June 19, 1956 N. AHLMANN 2,751,079

METHOD OF SCREENING

Filed Dec. 30, 1953 2 Sheets-Sheet 1

FIG. 1.

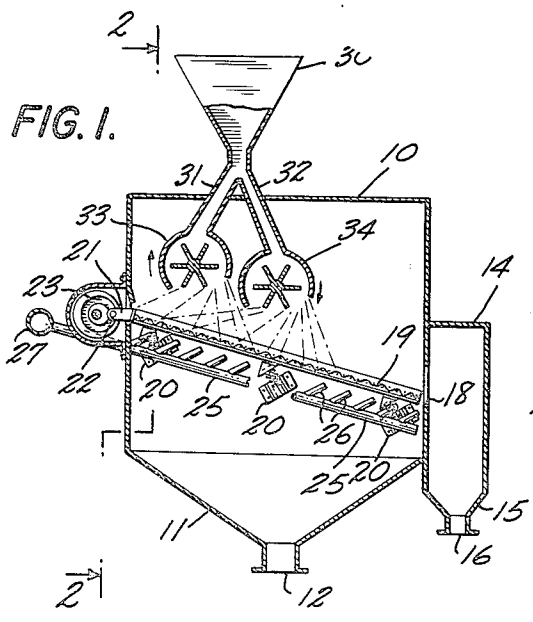
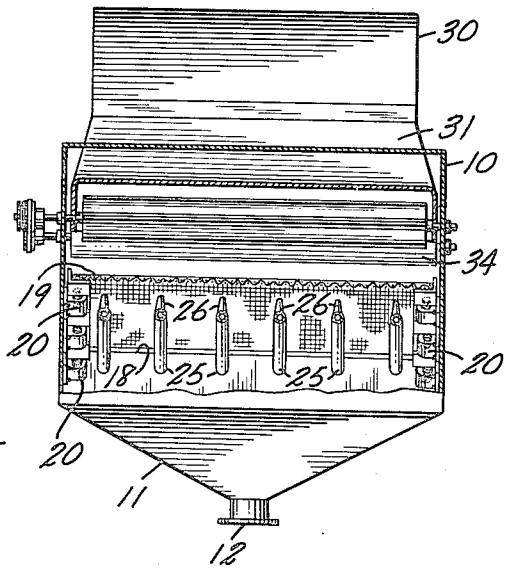


FIG. 2.



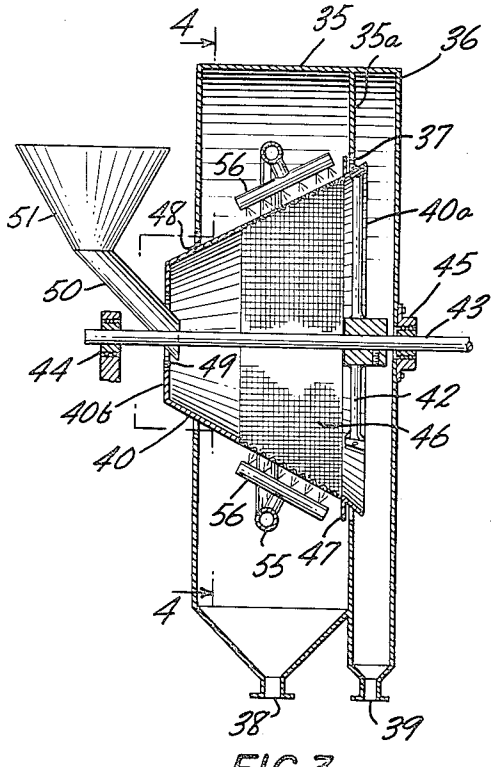
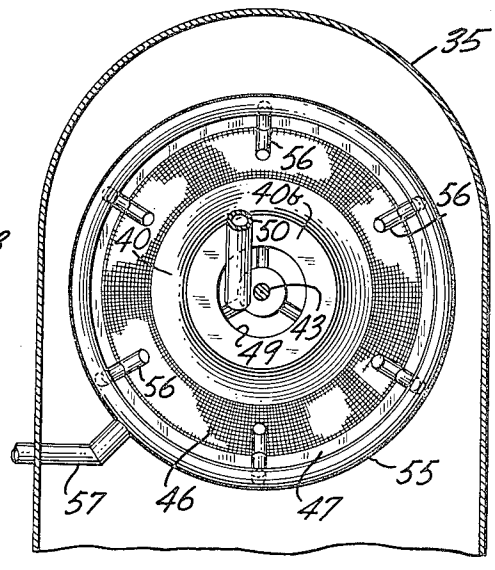


FIG. 3.

FIG. 4.



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METHOD OF SCREENING

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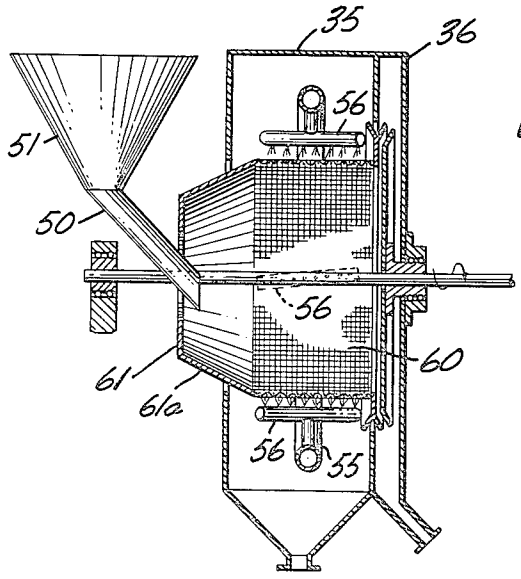
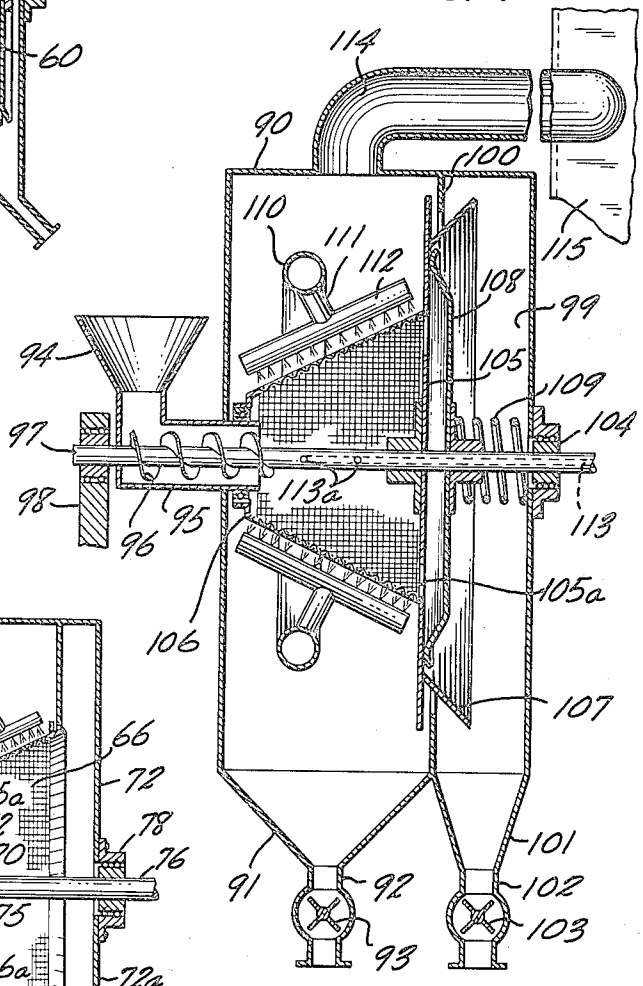


FIG. 5.

FIG. 7.



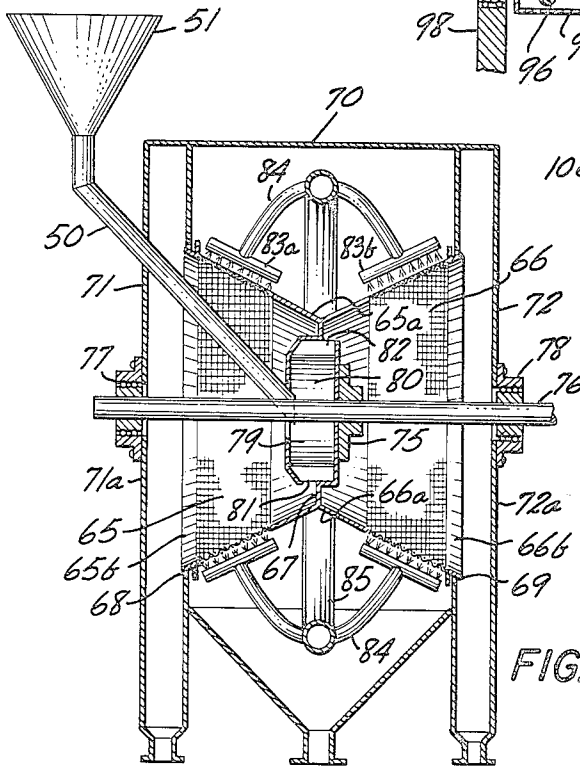


FIG. 6.

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United States Patent Office 2,751,079 Patented June 19, 1956

2,751,079

METHOD OF SCREENING

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Application December 30, 1953, Serial No. 401,266

Claims priority, application Denmark January 2, 1953

2 Claims. (Cl. 209—295)

This invention relates to the screening of fluent or dry material and is concerned more particularly with a method of screening, in which a gaseous medium under pressure is passed backwardly through the screen for the purpose of freeing the oversize material from the screen openings and thus facilitating the passage of the fines therethrough. The invention is also directed to novel apparatus, by which the method can be advantageously practiced.

Industrial screening operations are frequently carried on by means of vibrating or reciprocating flat screens or by means of rotary screens. In such screening apparatus, the material to be screened is kept in constant motion, so that the fines will pass through the screen meshes and the body of material is moved along the screen surface until all the fines have been removed therefrom. While the apparatus described is satisfactory for screening coarse material, such apparatus when provided with fine screens is subject to the objection that the constant sliding of the residual material on the screen causes heavy wear and also the capacity of the apparatus is low, because the passage of the fines through the small screen meshes is impeded by the residual material. Further, in such apparatus, the material is ordinarily subjected only to gravity and this keeps the capacity of the apparatus low.

For screening fine material, such as flour and pigments, apparatus has been used, which includes a stationary cylinder having its axis either horizontal or slightly inclined and formed in part of screen cloth. Within the cylinder is a central shaft carrying a stirrer which is rapidly rotated. The material to be screened is fed at one end of the cylinder and is advanced therethrough by the action of the stirrer, which throws the material against the screen. In such apparatus, the fines are thrown through the screen meshes under a force greater than gravity and the output is increased but the screen is subjected to heavy wear.

The present invention is directed to the provision of a novel method of screening, which can be carried on more rapidly than the methods practiced in prior equipment described above. In addition, the screen is protected during the practice of the method and the wear thereon is greatly reduced.

In accordance with the method of the invention, the material to be screened is caused to pass through the screen openings by the action of centrifugal force and, at the same time, a gaseous medium is passed through the screen in a direction opposite to the travel of the fines and acts to free the residual material from the screen. As a result, there is less wear on the screen and the screen meshes are kept from being clogged by oversize particles, so that the travel of the fines through the openings is at an increased rate.

In the practice of the new method, the material to be screened may be caused to advance along the screen by the fresh material being fed to the screen and, if desired, the fluid medium, which serves to cleanse the screen by freeing the residual material from the screen openings, may be directed against the screen in such a manner as to promote the travel of the material along it.

For a better understanding of the invention, reference may be had to the accompanying drawings, in which:

Fig. 1 is a vertical cross-sectional view of one form of the new screening apparatus;

Fig. 2 is a sectional view on line 2—2 of Fig. 1;

Fig. 3 is a vertical cross-sectional view of another form of the new screening apparatus;

Fig. 4 is a sectional view on line 4—4 of Fig. 3;

Figs. 5 and 6 are vertical cross-sectional views of two modifications of the apparatus shown in Figs. 3 and 4; and

Fig. 7 is a vertical cross-sectional view of another form of the new screening apparatus.

The new screening apparatus in the form shown in Figs. 1 and 2 includes a housing **10** having a hopper bottom **11** with an outlet **12**, through which the fines produced in the screening operation may be removed. A chamber **14** having a hopper bottom **15** and an outlet **16**, is mounted on a side wall of the housing in position to receive the oversize from the screening operation through opening **18**.

An inclined screen **19** is mounted within the housing **10** upon spring bearing supports **20** secured to the side wall of the housing. The lower end of the screen is adjacent the opening **18** leading to chamber **14** and the upper end of the screen is connected by links **21** with an eccentric pin **22** on a disc **23** carried by a shaft which may be driven by any suitable means.

A plurality of conduits **25** extend lengthwise beneath the screen **19** in parallel relation, and a series of nozzles **26** are connected along the lengths of the conduits. The nozzles **26** point generally towards the screen **19**, and are inclined towards the lower end thereof. The upper ends of the conduits extend through openings in the housing side wall and are connected to a header **27** which in turn connects with a reservoir for pressure gaseous medium which is ordinarily air. The finely divided material, such as cement raw material, for example, is supplied from a hopper **30** mounted above the housing **10** and connected by chutes **31** and **32** with rotary distributors **33** and **34**, respectively, which discharge the material upon the surface of the screen **19**.

In the operation of the device described, the jets of air flowing from the nozzles **26** pass through the screen and free the unscreened material from the screen in direct alignment with the jets but, elsewhere, the air passing through the screen does not prevent the fine particles from falling through the screen openings. The nozzles are so formed that the jets assist in moving the residual material toward the lower end of the screen, whence it passes through opening **18** into the chamber **14**.

The apparatus of Figs. 3 and 4 includes a housing **35** and a discharge chamber **36** having a common side wall **35***a* with an opening **37** formed therein. The housing and chamber have hopper bottoms with outlets **38** and **39**, through which the separated material and residue may be respectively removed.

A truncated cone structure **40** is supported by a spider **42** upon a horizontal shaft **43** rotatably mounted in bearings **44** and **45**. The cone structure is formed of an imperforate material except for a circumferential section which is formed of fine mesh screening material **46**. The enlarged open end **40***a* of the cone extends through opening **37** in partition **35***a*, and a circumferential flange **47** on the structure adjacent the partition prevents the fines from entering the chamber **36**. The opposite end **40***b* of the structure extends through an opening **48** in the housing side wall and has an opening **49**, through which a chute **50** leading from the supply hopper **51**, may be inserted. The cone shaft supporting the structure **40** may be rotated by suitable driving means.

A circular header **55** extends about the screen **46** within the housing **35**, and pipes **56** extending generally parallel

to the circumferential surface of the screen and spaced a short distance therefrom, are connected at intervals along the header. Air under pressure is supplied to the header by supply line **57**, and flows through orifices formed along the length of the pipes **57** towards the screen.

When the structure **40** is rotated, the unscreened material is fed into its interior from hopper **51** through the chute **50**. A component of the centrifugal force generated by the rotation of the cone assists in moving the material towards the discharge opening **37** and the residual material is also urged in this direction by the fresh material entering the structure. The part of the cone structure **40** first coming in contact with the material, as it is fed through the chute **50**, is a smooth, solid surface, on which the material may be distributed uniformly before it comes in contact with the screen. The air jets free the material from contact with the screen in those areas in direct alignment with the jets, but, elsewhere, the fine particles can pass through the screen, even though some air from the jets is passing in the opposite direction. As the fine particles pass through the screen **46** they are collected in the hopper bottom of the housing, while the residue passes through the opening **57** into chamber **36**.

The modified form of the apparatus shown in Fig. 5 differs from that shown in Figs. 3 and 4 in that the screen **60** is of cylindrical shape and the screen supporting structure **61** has a tapered end section **61***a*. Also the nozzle pipes **56** are placed at an angle to the axis of the screen. As the material from the hopper **51** is fed through chute **50** into the interior of the screen supporting structure, it falls upon the interior of the end section **61***a* and is distributed by centrifugal force evenly about the interior of the end section before it reaches the cylindrical screen **60**. Thus, as the screen is rotated in the direction indicated by the arrow, a component of force in the direction of the chamber **36** is imparted to the residual material by the air jets. If desired, the nozzle openings may be so formed that the jets point toward the screen surface at an angle and assist in advancing the material.

The modification shown in Fig. 6 includes two truncated cone screen structures **65** and **66** mounted in axial alignment with their ends **65***a*, **66***a* of smaller diameter separated by a common partition **67**. The opposite open ends **65***b*, **66***b* of the cone structures extend through openings **68**, **69** in opposite side walls of a housing **70**, which communicate with discharge chambers **71** and **72**, respectively. The cone structures **65** and **66** are supported by a hub **75** on a horizontal shaft **76** supported by bearings **77** and **78** secured to the outer walls **71***a* and **72***a* of the discharge chambers. An annular chamber **79** is mounted against one face of hub **75** and is secured to the common partition **67**, and the chamber is divided into a plurality of compartments by radial partitions **80**. Alternate compartments communicate with the interior of cone structure **65** through openings **81** in one wall of chamber **79**, while the remaining compartments communicate with the other cone structure **66** through openings **82**. Air jet pipes **83***a* and **83***b* are equally spaced about the respective screens and disposed parallel thereto, and are connected by conduits **84** with a header **85**. The header extends about the smaller ends of the cone structures and is connected with a fluid pressure reservoir.

In the apparatus of Fig. 6, the material from the hopper **51** is fed into the annular chamber **79** through chute **50** and, as the shaft is rotated, the material is evenly fed to the interior of the two cones. The material is moved by centrifugal force towards openings **68** and **69** communicating with the respective discharge chambers **71** and **72**, and, at the same time, the fine particles pass through the screens and are collected in the hopper bottom of housing **70**. The function of the air jets is the same as previously described.

The form of the new screening apparatus shown in Fig. 7 includes a housing **90** having a hopper bottom **91** with an outlet **92** controlled by a rotary valve **93**. The material to be screened is fed from a hopper **94** into the casing **95** of a screw **96** mounted on a shaft **97**. The shaft is rotated in bearings, one of which is carried by a standard **98**.

A discharge chamber **99** is formed to have a wall **100** in common with the housing **90** and the chamber has a hopper bottom **101** having an outlet **102** with a rotary valve **103**. The shaft **97** extends through the chambers and is provided with a second bearing **104** in the outer wall of chamber **99**. A circular disc **105** mounted on shaft **97** within housing **90** supports the large end of a screen **106** of truncated conical form, having its small end supported on a bearing encircling casing **95**. The disc **105** is provided with openings **105***a* therethrough and lies opposite an opening in the wall **100**. The disc carries a baffle **107**, which extends through the opening in the wall. A disc **108** mounted loosely on shaft **97** is urged to engage disc **105** outwardly from openings **105***a* by a spring **109** seated at one end against disc **108** and at the other end against the outer wall of chamber **99**.

A header **110** supplied with air under pressure from a suitable source, encircles the screen within housing **90** and is provided with a plurality of branches **111** leading to pipes **112**, which lie parallel to generatrices of the screen and are provided with a plurality of nozzle openings. The shaft **97** has a passage **113** supplied with air under pressure and leading from one end to outlets within the screen and an air exhaust duct **114** leads from housing **90** and may be connected to the inlet of a dust collector or cyclone separator, indicated generally at **115**.

With the construction described, the screen is closed at one end by the material in casing **95** forming a seal and, at the other end, by disc **108** forced against disc **105** by spring **109**. The material distributed over the interior of the screen is acted on by centrifugal force and also by air under pressure supplied through the shaft passage **113**; the pressure within the screen being greater than the pressure surrounding the screen within the housing **90**. The layer of material on the screen is freed therefrom by the action of the jets issuing from the nozzle openings in pipe **112**. As the oversize material accumulates in the space between discs **105** and **108**, disc **108** is forced backwardly against the action of a spring, and the material escapes from between the discs and falls into the hopper bottom of the discharge chamber. The excess air supplied through pipes **112** and passage **113** is led off through duct **114** and any dust entrained therewith is removed by means of the collector or separator **115**.

In the practice of the method in all forms of the apparatus described above, a gaseous medium under pressure, in the form of jet streams, is passed through the screen openings from the side thereof opposite from that on which the material is distributed. The material is freed from the screen at points in line with the axis of each fluid jet, and the location of the points in the material is constantly changing as the screen is moved relative to the jets. As a result, the layer of material covering the entire surface of the moving screen is subjected to a pulsating action, in which the particles in the layer directly in front of the jets are momentarily dislodged and are returned to the screen upon passing beyond the jets. The dislodgement of the particles from the screen occurs because the jets strike the particles with an impact great enough to overcome the centrifugal force holding the particles on the screen. The particles return at once to the screen after passing beyond the jets because, at the time they are freed from the screen by the jets, the particles are traveling along circular paths with the screen and such movement causes the particles to be acted on by centrifugal force. Although the particles are dislodged from the screen by jet action, their movement along circular paths continues and they pass beyond the jets and to points, where centrifugal force is acting on the particles and there is no opposing force, such as that of the jets. The unopposed centrifugal force quickly restores

the particles to the screen and, as they move back, a rearrangement of the particles over the screen openings occurs and fine particles pass through the openings before the coarse particles block the openings. The dislodgement of the particles from the screen and their rapid return to the screen occur at each row of jets and constitute the pulsating action of the layer relative to the screen, which enables the fine particles to pass through the screen openings at a rapid rate and makes it possible to screen the material with little wear on the screen, even though the meshes are extremely fine. In order to obtain the pulsating action, it is necessary to coordinate the surface speed of the screen and the pressure of the jets, so that the material supplied to the screen will form a continuous layer covering the entire inner surface of the screen and the jets will be able to overcome the centrifugal force acting on the particles on the screen and free the particles from the screen without moving the particles so far from the screen that they will not return to the screen and form a layer again before the particles pass beneath the next set of jets. In addition to hastening the screening action by creating the pulsations of the layer as described, the jets may be so directed against the screen that a component of the force exerted by the gaseous jets may be utilized to move the residual material across the screen surface towards the point of discharge. The use of the jets in this manner further reduces the wear on the screen, since the material is advanced by the jets toward the discharge while the material is free of the screen.

It goes without saying that the axis of the rotating screen structure may be arranged vertically or obliquely instead of horizontally.

I claim:

1. A method of screening material by means of a rotary screen having the shape of a surface of revolution, which comprises depositing the material on the inner surface of the screen at one end to form a layer covering the entire screen surface, rotating the screen at a speed sufficient to hold the layer against the screen by centrifugal force, advancing the material in the layer along the screen toward the other end, and causing the layer of material to pulsate relative to the screen by directing air under pressure in a plurality of rows of jets spaced throughout the circumference of the screen against the outer surface of the screen, the air pressure and the speed of rotation of the screen being such that the jets overcome the centrifugal force acting on the layer and momentarily free from the screen the portions of the material struck by the jets, the centrifugal force immediately returning such portions of the material to the screen after the portions of the material have passed the jets.

2. The method of claim 1, in which the jets of air are so directed against the screen that they assist in advancing the material in the layer along the screen.

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