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APPARATUS FOR PULVERIZING AND DISPERSING SOLID MATERIAL INTO LIQUID SUSPENSION

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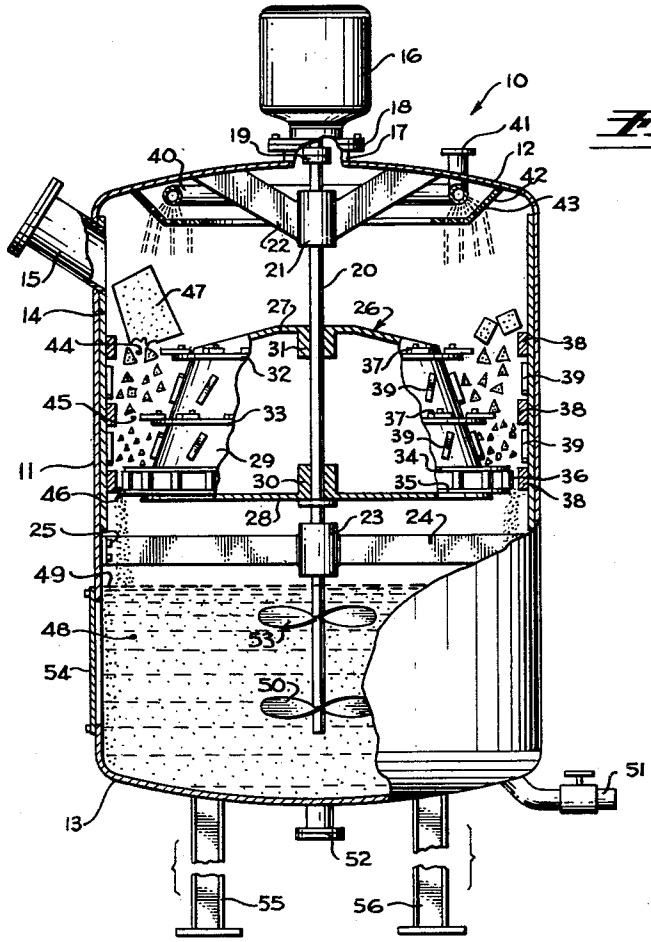

Fig. 1

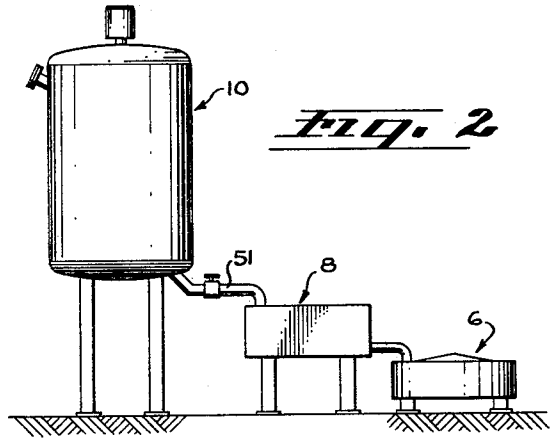

Fig. 2

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APPARATUS FOR PULVERIZING AND DISPERSING SOLID MATERIAL INTO LIQUID SUSPENSION

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It is the broad object of this invention to provide a unique method and a highly versatile apparatus whereby a solid material may be reduced to the desired particle size and almost simultaneously dispersed in a liquid media to thus make a hydrosol, oleosol, plastisol and the like.

More specifically it is the object of this invention to provide a method and a device whereby a cold solid chunk of relatively low penetration, high melting point asphalt or similar thermoplastic material together with its fibrous sack or container may be both reduced to small particle size and almost simultaneously dispersed in the desired amount and type of liquid desired.

Other objects of the invention include the avoidance of danger of any dust explosion and of heat build up within the mill housing itself; and the complete elimination of the usual dust problems normally experienced with the pulverization of a solid by means of the conventional impact mills.

It is also the object of this invention to provide a pulverization unit in combination with a mixing or dispersion unit whereby the operator may at will accomplish dry or wet pulverization with or without wet or dry mixing as well as wet or dry mixing sans pulverization.

Other objects of this method and apparatus will be apparent from the following specification, drawing and claims.

To fully understand exactly how and in what respects my process and device differs from the prior art it will be necessary to point out that the present day impact mills belong to two general classifications, one of which is an impact mill having a plurality of discs and the like all of equal circumference. These discs or rotors are mounted vertically on a horizontal shaft and are provided with impactors, shredders, cutters, hammers and the like. The impactors or hammers etc., may be of stationary or pivotal type or indeed may be a part of each disc itself. In operating this type of mill relatively large pieces of solid material are fed through a mill opening and the solid material passes downwardly into the path of the rapidly moving discs with their impactors. The solid material is thus struck with full shock of impact and is shattered and hurtled against a stationary target area. This so called target area usually consists of a screen, screed, breaker plate, perforated plate, lugs, pins or ribs and the like. The solid material hurtled by the impactors against the target area is further shattered by force of impaction with same. It is very important to repeat that the rotors or discs of this type of mill are of equal circumference and as a consequence the peripheral speed of each disc or rotor is identical to its companion disc or rotor.

The other common type of impact mill is one having a singular horizontal rotor or grinding table and the like provided with impactors, cutters, shredders etc., mounted on a vertical shaft and usually powered by a turbine type motor. In operation this type of mill relatively smaller sized particles of solid material are fed through the mill opening and the solid material passes downwardly against and upon the rapidly moving rotor and impactors etc. The solid material is struck by force of impaction thus shattering and accelerating the solid material to a high velocity. The shattered particles thus acquire by centrifugal force and by impaction a high kinetic

energy and are thus further shattered by impaction against suitable target areas located on the inner walls of the mill housing at points beyond the periphery of the rapidly moving rotor with its impactors etc. It is important to note that the speed on this rotor is constant and as a result each particle of solid material receives the same degree of impaction as some companion particle of solid material. It is important too to relate that neither of the two aforementioned mills provide means for dispersing or mixing the product resulting from the impaction.

I have discovered that I can obtain improved particle size reduction and at the same time achieve the objects of my invention if I employ a plurality of discs rotors and the like with impactors, impellors, shredders, cutters etc., mounted horizontally on a vertical shaft. My discs or rotors differ from the above mentioned mills in one very important manner in that I provide two or a plurality of discs of progressively larger circumference as the solid material passes downwardly from the mill opening. First the solid material is struck by full force of impaction by a primary rotor of relatively small circumference and the shattered material is hurtled against a first target area, following which the material thus shattered is directed downwardly against and upon a secondary rotor having a slightly larger circumference than the primary rotor. Thus the solid material is hurtled against a secondary target area by increasing peripheral speed and greater force of impaction and directed downwardly against and upon a tertiary rotor of even larger circumference than the secondary rotor from which it is thrown outwardly against the third target area from which point the thus pulverized material is thrust downwardly into a mixing, dispersion or temporary storage compartment which is provided with a suitable outlet port or ports as may be desired by the operator. My device permits many variants in operation as for example: (1) Dry pulverization, no mixing, (remove lower impellor or impellors). (2) Wet pulverization, no mixing, (lower impellor or impellors removed). (3) Dry pulverization and dry mixing. (4) Dry pulverization and wet mixing. (5) Wet pulverization and wet mixing. (6) Wet or dry mixing by bypassing upper pulverization chamber.

While I have indicated primary, secondary and tertiary rotor of progressively larger circumference it is apparent that more or fewer rotors could be employed without departing from the spirit of the invention. It is equally obvious that these rotors may be provided with any one or combinations of many types of impactors, shredders, cutters, maces, hammers and the like without departing from the objects of the process or device itself, and that such impactors may be separately pivoted or secured to, or may be integral parts of the crusher rotor. This same logic applies to the so called target area consisting of one or a combination of any of the following objects: projecting pins, pegs, ribs, screeds, cutter rings or similar projections against which the solid material is hurtled by means of the rotors with their impactors etc.

My process and device is implemented by two or more zones of impaction which consists essentially of primary, secondary, tertiary crushing areas wherein the solid material encounters progressively higher peripheral speeds with progressively diminishing distances to corresponding target areas beyond the periphery of the disc or rotors. Thus the solid material is struck harder and harder as it passes downwardly against ever diminishing tolerances in respect to distance between rotor or discs and the inner wall of the pulverization housing to thus obtain improved particle size reduction.

This invention is a continuation in part of my co-pending application filed August 20, 1958, Serial Number 756,083, "Method of Producing a Composite Liquid Bituminous Binder," now abandoned.

Other objects and advantages will become apparent in the ensuing specification and appended drawing in which:

FIG. 1 is a side elevational view of the crusher mill of an apparatus embodying my invention, with parts broken away and shown in section to better illustrate the construction; and

FIG. 2 is a schematic diagram of the apparatus.

The Apparatus

Referring now to the drawings in detail, I have shown therein, as an example of one form of an apparatus that may be utilized in the practice of the invention, a system wherein a mixer **6** receives from a surge tank **8**, a mixture of pulverized material and solvent which has been processed in a crusher mill indicated generally at **10**.

Referring now to FIG. 1, the mill **10** has a housing including a side wall **11**, a top wall **12** and a bottom wall **13** integrally joined to define a closed processing chamber. Secured to the inner face of side wall **11** is a cylindrical wear resistant liner **14**. Communicating with the upper area of this chamber is an inlet nozzle **15**. A motor **16**, mounted upon a flange **18** on a tubular neck **17** on the housing top **12** at the center thereof, has its drive shaft connected through a coupling **19** to the crusher shaft **20** which is mounted in bearings **21** and **23** on the vertical major axis of the crusher. Top bearing **21** constitutes an integral part of a spider **22** which is secured to and suspended from the housing top **12**. Bearing **23** is a part of a spider **24** which is secured at **25** to the side wall **11** of the housing.

The crusher embodies a drum **26** having a crown **27** presenting a frusto conical surface for deflecting chunks of material downwardly and outwardly, having a bottom disc **28**, having a frusto conical side wall **29** of relatively steep inclination with respect to the inclination of crown **27**, and having bearings **30** and **31** formed integrally with the bottom plate **28** and crown **27** respectively.

Secured to the side wall **29** (e.g. by welding) are upper and intermediate hammer support rings **32** and **33** and a pair of vertically opposed lower support rings **34** and **35**. Mounted between the rings **34** and **35** are grinder rollers **36**. Hammers **37** are pivotally mounted upon the support rings **32** and **33**. Opposed to the hammers **37** and rollers **36** respectively are three impact target rings **38** and between the rings **38** are two impact ribs **39**, the parts **38** and **39** all being mounted upon the liner **14**.

Mounted in the housing top **12** is a tubular fluid injection ring **40** having an inlet **41** extending through the top **12**. Injection ring **40** has a series of circumferentially spaced delivery apertures through which fluid is sprayed onto a deflector collar **42** having a large number of apertures **43** for directing the fluid downwardly in a cylindrical spray, into the annular area above the series of crusher gaps **44**, **45** and **46** which are defined between the hammers **37** and grinder rollers **36** on the one hand and the impact rings **38** on the other hand. It may be noted that the gaps **44**, **45** and **46** are of progressively decreasing radial width corresponding to the progressively increasing diameters of the paths of the hammers **37** and grinding rollers **36**.

At **47** is shown a relatively large chunk of asphalt material which has entered the crusher chamber through the inlet nozzle **15**. As the lower end of the chunk of material **47** reaches the plane of rapid rotation of the hammers **37**, smaller chunks of the material will be broken away from the large chunk **47** and will be thrown violently outwardly against the upper impact ring **38**, where they will be further reduced by exploding impact with the ring **38**. The finer chunks thus produced will drop through the gap **44** against the hammers **37** of the crusher ring **33** and will be further reduced by impact with these hammers and by being thrown against the intermediate impact ring **38**. The still finer particles thus produced will drop through the gap **45** against the rollers **36** and will be thereby thrown outwardly against the tertiary impact ring **38** and pulverized by impact and grinding action to produce a relatively fine stream of pulverized solid particles sifting downwardly in the spray of solvent liquid descending from the deflecting collar **43**. This mixture will collect in the bottom of the crusher tank to form the hydrosol **48** the upper level of which is indicated at **49**. Impellers **50** and **53** on the lower end of actuator shaft **20**, will continually agitate the hydrosol **48** to promote the suspension or dissolution of the solid particles in the solvent.

In the operation of the apparatus, the hydrosol will be drawn off through a valved outlet **51** and transferred to the surge tank **8** from which it will be again transferred into the mixer **6**. A drain connection **52** in the bottom **13** of the crusher tank, and a clean-out door **54** in the lower area of the side wall **11**, are provided for clean out purposes. Supporting legs **55** and **56** may be utilized for supporting the crusher tank at a suitable height for gravity draining into the surge tank **8**.

The Process

My improved process of pulverization will be partially apparent from the above description of the apparatus. In general, it contemplates the introduction of chunks of solid material into the upper of a series of impact-crushing gaps of progressively diminishing radial widths, in which the chunks of material are successively reduced to finer particle size, while an annular curtain of solvent spray is dropped into the crushing gaps, commingling with the particles as they are progressively reduced, and finally descending in a mixture of finely crushed particles and solvent mist, into a liquid body of the mixture of solvent and particles in the bottom of a crusher tank. In particular, the process utilized a series of crushing steps executed by a number of groups of crushing hammers or impellers, rotating respectively in a number of vertically spaced horizontal planes, in rotary paths of successively greater diameter, and with correspondingly increased speed of impelling and impact action at each of the successively lower planes of rotation. Thus, as the particles are progressively reduced in size, the finer particles are impacted by impellers rotating at a higher peripheral speed than the impellers at a higher level which act upon the larger particles. This higher speed of rotation of the impellers which act upon the finer particles is important in obtaining a satisfactory degree of further reduction of the finer particles.

I claim:

1. Apparatus for the processing of hydrocols, oleosols, and the like, wherein a solid material is pulverized and suspended in a liquid phase and is maintained in suspension or solution in a body of the liquid, said apparatus comprising: a mill housing; means supporting said housing in a fixed position on a vertical axis, said housing having an upper pulverization chamber and a lower dispersion chamber; an actuator shaft journalled in said housing upon the vertical axis thereof; means for rotating said shaft; a crusher rotor mounted on and driven by said shaft, said rotor comprising a plurality of groups of hammers rotating in respective paths of rotation which are vertically spaced from one another and are of progressively increasing diameter and peripheral speed of rotation from the upper toward the lower area of said rotor; means providing a plurality of fixed target areas on the inner wall of said housing in horizontally opposed relation to the respective groups of hammers and spaced therefrom by pulverizing gaps of respectively decreasing widths from the upper toward the lower area of said rotor; means at the top of said housing providing an annular spray of liquid descending through said gaps and mixing with the pulverizing material discharged from the lower gap into said dispersion chamber; and means for drawing off the suspension of liquid and solid particles from the lower area of said dispersion chamber in a controlled manner such as to maintain a body of liquid filling at least a portion of said dispersion chamber; said shaft projecting

downwardly into said dispersion chamber and further including an agitator secured to said shaft in a position for operation in said body of liquid in the dispersion chamber for inhibiting the settling out of the solid particles from said body of liquid.

2. Apparatus for pulverizing solid materials comprising a mill housing; means supporting said housing in a fixed position on a vertical axis, said housing defining a pulverization chamber; means for delivering chunks of solid material into the upper portion of said pulverization chamber at the periphery thereof; a crusher rotor rotatably mounted in said chamber for rotation on said vertical axis and comprising a plurality of groups of hammers rotating in respective paths of rotation which are vertically spaced from one another and are of progressively increasing diameter and peripheral speed of rotation in a downward direction; and means providing a plurality of fixed targets of circular configuration in respective vertically spaced horizontal planes, radially opposed to the respective groups of hammers and horizontally spaced therefrom by pulverization gaps of respectively decreasing width in a downward direction, said rotor further including a drum having a substantially closed periphery disposed circumferentially of said vertical axis and radially inwardly of but adjacent said hammers, for confining said chunks of solid material within said pulverization gaps during downward movement thereof in the pulverization chamber, wherein said hammers are pivoted to said drum periphery on vertical axes at their inner ends.

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