Oct. 2, 1923. 1,469,644

W. H. KOBBÉ

BURNING SULPHUR

Filed Aug. 8, 1922

Fig. 1,

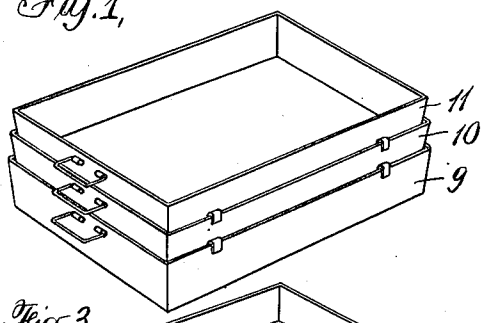


Fig. 2,

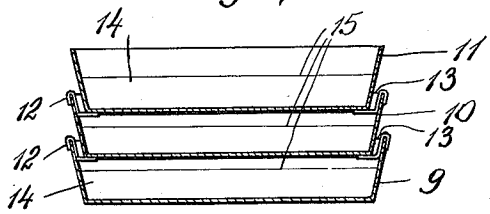


Fig. 3,

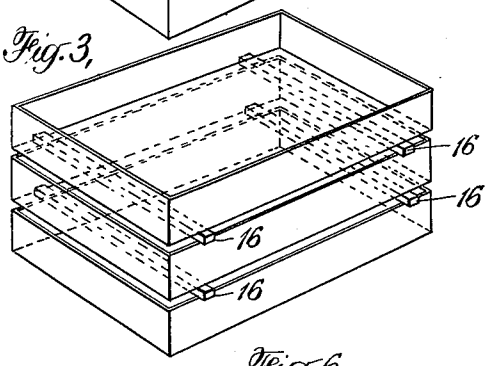


Fig. 4,

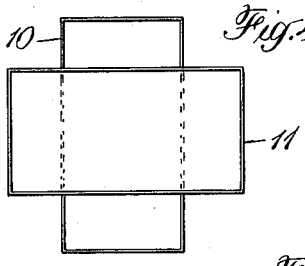


Fig. 5

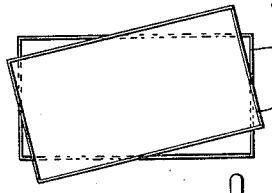


Fig. 6,

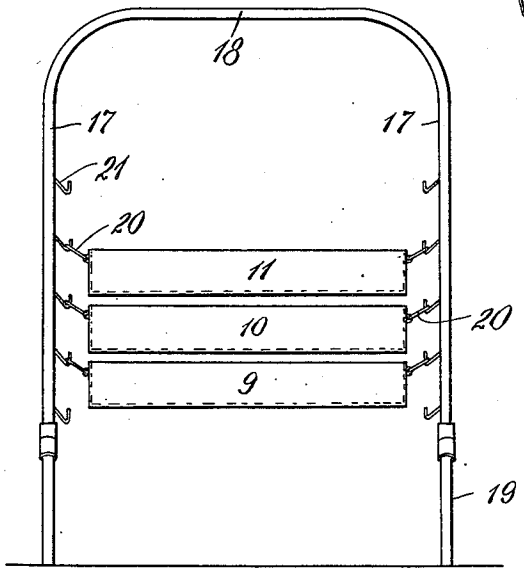


Fig. 7,

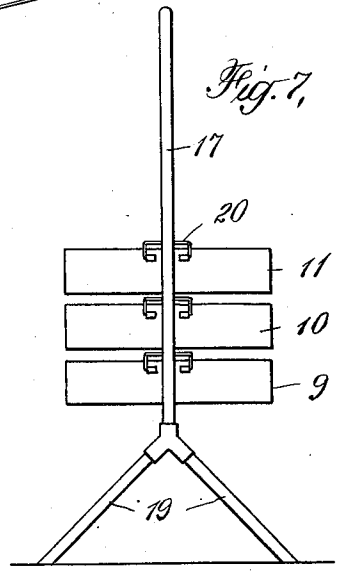
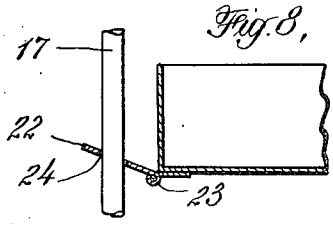


Fig. 8,



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UNITED STATES PATENT OFFICE.

WILLIAM HOFFMAN KOBBÉ, OF NEW YORK, N. Y., ASSIGNOR TO TEXAS GULF SULPHUR COMPANY, OF BAY CITY, TEXAS, A CORPORATION OF TEXAS.

BURNING SULPHUR.

Application filed August 8, 1922. Serial No. 580,419.

To all whom it may concern:

Be it known that I, WILLIAM H. KOBBÉ, a citizen of the United States, residing at New York city, in the county of New York, State of New York, have invented certain new and useful Improvements in Burning Sulphur; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the burning of sulphur, and more particularly to the burning of sulphur containing oil. The invention has for its general objects the provision of an improved method of and apparatus for burning sulphur and more especially sulphur containing oil.

The burning of sulphur in open pans or receptacles for the production of sulphur dioxide gas is practiced in many industries. For example, sulphur dioxide gas produced in this manner is employed for the curing of hops in vitaculture, for bleaching broomcorn, for bleaching cloth, for the preparation of dried fruits, such as apricots, peaches and the like, etc.

It is the general practice in such industries to place the separate open pans or receptacles containing the burning sulphur on the floor of the drying or curing room or on the ground out of doors.

The burning qualities of sulphur, even of a very high purity, are very adversely affected by small traces of petroleum oils and similar other organic impurities. This is due to the fact that oil and sulphur react at a moderate temperature to form an asphalt which spreads as a thin film over the surface of the sulphur and eventually extinguishes the flame, while the greater part of the sulphur remains unburned. In burning sulphur in open pans or receptacles, it has heretofore been necessary to employ a refined grade of sulphur, or sulphur in which the oil has been carbonized in order to effect satisfactory and complete burning of the sulphur. The present invention contemplates certain improvements in the burning of sulphur whereby unrefined or oil-bearing sulphur may be burned in open pans or receptacles at least as satisfactorily and effectively as the refined grades of sulphur.

In the mining of certain deposits of sulphur in regions where mineral oils exist, and wherein the sulphur is recovered in liquid form by underground fusion or liquefaction by means of water heated to a high temperature and the thus liquefied sulphur then pumped to the surface of the ground, it is frequently found that more or less mineral oil is present in the mined sulphur. The presence of this mineral oil, even in relatively small proportion, is prejudicial to the burning quality of such mined sulphur, because of the constant tendency for a film to form over the surface of the burning mass of such a nature as to choke and sometimes to entirely interrupt the combustion of the mass. The improvements characterizing the present invention are especially applicable to the burning of sulphur mined by underground fusion, but it is to be understood that the principles of the invention are applicable generally to the burning of sulphur and more particularly to the burning of sulphur containing small amounts of petroleum or other oils or other organic impurities.

In Letters Patent of the United States of Raymond F. Bacon and Harold S. Davis, Nos. 1,374,897 and 1,374,898, patented April 19, 1921, it is shown that when oil bearing sulphur is heated, for a brief period, to a sufficiently high temperature, some interaction takes place between the oil and the sulphur and eventually the oil is destroyed leaving the sulphur free-burning. The speed of this interaction between the oil and the sulphur increases as the temperature rises until at the boiling point of sulphur a comparatively short time is required to sufficiently destroy the oil to render the sulphur free-burning.

I have discovered that by superposing a plurality of open receptacles each containing sulphur to be burned, one above another, in relatively close proximity to each other, and simultaneously burning the sulphur in each of these receptacles, the heat of combustion of the burning sulphur in one receptacle will be transmitted to the adjacent receptacle or receptacles in such quantity as to insure the complete burning of the sulphur in at least one receptacle and generally in all of the receptacles. The superposed receptacles are preferably arranged as close to one another as possible, allowing

sufficient space between adjacent receptacles to permit the ingress of the required amount of air to support combustion of the sulphur and the egress of the resulting gaseous products of combustion.

When oil-bearing sulphur is ignited in an open receptacle combustion proceeds for a brief period until extinguished by the film of asphalt formed on the surface of the mass of sulphur. Practically all of the heat from the burning sulphur is swept away in the combustion gases, and all but the top layer of the sulphur to be burned is protected from the heat of combustion by an excellent heat insulator, namely, liquid sulphur. It will thus be evident that in the burning of sulphur in open dishes or receptacles little, if any, of the heat of combustion is imparted to the mass of sulphur to be burned, and such heat as is imparted to this mass of sulphur penetrates only to a relatively small distance beneath the top surface of the mass of sulphur to be burned.

The heat required to convert one gram of sulphur from a solid at 20° C. to a vapor at the boiling temperature of sulphur is approximately 213 calories, while the heat of combustion in burning sulphur to gaseous sulphur dioxide is approximately 2200 calories per gram. In other words, the heat evolved by burning sulphur to sulphur dioxide is over ten times that required to vaporize an equal quantity of sulphur. Where sulphur is burned simultaneously in a plurality of superposed pans in accordance with my present invention, the heat of combustion of the burning sulphur in each pan is available in very large part for heating up the sulphur in the adjacent receptacle or receptacles. Moreover, when burning sulphur in accordance with the invention, not only is the heat of combustion of the burning sulphur in one receptacle transmitted in large part to the sulphur in adjacent receptacles, but in addition a considerable quantity of heat is very probably imparted to the unburned sulphur in each of the superposed receptacles (with the possible exception of the top receptacle) by the heat of combustion of the burning sulphur in its own receptacle.

The accompanying drawings illustrate various arrangements of apparatus for carrying out my improved method of burning sulphur. In these drawings, Fig. 1 is a perspective view of three superposed receptacles appropriately arranged for the practice of the invention; Fig. 2 is a sectional elevation of the apparatus shown in Fig. 1; Fig. 3 is a perspective view of a modified arrangement of three superposed receptacles; Figs. 4 and 5 illustrate other arrangements of superposed receptacles adapted for the practice of the invention; Figs. 6 and 7 are respectively a side elevation and end elevation of an apparatus adapted for the practice of the invention, and Fig. 8 is a detail view of a modified receptacle supporting means for use in the apparatus illustrated in Figs. 6 and 7.

Referring first to Figs. 1 and 2 of the accompanying drawings, the improved sulphur burning apparatus there represented comprises a plurality of pans or receptacles 9, 10 and 11 of good heat conducting material such, for example, as iron or aluminum, superposed one above the other to form a tier. These receptacles have sloping sides and are adapted to telescope one within the other to a slight extent, as shown in Fig. 2. The two upper pans are supported by appropriate hooks 12 hanging over the top edge or rim of the two lower receptacles. The sloping sides of the receptacles provide a sufficient space 13 extending entirely around the periphery of the lower receptacles 9 and 10 for the ingress of sufficient air to support combustion of the sulphur in these receptacles and for the egress of the resulting products of combustion.

In carrying out my invention in the apparatus illustrated in Figs. 1 and 2, the sulphur to be burned is distributed in the receptacles 9, 10 and 11, the receptacles being separated from each other (that is, not superimposed) for this purpose. The approximate upper level of the sulphur in each receptacle at the beginning of the operation is indicated by the lines 15 in Fig. 2. The amount of sulphur placed in each pan is, of course, such as to provide a sufficient space between the top of the sulphur in one receptacle and the bottom of the upper adjacent receptacle for successful combustion. The sulphur in receptacle 9 is first ignited in any suitable manner, and receptacle 10 is then placed in position above it and the sulphur in receptacle 10 is then ignited. Receptacle 11 is then placed in position and the sulphur in it is also ignited.

The heat of combustion of the burning sulphur begins immediately to be transmitted between the adjacent receptacles and the temperature of the sulphur in all of the receptacles is thereby raised. A portion of the heat from the burning sulphur in receptacle 9 is reflected by the bottom of receptacle 10 and serves to heat up the sulphur in receptacle 9. Another portion of the heat from the burning sulphur in receptacle 9 is conducted through the bottom of receptacle 10 and assists in heating up the sulphur in this latter receptacle. In similar manner, the heat of the burning sulphur in each receptacle is transmitted in large amount to the sulphur in the various superposed receptacles.

At the commencement of the operation, that is, when the sulphur in the receptacles is first ignited, the sulphur in receptacle 9

burns as oil-bearing sulphur ordinarily burns in an open pan, that is, the asphaltic film begins to form and would eventually extinguish the flame, if it were not for the presence of receptacles 10 and 11. However, the heat of the burning sulphur in receptacle 9, although very low at the start, is sufficient to promote the burning of sulphur in receptacle 10, so that the sulphur in this receptacle will soon begin to burn very considerably better than when first ignited. The sulphur in receptacle 11, receiving the benefit of the heat of the burning sulphur in receptacles 10 and 9, burns still better than the sulphur in receptacle 10. The formation of the characteristic asphaltic film causes the sulphur in receptacle 9 to burn at a relatively low ebb during the first few minutes, but during this time the receptacle 11 becomes quite hot, so that the sulphur therein is substantially melted, and a portion of it heated to the boiling point. The transfer of heat downwardly from receptacles 10 and 11 soon sufficiently heats up the sulphur in receptacle 9, so that it commences to burn vigorously, and ultimately the sulphur in all three receptacles will reach the boiling point and burn fiercely, the oil in the sulphur being so modified by the heating action as to render the sulphur free-burning. In actual practice, I have found that the sulphur in receptacle 11 is first entirely consumed, leaving substantially no residue, then the sulphur in receptacle 10 is consumed, and finally the sulphur in receptacle 9 is substantially all consumed.

The following investigation illustrates the advantages resulting from the burning of sulphur in accordance with the present invention. Numerous experiments have shown that when sulphur is burned in single open pans or receptacles only about 24% of the sulphur is consumed, the remaining 76% being left unburned. These experiments were conducted with sulphur obtained from wells of the Texas Gulf Sulfur Company, at Gulf, Texas. In one of a number of investigations recently conducted with sulphur from the same source and of substantially the same grade, three iron pans three inches deep and eighteen by twelve inches in section were employed in the superposed arrangement illustrated in Figs. 1 and 2 of the accompanying drawings. Eight and one-third pounds of sulphur were placed in each pan, making a total of twenty five pounds of sulphur for the entire burner. The sulphur in each pan was ignited near the center, and the pans were placed in position one above the other. In about twenty minutes the upper layer of sulphur in each pan had melted and the asphaltic film had formed. At the end of twenty five minutes, the sulphur in the lower pan 9 was burning at a relatively low ebb, but the sulphur in the upper pans 10 and 11 was beginning to burn more rapidly. At the end of thirty minutes, the sulphur in pans 10 and 11 was burning fiercely, and the sulphur in the lower pan 9 was burning with more vigor. The sulphur in pan 9 soon reached substantially the same intensity of combustion as the sulphur in pans 10 and 11 and at the end of one hour after ignition the sulphur in all three of the pans was completely burned out, there being substantially no residue in pans 10 and 11, and only a very slight residue in pan 9. In addition to the complete burning of the sulphur, the method of the invention enables the burning of a very considerably larger amount of sulphur (substantially three times) in a given period of time than by the heretofore customary methods of burning sulphur in open receptacles.

Fig. 3 of the accompanying drawings shows a tier of sulphur-burning pans having straight sides, and of the type now successfully employed in certain industries, some of which have been mentioned hereinbefore. With these pans, which are not adapted to telescope with each other, it is convenient to separate them by means of horizontal bars 16 and by this means provide the necessary space for combustion purposes.

Figs. 4 and 5 show another arrangement of these standard sulphur-burning pans, which has been successfully employed by me, and in which no rods 16 are required. In these figures the pans are allowed to rest one directly upon the other, either at right angles or staggered at a smaller angle, as indicated in Fig. 5. In all of these various arrangements the principal point of importance is to arrange the pans in maximum proximity with each other and still allow sufficient space between them for the inflow of air and the exit of products of combustion. The particular arrangement best suited for the conditions of a particular locality will depend largely upon the conditions of draft at that place. If the sulphur is to be burned indoors, the arrangement shown in Figs. 3 and 4 will probably be chosen, but if the sulphur is to be burned out of doors, the arrangement shown in Fig. 1 or Fig. 5 may be found more desirable, depending upon the wind conditions.

In Figs. 6 and 7, I have illustrated a rack which is relatively inexpensive and yet admirably adapted to support a number of superposed sulphur-burning pans. This rack comprises a pair of uprights 17, connected at the top by a cross-bar 18 which serves as a handle, and is provided at the lower extremities with feet 19. It is necessary to provide the pans 9, 10 and 11 with handles 20, so that they may hang upon the stationary hooks 21 which are mounted in spaced relation upon the uprights 17. Such a rack may be adapted to support any num-

ber of sulphur-burning pans, depending upon the rate at which it is desired to burn the sulphur.

In Fig. 8 there is illustrated a means which may be substituted for the handles 20 and hooks 21 of the rack shown in Fig. 6. This device comprises a clutch member 22 of sheet metal hinged to the bottom of the pan at 23 and provided with an aperture 24 which is of slightly larger diameter than the upright 17 of the rack. The pans are equipped at each end with these clutch members 22, which are adapted to co-act with the uprights to support the pans in any desired position, as will be readily understood. By the use of this clutch supporting means, the pans may be spaced from each other at will, as is desired in order to obtain the proper relation for the desired rate of combustion. A further advantage of this means of support is that the pans may be readily dropped, one pan upon another, in order to extinguish the combustion of the suphur whenever it is desired to do so.

Numerous modifications of the apparatus illustrated in the accompanying drawings will at once present themselves to those skilled in the art. For example, a useful device to take the place of the ordinary sulphur fumigating candle could easily be made by constructing the rack or stand of Fig. 6 in diminutive form, and with the sulphur pans permanently attached to the uprights. A fumigating apparatus of this sort would be much more convenient for use, would be safer, and would be capable of fumigating a compartment more rapidly than the ordinary sulphur candle of commerce is capable of doing.

At the present time, oil-bearing sulphur is excluded from many places because of the difficulty of burning the same. It will be seen that the method of the present invention accomplishes the burning of oil-bearing sulphur with extraordinary facility, and with apparatus of great simplicity, which is also inexpensive.

I claim:

1. The method of burning sulphur containing small quantities of oil or other organic impurities which comprises igniting sulphur placed in a plurality of superposed receptacles each open to the atmosphere and so arranged that a substantial part of the heat of combustion of the burning sulphur is transmitted to an adjacent receptacle, thereby effecting the burning of substantially all of the sulphur contained in a plurality of the receptacles.

2. The method of burning sulphur containing small quantities of oil or other organic impurities which comprises igniting sulphur placed in a plurality of superposed receptacles so arranged that the products of combustion from each receptacle pass directly to the atmosphere, and disposed so that a substantial part of the heat of combustion of the burning sulphur is transmitted to an adjacent receptacle, whereby substantially all of the sulphur contained in a plurality of the receptacles is burned.

3. The method of burning sulphur containing small quantities of oil or other organic impurities which comprises igniting the sulphur contained in a plurality of separate open pans, and then placing the pans in superposed relation so that the heat of combustion of the burning sulphur is mutually transmitted between the pans in such quantity as to ensure the burning of substantially all of the sulphur in a plurality of the pans.

4. A sulphur burner comprising a plurality of open pans adapted to contain sulphur to be burned, said pans being stacked one upon the other in such manner that the products of combustion of the sulphur burning therein pass directly from each pan to the atmosphere, but at the same time permitting a mutual transmission between the pans of a substantial amount of the heat of combustion of the burning sulphur.

In testimony whereof I affix my signature.

WILLIAM HOFFMAN KOBBÉ.