H. E. ANDERSON.

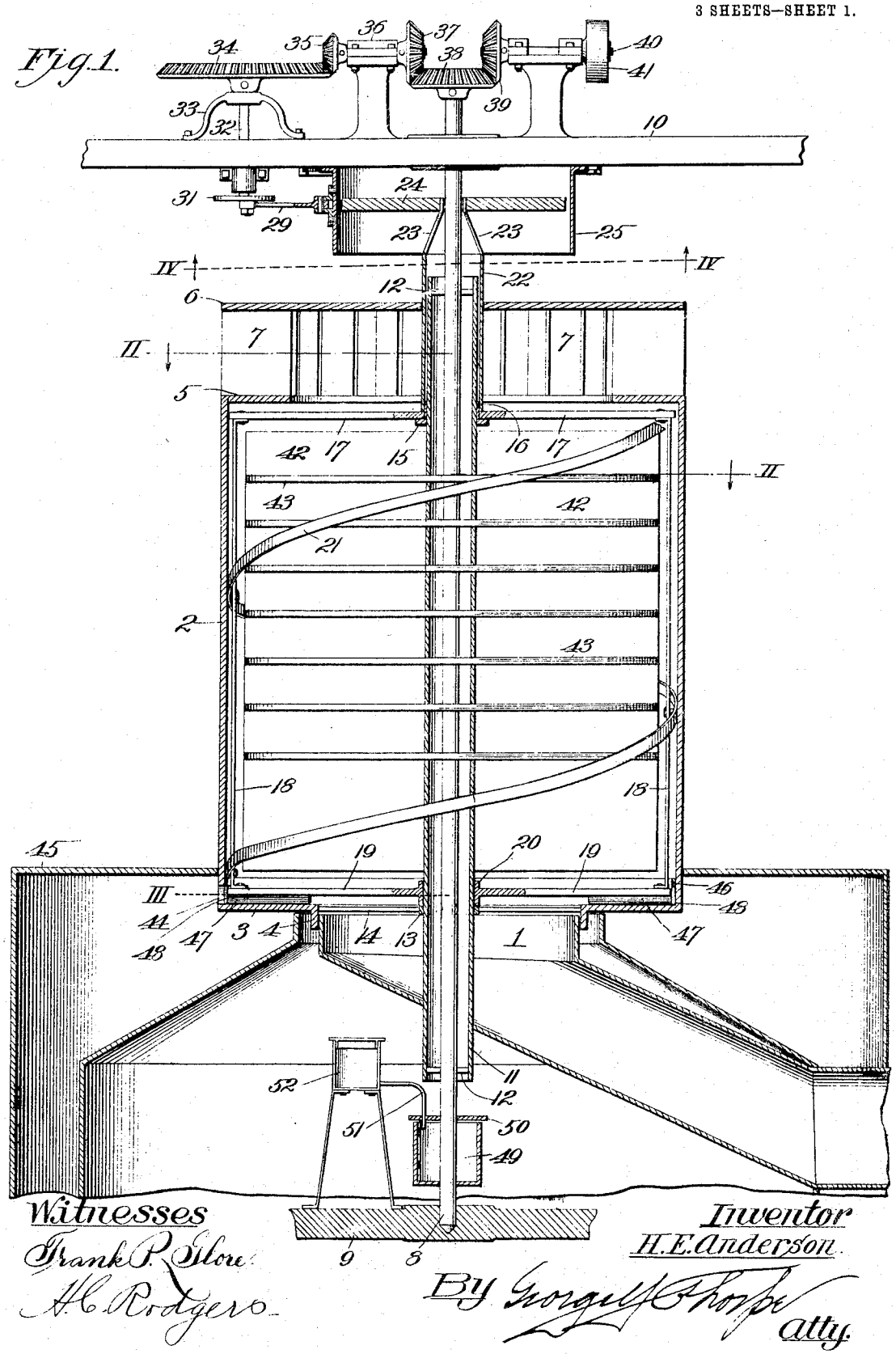
APPARATUS FOR SEPARATING SMOKE SUSPENDED MATTER.

APPLICATION FILED APR. 29, 1905.

**1,038,513.** Patented Sept. 17, 1912.

3 SHEETS—SHEET 1.

Fig. 1.




Witnesses

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3 SHEETS—SHEET 2.

Fig. 2.

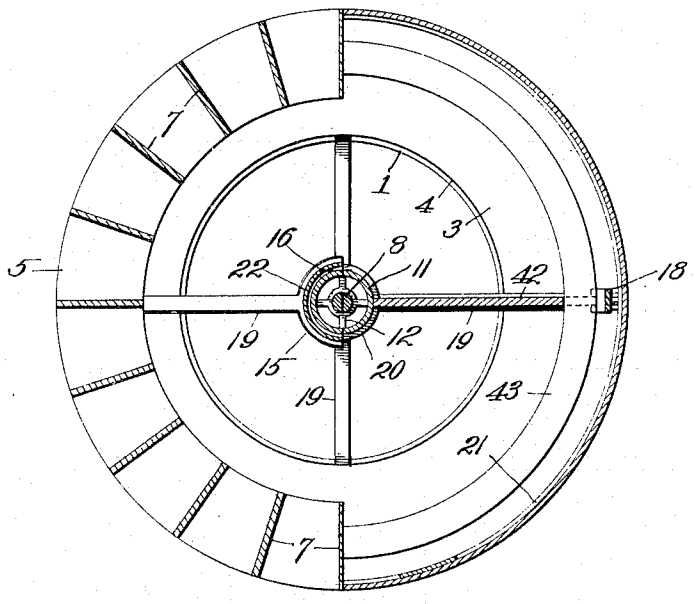



Fig. 3.

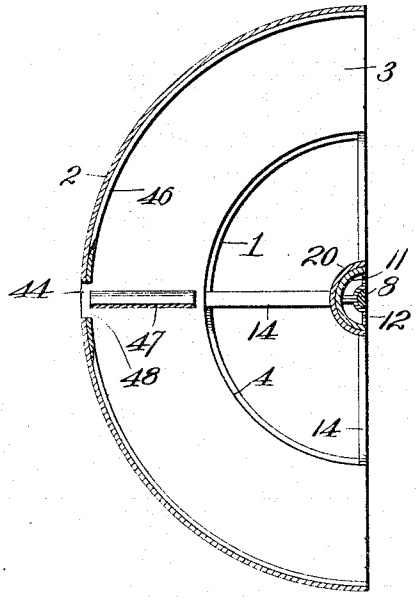
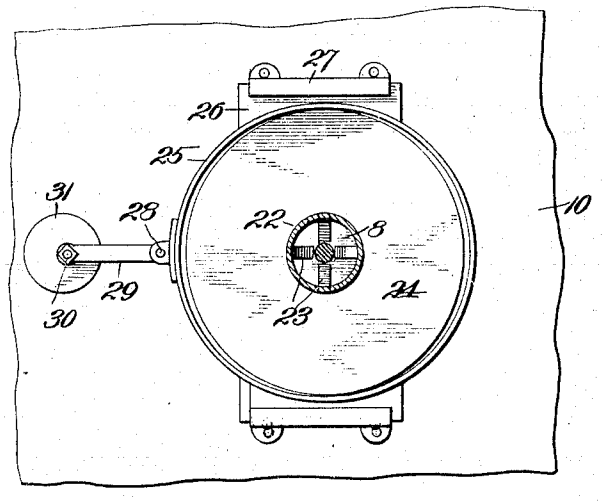



Fig. 4.

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3 SHEETS—SHEET 3.

Fig. 5.

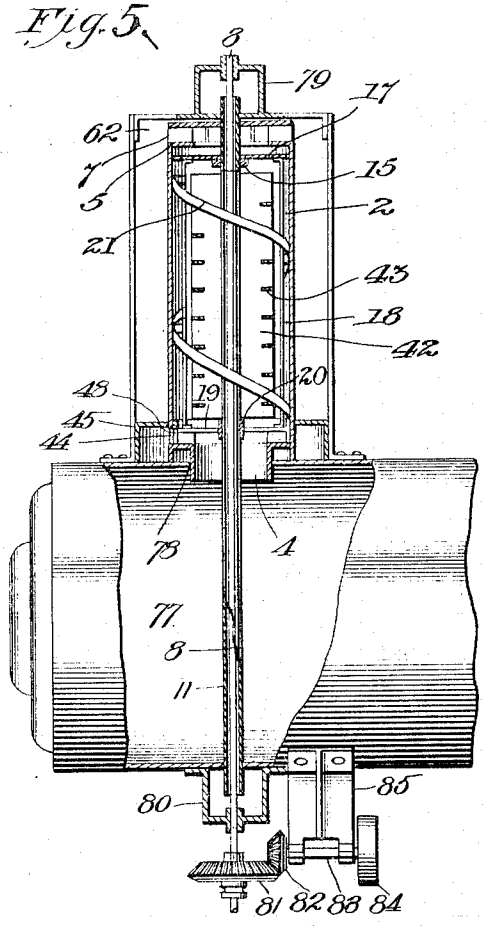



Fig. 7.

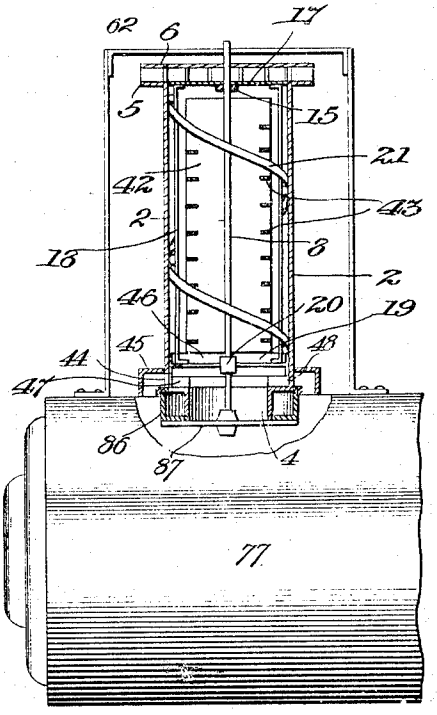



Fig. 6.

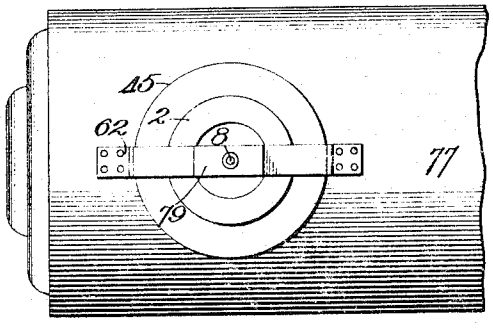
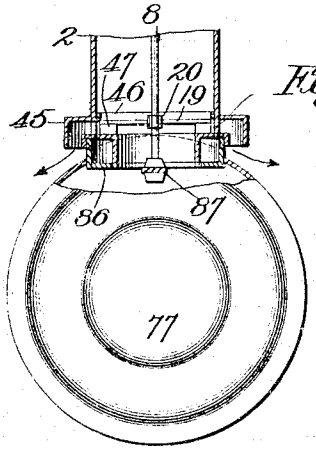



Fig. 8.

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# UNITED STATES PATENT OFFICE.

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## APPARATUS FOR SEPARATING SMOKE-SUSPENDED MATTER.

1,038,513. Specification of Letters Patent. Patented Sept. 17, 1912.

Application filed April 29, 1905. Serial No. 258,125.

*To all whom it may concern:*

Be it known that I, HAMILTON E. ANDERSON, a citizen of the United States, residing at Wichita, in the county of Sedgwick and State of Kansas, have invented certain new and useful Improvements in Apparatus for Separating Smoke-Suspended Matter, of which the following is a specification.

My invention relates to apparatus for separating smoke from the gases arising from the various processes of combustion; for separating the heavier gases from the lighter; for separating heavy metal-laden gases or fumes, or fine metallic particles from the lighter or non-metallic gases arising when smelting and blast furnace operations are in progress; for separating finely divided solids from gases; and for separating sparks from the gases arising from the various processes of combustion, and particularly for separating sparks and solids from the gases discharged from locomotives, threshing engines, and other types of engines, boilers or furnaces where fuel is consumed under strong draft, and my object is to produce an apparatus of the character named which performs the separating function efficiently and reliably.

A further object is to produce a revoluble centrifugal separating stack, or stack separator for separating the heavier products of combustion from the lighter, by the action of centrifugal force, said stack forming a flue, duct, tube, chimney or funnel for conducting the products of combustion, and provided with suitable means for conducting the products of combustion into it.

A further object is to produce a separating stack or stack separator, a portion thereof being stationary and a portion being revoluble, separation being performed in the revoluble portion by the action of centrifugal force, and to provide a suitable mechanism for driving said stack at a speed sufficient to produce efficient separation, or in some situations it may be driven by the kinetic energy of the gases passing through it and discharged from it through properly constructed discharge orifices or channels.

A further object is to provide the separating stack with efficient means for causing the gases and other products of combustion while therein to revolve with it, thus subjecting the products of combustion to the action of centrifugal force while passing through the separating stack, such centrifugal action causing the heavier products of combustion and solids to travel outward from the axis of rotation to the shell or shells of the revoluble stack thereby separating the solids from the gases and the heavier gases from the lighter. Also to provide the stack, or the revoluble portion thereof, with suitable and efficient means for scraping the solids from the wall or walls of the stack, and with efficient means for disposing the scrapings in a convenient position for discharge therefrom, and to provide the stack separator with suitable means for discharging the solids and heavier products of combustion from it into properly disposed reservoirs or receivers.

With these objects in view and others as hereinafter appear, the invention consists in certain novel and peculiar features of construction and organization as hereinafter described and claimed; and in order that it may be fully understood reference is to be had to the accompanying drawings, in which—

Figure 1, is a central vertical section of a separator embodying my invention; this style of separator being adapted particularly for reclaiming heavy smoke and combustible gases which would otherwise escape. Fig. 2, is a section on the line II—II of Fig. 1. Fig. 3, is a horizontal section taken on the dotted line III of Fig. 1. Fig. 4, is a section taken on the line IV—IV of Fig. 1. Fig. 5, is a view showing the apparatus as applied to a locomotive, to perform the function of a spark arrester, the apparatus being principally shown in central vertical section. Fig. 6, is a top plan view of the same. Fig. 7, is a view similar to Fig. 5, but showing a modified form of spark-arresting mechanism. Fig. 8, is a front view of the locomotive, broken away, and equipped with the apparatus shown by Fig. 7; said apparatus being shown in central vertical section.

Referring now to the drawings, in which like reference numerals refer to corresponding parts, 1 indicates the stationary part of a smoke stack, the shell thereof forming a flue, duct, tube, chimney or funnel for conducting the products of combustion, and 2, a shell forming a revoluble portion thereof, said shell having an inwardly projecting base flange 3, and a collar 4, at the inner margin of said flange,

which externally embraces the upper end of the stationary portion of the stack, fitting sufficiently close to prevent smoke escaping externally of said revolving shell. At its upper end the shell is provided with an inwardly projecting flange 5, which flange may form the base or bottom of a turbine wheel, 6 being the top plate of the turbine and 7 the blades connecting the top and bottom, which blades may be straight, curved or angular.

Extending centrally through and axially of the shell is a shaft 8, which in some connections may be stationary, as hereinafter more particularly referred to. In Fig. 1 and in the majority of the types of construction shown, the shaft is journaled at its lower end in a suitable bearing as at 9. and at its upper end in a suitable bearing as at 10.

In order to assist in cooling the products of combustion as they pass from the stack, and also keep the shaft 8 as cool as possible, said shaft is surrounded by an insulating tube 11, having its lower end extending through the lower stack portion and its upper end projecting above the shell and also above the turbine where the latter is employed. This tube is secured rigidly by spiders 12 to the shaft where the latter is of rotatable character, the spiders permitting cool air to circulate up through the tube.

13 is a collar rigidly secured to and surrounding the tube 11, and connected by radial arms 14 to the lower portion of the revoluble shell, so that the latter shall rotate with the tube. 15 is a similar collar secured to the tube near the upper end of the shell and journaled on said tube and collar 15 is a second collar 16, this collar having rigidly attached to it outwardly projecting arms 17, connected at their outer ends by vertical bars 18 to the outer ends of arms 19, projecting outwardly from a collar 20, journaled on the tube and the collar 13 thereof, these arms 17 and 19, bars 18, and collars 16 and 20, forming a frame which is rotatable independent of the shell. Said frame is equipped with a suitable scraper for removing accumulated carbon and other solid particles from the inner side of the shell, the scraper shown being in the form of a spiral as at 21.

22 is a pipe extending rotatably and snugly through the top of the turbine with a substantially air-tight connection and its lower end is secured rigidly to the collar 16, so as to turn therewith and converging upwardly from the upper end of pipe 22, are arms 23. Rigidly connecting said arms and journaled on the shaft is a friction wheel 24, and surrounding said friction wheel is a friction band 25, having longitudinal flanges 26, engaging guide plates 27, secured to the bearing 10. Band 25 is of elliptic form, and is pivotally connected as at 28, by link 29 to the wrist pin 30, of a similar wheel 31, which wheel is journaled on shaft 32, extending up through bearing 10, and bearing 33.

34 is a bevel gear meshing with a pinion 35, on a short shaft journaled in bearing standard 36, a bevel gear 37, on the other end of said shaft meshing with a bevel gear 38 on the upper end of shaft 8, and said gear 38 also meshes with the driving gear 39 on shaft 40 suitably journaled, equipped with a belt wheel 41 adapted to be driven in any suitable manner.

42 indicates vertical blades projecting rigidly from opposite sides of tube 11, and 43 annular baffle plates secured on the outer edges of said blades, the latter and the baffle plates being adapted to revolve within the scraping mechanism.

44 indicates one or more openings in the lower part of the shell and in communication with the annular receptacle 45 and fitting in the lower part of the shell is an annular band 46, secured rigidly to the lower end of the scraper frame, and with the latter provided with depending scraper blades 47 to operate on the bottom flange 3 of the shell, said band 46 being provided at suitable points with a pair of openings 48, for successive registration with opening 44 of the shell.

For the purpose of keeping the shell cool contiguous to its bearings, it is rigidly equipped with cups 49, having covers 50 slightly above the cups so that water may overflow from the latter, such water being introduced into the cup by means of a pipe 51, leading from a supply tank 52, supported from and above the adjacent bearings of the shaft, the drawings showing only one end of the shell so equipped.

Assuming that revolving motion is imparted to the shell through the medium of the gearing described and that smoke from the furnace is passing up from the stationary portion 1 of the stack, into the shell, it will be seen that the revolving blades 42 will give such smoke and the gases therein a centrifugal motion, and that through such centrifugal action the heavier particles of the smoke and gases will be thrown outward against the walls of the shell while the lighter or noncombustible gases will escape from the open upper end of the shell. If the latter is equipped with a turbine having straight blades at the proper angle, the furnace will be subjected to a forced draft under the suction thus created. If the turbine is equipped with curved or angular blades properly disposed, a portion of the kinetic energy of the escaping gases will be utilized, as will be readily understood, in assisting in the rotation of the shell, in fact in some instances the turbine may be relied

upon wholly for the purpose of rotating the shell and thereby causing the smoke and gases to travel upward in a spiral pathway.

In the revolution of the shell and the consequent centrifugal action of the smoke and gases, a large proportion of the former will impinge forcibly upon and adhere to the vertical walls of the shell and in order to remove such particles and return them to the furnace or collect them for any other purpose, the scraping mechanism is provided. Under ordinary conditions the scraping mechanism, because of its weight will turn with the shell, but at intervals its speed will be retarded so that the rotary movement of the shell and scraping mechanism will be at different speeds, the result being the spiral scraper will scrape the accumulation, such as carbon, etc., from the wall of the shell and permit it to drop and accumulate on the bottom flange of the latter. From the latter it is scraped by the scraping blades 47 and at the same time under the centrifugal force moves outward and piles against band 46, and is eventually under the centrifugal force, discharged through the opening 48, and opening 44, as the former successively registers with the latter, falling from the last-named opening into the receptacle or collector 45. This periodic differential movement between the shell and scraper is caused under the reciprocatory action of the friction band 25, which through the action of the disk 31, and link 29, comes into yielding frictional engagement with the periphery of friction wheel 24, and therefore retards the speed of the same and of the scraping mechanism rotatable therewith. In view of the fact that band 46 is covering shell-opening 44 for the greater portion of the time it is obvious that the gases cannot escape except for the very short fraction of time when the opening 48 is registering with opening 44. It will also be obvious that the separating action is made positive and reliable because the baffle-plates disposed near the wall of the shell and in the path of the upward movement of the heavier smoke and gases, materially check the velocity of their movement so that through the annular space formed between plates 42 and the shell, the scrapings from the latter may readily gravitate. In some connections it may be advisable to have the scraper mechanism stationary but in most cases it is undesirable because there would be a constant frictional engagement between it and the shell whereas by causing a differential movement at times only, the friction between the shell and scraper mechanism is reduced to the minimum.

Referring to Figs. 5 to 8 particularly which illustrate the use of the apparatus more especially as a spark arrester, 77 indicates the front end of a locomotive having an opening 78 communicating with the smoke box, through which depends collar 4 of the shell 2, this shell being equipped internally with a suitable scraper and means for baffling or trapping the smoke and gases in their upward progress contiguous to the wall of the shell, such mechanism corresponding to the mechanism shown in Fig. 1 and being identified by the same reference characters, it being also understood that the shell 2 is adapted for rotation as in the structure shown by Fig. 1 and through the same agencies. 45 is a receptacle or collector for the particles discharged through the opening 44 of the shell and by reference to Fig. 8, it will be seen that the sparks, etc., may fall to the ground at the opposite sides of the locomotive as indicated by the arrows in the last-named figure. 62 is a frame provided with an extension 79 forming a journal for the upper end of shaft 8, which in this instance depends through the bottom of the locomotive shell and is journaled in a bearing 80, depending from said shell, the shaft being adapted to be driven in this instance through the action of the exhaust from the locomotive and the turbine 7 at the upper end of the shell 2, and to insure a steady rotative movement of the shaft, which would tend to rotate intermittently under the pulsating force of the draft, a gear wheel 81 is secured to the shaft and meshes with a similar gear 82 on a short shaft 83 equipped with a fly or balance wheel 84; said shaft being journaled in a bearing bracket 85 depending from shell 77, any suitable governor, not shown, being provided to guard against rotation of the shaft at an excessive speed.

In Fig. 7, the shell is shown in operative position without extending the shaft down through the boiler or shell 77. In this case an angle ring 86, depends into the upper portion of the shell 77 and is connected by a cross bar 87 providing a bearing for the lower end of shaft 8, and for the depending flange 4 of the shell so as to assist in holding the latter against lateral movement, the collector or receptacle 45 as in Fig. 5 being arranged to receive the discharge from the shell 2. In this case the shaft 8 also journaled at its upper end in frame 62 is adapted to be equipped with a governing means (not shown) for insuring a steady rotation of the shell and for preventing it from rotating at an excessively high speed.

From the above description it will be apparent that I have produced an apparatus which in one form or another as described or suggested or any structures which are the mechanical equivalents of the same, will perform the various functions enumerated efficiently and reliably, it being understood of course that I reserve the right to make all changes in the form, proportion, detail con-

struction and arrangement of the parts as shall properly fall within the spirit and scope of the appended claims.

Having thus described the invention what I claim as new and desire to secure by Letters Patent, is:—

1. In an apparatus of the character described, a stack comprising a stationary portion to receive the products of combustion and a revoluble portion having an opening in one end to receive the products of combustion from the stationary portion and an opening in its opposite end for the discharge of such products, a revoluble scraper within said revoluble portion and adapted to scrape the wall of the latter, and means encircled by the revoluble scraper for causing the products of combustion in passing through the revoluble portion to travel circularly.

2. In an apparatus of the character described, a stack comprising a stationary portion to receive the products of combustion and a revoluble portion having an opening in one end to receive the products of combustion from the stationary portion and an opening in its opposite end for the discharge of such products, a revoluble scraper within said revoluble portion and adapted to scrape the wall of the latter, means encircled by the revoluble scraper for causing the products of combustion in passing through the revoluble portion to travel circularly, and means for automatically traveling on the lower end of the revoluble portion to discharge the scrapings off the wall from the stack.

3. In an apparatus of the character described, a stack comprising a stationary portion to receive the products of combustion and a revoluble portion to receive the products of combustion from the stationary portion, revoluble means within the revoluble portion of the stack for causing the products of combustion in passing through the revoluble portion to travel circularly, suitable horizontal portions rotating with the means revolving within the revoluble portion of the stack for preventing the products of combustion from passing vertically upward through the stack near the wall thereof, and means for scraping adhering matter from said wall to permit it to drop down to the bottom of the revoluble portion.

4. In an apparatus of the character described, a stack comprising a stationary portion to receive the products of combustion and a revoluble imperforate portion open at each end and adapted to receive at its lower end the products of combustion from the stationary portion and discharge them at its opposite end, and a turbine wheel at the discharge end of said revoluble portion to utilize a portion of the kinetic energy of the discharged products and revolve the revoluble portion.

5. In an apparatus of the character described, a stack, comprising a stationary portion, and a revoluble portion to receive the products of combustion from the stationary portion and provided with one or more discharge openings, means rotatable with the revoluble portion and within the same for causing the products of combustion to pass circularly through said revoluble portion and impinge against the wall of the same, and means to scrape the adhering matter from the wall of said revoluble portion and dispose it in position to be discharged through said discharge openings.

6. In an apparatus of the character described, a stack, comprising a stationary portion, and a revoluble portion to receive the products of combustion from the stationary portion and provided with one or more discharge openings, means rotatable with the revoluble portion and within the same for causing the products of combustion to pass circularly through said revoluble portion and impinge against the wall of the same, a scraping mechanism within and adapted to revolve with said revoluble portion, and means for retarding the speed of said scraping mechanism at times to cause it to scrape the walls of said revoluble portion of the stack.

7. In an apparatus of the character described, a stack, comprising a stationary portion, a revoluble portion to receive the products of combustion from the stack and having a bottom and an opening in said bottom, means for scraping matter adhering to the inner side of the wall of said revoluble portion, and means for scraping the bottom of said stack and disposing the scrapings in position to be discharged through the opening in said revoluble portion.

8. In an apparatus of the character described, a stack comprising a stationary portion, a revoluble portion communicating therewith, means for causing the products of combustion to revolve with the revoluble portion as they pass therethrough means within and contiguous to the wall of said revoluble portion to interrupt the circulation contiguous to said wall, means to scrape adhering matter from said wall, and means to discharge the accumulated scrapings from said revoluble portion.

9. In an apparatus of the character described, a stack comprising a stationary portion to receive the products of combustion and a revoluble portion to receive the products of combustion from the stationary portion, revoluble means within the revoluble portion of the stack for causing the products of combustion in passing through the revoluble por-

tion to travel circularly, suitable horizontal portions rotating within the means revolving within the revoluble portion of the stack for preventing the products of combustion from passing vertically upward through the stack near the wall thereof, means for scraping adhering matter from said wall to permit it to drop down to the bottom of the revoluble portion, and means for discharging the scrapings from the revoluble portion.

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

HAMILTON EDWARD ANDERSON.

Witnesses:
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