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(54) **Apparatus and method for processing waste**

(57) A waste separating apparatus (1) comprises a waste processing chamber (2) having at least two sections. At least one section of the waste processing chamber (2) comprises an input port (3). At least one other section of the waste processing chamber (2) comprises one or more outlet ports (4, 5). The apparatus further

comprises waste attrition means (6), which are located within the waste processing chamber (2). Any section which comprises an outlet port (4, 5) also comprises waste screening means (10, 11). Also any chamber section which comprises an input port (3) is devoid of waste screening means.

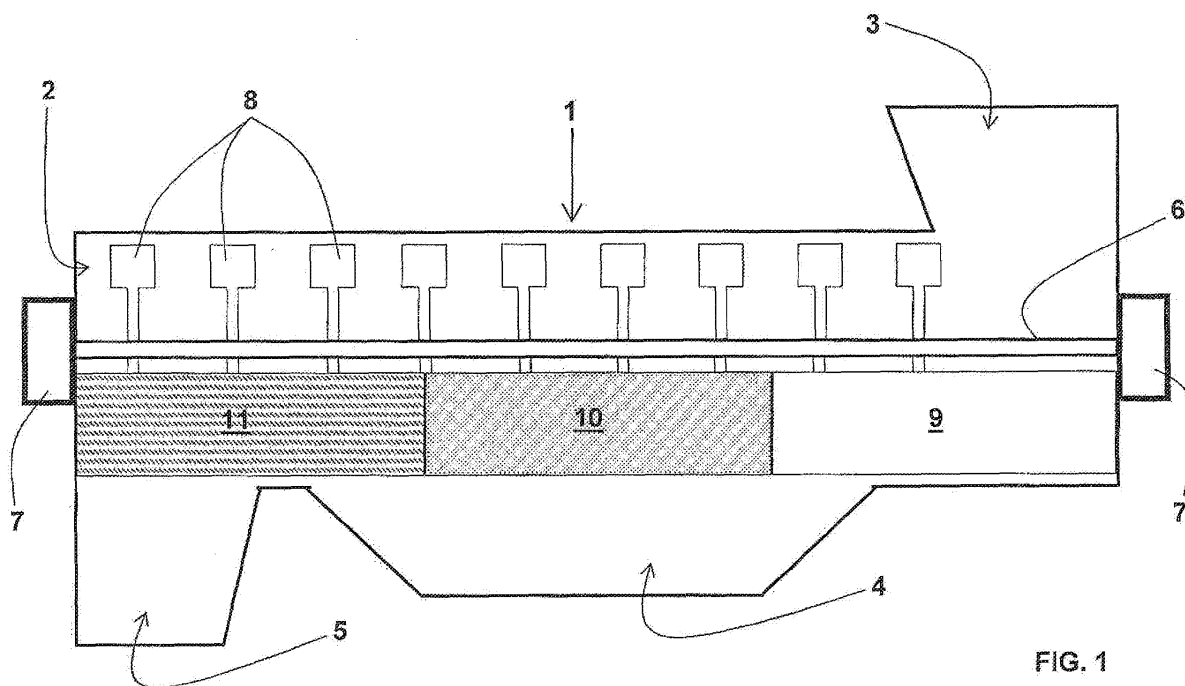


FIG. 1

Description

Field of the Invention

[0001] The present invention relates to the field of waste recovery and in particular the processing of waste materials to separate and recover paper fibres and mixed plastics waste.

Background of the Invention

[0002] The use of paper is widespread. The resultant build-up of paper waste, paired with environmental concerns, has given rise to a huge industry devoted to the recycling of paper waste.

[0003] The paper recycling and de-inking processes that are generally used at present by paper mills are not 100% efficient. Therefore, whilst most of the paper recovered by these processes can be reused for making recycled paper grades, the rejects from these processes are currently land-filled. Typically the rejects from these processes include wet strength paper, plastic laminated paper and plastics.

[0004] The recycling process involves an initial pulping process wherein the paper waste is broken down in hot water at levels of between 3% and 25% solids. Using this process standard paper grades are usually fully dispersed after 30 to 40 minutes. However wet strength papers (such as labels and fruit boxes) and plastic laminated papers generally take two or three times longer to break down and disperse. As a consequence it is considered commercially expedient to disperse the majority of fibres and then reject those materials that are more difficult to process (also known as reject materials).

[0005] Traditionally these reject materials (i.e. wet strength papers and plastic laminated papers) are disposed of in land-fill. Although alternative processes are known, such processes involve the use of high powered pulping and require the waste to be left for long periods to allow the laminated plastics to separate from the paper fibres. Consequently such processes have in the past been considered commercially less attractive than the land-fill option.

[0006] In recent times, political and economic pressures have started to dictate that a more efficient alternative to land-fill is employed when dealing with the above mentioned reject materials. As mentioned above, typical examples of these reject materials include cardboard boxes, and in particular wet strength fibres from fruit boxes, and the plastic laminated labels and packaging plastics that are associated with modern packaging.

[0007] Due to the large volumes of paper waste that needs to be recycled each year, various machines have been developed to break down the structure of the paper waste to such an extent that it can be efficiently reused in the recycled paper industry. An example of a machine that can be used to pulverize and reduce the size of paper waste is provided in US Patent 5,887,808. The grinding

apparatus shown in US 5,887,808 comprises a grinding chamber with a central rotating shaft upon which are mounted breaker bars, which impart a pulverizing action on the paper waste that enters the grinding chamber such that the waste is separated into much smaller particles.

[0008] Furthermore the grinding chamber of US 5,887,808 is provided with a plurality of sub-chambers each of which has an arcuate screening member located therein. Such arcuate screening members are provided with holes which serve to filter the pulverized waste paper according to the size of the resultant particles.

[0009] Although the apparatus of the prior art can be used to process the reject material from paper waste recycling processes mentioned above it does so inefficiently. This is due to the nature of reject materials obtained from most paper waste recycling processes.

[0010] In general, reject material from current paper recycling systems tends to have a moisture content that is over 50% moisture, and levels of 65% moisture are not untypical. The high moisture content of the reject material leads to 'blinding' of the holes in the screening plates after a very short operational time. As a consequence the level of separation achieved is unsatisfactory.

Summary of the Invention

[0011] The present invention improves on the existing machinery of the prior art such that it can more affectively handle the reject material (i.e. paper waste) from existing paper recycling and de-inking processes.

[0012] The present invention provides a waste separating apparatus comprising: a waste processing chamber having at least two sections, wherein at least one chamber section comprises an input port and at least one other chamber section comprises one or more outlet ports; waste attrition means rotatably mounted within the waste processing chamber; wherein any chamber section that comprises an outlet port also comprises waste screening means; and characterised in that any chamber section that comprises an input port is devoid of waste screening means.

[0013] By providing an area within the waste processing chamber that does not permit waste materials to exit the chamber via an output port it is possible to pulverize the waste material for longer, thereby enhancing the break down of the waste material by the attrition means. In this way the subsequent separation of the waste material via the waste screening means is improved.

[0014] Preferably any chamber section that comprises an outlet port is at least partially defined by said waste screening means. In this way the waste screening means actually form at least some of the wall of the waste processing chamber.

[0015] Preferably the waste processing chamber may be substantially cylindrical.

[0016] Preferably the apparatus may further comprise one or more breaker bars around the periphery of the waste processing chamber, said breaker bars being ar-

ranged such that the interaction of the waste attrition means with the breaker bars facilitates the breakdown of waste within the waste processing chamber. It is appreciated that, as the attrition means rotate within the waste separating chamber the waste materials get caught between the rotating attrition means and the breaker bars and are pulverized into smaller pieces. Preferably the waste attrition means may comprise a rotatable hammer assembly axially disposed through the waste processing chamber, said assembly having a plurality of circumferentially spaced hammers defining a rotation path within the chamber.

[0017] Preferably the rotatable hammer assembly comprises more than one type of hammer.

[0018] Preferably the hammers provided on the portion of the hammer assembly that is adjacent to the input port are primarily shaped to provide a pulverizing action, whereas the hammers provided on the portion of the hammer assembly that is adjacent the outlet ports are shaped to also promote air flow through the waste processing chamber.

[0019] By providing more than one type of hammer it is possible to initially maximize the break down of the waste when it enters the waste processing chamber. After the initial pulverization of the waste the creation of an air flow within the chamber helps to further separate the plastics and lightweight materials.

[0020] Preferably the hammers shaped to provide a pulverizing action are provided in the chamber section that is devoid of waste screening means. This arrangement maximises the breakdown of waste as it first enters the waste processing chamber.

[0021] In a preferred embodiment of the present invention the apparatus comprises: a waste processing chamber having a rotatable hammer assembly axially disposed there through, said assembly having a plurality of circumferentially spaced hammers defining a rotation path therein; said waste processing chamber further comprising a plurality of arcuate back bars, each of said arcuate back bars being substantially parallel to a tangent of said rotation path of said hammers defined at each back bar; a plurality of breaker bars attached to selected portions of the periphery of said waste processing chamber, each of said breaker bars being substantially perpendicular to a tangent of said rotation path of said hammers defined at each said breaker bar; two or more arcuate chamber components attached to said plurality of back bars such that a first inside radius prescribed by said arcuate chamber components and a second inside radius prescribed by said plurality of breaker bars are equidistant from a common central axis defined by said rotatable hammer assembly and said waste processing chamber; at least one inlet port through which waste can be introduced into said waste processing chamber; at least one outlet port through which waste can be discharged from the waste processing chamber; and characterised in that at least the arcuate chamber component closest to the input port comprises a non-screening blank

and at least one other arcuate chamber component comprises waste screening means.

[0022] Preferably the waste screening means may comprise a plurality of holes and/or slots.

5 **[0023]** Preferably the apparatus of the preferred embodiment comprises one non-screening blank and first and second waste screening means.

10 **[0024]** Further preferably the first waste screening means, which is located adjacent to the non-screening blank within the waste processing chamber, comprises a plurality of slots. Alternatively the first waste screening means, which is located adjacent to the non-screening blank within the waste processing chamber, comprises a plurality of holes.

15 **[0025]** Preferably the second waste screening means, which is located adjacent to the first waste screening means within said chamber, comprises a plurality of slots. Alternatively the second waste screening means, which is located adjacent to the first waste screening means within said chamber, comprises a plurality of holes.

20 **[0026]** The degree of separation of fibre and plastics achieved by the apparatus of the present invention has been found to be affected by the moisture content of the incoming paper waste being processed. It has been discovered that by varying the dimensions of the holes in the waste screening means it is possible to process paper waste with both high and low moisture contents.

25 **[0027]** Preferably for moisture contents of around 50% and more, such as packaging mill rejects (sometimes referred to as 'browns'), the screening means require a hole with a diameter of 30mm or more. The degree of separation obtained by this arrangement is such that the fibre recovered can be introduced back in the recycling process, although the degree of separation achieved is borderline.

30 **[0028]** Preferably for moisture contents of between 20% and 50% the size of the holes provided in the screening means can be reduced to around about 20mm, which gives improved separation.

35 **[0029]** Preferably for moisture contents of below 20%, and further preferably about 15%, the size of the holes provided in the screening means can be between 10 and 15mm, which provide a further improvement in separation. The potential for screen blinding is greatly reduced at the lower moisture levels because the fibres become more "fluffy" and are more easily dispersed by the apparatus of the present invention.

40 **[0030]** Preferably the apparatus of the present invention is further provided with moisture reduction means that reduce the moisture content of the waste entering the waste processing chamber via the input port.

45 **[0031]** Preferably the moisture reduction means may be located upstream of the waste processing chamber. In this way the moisture levels of the waste is reduced before it enters the waste processing chamber.

50 **[0032]** Alternatively the moisture reduction means may be integrated in to the waste processing chamber and in particular in any chamber section that comprises an input

port. In this way the moisture levels of the waste are reduced whilst the waste is being separated in the chamber section, thus providing a more compact waste separating apparatus. As the chamber section with the input port has no screening means the waste is retained longer, which allows more time for the moisture levels of the waste to be reduced.

[0033] Further preferably the moisture reduction means is a drying means the energy for which may advantageously be provided by existing low grade heat available from the existing Combined Heat and Power (CHP) generation plant of the paper recycling plant. One example of which is a Gas fired Turbine that needs both electricity and Steam generation from one power source.

[0034] Preferably the drying means comprises blow dryer that is capable of providing around 1700cfm to 2000cfm minimum of air at a temperature of between 80C to 400C . Preferably the higher cfm of 2000 plus combined with the lower temps of 80C to 120C is preferred for Paper rejects drying and separating.

[0035] Preferably the holes/slots may be countersunk on the side of the waste screening means that faces away from the waste processing chamber. This helps to reduce the blinding of the waste screening means.

[0036] Preferably the non-screening blank may comprise one or more breaker bars. Preferably 4 to 6 bars around the inner circumference of the 'beater' chamber are preferred for paper rejects.

[0037] The present invention also provided a method of processing paper waste having a plastics component in order to separate the paper fibres from the mixed waste plastics present in the paper waste, said method comprising the stages:

- a) using magnets to remove ferrous and non-ferrous metals from the paper waste;
- b) shredding the paper waste to ensure that such waste is of a size that is manageable for the next stage of the method;
- c) separating the shredded paper waste using the waste separating apparatus of the present invention to separate the paper fibres from the mixed waste plastics; and
- d) collecting said separated paper fibres and mixed waste plastics from the waste separating apparatus.

[0038] Preferably, where the waste separating apparatus comprises a rotatable attrition means, the attrition means may be rotated at speeds between 800 to 1000rpm to separate the paper waste.

[0039] Preferably the method may further comprise a moisture reduction stage, whereby the moisture content of paper waste is reduced before the separation stage. Further preferably the moisture reduction stage may take place before the shredding stage.

[0040] Alternatively the moisture content of the paper may be reduced concurrently with the separating stage. This can be achieved by providing moisture removing

means within the waste separating apparatus.

[0041] Advantageously the moisture reduction stage may reduce the moisture content of the paper waste to below 20%, and preferably to about 15%. By reducing the moisture content of the paper waste the potential for blinding of the waste screening means is reduced.

[0042] Preferably the paper waste is the reject material from paper recycling and/or paper de-inking processes, which would normally be disposed of in land-fill. This applies to packaging recycling mills, newsprint recycling mills, tissue recycling mills and printings and writings recycling mills. Another source of paper waste takes the form of packaging (such as liquid containers) made from plastic laminated paper (e.g. Tetra-pak ®). Currently such waste is either land-filled or subjected to expensive, high-energy pulping processes.

Brief Description of the Drawings

[0043] The present invention will now be described with reference to the Figures, wherein:

Figure 1 shows a partially exposed view of a preferred embodiment of the waste separating apparatus of the present invention; and
Figure 2 shows a flow diagram of a method of separating paper waste according to a preferred embodiment of the present invention.

Detailed Description of the Invention

[0044] The waste separating apparatus of the present invention described hereinafter is an adaptation of existing grinding apparatus. A brief overview of the separating apparatus 1, an example of which is shown in Figure 1, its provided below. However, it is appreciated that the skilled person would be well aware of technical specifications for the grinding apparatus that might usefully form the basis of the waste separating apparatus of the present invention, In this regard, reference is made to US 5,887,808.

[0045] The waste separating apparatus 1 of the present invention comprises a substantially cylindrical chamber 2. The chamber 2 has an input port 3, via which waste is introduced into the chamber 2, and two output ports 4 and 5, via which the separated waste exits the chamber 2. However it is envisaged that the apparatus may be provided with additional outputs as appropriate.

[0046] A hammer assembly 6, comprising a central axle, is rotatably mounted within the waste separating chamber 2. The rotation of the hammer assembly 6 within the chamber 2 is facilitated by rotation means 7, which may also comprise suitable drive means (not shown).

[0047] The hammer assembly comprises a plurality of hammers 8 that project outwards or radially extend from said central axle, preferably at an angle that is perpendicular to the plane of the axle. It will be appreciated that the shape and configuration of the hammers 8 may vary

depending of the composition of the paper waste that is being processed by the waste separating apparatus 1 provided they still deliver the required pulverizing action.

[0048] As the hammer assembly 6 rotates within the chamber 2 a pulverizing action is imparted upon any waste material that enters the chamber. This pulverizing action facilitates the separation and break down of said waste into its component parts, which in the present invention include, in particular, paper fibre and mixed waste plastics.

[0049] Preferably each hammer 8 is shaped and oriented so as to promote the flow of air and materials through the chamber 2. In this way the hammer can, by virtue of their rotational direction, slow down or speed up the passage of waste through the chamber 2. A rotation speed of 800 to 1000rpm is considered effective in both breaking down the waste and in promoting the flow of air with the chamber.

[0050] Although not shown in Figure 1 it is envisaged that it may be advantageous to provide more than one type of hammer on the hammer assembly. In such an arrangement the initial set of hammers (e.g. the first four to six hammers on the shaft) are 'attrition' type hammers. The 'attrition' type hammers are shaped to give maximum pulverization of the waste, possibly at the detriment the hammer's ability to promote air flow within the chamber.

[0051] By adopting these 'attrition' type hammers in the initial section of the waste processing chamber it is possible to maximise the pulverization of the waste when it first enters the waste processing chamber via the input port.

[0052] The remaining hammers on the rotating hammer assembly are of a 'paddle' type. Such are shaped to break down the waste whilst at the same time promoting air flow through the waste processing chamber. This causes the plastics and lightweight material to be blown through the chamber as rejects. It will be appreciated that when applying this arrangement of hammers the chamber is preferably provided with an outlet located at the end thereof to collect such 'blown' materials.

[0053] In existing grinding machines of the type described in US 5,887,808 some of the wall of the substantially cylindrical chamber is provided by arcuate screening elements. The chamber may be provided with more than one arcuate screening element, in such cases the arcuate screening elements are arranged in series along the length of the cylinder.

[0054] These arcuate screening elements are provided with a plurality of apertures of known sizes and configuration. In this way they can be used to screen the waste material within the chamber as it is being pulverized. In other words, once the waste material is small enough it can pass through the apertures.

[0055] On the other side of the arcuate screening elements are one or more output ports. It is appreciated that although not necessarily the case, the apparatus may be arranged such that each arcuate screening element has an associated output port, thus enabling more focused

separation of the waste.

[0056] The waste separating apparatus 1 of the present invention differs from those of the prior art by virtue of the fact that one of the arcuate screening elements is replaced with an arcuate non-screening blank 9. In the present invention it is the arcuate screening element that is located closest to the input port 3 which is replaced with an arcuate non-screening blank so as to ensue that the chamber section in which the input port is located is devoid of waste screening means.

[0057] By providing the arcuate non-screening blank 9 the level of attrition achieved in the section of the chamber 2 that is adjacent to the input port 3 is increased.

[0058] The remaining arcuate screening elements 10 and 11 are maintained to facilitate the separation of the pulverized waste. The apertures in the arcuate screening elements 10 and 11 may take the form of slots or holes. When the apertures in the screening means are holes, such holes are preferably between 10 and 30mm in diameter for waste having a moisture content of between 15 and 50%. When the apertures are slots, such slots are preferably between 10 and 20mm in length for waste having a moisture content of 15 to 50% moisture,

[0059] Advantageously a drying means may be provided to reduce the moisture content of the paper waste being processed to around 15%. In such an arrangement the apertures in the screening means can be between 10-15mm and preferably around 10-12mm.

[0060] It is envisaged that the size of the apertures in the screening means could decrease along the length of the chamber starting from the end of the chamber in which the input port is located.

[0061] Thus in arrangements where the screening means is provided by more than one arcuate screening element, it is anticipated that the first screening element could have apertures with a diameter of about 12mm and the subsequent screening element could have apertures with a diameter of about 10mm.

[0062] In order to further reduce the risk of the apertures becoming blocked by the waste the apertures are countersunk on the side of the arcuate screening element 10 or 11 that faces away from the chamber 2.

[0063] The waste separating apparatus of the present invention is to be used in the method of separating paper waste. A flow diagram of the various stages of the method of the present invention is shown in Figure 2.

[0064] The starting waste material A, which may take the form of reject material from an earlier recycling process or plastic laminated packaging (i.e. Tetra-pak ®), is initially subjected to magnets 12 which help remove both ferrous and non-ferrous materials B from the starting waste A.

[0065] The resultant waste C is then conveyed to a shredder 13, which shreds the non-metallic waste C to ensure that the processed waste D does not contain any material which is of a size that could impair the next stage of the process.

[0066] It is appreciated that the waste suitably needs

to be reduced to below 50mm to ensure that next stage of the process is not impaired. No screening basket is utilised in this reduction process, as this stage is used primarily to enable good cleaning of the waste in order to protect subsequent separation equipment.

[0067] The shredding step of the process is important as it allows for the use of smaller holes/slots in the arcuate screening elements, i.e. prevents the blockage of such holes by larger waste materials. Furthermore the shredding/de-sizing equipment in front of the waste separating apparatus is important for providing higher throughputs and maintaining consistent running conditions.

[0068] The processed waste D is conveyed from the shredder to the input port 3 of the waste separating apparatus 1, wherein the waste D is processed to produce multiple waste products E and F. In the described embodiment the waste products E and F exit the waste separating apparatus 1 via separate output ports 4 and 5 respectively.

[0069] It is appreciated that before the processed waste D is supplied to the input port 3 it could advantageously be subjected to a drying process that reduces the moisture content of the waste to 50% or below, and preferably 20% or below, and more preferably 15% or below.

[0070] The main waste products that exit the waste separation apparatus are mixed waste plastic materials and paper fibres, although such may still comprise small amounts of plastic material(see below). The reclaimed paper fibres can be reintroduced into the mills paper recycling system, thus enabling such to be used to produce recycled paper products.

[0071] It has also been discovered that the separated paper fibres (also referred to as organics) do tend to retain a proportion of plastic materials which make them suitable as organic 'fuels'. The paper mills can burn these 'fuels' in their combustor plants to generate power and heat.

[0072] At present paper mills typically dispose of de-inked sludge by burning despite the fact it has a very low calorific value. The organic 'fuels' produced by the waste separation apparatus of the present invention can be used to assist in the burning of the de-inked sludge, thereby reducing the need for other fuels, such as gas. This has the double benefit of disposing the paper mill rejects whilst at the same time reducing the cost due to gas.

[0073] It is appreciated that by varying the characteristics of the waste separation apparatus (for example the moisture levels, types of attrition and screening means) it is possible to control the amounts of plastic retained by the paper fibres, which allows the 'fuel' to be tailored to suit the combustor being used by the paper mill. In particular it has been discovered that reducing the moisture content of the paper waste to below 20% produces an effective 'fuel'.

[0074] This control over the manner in which the waste is separated by the waste separation apparatus means that some undesirable plastics, such as rigid PVC, can

be selectively rejected in to the mixed waste plastics stream and thereby kept out of the organic 'fuels'. This helps avoid expensive corrosion problems in the combustor that can occur when PVC is burnt.

5 **[0075]** The separated mixed plastics waste stream can be sent on to land fill. Alternatively the separated mixed plastics material can be used as an ingredient in the process described in UK patent application No. 0912807.5 so as to produce useful composite materials.

10 **[0076]** Alternatively the materials can be pelletized for a waste to energy (W2E) application.

[0077] The process of the present invention can be applied to any paper recycling stock preparation system for White/ Magazine papers, Newsprint papers, or corrugated kraft papers (sometime called 'browns'). It is particularly effective on the corrugated kraft recycling systems. It offers a low energy method for dealing with the current reject stream on the site of the paper recycling process, and affords a multi-million pound annual saving for the processor per annum compared to current practices. It is envisaged that the present invention could also be usefully applied to the processing of general packaging streams from supermarkets, for example.

25 **[0078]** The waste separating apparatus 1 has quite low energy requirements. It is anticipated that a motor size of 30KW will cope with around 5 tonnes per hour (tphr) input material for the recycling reject material, which have at least 30% moisture content. Around 6 tonnes per hour (tphr) of input material is anticipated for the plastic laminated packaging (e.g. Tetra-pak ®), which is generally around 10% moisture content.

30 **[0079]** It is envisaged that the moisture reduction of the waste to these lower % moisture contents can be achieved by mechanical pressing (such as in a Kufferath™ screw press). Alternatively the moisture content can be reduced using a conventional drying process that preferably utilises waste or low grade heat source as commonly found in paper recycling plants.

35 **[0080]** As already appreciated the moisture levels of the waste can be reduced using a drying means. One suitable drying mean is an industrial blow dryer that is capable of providing around 1700 - 2000cfm (cubic foot per minute) of air at a temperature of up to 400C.

40 **[0081]** As discussed previously the drying means may be provided separately upstream of the waste processing apparatus to reduce the moisture content of the waste before it reaches the waste processing apparatus.

45 **[0082]** However in a preferred embodiment the drying means may actually be located in or on the waste processing apparatus. In this way waste is dried when it enters the initial chamber section. As the initial chamber with the input port has no screening means the waste can be both separated (by the rotating attrition means) and dried before it enters the screening area. It has been discovered that rotation of the waste attrition means serves to enhance the effectiveness of the drying means at reducing the overall moisture content of the waste.

50 **[0083]** The level of wet strength and plastic laminated

papers in the reject material that is to be processed by the present invention varies from paper mill to paper mill. Typically paper mill reject materials are made up of around 60% to 80% wet-strength papers (cellulose) and plastic laminated papers that have not been broken down by the pulping and screening devices in the recycling processes, and between 35% and 15% of mixed plastics of all descriptions. The balancing 5% can be wood, metals and textiles. Ultimately, however, the actual composition of the reject materials is dependant on the machinery used by each mill, and also the quality of the incoming paper waste (reject material) supplied to the mill.

[0084] For example a typical browns mill, making corrugated papers, would have a reject level from its pulping system of around 10%. This consists of all the trash from the incoming cardboard boxes, the wet strength fibres from the fruit boxes etc, plus the laminated labels and packaging plastic associated with modern packaging. These rejects are currently land-filled and typically are at 50% to 60% moisture levels. They can be further treated by putting into a further high powered pulping system and left until the wet strength has fully broken down and the laminated plastics fully separated from the fibres, but as already outlined this is expensive and very time consuming.

[0085] As already mentioned, depending on the paper waste to be separated, the arcuate screening elements can have holes or slots in them, or indeed combinations thereof. Triangular holes have also been used. Any shape is utilised to give the required degree of separation. The moisture content of the paper waste being processed is also an important consideration when determining what types of screening elements to adopt.

[0086] During the processing of the paper waste, lighter materials are carried through the waste separating apparatus straight to one of the outlet ports, such materials are normally clean plastics. However the heavier, wet fibres (and some plastic) are accepted through the arcuate screening elements to the outlet port associated therewith.

[0087] The attrition that takes place within the waste separating apparatus loosens and then separates plastics. However, some of plastics material is so entangled in the paper fibres that it can exit the apparatus with the said fibres. This is not an issue with the mills as the paper fibre plus loose plastics can be re-introduced into the mills pulping system again and is easily separated out by the existing system second time around. It is anticipated that some care must be exercised to avoid overloading the existing system by re-introducing the separated material too rapidly.

Claims

1. A waste separating apparatus comprising:

a waste processing chamber having at least two

sections, wherein at least one chamber section comprises an input port and at least one other chamber section comprises one or more outlet ports;

waste attrition means rotatably mounted within the waste processing chamber, wherein any chamber section which comprises an outlet port also comprises waste screening means; and

characterised in that any chamber section which comprises an input port is devoid of waste screening means.

2. The waste separating apparatus of claim 1, wherein any chamber section that comprises an outlet port is at least partially defined by said waste screening means.
3. The waste separating apparatus of claim 1 or 2, wherein the waste processing chamber is substantially cylindrical.
4. The waste separating apparatus of claim 1, 2 or 3, wherein the waste processing chamber further comprises moisture reduction means.
5. The waste separating apparatus of any of claims 1 to 4, further comprising one or more breaker bars around the periphery of the waste processing chamber, said breaker bars being arranged such that the interaction of the waste attrition means with the breaker bars facilitates the breakdown of waste within the waste processing chamber;
6. The waste separating apparatus of claim 1 to 5, wherein the waste attrition means comprise a rotatable hammer assembly axially disposed through the waste processing chamber, said assembly having a plurality of circumferentially spaced hammers defining a rotation path within the chamber.
7. The waste separating apparatus of claim 6, wherein the rotatable hammer assembly comprises more than one type of hammer.
8. A waste separating apparatus according to any of the preceding claims comprising:

a waste processing chamber having a rotatable hammer assembly axially disposed there through, said assembly having a plurality of circumferentially spaced hammers defining a rotation path therein;

said waste processing chamber further comprising a plurality of arcuate back bars, each of said arcuate back bars being substantially parallel to a tangent of said rotation path of said hammers defined at each back bar;

- a plurality of breaker bars attached to selected portions of the periphery of said waste processing chamber, each of said breaker bars being substantially perpendicular to a tangent of said rotation path of said hammers defined at each said breaker bar;
- two or more arcuate chamber components attached to said plurality of back bars such that a first inside radius prescribed by said arcuate chamber components and a second inside radius prescribed by said plurality of breaker bars are equidistant from a common central axis defined by said rotatable hammer assembly and said waste processing chamber;
- at least one inlet port through which waste can be introduced into said waste processing chamber;
- at least one outlet port through which waste can be discharged from the waste processing chamber; and
- characterised in that** at least the arcuate chamber component closest to the input port comprises a non-screening blank and at least one other arcuate chamber component comprises waste screening means.
9. The waste separating apparatus of any of claims 1 to 8, wherein the waste screening means comprise a plurality of holes and/or slots.
 10. The waste separating apparatus of any of claims 8 or 9, comprising one non-screening blank and first and second waste screening means.
 11. The waste separating apparatus of claim 10, wherein the first waste screening means, which is located adjacent to the non-screening blank within the waste processing chamber, comprises a plurality of slots.
 12. The waste separating apparatus of claim 10, wherein the first waste screening means, which is located adjacent to the non-screening blank within the waste processing chamber, comprises a plurality of holes.
 13. The waste separating apparatus according to any claims 10 to 12, wherein the second waste screening means, which is located adjacent to the first waste screening means within said chamber, comprises a plurality of slots.
 14. The waste separating apparatus according to any claims 10 to 12, wherein the second waste screening means, which is located adjacent to the first waste screening means within said chamber, comprises a plurality of holes.
 15. The waste separating apparatus of any of claims 9-11 and 13-14, wherein the slots are 20mm in length.
 16. The waste separating apparatus of any of claims 9-10 and 12-14, wherein said holes have a diameter of between 10 - 30mm, and more preferably they are about 10mm in diameter.
 17. The waste separating apparatus of any of claims 10-16, wherein the holes/slots are countersunk on the side of the waste screening means that faces away from the waste processing chamber.
 18. The waste separating apparatus of any of claims 6-17, wherein the non-screening blank comprises one or more breaker bars.
 19. A method of processing paper waste having a plastics component in order to separate any paper fibres from any mixed waste plastics present in the paper waste, said method comprising the stages:
 - a) using magnets to remove ferrous and non-ferrous metals from the paper waste;
 - b) shredding the paper waste to ensure that such waste is of a size that is manageable for the next stage of the method;
 - c) separating the shredded paper waste using the waste separating apparatus according to any of claims 1-18 to separate the paper fibres from the mixed waste plastics; and
 - d) collecting said separated paper fibres and mixed waste plastics from the waste separating apparatus.
 20. The method of claim 19, wherein the waste separating apparatus comprises a rotatable attrition means and such is rotated at a speed of 800 to 1000rpm to separate the paper waste.
 21. The method of claim 19 or 20, wherein the method further comprises a moisture reduction stage whereby the moisture content of paper waste is reduced before the separation stage.
 22. The method of claim 21, wherein the moisture reduction stage takes place before the shredding stage.
 23. The method of claim 13 or 20, wherein the method further comprises a moisture reduction stage whereby the moisture content of paper waste is reduced concurrently with the separating stage.
 24. The method of claim 21, 22 or 23, wherein the moisture reduction stage reduces the moisture content of the paper waste to below 20%, and preferably to about 15%.

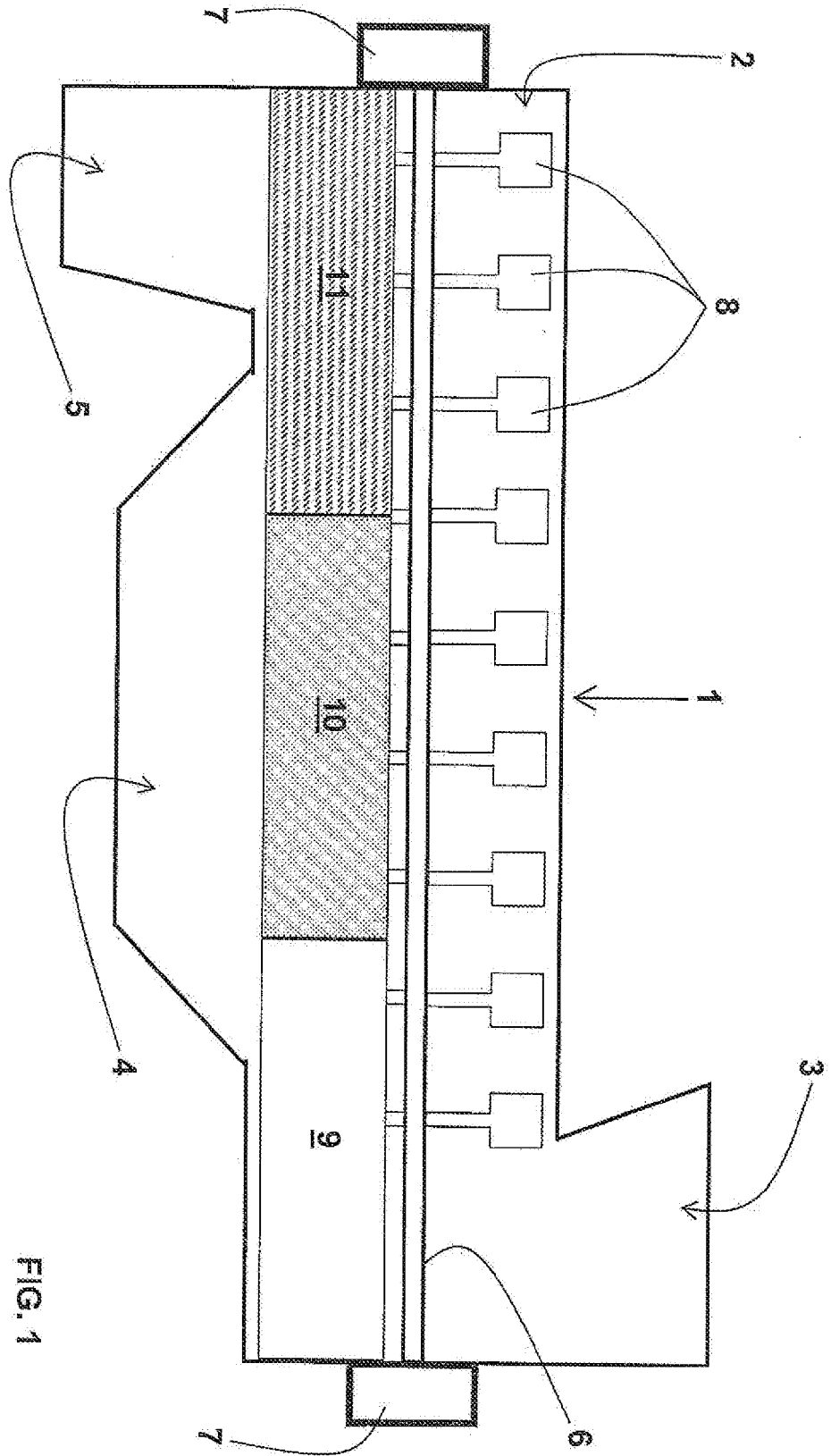


FIG. 1

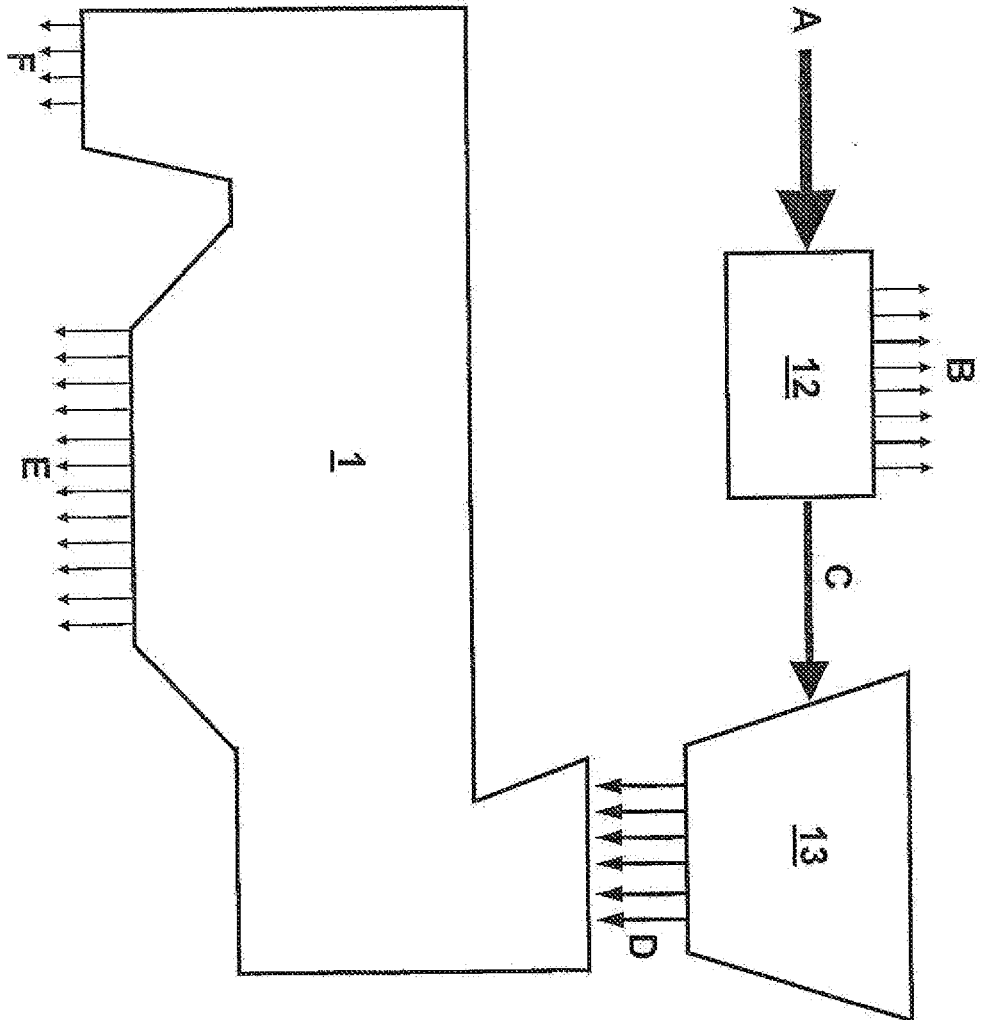


FIG. 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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