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(54) DRY ASH HANDLING SYSTEM FOR AN INCINERATOR.

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Courier Press, Leamington Spa, England.

Description

The present invention is directed to a dry ash handling system for a municipal waste incinerator that cools ash to room temperature for easy handling and, more particularly, to a system that collects ash in a car in a sealed tunnel, allows maximum burn-out of the waste to occur and water-spray cools the ash to a safe handling temperature while in the sealed tunnel before transporting the sealed car to a landfill.

Municipal solid waste incineration systems such as illustrated in Fig. 1, burn waste dumped in chute 10 in a rotary combustor 12 such as an O'Connor combustor described in detail in U.S. Patent Nos. 3,822,651 and 4,066,024. Part of the burned waste leaves the O'Connor combustor as fly ash which travels up an after burner/gas cleaning chamber 14 and is collected in a fly ash collection system. Bottom ash, including partially burned embers, fall out of the combustor 12 into an ash burning and collection hopper 16 which includes a water cooled stairway grate 18 that allows large embers more time to complete burn-out as they roll down the stairway 18. The stairway 18 includes air injection ports which force air against the large embers and attempts to complete burn-out by holding the larger pieces in the chamber 14 for an additional time. The ashes then fall into a quenching tank 20 which includes a conveyor 22 which carries the wet ash to an ash car 24. The water serves two functions: 1) it quenches the sometimes still smoldering ash, and 2) it forms an air seal between the ash pit and the combustor 12 which operates at a slightly negative pressure. Incineration systems that include a conveyor 22 are frequently taken out of service because large objects get caught in the drag conveyor flights, breaking a drag chain, causing the conveyor 22 to grind to a halt. The system, in such a situation, will be out of service for at least eight hours, the time required to cool down and then reheat the combustor 12. The water from tank 12, before discharge back into the environment, must be treated. The full ash car 24, loaded with wet ash, is carried to a landfill and emptied. Since waste carriers charge by the point for disposal, the wet ash is much more expensive to discard than would be the ash if it were dry.

Dry ash handling systems have been produced that replace the water tank 20 and stairway 18 with a slowly moving conveyor at the bottom of the combustor 12. The conveyor is located approximately four feet from the bottom edge of the combustor 12 and moves at a rate which allows approximately one foot of dry ash to be deposited on the conveyor. The conveyor is a grate type conveyor that allows air to be injected into the ash in an attempt to complete combustion of larger embers. However, considerable dusting and scattering of the ash occurs in such systems and at times burn-out of the ash is incomplete, resulting in smoldering ash being carried to the landfill.

Among the objects of the present invention are to provide a dry ash handling system which protects operating personnel and the environment from exposure to combustor ash, to provide a dry ash handling system with a positive combustor seal, to provide an ash handling system that allows maximum ash burn-out, to provide a system which will cool the ash to a safe handling temperature before transport to a landfill, and to provide a system which segregates batches of ash until analyzed and released for transport.

The above objects can be attained by a dry ash handling system according to claim 1 that allows ash to fall into a refractory lined ash car in a sealed tunnel. Any unburned waste is allowed to continue burning while in the car and until sprayed to quench any remaining smoldering embers and bring the moisture content up to an acceptable level. After removal from the sealed tunnel, the car is sealed with a lid and allowed to cool further before being sampled, tested and transported to a landfill by a tilt bed truck. At the landfill, a hinged door in the car allows the ash to be dumped.

These, together with other objects and advantages which will be subsequently apparent, reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

Fig. 1 depicts a municipal waste incinerator with a prior art wet ash handling system;

Fig. 2 is a cross-sectional view of a dry ash handling system according to the present invention;

Fig. 3 is a side view of the system of Fig. 2;

Figs. 4 and 5 are side and end views of a car 40;

Fig. 6 is a detailed view of a car wheel 74 and tunnel track 76;

Fig. 7 illustrates sealing details of a car 42;

Fig. 8 depicts the details of a sample port 110;

Fig. 9 shows an air infusion pipe 70 and exit door louvers 58;

Fig. 10 illustrates a lid 50 being clamped to a car 46;

Figs. 11 and 12 illustrate tunnel door 54 sliding mechanisms;

Figs. 13 and 14 are views of a tunnel door 54 bottom seal;

Fig. 15 is a side view of a tunnel door 54 top seal;

Fig. 16 is a top view of a tunnel door 54 side seal;

Fig. 17 illustrates the arrangement for weighing a car 42;

Fig. 18 shows a crane 200 for moving car lids 204;

Fig. 19 illustrates a truck 21 with a tilting bed 212 for emptying a car 46; and

Fig. 20 is a side view of an alternate tunnel embodiment.

Referring now to the drawings in detail and in particular, to Figure 2, bottom ash falls from a combustor 22 through a bifurcated chute 30 and is diverted by a mechanically operated ash

diverter gate 32 into one of two sealed ash tunnels 34 and 36. Each tunnel is approximately 18 meters long, 3 meters high and 3 meters wide. Three similar ash cars 40, 42 and 44 are positioned in each tunnel and one ash car 46 is shown outside each tunnel 34 or 36. Ash car 40 is waiting to be filled, car 42 is being filled with ash from the combustor 12 while car 44 is completing burn-out and being water-cooled by atomizer spray nozzles 48. 1.5 liters/second of water for one hour is necessary to cool the ash from 650°C to 21°C if no cooling outside the tunnel is allowed. Car 46 is being sealed with lid 50 before being transported to a landfill by a tilt bed truck 210.

If the car 42 is 2.5 meters by 2.5 meters by 6 meters it will hold approximately 25 tons of ash and can be filled in approximately 4 hours by a 254 cm diameter O'Connor combustor. When load cell 52 detect that car 42 is full, ash gate 32 pivots to allow ash to fall into tunnel 34, doors 54 and 56 on both ends of the tunnel are opened, allowing a tow motor type vehicle to push a car through the open door 54 at the same time shoving car 44 out door opening 56.

When the doors 54 and 56 are closed, air is allowed into the bottom of car 44 through louvers 58 in door 56. The air passes up through the ash and into the chute 30 through louvers 60 due to the −.00123 atmospheres pressure caused by combustor 12 in chute 30, allowing the ash in car 44 to continue to burn. Since it takes approximately 4 hours for a single car to be filled, with dual tunnels, the burn-out period can be approximately 7 hours, more than sufficient to allow combustion of unburned embers. The burn-out chamber can also include a chute for fly ash so that it can be commingled with the bottom ash.

The air for continued combustion enters a steel pipe 70 which extends from the car 40, as illustrated in Fig. 4. The pipe is 15 cm in diameter and includes air holes 72 located near the bottom of the pipe at a 30° angle which allows air to infiltrate the ash without clogging the air holes 72. An air flow rate through holes 72 of approximately ten percent of combustion air is sufficient to maximize burn-out and the holes 72 should be sized accordingly. Additional pipes 70 or holes 72 can be added if faster burn-out is desired. It is also possible to provide sloped sides in car 40 which may improve burn-out speed.

The cars 40—46 include notched wheels 74 that ride on 5 cm × 5 cm angle iron track 76 while in the tunnel 36. Fig. 6 illustrates the construction of a wheel 74 and track 76 in greater detail. The angle iron track 76 is welded to a deck plate 78 of the tunnel and carries a notched wheel 74. The notch 78 in the wheel 74 matches the shape of track 76. The flat surface of the wheel 74 allows the wheel 74 to roll on flat surfaces. The wheel 74 includes a carbon steel notched rolling surface 80 and a bronze press fit dry bearing 82.

The rear of the car 42 includes a swinging door 90 such as a dump truck door, rotating about bar hinge 92, as illustrated in Fig. 7. The edge of the door 90 and lip of the car 40 include a fiber frax gasket 94. The gasket 94 prevents ash from migrating around the door 90. The door 90 is held shut by several over-the-center dump truck latches 96 which provide a tight fit between the door 90 and car 40. Each car 40 includes a top flange 98 which has a fiber frax gasket 100 attached to the top edge around the perimeter. The chute 30 also has a fiber frax gasket 102 which mates with the gasket 100 of each car 42 when the car 42 is positioned under the chute 30. The gaskets 100 and 102 when the car is in position prevent dust from billowing out of the car 42 as it is being filled.

After a filled car 46 has been moved outside the tunnel 36 and the lid 50 attached, the plant operator can obtain ash samples through port-hole type sampling ports 110, illustrated in Fig. 8, spaced at periodic intervals on the side of the car. The sampling ports 110 include a cap 112 rotating on a bar hinge 114 and clamped in place by a latch 116. A sample thief identical to those used in grain storage elevators to sample grain from the interior of the elevator is inserted through the open sampling port 110 to obtain a sample for testing ash content to ensure that all the waste has been burned, including the complete combustion of hazardous chemicals. The interior wall 118 of the car 46 is lined with a cast refractory material, while the outer wall 120 is plate steel approximately 6 mm thick. The refractory lining 118 is provided because ash is typically deposited in the car at approximately 760°C.

The pipe 70 which extends through the end of the car opposite the hinged door 90 mates with door louver 58 using fiber frax gaskets 130 and 132, as illustrated in Fig. 9. The interior of the pipe is exposed to the openings in louver 58 which can be manually opened and closed to control airflow into the car 44. If mating between the louver 58 and pipe 70 becomes a problem because of inadequate movement by car 44 toward door 56, the louver 58 can be provided with a telescopic type extension.

The lid 50, illustrated in detail in Fig. 10, seals the car 46 for transportation to a landfill and includes a C-clamp 140 which clamps the lid 50 to the car 46 compressing fiber frax seal 100 and 142 together. The fiber frax seal 142 is attached to the edge of the lid 50 which is constructed of a 3 mm steel plate 144 and a 25 mm sheet 146 of plywood glued to the plate 144. The plywood provides rigidity at low weight, while the steel provides heat resistance.

The tunnel doors 54 and 56 are sliding doors which slide within a frame 150 which extends above the tunnel 36, as illustrated in Figs. 11 and 12. Plate steel 6 mm thick with angle iron reinforcements will provide a suitable door. The door is lifted by a reversible motor 152 of at least $\frac{1}{4}$ horsepower and a cable 154 that runs over a pulley 156. A limit switch 158 ensures that the door 54 is not raised past a point where it will be damaged.

A dust seal for the bottom of each door, for example, the door 54, fits over the tracks 76,

against the tunnel bottom 170 and is constructed of a steel pad 172 and a fiber frax gasket 174, as illustrated in Figs. 13 and 14. The top of each door is sealed with another pair of fiber frax gaskets 176 and 178, as illustrated in Fig. 15. One of the gaskets 176 is mounted on the door and the other gasket 178 is mounted on a 2.5 cm × 2.5 cm angle iron 180 welded to the top of the tunnel 36. The door, because of the negative pressure in the tunnel 36 created by combustor 12, will be pulled toward the tunnel 36, helping to create a dust-tight seal. To ensure that a very tight seal is created, an inflatable door gasket 182, located along the sides of frame 150, pushes the door against a fiber frax gasket 184, as illustrated in Fig. 16. An appropriate inflatable gasket can be obtained from Sealmaster Corp. of Kent, Ohio.

The weighing system for weighing the ash in car 42 to determine when a new car should be moved under chute 30 is illustrated in Fig. 17. The load cell 52 includes a substantially non-compressible load measuring device such as a piezoelectric sensor load cell, which supports the ends of two rail segments 190 and 192. The ends of the rail segments 190 and 192 supported by the load cells include a very small gap 194 between the rails which allows the rails to freely move. The other ends of the rail segments are substantially fixed in place. Only one of the rails in the weighing section under the car 42 includes a load cell, the other rail being a solid rail.

When a car 46 emerges from a tunnel 36 a telescoping gantry crane 200 that has an electromagnetic lifting device 202 obtains a lid 50 from a stack 204 and moves it onto the exiting car 46. When a car 206 returns, the telescoping gantry crane 200 lifts the lid 50 off of the car 206 after the C-clamps 140 holding the lid 50 on the car 206 have been removed.

The front wheels of each car are pivoting wheels to allow the car to be turned as it is moved about on a concrete pad surrounding the tunnels 34 and 36 by a tow motor type vehicle. The tow motor will also align the car 46 with the rails 76 of the tunnels 34 and 36. A car 46 which is full, is loaded onto a truck 210 by the pushing action of the tow motor. The truck 210 can be based on a highway coal carrying dump truck which includes a tilting hydraulically operated bed 212. The car 46 is strapped to the truck bed using dump truck latches or truck chain tighteners 214. When the truck 210 arrives at the landfill, the latches 96 are released from the rear door 90 and the bed 212 is tilted, dumping the contents of the car 46.

If there is insufficient room under the combustor 12 to provide two tunnels 34 and 36, as illustrated in Fig. 2, a single tunnel 218 can be provided if isolation chambers 220 and 222 are provided, as illustrated in Fig. 20. The entrance isolation chamber includes an external door 224 and an internal door 226 which cannot be opened simultaneously. The outgoing isolation chamber 222 also includes doors 228 and 230 that cannot be opened simultaneously. When a car is moved into the tunnel 218, first the isolation door 224 is opened. While the car is in chamber 220 a drive mechanism such as a chain pull is connected to the car. Next, the door 224 is closed. Then door 226 is opened and the car is pulled into the tunnel by the drive mechanism forcing a car into burn-out and cooling chamber 232 through the open door 228 into the outgoing chamber 222. Once a car is in isolation chamber 222 it can be removed by a tow motor after door 228 is closed and door 230 is opened.

Claims

1. An ash handling system characterized by a pair of sealable chambers (34, 36) openable at opposite ends, a birfurcated ash chute (30) entering each of said chambers (34, 35) and three ash cars (40, 42, 44) being positioned in each of said chambers, such that, one of said cars (40) is waiting to be filled, a second car (42) is being filled and a third car (44) is completing burn-out, the cars (40, 42, 44) entering one end of each of the chambers (34, 36) and exiting the opposite end thereof, and a diverter gate (32) which, when one of said cars (42) in one of the chambers (34) is full, is operated depending on a signal of a load cell 52 to divert the ash to said another car (40) waiting to be filled in the other chamber (36) so as to provide continual handling of the ash.

2. An ash handling system as recited in claim 1 characterized in that there are spray nozzles (48) disposed in the chambers (34 and 36) adjacent the bifurcated ash chute (30) for spraying the ash in a full car (44) to prevent smoldering of the ash when the car (42) has been loaded and moved under the spray nozzles (48).

3. An ash handling system as recited in claim 1 characterized in that there is a lid which fits tightly on the car (46) to prevent ash from escaping when the car (46) has been removed from the chambers (34, 36) and sealed, and a latchable hinged door (98) disposed on one end of the car (46) which allows the ash to be dumped from the car (46).

4. An ash handling system as recited in claim 1 characterized in that there are air entrance tubes (70) disposed in said cars (42) to allow air to move therethrough to burn unburned matter in said ash.

5. An ash handling system as recited in claim 1 characterized in that the load cell (52) includes a substantially no-compressive load measuring device.

Patentansprüche

1. Aschehandhabungssystem, gekennzeichnet durch ein Paar von dichtverschließbaren Kammern (34, 36), welche an gegenüberliegenden Enden geöffnet werden können, eine gegabelte Aschenrutsche (30), welche in jede der Kammern (34, 35) eintritt, und durch drei Aschenkarren (40, 42, 44), welche in jeder der Kammern so angeordnet sind, daß eine der Karren (40) wartet, gefüllt zu werden, eine zweite Karre (42) gerade gefüllt wird und eine dritte Karre (44) das Aus-

brennen vollendet, wobei die Karren (40, 42, 44) am einen Ende einer jeden Kammer (34, 36) eintreten und am anderen Ende derselben austreten, und ein Umlenkgatter (32), welches, wenn eine Karre (42) in einer der Kammern (34) gefüllt ist, in Abhängigkeit von einem Signal einer Beladungszelle (52) betätigt wird, um die Asche in die andere Karre (40) umzulenken, welche in der anderen Kammer (36) wartet, gefüllt zu werden, so daß eine kontinuierliche Förderung der Asche geschaffen wird.

2. Aschehandhabungssystem nach Anspruch 1, dadurch gekennzeichnet, daß Sprühdüsen (48) in den Kammern (34 und 36) neben der gegabelten Ascherutsche (30) angeordnet sind, um die Asche in einer vollen Karre (44) zu besprühen, damit ein Glimmen der Asche vermieden wird, wenn die Karre (42) beladen worden und unter die Sprühdüsen (48) bewegt worden ist.

3. Aschehandhabungssystem nach Anspruch 1, dadurch gekennzeichnet, daß ein straff auf der Karre (46) sitzender Deckel vorgesehen ist, um das Entweichen der Asche zu verhindern, wenn die Karre (46) aus den Kammern (34, 36) herausbewegt und abgedichtet worden ist, und daß eine einklinkbare Schwenktür (98) vorgesehen ist, welche an einem Ende der Karre (46) angeordnet ist, welches das Ausschütten der Asche aus der Karre (46) erlaubt.

4. Aschehandhabungssystem nach Anspruch 1, dadurch gekennzeichnet, daß Lufteintrittsrohre (70) vorgesehen sind, welche in den Karren (42) angeordnet sind, um eine Luftbewegung durch diese zu erlauben, um Unverbranntes in der Asche zu verbrennen.

5. Ascheförderanlage nach Anspruch 1, dadurch gekennzeichnet, daß die Beladungszelle (52) eine im wesentlichen inkompressible Beladungsmessungseinrichtung aufweist.

Revendications

1. Système de manutention de cendres, caractérisé par une paire de chambres (34, 36) pouvant être fermées hermétiquement et pouvant être ouvertes à leurs extrémités opposées, une goulotte (30) à cendres, à branches divergentes, pénétrant dans chacune desdites chambres (34, 35) et trois wagonnets (40, 42, 44) à cendres, positionnés dans chacune desdites chambres, de telle sorte que lorsque l'un des wagonnets (40) est en attente de remplissage, un second wagonnet (42) est en cours de remplissage et dans un troisième wagonnet (44) les cendres achèvent de brûler, les wagonnets (40, 42, 44) pénétrant par une des extrémités de chacune des chambres (34, 36) et sortant par l'extrémité opposée de ces dernières, et une porte (32) de détournement qui, lorsque l'un des wagonnets (42) dans une des chambres (34) est plein, est actionné en fonction d'un signal d'un capteur extensiométrique (52) pour détourner les cendres vers un autre wagonnet (40) en attente de remplissage dans l'autre chambre (36), de manière à assurer une manutention continue des cendres.

2. Système de manutention de cendres selon la revendication 1, caractérisé en ce qu'il comporte des buses de pulvérisation (48) disposées dans les chambres (34 et 36) en un endroit adjacent à la goulotte (30) à cendres, à branches divergentes, pour effectuer une pulvérisation sur les cendres dans un wagonnet plein (44) afin d'empêcher que les cendres continuent à se consumer quand le wagonnet (42) a été chargé et déplacé sous les buses de pulvérisation (48).

3. Système de manutention de cendres selon la revendication 1, caractérisé en ce qu'un couvercle s'ajuste de façon hermétique sur le wagonnet (46) pour empêcher les cendres de s'échapper lorsque le wagonnet (46) a été évacué des chambres (34, 36) et fermé de façon étanche, et une porte articulée verrouillable (98) qui est disposée sur une des extrémités du wagonnet (46) et qui permet de décharger les cendres du wagonnet (46).

4. Système de manutention de cendres selon la revendication 1, caractérisé en ce que des tubes (70) d'entrée d'air sont disposés dans les wagonnets (42) pour permettre à l'air de se déplacer à travers ces derniers afin de brûler les matières non consumées dans lesdites cendres.

5. Système de manutention de cendres selon la revendication 1, caractérisé en ce que le capteur extensiométrique (52) comprend un dispositif de mesure extensiométrique sensiblement non compressible.

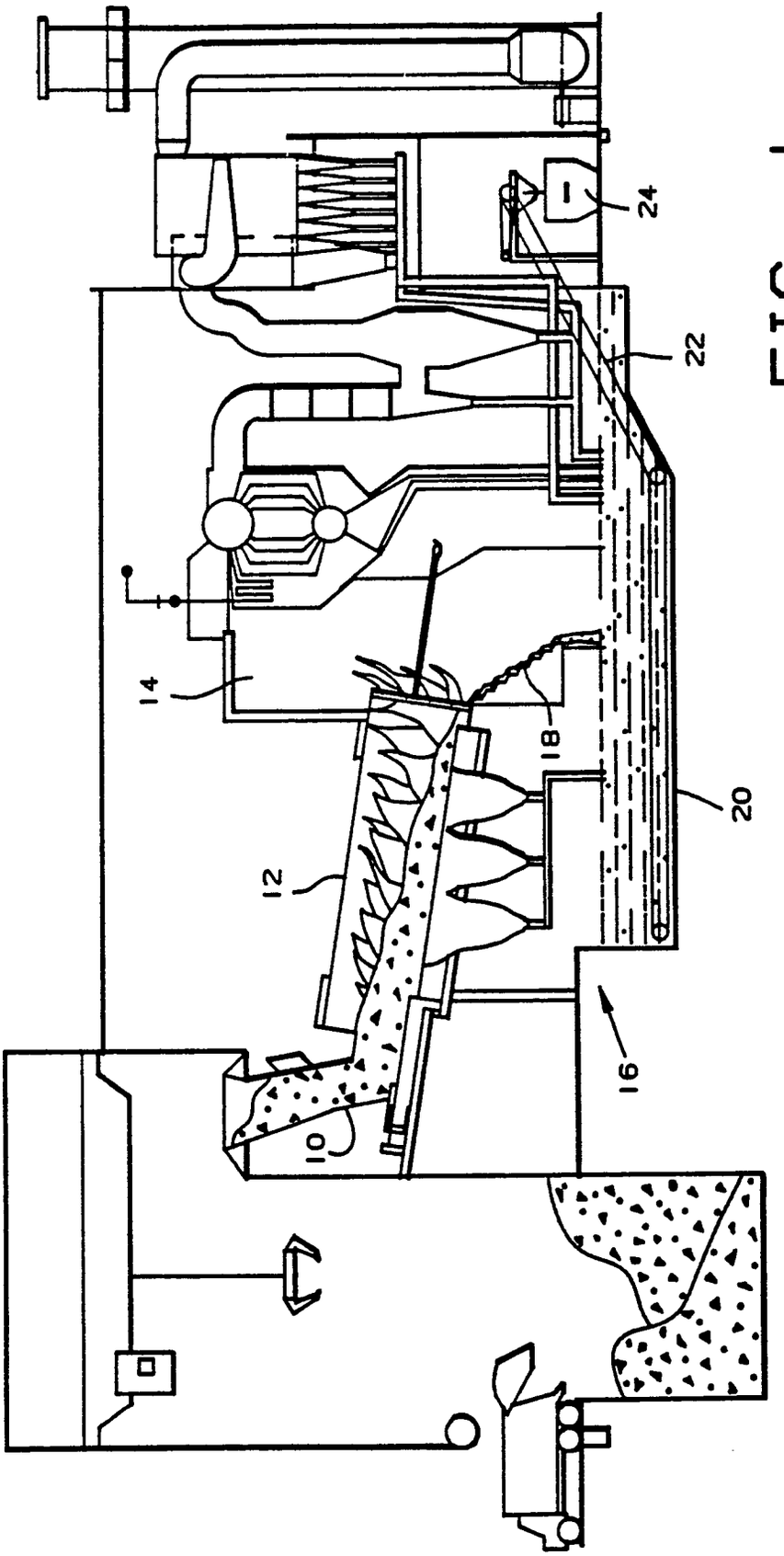


FIG. 1.

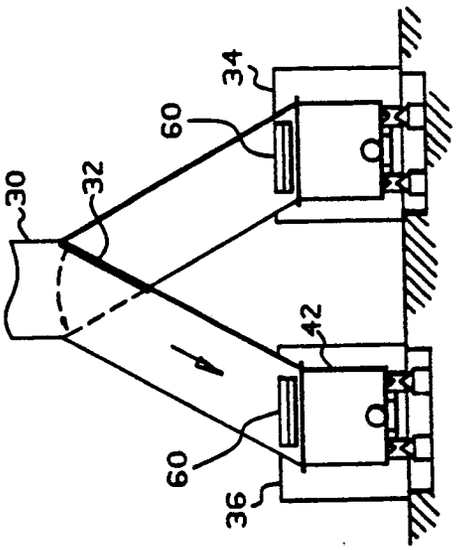


FIG. 2.

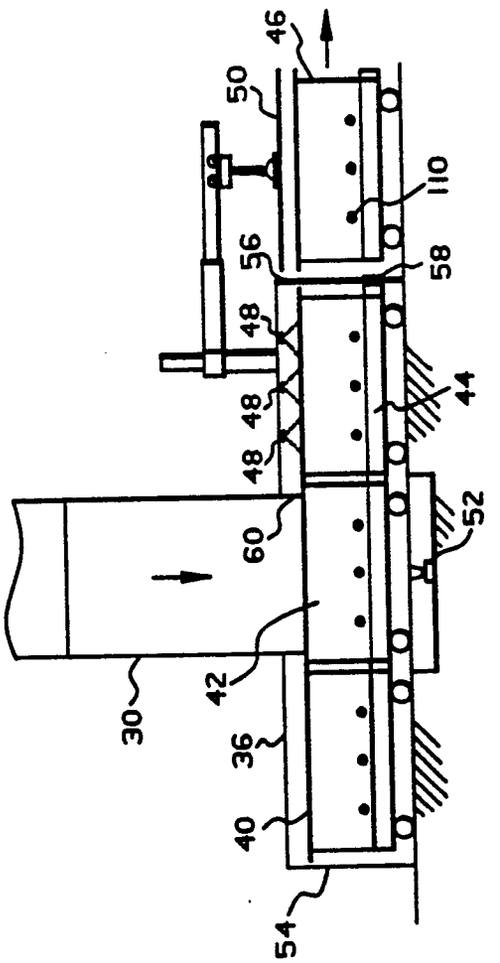


FIG. 3.

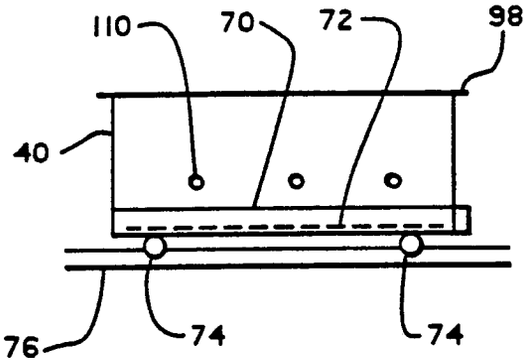


FIG. 4.

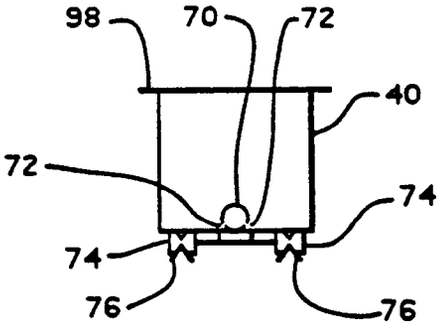


FIG. 5.

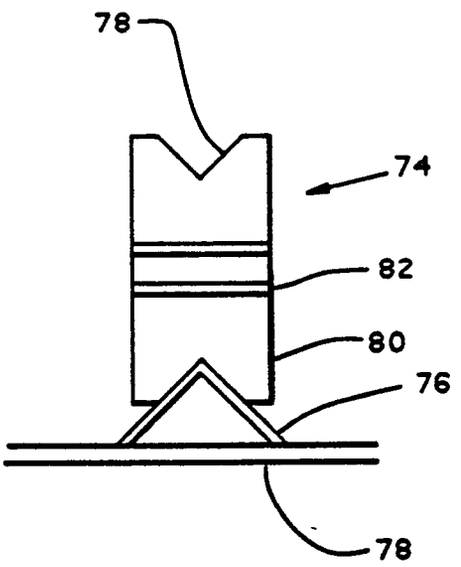


FIG. 6.

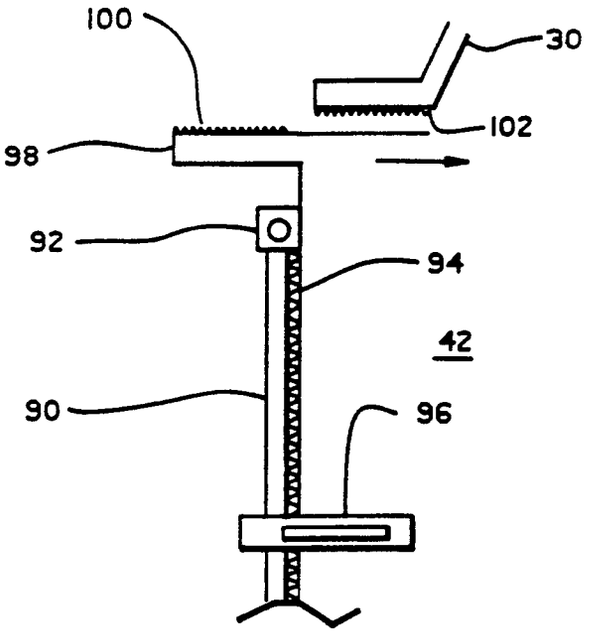


FIG. 7.

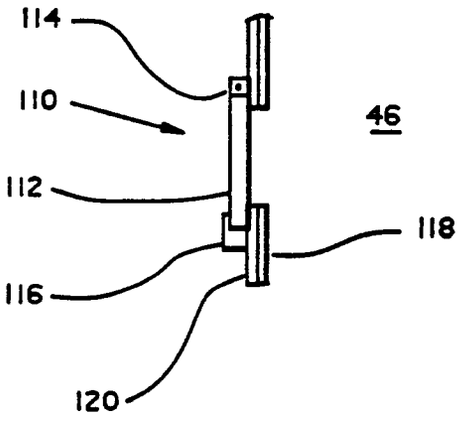


FIG. 8.

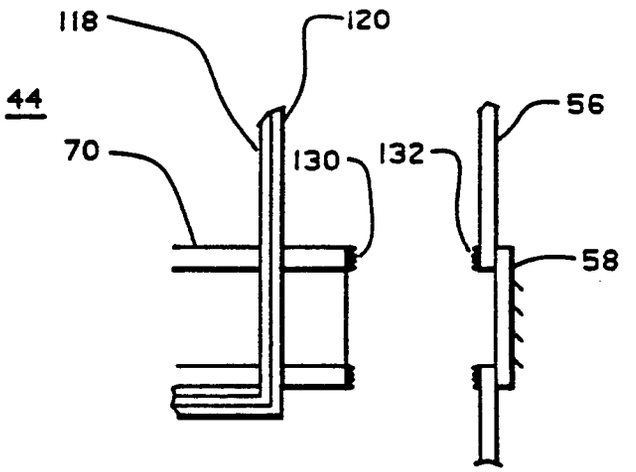


FIG. 9.

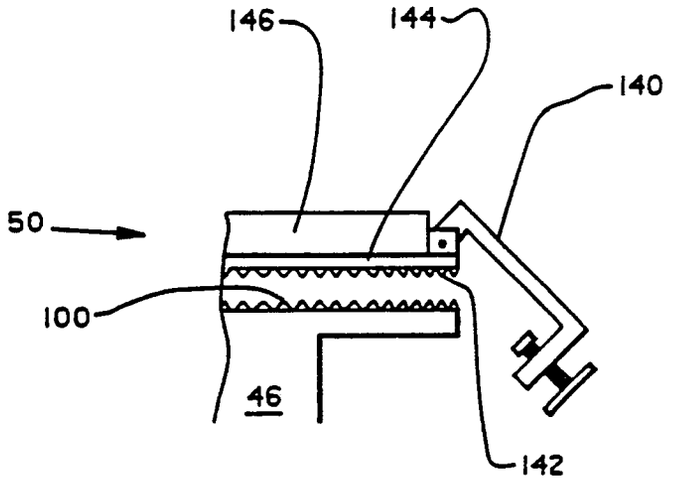


FIG. 10.

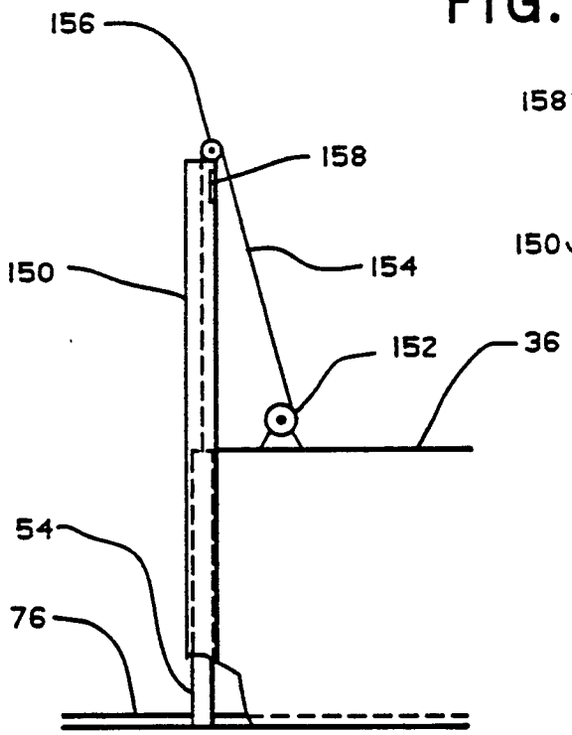


FIG. 11.

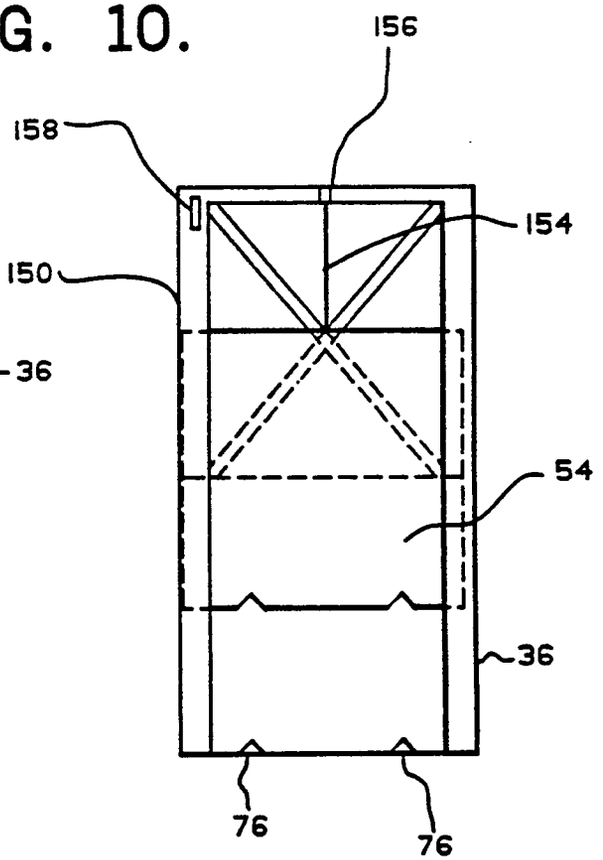


FIG. 12.

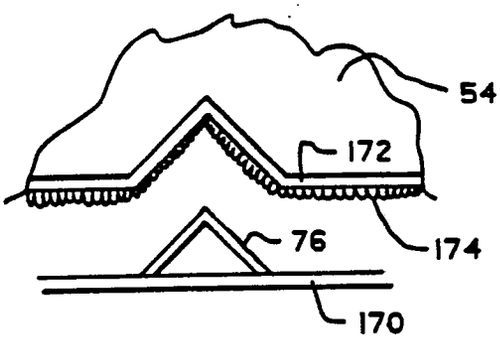


FIG. 13.

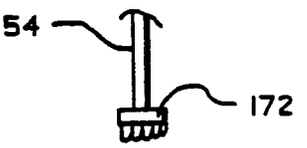


FIG. 14.

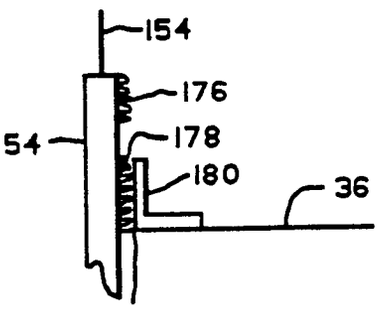


FIG. 15.

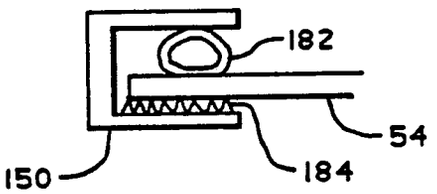


FIG. 16.

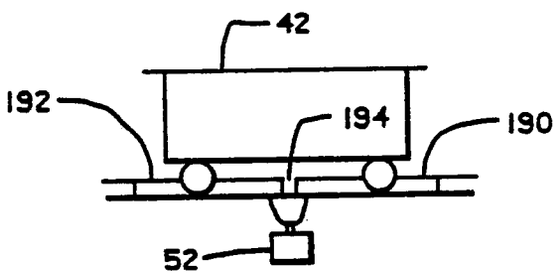


FIG. 17.

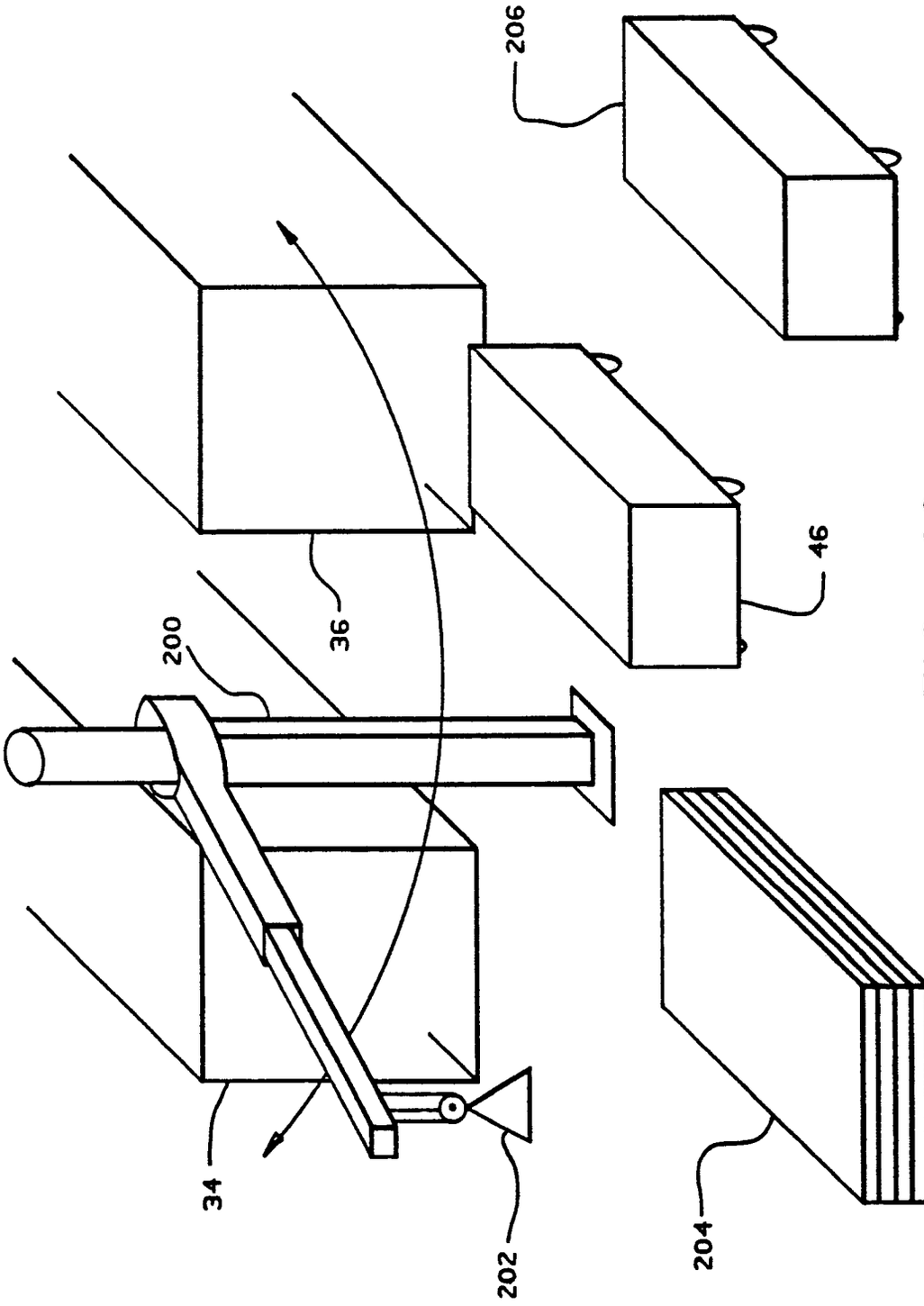


FIG. 18.

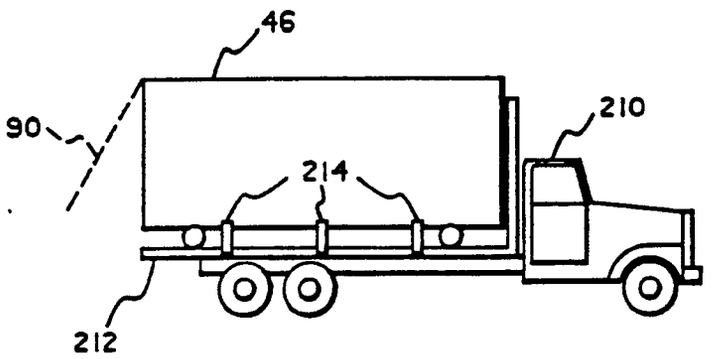


FIG. 19.

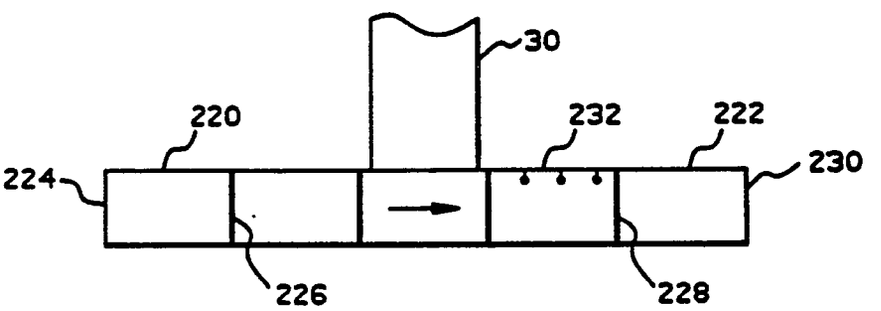


FIG. 20.