

April 16, 1963

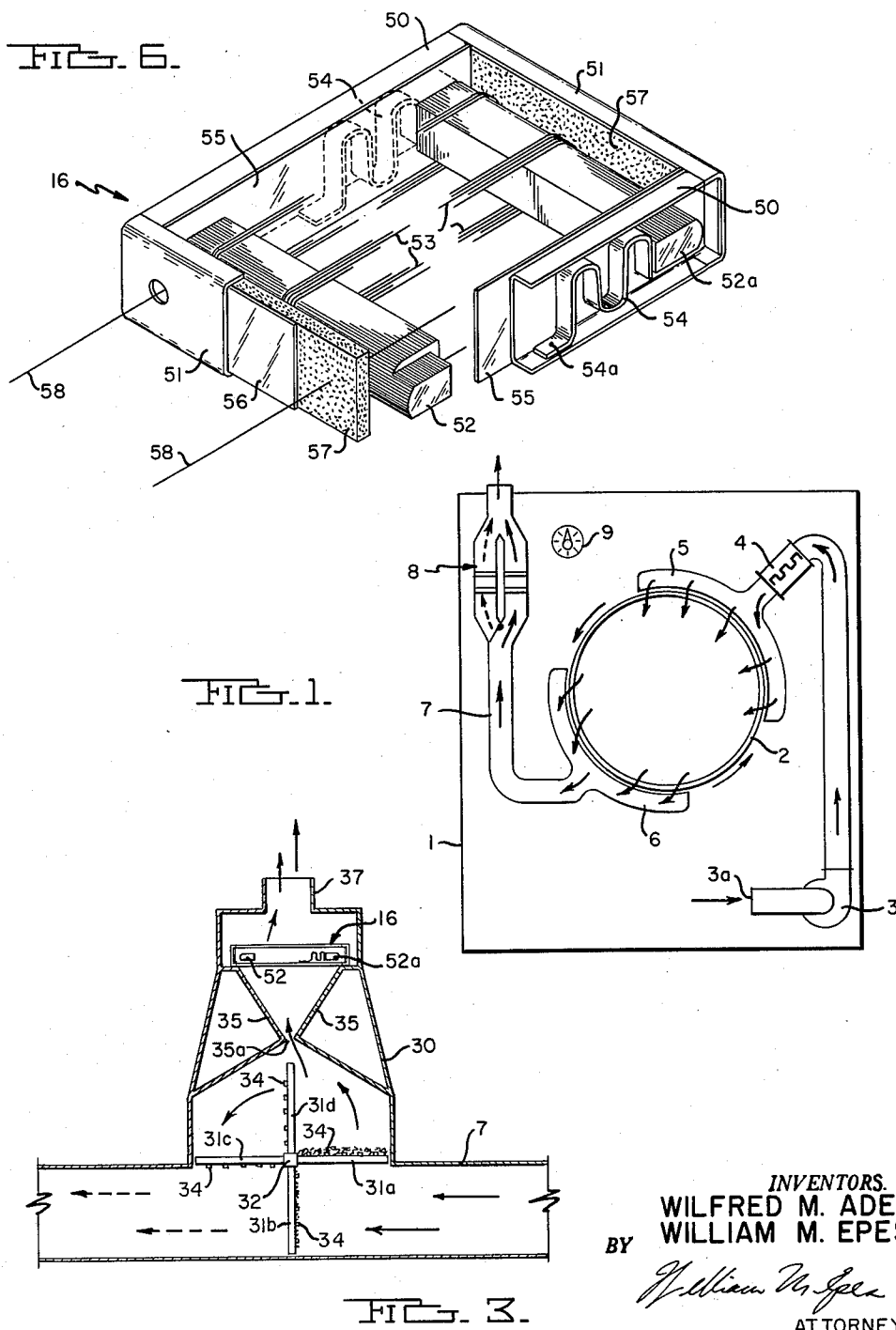
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LINT REMOVER FOR FABRIC DRYER

Filed July 23, 1957

2 Sheets-Sheet 1



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FIG. 4.

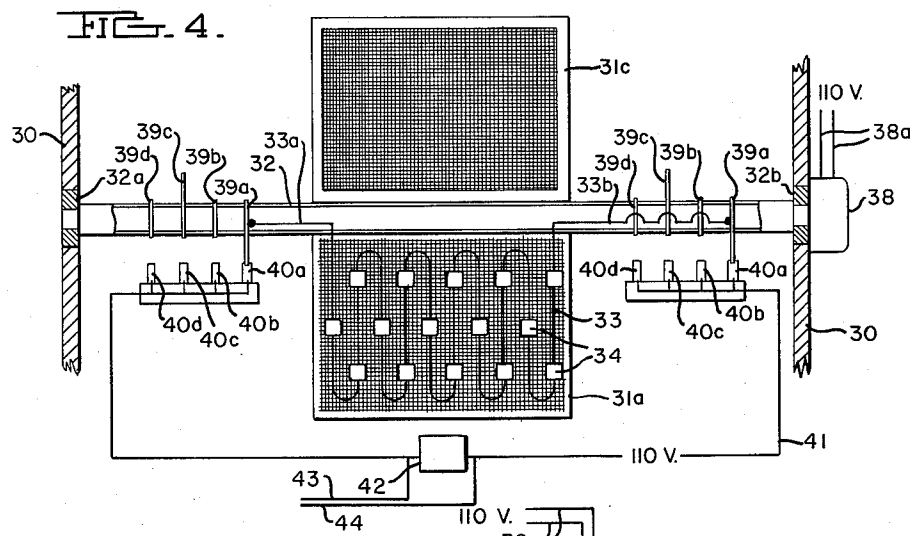


FIG. 5.

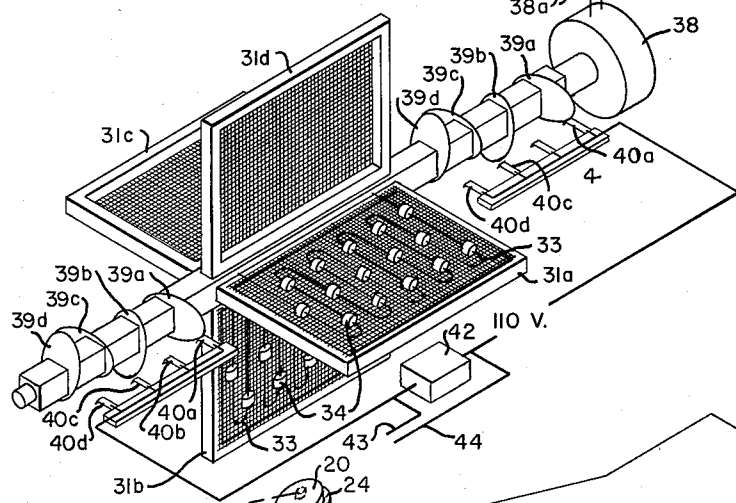
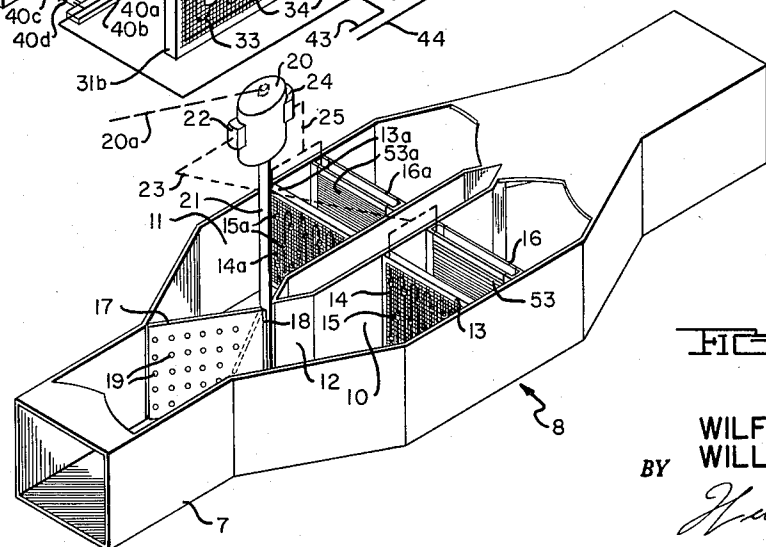


FIG. 2.



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LINT REMOVER FOR FABRIC DRYER

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2 Claims. (Cl. 34-79)

This invention relates to delinting devices for laundry driers.

In the operation of forced air circulation laundry driers, particularly those of the tumbling type, the collection and disposition of the lint in the exhaust stream from the drier presents a difficult problem. The substantial amount of lint produced precludes, for all practical purposes, the possibility of venting the lint-laden air directly into the room in which the drier is located. Even when a duct is provided to pipe the exhaust out of doors it is usually not possible to exhaust the lint-laden air without producing an objectionable amount of litter which collects on and clings to shrubs and the like.

For these reasons, laundry driers at the present time are normally equipped with lint filters which trap the lint and which require periodic cleaning to remove the accumulated lint. Unless such filters are cleaned at frequent intervals, however, the accumulated lint begins to impose an undesirably high backpressure against the circulating fan. Since, for reasons of economy, the circulating fans in laundry driers are not designed to operate against significant backpressures, the build-up in backpressure caused by the accumulation of lint leads to serious losses in drying efficiency. This loss in efficiency is of course increased if the operator of the drier fails to clean the lint filter after each operating cycle. This often occurs, particularly in the case of household type driers.

To eliminate these disadvantages of screen or bag type filters that require frequent cleaning, it has been suggested that the lint be removed by such means as water sprays and the like which will continuously remove and dispose of the lint in the stream. Such systems however are rather elaborate and expensive in themselves and furthermore usually require special plumbing connections with a resultant high installation cost.

The object of the present invention is to provide an economical and relatively simple method for removing and destroying the lint in the exhaust stream from a laundry drier.

It is a further object of the invention to provide such a method which will eliminate the nuisance of cleaning or replacing filters.

Another object of the invention is to provide a delinting system for a laundry drier which will insure the operation of the drier at all times at, or close to, its top drying efficiency.

A still further object of the invention is to provide a de-linting method for laundry driers which will permit the direct venting of the drier exhaust into living areas.

Still further objects of the invention will appear from the description which follows.

Reference is now made to the accompanying drawings in which FIG. 1 is a semi-diagrammatic illustration of a household type laundry drier equipped with a de-linting system constructed in accordance with the invention; and,

FIG. 2 is an enlarged perspective view of the de-linting system shown in FIG. 1; and,

FIG. 3 is a cross-sectional view of another embodiment of a de-linting system in accordance with the invention; and,

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FIG. 4 is an elevation of a portion of the system shown in FIG. 3 showing electrical connections; and,

FIG. 5 is a perspective view of the element shown in FIG. 4; and,

FIG. 6 is an enlarged perspective view of a catalyst unit of the type employed in the lint elimination systems illustrated in FIGS. 1 to 5.

Referring now particularly to FIG. 1, the reference numeral 1 represents the housing for an electric drier of the household type having a cylindrical tumbler basket 2 provided with perforations to permit heated air to circulate through the basket and over the moist laundry contained therein. Suitable means (not shown) such as an electric motor and the necessary speed reduction gears or pulleys are provided for turning the basket on its axis in the direction indicated by the arrows for the purpose of tumbling the laundry thereby to obtain more efficient contact with the heated air.

An air circulating fan 3 draws in air at 3a and passes it over an electric heating element 4 thereby to heat the air to the desired drying temperature. The heated air then passes into a distribution header 5 whence it passes through the perforations in the tumbler basket 2 and over the moist laundry. The moisture-laden air is collected in a collection header 6 whence it passes into an exhaust duct 7. In the exhaust duct 7 a lint elimination system in accordance with the invention is disposed which is indicated generally by the reference numeral 8.

A suitable timer, having a control dial 9 located on the exterior of the housing, is provided for automatically timing the duration of the drying cycle. As will be explained more in detail subsequently, the timer may also be employed for timing the operation of the de-linting system.

Referring now to FIG. 2, showing an enlarged perspective view of the lint elimination system 8, it may be seen that the system comprises a pair of ducts 10 and 11 arranged in parallel with respect to the exhaust air flow. In the embodiment shown, parallel ducts 10 and 11 are formed by enlarging the exhaust duct 7 and providing a divider partition 12 running along the center of the enlarged portion. In the ducts 10 and 11, filter screens 13 and 13a respectively are provided. Filter screens 13 and 13a may be of any desired construction such as a perforated plate, a wire screen, or the like. The perforations or mesh openings must of course be of such a size that the lint particles are effectively trapped on the surface of the filter without imposing an unnecessarily high restriction on the flow of air.

Arranged on the surface of the filter facing the flow of the exhaust air, an electric resistance filament 14 is provided for the purpose of periodically igniting accumulated lint as will be described more in detail hereafter. Electrically insulating beads 15 of porcelain or other suitable high temperature insulation, are strung on the resistance wire 14 to insulate it from the filter itself.

In each of the conduits 10 and 11, in series with the filters 13 and 13a, catalytic units 16 and 16a respectively are provided. As will be described in detail, the function of these catalytic units is to catalytically oxidize smoke and fumes resulting from the ignition of the lint on the filters 13.

Reference is now made to FIG. 6 which shows one of these catalytic units in perspective with some parts broken away. The unit consists of a rectangular frame having a pair of channel-shaped side members 50 and a pair of channel-shaped end members 51 which are welded or otherwise secured to side members 50. Mounted in this rectangular frame are a pair of filament supporting members preferably composed of a good grade of porcelain denoted by the reference numerals 52 and 52a. Around

the filament supporting members a wire filament 53 is wound to form a flat helical coil in which the adjacent turns are closely spaced. A portion only of the turns of the coil have been shown but it is understood that the coil is wound along the entire length of the filament supporting members 52 and 52a. In order to maintain the helical coil in a taut condition upon heating and cooling with accompanying thermal expansion and contraction of the filament, a pair of springs 54 are provided, mounted within the channel members 50 as shown and welded to the channel at 54a. Springs 54 urge filament supporting member 52a to the right as shown in the drawing keeping the helical winding under constant tension. To electrically insulate the metal frame members 50 and 51 from the filament, mica strips 55 and 56 are cemented or otherwise attached to the inner faces of these members. To prevent by-passing of gases, the space between end members 51 and filament support members 52 and 52a is packed with a suitable fibrous packing material 57, such as glass wool. Electrical leads 58 permit current to be passed through the filament 53. The filament 53 is composed of or provided with a coating of an oxidation catalyst. Preferably, the filament 53 is composed of a good quality resistance wire such as Nichrome (80% nickel-20% chromium) provided with a thin catalytic coating such as that described in U.S. Patent No. 2,731,541. A suitable coating may, for example, consist of a catalytic film having a thickness of approximately .0005" consisting of a mixture of activated alumina and activated beryllia which in turn is impregnated with a small percentage, for example 1% by weight (based on the weight of the oxide film) of finely divided platinum. Oxidation catalysts of this type are relatively inexpensive and have excellent activity and durability.

In use, the unit illustrated in FIG. 6 is energized by passing current through resistance filament 53 bringing it up to the temperature required for effective activity as an oxidation catalyst. Generally speaking, for use in accordance with the present invention, and using a catalytic film such as described above, temperatures of the order of from 700° F. to 1400° F. and preferably in the middle portion of this range will be found satisfactory.

It is to be understood, however, that the invention is not limited to any particular type of catalytic unit or any particular type of oxidation catalyst. While the particular type of unit and catalyst described represents a preferred embodiment of the invention, catalysts of other types and configurations may also be employed.

Flow through conduits 10 and 11 is controlled by a flap valve 17 mounted on a shaft 21 which is hinged at 18 to the center partition 12 for rotation back and forth between the position shown in solid and dotted lines so that the flow from exhaust conduit 7 may alternately be directed through conduits 10 and 11. Valve 17 is provided with a series of small perforations 19 for a purpose which will be described hereafter.

The operation of the flap valve 17 is controlled, in the embodiment shown in FIG. 2, by a circular solenoid 20. Shaft 21 is rotated by the solenoid in oscillating fashion so as to swing the valve 17 to and from its alternate positions. Automatic control of the time interval between each movement of the valve may be controlled by a suitable timer connected to the solenoid by a suitable electrical connection indicated by the dotted line 20a.

When the valve 17 is in the position as shown in the solid lines (FIG. 2) the flow of exhaust air will of course be through conduit 10 in which case lint will be trapped and collected on filter 13. After a predetermined interval, solenoid 20 will effect the movement of the valve 17 to the position shown in dotted lines such that the flow of exhaust air will be through conduit 11 and lint will be trapped and accumulated on filter 13a. Simultaneously with the movement of the valve to the position shown in dotted lines, an electric circuit is completed

which energizes both the electric igniter wire 14 on filter 13 and the catalytic electric resistance wire 53 of catalytic unit 16. The energization of elements 14 and 53 is effected automatically by means of a switch 22 mounted on solenoid 20, the electrical connections between switch 22 and elements 14 and 53 being indicated by the dotted line 23 which connects elements 14 and 53 in parallel to switch 22. Switch 22 is set to be closed when valve 17 moves to the position shown in dotted lines. Switch 22 preferably incorporates a time delay element which automatically opens the circuit following a predetermined interval after it has been closed. The interval during which the circuit remains closed, supplying current to elements 14 and 53, depends upon the length of time required to burn the lint accumulated on the filter as will be explained in detail hereafter.

While the valve 17 is in the position shown in dotted lines, lint of course accumulates on the filter 13a. After a predetermined interval when the accumulation has reached the maximum desirable depth, the solenoid 20 again actuates the valve 17 returning it to its initial position. Lint again begins to accumulate on filter 13 from which the lint accumulation has been removed by ignition as described. As the valve 17 is returned to the position shown in solid lines, a switch 24 is simultaneously actuated completing a circuit through connection 25 to elements 14a and 53a. As described in connection with switch 22, a time delay mechanism may be provided to shut off the circuit after a predetermined interval.

The operation of the de-linting device shown in FIGS. 1 and 2 will now be described. Assuming that the valve 17 is in the position as shown in solid lines the lint-laden exhaust stream from the dryer flowing through line 7 passes through conduit 10 and the lint in the stream is trapped by and accumulates upon filter element 13. As the lint accumulation builds up, the resistance to flow offered by the lint-laden filter of course also increases. However, before the increase in flow resistance becomes sufficient to materially effect the efficiency of the dryer (by decreasing the air flow through the tumbler basket) valve 17 is shifted by means of solenoid 20 to the position shown in dotted lines. This substantially isolates filter element 13 from the flow of the exhaust gases while simultaneously exposing to the exhaust air flow a fresh lint-free filter element, namely, element 13a in conduit 11. As mentioned previously, the operation of solenoid 20 may be controlled by a timer such as timer 9 which also controls the length of the drying cycle.

Simultaneously with the movement of valve 17 to the dotted line position, switch 22 is actuated closing the circuit supplying current to igniter element 14 and catalytic filament 53 through electrical connection 23. Upon energization, igniter element 14 is heated to red heat, igniting the lint accumulated on the surface of the filter. Upon ignition, the line burns with the production of the characteristic acrid odorous fumes and smoke accompanying the burning of fibers. Because of this objectionable odor and smoke thus produced, it would not be practicable to vent the combustion products directly into a living space. To overcome this difficulty, catalytic unit 16 is provided. With the closely spaced turns of catalytic filament 53 heated to an elevated temperature, such as 900° F., the fumes from the burning of the lint passing in contact with the closely spaced catalytic surface provided by the coiled filament 53 are catalytically oxidized and thus destroyed such that the effluent leaving the unit 53 is free from smoke and odor.

During the ignition operation, it may be seen that filter 13 and catalytic unit 16 are both substantially isolated from the flow of exhaust gases. Such isolation during the ignition operation is essential for several reasons. When exposed to a relatively high flow of exhaust gases at a relatively low temperature (e.g. 120° F. to 130° F.), both the ignition element and the electrically heated catalytic unit would require an excessively high

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flow of current to maintain them at proper operating temperatures. Likewise, when exposed to such high flows it would be impossible to eliminate the smoke and odor with the use of a relatively small catalytic unit, since the amount of catalytic surface required to effect the elimination is substantially proportional to the flow of the gases over the catalyst. Finally, the high flows would cause burning particles of lint to be carried away in the exhaust stream thus creating a fire hazard.

When the ignition operation is substantially isolated from the exhaust gas flow on the other hand, these difficulties are overcome. The lint is ignited and burned in a relatively quiescent zone and the resultant smoke and odors may be catalytically oxidized with the use of a small catalytic unit such as that shown.

According to the preferred embodiment of the invention, provision is made for permitting a very minor portion of the exhaust gases to flow over the filter and catalytic unit during the lint ignition operation. The rate of flow for this purpose is preferably just sufficient to supply the air required to maintain the combustion of the lint and to carry the resultant smoke and odors in a slow stream over the surface of the catalytic unit. This slow stream of air carrying the smoke and odors in contact with the catalyst prevents these fumes from accumulating within the combustion chamber and thus prevents the fumes from backing up into the main stream of exhaust gases or leaking into the adjoining room.

In the embodiment shown in FIG. 2, this slow stream of air across the filter and the catalytic unit is supplied by means of perforations 19 provided in the flap valve 17. These perforations, exposed to the flow of exhaust gases, permit a small fraction of the flow to pass through the perforations and over the filter and catalytic unit during the ignition operation. The size and number of perforations are adjusted empirically to provide the desired low flow.

As explained previously, the frequency of movement of the valve 17 to expose a clean filter to the exhaust gas flow depends chiefly upon the rate of accumulation of lint on the filter and the amount of accumulation that tends to set up an undesirably high backpressure. It may frequently occur that the duration of the cycle between movements of the valve 17 will substantially exceed the length of time required to ignite and burn off the accumulated lint. For example, the time interval between movements of the valve 17 may be 7 minutes while the time required to ignite and burn the accumulated lint may be of the order of 3 minutes. Under such circumstances it may often be desirable, in order to conserve electricity and to lengthen the life of the igniter element and that of the catalytic unit, to shut off the flow of current to these elements after the burn-off of the accumulated lint has been accomplished. For this purpose, switches 22 and 24 may be provided, as stated above, with a delayed action secondary switch which will automatically open the circuit after a predetermined time interval has elapsed following the closing of the primary switch. Such secondary switch may be, for example, one operating on the principle of thermal expansion, adapted to open the circuit after the expiration of a given time interval and hold it open until again closed by the primary switch. Such devices are well known and commonly available and therefore need not be described in further detail.

Reference is now made to FIGS. 3, 4, and 5, which illustrate an alternative embodiment of the invention. In FIG. 3, the reference numeral 7 refers to the exhaust duct carrying the lint and moisture-laden gases from the dryer in the direction shown by the arrows. Extending laterally from the exhaust duct 7 a housing 30 is provided. In the lower portion of housing 30, and extending into the exhaust duct, a set of filters 31a, 31b, 31c and 31d are provided mounted on a rotatable shaft 32. As may be seen in FIGS. 4 and 5, filters 31a to 31d are comprised

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of a rectangular frame mounting a wire screen. Each filter is provided with an electrical igniting element 33 insulated from the screen by means of porcelain beads 34.

In the upper portion of housing 30 a catalytic unit 16, constructed as shown in FIG. 6, is mounted (see FIG. 3). Between the lower part of housing 30 containing filters 31 and the upper portion containing catalytic unit 16, a flow-restricting baffle 35 is provided such that the lower portion of the housing communicates with catalytic unit 16 through a restricted opening 35a. The upper portion of the housing communicates with the atmosphere through a vent 37.

Referring now to FIGS. 4 and 5, it may be seen that the shaft 32 on which the filters 31 are mounted is rotatably carried in bushings 32a, 32b, which in turn are carried by the walls of housing 30.

The shaft 32 is rotated by means of a circular solenoid 38 mounted on the exterior wall of housing 30 as shown in FIG. 4, and supplied with current by means of lead wires 38a. Actuation of solenoid 38 is controlled by means of a timer, which is preferably incorporated in the timer 9 controlling the drying cycle, which actuates the solenoid at predetermined time intervals. At each actuation, the solenoid effects the rotation of shaft 32 by 90°. This 90° movement of the shaft 32 moves one filter into the lower portion of housing 30 and brings a fresh filter into the exhaust gas stream. Referring to FIG. 3, the shaft 32 rotates in a counter-clockwise direction as shown by the arrow. As seen in FIG. 3, filter 31b is exposed to the flow of the exhaust gases and the lint is accumulating upon this filter. At the same time, the lint which has previously accumulated on filter 31a is in the process of being ignited and the smoke and fumes produced flow upwardly through restricted passage 35a, over the heated filament 53 of catalytic unit 16, fume and smoke-free air being passed to the atmosphere through vent 37. After a predetermined time interval adjusted to prevent an undue accumulation of lint such as would create an undesirably high flow resistance, the shaft again rotates counter-clockwise bringing filter 31c into lint-collecting position and filter 31b into lint burn-off position.

During the lint burn-off a low flow of air is established through the filter containing the burning lint. As seen in FIG. 3, a very minor portion of the flow of exhaust air flows upwardly through filter 31a, restricted opening 35a, and catalytic unit 16, thus supplying the necessary oxygen for the burning operation and sweeping the resulting smoke and fumes in a slow current into contact with catalytic filament 58 in unit 16. The flow of air in this direction should be controlled by suitably restricting passage 35a so as preferably to be just sufficient to supply the necessary oxygen for the burning and to supply the sweep stream required to insure that the fumes are carried into contact with the catalytic unit.

FIGURES 4 and 5 show semi-diagrammatically the electrical connections for successively energizing and de-energizing the igniter elements 33 which are mounted on each of the filters 31a to 31d at the proper time intervals. FIGURE 4 is a top plan view with some parts broken away while FIGURE 5 is a perspective view of the same system.

As previously explained, solenoid 38 rotates shaft 32 counter-clockwise through an arc of 90° at predetermined time intervals as controlled by a timer. Mounted on shaft 32 are a plurality of contacts 39a, 39b, 39c and 39d which are arranged to selectively engage a second set of contacts, 40a, 40b, 40c and 40d. As may be seen, contacts 39a to 39d are arranged in two pairs, one on either side of the filter screens and are arranged in staggered relationship such that only one pair engages with its corresponding pair of contacts 40a to 40d at any one time. In the position of the shaft as shown in FIGURES 4 and 5, contacts 39a engage contacts 40a, completing a circuit through lead wire 41, a voltage source, an automatic time

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delay circuit breaker 42, and lead wires 33a and 33b connecting respectively the left and right hand contacts 40a to igniter element 33, thus completing a circuit through element 33.

On the next quarter turn of the shaft 32 in a counter-clockwise direction, filter 31b which has been collecting lint is brought up into lint burn-off position, while filter 31a is rotated to the position occupied by filter 31d as shown in FIGURES 4 and 5. When shaft 32 is thus rotated to this new position, engagement is broken between contacts 39a and 40a and made between contacts 39b and 40b, thus completing a circuit including igniter wire 33 of filter screen 31b. Lead wires corresponding to lead wires 33a and 33b, as shown in FIGURE 4, connect igniter wire 33 to right and left hand contacts 39b, the actual leads being omitted from the drawing for the sake of clarity. Igniter 33 of filters 31c and 31d are energized on the rotation of the shaft 32 in a similar manner.

As in the embodiment of FIGURE 2, the secondary switch 42 is operative to automatically open the circuit after it has been closed by engagement of contacts 39 and 40 after the elapse of a predetermined time interval and then to hold it open until it is again closed by the next quarter rotation of the shaft. As previously explained, the time interval between closing of the circuit through the engagement of the contacts and the opening of the circuit by means of secondary switch 42 depends upon the length of time required to completely burn off the charge of lint which had accumulated upon the filter.

Catalytic unit 16 is supplied with current simultaneously with the energization of igniter elements 33 by means of leads 43 and 44 which are connected in parallel to the circuit supplying igniter elements 33 across time delay secondary switch 42, as shown. Thus, whenever the circuit is completed or broken to igniter elements 33 on the respective filters 31a and 31d, the catalytically coated filament 58 of catalytic unit 16 is energized or de-energized respectively so that the catalytic filament 58 is maintained at the proper temperature for catalytically oxidizing smoke and fumes resulting from the ignition of the lint during all the ignition periods.

It is to be understood that other variations and embodiments other than those specifically illustrated are intended to be included within the scope of the invention which is to be determined by reference to the appended claims.

We claim:

1. In a laundry dryer having means for circulating heated air over moist laundry and an exhaust duct for exhausting moisture laden air from the dryer, a device for disposing of lint present in the exhaust stream com-

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prising a plurality of ducts constituting branches from said duct, a filter in each of the second-mentioned ducts, means operable to ignite lint collected on said filters, oxidation catalysts associated with each of said filters and positioned downstream thereof to catalytically oxidize the products of combustion, including smoke and odor, resulting from said ignition, and means cyclically diverting the major portion of said air stream from one of said second-mentioned ducts to another while permitting continued flow of air through said one second-mentioned duct just sufficient to supply the air required for said combustion, said igniting means being operable in conjunction with said diverting means to ignite the lint on a filter from which the major portion of said air stream has been diverted by said diverting means, and said diverting means functioning to divert the major air stream portion back to said one second-mentioned duct, in turn, following said ignition and combustion.

2. In a laundry dryer having means for circulating heated air over moist laundry and an exhaust duct for exhausting moisture laden air from the dryer, a device for disposing of lint present in the exhaust stream comprising a duct constituting a branch from said first-mentioned duct, a plurality of separate filters, means for cyclically and consecutively positioning said filters individually first in the first-mentioned duct to collect lint in said air stream and then in the second-mentioned duct, means for igniting the lint on a filter thus positioned in the second-mentioned duct, an oxidation catalyst positioned downstream of said igniting means in the second-mentioned duct and operative to catalytically oxidize the products of combustion, including odor and smoke, resulting from ignition of said lint, said second-mentioned duct being dimensioned to limit the flow of air there-through to an amount just sufficient to supply the air required for said combustion, and said positioning means functioning to return each of said filters, in turn, to a position in the first-mentioned duct following ignition and combustion of lint collected thereon and catalytic oxidation of the products of said combustion.

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