

BAG PRESS FEEDER ASSEMBLY

BACKGROUND

Field of the Invention

5 [0001] The present invention relates generally to a device for heat exchanged technology. More particularly, it relates to an apparatus that is part of a re-useable fuel processing unit for recycling plastic materials into refined fuel.

Background of the Invention

[0002] The use of feeder airlock systems in re-useable energy apparatus is known. Examples of known devices include U.S. patent No. 5,762,666 to Amrein et. al, U.S. patent No. 3,151,784 to Tailor, and U.S. patent No. 3,129,459 to Kullgren et. al. These patents teach airlocks with side gates (Amrein et. al.), a rotary feeder to an airlock using vanes (Tailor), and an extruder using electric heat (induction) (Kullgren). The Tailor device teaches a rotary style apparatus in which steel vanes are mounted to a shaft and spin inside a machined round housing. An opening is in the top and bottom of the housing to allow material to flow in and out of the housing. The vanes block the difference pressures between the inlet and outlet. However, multiple limitations exist within this design. A first limitation is that the prior art re-useable energy apparatus will not tolerate heat as the disclosed structural design of the prior art will expand and allow internal pressures to leak outwardly. Another limitation is that the vanes act as pockets and also carry the atmosphere from the inlet to the outlet. A third limitation concerns the rotation velocity. The rotation velocity must be slow to allow time for the material to fall out of the discharge or material will be carried back around and prevent refill from the inlet. A forth limitation is that prior art devices will not allow for a molten material, e.g., such as hot plastic, to traverse therethrough.

25 [0003] The Amrein device discloses a feeder airlock system using two valves, with a hopper or pipe between them to allow material fill. Although this design tolerates heat, it allows the atmosphere to enter the feeder from the inlet and pass through to the discharge. The Amrein device, however, is limited in that the device does not allow atmospheric gases in some processes as they will cause problems downstream. Another limitation with this device includes the incapability for allowing molten material, such as hot plastic, to traverse therethrough.

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[0004] The Kullgren device discloses an induction heated extruder. Kullgren describes an extruder that employs induction heating with the use of electric coils. Limitations with this apparatus include lacking an ability to create an airlock within its system. Thus, the described system is not conducive to allowing continuous feeding of plastic material(s).

5 Additionally, the system of Kullgren requires a thick long barrel that requires very high horsepower to achieve an internal pressure along with the required heat necessary to melt plastic material. Hence, the device of Kullgren drives up operating costs and expenses due to its high power requirement.

[0005] Processing plastic type materials, such as plastic bags, in conventional prior art systems is known to be problematic. For example, due to the characteristically light weight nature of the plastic type materials, difficulties exist for processing and feeding the same into an extruder. For instance, plastic bag materials possess an extremely low non-compressed weight averaging three pounds per cubic foot and, due to their aforementioned light weight characteristics, plastic bag materials have a tendency to spring open, float when moved and
15 form a very large bridge when stored.

[0006] Thus, the prior art does not readily provide continuous feeding and conveying of heated plastic materials. Additionally, the prior art does not easily provide systems for addressing recycled plastic materials for conversion into refined fuel products. Furthermore, prior art systems prove problematic in achieving an air lock for feeding and
20 manipulating heated plastic materials for subsequent processing.

[0007] Therefore, there is a need for producing a more efficient re-useable energy apparatus that provides capability for processing plastic type materials into usable and/or re-usable fuel products.

SUMMARY

25 [0008] According to first broad aspect, the present invention provides a material handling apparatus comprising a material press body having an inlet and an outlet; a power source for generating an airstream into the inlet of the material press body and through the outlet of the material press body, wherein the airstream captures and feeds a supply material into the material press body; a plurality of press augers for capturing and manipulating the supply
30 material into the material handling apparatus; and a drive system connected to drive and control the plurality of augers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The accompanying drawings, which are incorporated herein and constitute part of this specification, illustrate exemplary embodiments of the invention, and, together with the general description given above and the detailed description given below, serve to explain the features of the invention.

[0010] FIG. 1 is a schematic illustration of a re-useable energy apparatus according to one embodiment of the present invention.

[0011] FIG. 2 illustrates an assembled view of a bag press feeder assembly according to one embodiment of the present invention.

10 [0012] FIG. 3 illustrates an exploded view of the bag press feeder assembly of FIG. 2 according to one embodiment of the present invention.

[0013] FIG. 4 illustrates an alternate embodiment of a bag press feeder assembly according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

15 *Definitions*

[0014] Where the definition of terms departs from the commonly used meaning of the term, applicant intends to utilize the definitions provided below, unless specifically indicated.

20 [0015] It is to be understood that the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of any subject matter claimed. In this application, the use of the singular includes the plural unless specifically stated otherwise. It must be noted that, as used in the specification and the appended claims, the singular forms “a,” “an” and “the” include plural referents unless the context clearly dictates otherwise. In this application, the use of “or” means “and/or” unless stated otherwise. Furthermore, use of the term “including” as well as other forms, such as
25 “include,” “includes,” and “included,” is not limiting.

[0016] For purposes of the present invention, the term “comprising”, the term “having”, the term “including,” and variations of these words are intended to be open-ended and mean that there may be additional elements other than the listed elements.

[0017] For purposes of the present invention, directional terms such as “top,” “bottom,” “upper,” “lower,” “above,” “below,” “left,” “right,” “horizontal,” “vertical,” “up,” “down,” etc., are used merely for convenience in describing the various embodiments of the present invention. The embodiments of the present invention may be oriented in various ways. For example, the diagrams, apparatuses, etc., shown in the drawing FIG.s may be flipped over, rotated by 90° in any direction, reversed, etc.

[0018] For purposes of the present invention, a value or property is “based” on a particular value, property, the satisfaction of a condition, or other factor, if that value is derived by performing a mathematical calculation or logical decision using that value, property or other factor.

[0019] For the purposes of the present invention, the term “de-stoner hood” refers to a device that separates solid heavy objects from entering a prescribed area. In one exemplary embodiment, the de-stoner hood may be configured to prevent heavy objects like steel or aluminum from entering into the bag press hopper of the disclosed embodiment.

[0020] For the purposes of the present invention, the term “identical” refers to being similar in every detail; exactly alike.

[0021] For purposes of the present invention, it should be noted that to provide a more concise description, some of the quantitative expressions given herein are not qualified with the term “about.” It is understood that whether the term “about” is used explicitly or not, every quantity given herein is meant to refer to the actual given value, and it is also meant to refer to the approximation to such given value that would reasonably be inferred based on the ordinary skill in the art, including approximations due to the experimental and/or measurement conditions for such given value.

Description

[0022] While the invention is susceptible to various modifications and alternative forms, specific embodiment thereof has been shown by way of example in the drawings and will be described in detail below. It should be understood, however that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the invention is to cover all modifications, equivalents, and alternatives falling within the spirit and the scope of the invention.

[0023] Plastic waste material may be shredded and fed, for example, into a reactor (e.g., a pyrolysis reactor). Applying heat above 350 degrees Celsius will cause the shredded plastic material to melt and vaporize. Ultimately, an up-stream reactor may utilize back pressure to assist in the thermal cracking of carbon chains present in the plastic material to produce a refined fuel or re-useable fuel for subsequent use.

[0024] This application relates to an apparatus that may be part of a re-useable fuel processing unit. In one disclosed embodiment, an apparatus assembly may be used to feed plastic material into a reusable fuel processing unit including a pneumatic feed having a blower as a power source. It should be appreciated that the blower may be powered by the heat used to melt and vaporize the shredded plastic. The assembly may also include a screened air outlet, a plurality of press augers, a pinch conveyer system, a de-stoner hood, a receiver hopper, a low and high level indicators, ram, press screw inlet, pneumatic air cylinder, bag press inlet, outlet, and amp monitor. The pneumatic feed may be configured to move the plastic material at a fixed rate to the press feed receiver. The blower is used as a power source in which air from the blower is pulled through a screened hood. The screened air outlet may be substantially configured as the same identical shape as the bag press body. The press screw augers wipe the screen as they rotate allowing air flow through the bag press, ram, and receiver. A pinch conveyer system collects loose plastic material(s), such as plastic bags, and compresses them into a de-stoner hood (having a comparatively large body) allowing compressed plastic material(s) (e.g., plastic bags) to expand when disposed inside the de-stoner hood. The plastic material(s) (e.g., plastic bags) are conveyed into a receiver hopper thereby triggering a level indicator and starting a ram mechanism. The ram acts as an air cut-off gate that will push material into a press screw inlet. Once the ram starts to move, the pinch conveyer stops, thereby preventing material from entering the receiver hopper. Thus, the ram also acts as a cut-off gate. In a disclosed embodiment, the ram is pushed by a pneumatic air cylinder towards the bag press inlet. The ram may be configured to be larger than the receiver opening and designed with substantially the same identical matching face as the press screw augers. Full details of described embodiments are provided below.

[0025] Turning to FIG. 1, a disclosed embodiment of a heated airlock feeder or system 1000 is illustrated showing an apparatus in which the shredded plastic material is fed into a reactor (such as a pyrolysis reactor). The disclosed bag press feeder assembly 200 may be employed as part of a re-useable fuel processing unit that is readily configured for

continuously feeding recycled plastic materials and heating the same for subsequent processing into a fuel source, as described below.

[0026] Plastic bag type materials are known to be difficult to process feed into conventional prior art systems due to the inherent light weight nature of their material design.

5 Such plastic bag type materials may possess a very low non-compressed weight averaging, for example, approximately three pounds per cubic foot. Furthermore, such aforementioned materials may have a tendency to spring open, float when moved and form a very large bridge when stored. Embodiments of the disclosed design address and solve previous problems related to plastic bag conveying, receiving, storing and feeding and as described
10 above.

[0027] The disclosed bag press feeder assembly may be constructed from a variety of materials. Carbon steel may typically be employed in the disclosed design, but other alloys may be applied if required by certain conditions. Stainless steel or aluminum may also be employed within a construction design. Turning to FIGS. 2 and 3, the design of the bag press
15 feeder assembly 200 allows light materials to be collected and compressed into a higher density material. The inlet 81 of the unit is tangential to help allow the separation of the conveying air from the material. Eliminating air from within the disclosed design is important to remove or drastically reduce opportunities for combustion in an otherwise flammable working environment.

20 [0028] The plastic material being collected into the receiving hopper 82 is built to a point that a photo eye will indicate the level of material. This indicator will transmit a signal to a controller to stop the flow of material when capacity is indicated. In one disclosed embodiment, a ram press is configured to pull material from receiving hopper 82 into a press chamber 84, as material is lowered below the photo eye, more material is conveyed into
25 receiving hopper 82.

[0029] Plastic material may enter in either a clockwise or counterclockwise rotation based on a required design. As plastic material enters and circulates in the upper section of the receiver, it drops, due to gravity, into the lower section 82b. This section is designed to allow material to continuously fall and not bridge. The upper diameter is smaller than the base
30 discharge area creating a negative wall that forces any materials that would swell and cause bridging to be pushed in a downward direction following the sidewall shape.

[0030] Below the receiving hopper depicted on FIG. 2 at 82 is a square housing lined with ultra-high-molecular-weight polyethylene (UHMW) or low friction plastic, that has a void filling ram device 88 inside. In one disclosed embodiment, the housing is configured as a square geometry. Ram device 88 is powered by a pneumatic air cylinder 89. Ram device 88 or plug, travels inside the polymer liner 91 in a linear direction. The chamber 84 is of a prescribed shape (e.g., a generally square shape profile) with external support bars and matching connection flanges or seal flanges 86 and an inlet flange 83. A polymer liner, UHMW or nylon, is used to reduce the drag of the ram plug 88 as it is pushed.

[0031] Air cylinder 89 is mounted to a support frame 85 at the tail of the chamber depicted on FIG. 2 at 84. The other end of the air cylinder is connected inside RAM plug 88, e.g., to a plate that matches the auger's profile. The back end of the chamber 84 is sealed to prevent air leakage with a seal plate 87. By sealing the chamber, air movement is allowed to enter into the receiving hopper at the product inlet port 81, through chamber 84, through the press body, and then through the air discharge transition hood 100 and into a fan that can be located remotely.

[0032] The movement of RAM plug 88 slides beyond the opening depicted at 83, allowing material to fall from the receiving hopper 82 into chamber 84 through the opening connecting flange 83. RAM plug 88 is pulled to the rear of chamber 84 which allows for a large volume of material to drop in front of the RAM to be subsequently guided and pushed into the press device. Pneumatic cylinder 89 extends and pushes RAM plug 88 into an opening 98 of the bag press feeder 202.

[0033] The bag press feeder 202 consists of a press body or vertical double body 204 with a matching inlet flange 98 and an air discharge transition hood 100. Bag press feeder 202 connects to a support frame depicted 90 and to a lower hopper that comprise split eccentric reducers all of which may be welded to match up to the body and to the single diameter discharge flange. Within press body 204, counter rotating double flighted augers 92, 93 may be disposed. Augers 92, 93 are configured to receive and grab incoming material and manipulate the same to push the material to the lower hopper.

[0034] Augers 92 and 93 are located in a drum measuring approximately fourteen inches in diameter for each auger with heavy screw flight material welded solidly around the drum. The drum is designed as a lower tapered cone to match the bag press body shape. The drive shaft at 94 is supported and welded through the drum and extends into the gearbox 96.

Augers 92 and 93 are constructed where one has right-hand rotation the other has left-hand rotation. The left-hand and right-hand augers overlap. Due to this overlap augers 92, 93 act as self-cleaning mechanisms while pushing the plastic material downward into the lower section of the bag press feeder hopper. The pressure within the bag press feeder 202 increases as material is forced from the large opening at the top of the bag press feeder into the lower small opening of the bag press feeder. An access door 102 is a plug type door used to maintain the internal shape. Plastic material is pulled into the receiving hopper at the product inlet 81 by a fan located on the backside of a screened air outlet transition hood 100.

[0035] Main augers 92 and 93 may be configured as drum style augers. The concept of the drums is to have a large circumference preventing materials like plastic bags from wrapping completely around the drum. The disclosed design, along with overlapping, counter rotating auger flights prevents material from wrapping around the drum augers 92, 93. The base of the drum augers has two flights ending 180 degrees apart due to the double flights. Because the drum has flights on both sides that are 180 degrees apart, the force pressure downward does not deflect the drum auger when compressing material below.

[0036] As best illustrated in FIG. 3, a drive system may be provided to connect to and control augers 92, 93. The drive system may include a gearbox or drive mechanism 96 that may be powered, for example, by a helical gear motorized drive box or motor drive 97. Drive mechanism 96 may be maintained, for example, within a drive housing. From inside the drive housing exits transfer shafts 96d, spur gears 96e seals and bearings. The use of a multitude of spur gears 96e (e.g., four spur gears) reduces the overall size of the gearbox 96. In operation, the centerline difference between the two augers 92, 93 would otherwise require two large gears to meet in the middle, where the use of the four smaller spur gears makes the box smaller while maintaining equal force on all of the shafts.

[0037] Accordingly, in one disclosed embodiment, a pneumatic feed is used in the disclosed design to both move the plastic material at a fixed rate to the press feed receiver 82 and to remove any heavy objects. A standard blower may be used for the power source. The air from the blower is pulled through a screened hood 100 on a back side of a material press body or bag press body 99. In one disclosed embodiment, screen hood 100 tapers generally inwardly from a connection point onto a screened air outlet transition 302 may be configured as the same shape as the bag press body depicted at 99 creating a very small gap between augers 92 and 93 and the screen 302. Augers 92 and 93 wipe the screen 302 as it rotates,

allowing for air flow through the bag press, ram and receiver. Screen 302 maintains plastic material particles within bag press body 99 thereby preventing them from exiting at hood 100. However, the design of the screen 302 also allows airflow through the bag press into the bag press body 99 and out through hood 100 to eliminate and/or greatly reduce an otherwise combustible operating environment.

[0038] A conveyor system, such as a pinch conveyor system, may be employed to collect plastic material, such as loose bags, and compress them into a size that will be feed into a de-stoner hood 10. De-stoner hood 10 has a large body and allows the compressed plastic bag material to expand a little once disposed within inside the de-stoner hood. The bags are then conveyed into the receiver hopper 82 into the ram housing 84. The bags fill receiver hopper 82 to a fixed point triggering a level indicator. This will start ram 88 disposed below to push material into the press screw inlet 98. As ram 88 starts to move, the pinch conveyor stops to prevent further material from entering the receiver hopper 82. Ram 88 also acts as an air cutoff gate as it covers the receiver hopper opening 83. Receiver 82 has a negative wall design. The incoming material expands when it is inside the receiver 82. The hopper gets larger as its gets closer to the ram inlet 83. Ram 88 is pushed by a pneumatic air cylinder 89 to the bag press inlet 98, and at the same time cuts off the material flow due to its shape as the ram body is larger than the receiver opening 83 disposed above the ram body. Ram 88 may be configured to have a substantially identical face with the same shape and/or size as the press screw augers 92 and 93 allowing material to be pulled into the press body depicted 99. The plastic material is forced down the augers 92 and 93 by the metal flights 300. Disclosed embodiments provide one left hand flight auger 92 and one right hand flight auger 93 in the press body 99.

[0039] As more and more plastic material, such as plastic bags, is collected into the bag press, the plastic material is forced down and is compressed. As the plastic material (e.g., plastic bags) builds up inside the bag press body 99, the plastic material is pushed down where the diameter of the hopper gets smaller and smaller towards a compression area at outlet 103. The increase in material and decrease in area creates a higher density of plastic material and creates a pressurized seal.

[0040] The bag press motor drive 97 may include an amp monitor. The amp monitor may be set at a prescribed level to signal when the bag press is full and at the correct pressure. Depending upon the threshold level of the amp monitor, the motor drive is controlled to

operate or not operate based upon a prescribe value or amp range. When the material is allowed to discharge, the pressure is reduced in the compression area at outlet 103 and the computer may be initialized to start the fill process while continuing to monitor the motor amps.

5 [0041] Turning to FIG. 4, an alternate embodiment of a bag press feeder assembly is illustrated. A negative vacuum pressure is created within bag press body 99 to draw plastic material within. Accordingly, plastic material 402 is feed into inlet 404 of bag press body 99 by airstream 406. The disclosed configuration receives airstream 406 into inlet 404 of bag press body 99 towards auger 92 (93) and through screen 302 and hooded outlet 100.

10 [0042] A screened air outlet transition 302 may be configured as the same shape as the bag press body depicted at 99 creating a very small gap between augers 92 and 93 and the screen 302. Augers 92 and 93 wipe the screen 302 as it rotates, allowing for air flow through the bag press, ram and receiver. Screen 302 maintains plastic material particles within bag press body 99 thereby preventing them from exiting through screen 302 and hooded outlet
15 100. However, the design of the screen 302 also allows airflow through the bag press into the bag press body 99 and out through screen 302 and hooded outlet 100 to eliminate and/or greatly reduce an otherwise combustible operating environment.

[0043] By design, plastic material 402 is urged towards auger 92 (93) via airstream 406 and the back pressure created within bag press body 99. As more and more plastic material
20 402 is collected into bag press body 99, plastic material 402 is forced in downward direction 408 as it continues to compress. As plastic material 402 builds up inside bag press body 99, plastic material 402 is pushed downwardly where the diameter of the hopper gets smaller and smaller towards the outlet. The increase in material and decrease in area creates a higher density of material and creates a pressurized seal.

25 [0044] Having described the many embodiments of the present invention in detail, it will be apparent that modifications and variations are possible without departing from the scope of the invention defined in the appended claims. Furthermore, it should be appreciated that all examples in the present disclosure, while illustrating many embodiments of the invention, are provided as non-limiting examples and are, therefore, not to be taken as limiting the various
30 aspects so illustrated.

[0045] All documents, patents, journal articles and other materials cited in the present application are incorporated herein by reference.

[0046] While the present invention has been disclosed with references to certain embodiments, numerous modification, alterations, and changes to the described embodiments are possible without departing from the sphere and scope of the present invention, as defined in the appended claims. Accordingly, it is intended that the present invention not be limited to
5 the described embodiments, but that it has the full scope defined by the language of the following claims, and equivalents thereof.

CLAIMS

WHAT IS CLAIMED IS:

1. A material handling apparatus comprising:
 - a material press body having an inlet and an outlet;
 - a power source for generating an airstream into the inlet of the material press body and through the outlet of the material press body, wherein the airstream captures and feeds a supply material into the material press body;
 - a plurality of vertical press augers for capturing and manipulating the supply material into the material handling apparatus;
 - a drive system connected to drive and control the plurality of press augers; and
 - a screen configured in a fixed position and disposed at the outlet of the material press body,wherein the plurality of press augers scrape or wipe the screen as they rotate to allow air flow through the material press body.
2. The apparatus of claim 1, wherein the material press body includes a compression area disposed at an outlet tapered body structure.
3. The apparatus of claim 2, wherein a pressurized seal is created at the compression area.
4. The apparatus of claim 1, wherein the screen is configured to prevent the supply material from exiting the outlet but allows the airstream to pass therethrough.
5. The apparatus of claim 1, wherein the plurality of press augers rotate counter to one another.
6. The apparatus of claim 1, wherein the plurality of press augers overlap.

7. The apparatus of claim 1, wherein the plurality of press augers includes two press augers, wherein each auger has metal flights, wherein one is a right hand flight and one is a left hand flight.
8. The apparatus of claim 1, wherein a base of each plurality of press augers has two flights ending 180 degrees apart.
9. The apparatus of claim 1, wherein the drive system comprises a gearbox.
10. The apparatus of claim 9, wherein the gearbox comprises a helical gear.
11. The apparatus of claim 9, wherein the gearbox comprises spur gears.
12. The apparatus of claim 1, wherein the power source is a blower.
13. The apparatus of claim 1, comprising:
an amp monitor that signals when the material press body is full and at the correct pressure.
14. The apparatus of claim 1, comprising:
a feed for supplying the supply material to the inlet.
15. The apparatus of claim 14, wherein the feed is pneumatic.
16. The apparatus of claim 1, wherein the supply material is plastic.
17. The apparatus of claim 16, wherein the supply material is plastic bags.
18. The apparatus of claim 1, comprising:
a conveyor system configured to collect the supply material for feeding into a destoner hood.
19. The apparatus of claim 1,

wherein the power source is a blower and the blower is powered by heat used to melt and vaporize the supply material in the apparatus.

20. A material handling apparatus comprising:

a material press body having an inlet and an air outlet configured at a first direction away from the inlet;

a power source for generating an airstream into the inlet in the first direction towards and through the air outlet of the material press body, wherein the airstream captures and feeds a supply material into the material press body;

a screen configured in a fixed position and disposed at the outlet of the material press body;

a plurality of vertical press augers configured to receive and manipulate the supply material fed by the airstream into the material press body in a second direction, wherein the second direction is different from the first direction; and

a drive system connected to drive and control the plurality of press augers.

21. The apparatus of claim 20, wherein the power source is a blower and the blower is powered by heat used to melt and vaporize the supply material in the apparatus.

22. The apparatus of claim 20 or 21, wherein the plurality of press augers scrape or wipe the screen as they rotate thereby allowing air flow through the material press body.