May 18, 1937. A. J. SACKETT 2,080,508

MIXING AND SCREENING APPARATUS FOR FERTILIZER MATERIALS AND THE LIKE

Filed March 19, 1934 2 Sheets-Sheet 1

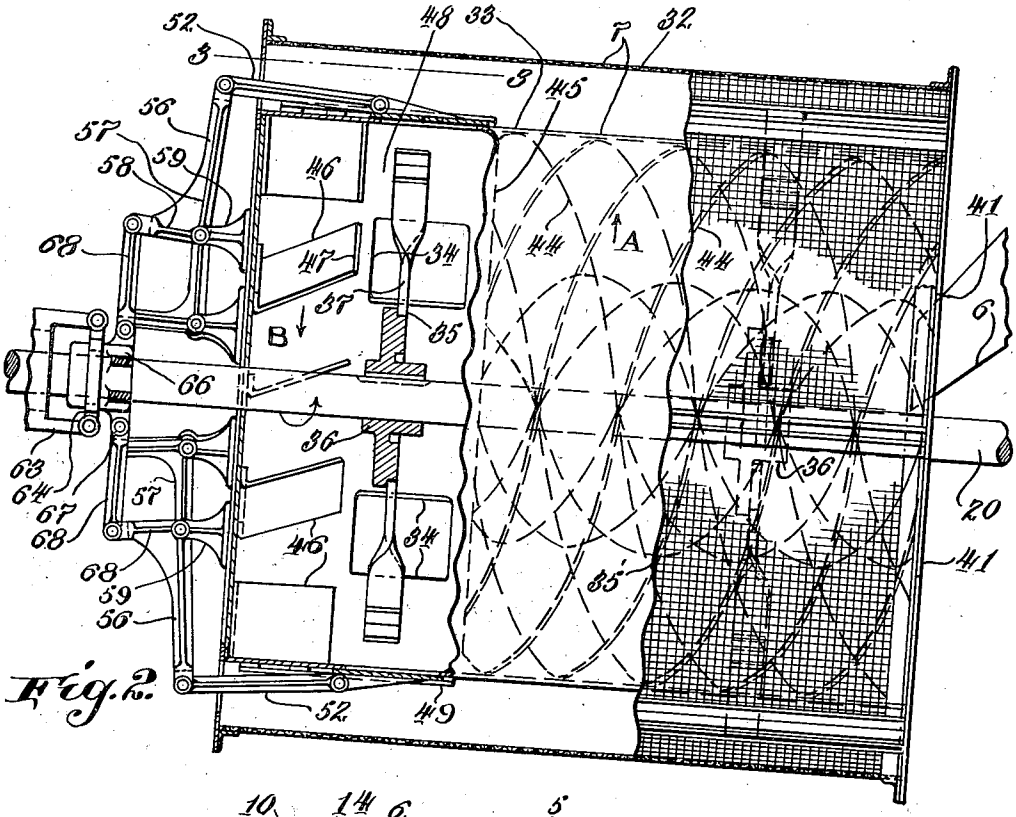



Fig. 2.

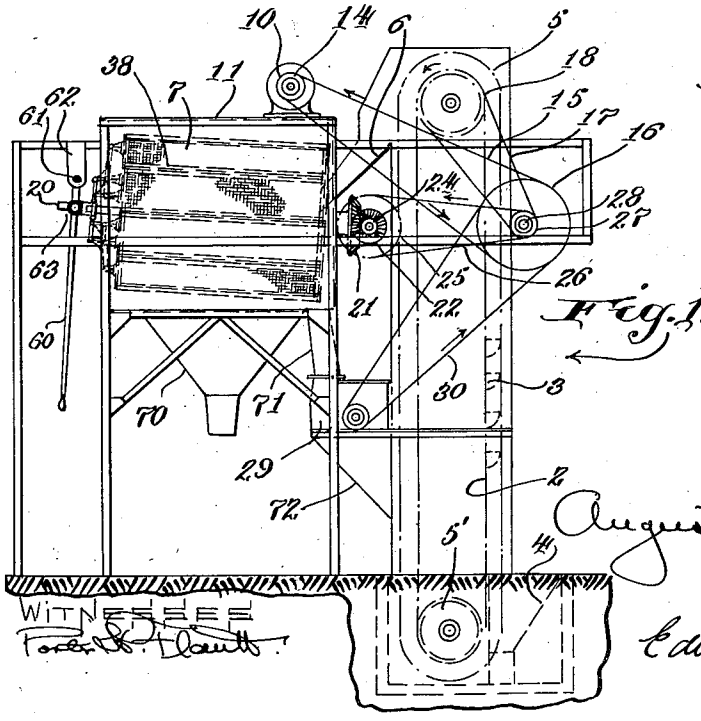



Fig. 1.

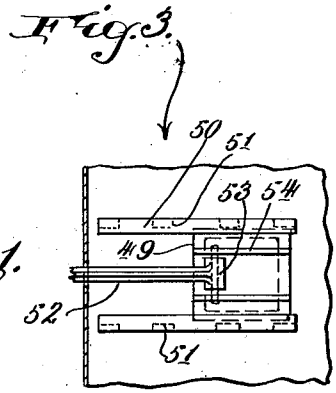



Fig. 3.

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WITNESSES

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MIXING AND SCREENING APPARATUS FOR FERTILIZER MATERIALS AND THE LIKE

Filed March 19, 1934 2 Sheets-Sheet 2

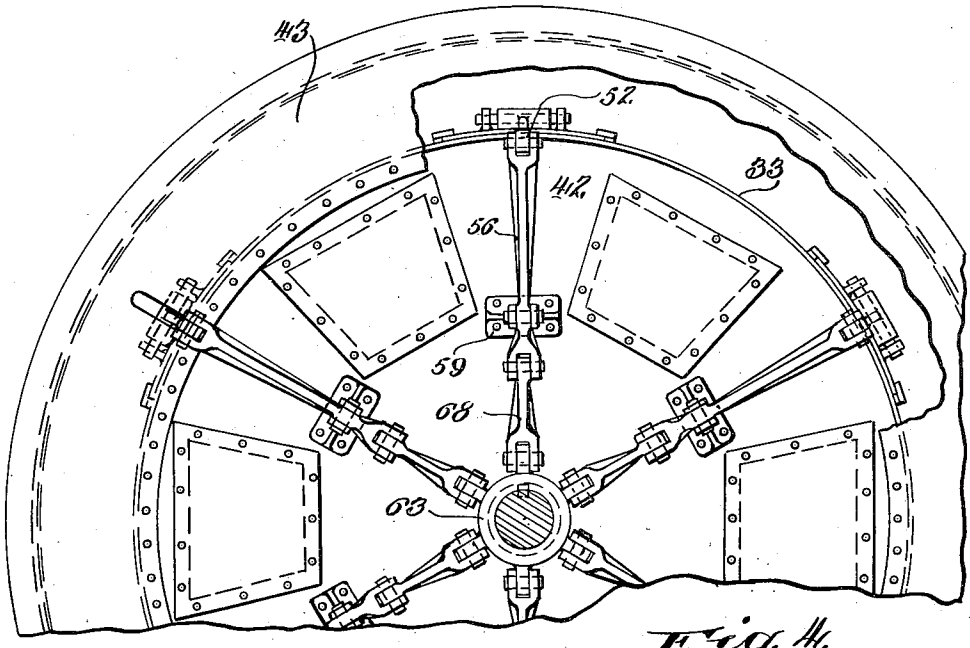



Fig. 4.

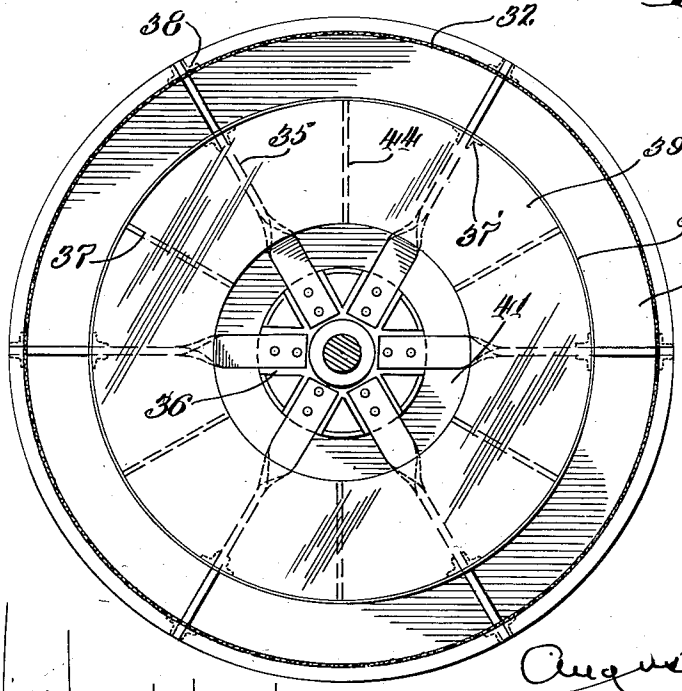



Fig. 5.

Witnesses

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Patented May 18, 1937 2,080,508

# UNITED STATES PATENT OFFICE

2,080,508

## MIXING AND SCREENING APPARATUS FOR FERTILIZER MATERIALS AND THE LIKE

Augustus J. Sackett, Anne Arundel County, Md.

Application March 19, 1934, Serial No. 716,314

7 Claims. (Cl. 209—235)

The invention relates to a machine for mixing and screening comminuted materials as fertilizer ingredients and the like and to the details of the mixing and screening apparatus as considered separately and in combination.

The object of the invention is to provide a batch mixer which can be constructed separately or as a combined mixing and screening apparatus which is capable of production at a comparatively small cost, which is quick and efficient in operation as compared with the prior art apparatus and which particularly in the combined mixer has the important advantage of economy of floor space and the even more pronounced advantage of reduced height.

The combined apparatus of the invention is adapted to mix and screen fertilizer ingredients and to mill the tailings or larger particles returning them to the mixing and screening apparatus for further treatment. The complete apparatus equipped to perform these three operations in accordance with the invention as shown is about 17 feet in height whereas the prior art apparatus in general use for the same purposes occupies a space of 35 feet in height requiring two elevators side by side and taking up a floor space considerably greater than that of the apparatus of the invention which requires but a single elevator. As the result of the peculiar construction and operation of the improved apparatus, the material is moved laterally in one direction during mixing and returned in the opposite direction in screening, the tailings being dropped at the end of the screening operation, reground or milled and fed to the elevator which returns them to the mixing and screening apparatus for further treatment.

In the accompanying drawings, I have illustrated an apparatus embodying the features of the invention in the preferred form, various modifications which it is not deemed necessary to illustrate being contemplated.

In the drawings, Figure 1 is a side elevation of the assembled apparatus.

Figure 2 is a side elevation of the mixing and screening cylinder, portions of the mixing and screening cylinders being broken away for convenience of illustration.

Figure 3 is a detail view showing a fragment of mixing cylinder wall including one of the valves for discharging material from the mixing cylinder to the screening cylinder, the cylinder wall and valve and valve ways being from the outside.

Figure 4 is a fragmentary end elevation of the mixing and screening cylinder looking at the same from the left in Figure 2 and showing the valve actuating mechanism, the actuating hub being removed.

Figure 5 is an elevation of the mixing and screening cylinder looking at the same from the right in Figure 2.

Referring to the drawings by numerals, each of which is used to indicate the same or similar part in the different figures, the construction shown, considered in a general way in reference to Figure 1, includes an elevator **2** provided with the usual buckets **3**. The elevator operates at its lower end in a pit **4** which may to advantage be formed in a basement or other similar floor, the elevator extending upwardly for a distance which in the apparatus as constructed may be about 17 feet to an upper pulley **5** about which the buckets rotate in counter clockwise direction as seen in Figure 1, discharging into a chute **6** which delivers the material to the combined mixing and screening cylinder **7** to be further described.

In accordance with the construction shown, the apparatus is driven by an electric motor **10** mounted on a beam or support **11**. This motor drives the upper pulley **5** by means of the reducing chain or belt mechanism **14, 15, 16, 17, 18.**

While the construction shown provides for a chain or belt drive, it will be understood that any convenient or preferred type of drive may be employed, the object being to impart a relatively slow speed motion to the elevator and to the mixing and screening cylinder **7**, a suitable speed being about 3 seconds to each revolution of the screening cylinder. This combined cylinder **7** in the form of the invention shown is mounted on a suitably inclined shaft **20** as hereinafter described. To this shaft is secured a beveled gear **21** driven by beveled gear **22** on a transverse shaft **24** which is in turn driven by a pulley or sprocket **25** which is driven by a chain or belt **26** from a small sprocket or pulley **27** on the shaft **28** of the pulley or sprocket **16** driven by belt **15** from the motor **14** as already described. The apparatus as shown in Figure 1 also includes a pulverizing or milling apparatus **29** driven by means of a belt or sprocket chain **30** from the shaft **28.**

The combined mixing and screening cylinder **7** considered both separately and in combination with the other elements of the machine is an important feature of the invention. It comprises an outer screen cylinder **32** of mesh wire or other suitable screen mesh which may be of any available foraminated material, and it also includes

an inner mixing cylinder **33** of sheet metal or the like which is preferably imperforate except for the valve openings **34** to be further described.

The mixing cylinder **33** is supported on and concentrically with the shaft **20** by means of spiders **35** composed of radiating arms **37** secured to collars **36** on said shaft and extending outwardly through the drum or cylinder **33** to which they are suitably secured by means of flanges **37'**. The radiating arms **35** extend outwardly beyond the mixing cylinder **33** into engagement with longitudinally arranged angle irons **38** which are shown as supporting the screen cylinder **32** from without.

Referring now to Figure 5, which is a view looking at the combined cylinder **7** from the right in Figure 2, the mixing cylinder **33** is partially closed at this end by an annular plate **39** leaving the screen cylinder open at this end, the annular opening through the screen cylinder discharges the tailings as further described, being indicated by reference character **40**. The cylinder **33** is also open at this end at the center of the plate **39**, the center opening being indicated by reference character **41**, it being noted in this connection that the spider **35** is spaced inwardly from the end of the cylinder. The chute **6** by which the material is fed to the mixing cylinder from the elevator enters the mixing cylinder through this opening as shown in Figure 2 discharging the material into the cylinder at this point.

It is also interesting to note at this time that the shaft **20** and the combined cylinder **7**, composed of screening cylinder **32** and mixing cylinder **33**, is slightly inclined upwardly from the right toward the left in Figure 2 in this instance in accordance with the upward inclination of shaft **20** already suggested, the angle of inclination being a matter of a few degrees from the horizontal substantially as shown or this angle may be varied to suit conditions. The upper or left hand end of the cylinder as viewed in Figure 2 is closed by means of end plates **42** and **43**, see Figure 4.

The lower or right hand end portion of the mixing cylinder **33** as shown in Figure 2 is provided with a series of blades or flights **44** which as hereinafter described have both a conveying and mixing function. These blades or flights are in the form of the invention shown secured to the inner surface of the outer wall of the cylinder **33** being supported in any convenient manner. They are shown as projecting inwardly therefrom in the form of the invention illustrated from the outer wall to the cylindrical plane of the central opening **41** in the lower or right hand end plate **39**. These blades **44** of which there are six in the form of machine shown are arranged each in the form of a left hand screw or helix the six blades being preferably parallel. When the cylinder **33** is rotated clockwise or to the right as seen from the right in Figure 3, the material introduced through the opening **41** is moved by the blades or flights **44** to the left, Figures 1 and 2, and up the incline.

The blades or flights **44** as they may be termed in the form shown occupy half or more than half of the cylinder **33** extending from the right end to and beyond the center. As shown they terminate on the transverse plane of the cylinder indicated by line **45** in Figure 2 which indicates the ends of these blades or flights. The mixing cylinder is provided at its opposite end, i. e., just inside the upper or left hand end in Figure 2 with mixing or beater blades **46**. These blades **46** as shown mounted on the left hand end wall or plate **42** of the mixing cylinder **33** and projecting inwardly toward the center of the cylinder in the direction of the axis, i. e., toward the flights or conveying and mixing blades **44**, being inclined inwardly and backwardly and oppositely to the direction of rotation as shown in Figure 2 so that they have a tendency to move the material to the right, i. e., oppositely to the direction of motion imparted to it by the conveyer and mixer blades **44**.

The right hand edges **47** of these blades are spaced away from the adjacent ends of the plates **44** indicated by the line **45** in the direction of the axis of the cylinder providing a mixing and discharge area or space **48** the proportions shown being satisfactory for this purpose. The oppositely inclined blades or vanes at the ends of the cylinders are referred to for convenience as sets of blades or vanes without involving any distinction between continuous blades and separate blades or any numerical limitation.

It is important to note that while the mixing or beater blades **46** are arranged around the entire periphery of the end plate **42** of the cylinder **33**, the portion of this cylinder which is toward the observer in Figure 2 is broken away in said figure and removed the corresponding portion of the end plate **42** together with the blades **46** carried thereby being likewise removed so that the blades **46** shown in the drawings are the ones which are located in the remote half of the cylinder. As already pointed out the combined cylinders rotate clockwise as seen from the right in Figure 2; hence the wall of the cylinder nearest the observer as seen in Figure 2 is moving upwardly in the direction of the arrow A and the remote wall of the cylinder including the portions of the flights **46** as shown in this figure is moving downwardly as indicated by arrow B.

The mixing and discharge space **48** is provided with valve openings **34** already referred to which as shown are in the nature of rectangular openings in the cylindrical wall of the mixing cylinder **33**.

These discharge openings or valve openings **34** are normally closed by valves or cover plates **49** illustrated in detail in Figures 2 and 3. These valves **49** are shown in the form of rectangular plates sliding in ways **50** which may be supported on lugs **51** by which they are spaced upwardly from the outside surface of the cylinder **33**, see particularly Figure 4. The valves **49** being on the outside of said cylinder, this spacing of the ways **50** from the wall of the cylinder **33** provides a self-cleaning feature of the ways which will be easily understood whereby material accumulated therein is released.

The valves **49** are operated by connecting rods **52** illustrated in Figure 3 as connected to said plates by wrist pins **53** extending through the ends of said rods and through the upright lugs or flanges **54** on said plates or valves.

Each connecting rod **52** is pivotally connected at its opposite end from the corresponding valve to the radially arranged arm **56** of a corresponding bell crank lever **57**, the other arm **58** of which lever is substantially parallel to the axis of the cylinder. There is one such bell crank and a connecting rod for each valve and each bell crank lever is pivotally mounted on a bracket **59** secured to the end plate **42**. The arms **58** of the respective bell crank levers **57** and the corresponding connecting rods **52** with their valves or

cover plates **49** are operated to open and close the valves by means of a hand lever **60**, see Figure 1, which is pivotally mounted at **61** on a suitable bracket **62** supported on the machine frame or other suitable stationary support, the lever being connected intermediately to an actuating hub **63** which is mounted to slide freely on the shaft **20**, said actuating hub **63** being connected to sliding collar **66** by means of inwardly projecting radial pins **64** which engage a groove **65** in said sliding collar **66** which is keyed to the shaft **20** to rotate therewith. This sliding collar **66** is provided with radial lugs **67** corresponding in number to the number of the valves **49** and bell crank levers **57**, each said lug being connected by means of a radially placed link **68** to the swinging end of one of the axially arranged arms **58** of said bell crank levers **57**.

The valves **49** are shown in normally closed position to open the valves releasing the mixed material from the mixing cylinder as hereinafter described thereby discharging it into the screening cylinder the lever **60** may be pulled to the left in Figure 1 applying tension to the links **68** and thus swinging the bell crank lever arms **56** outwardly to the left from the cylinder head **42** in turn applying tension to the connecting rods **52**, moving the valves or plates **49** to the left in Figure 3 and hence to open position.

In the operation of the machine, the comminuted materials to be mixed and screened are fed to the elevator **2** being presented in any suitable manner by shoveling or conveying to the pit **4** whereby the buckets **3** are filled as they pass around the bottom pulley **5'** and begin the upward traverse.

The buckets thus charged pass up the elevator traverse and swing about the upper pulley **5** being discharged into the chute **6**. The comminuted material thus fed to the chute **6** passes by gravity down the chute entering the opening **41** at the center of the lower or right hand end of the mixing cylinder **33**.

As already pointed out, the combined cylinder **7** comprising the screening cylinder **32** and the mixing cylinder **33** are mounted with their combined axis which is the axis of the shaft **20** inclined upwardly to the left as seen in Figure 2 at an angle of five or six degrees to the horizontal or at any convenient and suitable angle substantially as shown. The combined cylinder is driven in rotation as already described preferably at a slow speed which may to advantage be about 23 revolutions per minute. This speed of rotation is such that the material being treated instead of being kept in suspension remains in the lower portion of the cylinder **43** having a tendency to follow up or climb the upwardly moving side of the cylinder which is toward the observer in Figure 2. At the end of its upward path each particle rolls down the inclined surface. In this way, the material moves gradually to the left due to the action of the helical blades **44**, the material being at the same time subjected to a mixing action as it rolls down the incline of the upwardly moving side of the cylinder, being constantly deflected to the left by the action of the inclined or helical blades or flights **44**.

The machine as already stated is a batch mixer, i. e., the cylinder is charged with a definite quantity of the materials to be mixed, feeding is then discontinued and the mixing operation is completed and the material discharged after which discharge a new batch of material is fed to the machine. The quantity of material fed to the cylinder should never be in excess of that which will permit the material to accumulate at the bottom of the cylinder and roll down the upwardly moving side of the cylinder as it climbs the incline in the manner described, and to be controlled and moved by the mixing and conveying blades or flights **44**.

As the cylinder continues to rotate, the material is gradually fed to the left until it is discharged from the ends of the helical conveying and mixing blades or flights **44**, the said curve being indicated by the dotted line **45** in Figure 2. Beyond this point, the material enters the mixing and discharge space **48** in which space it has the tumbling action already described, being deflected to the left when it comes in contact with the blades **44** and to the right when it comes in contact with the oppositely inclined blades **46** which prevent accumulation of the material in the end of the cylinder and also combine with the helical blades **44** to complete the mixing operation in the mixing space **48**, the two sets of blades having the effect of deflecting the material back and fourth across the space **48** as it rolls down the inclined upwardly moving side of the cylinder.

When the mixing of the materials in this manner has been completed, the hand lever **60**, see Figure 1, is pulled to the left in said figure operating the valve actuating mechanism **52**, **56**, **58**, **68** etc. moving the plates **49** to the left and uncovering the valve openings **34**. This is preferably accomplished while the cylinder is in rotation.

Continued rotation of the combined cylinder **7** causes the mixed comminuted material to be discharged through the valve openings **34** into the outer or screening cylinder **32**. Further continued rotation of the cylinder results in a screening of the material in and by the screen cylinder **32** with the result that the mixed and screened material is dropped into the funnel **70**, Figure 1, whereby it is deposited in bags or in any suitable receptacle placed beneath the funnel for this purpose or it may be dropped on the floor and shoveled into bags, the filling and weighing of the bags at this point being, if desired, performed automatically in accordance with the existing practice in this regard.

It is of interest that the material being discharged from the mixing cylinder **33** through the valve openings **34** and thus in the zone of these valve openings near the upper end of the incline moves gradually down the incline as it is screened the funnel **70** underlying the center length of cylinder **32**. The tailings, i. e., the particles that are too large to pass through the screen, are discharged from the open end of this screen cylinder at the right in Figure 2, the annular opening at this end between the closed end **39** of the mixing cylinder and the screen cylinder **32** being indicated by reference character **40** in Figure 5.

The tailings thus discharged from the lower end of the screen cylinder **32** are dropped through the chute **71** into the pulverizing or milling apparatus **29**, see Figure 1, whereby the tailings which are too large to pass through the screen are further reduced in size and returned to the pit **4** by way of the chute **72**. From the pit **4** they are again picked up by the elevator **2** and carried back to the chute **6** and hence to the mixing cylinder **33** where they are further mixed and screened and combined with the mixture as discharged into funnel **70**.

As already pointed out, the improvement pro-

vides a mixing and screening apparatus which can be produced at a small cost and which is simple in construction and highly efficient in its operation performing in a single machine all three operations of mixing, screening and grinding the tailings which after grinding are returned automatically to the mixing and screening apparatus. An advantage of the improved apparatus of primary importance is the economy of space, a simple and cheap apparatus which is capable of performing these three operations in an highly efficient manner being contained within a space which is only half as high as that previously required for apparatus performing these functions, the floor space used by the improved apparatus being less than that required for the old apparatus of twice the height.

I have thus described an apparatus and method embodying the features of the invention in the preferred form the description being specifically and in detail in order that the manner of constructing, applying, operating and using the invention may be fully understood. However, the specific terms herein are used in a descriptive rather than in a limited sense, the scope of the invention being defined in the claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a machine for mixing and screening batches of dry comminuted materials in the manufacture of fertilizer containing these materials in fixed proportions, a mixing cylinder mounted to rotate and having its axis inclined upwardly, means for introducing comminuted materials into the lower end of the mixing cylinder helically inclined, blades in the mixing cylinder for advancing the material up the incline in the general direction of the axis as the cylinder rotates, means for rotating the cylinder to roll the material in the cylinder, mixing and advancing it, oppositely inclined blades at the upper end of the cylinder for mixing the materials and projecting them down the incline to complete said mixing, said respective sets of blades in the mixing cylinder being spaced apart in the direction of the axis to provide an intermediate combining area, means in said area for discharging the mixed materials from the mixing cylinder at the end of the mixing operation, and a screen having a portion located beneath the mixing cylinder to receive the materials therefrom and inclined downwardly from said portion, and means for operating this screen to screen the materials discharged from the mixing cylinder.

2. In a machine for mixing batches of dry comminuted materials in definite proportions in the manufacture of fertilizer, a mixing cylinder, means for supporting the same to rotate about an axis which is inclined upwardly from the horizontal, means for introducing comminuted materials to be mixed at the lower end of the said cylinder, a set of blades inclined to the direction of rotation to move the material along the mixing cylinder up the incline in the general direction of the axis as the mixing cylinder is rotated, said blades extending from the lower end of the cylinder to a point near the upper end of the cylinder, a set of mixing blades at the upper end of the cylinder oppositely inclined to the direction of rotation as compared to said first set of blades to move the materials down the incline in the general direction of the axis, means for rotating said cylinder to roll the materials to mix them and move them by the action of said blades, said two sets of blades being spaced apart in the direction of the cylinder axis leaving a free combining space between said sets of blades and near the upper end of the cylinder, means controllable by the operator for discharging the mixed materials from said combining space at the end of the mixing operation, and a screen enclosing the mixing cylinder and spaced vertically therefrom and secured thereto to rotate therewith in screening the material and inclined downwardly in the general direction of the incline of the mixing cylinder from a point opposite the discharge of the latter to its intake end, the screen having a discharge opening at its lower end for tailings whereby the material after being mixed is received by the screen near its upper end and screened as it is passed downwardly toward the lower end of the screen, the tailings being discharged at said lower end of the screen.

3. In a machine for mixing batches of dry comminuted materials in definite proportions in the manufacture of fertilizer, a mixing cylinder mounted to rotate on an inclined axis, means for feeding the cylinder at the lower end, mixing blades extending from the lower end of the cylinder to a zone well beyond its longitudinal center and inclined to the axis of the cylinder for mixing the material in the cylinder and feeding it up the incline, mixing blades at the upper end of the cylinder oppositely inclined to the said first mentioned blades for projecting the material away from the upper end of the cylinder, the cylinder having a central mixing zone intermediate the longitudinal center of the cylinder and its upper end and between said first and second mentioned mixing blades and having discharge openings therein, doors for closing said openings and means within the control of the operator and operable while the cylinder is in rotation to open said doors to discharge the material from said cylinder at said mixing zone.

4. In a batch mixer for fertilizer materials, a mixing drum mounted to rotate, a screen surrounding the drum, spaced outwardly radially therefrom and connected thereto to rotate therewith, the bottom of the screen being inclined to the horizontal substantially in a plane of the axis of rotation, means for feeding the materials into the end of the drum which is adjacent the lower end of the screen, the screen having an opening at said lower end for discharging tailings from the screen, the drum having mixing and propelling vanes distributed along its walls on the inside extending from each axial end of the drum and a mixing zone, located in the drum near the end thereof which is adjacent the upper end of the screen, said vanes at the respective ends of the drum being helically and oppositely inclined and extending to and terminating at the axial ends of said zone, leaving the zone substantially free for mixing and rolling of the material therein, means for rotating the drum to cause the vanes at the lower end which is the feed end to propel the materials from the feed end to and across said zone also causing the set of vanes at the opposite end to return the materials to said zone and to mix them in propelling and by rolling in said zone, the drum having a door opening in its walls leading outward radially from said zone into the screen, a door for said opening, and operating means for the door operable while the drum is rotating, to discharge the mixed material and means for catching and returning the material passed through the screen, from the drum on to the upper end of the screen.

5. The construction of claim 4, provided with means for receiving the tailings from the lower end of the screen, means for grinding them, and means for returning them to the mixing drum whereby a batch of fertilizer of exactly the predetermined proportions is obtained.

6. In a machine for dry mixing fertilizer materials, a drum mounted to rotate about an axis widely deflected from the vertical, a feed for introducing the ingredients to be mixed at one axial end of the drum, a helically inclined conveying and mixing means extending along the inside of the drum from said axial end toward the other end of the drum, oppositely inclined propelling means at the other end of the drum, both said means being discontinued at points spaced in an axial direction to provide a free mixing zone, a drive for rotating the drum to move the materials from the feed end to the point of introduction to said zone and to roll them therein, both said means serving to project the materials transversely of said zones and the projecting means at the upper end serving to prevent accumulation of the materials at that end, a rotating screen surrounding the drum and inclined downwardly from said zone, the walls of the drum at said zone having discharge openings, a door for each opening carried by the drum and means operable while the drum is rotating for operating said doors.

7. In a machine for mixing batches of dry comminuted materials in definite proportions in the manufacture of fertilizer, a mixing cylinder mounted to rotate on an axis inclined upwardly to the horizontal, means for rotating the cylinder, means for feeding material to the cylinder at the lower end, flights in said cylinder helically inclined to the direction of rotation and extending from the lower axial end of said cylinder toward the upper end, said flights serving to move the material up the incline in the direction of its axis as the cylinder rotates, said flights terminating relatively near to but short of the upper end of the cylinder, oppositely inclined blades at the upper end of the cylinder spaced in an axial direction away from said flights to provide an intermediate mixing space between the longitudinal center of the cylinder and its upper end, the materials being mixed receiving opposite impulses from said flights and said blades whereby they are moved transversely of said mixing space and also rolled in the direction of the circumference as the cylinder rotates, the blades preventing accumulation of material at the upper end of the cylinder, an outer screening cylinder enclosing said mixing cylinder and inclined in the same direction and connections whereby the screening cylinder is rotated, the mixing cylinder having adjacent its upper end and between said flights and blades means controllable by the operator whereby the materials therein are discharged at the will of the operator into the screening cylinder near its upper end to be screened thereby as they move down the incline due to the rotary motion and the action of gravity and a discharge for tailings at the lower end of the screen.

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