

Nov. 10, 1953

H. R. SUTER ET AL
CATALYTIC FUME INCINERATION

2,658,742

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3 Sheets-Sheet 1

Fig. 1.

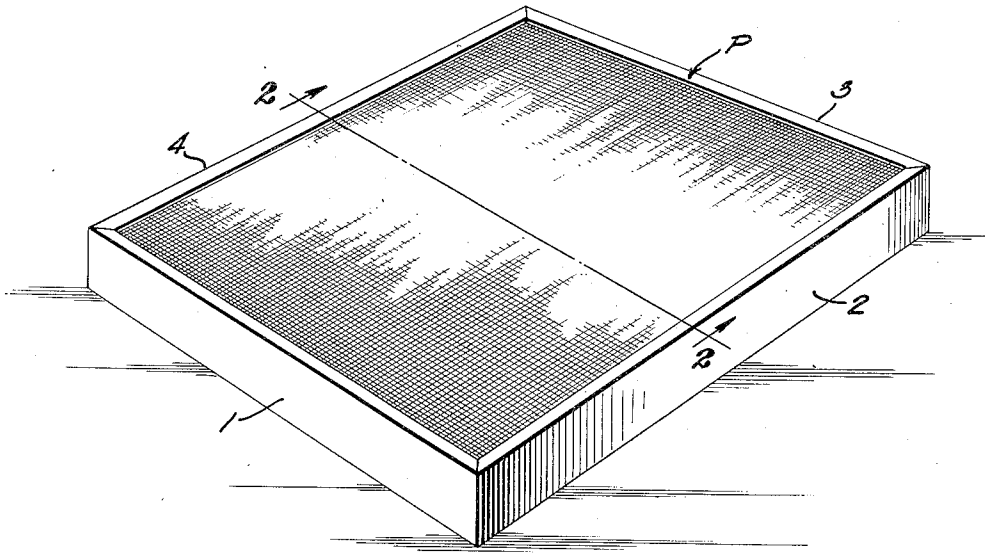


Fig. 2.

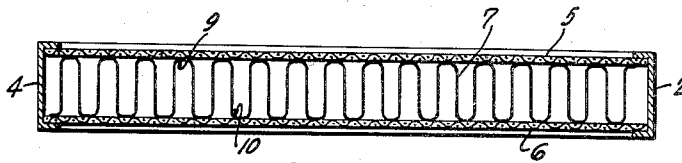


Fig. 3.

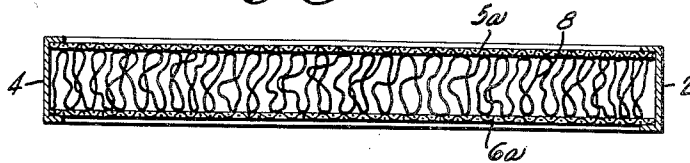
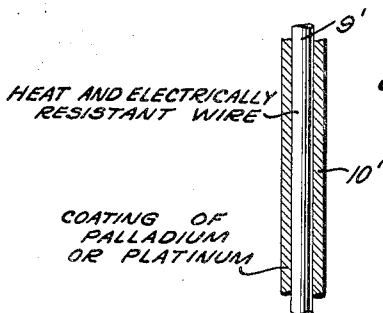


Fig. 4.



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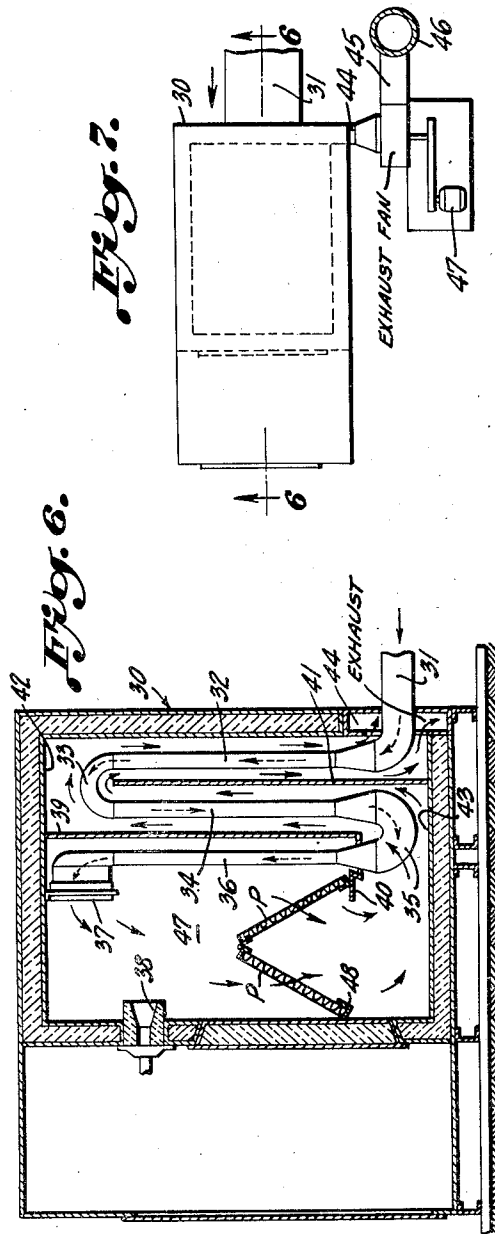
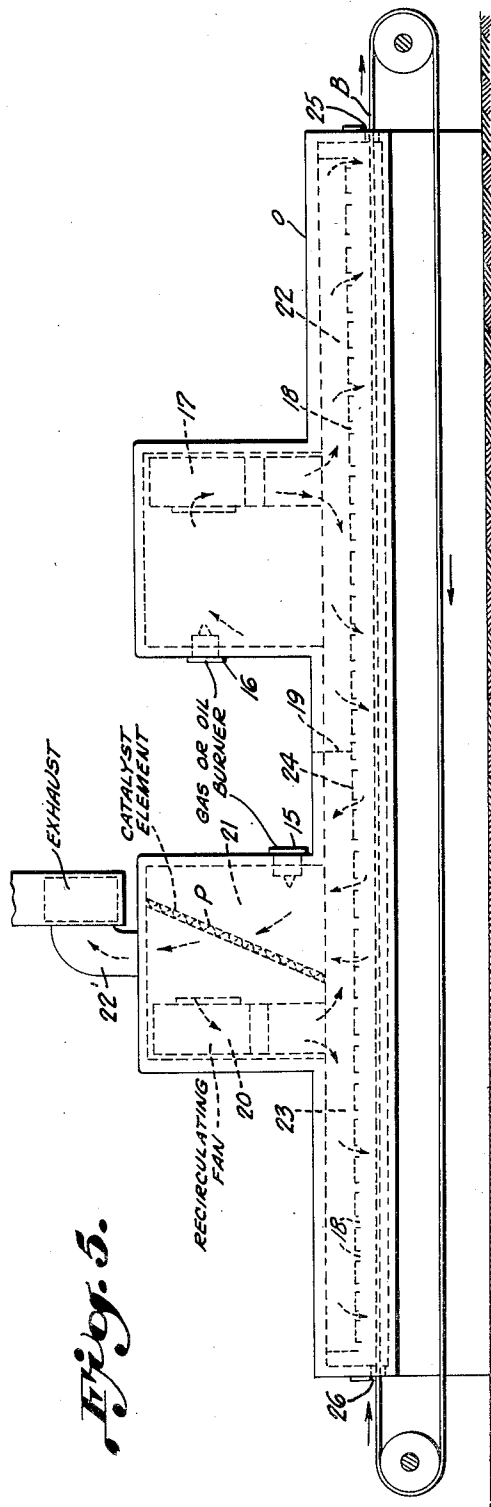
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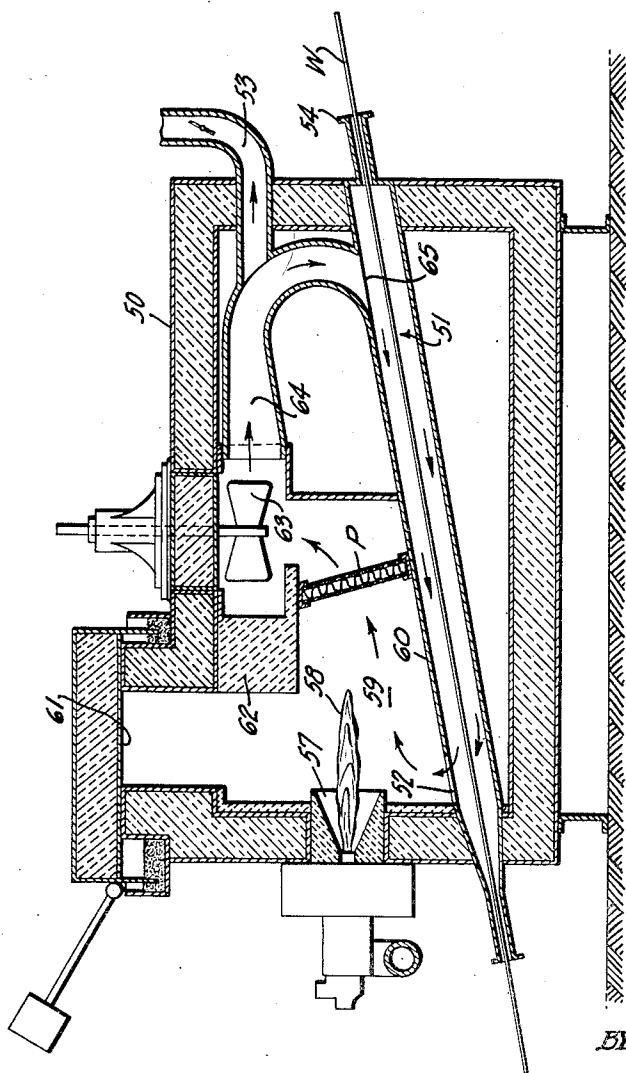
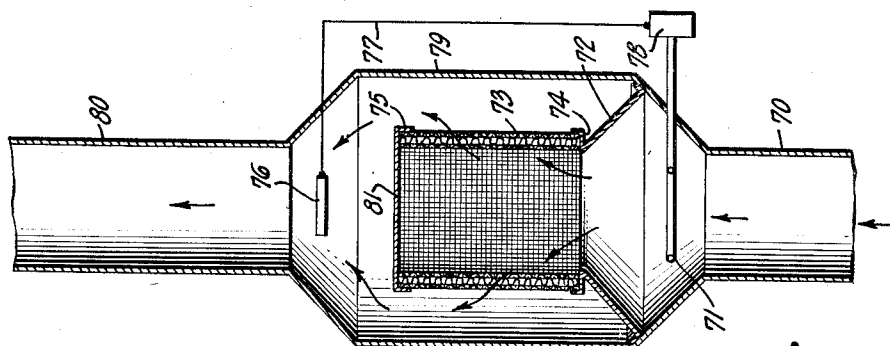
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CATALYTIC FUME INCINERATION

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3 Sheets-Sheet 3



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2,658,742

CATALYTIC FUME INCINERATION

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19 Claims. (Cl. 263—3)

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This invention, relating as indicated to catalytic fume incineration, is more particularly directed to a solution of the problem occurring with the operation of industrial ovens of usual design, such ovens being employed for the drying and baking of enamels, insulating varnishes, or other surface coatings and impregnates. The presence of inflammable vapors in the oven atmosphere requires exhausting the air at a rate sufficiently high to prevent reaching the lower limit of explosibility which occasions an enormous waste of heat and at the same time creates a public nuisance when the oven exhaust is vented to the atmosphere. The odor of such vapor is not only offensive but it is in some cases harmful, particularly when operating temperatures are such that partial decomposition or oxidation occurs. The invention is not restricted to oven exhausts, but is broadly applicable to air streams containing volatile, combustible material, either for purposes of elimination of air pollution, or for utilization of heat of combustion.

The object of this invention is to provide a catalytic agent which will be useful in the combustion of combustible vapors in the exhaust gases from industrial ovens or from other processing operations.

Another object of the invention is to provide a catalyst, reactive elements of which are disposed on the surface of metallic alloys having high thermal and electrical resistances so that the necessary temperatures for optimum reactivity may be obtained through the supplying of heat by the passage of electrical currents through the metal base of the catalyst, thus making for the ultimate in energy efficiency and in precise temperature control, inasmuch as the heat is supplied at the seat of the chemical reaction without the necessity for transfer through the medium in which the reaction is occurring.

Another object of the invention is to provide a means of utilization of the heat of combustion of volatile materials which may be present in industrial oven or furnace atmospheres through the employment of a suitable catalyst disposed within the recirculating system of said oven or furnace.

Another object of the invention is to provide a means of elimination of the nuisances which arise from the exhausting of volatile combustible materials from ovens, furnaces or other processing equipment, such nuisances being concerned with obnoxious odors, objectionable material from the standpoint of health and comfort, fire hazards arising from possible condensation and

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accumulation of combustible materials in exhaust ducts and stacks, and other objectionable features.

Another object of this invention is to provide a means for recovery of the heat of combustion of gases consisting of mixtures of combustible materials with air in concentration less than the lower limit of explosibility, such that flame propagation and combustion by the usual burners is not possible.

It is one specific object of the invention to provide apparatus for removing combustible vapors from oven exhausts and the like by catalytic fume incineration.

Another specific object of the invention is to provide a method of removing combustible vapors from oven exhausts, which is inexpensive and in which all of the objectionable components of the exhaust gas are converted to innocuous substances.

A still further specific object of the invention is to provide a method of forming catalytic wire, ribbon, or screen which is capable of use in removing deleterious vapors from oven exhaust streams.

Another detailed object of the invention is to provide a screen in the form of a flat panel or cylindrical member which is catalytically active to effectively remove harmful ingredients in oven exhaust streams.

The use of platinum or palladium as a catalyst for combustion of volatile materials in concentrations less than the lower limit of explosibility is old in the art. It is commonly employed in chemical analysis and in indicating or control instruments. The use of these metals or other metals from this class of elements as such in catalytically active form has been precluded by high cost from application to the purposes of this invention. This invention makes such employment of the noble metals economically practicable because of the drastic reduction in the quantity of these metals which are required. The combination of platinum or palladium or other noble metal coating in catalytically active form on a base of heat and electrically resistant metal has not been practiced heretofore as far as we are aware.

Prior practice in the elimination of volatile combustible material from exhaust streams of ovens, furnaces or other industrial processing equipment consists of several schemes. One of these is removal by incineration. Inasmuch as the concentration of combustible matter is of necessity less than the lower limits of explosi-

bility for reasons of safety, the energy available by combustion is inadequate to maintain the combustion by flame in the gas phase, and therefore external heat must be supplied to maintain the entire gas stream at inordinately high temperatures, making this an excessively expensive procedure. For example, temperatures between 1100° F. and 1500° F. are required to oxidize hydrocarbon vapors frequently present in oven exhaust gases. Furthermore, refractory linings requiring frequent replacement must be used at considerable expense.

Another method consists of scrubbing the gas stream with water. This may partially remove volatile materials through a cooling effect producing partial condensation. This method is generally unsatisfactory because of incompleteness of removal, the large amounts of water which are required, and the formation of sludges which create another disposal problem.

Another method is the adsorption of the vapors on activated carbon, silica or other adsorbing agents. This has the disadvantage for the purposes in mind of requiring duplicate bulky equipment, it being necessary to carry on adsorption and desorption in cycles. The value of the solvents recovered is ordinarily not high enough to justify installation and operating space and cost.

The means of removal which we have developed is subject to none of these shortcomings and is believed to be a novel solution of a very acute industrial problem.

To the accomplishment of the foregoing and related ends said invention then consists of a means hereinafter fully described and particularly pointed out in the claims.

The annexed drawings and following description set forth in detail certain apparatus, procedures and structures embodying the invention, such disclosed means constituting, however, but several of the various methods, apparatus and articles in which the principles of the invention may be embodied.

In said annexed drawings:

Fig. 1 is a perspective view of a panel or unit.

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1.

Fig. 3 is a sectional view similar to Fig. 2 of a modified form of panel.

Fig. 4 is a sectional view of a catalytic element.

Fig. 5 is a side elevation of a drying oven.

Fig. 6 is a sectional view taken on line 6—6 of Fig. 7 of a recuperative type catalytic fume incinerator.

Fig. 7 is a plan view taken from above of Fig. 6.

Fig. 8 is a central vertical sectional view of a wire treating apparatus.

Fig. 9 is a central sectional view of another embodiment of a catalytic fume incinerating apparatus.

Stainless steel, Chromel and Nichrome (trade names for alloys of nickel and chromium, or nickel, chromium and iron) or any other similar heat and electrically resistant material may be used as a base metal for the catalyst. The metal in the form of wire, screen or other physical form is cleaned in a manner usually practiced in preparation of metals for electroplating. This may be done in a hot alkaline bath containing caustic soda, silicates and phosphates with surface active agents, by electrocleaning in suitable solutions or by other means well known in the art. Metallic palladium, platinum or mixtures of the two metals are deposited in catalytically active form on the base metal, either by immersion plating or

by electroplating. We prefer to use palladium and to deposit it by electroplating, although we do not wish the invention to be restricted to this element and this process.

As an example, Chromel screen, wire or mat is precleaned by immersion in a hot solution of sodium orthosilicate with a surface active agent, such as a fatty acid soap, for example, sodium stearate, palmitate or oleate, or alkyl aryl sulfonate such as the sodium salt or dodecyl benzene sulfonic acid. It is thoroughly rinsed and is plated with spongy palladium in a bath containing 0.5 gram of palladium chloride per liter and 4 ml. of 37% hydrochloric acid per liter. The plating solution is operated at 160 to 170° F. and the current density is such that a uniform coating of spongy palladium approximately 0.5 millimeter in thickness is deposited within one to three minutes. Pure graphite anodes may be used, or alternatively metallic palladium anodes which will serve to replenish palladium to the solution. After plating, the catalyst is carefully rinsed free of soluble materials and is heated to approximately 600° F. in an air stream containing volatile hydrocarbons such as hexane or other hydrocarbon fractions in concentrations less than the lower limit of explosibility, whereupon surface combustion takes place, thus conditioning the palladium coating for service and increasing its tenacity to the base metal.

As a second example, the Chromel or Nichrome wire, screen, or mat is precleaned as before and immersed at 180° F. in a solution containing 0.8 gram per liter of palladium chloride and 6 ml. of 37% hydrochloric acid per liter. The solution is agitated gently for a period of up to three or four minutes or until the surface of the metal is uniformly coated with amorphous palladium. No electric current is applied, the deposition occurring by replacement of palladium by nickel and/or chromium which slowly dissolves from the base metal. The catalyst is rinsed and conditioned for service as in the previous example.

Although either procedure may be used, electrodeposition is preferred inasmuch as it prevents dissolution of the base metal, which can contaminate and inactivate the catalytic surface if the bath is used repeatedly.

Mixtures of platinum and palladium chlorides may be used, which will result in greater tenacity of the active coating to the base metal, and greater resistance to extreme high temperatures.

Palladium chloride concentrations up to 10 grams per liter can be used, and hydrochloric acid concentrations up to 10 grams per liter. Temperatures on the order of 170° F. have been found to produce structures with optimum catalytic activity, although it is possible to obtain active deposits at all solution temperatures from the freezing point to the boiling point. Current density, temperature, palladium or platinum concentration and acidity are all interrelated, and the choice of conditions is partly dictated by the base metal used. Increasing the acidity, or the temperature will increase the rate of attack on the base metal by the acid in the solution, and thus the rate of deposition of noble metal by replacement. In electroplating, for a given set of conditions, the current density should be such that evolution of hydrogen, either by attack of the metal by acid or by electrodeposition from solution does not occur. At the proper conditions, a uniform, adherent coating approximately 0.5 mm. in thickness will be deposited in a period of five minutes or less. In the event of the

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use of graphite anodes, chlorine which is evolved should be prevented from diffusing into the cathode zone by means of porous membranes. By following these general directions, one skilled in the art will be able to duplicate our results.

As an example of the performance of catalyst screens or assemblies prepared as directed, following is a set of typical data obtained by means of a small scale test unit which provided means of passing heated air, into which naphtha was vaporized in controlled amounts, through a catalyst assembly. Temperatures were measured by means of thermocouples inserted in the entering and exit air streams and in contact with the catalyst, and air samples before and after passage through the catalyst were withdrawn for analysis by conventional methods. The catalyst assembly consisted of two 16-mesh screens and one 80-mesh screen, the first 16-mesh screen being fitted with electrical connections for direct resistance heating. The entering air contained hydrocarbon vapor in such concentration that the heat released on complete combustion amounted to 37 British thermal units per cubic foot, and was maintained at a temperature of 300° F. It was passed through the catalytic element at the rate of 300 feet per minute. On starting the air flow, electric current was passed through the primary screen so as to heat it to 900° F., and after surface combustion was initiated, this current was stopped. On reaching a steady condition the primary screen temperature was 900° and the second and third screens at higher temperatures. Samples were withdrawn and analyzed for carbon dioxide before and after complete combustion using conventional analytical techniques. Complete combustion was accomplished in the passage through the catalyst under the conditions stated, as evidence by identical carbon dioxide content in the exhaust gas sample before and after subjecting to quantitative combustion in the analytical apparatus. The exhaust gas had no perceptible odor.

As a second example, in a small commercial unit having a catalyst assembly consisting of two 16-mesh screens, between which is packed wire as illustrated in Fig. 3, air passed through the unit at the rate of 100 linear feet per minute, the entry air being at a temperature of 500° F. and containing combustible solvent such that the heating value was 5.5 B. t. u. per cubic foot. The exhaust air was at a temperature of 900° F., and was free from odor. No gas or electrical heating was used.

Referring now to the drawings, and more particularly to Figs. 1 to 4 inclusive, it will be seen that we have provided a panel generally indicated by the reference letter P, the panel in this instance being of rectangular formation and comprising parallel walls 1—3 and 2—4. These walls are provided with inwardly extending flanges and a metallic screen 5 is secured to the upper flanges as viewed in Fig. 2. Another metallic screen is secured to the lower flanges as viewed in Fig. 2. A series of parallel rows of wire 7 extends between the screens 5 and 6, the wire having an undulating or wavy appearance, as shown in Fig. 2. The wire, as we subsequently describe in detail, is of sufficient resilience as to normally form good contact between the upper and lower bends thereof, and the adjacent screens. For example, the portion 9 of the wire 7 exerts a pushing action against the inner surface of the upper screen 5. In like manner the portion 10 of a lower bend of the wire 7 pushes against the inner surface of the screen 6. It is

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important that contact be made between the two screens because surface combustion may initially take place at any point and if good contact is had throughout the extent of the screen, the reaction will be rapidly transferred from the point of origin to the entire screen. Thus, if necessary, the bends 9 and 10 may be welded to the screens throughout the extent of the wire strip 7. It will be further understood that there are spaced rows of such wire strips extending from the wall 1 to the wall 3 of the panel P.

In the modification shown in Fig. 3 the wire strip 8 is similar to the strip 7 except that it is not provided with regularly reversed curves or bends. In this case the strip 8 is pushed with some force between the upper screen 5a and the lower screen 6a. This is a less expensive construction but one which will function under certain conditions.

In Fig. 4 we have shown a portion of wire greatly magnified, this wire forming the wires of the various screens 5, 6, 5a and 6a, as well as the multiplicity of strips 7 or 8 in each of the panels shown. The wire comprises a base of metal which is resistant to high temperatures and also resistant to flow of electrical currents. In some cases the screen is preheated by means of resistance heating which necessitates a metal which can carry the current to the point of incandescence without failure. The base is preferably formed, as previously set forth, of an alloy such as Nichrome, Chromel or stainless steel. It is to be understood that the invention is not restricted to these particular metals since any metal possessing the two characteristics outlined above, of being heat and electrically resistant, will suffice.

The base or core 9' is coated, as previously described, with a spongy plate of palladium 10', platinum or any other of the noble metals such as osmium, ruthenium, rhodium, and iridium. We prefer to use palladium although we have used platinum and mixtures of palladium and platinum.

The wire as shown is circular in cross-section in Fig. 4. That is, the core 9' is shown having a circular cross-section but it is, of course, possible to use ribbons of wire either for the filling strips as 7 and 8 or the screens 5 and 6. The ribbons will have a rectangular cross-section and in some instances may prove more effective than wires of circular cross-sections. However, in any event, we do not desire to be restricted to the particular cross-section which may be circular, rectangular, square, or triangular.

The particular form or geometrical shape of the panel P will, of course, depend upon the shape of the duct into which it is to be installed and, here again, limitation as to form is not to be inferred. It will be noted that in Fig. 9 of the drawings we have shown the fume incinerator in the form of a cylinder and, of course, the particular form again depends upon the particular installation and exhaust duct. Actually the surrounding walls 1, 2, 3 and 4 of panel P may be omitted in which event the ribbons either 7 or 8 will be tack welded or otherwise secured to the screen members so as to maintain the various elements in assembled relationship.

Referring now to the apparatus shown in Fig. 5 which comprises a drying oven of the recirculating type, it will be noted that material to be heat treated is carried on the belt B. This belt passes over pulleys and the upper run thereof extends through the oven O which has its upper portion

transversely divided by partition 19 for reasons hereinafter set forth. This forms an upper chamber 22 and an upper chamber 23 immediately above the perforated partition 24. The heated air from gas burner 16 passes through circulating fan 17 and thence downwardly through an outlet in the lower portion thereof to the chamber 22. After this, the heated air passes through the slots or openings 18 in partition 24 to contact material to be baked, or otherwise heat treated, lying upon belt B. Some air also passes between the lateral edges of partition 24 and the side walls of the oven, since the partition does not extend across the entire width of the oven. Room air enters the oven at the outlet end and around burner opening 16. This causes the air which has been heated by the burner 16 to be forced backwardly and upwardly around the sides of upper chamber 23, into chamber 21. This air is again heated by burner 15 after which it passes through the catalytic screen P. A portion of the air is then exhausted through the duct 22' and the remaining portion due to the action of recirculating fan 20 passes downwardly through the chamber 23.

From the foregoing disclosure it will be seen that all of the heated air after contacting the material to be heat treated upon the belt B must be passed through the catalytic screen P and eventually finds its way out through exhaust 22.

In operation the burner 15 is employed in order to raise the temperature of the air to the minimum temperature for catalytic oxidation of the volatile constituents of the gases, or vapors, arising from the materials being treated. For example, in the case of articles which have been coated with paints, lacquers, enamels, and the like, the vapors arising after the heat treatment are susceptible to surface combustion on catalysts prepared as previously described at temperatures in the order of 500° F. This is in contrast to temperatures of 1100 to 1500° F. which are required for oxidation in the absence of the catalyst. If the temperature of the air bearing the vapors at the catalyst surface P is less than that necessary to initiate surface combustion, the burner 15 must be employed and adjusted accordingly. When surface combustion is started, the temperature of the air on the exit side of the catalyst, and the catalytic element itself, will be higher than that of the air on the inlet side because of the liberation of the heat of combustion. The rise in temperature will be proportioned to the concentration of combustible matter in the air stream, and it is not unusual for the catalyst to reach incandescence, and the air temperature to be increased by several hundred degrees on passage through the catalytic element, under normal operation conditions for installations of this kind. Perfectly satisfactory combustion is obtained, however, at lower operating temperatures. When surface combustion has been established, the fuel feed to the burner 15 is decreased or shut off entirely, a part or all of the heat necessary to maintain operating temperature being supplied by the combustion of the vapor. This results in a substantial reduction in the operating cost of the oven, the principal item of which is fuel. In our invention part of the volatile combustible solvents which are normally exhausted to the atmosphere are utilized as fuel, and at the same time the noxious or objectionable character of the effluent gases is completely eliminated. It should be explained that the saving in heat is occasioned by the fact that the

highly heated gases on the exit side of the screen P are in part recirculated by the fan 20 and contact material on belt B when such material is at its lowest temperature within the oven.

Referring now to Fig. 6, this figure depicts a recuperative type unit which is intended for applications where the temperatures of the fume-bearing air are relatively low, and when the energy employed in heating the air to the minimum temperature for catalytic oxidation, as well as that liberated by the catalytic oxidation, is not returned to the process by recirculation of air, but rather is employed to preheat the incoming air. The purpose of such units is to convert harmful or odorous constituents of the gases from baking or other processes to innocuous products of combustion prior to exhausting to the atmosphere, and to do so with the minimum expenditure of fuel.

The inlet 31 may be connected to any type of oven and it passes through a vertical wall in the unit 30 in this particular instance also passing through the exhaust duct 44. The inlet then extends upwardly through a vertical reach 32, upper bend 33, vertical reach 34, lower bend 35, vertical reach 36, and discharge port 37. The hot gases are forced into the burner chamber 47 and then pass downwardly to the catalytic screen P—P. During the course of the downward movement, the flame 38 extends transversely through the flowing stream of gases so as to heat such gases to the necessary temperature for catalytic oxidation for the particular gases and catalyst involved. It is to be understood, however, that it is not necessary to employ the burner 38 in all instances since in some cases the fume laden gases, after passage through the heat exchanger 32 to 37, will have attained catalytic incineration temperature as a result of heat generated on the catalyst P alone.

It might be well to state here that the screen is formed in two panels, P—P, hingedly connected merely for convenience in shipping. Obviously the screen could be made in one piece and as far as we have been able to determine, the physical configuration is not critical. Stated in other words, it may present a flat transverse surface or two angularly related surfaces or a conical or cylindrical surface. In the present case the panels P—P are supported on a flange 48 connected to an interior wall of the unit 30 along one side thereof. On the other side the partition 40 extends in such manner as to support the right-hand panel P and also to separate the burner chamber 47 from the remainder of the unit.

A depending vertical partition 39 is provided so as to extend between the reaches 34 and 36 of the inlet 31. In like manner an upstanding partition 41 is provided so as to stand between the vertical reaches 32 and 34. In this way a sinuous path is formed for the gases after they leave the catalytic screen P—P.

The catalytic screen as explained hereinbefore increases the temperature of the hot gases leaving the same and due to the heat exchanging relationship of the inlet and outlet gas passages the incoming gases are heated prior to contact with the catalytic screen. In some instances the temperature of the gases in the inlet is increased to such an extent that it is not necessary to employ the burner. However, upon starting, for example, it may be necessary to bring the temperature of the catalytic screen up to the point of combustion of the volatile constituents.

The gases after passing along outside the verti-

cal reach 32, flow outwardly through exhaust duct 44 and exhaust fan 45 to stack 46, as shown in Fig. 7. A motor is diagrammatically illustrated at 47 which operates the exhaust fan as in conventional practice.

Referring now to Fig. 8, the type of furnace here illustrated is particularly adapted to treat a wire which has just been enamelled and this may be referred to as a recirculating oven somewhat similar to that shown in Fig. 5. In this form a series of wires W pass to the left as viewed in Fig. 8 through an oven generally indicated at 51. This oven has a hot air outlet at 52 and is provided with an exhaust duct 53 above the entrance end 54. The hot gases with the volatile constituents rise through opening 52 into a heating chamber 59. Heat is supplied in the chamber 59 by the burner generally indicated at 57, the flame 58 extending across the path of flow of the hot gases from the inlet 52 to the catalytic screen P. The burner chamber 59 is formed by the upper wall 60 of heating chamber 51 and the vertical walls of the unit as well as the interior surface 61 of the cover and the refractory block 62. A fan 63 draws the hot products of combustion through the catalytic screen P and thence it is forced through the passage 64 entering the heating chamber 51 through the opening 65, or exhausted through duct 53. The hot gases entering opening 65 then pass along the material to be treated and up through outlet 52.

This unit operates similarly to the others in that the burner 57 may or may not be employed, depending upon the particular nature and concentration of the constituents of the gas rising from the freshly enamelled wire. It should be pointed out, however, that the temperature on the right-hand side of the catalyst screen P may be several hundred degrees higher than the temperature on the left-hand side thereof so that here again two important advantages result; namely, reduction in fuel consumption and the elimination of odorous and harmful ingredients in stack gases.

Referring now to Fig. 9, in this figure we have shown the simplest form of the invention and this consists of an installation in the exhaust stack of an oven or the like. This stack is shown as having an inlet 70, an enlarged portion 71, and an outlet 80. Within the enlarged portion 71 a catalyst screen 73, which in this embodiment is cylindrical in form, is centrally mounted. The mounting consists of a sleeve 72 secured to the stack and having a circular flange 74 upon which the cylindrical screen rests. A cover member 81 extends across the top of the screen and this is provided with dependent flanges 75 so as to effectively close the upper portion of the cylindrical screen.

A burner 71 is shown, this being mounted below the screen so as to heat the incoming gases to the minimum temperature for catalytic oxidation of the combustible constituents of the effluent gases. This burner is operated by the control 78 which is connected to the temperature responsive means 76 by line 77. Here again the burner may or may not be employed, depending upon the temperature of the effluent gases and if preferred, the screen 73 may be provided with electrical connections so that the screen itself acts as a resistance and, of course, the source of current may be controlled by an element similar to the element 76.

We claim:

1. A catalytic fume incinerating unit compris-

ing an exterior metal screen lying in one plane and another interior metal screen lying in a second plane parallel to the first plane with a filling of metal wire that contacts said screens in a multiplicity of locations, said metal wire comprising a heat and electrically resistant core selected from the group consisting of an alloy of nickel and chromium and an alloy of nickel, chromium, and iron with a coating of amorphous noble metal, selected from the group consisting of platinum, palladium, and mixtures thereof.

2. A unit as set forth in claim 1 wherein one of said screens is formed of wire similar to the wire of said filling.

3. A unit as set forth in claim 2 wherein the other screen is formed of wire similar to said filling.

4. A unit as set forth in claim 1 wherein the wires of said screens and said filling are similar in composition.

5. A unit as set forth in claim 1 wherein the wires of said filling are haphazardly arranged.

6. A unit as set forth in claim 1 wherein the wires of said filling are arranged in parallel rows, each row having an undulating configuration presenting oppositely disposed, smoothly rounded bends contacting said screens.

7. In an apparatus of the character described, a heating chamber, a hot air inlet leading into said chamber, an air outlet leading out of said chamber, a source of heat adjacent said outlet, and a passage leading from said source of heat and communicating with said hot air inlet, an exhaust duct leading from said passage, there being a heat producing catalyst element mounted between said outlet and said passage in such manner that all of the heated air passing from said element to said exhaust duct must pass through said screen, whereby the amount of heat originally required from said source is materially reduced.

8. In an apparatus of the character described, a heating chamber, an air inlet at one end of said chamber, an air outlet at the other end, a source of heat adjacent said outlet, and a passage leading from said source of heat and communicating with said air inlet, an exhaust duct leading from said passage to the atmosphere, there being a heat producing catalyst element mounted between said outlet and said passage in such manner that all of the heated air passing from said source of heat to said exhaust duct must pass through said element, whereby the amount of heat originally required from said source is materially reduced, said exhaust duct being connected into said passage at a location between said catalyst element and said inlet.

9. In an apparatus of the character described, an insulated casing, an inlet duct having a discharge port, a burner chamber, a heat producing catalyst element and an exhaust duct leading to the atmosphere; said port lying within said burner chamber and said element being mounted between said chamber and said exhaust duct and means to cause the hot gases leaving said element to pass along said inlet duct in heat exchanging relationship to said exhaust duct.

10. Apparatus as set forth in claim 9, wherein said burner chamber has a burner mounted therein with flame directing means causing the flame from said burner to extend transversely across the path of flow from said discharge port to said element.

11. Apparatus of the character described, comprising an exhaust duct adapted to convey hot

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fume laden gases, an inlet, an outlet, and a heat producing catalyst element; said element being positioned between said inlet and outlet in such manner that all of said gases entering said inlet must pass therethrough to reach said outlet whereby the combustible constituents of said gases are ignited and thus oxidized, said element comprising a screen formed of wire, said wire comprising a core selected from the group consisting of an alloy of nickel and chromium and an alloy of nickel, chromium, and iron with a coating of amorphous noble metal selected from the group consisting of platinum, palladium, and mixtures thereof.

12. In an apparatus of the character described, comprising an exhaust duct adapted to convey hot fume laden gases, an inlet, an outlet, and a heat producing catalyst element; said element being positioned between said inlet and outlet in such manner that all of said gases entering said inlet must pass therethrough to reach said outlet whereby the combustible constituents of said gases are ignited and thus oxidized, said element comprising a screen formed of wire, said wire comprising a core selected from the group consisting of an alloy of nickel and chromium and an alloy of nickel, chromium, and iron with a coating of amorphous noble metal selected from the group consisting of platinum, palladium, and mixtures thereof, means to initially heat said element to the minimum temperature for catalytic combustion of said combustible constituents, and other means to control said initial heating means.

13. A method of catalytic fume incineration which comprises the steps of conducting fume laden gases to an exhaust duct, then passing said gases through a wire screen catalyst element, such wire consisting of a core selected from the group consisting of an alloy of nickel and chromium and an alloy of nickel, chromium, and iron and being provided with a coating of amorphous metal selected from the group consisting of platinum, palladium, and mixtures thereof, causing ignition of the combustible constituents of said fume laden gases and then passing said gases to the atmosphere.

14. A method as set forth in claim 13 wherein said element is initially heated to the minimum temperature for catalytic combustion of said combustible constituents or higher and when said temperature has been reached such initial heating is discontinued.

15. In an apparatus of the character described, a heating chamber, an air inlet at one end of said chamber, an air outlet at the other end, a source of heat adjacent said outlet, and a passage leading from said source of heat and communicating with said air inlet, an exhaust duct leading from said passage, there being a heat producing catalyst element mounted between said outlet and said passage in such manner that all of the heated air passing from said element to said exhaust duct must pass through said element, whereby the amount of heat originally required from said source is materially reduced, said exhaust duct being connected into said passage at a location between said catalyst element and said inlet, and means to cause part of the hot gases leaving said element to pass into said exhaust duct.

16. In an apparatus of the character described, a heating chamber, an air inlet at one end of

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said chamber, an air outlet at the other end, a source of heat adjacent said outlet, and a passage leading from said source of heat and communicating with said air inlet, an exhaust duct leading from said passage, there being a heat producing catalyst element mounted between said outlet and said passage in such manner that all of the heated air passing from said element to said exhaust duct must pass through said element, whereby the amount of heat originally required from said source is materially reduced, said exhaust duct being connected into said passage at a location between said catalyst element and said inlet, and means to cause part of the hot gases leaving said element to pass into said exhaust duct, and means to cause the remainder of the hot gases to pass to said air inlet.

17. In an apparatus of the character described, a heating chamber, an air inlet at one end of said chamber, an air outlet at the other end, a source of heat adjacent said outlet, and a passage leading from said source of heat and communicating with said air inlet, an exhaust duct leading from said passage, there being a heat producing catalyst element mounted between said outlet and said passage in such manner that all of the heated air passing from said element to said exhaust duct must pass through said element, whereby the amount of heat originally required from said source is materially reduced, said exhaust duct being connected into said passage at a location between said catalyst element and said inlet, said burner chamber having a burner mounted therein with flame directing means causing the flame from said burner to extend transversely across the path of flow from said air outlet to said screen.

18. Apparatus as set forth in claim 12 wherein said initial heating means comprise a burner located between said inlet and said element.

19. Apparatus as set forth in claim 12 wherein said initial heating means comprises a source of electricity connected to said heat-producing catalyst element as a resistance.

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