United States Patent

Ishibashi et al.

[15] **3,698,362**

[45] **Oct. 17, 1972**

[54] **METHOD AND APPARATUS FOR INCINERATING WASTE OIL**

[72] Inventors: **Wataru Ishibashi; Satoru Nakano,** both of Shigaken; **Takeo Yokotani,** Osaka, all of Japan

[73] Assignee: **Iwatani & Co., Ltd.,** Osaka, Japan

[22] Filed: **Jan. 15, 1971**

[21] Appl. No.: **106,742**

[30] **Foreign Application Priority Data**

March 23, 1970 Japan 45/24654
June 4, 1970 Japan 45/48957

[52] **U.S. Cl.** .....**122/136 R,** 122/DIG. 1
[51] **Int. Cl.** **F22b 7/00**
[58] **Field of Search** .....431/7, 164, 165, 170, 190, 431/351, 352, 326; 122/136 R, DIG. 1

[56] **References Cited**

UNITED STATES PATENTS

836,219	11/1906	Schutz	431/164 X
1,177,067	3/1916	Van Amburgh	431/165
1,499,431	7/1924	Willett et al.	431/190 X
1,785,154	12/1930	Symmes	431/7
1,983,386	12/1934	Mikeska	431/190 X
3,291,182	12/1966	Dow et al.	431/165

FOREIGN PATENTS OR APPLICATIONS

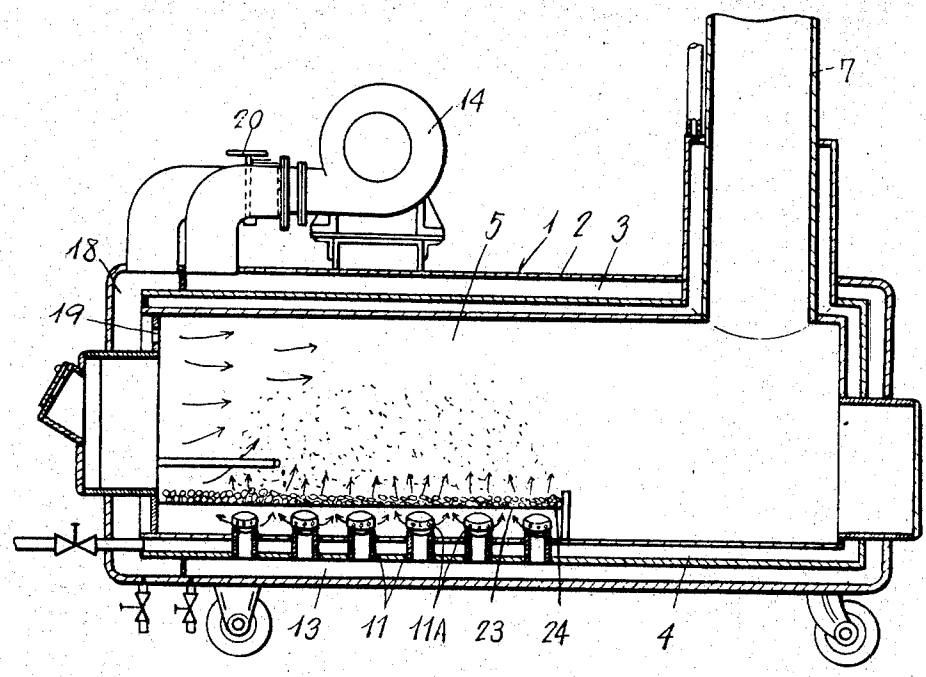
412,225	6/1931	Great Britain	431/190

Primary Examiner—Carroll B. Dority, Jr.
Attorney—Arthur Schwartz

[57] **ABSTRACT**

Waste oil to be incinerated is atomized in a combustion chamber by primary air emanating from air tuyeres arranged on the floor of the combustion chamber, and is agitated by secondary air additionally introduced into the combustion chamber. The atomized waste oil is well mixed with air, and the waste oil is then ignited so that it can be incinerated in complete combustion without applying any additional burning device or agent.

6 Claims, 3 Drawing Figures

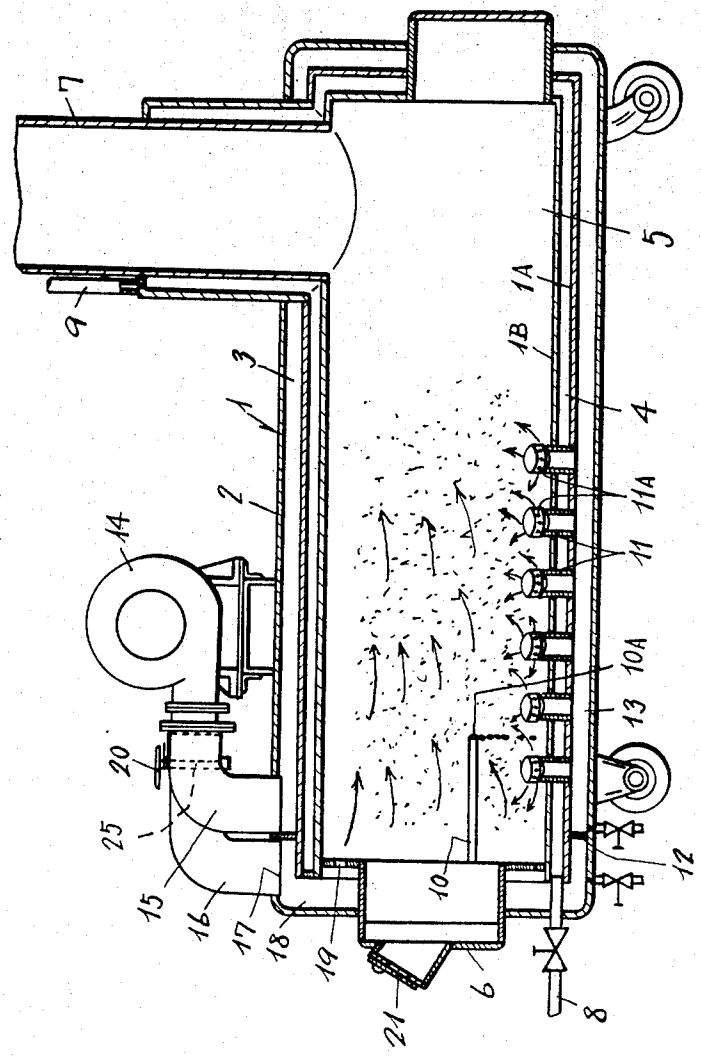


PATENTED OCT 17 1972

3,698,362

SHEET 1 OF 2

FIG. 1



INVENTORS
WATARU ISHIBASHI,
SATORU NAKANO,
TAKEO YOKOTANI

BY

ATTORNEY

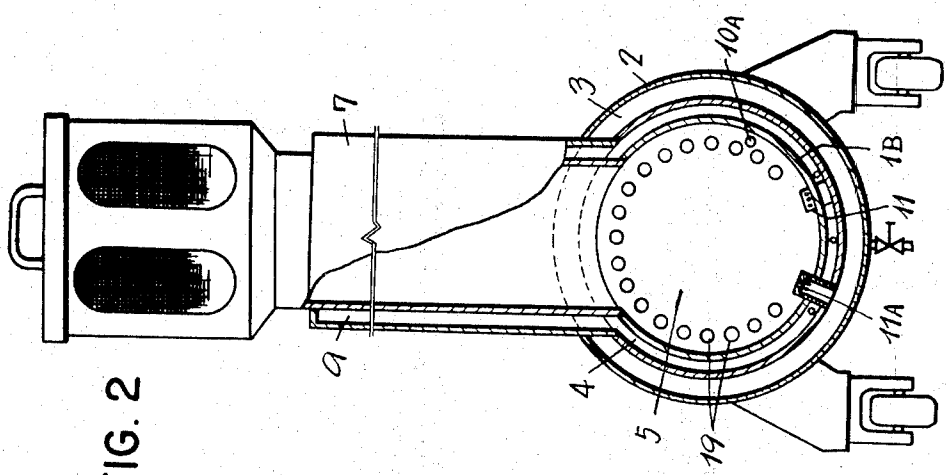


FIG. 2

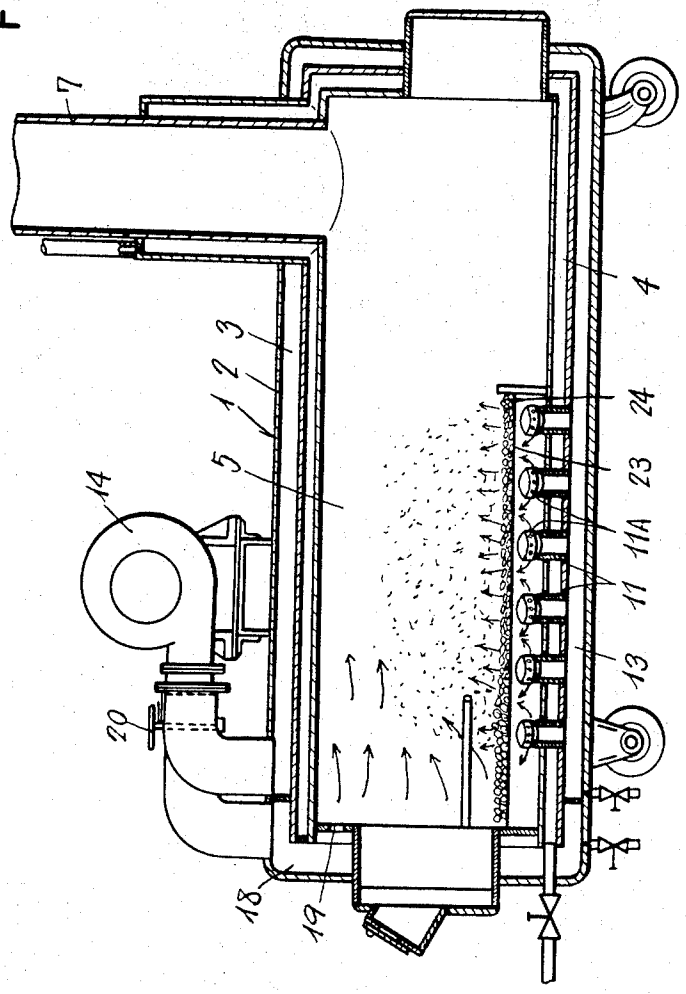


FIG. 3

INVENTORS
WATARU ISHIBASHI,
SATORU NAKANO,
TAKEO YOKOTANI

BY

ATTORNEY

METHOD AND APPARATUS FOR INCINERATING WASTE OIL

BACKGROUND

The present invention relates to an improved method and apparatus for completely and effectively incinerating industrial waste oil such as used engine oil and lubricating oil. More particularly, the present invention relates to a method and an incinerator for burning such oil completely by itself, without applying any burning agent or a burner.

Throughout the world, the greatest social concern at present is that waste oil, a kind of industrial waste, is endangering public sanitation and safety by fouling water, and sometimes causing fires and odor. To avoid these social problems, many countermeasures have been proposed, among which is a furnace for incinerating waste oil. However, the difficulty which is common to all of the proposed methods and apparatus is that complete combustion, or at least continuous combustion is almost impossible to achieve, because of the 5 to 40 percent water content existing inseparably from the oil content, i.e., in the emulsive state.

For example, a furnace has been proposed, in which waste oil to be incinerated is stored on its floor while burning hot air is taken in from outside through one or more burners at the furnace door to fire the oil, having a water content. But in this situation, for smooth igniting, waste oil usually must be previously heated before burning. Waste oil cannot be continuously burned by an intermittent fire since the water and oil contents in waste oil are separately evaporated in the waste oil supply pipe, or the water and oil is expelled from burners alternately. This is because the water content is first evaporated while the oil content is still in a liquid state.

The disadvantage in the previous method as pointed out above is chiefly that the water and oil contents are not separable in the emulsive state in waste oil. Therefore, it is impossible to answer the social need which strongly desires a solution of the problem caused by waste oil, by utilizing known methods and apparatus. Also, it is preferable to be able to burn the oil at the location where waste oil is produced.

SUMMARY

The object of this invention is to provide a method and apparatus for incinerating waste oil effectively by burning the waste oil by itself, irrespective of its relatively large water content, and without the use of a burner or burning agent.

Briefly stated, waste oil is accumulated on the floor of the furnace by continuously supplying it into a furnace or a combustion chamber. Then, the oil on the floor is dispersed into drops by primary air eminating from air tuyeres arranged on the floor of the furnace. The tuyeres are provided with air nozzles designed to send out air in all directions along the outer surfaces. The primary air continues to disperse the oil drops causing them to fly against the inside walls of the furnace so that the drops are further broken up into particles as fine as in an atomized condition. The foggy atomized oil is then agitated in the combustion chamber by secondary air supplied from other openings and is well mixed with air. Once the foggy oil atmosphere is fired, the atomized foggy oil easily absorbs heat from the heated air, and at the same time, the water contained in the waste oil quickly evaporates. In this way, complete combustion of the waste oil is achieved by the synergistic effect caused by the atomizing of the oil and the resulting evaporation of water contained in the oil.

BRIEF DESCRIPTION OF DRAWINGS

This invention will be more particularly described by way of example, with reference to the drawings, wherein:

FIG. 1 is a front view in vertical section showing an apparatus constructed in accordance with the present invention;

FIG. 2 is a right side view showing the end face of the body of the apparatus illustrated in FIG. 1, parts being broken away to reveal the internal construction; and

FIG. 3 is a front view in vertical section showing another embodiment of an apparatus constructed in accordance with the present invention.

DETAILED DESCRIPTION

The cylindrical body 1 of a metal furnace has an annular double wall structure, i.e., an outer wall 1A and an inner wall 1B. In addition, the body 1 is covered by an outermost mantle 2 of metal, providing an annular passage 3 for primary air between the mantle 2 and the outer wall 1A. The space between the outer wall 1A and the inner wall 1B provides a cooling water jacket 4, and the closed inside space of the body 1 provides a combustion chamber 5, at the front face of which is a furnace door 6, and at the back of which is a stack 7.

The water jacket 4 is supplied with water through an inlet pipe 8, and, after circulation, the water is taken away in the form of hot water by an outlet pipe 9. A supplying pipe 10 for the waste oil is inserted into the combustion chamber, in such a manner that the waste oil falls against the wall of the chamber 5. Arranged on the floor are air tuyeres 11 of cylindrical shape, each tuyere 11 being provided with air nozzles 11A around its circumferential surface, so that an air jet can be sent out in all directions. The tuyeres 11 are connected at their lowest portions to a primary air chamber 13 consisting of the passage 3 closed with a separator 12. The chamber 13 is supplied with primary air by a blower 14 mounted on the mantle 2 through a duct 15. The duct 15 is divided by a damper 25, and a bypass pipe 16 is connected at its terminating end 17 to an inside chamber 18 situated around the furnace door 6. The air in the inside chamber 18 is sent through openings 19 into the combustion chamber 5. The amount of secondary air is adjusted by a valve 20, and an operator can watch the burning condition of the oil through observation window 21.

It will further be noted that the device has wheels, and can be made mobile. Therefore, burning can take place in any convenient area so that vast quantities of waste oil need not be transported.

Referring to FIG. 3, illustrating a further example of the incinerator, in which, above air tuyeres 11, is a metallic screen 23, completely covered by metallic grains 24. Preferably, the grains 24 should be alumina or copper balls of 8 mm to 30 mm in diameter, having good heat-radient, heat-absorbing, heat-resistant properties.

OPERATION

The operation of this invention will be described as follows:

The air delivered by the blower **14** is divided by the damper **25** into the duct **15** and the by-pass duct **16** as primary and secondary air respectively. The primary air is sent under pressure through the nozzles **11A** of the tuyeres **11** into the combustion chamber **5** via the primary air chamber **13**. The accumulated oil is dispersed in drops above the floor **1B**. In the example illustrated in FIG. **3**, the primary air passes through the layer of the grains **24** on the screen **23**, causing the oil to be blown from the surface of the individual grain in form of fine drops in the combustion chamber **5**. In this way, the oil is blown up from the combustion chamber **5** in the form of fine droplets, which, in addition, are caused by the primary jet of air to collide with the wall of the chamber **5**, finally becoming atomized. The secondary air is then blown into the combustion chamber **5** under pressure through the openings **19**, dispersing the atomized oil thus produced throughout the combustion chamber **5**. The foggy waste oil formed in the aforesaid manner is agitated in the chamber. Thus, waste oil can be advantageously atomized by virtue of the synergistic effect of the primary air jet and the impact against the wall, thus the surface of the oil is infinitely increased.

In such a condition, the atomized oil is ignited from the furnace door **6**, and starts to burn. Once it is fired, the atomized oil absorbs heat from the heated air in the combustion chamber, so that the water easily evaporates from the waste oil, lowering the flash point of the remaining oil, thereby ensuring the stable burning of the oil in a continuous manner. The body **1** of the furnace is protected against possible corrosion due to the high temperature, and is also thermally insulated from the outside, by the cooling water in the jacket **4**. The cooling water is discharged from the outlet pipe **9** in the form of hot water.

As described above, in the example illustrated in FIG. **3**, the primary air passes through the layer of the grains **24** on the screen **23**, causing the oil to blow off the surface of the grains. In the process of passing through the grains **24**, the oil is advantageously broken up into finer droplets by the interparticle impact caused by the primary air jet. Once the foggy atomized oil thus produced is ignited, and starts to burn, the metallic grains **24** are heated into red-hot balls, so that the oil sticking to the surfaces of the individual grains **24** is more readily heated prior to being blown off, with the advantage that the water contained in the oil evaporates more quickly than otherwise.

The date relative to the incineration of waste oil utilizing the aforesaid apparatus according to the present invention is illustrated as follows:

The specifications of incinerator used:

The inner diameter and material of inner-walled cylinder 1B	300mm ×1000mm of iron
The thickness of the inner cylinder	6.4mm
The inner diameter and material of outer-walled cylinder 1A	360mm§×1000mm of iron
The thickness of the outer cylinder	3.2mm
The inner diameter and material of the mantle 2	420mm ×1000mm of iron
The thickness of the mantle	3.2mm

The waste oil specimen used in the incineration is as follows:

One example included water added to used engine oil from automobiles to produce a water content of **10%, 20%, 30%** and **40%** (per cent by weight) respectively. Another example included used light oil with water added to produce a water content of **10%, 20%, 30%** and **40%** respectively for specimen.

These waste oils have the following features:

Used engine oil for automobile

General properties:		
Flash point:	130°C	
Viscosity (50°C):	62.5 (centistokes)	
Ash content:	0.90%	
Water content:	2.0%	
Specific properties:	Viscosity (50°C centistokes)	Ash Content
With 10% water	72.0	0.84
With 20% water	78.5	0.75
With 30% water	162.3	0.66
With 40% water	223.6	0.57

Used light oil

General properties:		
Flash point:	94°C	
Viscosity (50°C)	4.5 (centistokes)	
Ash content:	0.23%	
Water content:	0.0%	
Specific properties:	Viscosity (50°C centistokes)	Ash Content
With 10% water	12.8	0.21
With 20% water	13.0	0.19
With 30% water	36.5	0.17
With 40% water	76.4	0.15

The data derived from the fire-incineration of the aforesaid waste oils by and according to the method and apparatus of the present invention is as follows:

Specimen	(*) Properly-burned amt. (L/Hr)	(**) temp. Furnace °C	Analysis of Gas (Per Cent) O_2	CO_2	N_2	CO	C_mH_n	Cooling Water Inlet °C	Outlet °C	Rate (L/Hr)
1. engine Oil	7.8	700	5.6	10.4	84	0.00	0.00	15	70	600
10% water	8.1	710	6.2	9.8	83	0.0	0.0	15	68	600
20% water	9.3	690	5.4	10.4	84	0.0	0.0	15	64	600
30% water	10.0	680	5.3	10.2	85	0.0	0.0	15	64	600
30% water	11.5	670	5.3	10.3	84	0.0	0.0	15	62	600
2. Light Oil	7.5	740	6.1	9.8	84	0.0	0.0	15	69	600
10% water	8.4	730	5.3	10.2	85	0.0	0.0	15	66	600
20% water	9.6	700	5.2	10.2	85	0.0	0.0	15	66	600
30% water	10.2	690	5.6	10.6	84	0.0	0.0	15	65	600
40% water	11.4	660	5.8	10.0	84	0.0	0.0	15	63	600

(*) The properly-burned amount means the amount of material burned per hour in complete combustion without black smoke in the chimney, the complete combustion being confirmed by analysis of the gas.

(**) The temperature was measured by an alumel-chromel thermocouple placed at the center of the combustion chamber.

(***) The gas was analyzed by the Orsat apparatus.

Waste oil is finally changed into an atomized condition by virtue of the synergistic effect of the primary air jet and the resulting impact against the inside walls of the combustion chamber, increasing the surface area of the oil particles per unit weight, in spite of a relatively large water content, so that the atomized oil can be well mixed with air during the agitation subsequently caused by the secondary air. As a result, the oil can easily be ignited and fired. Once it is fired, the oil absorbs heat from the heated air, allowing the water contained in it to evaporate very quickly providing an even temperature throughout the combustion chamber.

Thus, in spite of a relatively large water content, waste oil can be burned continuously and completely, which might otherwise be almost impossible to achieve because of the undesirable diffusion of vapor caused by heat covering the oil surface, or by the separated state of the oil and water. In accordance of the present invention, such as the experimental data shows, waste oil can be burned completely even if it contains 40 percent water. Therefore, this invention will be of great value to factories which have difficulties in solving the problems involved in the incineration of waste oil.

What is claimed is:

1. An apparatus for incinerating waste oil comprising:
   a. an outermost mantle,
   b. an outer wall spaced interiorly from the outermost mantle and defining a first passage therewith,
   c. an inner wall defining a combustion chamber spaced interiorly from the outer wall and defining a second passage therewith,
   d. means for supplying waste oil to the combustion chamber,
   e. a layer of grains disposed within the combustion chamber,
   f. means for supplying cooling water to the second passage,
   g. means for providing communication between the first passage and the combustion chamber whereby the means includes a plurality of nozzles located within the combustion chamber,
   h. means for supplying a primary source of air to the first passage, through the plurality of nozzles and bed of grains, into the combustion chamber,
   i. a plurality of openings at one end of the combustion chamber,
   j. means for supplying a secondary source of air through the plurality of openings and into the combustion chamber across the layer of grains, and
   k. means at the other end of the combustion chamber for withdrawing the products of combustion.

2. An apparatus for incinerating waste oil comprising:
   a. an outermost mantle,
   b. an outer wall spaced interiorly from the mantle and defining a first passage therewith,
   c. an inner wall defining a combustion chamber, spaced interiorly from the outer wall, and further defining a a second passage therewith,
   d. means for supplying waste oil to the combustion chamber,
   e. means for supplying a primary source of air to the first passage,
   f. means for providing communication between the first passage and the combustion chamber for supplying the primary source of air thereto,
   g. means for supplying cooling water to the second passage, and
   h. means for supplying a secondary source of air into the combustion chamber in a direction substantially perpendicular to the direction of the primary source of air supplied thereto such that the waste oil supplied to the combustion chamber is atomized by virtue of the synergistic effect of the primary air source and the resulting impact of the oil against the inner wall of the combustion chamber.

3. The apparatus of claim 2 further including:
   a. a screen disposed within the combustion chamber over the means providing communication with the primary source of air, and
   b. a layer of metallic grains on the screen such that the primary source of air is caused to pass through the grains and the secondary source of air is caused to pass across the grains.

4. The apparatus of claim 3 wherein the grains are of a metal selected from the group consisting of aluminum and copper.

5. The apparatus of claim 1 wherein the means for providing communication between the first passage and the combustion chamber includes:
   a. a plurality of tuyeres, and
   b. a plurality of nozzles affixed to the exit ends of the tuyeres.

6. The apparatus of claim 1 wherein one end of the combustion chamber is provided with a plurality of openings for receiving the secondary source of air.

* * * * *