The present invention relates to an improved method of treating finely divided flocculent powders, such as carbon black, for the purpose of increasing the apparent density in bulk of the powder, and thereby to render it substantially dustless. At the same time the present process is intended to impress upon such products a form adapted to resist loads imposed on the particles during normal handling and shipping of the material.

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.

As a result of the improved process herein disclosed, it is possible to reduce the size of the minute interstices or interstitial spaces between adjacent particles, flakes, crystals, or other units of the mass, and bring the individual units of the mass closer together without altering their individual size or character to any material or appreciable extent. In the dry state the minute interstices are ordinarily filled with absorbed and occluded gas or atmospheric air, which gives to the powdered material a distended or inflated condition which causes dispersion or dusting of the particles into the atmosphere.

The present invention is adapted to produce easily handled agglomerates or shaped masses of the finely divided solids, such as 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 in its broad sense to include lampblack, gas black, or other black carbon 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 smaller gas nature and particularly for transforming an impalpable powder into free flowing 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 dry flocculent powders to form shaped agglomerates thereof which are 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 irregular 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 fragile internal structure such that the pellets can be readily broken up to make the discrete particles available for dispersion in the dispersion medium.

Carbon black as originally produced may be said to have an apparent density in bulk of approximately 3 lbs. per cubic foot. It has been the practice to increase this apparent density in bulk to about 8 to 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 apparent density in bulk higher than before the treatment, 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 unpolished and irregular end surfaces. 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 oc-
cluded atmospheric air or other gases are dis-
placed 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 admitting the powder and the vapor phase of the liquid, either of which the vapor is condensed and the powder thereby wetted.

The liquid and the material is thoroughly inter-
mixed 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 aggre-
gated particles. During the intervening time the liquid or the vapors of the liquid force out and displace the gas, resulting in bringing the par-
ticles of the mass much closer together and re-
arranging 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 with-
drawal 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 removal of the liquid may be accomplished by evaporation alone or by heating at a temperature below that which will in any way adversely or deleteriously affect the material by melting, decomposing, charring, or otherwise.

Prior to the present invention objections have been raised to the use of a liquid for the purpose of displacing the occluded gases on the ground that there is formed a very persistent adhesion of particle to particle, with the resultant clump-
ing together of the particles and the loss of ready dispersibility of the particles into an end product. The present process preserves the finely divided character of the treated solid parti-
cles while utilizing the benefits of a fluid for wetting of the particles for the purpose of remov-
ing the occluded gases.

The present invention proposes to form the dustless pellets in the form of columnar frag-
ments 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 adjacent side surfaces of the particles have a non-adherent rolling contact. By providing such rolling contact and the varying lengths of the fragments, bridging of the processed mate-
rials in conveyors, bins, chutes, and the like, is largely eliminated. A distinct advantage is de-ived by forming the pellets as columnar frag-
ments with the use of a series of rolls which are 

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withstand loads during shipment and handling which would crush particles of spherical shape for example.

In accordance with the present invention the carbon black is moistened with water and steam and the mass is mixed to form a paste. The paste is then worked in a convor, preferably steam-packeted, and is pressed be-
tween the rotor and stator members. This forces the mass through the openings in the stator member of the said mill so that stiff, dusty, wet pellets are rejected from the mill. The pellets are then conveyed to a drying chamber where they are dried, preferably at a temperature above the boiling point of water so that speedy and effective drying may take place. The pellets from the pellet mill are warm at the time they enter the drier and this assists in drying the pellets by the heat supplied in the drier. The dried pellets so produced can then be transported to storage hoppers or bins, or other receptacles.

For carrying out the process of the present in-
vention an apparatus may be employed similar in nature to the one shown diagrammatically in the accompanying drawing, the single figure of which is a diagrammatic representation 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 illus-
tration and not as limiting the scope of the invention. It is to be further understood that my invention contemplates a process operative upon any finely divided powdery material and is intended to cover all such materials. Thus the term 'powdery material' is intended to cover a material consisting in the form of a powder or slurry, such as a powder or slurry consisting of carbon black suspended in a water solution, or any other substance which is utilized in carrying with carbon black, which is a typical and especially apt example of one use of the pres-
ent invention, is adaptable for use with any finely divided flocculent or powdery material.

In carrying out the present invention according to the embodiment indicated in the diagram mentioned, the dry carbon black may be fed through a conveyor 1 into a con-
ventional pellet mill mixer 2 or other suitable device adapted to mix the material thoroughly. Into this mixer 2 is introduced jets of hot water or steam and water if preferred. The use of steam is desirable as it assists in dispacing readily the gases absorbed on the carbon black par-
ticles and the gases and air which occupy the interstitial spaces of the dry black.

The material is thoroughly mixed to form a substantially uniform paste. The paste mass is dis-
charged from the mixer 2 through a chute or is otherwise transferred to the pellet mill 3. The pel-
let mill 3 is of conventional design containing rotor and stator members between which the paste is worked and forced through a plurality of pelleting openings in the stator portion of the pellet mill. The mill preferably is steam-jack-
eted or otherwise heated so as to retain the heat in the chamber in which the carbon black is pelleted.

These moist, heated pellets are delivered from the chute 4 to the belt conveyor 5 and are trans-
ferred thereby to the drying chamber 6, which in a preferred embodiment is a moving belt type of dryer. The pellets are fed into the hopper or mouth portion of the drying cham-
ber 6 and fall upon a perforated conveyor 8 which permits ready circulation of the heated drying medium throughout the drier and the mass of pellets carried on the conveyor.

Heated air at approximately 500° F. is intro-
duced into the chamber 6 through the inlet 

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conduit 9 from any suitable source of heated air or gas. The air or gas is under sufficient pressure to force it into the drier and over and through the mass of pellets on the perforated conveyor. An exhaust blower 10 is connected to the chamber 6 through the outlet conduit 11 and creates a suction effect in the chamber which facilitates the drying operation.

The air preferably enters the chamber at approxi-
mately 500° F., and is discharged at approxi-
mately 250° F. The temperature of this drying 

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The pellets are dried as they are carried through the chamber 5 on the perforated belt 8. The pellets, now dried, are discharged from the belt 5 into the chute 12 and fall upon the conveyor 13 which transports them to the elevator 14 and thence to the storage receptacle 15.

The speed of the various conveyors preferably is suitably adjusted to cooperate with the conveyor 8 to allow proper time for the drying step as well as to insure smooth transfer of the pellets and effective continuous operation throughout the entire process. For like reasons the speed of the pellet mill is suitably adjusted to insure the proper production of pellets. Pellet size is controllable by the sizes of the pellet openings in the stator of the pellet mill.

In a preferred embodiment of the invention the dry black and water are mixed in the proportion of approximately 50% by weight of the dry black to approximately 50% by weight of water and steam or either. The dry black used may be unagitated black having an apparent density of approximately 3 lbs. per cubic foot or it may be an agitated black having an apparent density of approximately 8 lbs. per cubic foot. In either case, the dried black discharged in the storage tank 18 at the conclusion of the process has a specific weight of approximately 24 lbs. per cubic foot. In a typical specimen of the product, approximately 91.7% was retained on a standard 100 mesh testing screen; approximately 4.7% was retained on a standard 200 mesh testing screen; and approximately 1.9% was retained on a standard 300 mesh testing screen, the balance being fines which passed through the 300 mesh screen. The moisture content was less than approximately 1%.

The completed product is characterized by being in the form of generally cylindrical pellets of varying lengths. Other geometric forms may also be employed as long as such forms are embodied in columnar fragments, that is, having a length greater than the diameter of the pellet. The ends of the pellets are generally irregular, which for certain purposes is desirable as the irregular portions are readily broken off to assist in breaking up the entire pellet when the carbon black is to be incorporated in a dispersion medium, such for example as water, rubber, oil, resins, and the like or similar mediums.

I claim:

1. The process of forming readily dispersible but substantially dustless carbon black particles which comprises wetting dusty carbon black with substantially equal amounts by weight of water, working the wetted mass to form a substantially homogeneous paste in which the wetted carbon black particles are substantially uniformly distributed and the adsorbed and occluded gases are displaced by the water, forming the homogeneous paste into columnar pellets of varying lengths, generally cylindrical in shape and having irregular end surfaces, and thereafter heating the pellets to remove a substantial portion of the water whereby the individual carbon black particles are compacted into readily dispersible dry substantially dustless pellets of columnar form-sustaining proportions and which are relatively non-adherent and possess sufficient strength to withstand without crushing the compression loads due to bulk handling of the particles.

2. The process of forming readily dispersible but substantially dustless carbon black particles which comprises wetting dusty carbon black with substantially equal amounts by weight of steam and water, condensing the steam, working the wetted mass to form a substantially homogeneous paste in which the wetted carbon black particles are substantially uniformly distributed and the adsorbed and occluded gases are displaced by the water, forming the homogeneous paste into columnar pellets of varying lengths, generally cylindrical in shape and having irregular end surfaces, and thereafter heating the pellets to remove a substantial portion of the water whereby the individual carbon black particles are compacted into readily dispersible dry substantially dustless pellets of columnar form-sustaining proportions and which are relatively non-adherent and possess sufficient strength to withstand without crushing the compression loads due to bulk handling of the particles.

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