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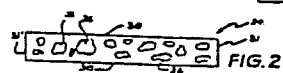
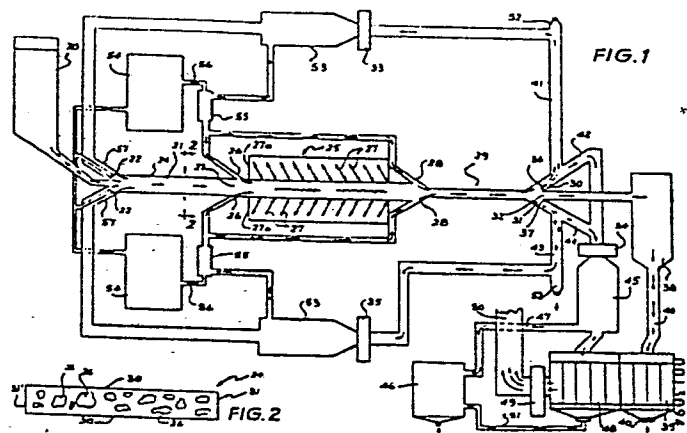
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(54) **Coal and mineral cleaning process and apparatus using shock frequency separation.**

(57) **Particulate solids (26) such as minerals comprising chemically or physically bound components of different hardnesses are to be broken down into smaller particles by means of shock frequency methods (25). The particles travel at high velocities and undergo inertia changes to cause the breakup. An apparatus for carrying out the method is also provided.**



"COAL AND MINERAL CLEANING PROCESS AND APPARATUS
USING SHOCK FREQUENCY SEPARATION"

This invention relates to a method and apparatus
of breaking the physical bond of particulate solids to
5 break the solids into fine particles. The invention also
provides for a method of breaking composite particulate
solids into their constituents.

For the purpose of this specification, composite
particles are defined as particles which comprise a
10 conglomeration of various constituent particle substances
physically or partly chemically bound together.

Most solid natural resources exist in composite
forms which contain pure constituent substances of
varying degrees of usefulness and end value. An example of
15 such a composite form is the grain product wheat which
contains flour, fiber, and germ. The flour particles in
turn comprise starch and protein particles physically
bound together and which are presently separated by
involved dry and wet processing means.

20 Most mineral and coal resources are recovered as
composite (not pure) particles, which must undergo further
complex processing to yield the desired valuable
constituent substance in a substantially pure form, and in
some cases, the cost of such processing exceeds the value
25 of the end product or there is simply no way of carrying
out a sufficient extraction so that many necessary
resources are left untapped or cannot be efficiently
processed to a high grade product.

Existing methods of extracting the various
30 constituent substances usually comprise crushing the solid
particles to a smaller size lump, grinding the lumps into
fine particles, followed by physical or chemical
processing of the fine particles to recover the desired
constituent substances. This is obviously a multi-stage
35 and thus costly and slow process.

We shall consider coal as an example of a
naturally occurring substance. Coal, when found in high
grade deposits, can be mined and used directly after

reduction to a usable particle size.

When coal is originally laid down, in places such as swamps, the organic matter which forms the coal is interspersed with generally small particles of inorganic material. The inorganic matter will hereinafter be referred to as ash. The ash particles generally have rounded edges because of the abrasion they undergo during their life before inclusion in the organic matter. Thus, the coal is basically a continuous layer of organic matter which includes varying amounts of ash particle inclusions or layers.

In a low grade (secondary) coal, it is essential to remove a great percentage of the ash for two main reasons. Firstly, the ash lowers the calorific value of the coal (i.e., coal as mined). Secondly, when the coal is burnt, the ash creates unacceptably high levels of pollution. However, it is presently not possible to economically reduce the ash content sufficiently in many coals to enable those coals to be sold and burnt. The main problem with existing coal-ash separation processes is that as the coal is ground into fine particles, so is the ash, making separation extremely difficult.

Thus, if the pure coal can be broken into very fine particle sizes in relation to the ash, i.e. without breaking the ash particles, then it may be readily separated from the ash.

The particle size distribution of the ash of a typical N.S.W. coal would be as follows:

	<u>Mineral</u>	<u>Particle Size Range (Microns)</u>
30	Feldspar	25-100
	Quartz	5-200
	Mica	40-80
	Kaolinite	15-375
	Carbonates	20-1250
35	Pyrites	5-400

In secondary coals, the ash makes up from about 6 to about 60 percent by weight of the coal ex-mine.

Thus as mentioned above, to reduce the ash to a suitably low level, it would be necessary to reduce the

pure coal to a particle size which in this instance would be less than say 20 microns, whilst not reducing the particle size of the ash. Thus the coal particles have a mass infinitely smaller than the ash particles. In the above
5 secondary coal, by removing all particles in excess of the 20 micron particle size would reduce the ash content of all particles left in the coal to 0.5 to 0.3 percent by weight ash. Even ash levels of about 0.10 percent by weight may be reached by further size reduction and
10 separation of the coal.

Therefore, if there can be selective breaking down of a particular particle constituent, then that particle can be separated from the larger particles.

Very often it is desirable to produce a very
15 fine particle size product in large quantities, however the normal grinding methods are slow and often inject impurities into the product from the grinding mill. Furthermore, it may be desirable to dry a wet or moist substance whilst carrying out size reduction or to
20 chemically treat it to convert certain constituents to say gases, or break down chemical bonds which bind particular constituent groups together, so that by further physical treatment they may be separated.

It is an object of this invention to provide a
25 method and apparatus for substantially selectively breaking the bond of a constituent substance of a composite particle or a pure particle.

In one broad form the invention provides a method of breaking the bond of a particulate solids feed
30 into fine particles comprising feeding the feed solids into a high speed gas stream, applying to the solids being carried in the gas stream a shock treatment which has been determined according to the characteristics of the bond between the particles of the solid to reduce the material
35 to smaller particles, and collecting the particles which have been subjected to said shock treatment.

In a further broad form the invention provides a method of selectively reducing in particle size a particular constituent or constituents of a composite particle,

comprising feeding the composite particle feed solids into
a high speed gas stream, applying to the solids being
carried in said gas stream a shock treatment which has
been determined according to the bond between the pure
5 particles and/or the constituent particles to be reduced
from the composite particle, separating the particles
following said shock treatment, and collecting separated
fractions.

By varying the temperature of the gas stream
10 in either of the above broad forms the feed material may
be dried, volatiles evaporated or chemical reactions
initiated.

Furthermore, by including specific chemicals
with the feed, it may be possible to carry out reactions
15 during the particle reduction or reactions with gases
(volatiles) given off during the processing.

In a further broad form the invention provides
an apparatus for reducing a particulate solid into finer
particles comprising an elongate flow chamber, means to
20 feed particulate solids into said chamber, high pressure
gas from gas production means into said chamber to fluidize
said particulate solids and carry said particulate solids
through said chamber into a gas-solid flow stabilization
zone leading to a shock treatment zone wherein said shock
25 generation zone there is provided means adapted to impart
a predetermined shock to said particles according to the
particular characteristics of the particles to be broken.
Furthermore there is preferably provided means to separate
and collect the various particle fractions following
30 treatment in said chamber.

The invention will now be described by way of
example only with reference to the accompanying drawings,
wherein:

Figure 1 is a diagrammatic view of the process
35 and apparatus of the invention; and

Figure 2 is a view of the section 2-2 of Figure 1.

The process is hereinafter described with
reference to composite particles. However, it is equally
applicable to noncomposite particles for size reduction,

drying or chemical treatment.

Coal shall be used by way of example only as the composite particulate solid to which the process is applied.

5 Coal which has been reduced to a particle size less than $1\frac{1}{2}$ inches is held in a sealed hopper 20 which is kept topped up by dual valves (not shown) which prevent the ingress of excess air to the hopper.

10 The coal in the hopper 20 may be preheated prior to feeding into the system to prevent a temperature gradient effect with the system which if present may induce air to flow from the system into the hopper 20.

The coal hopper 20 directs a thin stream of coal into a first stage 21. The first stage 21 is an elongate 15 chamber 24 of rectangular cross-section (Figure 2). The separation between the walls 30 and 30' being relatively small, about 2 inches, compared to the width between the walls 31 and 31' which may be of the order of feet.

20 Adjacent the coal feed entry to the hopper are gas jets 22 which feed high temperature-high pressure gas into the first stages 21. The jets 22 are as broad as the chamber 24 or as many as are required to make up the width of the chamber 24. The streams from jets 22 must always be opposed to one another to keep the particles 25 away from the walls. The jets are inclined to the direction of flow of the chamber at up to 30° , preferably from 5° to 30° . Typical pressure values for this gas may be as high as 11,000 psig and 1500°F at the point of entry 22. However, for coal it is essential that the temperature 30 of the gas does not raise the temperature of the coal above 600°F as this will cause gasification and some combustion of the coal. The entry area of the first stage 21 is thus a high pressure-temperature region, although as the gas enters the first stage 21 it expands, 35 accelerates and loses temperature.

The gas entering the first stage 21 picks up the coal particles, sandwiches them between the two streams, and accelerates them along the first stage to the beginning of the second stage designated 23 in Figure 1.

At the point 23, the particles have a high velocity, say about 4,000 to 5,000 ft./min. or even higher if necessary. The lower value of the velocity of the gas stream along the first stage 21 must always be sufficiently high to
5 ensure the particles are carried in the gas stream in a suspended state.

Acceleration along the first stage 21 longitudinally separates the particles from their feed point along the first stage 21. It also establishes a streamline
10 flow wherein the particles are carried in streamlines in the gas flow, which is believed to be laminar even at these high velocities, at a point intermediate the walls 30 and 30'. This prevents contact and associated abrasion with the walls. As shown in Figure 2, the particles 32
15 are being carried at a substantial separation from one another. This is to avoid interparticle contact and is believed to be the optimum flow situation.

As the flow proceeds along the chamber, the temperature and pressure of the gas stream decreases, and
20 the velocity increases. Depending on the particles being transported in the first stage and the length thereof it may be necessary to incorporate additional gas jets along the chamber 24 to boost the flow.

At the end of the first stage 21, the particles
25 travelling at high speed enter the second stage 25. The elongate chamber 24 of the first stage 21 passes into the second stage 25. At the entry to the second stage, further high pressure-high temperature gas jets 26 are provided. These jets 26 inject gas uniformly across and into the
30 chamber 24 at a sufficient angle to the chamber to ensure the entering gas is as close to the direction of flow as possible. This adds kinetic energy, maintains the velocity or further accelerates the particles into the second stage 25. Additionally, particles 26 which may be travelling
35 along the walls 30, 30', 31 or 31' are moved towards the center of the chamber 24.

The particles 26 on entering the second stage 25 are basically still intact from their original feed point into the chamber 24.

As the particles 26 travelling at high velocity (range 4,000 to 5,000 ft./min. depending on the shock resistance of the particular particles) pass through the second stage 25, they are subjected to shock forces which try to alter the direction of flow of the particles 26. The object of this is to create sufficient forces within each particle to overcome the physical bonds holding the particle together so that it disintegrates, thus separating the 'constituent components into individual particles instead of the original composite particle.

Careful control of the shock forces can result in excellent disintegration into individual constituents. Furthermore, by establishing a characteristic shock, which is equal or just greater than the forces involved in the bonding of the particle, for a particular constituent, e.g. the pure coal constituent of an ex-mine coal particle, then that constituent may be reduced in particle size relative to other constituents, separation by particle size can then be readily achieved, thus obtaining a relatively high purity product.

The determination of the nature, force and duration of the shock to be applied to the particles to be broken is dependent upon the particle characteristics. However, it is basically a trial and error procedure to determine the operating ranges of the parameters for each particle as each substance has basically different characteristics. Even within say one seam of coal, the coal at the top of the seam can be quite different to that lower down the seam.

Thus, to determine the shock necessary to break the particle bonds, particles are fed into the apparatus. The gas flow must be sufficiently fast to carry the particles in the stream without dropping out. The gas flow velocity will depend upon the particle size and specific gravity.

The number of plungers to be operated and the frequency of operation of each plunger is then determined by working up from a minimum frequency and number of plungers to a point where particle reduction occurs. By

increasing the number of plungers in use, the length of time that the particle is subjected to the shocks may be increased or reduced.

5 The amplitude of length of movement of the plungers is also varied to determine an optimum value and a suitable range. Furthermore if more than one successive plunger is used, then the wavelength of the shock may be increased.

10 If greater shocks are required, the gas flow velocity should be increased and also the frequency may be increased to a point where the whole particle breaks.

By altering amplitude and frequency back to minimum values and up to maximum values, operating ranges may be determined. This will allow correct operating conditions for composite particles to be determined for the selective breaking of desired particles.

15 It may be necessary to have a frequency and/or amplitude gradient along the shock chamber or some other type of suitable wave form.

20 If the shock magnitude is insufficient, then by increasing the total pressure of the system, the gas density is increased and the shock intensity is magnified.

It is very desirable to monitor the particles leaving the shock chamber by scanning, diffraction or photographic means so that any change in particle size reduction away from the required product can be readily determined and appropriate adjustments made to the system.

25 It is also very desirable to maintain a constant feedrate to the system to ensure the system will run as close to an optimum steady state as possible. If the feedrate increases substantially the gas flow velocity will obviously drop and the shock which has been programmed to be applied to the particles will be reduced. This is because at a lower velocity the shock frequency is increased, however, the kinetic energy of the particles is substantially reduced. Thus as the nature of the system is motivated by the pressure and temperature conditions, substantial feedrate changes dramatically affect the energy and velocity parameters.

The preferred means of creating the desired shocks is to arrange along the walls of the second stage 25 a series of parallel plunger-type members 27 which are adapted to reciprocate in the directions of the arrows.

5 The reciprocation results in the plunger 27 intruding into the flow of the chamber 21 a predetermined distance which we shall call the amplitude. As the first plunger 27(a) protrudes into the chamber 21, the opposite plunger 27(b) withdraws. Each successive plunger on the one side 10 of the chamber is individually controllable with regard to its reciprocation rate, or frequency, whilst the opposing pairs of plungers, e.g., 27(a) and 27(b), are controlled to reciprocate with the same frequency.

Thus, each opposing pair of plungers by moving 15 into and out of the high velocity air stream creates pressure waves within the gas stream to continually apply shocks to the particles transverse to or at an angle to the direction of flow of the gas stream.

There are any number of plungers 27 along the 20 wall sufficient to create the desired shock. Typically there may be say 50 pairs of plungers 27 along the walls. The plungers 27 intrude into stream up to 30% of the chamber height i.e., $.3 \times 2" = 0.6"$ for a 2" high chamber.

As the particles pass through the shock chamber 25, they are preferably sufficiently separated due to the acceleration along the chamber, so that they do not interact and grind on one another. If the particles "grind" on one another, then the harder particles are shattered into smaller particles which makes their separation from 30 the smaller soft particles virtually impossible by physical particle separation means.

After leaving the shock chamber 25, the flow enters a third stage 29 at a speed of 500 to 1,000 ft./min. Due to the lengthening of path by the application of the 35 shock frequency and the reduction of the mass of the individual particle, much of the kinetic energy has been converted to heat. As the particles leave the shock chamber 25 because they have been split into many smaller particles than when they entered and have undergone

disruption from their original ordered paths their flow pattern must be restabilised by further acceleration prior to separation. Thus, further high pressure gas at say 2,000 psi, is introduced through nozzles 28 which
5 direct the gas substantially in the direction of flow of the major gas stream. This high pressure gas injection from opposite sides of the flow chamber 29 creates a venturi-type effect to accelerate the gas flow and bring the particles leaving the shock chamber 25 away from the
10 walls of the flow chamber 29 to prevent grinding of the particles on the walls of the flow chamber 29. As mentioned above, it is desirable to prevent the particles grinding on one another or the walls of the chamber as this may cause the larger harder particles to shatter
15 into smaller particles and thus reduce separation efficiency. In this regard, the walls of the chamber 24 and 29 may be lined with a material of hardness which is greater than the particles being broken but softer than the harder particles which are not to be broken.

20 Additional nozzles such as nozzles 28 may be provided along the third stage to inject additional high pressure gas to maintain or further accelerate the gas flow.

The particles travelling at high speed, up to
25 4,500 ft./sec., are then processed through a known type of particle separation unit which separates the particles according to their flow and specific gravity characteristics. Consequently, the large heavy particles may be separated from the smaller lighter particles, and inter-
30 mediate particle sizes may also be separately recovered.

As shown in Figure 1 the particles leaving the third stage 29 have three alternative paths 30, 31 and 32 to take, paths 30 and 31 being effectively identical paths. These two paths are distinguished from path 32 in two ways.
35 Firstly, they are at an angle to the direction of flow of the stream in the third stage 29. Secondly, they are the exhaust channels for the gas flow.

The gas exhausts through paths 30 and 31 due to exhaust fans 33, 34, and 35 inducing gas flow through those

paths. The path 2 is effectively a "still" gas flow region. Thus, as the particles leave the third stage 29, the smallest and lightest particles will be carried with the gas flow into paths 30 and 31 whilst the larger, heavier particles will continue directly ahead as they are too heavy to change their direction of flow fast enough to be included in the gas flow entering paths 30 and 31 before reaching the separation points 36 and 37.

The heavier particles which enter path 32 continue ahead to a collector 38 and fall through duct 40 to a series of filters 39 where they may be collected and ejected through a central port 40.

The gas flow and fine particles entering paths 30 and 31 are then separated, splitting the paths 30 and 31 into two channels, 41, 42 and 43, 44 respectively. The following description of path 30, channels 41 and 42 is also applicable to path 31 and channels 43 and 44.

Channel 41 communicates exhaust fan 33 with path 31, whilst channel 42 is communicated with an exhaust fan 34.

The channel 41 takes off excess gas at an angle, to the channel 42, sufficiently great to avoid entrainment of fine particles in the gas stream.

The fine particles are induced by exhaust fan 34 to travel along the channel 42 and into a collector 45 from where the settled fine particles are carried to a final collection unit 46 through conveying means 47.

The air entering the collector 45 then passes through filters 48 and exits through exhaust fan 49 and flue 50, whilst particles collected in the filters 48 are collected and transferred through conveyor 51 to collection unit 46.

The channels 41 and 43 include moisture collection means 52 to remove moisture which may condense in the ducts due to the dropping of temperature of the gas leaving the processing apparatus.

The gas travelling in ducts 41 and 43 is extracted through exhaust fans 33 and 35 and passes into a moisture "drop-out" unit 53 wherein any remaining moisture

in the gas stream is removed.

The gas from unit 33 is fed into the energy exchange unit by induction venturi effect created by the introduction through ducts 56 of high speed gas from the gas generators 54 to moderate the temperature and pressure of the gas from the generators 54 as required. This is necessary to ensure a reducing pressure gradient from the feedpoint to the final stage. The remainder of the dry gas leaving the units 53 is fed into the start of the first stage 24 through ducts 57 by venturi effect and fans 33 and 35.

Where coal is to be fed through the apparatus the temperature of the gas should be kept less than 600°F to avoid combustion of the coal. However, it is usually desirable to introduce the gas at a temperature of about 500°F. This will dry the coal of any, or most, moisture it may be carrying.

Different feed stocks will require different temperatures depending on their characteristics. In particular most food grain products such as wheat must be kept at relatively low temperatures to avoid degradation of protein and other constituents.

In some instances it may not be possible to break certain minerals by shock treatment alone. In these cases it may be advantageous to chemically treat the mineral to break or weaken interparticle bonds and/or intraparticle bonds prior to shock treatment in the apparatus of the invention.

In the case of coal, if lime (Ca CO_3) is added to the feed hopper and heated with the coal and fed through the apparatus with the coal, then the sulphur in the coal will form CaS instead of the pollutant sulphur oxides and H_2S gas. Furthermore the amount of carbon from the coal which would form CO gas is reduced. Thus the effectiveness of the units for treating coal is further increased.

Claims

1. A method of breaking the bond of a particulate solids feed into fine particles comprising feeding the feed solids into a high speed gas stream, applying to the solids being carried in the gas stream a shock treatment which has been determined according to the characteristics of the bond between the particles of the solid to reduce the material to smaller particles, and collecting the particles which have been subjected to said shock treatment.

2. A method of selectively reducing in particle size a particular constituent or constituents of a composite particle, comprising feeding the composite particle feed solids into a high speed gas stream, applying to the solids being carried in said gas stream a shock treatment which has been determined according to the bond between the pure particles and/or the constituent particles to be reduced from the composite particle, separating the particles following said shock treatment, and collecting separated fractions.

3. The method of claims 1 or 2 wherein the particles being carried in said gas stream are distributed across the stream so that they have minimal contact with each other.

4. The method of any of claims 1 to 3 wherein the gas stream and the particles being carried therein pass through a flow stabilisation zone before entering a shock treatment zone, wherein in said flow stabilisation zone the particles are accelerated up towards the velocity required prior to said shock treatment.

5. The method of claim 4 wherein said shock treatment is a straight line continuation of said stabilisation zone.

6. The method of claim 5 wherein the particles being carried in said gas flow are kept from contact with the walls of said flow stabilisation and shock treatment zones.

7. The method of any one of the preceding claims wherein said shock treatment is by means of altering the velocity of said gas and particle stream as it passes through said shock treatment zone.

8. The method of claim 7 wherein said velocity is altered by repeated change of direction in a reciprocal manner according to the characteristics of the particle bonds to be broken.

9. The method of any one of the preceding claims wherein high temperature fluidizing gas is used to evaporate moisture or volatiles from said feed solids.

10. The method of any one of the preceding claims wherein the fluidizing gas comprises a reactive gas.

11. The method of any one of the preceding claims wherein coal is the feed material.

12. The method of claim 11 wherein lime is added to the feed solids material.

13. The method of claim 11 or 12 wherein hydrogen is added to the fluidizing gas.

14. The method of claim 12 wherein the fluidizing gas forms a non-explosive mixture with the coal.

15. The method of any one of the preceding claims wherein the particles leaving the shock treatment zone pass directly into a flow acceleration zone and into a particle size separator.

16. The method of any one of the preceding claims wherein the entire system is integrally sealed so that it can be operated at temperatures other than atmospheric to alter the shock effect.

17. An apparatus for reducing a particulate solid (26) into finer particles comprising an elongate flow chamber (23), means to feed particulate solids into said chamber (20), high pressure gas from gas production means (54) into said chamber to fluidize said particulate solids (26) and carry said particulate solids (26) through said chamber (23) into a gas-solid flow stabilisation zone (24) leading to a shock treatment zone (25) wherein in said shock treatment zone (25) there is provided means (27) adapted to impart a predetermined shock to said

particles according to the particular characteristics of the particles to be broken.

18. The apparatus of claim 17 wherein there is further provided means (30, 31, 32) to separate and collect the various particle fractions following treatment in said chamber (27A).

19. The apparatus of claim 18 wherein the particles (26) leaving the shock treatment zone (25) travel through a coaxial chamber (29) with that of the shock treatment zone wherein said particles are re-accelerated before being fed into a particle separation device (30, 31, 32) which splits the particle flow stream by removing the gases and finest particles in peripheral throughflow outlets (30, 31) whilst the larger heavier particles are removed in a slower moving central air-stream (32).

20. The apparatus of any one of claims 17 to 19 wherein means to feed (20) the particulate solids into said chamber comprises a sealable feeding device which is adapted to continuously feed said solids to said chamber.

21. The apparatus of claim 20 wherein means are provided to preheat the contents of said feeding device.

22. The apparatus of any one of claims 17 to 21 wherein the chamber (24) has a substantially rectangular transverse cross-section.

23. The apparatus of claim 22 wherein the width dimension (31) of the said rectangular cross-section is relatively small compared to the length dimension (30).

24. The apparatus of claim 22 wherein the width dimension does not exceed six inches.

25. The apparatus of any one of the preceding claims 22 to 24 wherein there is at least one set of flow booster nozzles (26) positioned across each wall (30) comprising the length dimension of said rectangular cross-section to inject high pressure gas into said gas stream at an angle of up to 30° to the direction of flow of the gas stream.

26. The apparatus of any one of claims 17 to 25 wherein the shock treatment is provided by a series of

plungers (27) located one after the other along the chamber and which reciprocate into and out of the gas flow through the length dimension walls (30) of the chamber, each plunger having an opposing plunger (27) in the opposite wall (30') which withdraws from the chamber (27A) as the first-mentioned plunger enters the chamber and enters the chamber as the first-mentioned plunger leaves the chamber.

27. The apparatus of claim 26 wherein the plungers have a maximum intrusion into the chamber of up to 30% of the width dimension (31) of the chamber.

28. The apparatus of claim 27 wherein the frequency of each pair of opposing plungers (27) and the movement between adjacent plungers relative to one another is determined according to the shock required to break the bonds of the particle.

29. The apparatus of claim 26 wherein the plungers (27) are driven by electromagnetic means.

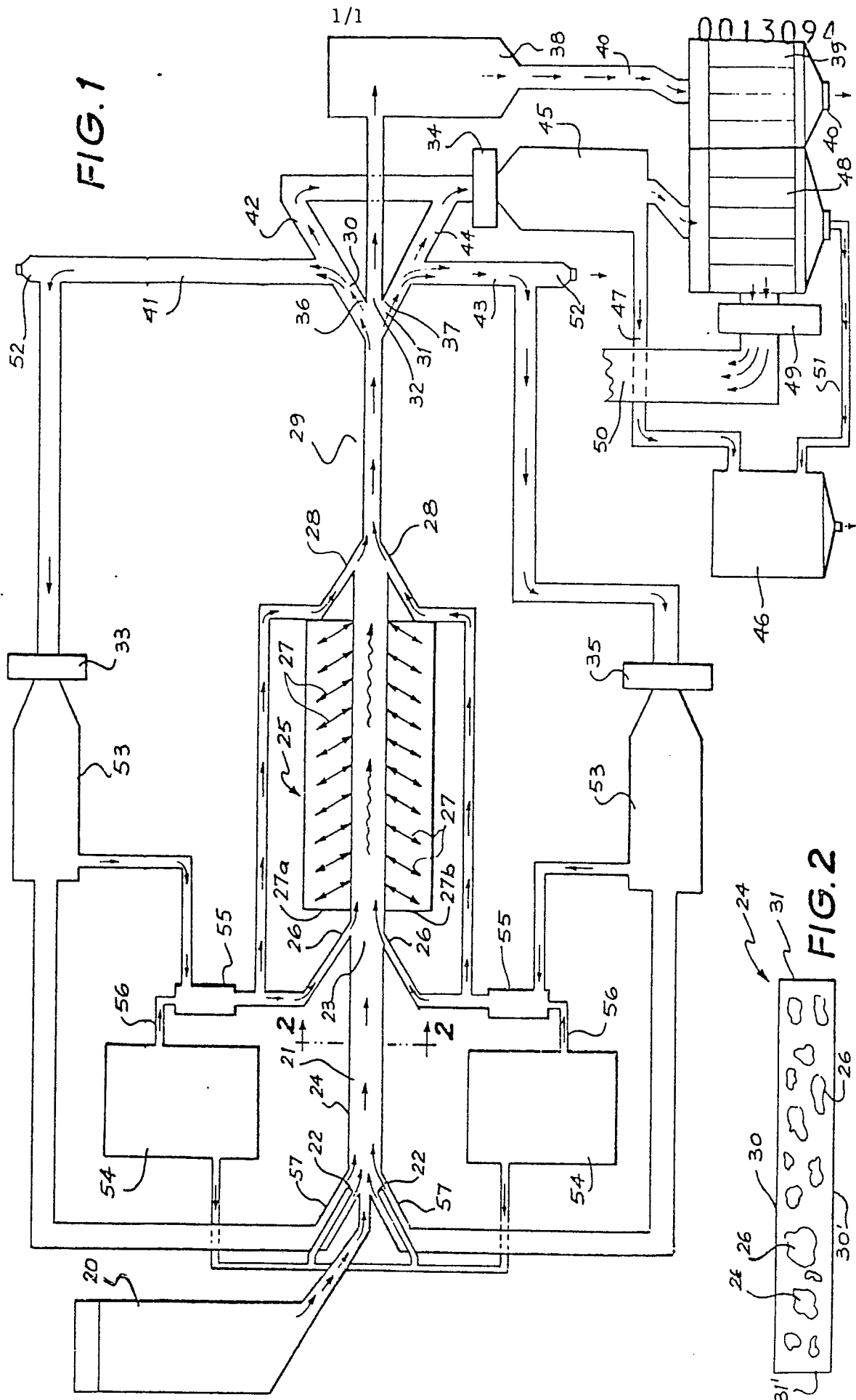
30. The apparatus of any one of claims 17 to 29 wherein the gas being removed from the particles which have passed through the chamber is recycled (41) back to the high pressure gas generation plant (54) to utilise its kinetic and thermal energy.

31. The apparatus of claim 30 wherein the recycled gas is fed directly into the feedpoint (57) of the chamber (24).

32. The apparatus of claim 30 or 31 wherein the recycle gas passes through water dropout units (52) to dehydrate it.

33. The apparatus of claim 32 wherein the recycle gas (41) passes through blowers (33) to boost its flow and assist in withdrawing it from said chamber.

34. The apparatus of claim 33 wherein the recycle gas (41) passes through sulphur removal units (53) after passing through said blowers (33).





European Patent
Office

EUROPEAN SEARCH REPORT

0013094

Application number

EP 79 30 2842

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
P	<u>DE - A - 1 782 234</u> (TITAN GmbH) * Pages 7,8,9,10,11,12 *	1,2,7, 17,18	B 02 C 19/00
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	<u>US - A - 3 811 623</u> (SPEER) * Column 13, lines 36-48 and 54-58; column 14, lines 11-21 *	1,2,17, 18,19	
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	<u>DE - B - 1 135 736</u> (STEPANEK) * Column 4, lines 45-60 *	1,2,17 18	TECHNICAL FIELDS SEARCHED (Int.Cl.)
	--		B 02 C
	<u>US - A - 4 156 593</u> (TARPLEY) * Column 3, lines 52-68; column 4, lines 1-4; column 5, lines 31-45 *	1,26	

The present search report has been drawn up for all claims			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family. corresponding document
Place of search The Hague	Date of completion of the search 19-03-1980	Examiner VERDONCK	