Jan. 4, 1944. B. H. FOSTER 2,338,504

FLUE BAG FILTER

Filed Feb. 18, 1941

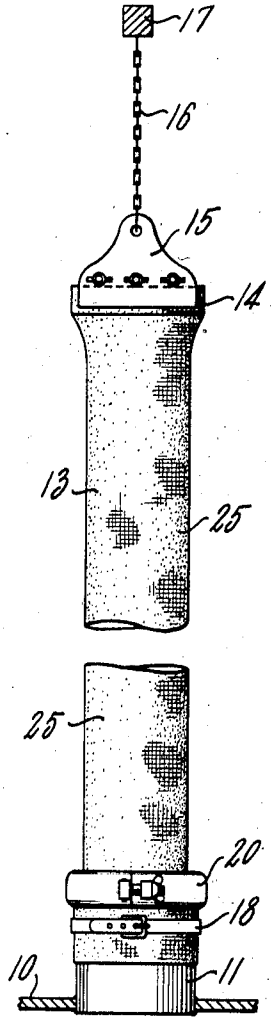


Fig. 1

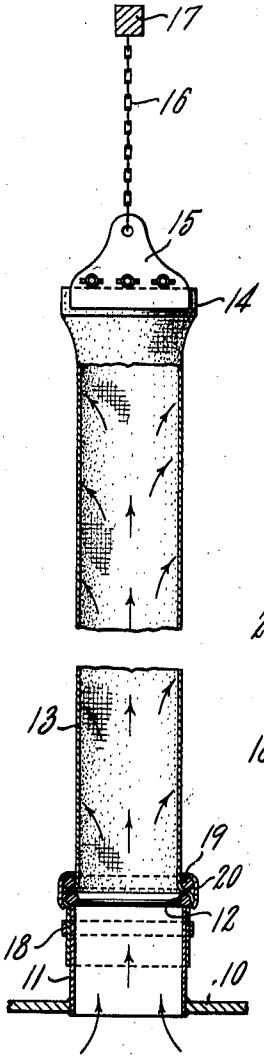


Fig. 2

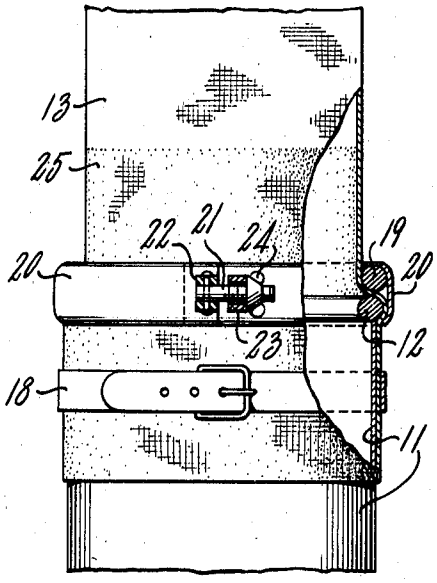


Fig. 3

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FLUE BAG FILTER

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Application February 18, 1941, Serial No. 379,423

2 Claims. (Cl. 183—73)

This invention relates to improvements in filters used for separating dust from dust-laden gases, such as are used for recovering dust from gases discharged from ore-roasting furnaces, cement kilns, and the like.

This application is a continuation-in-part of my prior application Serial No. 373,155 filed January 4, 1941.

In the field of metallurgy, roasting is employed to treat certain ores, and the gases resulting from such roasting operation are commonly filtered to remove therefrom the finely divided solids, such as lead oxide or zinc oxide.

When ore roasting and similar operations are carried out upon a large scale, the effluent gases are commonly conducted to a filtering plant or bag house equipped with a large number of filter bags or tubes. These bags are usually made of wool or cotton goods woven in the form of a tube. In some installations the bags are about 30 feet long and about 18 inches in diameter, while in others they are about 7 to 8 feet long and about 8 inches in diameter. In either type the bag is closed at its upper end by folding the tube over and securing a clamp thereto, which clamp may be secured to a supporting chain or hook to hold the bag in a vertical position.

The lower ends of these bags are secured over upwardly extending metal thimbles or tubes which deliver the gas to be filtered into the bags, and these thimbles may lead upwardly from a chamber, or may be connected to a large pipe or flue by a manifold which delivers the gas to the various thimbles. Bags of the smaller type are mounted inside of vacuum boxes so as to increase the operating efficiency of the filter system.

It has been the usual practice heretofore to pull the lower end of the bag down over a thimble and secure it thereto by placing a strap or tie cord about the portion of the bag which surrounds the thimble. When the filter is in use the bags are shaken mechanically, at intervals, by lowering and raising the supports for the upper ends of the bags to dislodge the particles from the walls thereof. This shaking of the bags greatly increases the wear upon the same, particularly where they are secured to the thimbles. Furthermore shaking a bag gives the falling particles adjacent the inner walls thereof an opportunity to enter the space between the bag and the upper end of the thimble to accumulate in the pocket thus formed above the tie strap.

The accumulation of these particles at this point creates a bulging strain upon the bag and may keep this portion of the bag in a moist condition, that increases the destructive action of the chemicals upon the bag structure, all of which is injurious to the fabric forming the filter bag. It is found in practice that rupture of the bag almost invariably occurs first at a point adjacent the upper end of the thimble, due to the injurious actions just mentioned. It has also been found that considerable abrasive wear of the fabric in the main body of the bag takes place, as a result of the continuous combined action of the fine solid particles and the flow of gases through the fabric.

When the filter bags are made of cotton or wool, it is not practical to subject them to a temperature above 200° F. because of the rapid deterioration of the fabric when subjected to a higher temperature, and also due to the fire hazard.

The gases to be filtered usually leave the roaster at a temperature much higher than 200° F., therefore to reduce the temperature of these gases it is necessary to bleed air into the flues leading to the bag house.

This introduction of air into the flues to lower the temperature of the gases reduces the capacity of the roasting furnace and increases the fuel and labor costs. The smelters and refiners would prefer to supply the gases to the filters at a temperature of approximately 350° F. for more efficient operation, and in an effort to filter the gases at this higher temperature asbestos bags have been used heretofore, but they have failed to give as satisfactory a life as the cotton and woolen bags because of the mechanical wear.

Having in mind the foregoing, one important feature of the present invention resides in improved mechanism for securing the lower end of a filter bag to the upwardly projecting thimble so as to prevent the particles within the bag from accumulating about the upper end of the thimble, with the injurious effect above mentioned.

Another feature of the present invention resides in the treatment of the lower portion of the bags with a flexible plastic material to thereby increase its durability so as to increase the life of the bag near the upper end of the thimble, where it tends to deteriorate most rapidly. In many cases however it may be desirable to treat the entire bag with the flexible plastic material so as to bind the fibers together and coat the fibers and threads, whereby abrasion and disintegration of the fabric is greatly reduced and the life of the bags is thus prolonged.

Another feature of the invention resides in

asbestos filter tubes or bags formed of a finer and more closely woven asbestos fabric than that employed in this field heretofore, to thereby provide more threads to the inch and having higher twist in the single yarn, and also improve the filtering properties.

The above and other features of the invention and novel arrangement of parts will be more fully understood from the following description when read in connection with the accompanying drawing showing one good practical embodiment of the invention.

In the drawing:

Fig. 1 is a front elevation of a bag filter unit constructed in accordance with the present invention.

Fig. 2 is a vertical sectional view of the construction of Fig. 1; and

Fig. 3 on a larger scale is a front elevation of portion of Fig. 1, with part thereof in section and showing only the lower part of the bag as treated with the flexible plastic material.

In the drawing 10 is a flue floor or partition having any desired number of circular holes formed therein to receive the upwardly extending thimbles or tubes 11, only one of which is shown in the drawing. The gases to be filtered are supplied to the space below the floor 10 from the roasting furnace by mechanisms, not shown, so that these gases may pass upwardly through the thimble and into the filter bag as indicated by the arrows. The thimble or tube 11 formed of metal is preferably provided at its upper end with a ring or bead 12 to provide the upper end of this tube with a smooth rounded surface which will not cut the tubular fabric.

The filter bag 13, as above stated, in some cases has a diameter of about 18 inches and in other cases has a diameter of about 8 inches. These tubes are woven on a flat loom having a lower and an upper shed to thereby weave the upper and lower sides of the tube which are joined at the selvage in a well known manner.

In order to form the bag 13, the tubular fabric is closed at its upper end by folding the same over as at 14, and it is held in this folded position by any suitable clamp such as 15, which clamp may be supported by a chain 16 secured to a rail or bar 17 to thereby support the bags in an upright position. The lower end of the bag 13 is slipped over the upwardly extending thimble 11 and may be secured thereto by placing a strap 18 around the thimble over the lower portion of the bag.

When the lower end of the bag 13 was secured to the thimble 11, heretofore, in the manner just described and the bag was shaken to dislodge the particles deposited upon the walls thereof, these particles would tend to accumulate between the inner wall of the bag and the upper portion of the thimble 11 and form a bulging pocket which would place an injurious strain upon the fabric and subject the same to other injurious actions.

An important feature of the present invention resides in a simple construction for overcoming this difficulty, which will now be described.

I have found that all tendency to form the objectionable pocket just mentioned may be avoided by providing the bag 13 with a metal ring 19 which preferably is the same size in diameter and in cross-section as the bead 12. This ring 19 is slipped over the bag 13 so that it will rest upon the upper end of the thimble 11 when the lower end of the bag is pulled downwardly over the thimble as shown in each figure of the drawing. This prevents the bag from bulging or increasing its diameter at this critical point where it meets the thimble 11.

It is important that the ring 19 be properly centered with respect to the bead 12 and that it be clamped to this bead with the lower portion of the bag 13 lying therebetween. This is readily accomplished by providing the split clamping band 20 adapted to surround the bead 12 and ring 19 as shown and be clamped tightly thereabout. This band 20 may be clamped in the position just mentioned by providing it with the threaded bolt 21 pivotally secured to a lug 22 upon one end of the band 20 and adapted to project through a hole in a projection 23 secured to the other end of the band 20 to receive the clamping wing nut 24. The clamping band 20 preferably is made curved in cross section as best shown in Fig. 3 so that it will force the bead and ring together and firmly clamp the bag therebetween to hold the lower end of the bag and prevent any possibility of the particles passing into the space between the outer wall of the tube 11 and the portion of the bag clamped thereto by the strap 18, even when the bag is energetically shaken to loosen the particles from its walls.

When the means for supporting the upper end of the bag is moved up and down to dislodge the particles from the walls of the bag, the bag is subjected to an injurious action at the point where it is clamped between the bead 11 and ring 19. I have found, however, that the wear upon the bag at this point may be largely reduced by coating or impregnating this portion of the bag as indicated by 25 of Fig. 3 with a flexible plastic material such for example as a permanently flexible alkyd or vinyl resin or other synthetic resin that will not volatilize at the filtering temperature. Particularly suitable are oil-modified and phenol-modified alkyd resins. This treatment increases the resistance of the fabric to abrasion adjacent the thimble and protects it against wear.

The treatment with flexible resin may with great advantage be extended to include treatment of the entire bag as indicated by 25 in Fig. 1. This eliminates the disintegrating effects on the bag of the abrasive action of the fine solid particles which become lodged in the fabric and are kept in agitation by the rapid flow of gases through the fabric. It also overcomes the tendency of the gas flow itself to loosen the fibers and thus weaken the fabric. The fibers in each constituent thread of the fabric are coated and adhered together without filling up the interstices betwen the threads. As a result the treated fabric remains porous and highly permeable to gases. The resinous material is applied by well known methods, such as by passing the fabric through a bath comprising a solvent solution or an aqueous emulsion of the resinous size capable of penetrating well into the interior of the threads, removing superfluous liquid by means of wringer rolls, and drying. The resin content of the bath should be selected so that the dry weight of resinous material deposited on the fabric is between 1% and 10%, and preferably from 2% to 5%, of the weight of the fabric. The resin treatment such as has just been described has enabled an asbestos flue bag to withstand six months of service without any weakening of the fabric, whereas an untreated bag lost 50% of its strength under the same conditions.

A further feature of the present invention re-

sides in a flue filter bag formed of an asbestos tube that is woven with fine, strong asbestos yarn to give a finer mesh and more durable weave than the asbestos flue filter bags employed heretofore. A fabric suitable for use as a flue filter should be firmly woven with a relatively close weave so as to prevent the particles which should be retained from escaping through the interstices of the fabric, and it should be sufficiently porous to filter the desired amount of gas per minute. Such for example as 80 to 90 cubic feet of gas per minute to be filtered by a bag having the larger dimensions above mentioned.

The following table is one example of a woven asbestos fabric which I have found is well adapted for use as the bag 13 shown in the drawing. The table also shows for comparative purposes an asbestos fabric of a type that has been employed heretofore as a flue filter bag, but in practice was found to be less satisfactory than the cotton and wool bags which have been used in this field for many years.

	New asbestos fabric	Old asbestos fabric
Ends per inch	31	26
Picks per inch	30	14
Warp yarn	20 cut/1	22 cut/2
Filling yarn	20 cut/1	22 cut/2
Twist per inch in single yarn-warp	12	10
Twist per inch in single yarn-filling	12	10
Wt. ozs. per sq. yd	20	24
Gauge [1]	.040"	.056"

[1] The gauge of the fabric was measured by an automatic micrometer having a pressure foot 3/8 of an inch in diameter and actuated with a constant pressure of 6 ounces.

It will be apparent from the tabulations of this table that the asbestos fabric herein disclosed has a greater number of threads per inch than that of the asbestos fabric employed in flue filter bags heretofore, and that it is of finer gauge and is produced of a higher twist single yarn than that of the prior construction. Furthermore, the present fabric is of lighter weight than the prior asbestos fabric. This in turn lessens the weight which must be supported by the walls of the long tube or bag 13.

The above features pertaining to the bag construction and means for securing the bag to the thimble all contribute to the wearing properties of the bag, and make it practical to filter gases at a much higher temperature than when a cotton or wool bag is used.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. A flue bag filter comprising in combination, a filter bag of fibrous material, means for supporting the bag in a vertically suspended condition, an upwardly extending tube having a bead at its upper end and adapted to enter the lower end of the bag to deliver gases thereto, an encircling binding means adapted to be secured tightly around the portion of the bag that surrounds said tube, a ring of approximately the same size as said bead adapted to encircle the bag and deflect it inwardly directly above the bead, and a clamping band adapted to embrace the bead and ring and curved transversely so that it will force the ring towards the bead to clamp the bag therebetween as this band is tightened about the ring.

2. A flue bag filter comprising in combination, a filter bag of fibrous material, means for supporting the bag in a vertically suspended condition, an upwardly extending tube having a bead at its upper end and adapted to enter the lower end of the bag to deliver gases thereto, a ring of approximately the same size as said bead adapted to encircle the bag and deflect it inwardly directly above the bead, and a clamping band adapted to embrace the bead and ring and curved transversely so that it will force the ring towards the bead to clamp the bag therebetween as this band is tightened about the ring.

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