Oct. 12, 1965 H. B. JONES ETAL 3,211,369

METHOD AND APPARATUS FOR HANDLING PIPELINE COAL

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FIG. 1

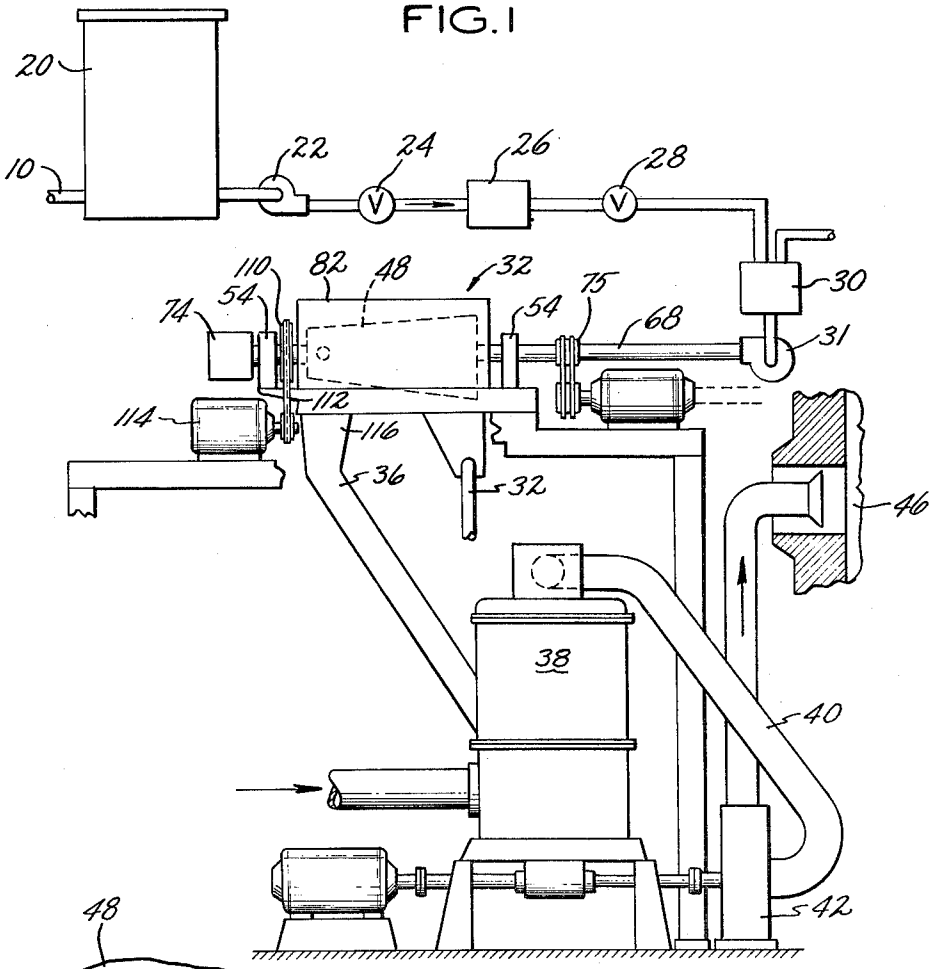


FIG. 4

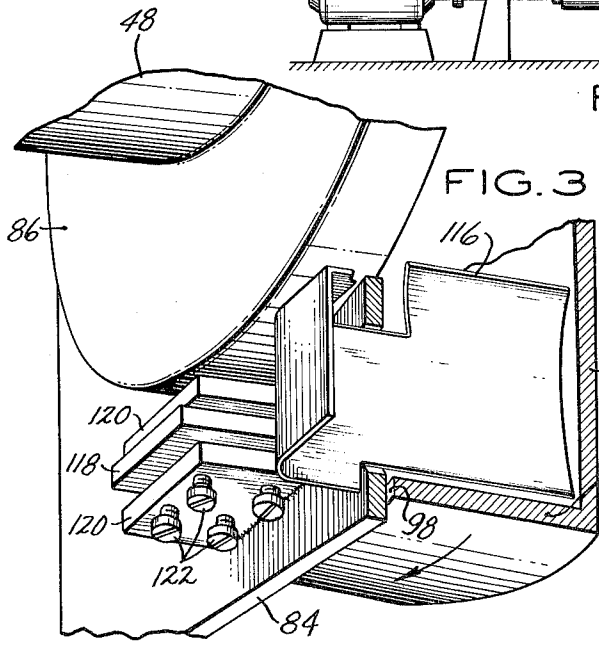


FIG. 3

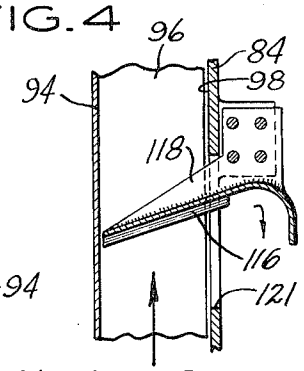
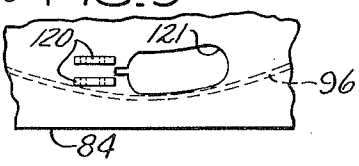


FIG. 9



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METHOD AND APPARATUS FOR HANDLING PIPELINE COAL

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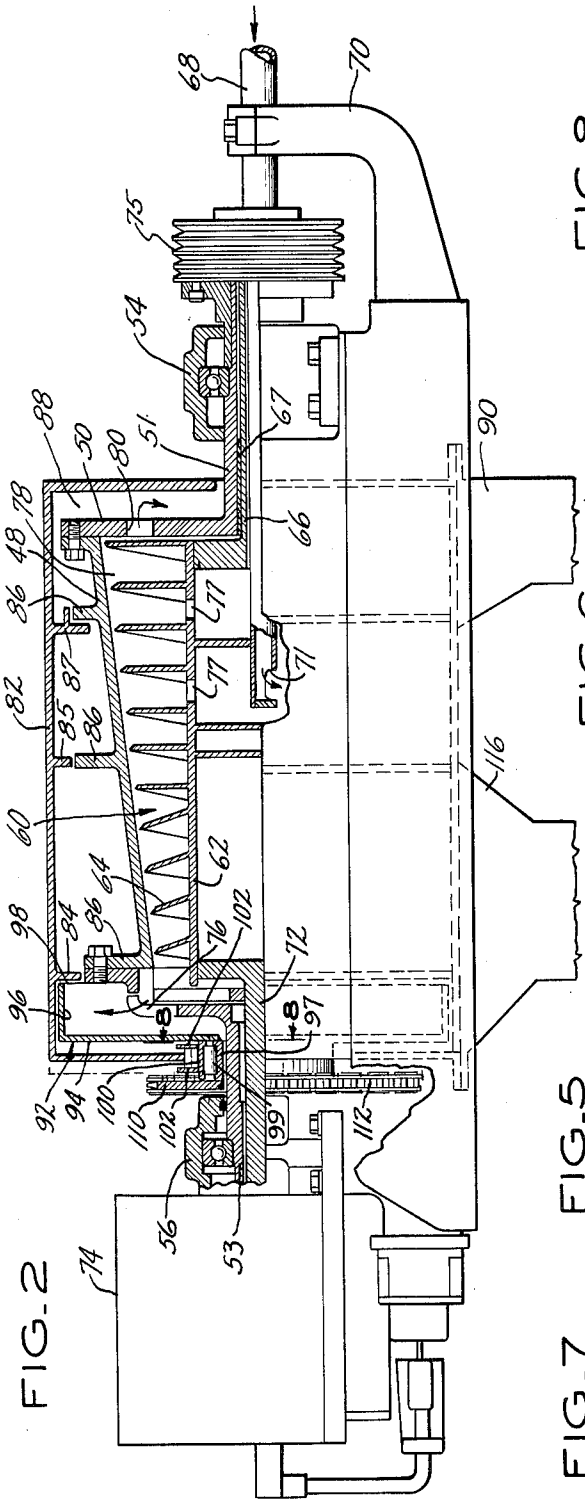


FIG. 2

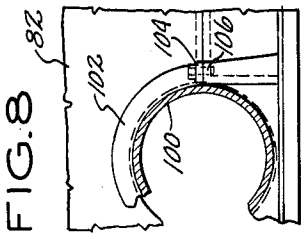


FIG. 8

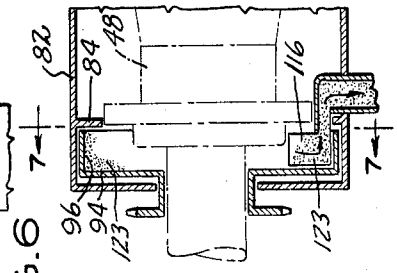


FIG. 6

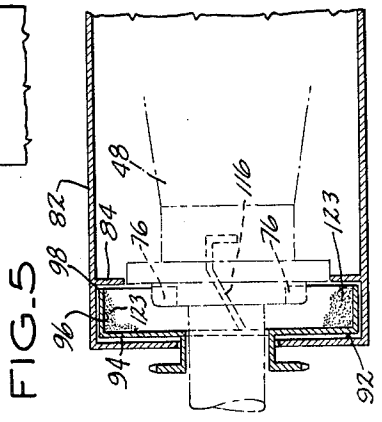


FIG. 5

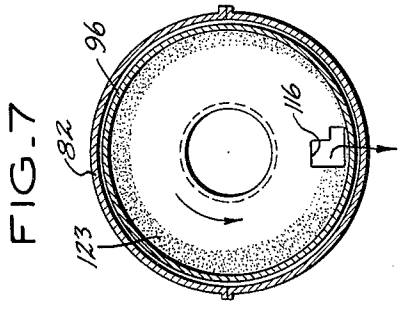


FIG. 7

United States Patent Office 3,211,369 Patented Oct. 12, 1965

3,211,369
METHOD AND APPARATUS FOR HANDLING PIPELINE COAL

Harry B. Jones, Wethersfield, and Donald J. Frey, Hazardville, Conn., assignors to Combustion Engineering, Inc., Windsor, Conn., a corporation of Delaware

Filed Aug. 6, 1962, Ser. No. 215,203
3 Claims. (Cl. 233—7)

This invention relates generally to a method and apparatus for the handling of a liquid-solid slurry and has particular relation to an improved method and system for providing a continuous flow of partially dewatered solid from a supply of a liquid-solid slurry and particularly a slurry of crushed coal and water of a consistency such that it is pumpable over long lengths of pipeline.

In a system for handling a liquid-solid slurry and particularly in a system for handling a pumpable slurry of crushed coal and water wherein it is desired to provide a continuous and regulated supply of mechanically dewatered solids, it is necessary that the various components of the system including the mechanical dewatering device be able to operate continuously, performing its desired functions without interruption over relatively long periods of time. With a slurry such as the pumpable coal slurry which may originally have had a water concentration of 50 percent and where the mechanical dewatering reduces this concentration to approximately 20 percent, special precautions with regard to the handling of the thus concentrated slurry must be taken particularly at the outlet of the dewaterer to insure that a steady flow is maintained and that plugging or stoppage is not encountered. The present invention is directed to an improved method and system employing a centrifuge dewatering device of particular construction for the handling and dewatering of a liquid-solid slurry (such as a pumpable coal slurry) and with the method and organization being such as to provide for sustained operation over long periods.

Accordingly, it is an object of the present invention to provide an improved method and apparatus for the handling of a liquid-solid slurry.

Other and further objects of the invention will become apparent to those skilled in the art as the description proceeds.

With the aforementioned objects in view, the invention comprises an arrangement, construction and combination of the elements of the inventive organization in such a manner as to attain the results desired as hereinafter more particularly set forth in the following detailed description of an illustrative embodiment, said embodiment being shown by the accompanying drawing wherein:

FIGURE 1 is a diagrammatic representation of a system embodying the present invention;

FIGURE 2 is a detailed sectional view of the centrifuge of the invention;

FIGURE 3 is an enlarged fragmentary detailed illustration showing the plow or scraper blade associated with the gutter or rotating collecting member;

FIGURE 4 is a fragmentary view looking down on the plow and showing its angular disposition with regard to the collecting member;

FIGURE 5 is a fragmentary simplified horizontal section showing the rotating collecting member in the casing of the centrifuge and the annular buildup of concentrate therein;

FIGURE 6 is a sectional view similar to that of FIGURE 5 but in the vertical plane;

FIGURE 7 is an end view of the collecting member taken from line 7—7 of FIGURE 5;

FIGURE 8 is a detailed section taken along line 8—8 of FIGURE 2 and;

FIGURE 9 is a fragmentary elevational view showing the configuration of the opening in the baffle through which the plow directs the concentrate.

In the handling of pipeline coal and the supplying of this coal to a furnace for burning therewithin, as for example the furnace of a vapor generator, the coal slurry as it is conveyed through the long pipeline is of a consistency such as that which is desirable to remove a portion of the water prior to introducing the same into a firing system of a furnace. This concentration of the coal slurry may be effected by means of a centrifuge dewatering device, and the concentrate egressing from the centrifuge may be conveyed to a furnace, such as a cyclone furnace, for burning therewithin or to a grinding mill and thence to a furnace. For the details with relation to such systems for the handling and burning of coal thus transported through a pipeline, reference is made to U.S. application 159,600 filed December 15, 1961, in the names of James Jonakin and Robert C. Tulis, and U.S. application 159,603 filed December 15, 1961, in the name of James Jonakin.

Referring to the drawing and particularly the diagrammatic representation of FIGURE 1, a liquid-solid slurry, as for example a coal-water slurry having crushed coal with a particle size of ¼" or less mixed with water such that the percent of coal is between 50 and 60 percent, is conveyed to the surge or storage tank **20** from the pipeline **10** with the slurry being pumped from the tank **20** by the pump **22** through a control valve **24**, past a flow meter **26**, such as a magnetic flow meter, through a shut-off valve **28** to a hopper **30**. From this hopper, the slurry is pumped by pump **31** to the centrifugal filter or dewaterer **32** where the concentration of the slurry is substantially increased such as to 75 or 85 percent solids. The filtrate is conveyed from the dewaterer through the discharge conduit **34** while the concentrate is conveyed through the duct **36** to pulverizing mill **38**. Pulverized coal is discharged from the mill through duct **40** to fan **42** which in turn conveys this pulverized coal in a stream of heated air to a furnace identified as **46** where the fuel is burned.

The centrifuge operates on the principle of separating the fluid from the liquid by sedimentary action with the solids being retained against the walls of the rotating bowl of the centrifuge while the liquid is drained from the bowl. Accordingly, the centrifuge comprises rotating bowl **48** which includes at one end a head **50** and to the other a head **52** with the head **50** having a cylindrical extension **51** that is received and supported in bearing **54** while head **52** has a cylindrical extension **53** that is supported and received in bearing **56** with these bearings in turn being supported on the base **58**. Accordingly, the bowl rotates about its horizontal axis and within these bearings **54** and **56**.

Mounted within the bowl is the screw conveyor identified generally as **60** and which includes the hub **62** about which is mounted helical screw **64**. Extending from the right end of the hub **62**, as viewed in FIGURE 2, is the hollow shaft **66** with the shaft being journaled via bearing **67** within the cylindrical extension of the head **50** and there being received within this shaft the supply conduit **68** which is supported by the bracket **70** and which is effective to introduce slurry into the center of the hub through the outlet **71** provided at the inner end of the conduit. From the other end of hub **62** there extends the shaft **72** which is connected with the gear drive identified generally as **74**. This gear drive is also connected with the rotating bowl **84** by means of the cylindrical extension provided on the heads **52**.

The bowl is rotated through a suitable drive, as through the pulley **75**, which is connected via suitable belts to a drive motor and by rotating the bowl, the screw conveyor assembly is rotated through the gear drive **74**. This gear

mechanism is such that the conveyor is rotated at a speed that varies by some 10 or 30 revolutions per minute from that of the bowl with the direction of rotation of the screw conveyor with relation to the bowl being such that the helical screw conveys the concentrated solids with the bowl axially therealong to the solid discharge outlets **76** at the end of the bowl with these preferably being a plurality of such openings circumferentially spaced.

In the operation of the centrifuge, slurry is introduced into the hub of the screw conveyor through the conduit **68**. The screw conveyor and the bowl rotate about the horizontal axis at a relatively high speed as for example 1000 to 2000 r.p.m., and the slurry passes out through the ports **77** provided in the hub and into the area between the hub and the bowl. The solids are thrown and retained against the inner surface of the bowl, and the screw conveyor moves the solids along the bowl towards the outlet **76**. The liquid forms a pool designated **78**, and there is provided in the head **50** one or more outlets **80** for this filtrate.

The rotating bowl of the centrifuge is mounted within the casing **82** which is formed in two parts (upper and lower) with the upper being removably fastened to the lower as by bolting, with these two halves having cooperating flanges by means of which they are joined. There is provided within the casing baffles **84**, **85**, and **87**, which cooperate with annular rings **86** formed on bowl **48** so as to provide a restriction or labyrinth which is for the purpose of preventing the intermixing of the concentrate and filtrate after they have been separated and discharged from the rotating bowl. The filtrate is discharged into the chamber **88** in casing **82** and passes down to and out the outlet hopper **90**.

Disposed about the end of the bowl from which the concentrate is discharged is the collecting member or gutter **92**. As illustratively disclosed, this collecting member takes the form of a circular plate **94** which has secured to its periphery, rim **96** with this rim extending in an axial direction so that its inner face **98** lies adjacent but spaced from the baffle **84** as disclosed. The plate **94** is secured to hub **97** with this hub being disposed within a suitable bearing **99** so that the collecting member may freely rotate with the axis of rotation of the collecting member being the same as that of the bowl **48**. The bearing **94** is mounted in stationary ring **100** which has secured to the upper region laterally extending plates **102** which are formed in a semi-circular arch and welded to the outer surface of the ring with the ends of these plates being secured to a transversely extending flat plate **104**. Complementary with this plate **104** is the plate **106** mounted on the lower portion of the casing of the centrifuge with support gussets extending down from the plate **106** to provide a more rigid construction. Secured to the outer end of hub **97** is the gear **110** which, together with chain **112** and motor **114** (FIG. 1), provides a drive for the collecting member.

The collecting member is rotated at a speed that is much less than that of the bowl **48**, and the concentrate that egresses from the outlets or discharge ports **76** of the bowl is thrown generally radially outward and engages the inner surface of the collecting member of gutter. The material is removed from the collecting member at the lower region thereof with there being provided a stationary scraper or plow **116** which may have the configuration in FIGURE 3 and which conforms closely to and is adjacent the inner surface of rim **96** and the inner surface of plate **94**. This plow is inclined in an upward or upstream direction relative to rotation of collecting member **92** with the plow being provided with a bracket **118** which is clamped to the baffle **84** with the bracket being received between plates **120** that are secured to this baffle and with such screws **122** engaging and retaining the bracket in place. An opening **121** is provided in the baffle **84** at the location of the stationary plow **116** with this opening being somewhat elongated at the upstream direction of rotation of the collecting member from the location of the plow **116**. With this arrangement, the concentrate is continuously removed from the collecting member by the plow **116** with the concentrate egressing through the opening **121**. The outer end of the plow **116** is provided with a downwardly directed baffle which directs the concentrate downwardly into the discharge chute **116** which in turn is connected with the duct **36**.

With this arrangement for removing the concentrate from the centrifuge, a continuous and relatively uniform discharge of concentrate is provided with the discharge being at the particular location that is desired and with there being no buildup of concentrate within the centrifuge. Moreover, these objectives are achieved in a manner which requires little power of consumption and with there being little wear on the mechanism that is utilized to achieve this steady discharge flow.

In the operation of the centrifuge, the bowl **48** may rotate between 1000 and 2000 r.p.m. while the collecting member **92** will rotate very slowly, such as between 10 and 20 r.p.m. With this great difference in rotational speed, it makes no difference in which direction the collecting member rotates with relation to rotation of the bowl. The concentrate which egresses from the bowl remains generally at the inner peripheral surface (building up somewhat on the outer extremity or region of plate **94**), collecting member throughout the rotation thereof with an annular layer of the concentrate (**123** in FIGS. 5, 6, and 7) being built up on the surface of the collecting member and with this layer being continuously removed by the stationary pump **116**. Since concentrate is continuously egressing through outlets **76** of the bowl throughout 360° of its rotation, this annular **123** of concentrate gets progressively thicker as the circumferential distance from the plow **116** increases.

The control of the liquid-solid slurry to the centrifuge may be effected by means of regulating pump **31** or by other suitable means with a steady discharge from the centrifuge being provided which may be maintained over extensive periods as required in various processes, such as the firing of a furnace, and with the wear and power consumption encountered in discharging the concentrate from the centrifuge being maintained at an optimum low value.

While we have illustrated and described a preferred embodiment of our invention, it is to be understood that such is merely illustrative and not restrictive and that variations and modifications may be made therein without departing from the spirit and scope of the invention. We therefore do not wish to be limited to the precise details set forth but desire to avail ourselves of such changes as fall within the purview of our invention.

What is claimed is:

1. In a system for providing a continuous supply of mechanically dewatered coal for the firing of a furnace the combination of a centrifuge adapted to continuously receive a slurry of crushed coal and water, said centrifuge including a bowl, mean mounting said bowl on a horizontal axis, means for rotating said bowl about said axis, said bowl having a concentrate outlet at one end from which the concentrate is generally radially directed and a filtrate outlet remote from said concentrate outlet, shaft means projecting from said bowl at the end thereof adjacent said concentrate outlet with said shaft means being co-axial of the bowl, annular means positioned in proximity of the concentrate outlet end of the bowl and providing a collecting surface for receiving the concentrate as it is directed radially from the bowl, this annular means being co-axial of said axis, means for rotating said annular means about said axis at an angular velocity substantially less than that of said bowl, means disposed at a generally fixed location at the lower portion of the annular means and extending into close proximity to the collecting surface of said annular means ef-

fective to engage and continuously remove the concentrate from said annular means at said location.

2. The organization of claim 1 wherein the bowl is rotated at a speed of between 1000 and 2000 revolutions per minute and the annular means is rotated at a speed of between 10 and 20 revolutions per minute.

3. In a system for providing a continuous supply of mechanically dewatered coal for the firing of a furnace the combination of a centrifuge adapted to continuously receive a slurry of crushed coal and water, said centrifuge including a bowl, means mounting said bowl on a horizontal axis, means for rotating said bowl about said axis, said bowl having a concentrate outlet at one end from which the concentrate is generally radially directed and a filtrate outlet remote from said concentrate outlet, shaft means projecting on said bowl at the end thereof adjacent said concentrate outlet with said shaft means being co-axial of the bowl, annular means positioned in proximity of the concentrate outlet end of the bowl and disposed about said shaft means co-axial thereof, said annular means having a horizontal collecting surface disposed to receive the concentrate generally radially directed from the bowl with this collecting surface being at

one longitudinal extremity of said annular means, means for rotating said annular means about its axis at an angular velocity substantially less than that of said bowl, a stationary plow member mounted at a fixed location at a lower region of the annular means, said plow extending into close proximity to said horizontal collecting surface and effective to engage and continuously remove the concentrate from said surface.

References Cited by the Examiner

UNITED STATES PATENTS

884,830	4/08	Lindahl	233—10
1,806,241	5/31	Dupuis	233—7
2,346,151	4/44	Burk	110—7
2,740,580	4/56	Schmiedel	233—7
2,919,848	1/60	Howe	233—7
2,920,923	1/60	Wasp et al.	302—66
3,073,652	1/63	Reichl	302—66

JAMES W. WESTHAVER, *Primary Examiner.*

FREDERICK L. MATTESON, JR., KENNETH W. SPRAGUE, *Examiners.*