July 17, 1923. 1,462,023

W. M. STRONG

OIL SHALE RETORT

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Fig. 1.

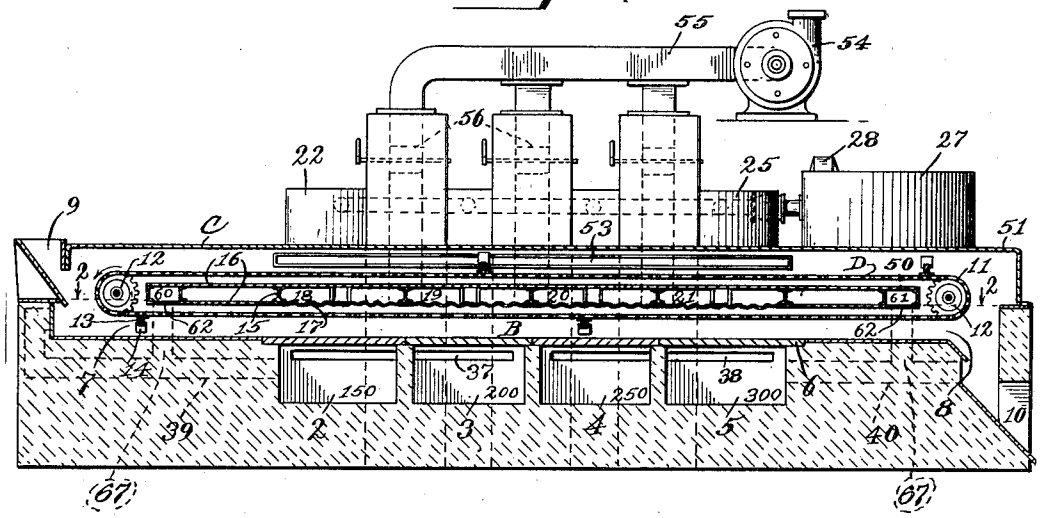
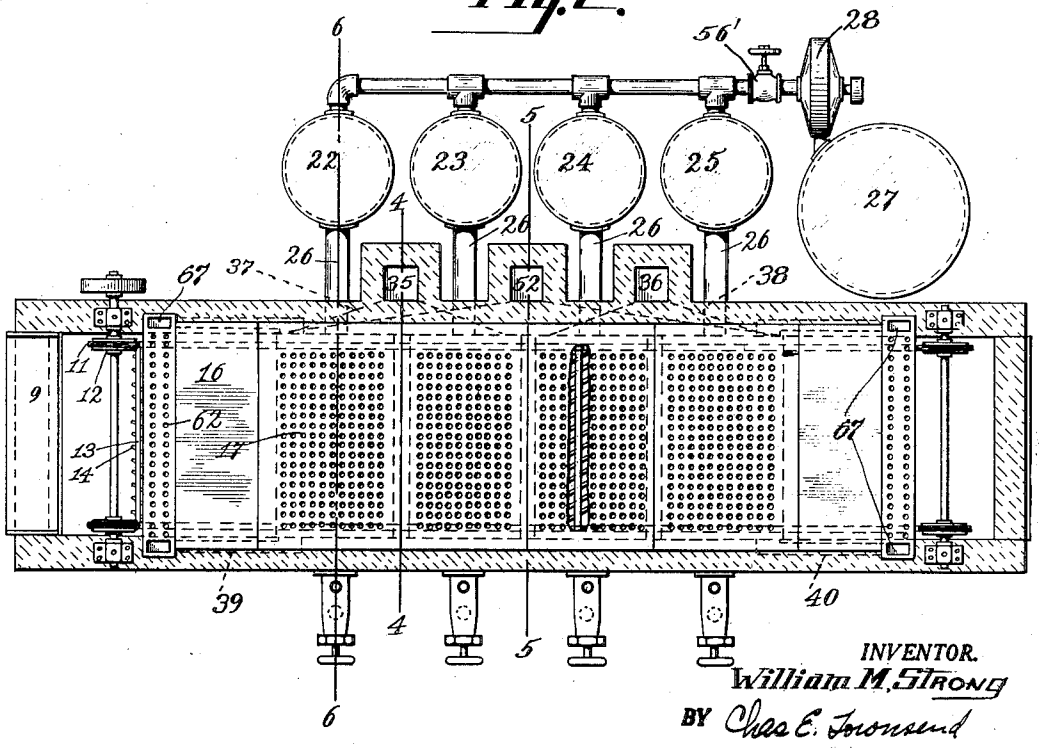


Fig. 2.



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Fig 4.

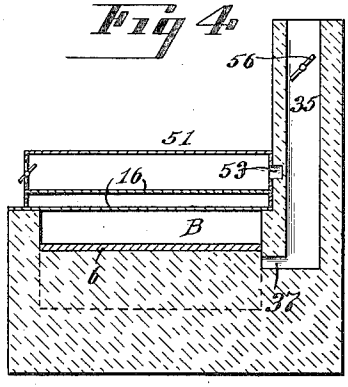


Fig 5.

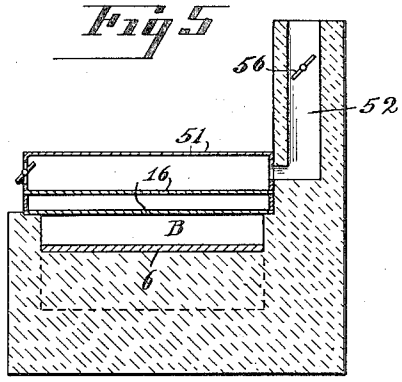


Fig 6.

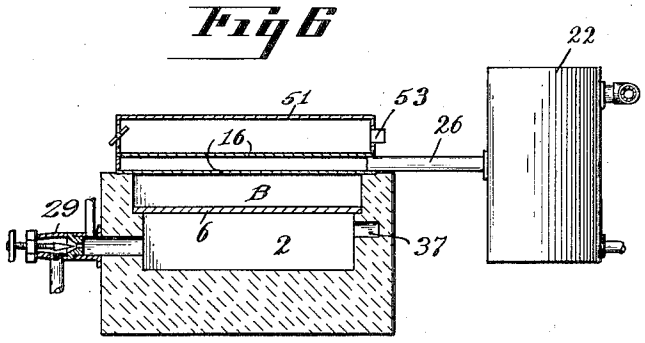
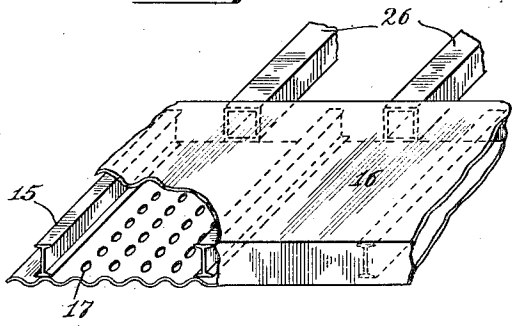


Fig 3.



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Patented July 17, 1923. 1,462,023

UNITED STATES PATENT OFFICE.

WILLIAM M. STRONG, OF SAN FRANCISCO, CALIFORNIA.

OIL-SHALE RETORT.

Application filed July 26, 1920. Serial No. 397,774.

To all whom it may concern:

Be it known that I, WILLIAM M. STRONG, a citizen of the United States, residing at the city and county of San Francisco and State of California, have invented a new and useful Improvement in Oil-Shale Retorts, of which the following is a specification.

This invention relates to an apparatus for obtaining oils, spirits, gasses, etc., from organic materials, such as oil shale and peats, containing petroleum, resins or oils, or from other materials.

In the process of extracting oil and petroleum products from Colorado and Wyoming oil bearing shales, various forms of air tight retorts have been tried and found inefficient and impracticable. This is due to several causes:

First: Destruction of the retorts by the high temperature required to volatilize the petroleum contents of the shale.

Second: The richer shales have a tendency to fuse and in this condition adhere to the sides of the retorts and clog the same.

Third: A great waste of time and labor is incurred due to the cumbersome methods required when loading and discharging the retorts.

Fourth: The capacity is small because of intermittent operation.

Fifth: Heat waste and losses are also encountered which materially reduces the general efficiency of plants of this character.

Sixth: The process of distillation of the petroleum contents of oil shale in the usual form of gas tight retorts results in a mixture of all distillates being obtained therefrom requiring refinery treatment in order to separate the several commercial products into gasoline, kerosene, lubricating oils, fuel oil, etc.

To overcome these objections and to provide a practical apparatus of simple design, in which oil shales of the character specified and other materials may be sufficiently and economically treated. I found that the following features or objects are desirable:

Continuous feed and discharge of the material.

Continuous movement and agitation of the material while subjected to heat.

Even distribution and the presentation of a comparatively thin layer of material while subjected to heat to permit uniform exposure of the same.

Instant removal by suction of all vapors and gases liberated.

Temperature variation and regulation throughout the furnace and distilling chamber permitting several "cuts" or separation of distillates being made during first treatment of shale.

Cooling of certain parts of the apparatus and mechanism employed.

Large capacity.

Exclusion of oxygen from the distilling chamber.

Draft control, etc.

With these features and objects in view, the invention also consists of the parts and the construction, combination and arrangement of parts as hereinafter more fully described and claimed, having references to the accompanying drawings, in which—

Fig. 1 is a longitudinal central vertical section through the apparatus.

Fig. 2 is a plan section taken on line 2—2, Fig. 1.

Fig. 3 is a perspective detail view partly broken away, showing one of the suction chambers through which the vapors and gases are removed.

Fig. 4 is a cross section on line 4—4, Fig. 2.

Fig. 5 is a cross section on line 5—5, Fig. 2.

Fig. 6 is a cross section on line 6—6, Fig. 2.

Referring to the drawings in detail, and particularly to Figs. 1 and 2, it will be seen that the lower portion of the apparatus is constructed of refractory material, such as fire brick or the like, as indicated at A, and that a distilling chamber B is formed which is housed in or partly inclosed by a superstructure or hood C consisting mainly of metal. The distilling chamber is formed directly above a series of furnace chambers indicated at 2, 3, 4 and 5, and the bottom portion of the distilling chamber consists of a metal plate 6, over which the material to be treated is passed. The distilling chamber is provided with an inlet opening 7, at one end and with a discharge opening 8 at the opposite end. The chamber is long when compared to its width and as such is capable of continuously handling a large volume of material. The material, for instance oil shale, is delivered to the inlet opening 7 by means of a hopper 9 and is then fed in a forward direction over

the plate 6 through the chamber B by means of an endless conveyor D, which finally delivers the material to the discharge opening 8 where it drops by gravity through an opening 10; a waste conveyor or other means not here shown being provided to remove the material. The conveyor consists of a pair of interspaced sprocket chains 11, which are carried by sprocket wheels 12 arranged at opposite ends of the chamber B. These chains are connected by bars 13 and these bars in turn carry blades or rabbles 14 which serve the function of advancing and agitating the material while passing through the chamber B.

The roof of the chamber B consists of transversely disposed I-beams 15, which are inclosed by upper and lower plates 16; the plates directly above the plate 6 being preferably corrugated and perforated as at 17 to receive the vapors liberated by the material during its passage over the plate 6. The I-beams 15 serve the function not only of supporting the plates 16 and 17, but also that of forming a series of intermediate chambers such as indicated at 18, 19, 20 and 21. These chambers are connected with the respective condensers 22, 23, 24 and 25, by means of flues or pipes 26 and the condensers are in turn connected with the gas tank and washer as at 27; a constant suction being maintained in the chambers 18, 19, 20 and 21, and the connected condensers by means of a suction and pressure blower 28 interposed between the condenser and the gas tank 27, any suitable type of condenser being employed.

By referring to Figs. 1 and 2, it will be seen that the respective furnace chambers 2, 3, 4 and 5, are provided with gas burners 29 supplied with fuel by the tank 27. This is obviously an advantage as it permits independent regulation and variation of temperature in the respective furnace chambers and also in the distilling chamber. For instance the material first entering the distilling chamber or passing over the plate 6 may first be subjected to a temperature of say approximately 150° C. As it advances the temperature may be increased, for instance to 200° C. when passing over the furnace chamber 3. To 250° C. when passing over the furnace chamber 4, and finally to 300° C. when passing over the furnace chamber 5. This permits a considerable temperature range with corresponding "cuts" of distillates and variation within the distilling chamber and volatilization of the petroleum products contained at predetermined temperatures. For instance lighter oils and gases will be liberated at the front end of the distilling chamber, intermittent products through the center portion thereof, and the heaviest products when the discharge end is reached. The different suction chambers 18, 19, 20 and 21, are thus receiving vapors and gases condensible at different temperatures and condensation thereof can therefore be easily regulated by the several condensers employed.

To permit a free discharge of the products of combustion produced in the several furnace chambers 2, 3, 4 and 5, are provided two stacks such as indicated at 35 and 36. The stack 35 communicates through a duct 37 with the chambers 2 and 3, while the stack 36 communicates with the furnace chambers 4 and 5 through a duct 38. The end chambers 2 and 5 are provided with auxiliary ducts 39 and 40, respectively. These ducts communicate with the inlet and discharge openings formed at the ends of the distilling chamber and with a chamber 50 formed above the suction chambers 18, 19, 20 and 21, by an inclosing hood 51. The function of the upper chamber 50 is threefold, first, that of removing air from the shale or material delivered; and replacing the air by gas from the combustion chamber. Secondly, that of removing gases or products of combustion escaping from the ducts 39 and 40, and third that of cooling the conveyor chains by passing fresh air through suitable openings in front of the hood over the conveyor chains, the bars 13 and the rabble blades 14 carried thereby. The chamber 50 is connected with a central stack 52 by means of a duct 53 and the three stacks are connected with a suction fan 54 by means of a pipe 55, a damper 56 being placed in each stack to regulate the draft or flow therethrough.

Further reference to Figs. 1 and 2 will show that a pair of end chambers 60 and 61 are provided. The bottom portion of each chamber is perforated as at 62 to form communication with the inlet and discharge openings, respectively. Each chamber receives products of combustion from the end furnace chambers 2 and 5 through ducts or passages 63 formed in the side walls of the apparatus and products of combustion may therefore enter the chamber 61 and discharge through the perforated bottom sections 62 thereof as will hereinafter be described; the purpose being, to provide combustion chamber gas in place of air entering at the ends of distilling chamber.

In actual operation shale broken to suitable size is delivered to the hopper 9, entering the forward end of the distilling chamber. The enclosed air in the mass of shale encounters hot gases in the form of products of combustion delivered through the chambers 60 and the ducts 39. These gases preheat the air and shale to a certain extent and drives out the air contained, due to the fact that the gases are travelling upwardly towards the chamber 50 due to the suction

maintained in the stack 52 by the suction fan 54. There is a constant flow of products of combustion through the duct 39 upwardly through the incoming mass of shale. This flow as stated is maintained by the suction blower 54 and serves the function of driving out air, replacing it with oxygen free gases, and also the function of preventing free oxygen of the air to any extent from entering the inlet or outlet end of the distilling chamber. A similar flow of hot gases or products of combustion is maintained through the duct 40. These gases pass through the discharging shale from which the petroleum products have been removed and serves the function of excluding air at this end of the distilling chamber. The products of combustion employed will also in this instance rise into the chamber 50 and will finally discharge through the duct 53 and stack 52 and pass out through the suction fan 54. Air containing free oxygen is in this manner excluded and the partially preheated mass of shale will finally reach the forward end plate 6 where the temperature of the shale is rapidly increased, the lighter oil products and gases being first liberated, then the intermediate products and finally the heaviest products when the rear or discharge end of the plate 6 is reached, this being due to the varying temperature of the plate maintained by the several furnace chambers, 2, 3, 4 and 5. The oil vapors, gases, etc., liberated from the heated shale are instantly removed by the suction maintained in the collecting chambers 18, 19, 20 and 21. They are thereby prevented from escaping either through the inlet or discharge end of the distilling chamber and are furthermore rapidly condensed as they are almost instantly delivered to the respective condensers shown at 22, 23, 24 and 25.

In actual practice it is possible that some of the vapors may partially or wholly condense directly in the collecting chambers just referred to. If such should be the case it is obvious that they would collect in the trough formed by the corrugated bottom section 17. These troughs will convey the distilled products to the respective pipes 26 and the connected condensers and leakage or return to the distilling chamber or plate 6 will thus be obviated. In actual practice it is of course essential to maintain a so called atmospheric balance between the distilling chamber and the respective ends of the chamber 50 as a certain amount of oil vapors and gases might escape through the inlet and discharge openings in the distilling chamber if the suction in the chamber 50 should be greater that that in the distilling chamber; or in the event of a more rapid liberation of vapor due to abrupt change from lean to rich shale. Conversely, a small amount of air or products of combustion might enter the distilling chamber through the respective inlet and discharge openings if the suction in the collecting chambers 18, 19, 20 and 21 should be in excess of that in the chamber 50, or more rapid than the volume of vapor liberated. A working balance must therefore be maintained between the two and this balance is maintained by regulating the velocity through the several ducts and suction fans by means of the dampers indicated at 56 and the valve 56′.

From the foregoing it should be obvious that a comparatively simple, compact, easily operated and controlled apparatus has been provided by which oil shales or other products may be efficiently and economically handled. Uniform exposure and heat of the material treated is maintained by exposing a thin moving layer thereof to the plate 6. Sticking or clogging is obviated; the amount of operators or labor required is small; heat losses are reduced to a minimum, due to the constant operation permitted and large capacity is certainly insured due to the general arrangement of design and mechanism employed for handling the material. High temperatures can also be maintained as the plate 6 is practically the only part of the apparatus which can be destroyed by heat action. This may be easily replaced from time to time if required. No other part of the apparatus or mechanism employed is subjected to heat destruction as these are not sufficiently exposed or heated. For instance, a constant draft is maintained through the chamber 50 from both ends and front. This cools the upper part of the structure and similarly the conveyor chains, bars, etc., passing therethrough. These members are only exposed to heat when passing through the distilling chamber, but are again cooled or materially lowered in temperature during passage through the upper chamber 50. Air oxygen exclusion is maintained by the novel arrangement of passing products of combustion through the incoming and outgoing material and air tight doors, stuffing boxes, etc. are thereby avoided, thus materially simplifying the structure as a whole.

While certain features of the present invention are more or less specifically illustrated, I wish it understood that various changes in form and proportion may be resorted to within the scope of the appended claims, similarly that the materials and finish of the several parts employed may be such as the experience and judgment of the manufacturer may dictate or varying uses may demand.

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

1. In an apparatus of the character de-

scribed a housing having a distilling chamber formed therein, a main inlet and outlet opening formed in the housing, a second inlet and outlet opening formed within the housing and communicating with the distilling chamber and the first named inlet and outlet openings, a furnace chamber formed in the housing below the distilling chamber, and ducts formed in the housing for maintaining a flow of furnace gases past said second named inlet and outlet openings to exclude air from the distilling chamber and to prevent oxidization of the products of distillation.

2. A retorting apparatus for oil shale and like products comprising a housing having a distilling chamber and a superposed chamber contiguous to the distilling chamber formed therein, an inlet and an outlet opening formed in the housing, said opening communicating with the distilling chamber and the second named chamber, a furnace chamber formed in the housing below the distilling chamber, ducts formed in the housing for maintaining a flow of combustion chamber gases past the inlet and outlet openings of the distilling chamber and directing said gases into the second named chamber, and means for maintaining an approximate balance of atmospheric pressure between the distilling chamber and the second named chamber.

3. In an apparatus of the character described a housing having a distilling chamber formed therein, a second chamber formed adjacent thereto, an inlet and an outlet opening formed in the housing, said openings communicating with the distilling chamber and the second named chamber, means for maintaining a flow of gases past the inlet and outlet openings into the second named chamber, means for maintaining an approximate balance of atmospheric pressure between the distilling chamber and the second named chamber, a plurality of collecting chambers formed intermediate the second named chamber and the distilling chamber, and perforated bottom sections in said intermediate chambers to quickly remove vapors and gases liberated in the distilling chamber.

4. In an apparatus of the character described a housing having a distilling chamber formed therein, a second chamber formed adjacent thereto, an inlet and an outlet opening formed in the housing, said openings communicating with the distilling chamber and the second named chamber, means for maintaining a flow of gases past the inlet and outlet openings into the second named chamber, means for maintaining an approximate balance of atmospheric pressure between the distilling chamber and the second named chamber, a plurality of collecting chambers formed intermediate the second named chamber and the distilling chamber, perforated bottom sections in said intermediate chambers to quickly remove vapors and gases liberated in the distilling chamber, an endless conveyor passing through the distilling chamber and the second named chamber, and feed members carried by said endless conveyor to deliver material to the distilling chamber to maintain it in constant movement while passing therethrough and to discharge the material from the distilling chamber.

5. In an apparatus of the character described a housing having a distilling chamber formed therein, a second chamber formed adjacent thereto, an inlet and an outlet opening formed in the housing, said openings communicating with the distilling chamber and the second named chamber, means for maintaining a flow of gases past the inlet and outlet openings into the second named chamber, means for maintaining an approximate balance of atmospheric pressure between the distilling chamber and the second named chamber, a plurality of collecting chambers formed intermediate the second named chamber and the distilling chamber, perforated bottom sections in said intermediate chambers to quickly remove vapors and gases liberated in the distilling chamber, an endless conveyor passing through the distilling chamber and the second named chamber, feed members carried by said endless conveyor to deliver material to the distilling chamber to maintain it in constant movement while passing therethrough and to discharge the material from the distilling chamber, a series of furnace chambers arranged below the distilling chamber, and means for regulating the temperature in each furnace chamber.

6. An apparatus for retorting shale and like products, comprising a housing having a distilling chamber formed therein, said housing having feed and discharge openings formed therein in communication with the distilling chamber, and also an outlet for the distilled products, a furnace chamber disposed below the distilling chamber, flues connected with the furnace directing the products of combustion past the feed and discharge openings of the distilling chamber to exclude entrance of air, and means for maintaining an approximate atmospheric balance between the furnace flues and the distilling chamber.

7. In an apparatus of the character described a housing having a distilling chamber formed therein, a metal plate forming the bottom of the chamber, an inlet and an outlet opening formed in the housing and communicating with the chamber, means for delivering material to be treated through the inlet opening, said means adapted to advance the material through the distilling

chamber and to discharge it therefrom, a series of furnace chambers formed below the plate, and means for regulating the temperature in each furnace chamber to gradually increase the temperature in the plate from end to end, a series of collecting chambers formed in the housing directly above the bottom plate and spaced therefrom, perforated plates forming a bottom section for each collecting chamber, and means for maintaining a suction in each collecting chamber to rapidly remove the products liberated by the material passing through the distilling chamber.

8. In an apparatus of the character described a housing having a distilling chamber formed therein, a metal plate forming the bottom of the chamber, an inlet and an outlet opening formed in the housing and communicating with the chamber, means for delivering material to be treated through the inlet opening, said means adapted to advance the material through the distilling chamber and to discharge it therefrom, a series of furnace chambers formed below the plate, means for regulating the temperature in each furnace chamber to gradually increase the temperature in the plate from end to end, a series of collecting chambers formed in the housing directly above the bottom plate and spaced therefrom, perforated plates forming a bottom section for each collecting chamber, means for maintaining a suction in each collecting chamber to rapidly remove the products liberated by the material passing through the distilling chamber, means for regulating the draft in the respective furnace chambers, and means for regulating the suction in the collecting chambers.

9. In an apparatus of the character described a housing having a distilling chamber formed therein, a metal plate forming the bottom of the chamber, an inlet and an outlet opening formed in the housing and communicating with the chamber, means for delivering material to be treated through the inlet opening, said means adapted to advance the material through the distilling chamber and to discharge it therefrom, a series of furnace chambers formed below the plate, means for regulating the temperature in each furnace chamber to increase by stages the temperature in the plate from end to end, a series of collecting chambers formed in the housing directly above the bottom plate and spaced therefrom, perforated plates forming a bottom section for each collecting chamber, means for maintaining a suction in each collecting chamber to rapidly remove the products liberated by the material passing through the distilling chamber, means for regulating the draft in the respective furnace chambers, means for regulating the suction in the collecting chambers, a chamber formed in the housing above the collecting chambers, said chamber communicating with the inlet and outlet openings of the distilling chamber, ducts forming a communication between the ends of the last named chamber and the furnace chambers, a communication between said chamber and the means for maintaining a suction in the furnace chambers, and means for regulating the suction in the last named chamber.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

WILLIAM M. STRONG.

Witnesses:
W. W. HEALEY,
A. M. HEALEY.