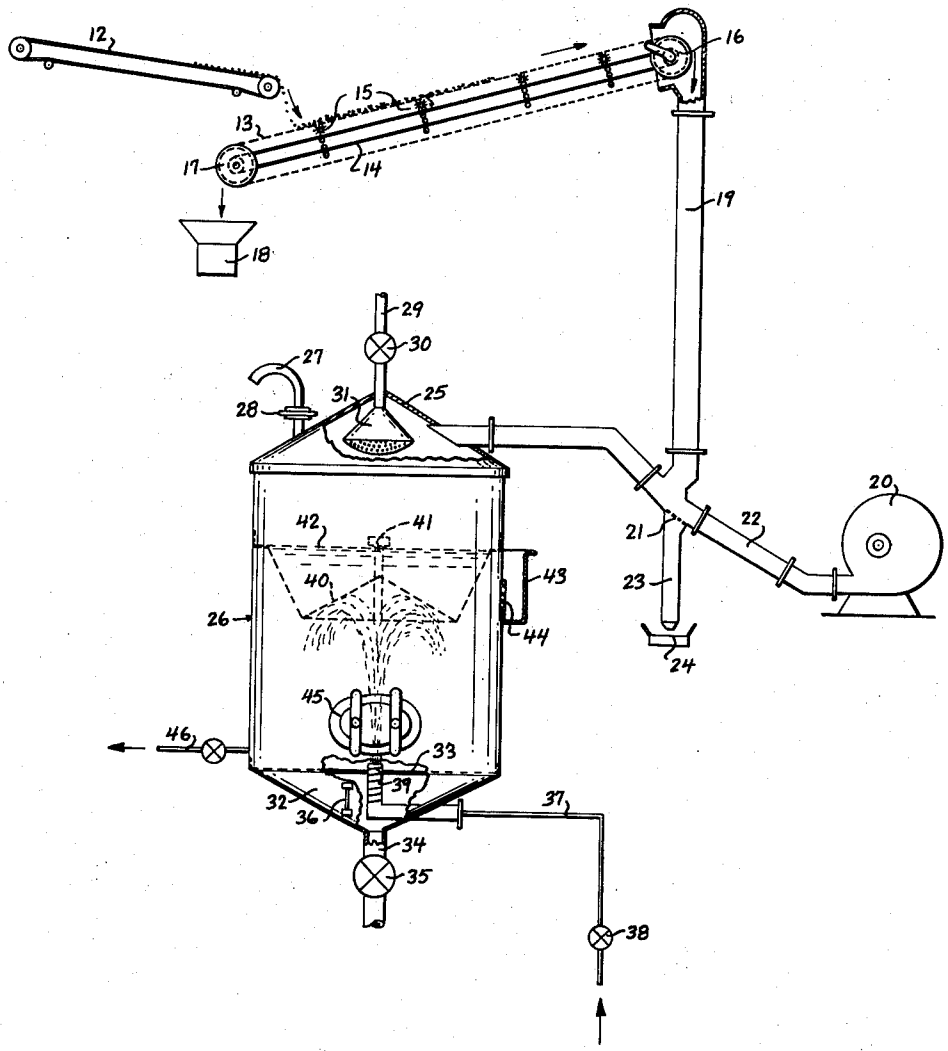
Sept. 25, 1962 NAOMITSU MEGUMI 3,055,498

SLAGWOOL REFINING METHOD AND APPARATUS

Filed March 4, 1960

3 Sheets-Sheet 1

FIG. 1



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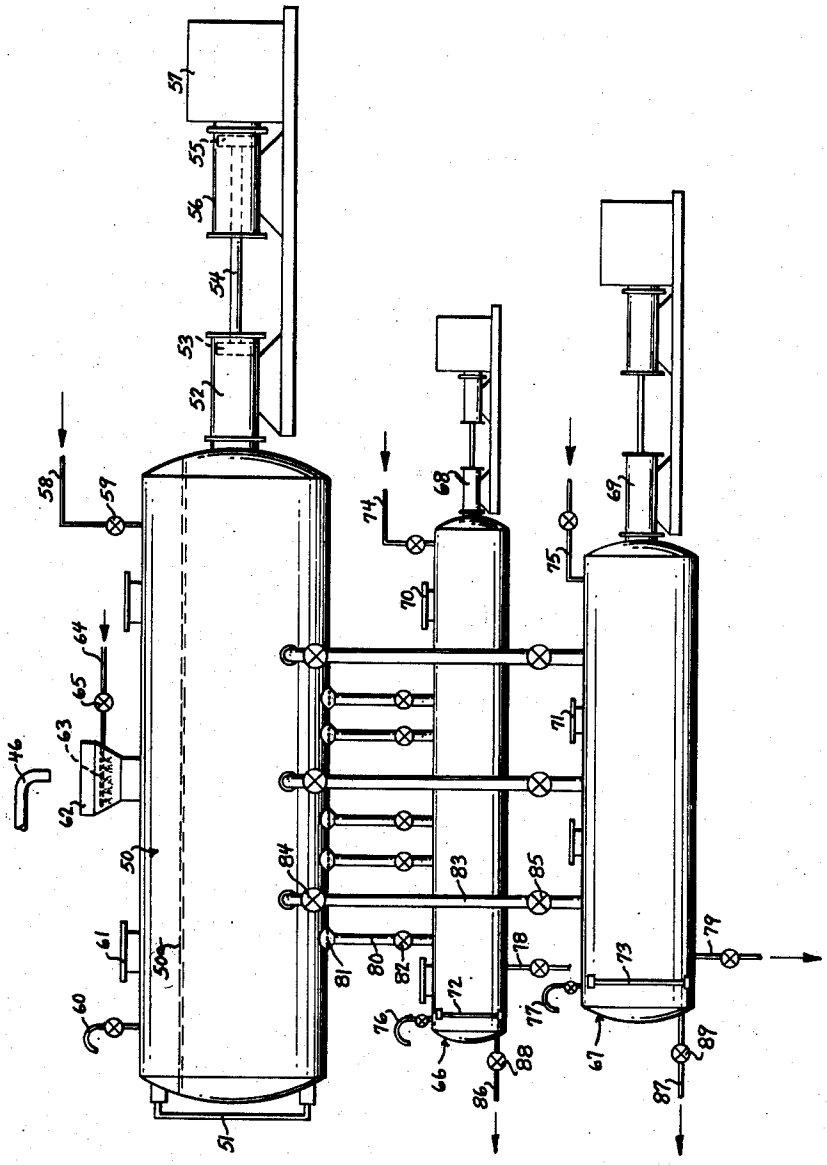
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3 Sheets-Sheet 2

FIG. 2



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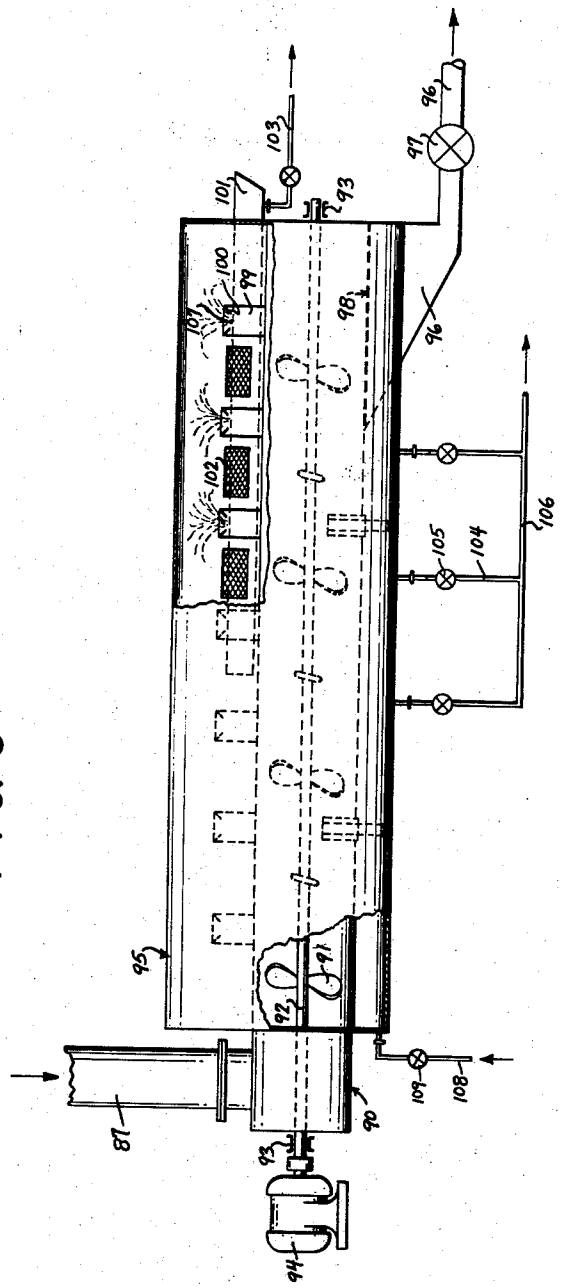
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SLAGWOOL REFINING METHOD AND APPARATUS

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FIG. 3



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SLAGWOOL REFINING METHOD AND APPARATUS

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The present invention relates to method and apparatus for the refining of slagwool.

Raw slagwool as it leaves the blowing chamber is a fleecy material whose fibers are composed principally of SiO_2 and CaO which have an electrically non-conductive nature. However, raw slagwool is contaminated with both metallic and non-metallic materials in the form of powder or small grains. These non-fiber materials are not only carried by the slagwool but often adhere to the fibers and cause them to stick together.

Before the present invention efforts have been made to remove the non-fiber materials in the raw slagwool by various washing processes, but these have been only partially successful. In fact, not only have such refining processes commonly failed to separate fibers which have stuck together, but have resulted in additional fibers sticking with the result that lumping is caused. As a consequence, heretofore raw slagwool has not been eligible for the manufacture of mineral pulping, felting and paper.

Raw slagwool whether in the virgin state or in the form of sheeting reinforced with other materials after water treatment has limited use for thermal insulating, heat resisting and sound arresting purposes. Since the non-fiber materials therein contain considerable CaO which will alkalify by chemical action thereby absorbing moisture, when the slagwool is used with certain metallic materials rust results causing degradation. Also, when such slagwool is used its fibers often disintegrate in the course of use. The dust of the fibers so destroyed may of course be injurious to health and damage machine or other installations in the surrounding areas.

Accordingly, the present invention aims to provide process and apparatus for refining slagwool to a degree making it fit to be manufactured into slag-fiber pulping, felting and paper, and suitable for electrical insulation.

More particular objects and advantages will appear and be understood in the course of the following description and claims, the invention consisting in the novel construction and in the adaptation and combination of parts hereinafter described and claimed.

In the accompanying drawings:

FIGS. 1–3 are diagrammatic elevational views illustrating the apparatus used in the practice of the present invention.

For outline purposes I have arbitrarily divided the invention into three stages corresponding to FIGS. 1–3.

First Stage

During the first stage (FIG. 1), the raw slagwool feeds from the blasting furnace to a conveyor **12** and is mechanically agitated as by combing, air blasted, and water agitated and washed. The combing apparatus comprises a series of rotating brushes **15** power-driven between the sloped upper runs of a continuous outer metal net screen **13** and a narrower continuous inner closed belt **14**. These are in turn driven together in concentric relation by a pair of powered rollers **16—17** each having a circumferential groove therealong which is stepped at both ends of the roller for receiving the belt **14** at the bottom and the wider side portions of the screen **13** on the steps. The brushes **15** rotate in the same direction as the rollers **16—17**, but considerably faster, so that as raw slagwool delivered from the conveyor **12** to the screen **13** is carried thereby upwardly toward roller **16** it is combed by the

bristles of the brushes **15** working between the meshes of the screen. By the resulting agitation grains of non-fiber material are freed to fall through the screen onto the belt **14**. These grains are pushed by contact of the brushes with the upwardly travelling upper run of the belt **14**, downwardly therealong until they are pushed past the roller **17** whereupon they drop into a slag receiver **18**.

In the meantime slagwool reaching the roller **16** on the screen **13** discharges therefrom into a chute **19**. This chute intersects a sloping section of an air blast pipe **22** which is fed from a blower **20**. At the point of intersection a screen **21** separates the blast pipe from a depending slag pipe **23** which dumps onto a slag conveyor **24**. Pressure from the blower **20** is sufficient for the air blast to carry slagwool dropping from the chute **19** up the inclined section of the pipe **22** and out into the conical cover **25** of a water tank **26** while the air blast separates some of the non-fiber materials which then find their way through the screen **21** to drop onto the slag conveyor **24**.

Continuing to the tank **26**, it will be noted that its cover **25** has an off-center vent **27** provided with a screen **28** and has a center water feed pipe **29** with a valve **30** for supplying a spray head **31**. At its lower end the tank has a conical sediment section **32** which is separated from the tank proper by a screen **33** and has a drain pipe **34** with a valve **35** at its apex. Sediment level may be viewed through a gauge **36**. A second water feed pipe **37** with a valve **38** leads into the tank through the sediment section **32** to supply a spiral nozzle **39** which projects upwardly through the screen **33**.

Between the spray head **31** and nozzle **39** is located a conical or semi-spherical baffle **40** which is spaced from the walls of the tank **26** and is held in such position by welded strap arms **41**. The tank water level, indicated at **42**, is determined by an overflow bowl **43** which communicates through a screen **44** with the tank. A manhole **45** is provided for access to the tank **26** and particularly the lower part thereof. Discharge from the tank proper occurs through an outlet pipe **46** having a valve **47** and located just above the level of the screen **33**.

As before mentioned, the air blast from the blower **20** carries the raw slagwool into the top of the tank **26**. This slagwool is blown down to the surface **42** of the water by the water jetting from the spray head **31** and is caused to travel downwardly from the rim thereof. Simultaneously, water from the feed pipe **37** jets in a spiral path from the nozzle **39** against the underside of the baffle **40** and flows down from the rim of the baffle toward the inside wall of the tank to intersect the path of the slagwool. The slagwool continues its downward travel below the rim of the baffle **40** until it engages the screen **33** from whence it is caught by the spiral water jet from the nozzle **39** and cascaded upwardly to the baffle **40** and circulated back down along the inside wall of the tank. During this water agitation and washing of the slagwool, non-fiber material passes through the screen **33** for deposit therebeneath while water containing slagwool is discharged at a predetermined rate through the outlet **46** for further refining in the second stage.

Second Stage

In the apparatus for the second stage, which may be called a "piston separator" a cylindrical separating tank **50** is placed with its longitudinal axis horizontal and has closed end bells, one equipped with a sight gauge **51** and the other connecting with a cylindrical neck **52**. Working in this neck is a stirring piston **53** having its rod **54** driven by a double-acting agitating piston **55**. This piston operates in a cylinder **56** by alternately venting and supplying the ends of the cylinder with pressure fluid from a pump unit **57**. At the top, the master tank has a water fill line **58** with a valve **59**, a vent **60**, manholes **61**, and an

inlet funnel 62. The latter is fed from the first stage by the pipe 46 and has a spray pipe 63 supplied by a feed pipe 64 and controlled by a valve 65.

Below the separating tank 50 are located a non-fiber sediment tank 66 and a receiving tank 67. These tanks have stirring piston assemblies 68—69, respectively, at one end with pistons operating in the same manner as stirring piston 53. They also are equipped with respective manholes 70—71, sight gauges 72—73, valved water fill lines 74—75, vents 76—77, and valved exhaust cleaning lines 78—79. The savings tank 66 is fed at the top from the extreme bottom of the separating tank 50 by a gang of depositing pipes 80 each having a screen 81 at the top and a valve 82. Pipes 83 feed into the top of the receiving tank 67 from a level in the separating tank 50 somewhat above the screened mouths of the pipes 80 and each has conveying and pouring valves 84—85. Discharge from the tanks 66—67 is accomplished by pipes 86—87 controlled by respective valves 88—89.

In the operation of my piston separator the liquid mix of partially refined slagwool fibers and water from the first stage are sent to the tank 50 via the pipe 46 and funnel 62. This liquid mix is diluted by water added through the spray pipe 63 as it enters the tank. The feeding is terminated before the tank is filled, the maximum desired level being indicated at 50*a* and being observed through the gauge 51. Then the piston 53 is set into operation to place the tank 50 alternately under high and low pressures and thereby stir and intermix the liquid and air therein. In the course of this action soluble non-fiber material theretofore adhering to the fibers is dissolved by the water, insoluble non-fiber material adhering to the fibers is separated therefrom, and fiber lumps are disjointed and untangled into their individual fibers. As operation of the piston is repeated the fiber, being light, floats to the surface while the non-fiber material, being heavier, sinks to the bottom of the tank 50. This non-fiber material passes through the screens 81 into the depositing pipes 80 and down to the sediment tank 66 as water is permitted to flow in such path by opening of the valve 82. It should be understood however that the tank 66 has been theretofore partly filled with water through the line 74. The operation of the piston 53 is continued for several minutes as the non-fiber material is descending to the sediment tank. Then when such operation is stopped the valves 82 are closed and the valves 84—85 are opened. As a result the liquid remaining in the tank 50 flows into the receiving tank 67 and carries the slagwool fibers therewith. Then the discharge valve 89 is opened and the water and fibers mix is sent to the specific gravity separator (FIG. 3) by the pipe 87. During this time operation of the piston unit 69 helps the flow of the material and causes further separation of non-fiber material by the piston's stirring action.

In the meantime the water which has dumped into the sediment tank 66 together with the non-fiber material is discharged through the pipe 86 by operation of the piston unit 68 and additional water fed through the feed line 74 after opening the valves 88. After the tank 66 is emptied, the piston 68 stopped, and the valve 88 closed, the tank is again partially filled with water by the fill line 74 in preparation for the start of another cycle of the second stage.

For continuous operation of all three stages, two or three of the second stage apparatus are placed in parallel between the first and third stages.

Third Stage

Continuing to FIG. 3, there is illustrated further separating apparatus which may be termed a "density separator." This device comprises an elongated cylinder 90 which is closed at its ends and contains a set of propeller-like blades 91 driven by a center shaft 92. This shaft extends through the end walls of the cylinder into bearing 93 and is driven as by a motor 94. Other than for an end entry portion receiving a continuation of the pipe 87 from the second stage, the cylinder 90 is eccentrically shrouded by a cylindrical case 95 with the longitudinal center of the cylinder being spaced beneath that of the case. A sediment depositing chamber 96 intersects the underside of the end of the cylinder which is opposite from its entry end and depends through the bottom of the case 95 to an exhaust line controlled by a valve 97. The mouth of the chamber 96 is covered by a screen 98.

The cylinder 90 has a row of overflow pipes 99 each of which has a downwardly directed frustro-conical baffle ring 100 at the top. Immediately below the level of these baffles 100 the case 95 is fitted with an external trough or gutter 101 which extends about half its length. This trough 101 communicates with the inside of the case 95 by screened openings 102. The ends of the trough are closed and it is provided with a drain line 103. In this regard, drain lines 104 with valves 105 are provided along the bottom of the case 95 and intersect a common drain pipe 106.

In the operation of the gravity separator, the blades 91 are turned slowly and function to accelerate the flow of material entering the cylinder 90 from the second stage via pipe 87. When the cylinder 90 is full the liquid rises up through the overflow pipes 99 and into the case 95 through the orifices 107 defined by the baffles 100. Since the floatage of the fibers is high they pass freely through the orifices 107 while any non-fiber material, because of its weight, partially deposited at the bottom of the cylinder 90 and partially rises up along the interior wall of the overflow pipes 99. The latter non-fiber material is prevented by the baffles 100 from rising out of the overflow pipes into the case 95 and eventually also deposits at the bottom of the cylinder 90. This non-fiber sediment is moved by the propeller action onto the screen 98 through which it drops into the sediment chamber 96 for discharge as determined by the valve 97.

Part of the liquid in the case 95 is filtered by the screens 102 below the level of the orifices 107 and discharges into the trough 101 from whence it is carried away by line 103. Since such filtering separates the fiber from the liquid, the density of the mixture of liquid and fiber in the case 95 gradually rises. This density is further adjusted by controlling the feed of fresh water through a line 108 into the bottom of the case by a valve 109.

When the refining of the slagwool fiber has thus been completed, the water and fiber mix, having been regulated to the desired fiber density, is discharged from the case 95 through selected branches 104 of the discharge pipe 106 as controlled by the valves 105.

From the third stage the fiber and water mix can be sent to a suitable forming machine by which the water is drained and the fibers made into mineral pulp or felt, or sent into a Fourdrinier machine and then dried to be made into mineral paper. These resulting products are of excellent quality and appearance (very white), and in fact the mineral paper can be as thin as 0.2 mm.

It is thought that the invention will have been clearly understood from the foregoing detailed description. Changes will suggest themselves and may be resorted to without departing from the spirit of the invention, wherefore it is my intention that no limitations be implied and that the hereto annexed claims be given a scope fully commensurate with the broadest interpretation to which the employed language admits.

What I claim is:

1. In a method for refining slagwool, dropping the slagwool across an air stream to remove non-fiber materials, immersing the slagwool conveyed by said air stream in a water bath and circulating the slagwool therein to remove further non-fiber materials which settle as sediment in said bath, drawing off water and slagwool from said bath above the sediment level therein and conveying

it to a second water bath, pulsating the water in said second bath to remove still further non-fiber materials which settle as sediment, drawing off the latter said sediment, and then conveying the remainder of said second bath to a collection point.

2. In a method for refining slagwool, brushing and air blasting the slagwool to remove non-fiber materials, immersing the slagwool in a first water bath and circulating it therein to remove further non-fiber materials as sediment, drawing off water and slagwool from said first bath above the sediment level therein and conveying it to a second water bath, agitating said second bath to remove further non-fiber materials which settle as sediment, drawing off the latter said sediment, conveying the remainder of said second bath to a third water bath filling a confined chamber, agitating said third bath and gently urging the water therein to flow upwardly with slagwool fibers slowly while blocking the passage of non-fiber materials heavier than said fibers, and separately collecting said non-fiber materials as sediment and said upwardly flowing fibers as a refined product.

3. In slagwool refining apparatus, an outer endless screen belt having its upper run travelling on an upward slope toward a slagwool discharge end, means for conveying raw slagwool to the lower end of said upper run, an inner solid endless belt travelling with said screen belt and spaced inwardly therefrom brush means turning between the upper runs of said belts in the same direction of travel as and faster than the belts, and arranged to agitate slagwool conveyed by the upper run of said screen belt to thereby free non-fiber material in said slagwool so that it will drop onto the upper run of said inner solid belt, said brush means also being arranged to contact said upper run of the inner belt and thereby work non-fiber material which has dropped thereon downwardly therealong to discharge from the lower end of the inner belt.

4. In slagwool refining apparatus, an upright closed tank having a bottom sediment collecting section separated from the tank proper by a screen means for introducing liquid to said tank and for maintaining a liquid level below the top of the tank and well above said screen, baffle means mounted in said tank to occupy a position in said liquid above said screen and spaced from the side walls of the tank, means for conveying slagwool into said tank above said liquid level, liquid spray means at the top of said tank directed downwardly, upwardly aimed nozzle means in said tank below said baffle means and supplied with pressurized liquid for directing such liquid toward the underside of the baffle means, and a fiber-liquid outlet from said tank closely above said screen.

5. The structure of claim 4 in which said baffle means comprises an upright conical baffle.

6. The structure of claim 5 in which said nozzle means comprises a spiral nozzle producing a spiral liquid discharge path directed toward the concave underside of said conical baffle.

7. The structure of claim 4 in which said tank has a top vent and said means for conveying slagwool comprises an air blast pipe leading into the top of the tank, a slagwool chute intersecting said air blast pipe, and blower means for forcing air through said air blast pipe toward said tank.

8. In slagwool refining apparatus, an elongated generally horizontal separating tank, means for conveying slag-wool liquid mix into the top of said tank, means for controlling the level of material in said tank, a cylindrical neck extension on one end of said tank below said level, a piston in said neck, means for reciprocating said piston to pulsate said mix in the tank and thereby separate non-fiber material from the slagwool fibers, screened non-fiber material outlet means at the extreme bottom of said tank, and fiber material outlet means in said tank above the level of said non-fiber outlet means.

9. The structure of claim 8 in which a sediment tank is located below said separating tank and is pipe connected to said non-fiber material outlet means, and in which such pipe connection has valve means for controlling flow from said separating tank to said sediment tank.

10. The structure of claim 8 in which a receiving tank is located below said separating tank and is pipe connected to said fiber material outlet means, and in which said pipe connection has valve means for controlling flow from said separating tank to said sediment tank.

11. The structure of claim 10 in which said receiving tank is elongated in the horizontal direction and has a valve controlled discharge pipe near one end and a cylindrical neck extension at the other end, a piston in said neck, and means for reciprocating said piston.

12. In slagwool refining apparatus, an elongated horizontal cylinder, a case shrouding most of the length of said cylinder and defining a collection chamber thereabout, a row of overflow pipes at the top of said cylinder opening into said collection chamber, each said overflow pipe having a baffle ring at the top for blocking non-fiber material and defining a respective fiber passing orifice, means for controlling the level of material in said collection chamber at about said orifices, a screened sediment chamber opening to the bottom of one end of said cylinder, a slagwool-liquid material inlet near the other end of said cylinder, bladed rotating means extending lengthwise of said cylinder for urging the material in the cylinder from said inlet toward said sediment chamber, and a valve controlled fiber-liquid discharge line from the bottom of said case.

13. In slagwool refining apparatus, an elongated horizontal cylinder having a slagwool-liquid inlet and a screened bottom sediment chamber, a case defining a collection chamber around a lengthwise portion of said cylinder, an overflow pipe projecting upwardly from said cylinder into said collection chamber, and an inverted frustro-conical ring in said pipe for blocking non-fiber material and defining a fiber passing orifice and means for withdrawing fiber-liquid from said collection chamber independently of said collection chamber.

14. The structure of claim 13 in which said case has a liquid overflow gutter communicating with said collection chamber by a screened opening, the top of said gutter being close to the level of said orifice.

15. The structure of claim 13 in which a bladed shaft is journal-mounted in said cylinder with its blades shaped and arranged to urge slag-wool liquid material in said cylinder up through said orifice.

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