

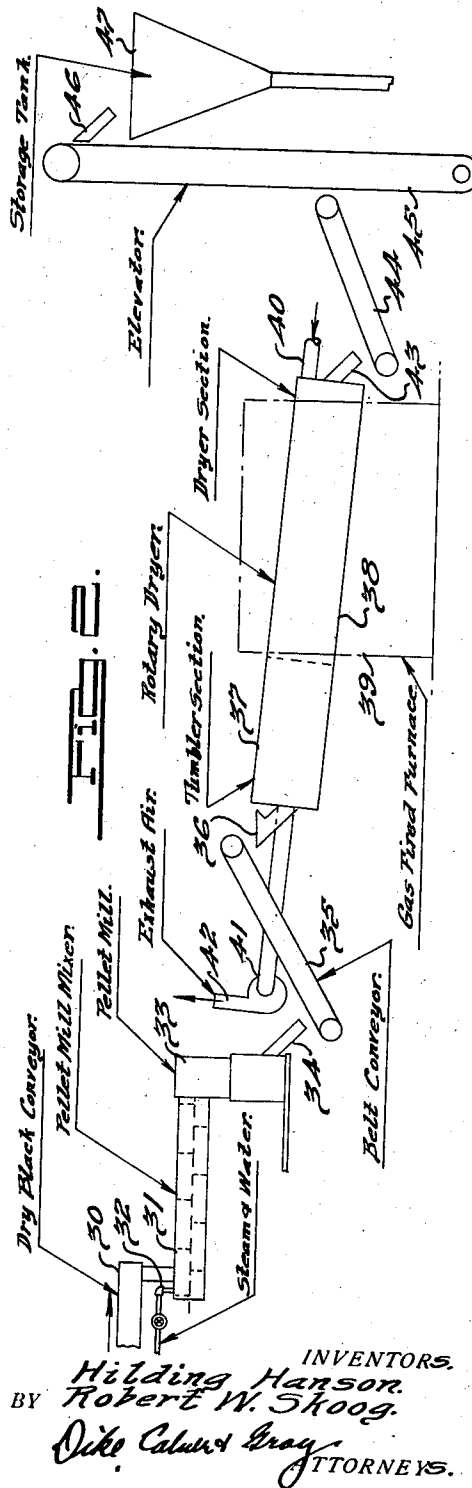
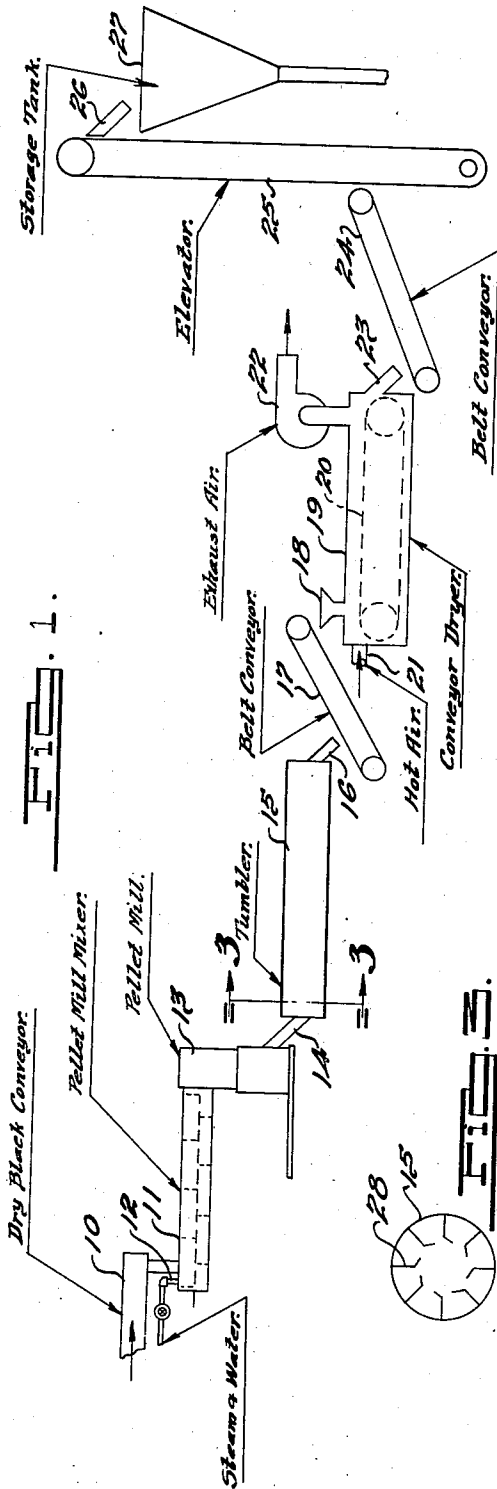
May 19, 1942.

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2,283,364

PROCESS FOR AGGLOMERATING CARBON BLACK

Filed April 29, 1938



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UNITED STATES PATENT OFFICE

2,283,364

PROCESS FOR AGGLOMERATING CARBON
BLACK

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Application April 29, 1938, Serial No. 205,138

3 Claims. (Cl. 23—314)

The present invention relates to an improved method of treating finely divided flocculent powders, such for example as carbon black, for the purpose of increasing the specific weight of the powder and to render it substantially dustless. At the same time the present process is intended to impress upon such products a form adapted to sustain without breaking the loads imposed on the particles during normal handling and shipping of the materials.

The present invention provides an economic and commercial means of reducing a given mass of flocculent powders to a fraction of its untreated bulk or volume without impairing the working qualities or dispersion of the treated product in an end product.

The present invention is adapted to produce easily handled agglomerates or shaped masses of the finely divided solids, such for example as carbon black, for the purpose of overcoming the objectionable properties of such materials such as the formation of dust during the handling of the mass and during the mixing of the same with dispersion mediums of various kinds.

As an important example of the present invention, carbon black may be taken as the finely divided solid material to be treated. The term "carbon black" as used herein is used in its broad sense to include lampblack, gas black, and other carbon black substitutes commonly employed as pigments or fillers. It is to be understood, however, that the apparatus and process of the present invention may be successfully utilized in treating other finely divided material of a flocculent nature and particularly for transforming an impalpable powder into relatively minute granules or dustless aggregates so as to better adapt it for purposes of handling, shipment or storage and use.

It is, therefore, a principal object of the present invention to provide a method of treating flocculent powders to form shaped agglomerates capable of ready and uniform dispersion in a selected dispersion medium, the agglomerates occupying a decreased space and being more readily shipped, stored and handled than the unagglomerated flocculent powder.

A further object of the present invention is to provide an improved method of treating flocculent powders to form pellets of generally columnar shapes which are non-adherent and possess sufficient density to resist ready displacement in the air, the pellets themselves being of such shapes and strengths as to resist crushing in normal handling and shipping but possessing

a readily frangible internal structure such that the pellets can be readily broken up to make the individual particles of the powder available for dispersion in the dispersion medium.

Another object of the present invention is to provide substantially dustless agglomerates of finely divided normally flocculent powdered materials, such for example as carbon black, which are of substantially uniform sizes and of regular shapes, the agglomerates being substantially cylindrical in contour with hemispherical end surfaces which eliminate sharp edges and irregular shaped end surfaces on the formed agglomerates.

Carbon black as originally produced may be said to have a specific weight of approximately 3 lbs. per cubic foot. It has been the practice to increase this weight from about 8 to about 12 lbs. per cubic foot by a densifying operation. The densified carbon black may then be increased in weight to approximately 25 lbs. per cubic foot by a compressing operation. The resulting compressed carbon black is still inconvenient to handle because it readily reverts to its initial dusty form.

As contrasted to a compressed carbon black, carbon black processed by the present invention is converted into small granules of increased specific weight, the particles forming the internal parts of such agglomerates being held in a relatively tenacious structure. Each of the resulting granules presents more or less cylindrical shaped pellets having non-adherent surfaces and polished, regular end surfaces generally hemispherical in shape. The carbon black in this form possesses all of the advantages of convenience in handling and distribution above discussed and in addition it disperses satisfactorily in dispersion mediums in which the carbon black is to be employed.

By way of example but not of limitation, other fine dry powders which may be processed according to the present invention in addition to carbon black may include zinc oxide, iron oxide, or any other finely divided solid which in its dry state is of a substantially dusty character and which is to be incorporated in a dispersion medium as minute discrete particles which form the fillers or coloring matter of the completed product.

In carrying out the present process the occluded atmospheric air or other gases are displaced by a liquid which will not act as a solvent for the mass being treated and which will not act to chemically or mechanically change the

particles themselves. This displacement may occur by admixing the powder and either the liquid or vapor phase of the liquid, after which the vapor is condensed and the powder wetted by the condensed liquid.

The liquid and the material is thoroughly intermixed in any suitable manner and by means of any suitable mixing machine. The relative proportions of liquid and solid are preferably such as to form a paste or wet plastic mass which may be formed into the desired form of aggregated particles. During the intermixing the liquid or the vapors of the liquid force out and displace the gas absorbed by the particles or occluded between the particles, resulting in bringing the particles of the mass much closer together and rearranging or shifting these particles so that the interstitial spaces are of much smaller magnitude when filled with such a liquid than when filled with gas. After the gas has been expelled, the particles are formed into the desired sized and shaped agglomerates and the liquid is removed without increasing materially the sizes of the interstitial spaces. In such cases, the withdrawal of the liquid presumably serves to further draw together the individual particles and thus results in a further reduction in the volume of the total mass.

The present invention proposes to form the dustless pellets in the form of generally columnar particles which may be triangular, cylindrical, square, hexagonal, octagonal, or other desired shape in cross section. The fragments are of different lengths and preferably are so formed that the adjacent side and end surfaces of the particles have a non-adherent rolling contact. By providing such rolling contact, bridging of the processed materials in conveyors, bins, chutes, and the like, is largely eliminated. A distinct advantage is derived by forming the pellets as columnar fragments as this shape adapts the particles to withstand loads during shipment and handling which would crush particles of other shapes.

For carrying out the process of the present invention an apparatus may be employed similar in nature to that shown diagrammatically in the accompanying drawing, the figures of which show the elements of apparatus utilized in carrying out the present embodiment of the invention there depicted, as well as showing the order of the successive steps of that process. It is to be expressly understood, however, that this apparatus is shown merely for purposes of illustration and not as limiting the scope of the invention. It is to be further understood that the present invention contemplates a process operative upon any finely divided powdery material and is intended to cover all such materials. Thus the following apparatus, while described as operating with carbon black, which is a typical and especially apt example of one use of the present invention, is adaptable for use with any finely divided flocculent or powdery material.

In the drawing:

Fig. 1 is a diagrammatic view showing a method which embodies the present invention;

Fig. 2 is a diagrammatic view showing a method embodying a modified form of the invention shown in Fig. 1;

Fig. 3 is a diagrammatic sectional view taken substantially on the line 3-3 of Fig. 1 looking in the direction of the arrows.

Before explaining in detail the present invention it is to be understood that the invention is

not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawing, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation, and it is not intended to limit the invention claimed herein beyond the requirements of the prior art.

In carrying out the method embodying the present invention according to the diagrammatic view of Fig. 1, a mixture of dry carbon black and water is effected to form a paste-like mass of the desired consistency. Such a mass is formed into agglomerated particles substantially cylindrical in shape by the operation of a pellet mill. The wet particles are then subjected to a rotary tumbling operation which further shapes the particles to provide a shape which is substantially cylindrical with hemispherical end surfaces. When the particles have been so formed the moisture is removed from the particles either by treatment in a conveyor drier, as shown in Fig. 1, or by treatment in a rotary drier, as shown in Fig. 2.

The general method of the present invention may be practiced in accordance with the diagrammatic view shown in Fig. 1 wherein 10 designates a dry black conveyor for delivering dry black which may be either loose black having an apparent density of approximately 3 lbs. per cubic foot or an agitated black having an apparent density of approximately 8 lbs. per cubic foot. Such black is delivered to the mixing apparatus 11 which is of any desired type of mixer, as for example a mixer having a central shaft with mixing arms thereon which may be power driven to thoroughly admix the dry black with steam and water which is delivered through the delivery conduit 12 either at one or several points in the mixer 11.

The thoroughly wetted black at the time it is fed to the pellet mill 13 preferably comprises approximately 50% carbon black and 50% water by weight. This gives a stiff paste-like mass which may be formed into generally cylindrical pellets of varying lengths by the action of the pellet mill.

A form of pellet mill which is satisfactory for the present purpose is a mill known in the art as the "California" pellet mill, which comprises a perforated stator member through which the paste is extruded by the action of a rotary member which bears upon the pasty mass fed to the machine and extrudes it through the perforations of the stator member.

The formed particles of wet carbon black are then delivered through a delivery chute 14 to the rotary tumbler 15. The rotary tumbler 15 is preferably formed as a cylindrical shell having inside a series of flights 28 (shown in Fig. 3). During passage through the rotary tumbler the generally cylindrical particles delivered from the pellet mill through the chute 14 are further compacted and the irregular end surfaces are formed into generally hemispherical surfaces. Such a form has been found to be desirable as it imparts a free flowing characteristic to the finished product and eliminates breaking of the end surfaces and the dusting off of the irregular particles which sometimes occurs in the handling of dustless blacks of generally cylindrical shape having irregular end surfaces thereon.

For certain purposes it is to be understood that

the irregularly shaped end surfaces of cylindrical agglomerates of carbon black may be found desirable as it permits a somewhat more ready dispersion of such particles than where the particles are formed by the process herein disclosed. However, for many purposes a structurally stronger particle is desired and such a particle is formed by the rotary tumbling operation which occurs in the tumbler 15.

The particles from the rotary tumbler 15 are discharged through a chute 16 to a belt conveyor 17, from which they are discharged from the hopper 18 to the conveyor drier 19. As shown here, the conveyor drier comprises a screen 20 in the form of an endless belt which carries the particles from the point of discharge from the hopper 18 to the point of discharge of the dried particles into the chute 23.

During the passage of the particles through the conveyor drier, hot air or gas is drawn into the shell of the drier through the inlet duct 21 and is exhausted through the air exhaust duct to which is connected a blower 22. In a preferred operation the hot air or gas is conducted into the conveyor drier at a temperature of approximately 500° F. and is discharged at a temperature of approximately 250° F. This has the effect of substantially reducing the moisture content of the particles treated and in an average example it has been found that the moisture content of the discharge particles is in the neighborhood of approximately 1.16% by weight.

The dried particles will be found to have a specific weight of approximately 24.2 lbs. per cubic foot when discharged from the conveyor drier through the discharge duct 23. The particles may be delivered to the belt conveyor 24 and to an elevator 25, through which they may be discharged through the discharge duct 26 to a storage tank or hopper 27.

A representative sample of the completed product taken from the storage tank or hopper 27 will be found to possess a substantially uniform size. The particle size will, of course, depend upon the size of the perforations in the stator member of the pellet mill 13 but in a typical example it was found that approximately 92.8% of the completed material was retained on a 100 mesh standard testing screen, approximately 3.77% was retained on a 200 mesh screen, approximately 1.63% was retained on a 300 mesh screen, while the balance passed through the 300 mesh screen and was recovered from the testing pan.

A modified embodiment of the invention is shown in Fig. 2. As here shown, the dry black is delivered through the dry black conveyor 30 and is passed through the mixer 31 where it is admixed with steam and water, fed to the mixer from the supply pipe 32, which forms a pasty mix of approximately 50% carbon black and 50% water, which is passed through the pellet mill 33 and discharged through the discharge duct 34. This portion of the modified process is substantially the same as the comparable portion of the process shown in Fig. 1.

The particles are discharged from the pellet mill 33 through the duct 34 to an endless belt conveyor 35 which discharges into a hopper member 36. The hopper member 36 feeds the wet particles into the tumbler section 37 which is comparable in interior construction and operation to the tumbler 15 shown in Fig. 1. After passing through the tumbler section 37, the wet particles are fed to the rotary drier 38. The

drier preferably is a cylindrical rotary shell which passes through a gas fired furnace section 39, wherein it is heated to the desired temperature. In a preferred embodiment the tumbler section is approximately one-third the length of the drier section.

The drier section and the tumbler section are ventilated by air or other suitable gas which is drawn in through the inlet duct 40. When using air as the scavenging medium it is preferably preheated to a temperature of approximately 150° F. upon admission through the inlet duct 40. An exhausting fan 42 connects with the exhaust duct 41 and withdraws the scavenging air from the end of the tumbler section. By this arrangement the heated air drawn through the drier section and the tumbler section makes for an efficient removal of the moisture in the wet particles as they pass through the tumbler section 37 and the rotary drier 38.

By subjecting the particles to rotary tumbling motion during the drying, it has been found that many of the fine particles which may be separated from the agglomerates by the action of a conveyor type drier are re-agglomerated and re-formed so that a larger percentage of the larger particle sizes may be achieved by the use of such drying apparatus.

The dried particles are discharged from the discharge duct 43 at a temperature of approximately 200° F. A test of a representative sample discloses approximately 1.4% moisture by weight. The particles are discharged to the endless belt conveyor 44 and to the elevator 45, from which they are discharged from the duct 46 to the storage tank or hopper 47.

A representative sample taken from the storage tank or hopper 47 shows a specific weight of approximately 24.2 lbs. per cubic foot. The particles are generally cylindrical in shape and have hemispherical end surfaces which are relatively smooth and polished. The particles show an exceptional uniformity as to size and upon testing in the same manner that the product of Fig. 1 was tested, it was found that 99.69% was retained on the 100 mesh screen and the balance was substantially equally distributed between the 200 and the 300 mesh screen tests and in particles which passed through the 300 mesh screen and were recovered from the testing pan. These particle sizes were made with the same type and size of pellet mill in both instances, the stator members used were uniform as to size, so that the initial formation of the wet mass of carbon black into generally cylindrical particles was the same in both instances. It is to be noted that the process as shown in Fig. 2 produces approximately 7% more of the larger particles than does the process as shown in Fig. 1, although the initial wet pellets are formed under the same conditions and are of substantially the same average sizes in both instances. Related subject matter is claimed in Patent 2,213,059, issued August 27, 1940, to H. L. Teegerstrom.

We claim:

1. In a process of forming substantially dustless agglomerates of carbon black, the novel steps of extruding a paste of substantially equal parts by weight of water and carbon black to form columnar segments having smooth sides and rough and irregular ends, thereafter tumbling the wetted segments to form smooth substantially hemispherical ends thereon, and thereafter drying said tumbled segments.

2. A process of forming densified substantially

dustless carbon black particles which may be readily broken up for dispersion in a desired dispersion medium but have sufficient strength to withstand handling, shipping and storage without disintegration and the formation of dust, which comprises displacing the adsorbed and occluded gases of a mass of dry carbon black by wetting the mass with water and working the wetted mass to form a substantially homogeneous paste, extruding the said paste to form pellets of generally smooth sided cylindrical shape but having relatively sharp edges and rough irregular surfaces on each end thereof, subjecting the said wet pellets to a rotary tumbling agitation to remove the said sharp edges and rough irregular surfaces from the ends and form smooth substantially hemispherical ends thereon, and thereafter dehydrating the formed wet pellets by subjecting them to heat not exceeding approximately 500° F. thereby effecting a removal of water without causing a chemical change in the carbon forming the pellets.

3. A process of forming densified substantially dustless carbon black particles which may be

readily broken up for dispersion in a desired dispersion medium but have sufficient strength to withstand handling, shipping and storage without disintegration and the formation of dust, which comprises displacing the adsorbed and occluded gases of a mass of dry carbon black by wetting the mass with water and working the wetted mass to form a substantially homogeneous paste, extruding the said paste to form smooth sided substantially cylindrical masses of varying lengths, the end surfaces thereof being irregular in contour and forming sharp edges at the points of juncture with the sides thereof, thereafter substantially equalizing the varying lengths of said masses and forming smooth-surfaced substantially hemispherical ends thereon by subjecting the wetted pellets to a rotary tumbling agitation, and thereafter dehydrating the formed wet pellets by subjecting them to heat not exceeding 500° F. thereby effecting a removal of water to produce dried carbon black pellets having substantially the same size and shape as said wet pellets.

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