Nov. 1, 1966 R. D. MITCHELL 3,282,424

SCREEN CLEARERS FOR GRAIN CLEANING APPARATUS

Original Filed Nov. 22, 1961 5 Sheets-Sheet 1

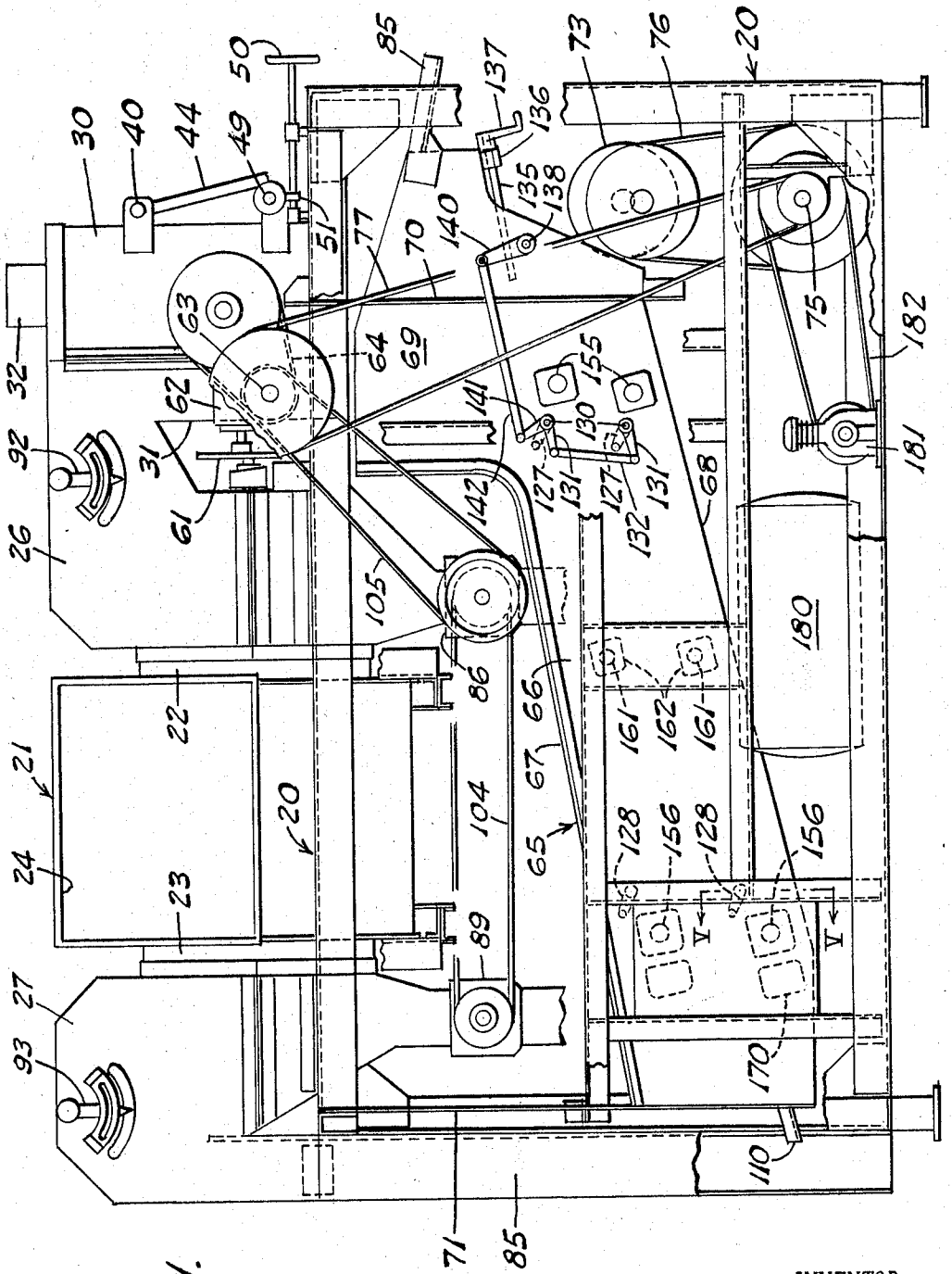


FIG. 1.

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SCREEN CLEARERS FOR GRAIN CLEANING APPARATUS

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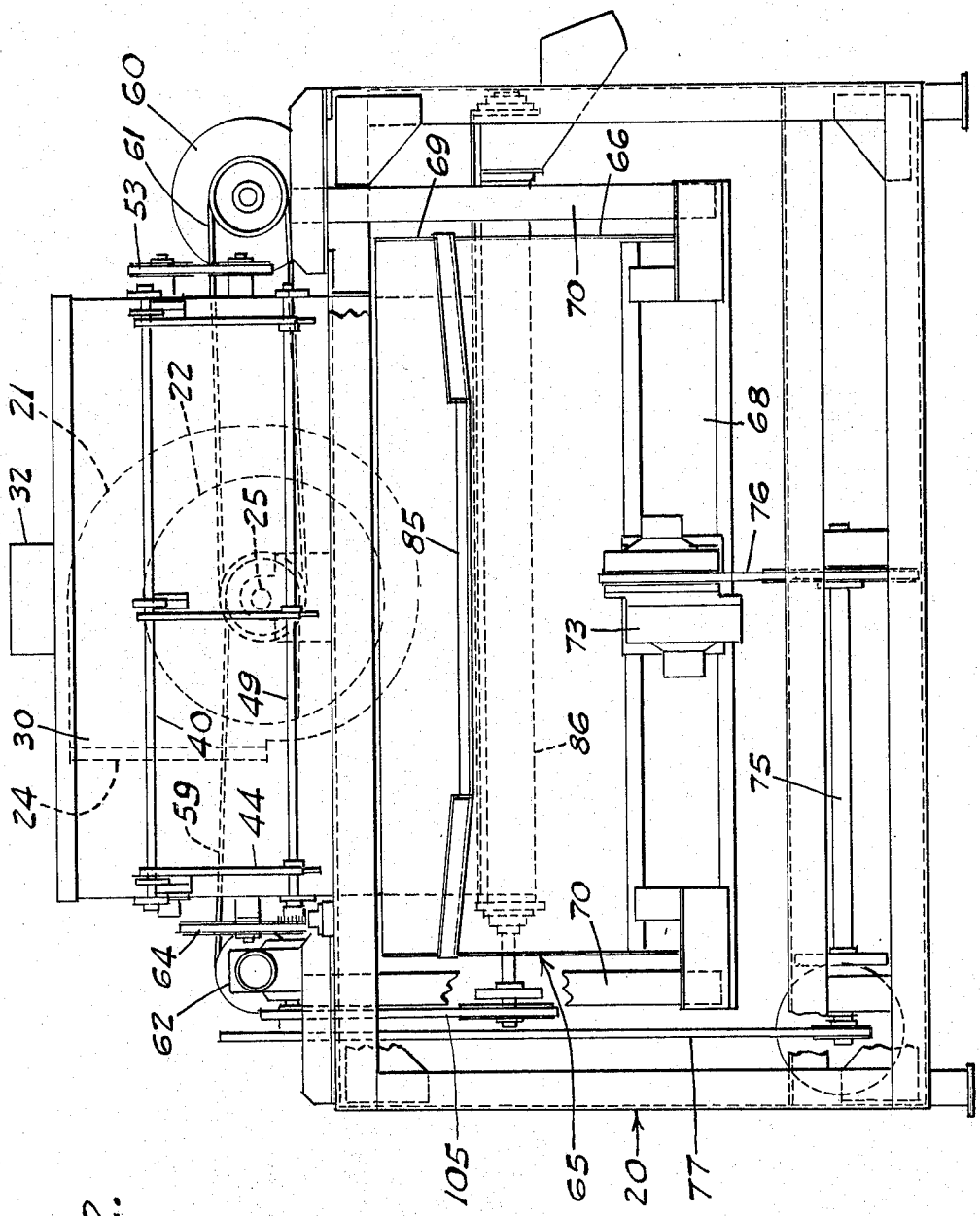


FIG. 2.

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SCREEN CLEARERS FOR GRAIN CLEANING APPARATUS

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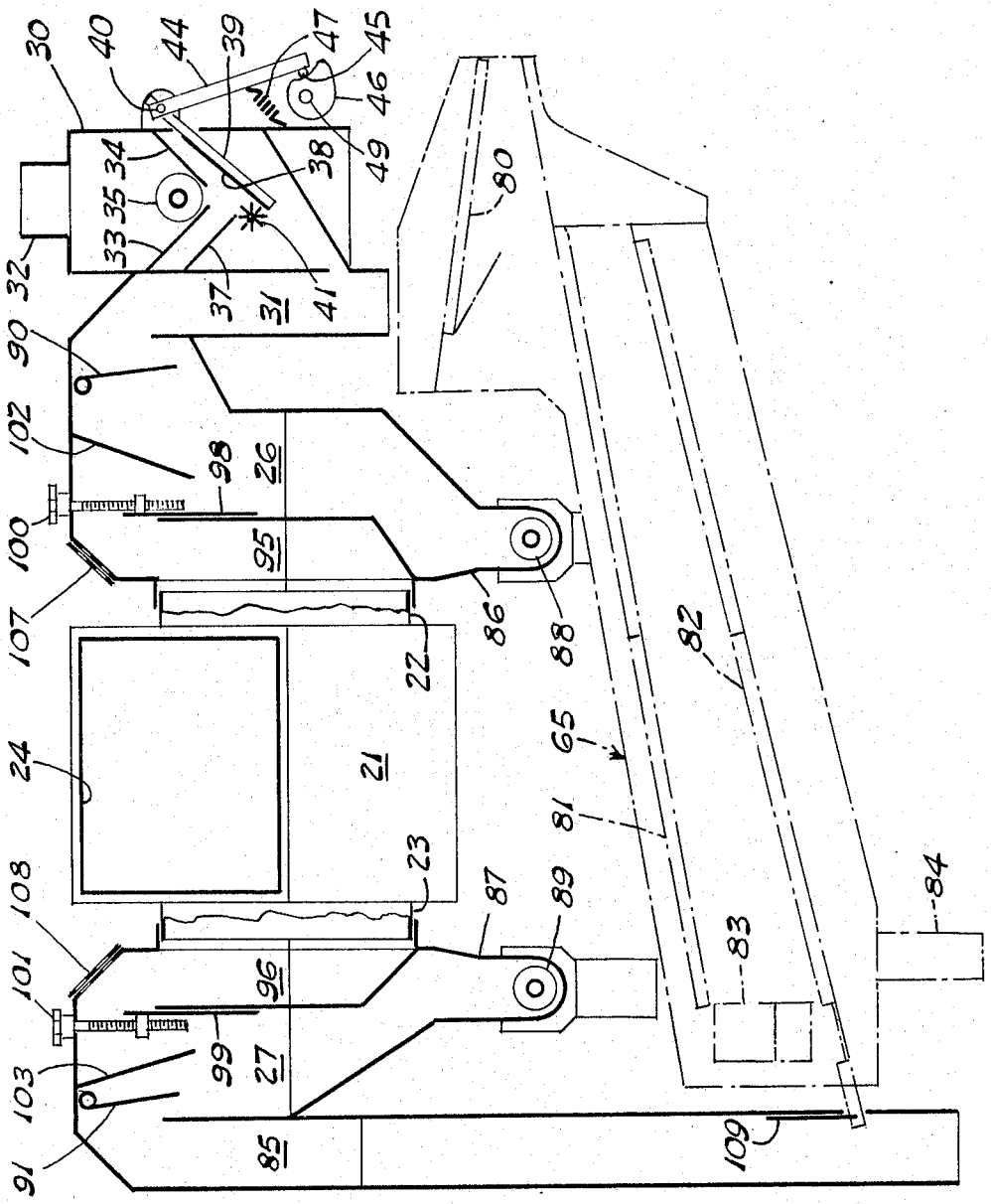


FIG. 3.

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SCREEN CLEARERS FOR GRAIN CLEANING APPARATUS

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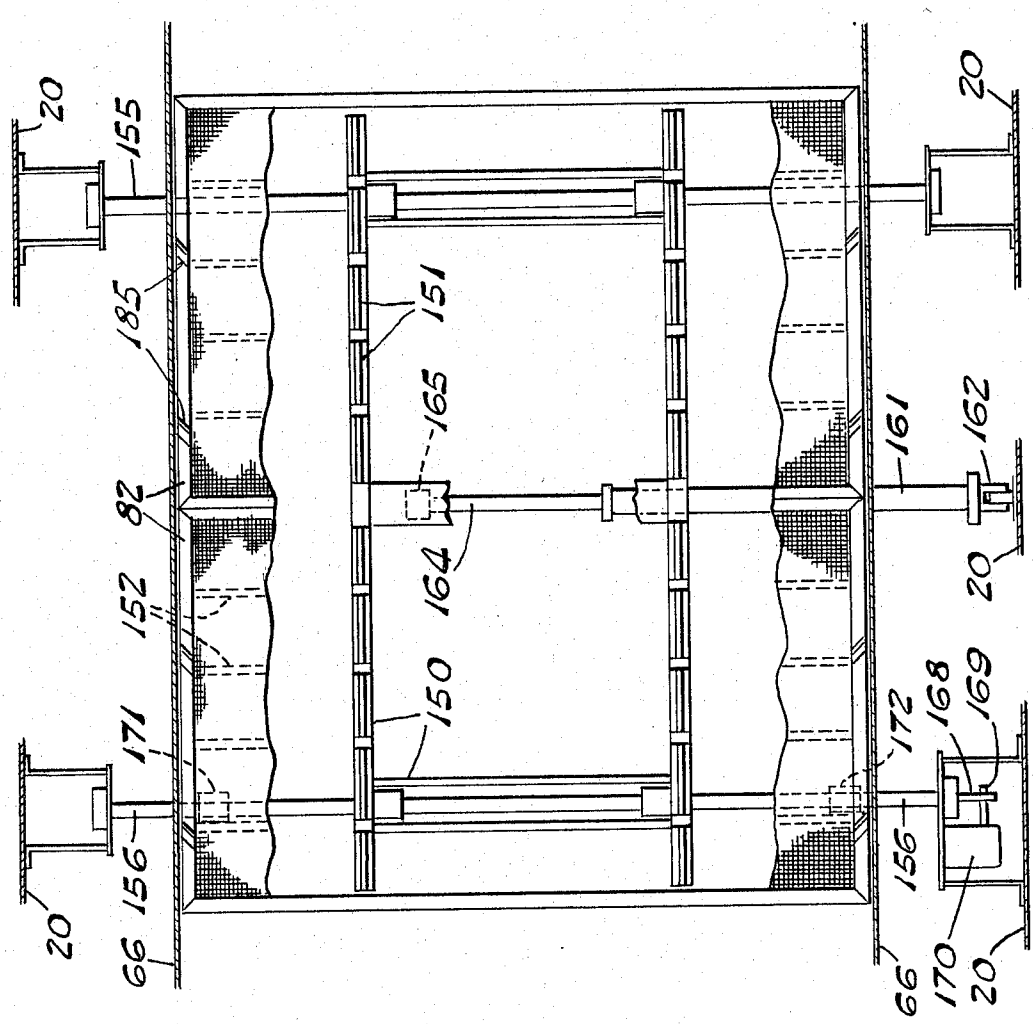


FIG. 4.

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SCREEN CLEARERS FOR GRAIN CLEANING APPARATUS

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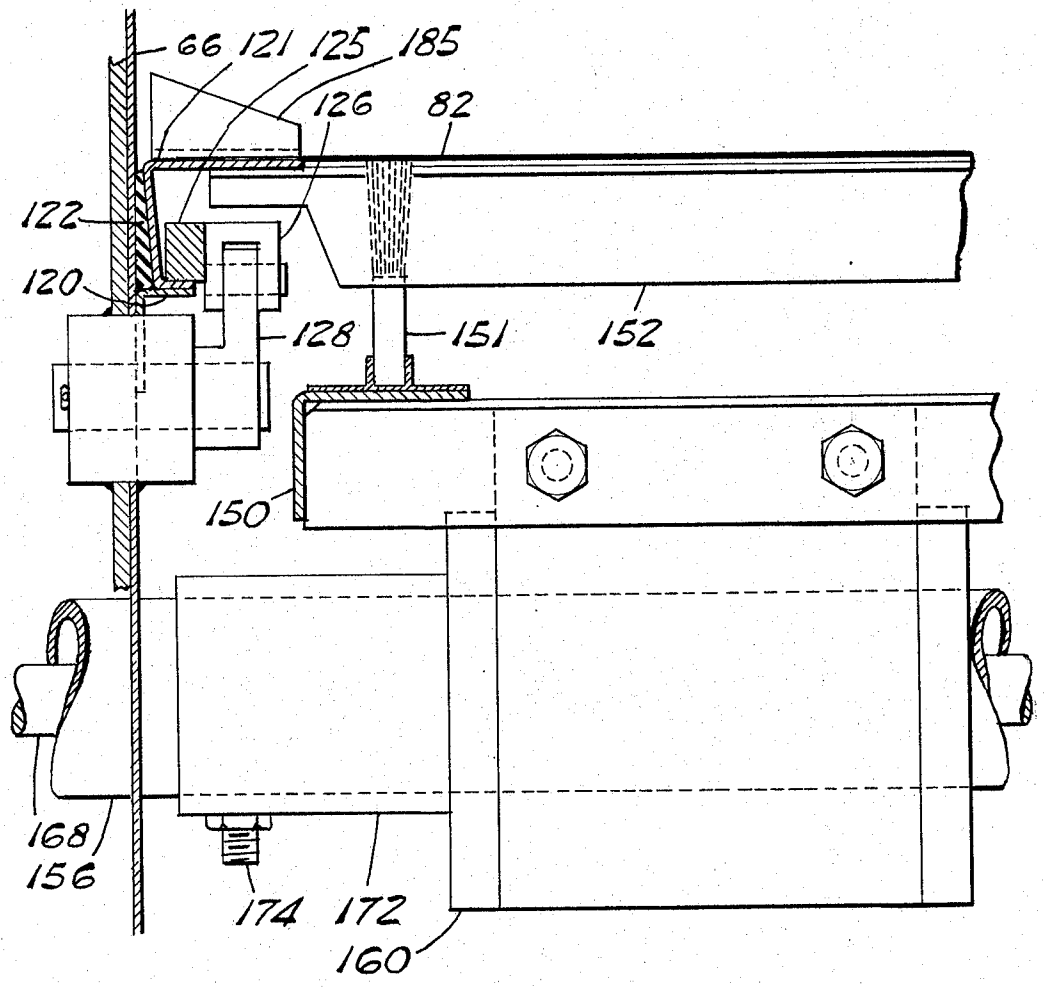


FIG. 5.

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United States Patent Office 3,282,424 Patented Nov. 1, 1966

3,282,424

SCREEN CLEARERS FOR GRAIN CLEANING APPARATUS

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Original application Nov. 22, 1961, Ser. No. 154,245. Divided and this application Apr. 29, 1965, Ser. No. 461,221

2 Claims. (Cl. 209—388)

This application is a division of my co-pending application, Serial No. 154,245 filed November 11, 1961, now abandoned.

This invention relates to apparatus for cleaning dry granular material by removing therefrom various undesirable material. For instance, the apparatus may be usefully employed in cleaning cereal grain by separating therefrom dust, chaff, seeds, undersize grain, dirt, and other foreign matter.

The appartus of the present invention, speaking generally, employes several superposed vibratory classifying screens in conjunction with air currents for carrying off chaff and other light undesired particles and material. The use of this general arrangement for cleaning grain is well known and the present invention is directed, among other things, to an improved general arrangement and cooperation of several of the functional components of grain cleaning apparatus of the general type indicated above.

While this application discloses and discusses the improvements of the present invention particularly with reference to cleaning apparatus for cereal grain, certain of the novel principles and teachings of the invention are applicable to apparatus for grading and separating other dry granular material according to different types and sizes and are also applied to combined apparatus for both grading and cleaning the grain or other dry granular material.

Due to the employment of vibratory screens for separating good clean grain from various undesirable materials, which screens are caused to reciprocate rapidly in a generally longitudinal direction, highly undesirable but generally unavoidable vibration of the entire machine structure is a commonplace. The means for vibrating the screens reacts against the machine framework and thus vibrates the entire grain cleaner structure to a very marked degree. The reactionary vibration of the machine frame appears to manifest itself as an oscillatory movement about a generally horizontal transverse axis.

It is conventional in the prior art in apparatus of this general type to provide reciprocating brushes beneath the screen to keep the screens clear and unclogged. The present apparatus provides novel fluid pressure actuated brush drive means which avoids the usual necessity for mechanical driving connections between the brush elements and the general framework of the machine.

The low pressure pneumatic power system for reciprocating the brushes is also superior to the positive mechanical drive means employed in the prior art for the reason that overloading or blockage of the screens that prevents the reciprocation of the brushes will not cause mechanical breakdown owing to the yieldability of the drive. The compressible fluid drive medium permits the brushes to stop without damage and start against when the obstacle is cleared.

Other objects and advantages of the grain cleaner apparatus of the present invention will become apparent to those skilled in this art from a study of the exemplary form hereinafter set forth. However, while a particular embodiment is illustrated in the accompanying drawings and is described in detail in the following specification, it is to be understood that such embodiment is by way of

example only and that the principles of the invention may be variously applied and employed. The spirit and scope of the invention is not to be considered as limited to the form set forth herein by way of example nor otherwise than as defined in the appended claims.

In the drawings:

FIG. 1 is a general side elevational view of one form of the grain cleaner apparatus of the present invention;

FIG. 2 is an end elevational view of the apparatus of FIG. 1 viewed from the right hand end of FIG. 1;

FIG. 3 is a schematic view taken similarly to FIG. 1 showing the air flow passages and other portions of the apparatus diagrammatically;

FIG. 4 is a fragmentary top plan view of a portion of the screen and screen housing structure of the apparatus of FIGS. 1 and 2, partly in cross-section; and

FIG. 5 is a fragmentary cross-sectional view taken generally as indicated by the line V—V of FIG. 1 but on a larger scale.

Like characters of reference denote like parts throughout the several figures of the drawings. In the exemplary embodiment of the invention set forth herein to illustrate the various novel principles and features of the invention a rigid framework of horizontal and vertical structural members designated generally by the numeral **20** supports the various operating components of the machine in their proper relative positions.

In general the upper portion of the machine includes a feed box or entry arrangement for the grain to be cleaned and a blower or fan with appropriate duct work for connecting the suction side thereof to take up relatively light undesired matter from the grain being cleaned. This upper portion is shown schematically in FIG. 3. The lower portion of the machine is given over principally to a so-called screen deck which comprises a series of slightly inclined superposed vibratory or reciprocatory screens with brush means for maintaining the screens clear and effective to accomplish their screening functions. The screen deck structure and the brushing mechanism are illustrated mainly in FIGS. 4 and 5.

Mounted generally centrally of the upper portion of the machine is a centrifugal fan or blower designated generally by the numeral **21** and having its axis of rotation extending lengthwise of the machine, that is, from the feed end to the delivery end. Blower **21** has two axial inlet ports designated **22** and **23** which are directed. respectively, toward the head or feed end of the machine and toward the tail or delivery end.

Blower **21** discharges laterally, as at **24**, air which in normal operation has picked up and subsequently discharged chaff, light dirt and dust and other foreign matter which it draws from the grain and is separated from in a manner which will presently appear. The rotor shaft of fan or blower **21** is shown at **25** in FIG. 2.

As will be noted from a consideration of FIGS. 1 and 3, blower inlet port **22** communicates with a head chamber **26** and blower inlet port **23** communicates with a tail chamber **27**. Mounted alongside of the head chamber **26** at the extreme right hand side of the machine as viewed in FIG. 1 is a feed box **30** into which the grain to be cleaned is deposited.

As schematically indicated in FIG. 3 the hoods which form the head and tail chambers **26** and **27** are separable from the underlying duct structure generally along a horizontal plane through the axis of blower rotor shaft **25**. Thus removal of the head and tail chamber hoods exposes the air passage duct portions for ready access for cleaning or other purposes.

Referring to the schematic view, FIG. 3, a desired flow of grain from feed box **30** passes into the lower portion of a vertical duct or suction leg **31** which leads upwardly to the head chamber **26**, the grain dropping to the head

end of a screen deck or housing shown generally in FIGS. 1 and 3.

The feed box **30** and the means for controlling the rate of grain feed therefrom are best shown in FIG. 3 wherein the numeral **32** designates an entry or filler duct and the numerals **33** and **34** designate a pair of inclined wall members which converge downwardly to form a restricted grain passageway.

A helical screw conveyor distributor member **35** is disposed in the apex formed by the wall members **33** and **34** and the helical formations thereof are of opposite hand in both directions outwardly from the center of the screw membed toward its ends. Accordingly, grain flowing downwardly to the screw member **35** is distributed outwardly toward the opposite ends of the trough formed by the wall members **33** and **34** so that the grain is more or less uniformly distributed along the feed box **30** which is elongated in a direction perpendicular to FIG. 3.

From the aforesaid trough the grain falls to a further pair of inclined trough-forming wall members **37** and **38**, the former of which is fixed within the feed box **30** and the latter of which is attached to several arms **39** which are fixed to an adjusting rock-shaft **40** mounted in bearings at the outside of feed box **30**. A feed wheel **41** is mounted in the trough formed by the wall members **37** and **38** and is provided with vanes which extend therealong in an axial direction whereby grain is fed downwardly through the trough by rotation of feed wheel **41**.

Means are provided for regulating the rate of feed of the grain independently of the speed of rotation of the feed wheel **41** by moving the adjacent portion of the wall member **38** toward and away from feed wheel **41** to reduce or enlarge the passageway. It will be noted from FIG. 3 that rockshaft **40** is provided with control arms **44** which terminate in cam followers **45** which engage adjustable control cams **46**. Extension coil springs **47** hold followers **45** in engagement with cams **46**.

The springs **47** also provide a yieldable means for urging the movable wall member **38** toward the fixed wall member **37**. Thus when unusually large pieces of material must pass between these wall members the wall member **38** may move resiliently away from wall member **37** to permit such passage, by rotation of feed wheel **41**, without damage to the plates or associated mechanism. After the large piece has passed between the wall members the spring **47** will return wall member **38** to its adjusted position.

Cams **46** are fixed to a camshaft **48** and a handwheel **50**, shown in FIG. 1, regulates the angular positions of cams **46** by way of a worm and wheel connection with camshaft **49** as at **51**. The distributing screw member **35** and the feed wheel **41** are belt connected as shown at **53** in FIG. 2 for rotation in the same direction at approximately the same speed, the screw member **35** being driven from feed wheel **41** as will later appear.

As shown in FIG. 2, an electric driving motor **60** mounted on the top of framework **20** is belt connected as at **61** to the rotor shaft **25** of blower **21** to drive the same. A further belt connection **59** from shaft **25** extends to a speed reducing gear unit **62** having an output shaft **63** and feed wheel **41** is belt connected to the latter as indicated at **64** in FIGS. 1 and 2.

Reference will now be had to the screendeck structure, a housing for which is indicated generally by the reference numeral **65** in FIG. 1 and further details of which are shown more particularly in FIGS. 4 and 5.

Referring to FIG. 1, the screen deck structure comprises generally a housing having side walls **66** and top and bottom walls **67** and **68**. The side walls **66** extend generally longitudinally and in a downwardly inclining direction toward the tail end of the machine, the left hand end as viewed in FIG. 1. At the right hand end the housing is enlarged upwardly as clearly shown at **69** in FIG. 1, thus forming a receiving chute for material falling from the feed box **30**.

The screen housing is suspended for reciprocatory movement in a generally left-to-right horizontal direction as viewed in FIG. 1 by pairs of fore and aft flexible steel straps designated **70** and **71**, respectively, which straps are attached to the machine framework at their upper ends and to the screen housing structure at their lower ends. The screen housing structure is adapted to be rapidly reciprocated for effective vibratory screening action by a conventional eccentric drive mechanism designated **73** in FIG. 1. A typical drive of this type, known in the art as a Buhler drive, is shown in Roth Patent No. 1,517,587.

In the present instance the eccentric drive mechanism **73** is driven from a countershaft **75** by a belt connection **76** and the countershaft **75** is driven from the output shaft **63** of speed reducer **62** by a belt connection **77**.

Supported between the side walls **66** of the screen housing structure are a series of three superposed screens including a relatively short scalper screen **80**, shown in dot and dash lines in FIG. 3, which is positioned in the upwardly extending right hand portion **69** of the screen housing and inclines downwardly to the right as viewed in FIGS. 1 and 3. The remaining two screens, one above the other, are designated **81** and **82** and inclined downwardly to the left as viewed in FIG. 1. The upper screen **81** is generally called the main screen and the lower screen **82** is called the sand or seed screen. Each of these screens in the present instance comprises two screen units in edge to edge relation, as will later appear.

The scalper screen **80** receives the grain falling from the feed box **30** by way of the suction leg **31** and since the scalper screen is of relatively coarse mesh it passes all excepting the larger pieces of foreign matter or debris, the latter being discharged from the machine by way of a chute designated **85** in FIG. 1.

The main screen **81** is of such mesh as to pass good grain but hold thereon all undesired matter larger than the good grain. The lowermost screen **82** which finally receives the grain through the main screen is of relatively fine mesh and merely passes sand, seeds and similar fine impurities which are generally of smaller particle size than the good clean grain. Foreign matter held on main screen **81** discharges through a chute **83** and fines falling through screen **82** to bottom pan or wall **68** pass out of the machine through a duct **84**.

The screen deck structure is the subject of further novelty as to the means and method of mounting and releasably securing the screen elements therein and as to the means provided for brushing the bottoms of the screens to maintain the same clear and unclogged for performing their screening functions. Further details of the screen structure will be described later herein, following a description and discussion of the general structure and operation of the grain cleaner generally. In this connection reference will now be had to the diagrammatic view, FIG. 3, which presents the grain cleaner as viewed in FIG. 1 but in schematic form.

The feed box **30** and its adjuncts and the suction leg **31** adjacent thereto have been previously described, as has the blower **21** and its two inlet ports **22** and **23** and its discharge duct **24**. It will be noted from FIG. 3 that good grain from the lower end of the final screen **82** discharges into the lower end of a vertical duct **85** called herein the tail air suction leg. It will be noted also that the head and tail suction legs **31** and **85** discharge at their upper ends into the head and tail chambers **26** and **27**, respectively.

To promote precipitation of chaff and other light materials from the air passing from the suction legs **31** and **85** through the head and tail chambers **26** and **27** and to the blower **21** the head and tail chambers are each provided with a series of baffles which cause the air to pursue a tortuous expanding path through the head and tail chambers. This expansion of the area of the flow path in the direction of flow reduces the velocity of the air whereby solid particles entrained therein fall into hoppers **86** and

87 at the lower ends of these chambers, from whence it is moved laterally from the machine by means of a pair of conveyor screws 88 and 89, respectively.

Referring to the head chamber 26, a pivoted damper plate 90 regulates the passage area between the suction leg 31 and chamber 26. A similarly located pivoted damper plate 91 is provided in the tail chamber 27 to regulate the flow area between tail suction leg 85 and chamber 27 and manual adjusting control means for the damper plates 90 and 91 are provided externally of the machine as shown at 92 and 93, respectively, in FIG. 1.

Air passing into the blower inlets 22 and 23 from the head and tail chambers goes by way of fan or blower inlet chambers designated 95 and 96, respectively, which communicate at their upper ends with the head and tail chambers, such communication being under the control of slide dampers 98 and 99, respectively, which are regulated vertically by screw mechanism designated 100 and 101, respectively.

It is desired that air entering the head and tail chambers flow downwardly (thence upwardly to the blower inlet chambers, to further promote precipitation of solid matter entrained in the air. Accordingly the head and tail chambers are provided with fixed baffles designated 102 and 103, respectively, which extend downwardly from the upper ends of these chambers medially between their entry and discharge sides.

It will be noted that air passes upwardly through the scalper screen 80 to suction leg 31 to entrain chaff, dust and other light impurities from the grain as it enters the screen structure. Again at the discharge end, the screened grain falls into the tail suction leg wherein air is passing upwardly to the blower to entrain chaff and other relatively light material which has not been previously separated or which was removed from the grain in the course of the cleaning and screening process.

As shown in FIG. 1, the chaff hopper screw conveyors 88 and 89 are connected for joint rotation by a belt 104, the conveyor screw 88 being driven from the output shaft 63 of speed reducer 62 by a belt connection 105.

The effective suction at the head and tail ends of the machine may be independently regulated by means of a pair of sliding valve plates 107 and 108 located against upper wall portions of the blower inlet chambers 95 and 96, respectively. The valve plates 107 and 108 and the underlying wall portions of the inlet chambers each have a multiplicity of perforations, as indicated in FIG. 3, and the inlet chambers may thus be selectively vented to atmosphere in varying degrees by reason of the fact that the perforations of the valve plates are in registry with the underlying perforations in the inlet chamber walls in greater or less degree, according to the horizontal positions of adjustment of the valve plates. The valve plates 107 and 108 may be entirely closed by moving the plates so that the respective perforations of the plates and the wall portions are entirely out of registry.

Flow of good grain from screen 82 into tail leg 85 by way of a chute 110 may be controlled or arrested as desired by vertical adjustment of a sliding valve plate 109 associated with the tail leg 85.

Reference will now be had to further details of the construction and operation of the screen deck structure illustrated particularly in FIGS. 4 and 5. As indicated earlier herein, both the main screen 81 and the lowermost screen 82 comprise two screen sections lying in abutting relation, each section extending the full width of the screen deck. The manner in which these screen sections are supported and retained in the screen deck housing is shown in detail in FIG. 5, wherein the numeral 120 designates an angle iron rail member fixed to the interior wall of a side wall 66 of the screen housing 65. It is to be understood that two pairs of rail members 120 are provided, an upper and a lower rail member at the interior of each side wall 66 to provide ledges for supporting the opposite side edges of the screens 81 and 82.

The screen member 82 which is illustrated fragmentarily in FIG. 5 includes a frame portion 121 of channel cross section which extends thereabout and is adapted to rest on the rail members 120 at opposite sides of the screen housing. In the illustrated instance frame portion 121 is tapered as shown to fit between wedge shaped longitudinal gasket members 122 of rubber or the like whereby the screen members fit snugly between the housing side walls 66. For conveniently and securely locking the screen members 81 and 82 in assembled position and for releasing them when desired the following locking arrangement is provided.

A longitudinal locking or clamping bar 125 overlies each rail member 120 and is provided with inwardly projecting yoke portions 126 at its opposite ends which are pivoted to the upper ends of rock arms, the rock arms at the feed end being designated 127 in FIG. 1 and the rock arms at the delivery end being designated 128 in FIGS. 1 and 5. The rock arms 127 at the feed end of the screen housing are fixed to the inner ends of rock shafts 130 which are jointly oscillated to effect locking movements of the screen members 81 and 82 in a manner which will now be described.

Exteriorly of the side walls 66 of the screen housing the rock shafts 130 are connected for joint rocking movement by arms 131 and a connecting link 132. As shown in FIG. 1, an operating screw 135 is mounted at the feed end of screen housing 65 as at 136 for free rotation but in a manner to prevent axial movement. An operating handle 137 is provided at the outer end of screw 135 and its inner end engages an internally threaded arm (not shown) on a rock shaft 138. Rock shaft 138 has operating connection with the rock shafts 130 at opposite sides of the screen housing 65 by means of rock arms 140 and 141 and a connecting link 142.

From the foregoing it will be seen that operation of screw 135 in one direction or the other by manipulation of handle 137 will rock the several arms 127 in opposite directions. Since each arm 127, its companion arm 128, and the connecting locking or clamping bar 125 form, in conjunction with the side wall 66 to which the arms 127 and 128 are pivoted, a parallelogram linkage, rocking movements of the arms 127 are automatically duplicated in the several arms 128.

Thus all of the locking or clamping bars 125 are jointly raised and lowered in a parallel manner by manipulation of handle member 137 of screw 135. This operation either clamps the lower flanges of the several screen framing channels 122 to the supporting rail members 120 or releases them. Raising movements of the locking bars 125 causes them to engage the upper interior portions of the screen framing channels 121 to raise the screen sections clear of the supporting rail members 120 for ready removal.

In grain cleaners of the prior art it is customary to provide means for continuously brushing the under surfaces of the screens to maintain their effectiveness. The apparatus of the present invention provides novel means for accomplishing this function in the form of fluid pressure actuated motor means which acts directly upon the brush supporting structure to reciprocate the same without mechanical connection to or transmission from the screen housing structure generally.

This is of particular advantage because of the vibratory action of the screen structure and the desirability of isolating the same from the remainder of the machine as far as is practically feasible. In the arrangement of the apparatus of the present invention the supporting and driving means for the brush mechanism is mounted independently of the screen structure itself.

Referring particularly to FIGS. 4 and 5, a generally rectangular brush supporting frame is designated by the numeral 150 and a plurality of longitudinal rows of brush members is designated 151. The lateral spacing of the rows of brush members is approximately equal to or

slightly less than the degree of lateral reciprocation of the brush supporting frame **150** so that the entire under surface of the screens is kept clear and it will be noted that the individual brush members of each row are spaced from each other a short distance whereby they clear a series of lateral reinforcing angle members **152** of the screen members **81** and **82**.

The supporting and reciprocating means for the brush supporting frame **150** is illustrated in FIG. 4, to which reference will now be had. As indicated above, the brush frame support is independent of the remainder of the screen structure, including the screen housing. A pair of tubular brush frame support shafts **155** and **156** extend laterally through the screen housing just below each of the screen members **81** and **82** and the two pairs of shafts **155** and **156** are fixed at their opposite ends to the general framework **20** of the apparatus as indicated in FIG. 4

Fixed to the underside of each brush frame **150** adjacent to its four corners are bearings **160**, preferably of the lineal ball type, which mount the brush frame on the tubular shafts **155** and **156** for lateral sliding movement. Reciprocation of each brush frame **150** is effected by an air cylinder **161** wihch is attached at one end to the machine framework **20** as at **162** and has a piston rod **164** which is attached at its outer end to the brush frame **150** as at **165**. It will be seen from the foregoing that both the reciprocable mounting of each brush frame and its reciprocating means are supported entirely independently of the screen housing generally.

Each cylinder **161** is double acting and is provided with conventional conduit and passage means for supplying operating air pressure alternately to its opposite ends. The means for shifting the valve positions at each end of the lateral movement of the brush frame will now be described. A valve shifting rod **168** extends through the tubular brush frame mounting shaft **156** and engages a shifting lever **169** of a valve shifting mechanism **170**.

A pair of valve shifting collars **171** and **172** are slidably mounted on shaft **156** at each side of the screen housing just inwardly of the side walls **66** thereof and studs **174** extend through the collars **171** and **172** and into valve shifting rod **168** whereby the collars **171** and **172** and the valve shifting rod **168** are fixed for joint axial movement. The studs pass through longitudinal slots in shaft **156** to permit such movement independently of shaft **156**.

As a brush frame **150** reaches its limit of movement in either direction one of the bearings **160** thereof which slides on shaft **156** during such movement abuts an adjacent valve shifting collar **171** or **172**, as the case may be, and thus moves valve shifting rod **168** to reverse the valve shifting mechanism **170** and thus reverse the direction of piston rod **164** and brush frame **150**.

In FIG. 1 the numeral **180** designates an air pressure storage tank which may be employed to supply operating fluid pressure to the brush actuating cylinders **161**, pressure thereafter being generated by an air compressor **181** driven from shaft **75** by a belt connection **182**. If desired, side panel members may be attached to the exterior of framework **20** to enclose the working parts of the apparatus.

In FIGS. 4 and 5 the numeral **185** designates a series of angle members which are secured to the upper surfaces of the frame portions **121** of the screen members in obliquely disposed position, as shown in FIG. 4. Grain tending to move downwardly along the screen frame portion is thus deflected inwardly to the screen surface proper at various points along the side edges of the screen surfaces.

I claim:

1. In a grain cleaner, a supporting frame, a screen and means mounting the same for vibratory movement relative to the frame, a brush frame disposed beneath said screen having brush members engageable against the under side of said screen, means mounting said brush frame for sliding movement beneath and generally parallel to said screen, air pressure actuated piston and cylinder means connecting between said supporting frame and said brush frame for sliding the latter, and means arranged in controlling relation to said air pressure means including an operating member mounted on said supporting frame movable in response to engagement with said mounting means, said air pressure actuated piston and cylinder means being operable to reciprocate said brush frame in response to said latter movement.

2. In a grain cleaner, a supporting frame, a screen and means mounting the same for vibratory movement relative to the frame, support means fixed to said supporting frame, a brush frame disposed beneath said screen having brush members engageable against the under side of said screen, slide bearing means mounted on said support means and supporting said brush frame for independent sliding movement beneath and generally parallel to said screen, air pressure actuated piston and cylinder means connecting between said supporting frame and said brush frame for sliding the latter, and means arranged in controlling relation to said air pressure means including an operating member mounted on said support means movable in response to engagement with said slide bearing means, said air pressure actuated piston and cylinder means being operable to reciprocate said brush frame in response to said latter movement.

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