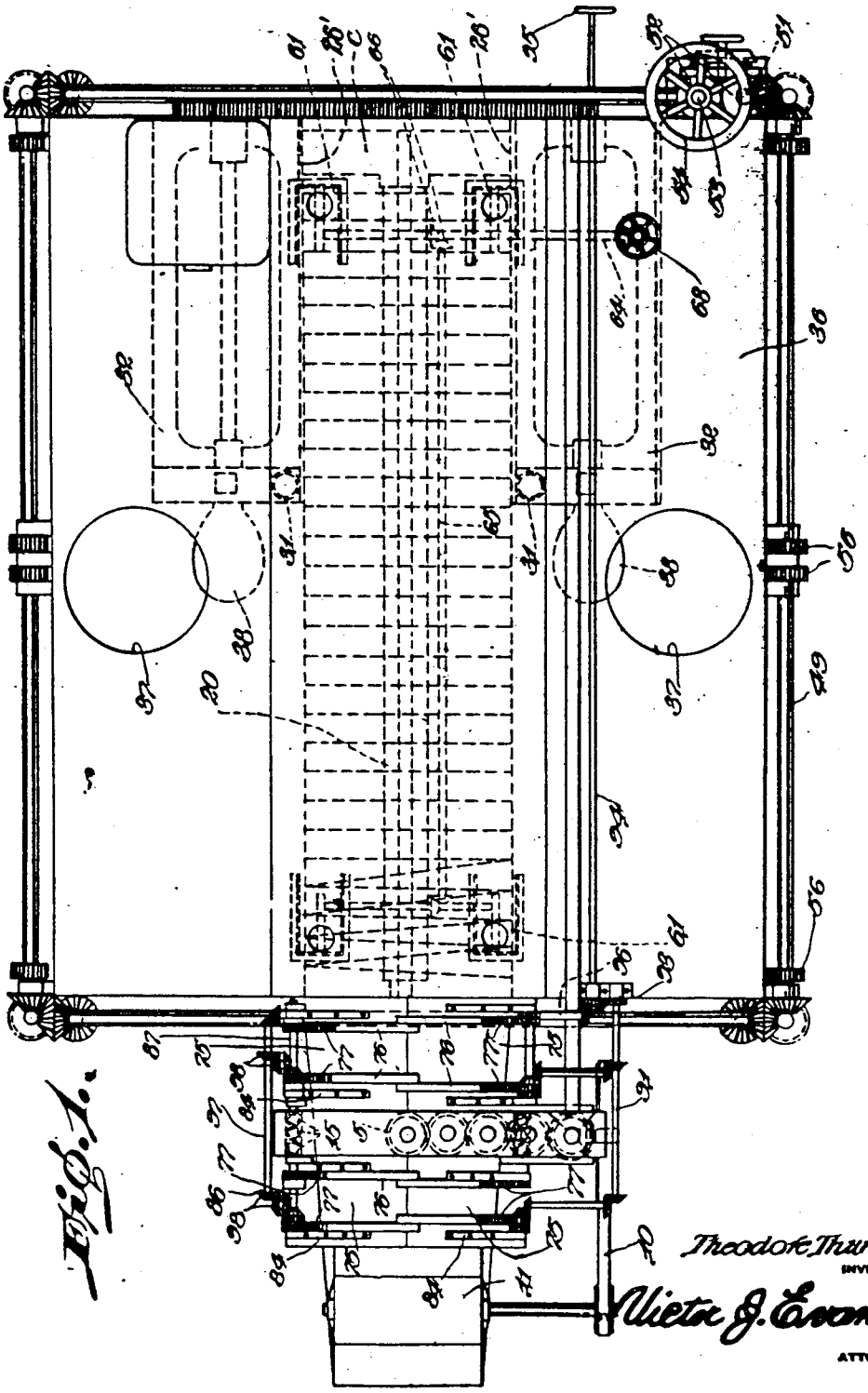


Fig. 1.

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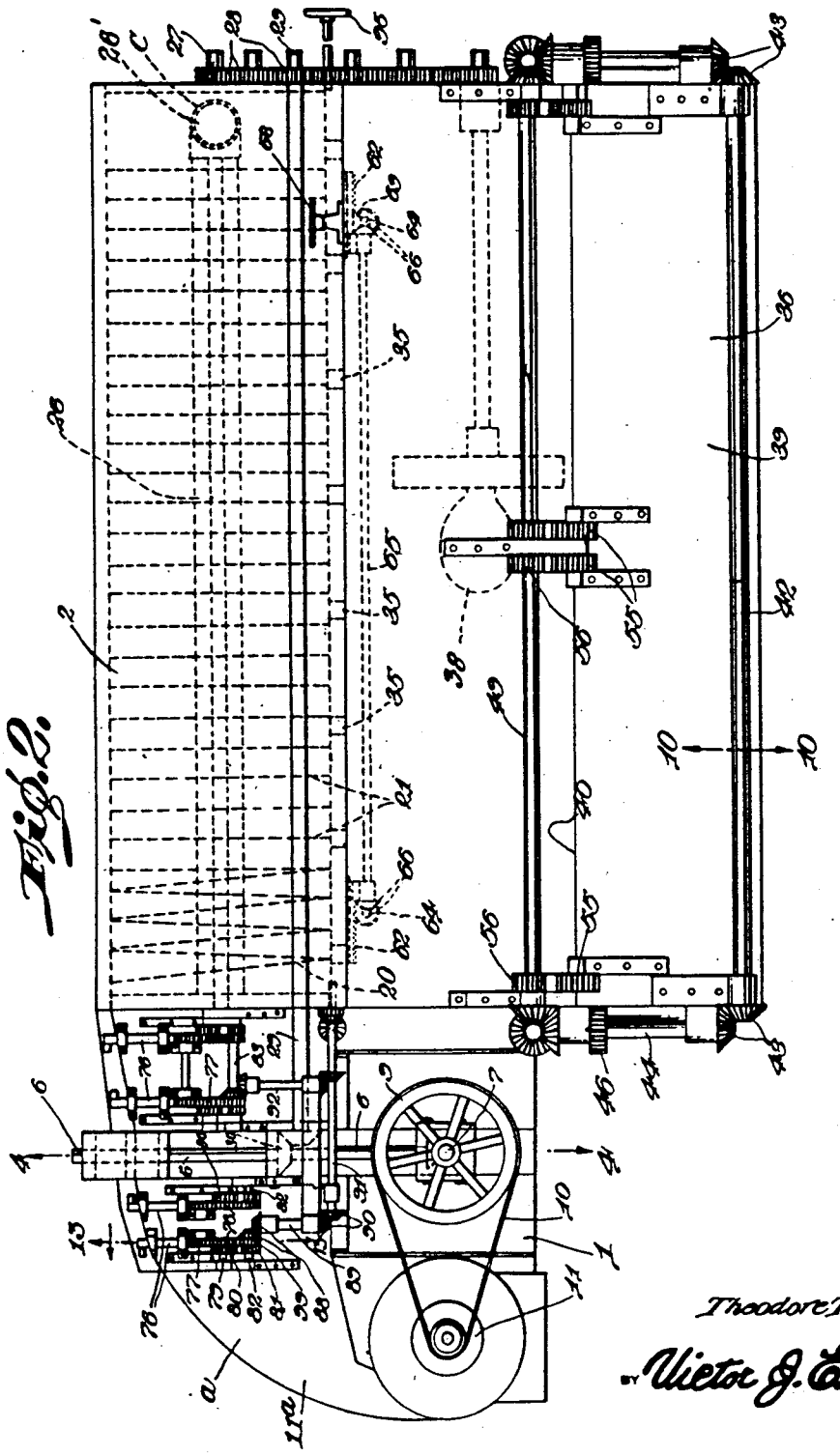


Fig. 2.

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6 Sheets-Sheet 3

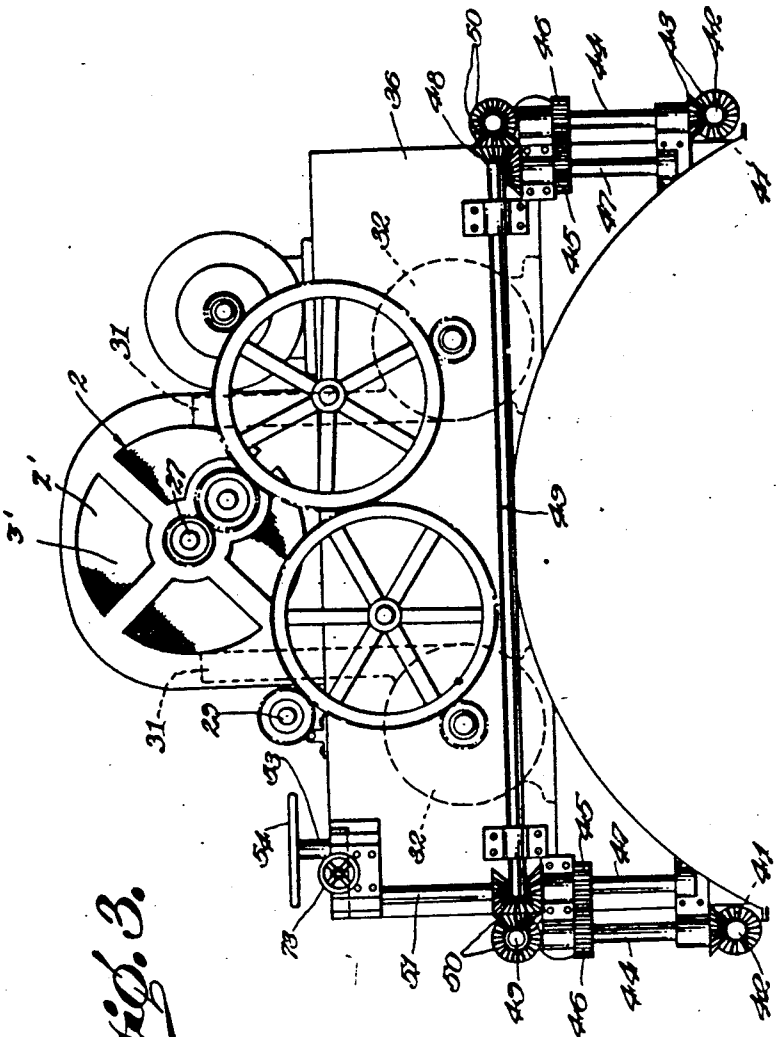


Fig. 3.

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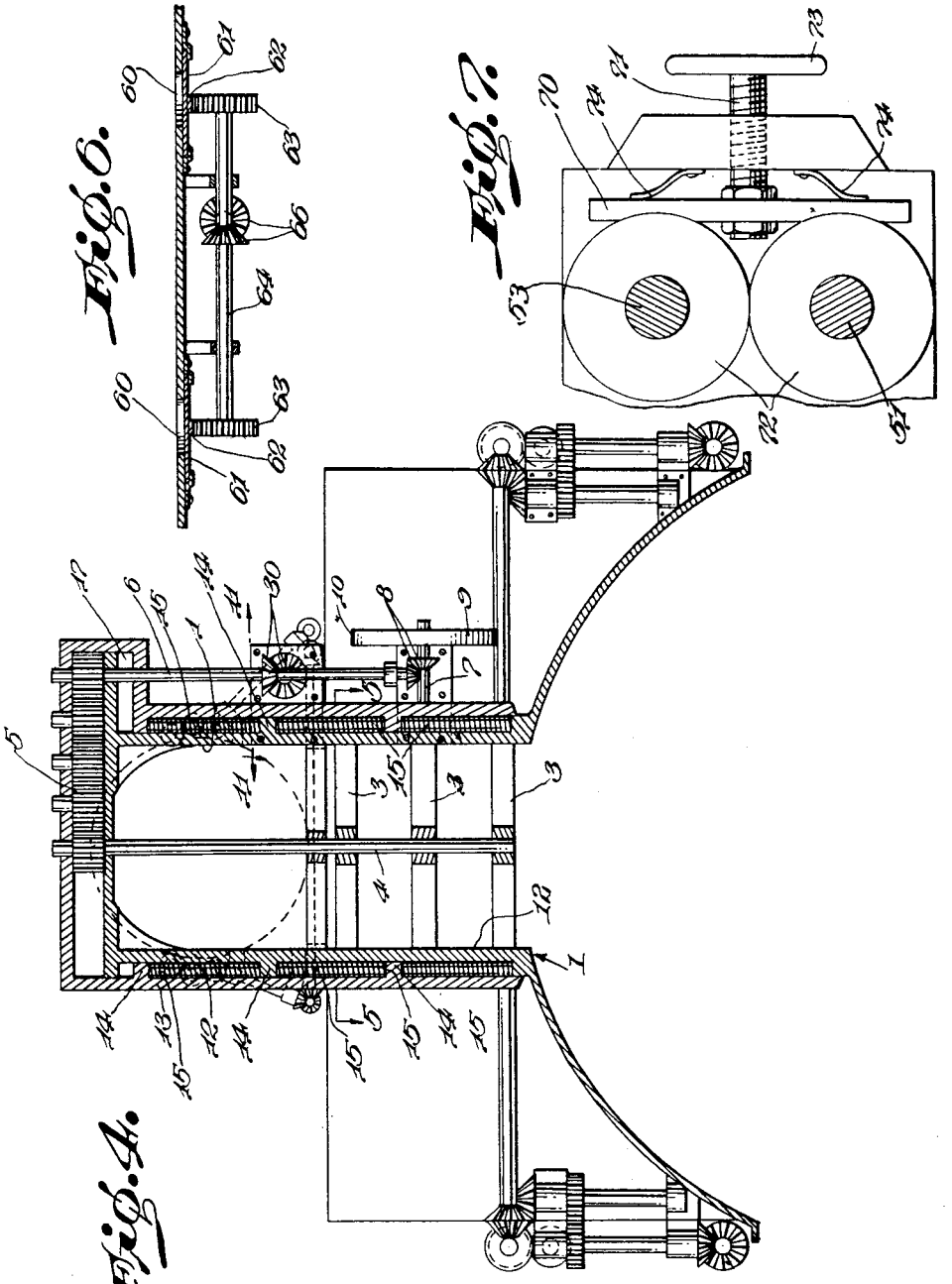


Fig. 4.

Fig. 6.

Fig. 7.

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SMOKE WASHER

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Fig. 8.

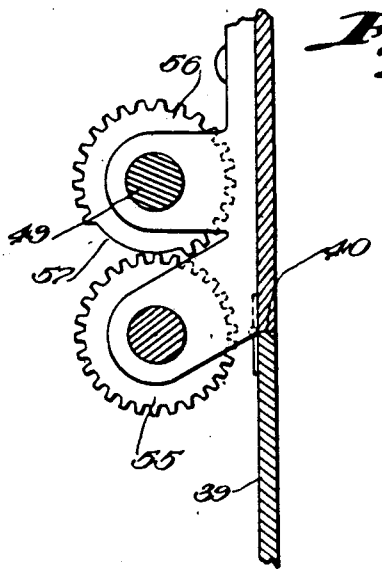


Fig. 9.

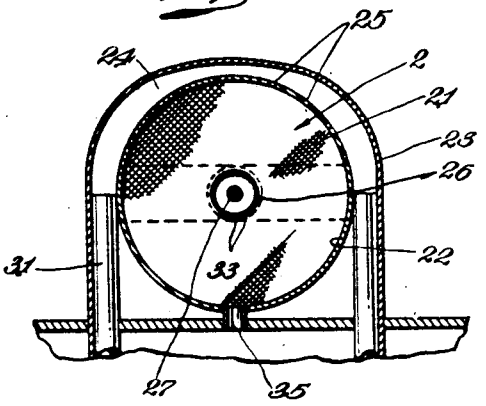


Fig. 10.

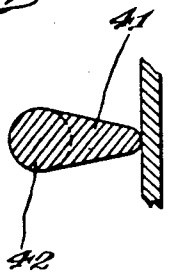
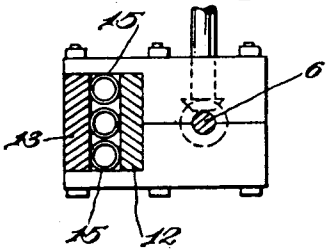


Fig. 11.



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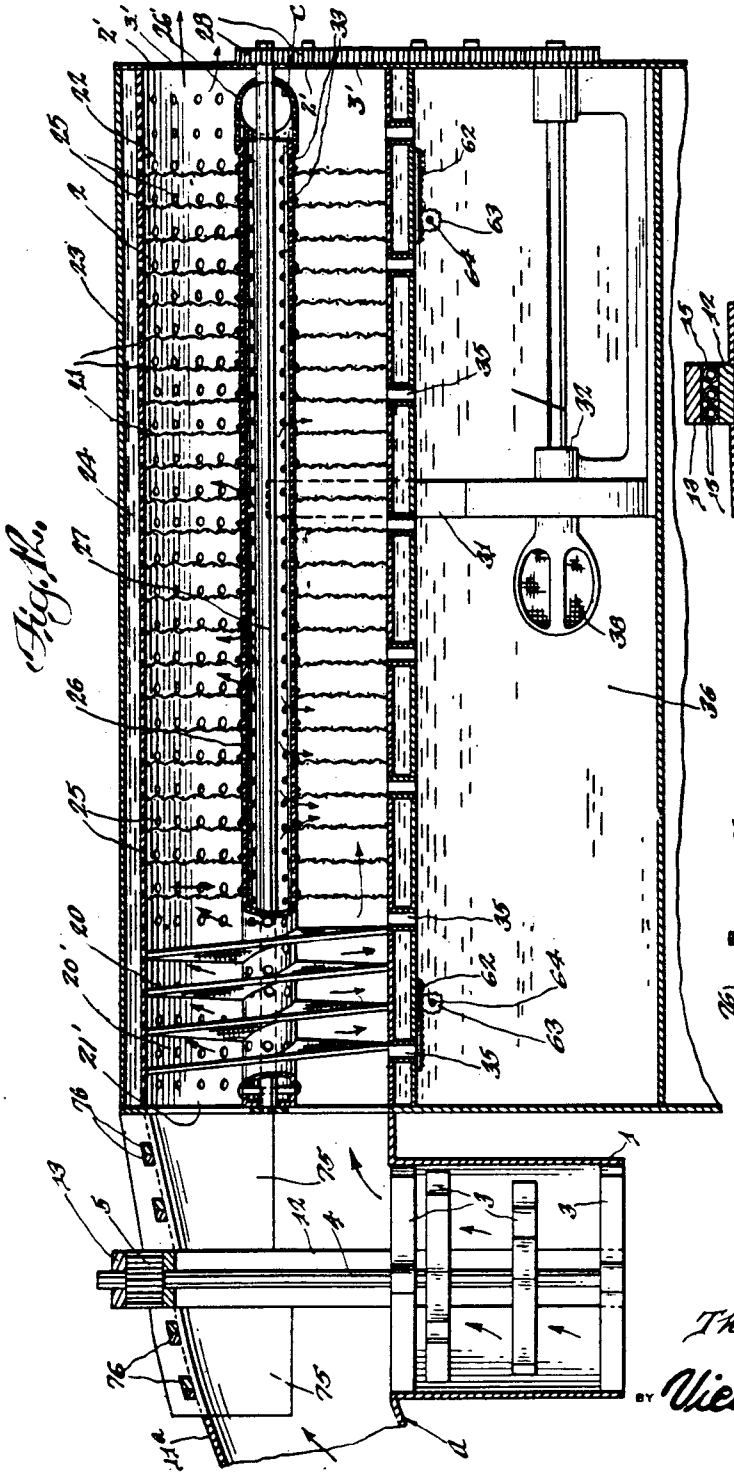


Fig. 12.

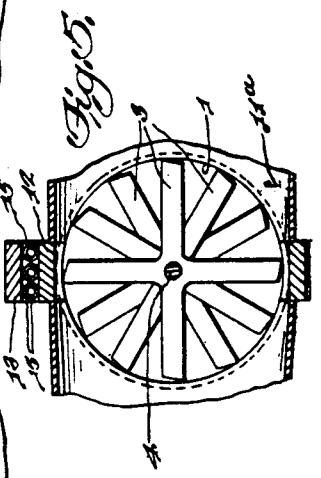


Fig. 5.

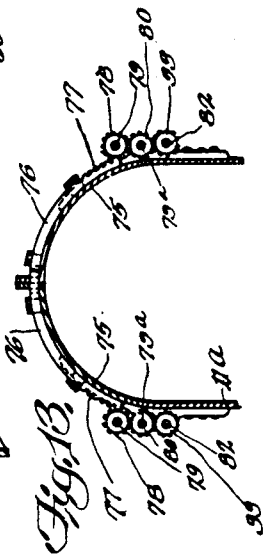


Fig. 13.

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Patented Aug. 30, 1927. 1,641,018

UNITED STATES PATENT OFFICE.

THEODORE THURCHAK, OF CHICAGO, ILLINOIS.

SMOKE WASHER.

Application filed April 2, 1923. Serial No. 629,382.

This invention relates to a smoke washer or smoke washing machine which is adapted to be used in connection with locomotive engines, boilers, heating plants or the like, particularly in cities, and an object of the invention is to provide a device which will wash the soot, cinders and the like from the smoke prior to the issuing of the smoke from the stack, thereby eliminating the black obnoxious foreign materials from the smoke permitting the latter to issue in a clean state and consequently eliminate the discoloring of buildings, the fouling of the air, etc., as is caused by washed soot containing smoke.

Another object of the invention is to provide a smoke washer which contains a passageway between the boiler and the stack through which the smoke travels and in which the smoke is subjected to cross streams of water for removing the soot, cinders and the like therefrom, the water passing under force imparted thereto by suitable pumps so as to thoroughly wash and cleanse the smoke.

A further object of the invention is to provide in a structure as specified means whereby the smoke may be directed to the stack without passing through the washer, if it is so desired and also to provide means whereby the water may be removed from the washer when it becomes soiled to such an extent as to impair its cleansing or detergent properties.

Another object of the invention is to provide a plurality of rotary devices for cutting up or breaking up the smoke as it enters the washer to insure more thorough cleansing thereof.

Other objects of the invention will appear in the following detailed description taken in connection with the accompanying drawings wherein:—

Fig. 1 is a top plan of the improved smoke washer.

Fig. 2 is a side elevation of the improved smoke washer.

Fig. 3 is an end elevation of the smoke washer.

Fig. 4 is a fragmentary vertical section taken on the line 4—4 of Fig. 2.

Fig. 5 is a horizontal section taken on the line 5—5 of Fig. 4.

Fig. 6 is a fragmentary sectional view of the bottom of the washing chamber showing the closures for the outlets.

Fig. 7 is a detail of the means for locking the door securing means against operation.

Fig. 8 is a detail of the door opening and closing gears and associated parts.

Fig. 9 is a transverse vertical section through the washing chamber and associated parts.

Fig. 10 is an enlarged detail view on the line 10—10 of Fig. 2.

Fig. 11 is a detail horizontal section on the line 11—11 of Fig. 4.

Fig. 12 is a longitudinal vertical sectional view through the washer.

Fig. 13 is a fragmentary sectional detail view taken substantially on line 13—13 of Fig. 2.

Referring more particularly to the drawings, the improved smoke washer comprises an entrance compartment *a* which is adapted to have communication with the smoke outlet of a boiler, furnace or similar structure, and through which the smoke passes into the washing chamber proper, 2. A plurality of rotary smoke disintegrating blades or members 3 are provided which are mounted in the smoke entrance 1 of the chamber (*a*), and are adapted to break up the smoke to prevent heating of the top of the device and retard the force of the issuing smoke. The smoke disintegrating members 3 are carried by a vertical shaft 4 which extends through a portion of the entrance chamber (*a*) and is rotated through the medium of a train of gears 5 which are in turn operatively connected to a shaft 6. The blades 3 will also serve to prevent the draught from returning smoke into the boiler. The shaft 6 is in turn rotated from a shaft 7 which extends transversely to the shaft 6 and is connected thereto by means of beveled or miter gears 8. A belt pulley 9 is mounted upon the shaft 7 and is adapted to be connected by a belt or other suitable power transmitting structure as shown at 10 to a motor driven fan or blower structure 11 of any approved type which is provided for creating a draught through the smoke washer. A conduit 11^a extends from the outlet of the fan and communicates with the compartment *a* above the blades 3.

The main portion of the entrance chamber (*a*) is composed of an inner shell 12 and an outer shell 13 which slidably engage one with the other and which have suitable ribs

14 formed thereon, which engage respectively with the sections 12 or 13. Cushioning springs 15 are provided and engage the ribs 14 to provide a cushioning action between the sections 12 and 13. Limited movement of the sections 12 and 13 is permitted by means of the springs 15 and as provided by the space 17, so as to prevent breakage of the parts under the force of the products of combustion passing therethrough and into the washing chamber 2.

The washing chamber 2 extends horizontally and has a spiral screen 20 positioned at its entrance, and extending a short distance therein. Inwardly from the inner end of the spiral screen 20 are positioned a plurality of screen discs 21 which are spaced one from the other and through which the smoke must pass during its travel through the washing chamber. The washing chamber 2 comprises the inner wall 22 forming a substantially cylindrical casing in which the screens 20 and 21 are mounted and the outer wall 23 which provides a water chamber 24 outwardly of the upper half of the inner wall 22. The inner wall 22 is provided with a plurality of perforations 25 at spaced points so as to permit water to flow, from the chamber 24 in criss cross streams substantially diametrically through the chamber 21 to subject the smoke passing therethrough to cleansing streams of water.

A tube 26 extends longitudinally through the chamber 2 along the axis of the circular inner wall 22 and it is carried by a shaft 27. The shaft 27 is connected by means of gears 28 with a shaft 29, which shaft is in turn connected by means of beveled gears 30 to the shaft 6 so that the shaft 27 and tube 26 carried thereby will be rotated by operation of the fan 11. The water chamber 24 has inlet communication through suitable pipes 31 with pump structures 32 which force the water under pressure into the chamber 24 causing it to flow under pressure through the openings 25. The tube 26 has inlets 26′ which communicate with the water space 24 so that water will be forced therethrough and will issue from the tube through the openings 33, moving in the opposite direction to the direction in which the streams of water move which enter the chamber formed by the inner wall 22 through the openings 25 thus subjecting the smoke to action from the streams of water flowing towards and from the axis of the cleansing chamber. The tube 26 is connected to the transverse pipe *c* in such a manner as to provide for rotation of the tube, but at the same time establish communication between the tube 26 and the supply pumps 32, thus allowing the tube 26 to rotate at the same time liquid is being supplied thereto.

The water, and the soot, cinders and other foreign matter which is washed from the smoke pass out of the cleansing chamber through suitable outlets 35 into the tank 36 upon which the cleansing chamber 2 is mounted. The tank 36 has openings 37 in its top, by means of which it may be filled, and the water is drawn out of the tank, by means of the pump structures 32, and travels in a continuous stream through the cleansing chamber 2, back into the tank and through the pumps. Screens of any suitable structure as indicated at 38 are provided for preventing cinders, and other foreign material from being sucked into the pumps during their operation and returned to the cleansing chamber 2.

The side walls 39 of the tank 36 are hingedly supported at the line indicated at 40, so as to permit them to be swung outwardly to empty the water from the tank when the water becomes soiled to such an extent as to render it practically useless. The outlet doors or hinged side walls 39 of the tank, are normally held closed by means of locking cams 41 which are carried by suitable shafts 42. All of the shafts 42 are connected by means of beveled gears 43 to suitable vertical shafts 44 which are in turn connected by means of a regular gear 45 and an intermittent gear 46 to a second vertical shaft 47. The vertical shafts 47 are connected by means of suitable beveled gears 48 to horizontal shafts 49. All of the horizontal shafts extending about the sides and across the ends of the tank are connected for unitary rotation by means of beveled gears 50, and one of the shafts 49 is connected by means of a shaft 51 and suitable gearing as indicated at 52 to a vertical hand shaft 53 upon which a hand wheel 54 is mounted so that when the hand wheel 54 is rotated the shafts 49 will be rotated which will in turn rotate the shafts 42 and move the locking cams 41 out of binding engagement with the hinged doors or side sections 39. Immediately after the cams 41 have been swung out of locking engagement, the weight of the water will force the doors open upon their hinges and permit the water to flow from the tanks. After the tanks have been drained, the hand wheel 54 may be operated in a reversed direction, and immediately prior to the movement of the cams 41 into locking position, the doors or hinged side sections 39 will be swung into closed position by means of the gears 55 which are carried by the doors 39 and mesh with the intermittent gears 56 which are mounted upon the shafts 49. The gears 56 have portions of their perimeters or faces free from teeth as shown at 57 so as to permit rotation of the shafts 42 for certain intervals without rotating the shafts 49 permitting the elapsing of sufficient time to move the locking cams 41 out of locking position before the doors 39 are swung open and also per-

mitting the doors 39 to be swung into closed position before the shafts 42 are rotated to move the locking cams 41 into locking position. This latter movement is permitted by means of the intermittent gears 46.

Emergency outlets 60 for the cleansing chamber 2 are provided to permit thorough cleaning of the cleansing chamber and removal of cinders or other foreign material which might accumulate therein. The openings 60 are normally closed by sliding closures 61 which have racks 62 on their under surfaces. Gears 63 mesh with the racks 62 and these gears are carried by cross shafts 64. The shafts 64 are connected to a shaft 65 by means of beveled gears 66 so as to permit simultaneous opening of all of the outlets 60. A hand wheel 68 is provided which is connected by suitable beveled gears 69 to the shaft 65 to permit manual operation of the closures 61.

The shaft 51 and consequently the shafts 42 and 49 are locked against accidental rotation by means of a brake bar 70 which is carried by a feed screw 71 and is adapted to have braking clamping engagement against friction wheels 72 which are mounted upon the shafts 51. A suitable hand wheel 73 is provided for adjusting the feed screw 71, and flat springs 74 are also provided which engage against the bar 70 and urge it into frictional engagement with the wheel 72, and also urge it inwardly so as to prevent accidental turning movement of the feed screw 71.

At times it may be desired to permit the smoke to pass out of the furnace boiler or the like without passing through the smoke washer and to permit this, a plurality of doors 75 are provided, which doors are positioned on an angle to the horizontal and vertical, as illustrated in Figure 13 of the drawings. The doors 75 are normally held in closed locked positions by means of locking bolts 76, which locking bolts have racks 77. The racks 77 mesh with gears 78 which are mounted upon stub shafts 79. Stub shafts 79^a positioned at the axes of the doors have gears 80 mounted thereon which mesh with intermittent gears 81 carried by shafts 82 and 83 which are disposed below the axis of the hinges 84 of the doors. The shafts 82 and 83 are positioned for opening the doors at one side of the device, while corresponding shafts 86 and 87 are provided for opening the doors at the other sides, slight differences in construction at these points being necessary owing to the manner of operation, however, all of the doors are locked by means of the sliding locking bolts 76 which carry the rack 77 and with which the gears 78 mesh.

The shaft 82 is connected by means of beveled gears 88 to a shaft 89 which is in turn connected by means of beveled gears 90 to a shaft 91. The shaft 83 is connected to the shaft 91 by means of a shaft 92 and suitable sets of beveled gears. The shaft 91 is in turn connected by suitable gears 93 with a shaft 94 which extends throughout the length of the washer and has a hand wheel 95 thereon to permit manual rotation of the shaft 94 for operating the locking bolts 76 and opening the doors 75. The shaft 94 is connected by means of a shaft 96 with a shaft 97 which shaft is in turn connected through suitable beveled gears as indicated at 98 with the shafts 86 and 87.

Owing to the construction of the intermittent gears 81, when the shaft 94 is manually rotated, the gears 78 will be operated through the medium of the gears 99 to move the locking bolts 76 out of locking position, after which the doors will be swung open upon their hinges by continued rotation of the shaft, permitting the smoke to pass outwardly out of the washer without passing through the cleansing chamber 2. During the closing of the doors the reversed action takes place.

It will be apparent from the foregoing description taken in connection with the accompanying drawings that the smoke from the entrance chamber (*a*), which chamber receives the smoke from a boiler, furnace or like structure, will pass in an upwardly direction through this entrance chamber on its journey toward the washing chamber 2 and during the passage of the smoke in this direction the smoke necessarily comes into contact with the rotary smoke disintegrating plates 3. Above the plates 3 the smoke meets the air drawn from the atmosphere and forced toward the chamber 2 by the fan 11. The force of the air carries the smoke into the washing chamber 2 where the smoke finds exit from this washing chamber through the screen member 2′ providing the end wall 3′ of the washing chamber at the discharge end thereof. As the smoke enters the washing chamber 2 a certain amount will travel in the direction indicated by the arrows in Fig. 12 into contact with the spiral screen member 20 and through the spiral passage 20′ at the intake end 21′ of the washing chamber provided by the member 20. This spiral screen member 20 serves in its principal capacity to arrest the heavier unburned particles of combustion and causes these heavier particles to travel in a path through the spiral passage to be deposited within the washing chamber until removed therefrom by the streams of water which continually flush the interior of the washing chamber, certain of said streams being represented by arrows, Fig. 12.

The streams of water from the tube 26 are directed radially from the longitudinal axis of the washing chamber and the streams

from the perforations 25 are directed transversely of the washing chamber as shown by certain arrows, Fig. 12. The finer unburned particules of combustion are arrested in their passage through the washing chamber by the various spaced screen members 21 and are likewise deposited within the washing chamber to be flushed therefrom by the various streams of water into the tank 36 to await removal therefrom. The smoke less such particles of combustion as have been removed by the various screen members continues its course through the washing chamber to find exit through the screen member 2′ at the discharge end of the washing chamber as best illustrated in Fig. 12 of the drawings.

As herein mentioned a motor driven fan which has its fan blades (not shown) operating in the chamber *a* is provided for creating a draft through the washing chamber 2. While this motor driven fan is provided primarily for this purpose it is also apparent from the description herein taken in connection with the accompanying drawings that this motor driven fan is utilized for rotating the tubular member 26 and the disintegrating plates 3. By increasing the draft through the washing chamber 2, through the medium of the motor driven fan, it is manifest that the unburned particles of combustion will be brought into contact with the screen members with great force and due to this fact these unburned particles of combustion are thrown away from the screen members to find lodgement within the washing chamber to be flushed therefrom in the manner herein set forth.

It is, of course, to be understood that the invention may be constructed in other manners and the parts associated in different relations and, therefore, I do not desire to be limited in any manner except as set forth in the claims hereunto appended.

Having thus described my invention what I claim is:—

1. In a smoke washer, an outer wall forming a cleansing chamber having a spiral screen therein at its entrance and extending a short distance within the chamber, a plurality of transverse straight screens positioned within the chamber in spaced relation from the inner end of the spiral screen to the outlet of the chamber, an inner wall surrounding said screens, said outer and inner walls defining a water chamber, said inner wall provided with a plurality of perforations to permit the entrance of water in streams into the cleansing chamber, a rotary tube extending axially through said cleansing chamber and provided with a plurality of perforations, means for forcing water under pressure through said tube and out of said perforations, a water tank positioned for receiving the water from said cleansing chamber, outlet doors for said tank, and means for releasably securing said doors in closed position.

2. A device of the class described including a body defining a washing chamber including an intake and a discharge end, a member at the intake end defining a spiral passage, spaced screen members arranged longitudinally within the washing chamber between the said member and the discharge end, an intake conduit communicating with the chamber at the intake end, rotatable means for discharging liquid radially from the longitudinal axis of the washing chamber, means for supplying liquid to said discharge means, means for rotating said discharge means, and means operable by the means for rotating the discharging means for compelling passage of smoke through the washing chamber from the intake conduit.

3. A device of the class described including wall portions defining a liquid tank, a body above the tank defining a washing chamber in communication with the liquid tank and including an inlet and discharge end, an outer wall around said body defining together with the body a liquid chamber, there being perforations formed in the body effecting communication between the liquid chamber and the washing chamber, and means confined in the liquid tank for delivering the liquid in said liquid tank under pressure to the liquid chamber to be discharged through the perforations under pressure into the washing chamber, and means whereby said discharged liquid is returned from the washing chamber into the liquid tank.

4. A device of the class described including wall portions defining a liquid tank, a body above the tank defining a washing chamber in communication with the liquid tank and including an inlet and discharge end, screen means disposed in spaced relation with respect to each other in a longitudinal direction with respect to the washing chamber, an outer wall around said body defining together with the body a liquid chamber, there being perforations formed in the body effecting communication between the liquid chamber and the washing chamber, and means confined in the liquid tank for delivering the liquid in said liquid tank under pressure to the liquid chamber to be discharged through the perforations under pressure into the washing chamber, and means whereby said discharged liquid is returned from the washing chamber into the liquid tank.

5. In a smoke washer, an inner wall forming a cleansing chamber, a perforated tubular member mounted in the cleansing chamber and disposed axially thereof, spaced screens mounted in said chamber and disposed transversely thereof about the tubu-

lar member, the wall of the chamber being perforated, an outer wall surrounding the chamber and forming therewith a water space, a cross-pipe mounted in the cleansing chamber and communicating with the water space, said tubular member communicating at one end with the cross-pipe and being mounted for rotation, means for supplying water under pressure to the water space, and means for rotating the tubular member.

6. In a smoke washer, an inlet wall forming a cleansing chamber, a perforated tubular member mounted in the cleansing chamber and disposed axially thereof, spaced screens mounted in said chamber and disposed transversely thereof about the tubular member, the wall of the chamber having its upper portion perforated, an outer wall surrounding the chamber and forming therewith a water space, means for supplying water under pressure to said space, and outlet members extending from the lower portion of the cleansing chamber through said water space, the tubular member communicating with said water space.

In testimony whereof I affix my signature.

THEODORE THURCHAK.