To all whom it may concern:

Be it known that I, DAVID T. DAY, a citizen of the United States, residing in the city of Washington, District of Columbia, have invented certain new and useful Improvements in Methods of Firing Retort Furnaces, of which the following is a specification.

This invention relates to a new fuel and a method of using the same to fire retorts in which a part of the material has been treated.

The improvement is directed to the use of the hot spent solid material from distillation retorts as part of the fuel to which fresh dust, and hence undesirable because it is dust, of the same original matter, is added. In this way, otherwise waste materials may be used to advantage as fuel, and the heat of the spent material is partially saved.

In the distillation of oil shale, it is customary to run crushed shale through a screw conveyor retort tube in a furnace. The crushing of the shale produces a mixture of lumps and dust, the latter material being relatively undesirable because it tends to clog the apparatus and become a sticky oil mud. The waste shale or “spent” shale as it is discharged from the retort is quite well exhausted of its volatilizable matter and is chiefly in the form of lumps of shale in which and on which carbon or coke has been deposited as a result of the destructive distillation within the retort. This spent shale as it leaves the retort is nearly dull red with heat, and about ready to burn as soon as sufficient air is provided. However, the coke deposited on the lumps will not burn with sufficient flame to satisfy the requirements of a fuel. On the other hand, fresh shale dust or fines contains sufficient natural fresh oil to burn with a substantial flame. This invention is therefore directed to combining hot spent shale and fresh shale dust so as to use the useful qualities of both of these otherwise waste materials. The resultant effect is a highly satisfactory fuel suitable immediately for heating retorts. The invention also includes details of the particular method of combining the hot spent shale with the fresh shale.

The above and other details and advantages are described and claimed in the following specification and claims, and one form of apparatus suitable for conducting the method and preparing the fuel is illustrated on the attached sheet of drawings, on which the single figure represents in vertical sectional elevation, a retort within a furnace, a separator for separating shale into fines and lumps, and a travelling grate onto which the hot spent shale and fines are deposited at substantially the same location.

Referring in detail to the apparatus which is illustrated rather diagrammatically, 1 indicates a receiving hopper for fresh shale such as comes from a crusher, not illustrated, and which is a mixture of dust and lumps. 2 indicates a rotary screen separator driven by a pulley 3 from any suitable source of power. The dust or fines which passes through the screen drops into a hopper 4 and through a pipe 48 to the outlet end 49 thereof within a fuel mixing hopper adjacent the furnace grate, as will be described. A valve 45 is positioned in the down pipe 48 to regulate the amount of fines deposited on the grate. Lumps of shale are discharged from the lower end of the separator into a hopper 5 positioned at the receiving end of the retort which will now be described.

The retort structure includes a furnace having the enclosing walls 6, with a fire box 7, and a stack 8. The front end of the furnace next adjacent the down pipe 48 and the hopper 5 is provided with a lower opening 66 in which is located a mixing hopper which will be described. Within the furnace walls and extending substantially horizontally above the fire box are the retort tubes in which the lumps of shale are to be treated. These tubes are indicated by an upper tube 9 and a lower tube 10, in which are respectively screw conveyors 9a and 10a, which in turn are operated by the respective gears 9b and 10b, located at the exterior of the furnace wall 6 and mounted on projecting ends of the conveyor shafts. A drive wheel 11 is secured to the shaft on which the gear 10b is mounted and serves to rotate the screw conveyors and is driven by any suitable source of power. It will be observed that the gears 9a and 10b are meshed together, and hence the gears must revolve in opposite directions and correspondingly cause the conveyors to feed in opposite directions.

Shale is admitted from the hopper 5 through an upper rotatable valve 12 to the adjacent end of the tube 9 and is passed through the length of that tube and finally...
dropped at the extreme opposite end into the conveyor tube 10, and thence passed in a reverse direction, to the left in the drawing, and finally discharged through the rotatable valve 13 into a fuel mixing hopper 14 and onto the top of a traveling grate.

The traveling grate 15 is illustrated diagrammatically and is preferably formed of a series of connected elements, thus forming a continuous grate. One end of it is mounted on a horizontally extending sprocket member end support 16, located adjacent the front opening 6, and preferably on the outside of the furnace wall. A corresponding end support 16 is located at the opposite end of the furnace and in such a position that the grate may discharge the spent fuel as the connected elements of the grate pass around the support 16. It will be understood that the front support 16 and the rear support 16 will be as wide as the width of the grate and that they may be likened to elongated cylindrical sprocket wheels or composed of a plurality of individual sprocket wheels arranged side by side and keyed on or revolving freely on a central supporting shaft extending horizontally transverse to the direction of movement of the grate bed. Such details do not form a part of the present invention, and are therefore not illustrated in detail. Power means, not indicated, may be applied to either of the supports 16 or 16, but is preferably applied to 16, because it is at the cooler portion of the furnace. Other supporting means may be used beneath the grate intermediate of 16 and 16, to support the weight of the grate according to the requirements of traveling grate furnace practice. A down chute 17 is positioned adjacent to and beneath the support 16, to collect the fuel discharged from the grate and deposit it in the ash pit 18, which latter may be reached from the exterior at the rear of the furnace through an opening 6 in the furnace wall.

The method of firing the retort and providing the fuel therefor will now be described. After the lumps of shale are introduced into the retort tubes they undergo destructive distillation effected by the heat from the furnace, and gases and vapors are led off through the pipe 8 to suitable condensers, not shown. The spent shale discharged from the lower tube and out through the valve 13 reaches the hopper 14 and grate 15 in a very hot condition. A substantial part of its volatilizable content has been driven off, and some of the material has been cracked in and on the lumps of shale. As a result the lumps are coated and impregnated with coke, which is in nearly red hot condition. This material, however, while it does not have much flame, is capable of providing great heat. As it is discharged from the valve 13 onto the hopper 14, fresh oil shale fines are admitted from the pipe 4. It will be observed that the lower end 4 of the fines inlet pipe terminates substantially directly below the spent shale discharge valve 13. The spent shale is dumped around and above the pipe end 4 and thus tends to keep the pipe end closed against the discharge of fresh shale until movement of the grate carries material away from the region of the pipe end, drawing along with it a portion of fresh shale from within the pipe. The movement of the grate thus serves to draw as much fuel as is needed from the hopper. By running the grate 15 at a speed such that it takes away the spent shale as rapidly as it enters the hopper, the mouth of pipe 4 may be thus kept free from accumulated hot shale and the fresh shale dust is allowed to slide out of the pipe 4 to supplement the hopper supply until the pipe end is buried again. Thus, a uniform level is maintained in the hopper which is desirable to insure a uniform bed on the grate. The mass of material within the hopper chokes off the passage of air and combustion is not free until the fuel is drawn away from the hopper to position in the fire box beneath the retort tubes.

The fines contain the full content of volatilizable material, and are capable of burning with sufficient flame to assist the hot spent shale in the heating of the retort. The fines do not serve as satisfactory fuel when used alone, and they are preferably not introduced into the retort tubes for reasons hereinafter stated, but when mixed with the hot lumps of spent shale, the resultant bed of fuel is sufficiently open for combustion to proceed rapidly. It is to be noted also that this method makes it possible to heat the fines much more quickly than would be possible if they were treated alone as fuel. The condition of the lumps of hot spent shale is due to the nature of the treatment in the retort. The distillation is conducted at intense heat and under conditions characterized by the absence of air or oxygen. If there were sufficient oxygen in the interior of the retort tubes, the material would probably begin to burn before it was discharged from the lower tube. As a result the lumps of spent shale are discharged in condition to immediately begin to burn, and the tendency to ignite is used to advantage by the addition of the flame providing fines.

I claim:

1. The method of firing retort furnaces, which method comprises, first, passing oil shale through a retort heated by a furnace and discharging the spent shale from the retort in hot condition, and secondly, using the hot spent shale as part of the fuel for the furnace by adding to it fresh oil shale and passing the mixture on a traveling grate through the furnace of the retort from
which retort the spent shale was discharged.

2. The method of firing retort furnaces, which method comprises treating fresh oil shale to separate it into fines and lumps, passing the lumps through a retort heated by a furnace, passing the spent shale from the retort, and using the fresh shale while yet hot together with the fresh shale fines as the fuel for the furnace.

3. The method of firing retort furnaces, which method comprises treating fresh oil shale to separate it into fines and lumps, passing the lumps into and through a retort heated from beneath by a furnace and thus subjecting the lumps of shale to a distillation treatment sufficient to separate the lumps, passing the hot solid material from the retort and onto a traveling grate, adding fresh shale fines to the solid material while yet hot, and passing the mixture through the furnace and beneath the retort.

4. A continuous method of firing retort furnaces, which method comprises treating fresh oil shale to separate it into fines and lumps, continuously passing the lumps into and through a retort heated from beneath by a furnace and thus subjecting the lumps of shale to a distillation treatment sufficient to separate the lumps, continuously passing the hot solid material from the retort and onto a traveling grate, continuously adding fresh shale fines to the solid material while yet hot, and continuously passing the mixture through the furnace and beneath the retort.

5. The method of firing retort furnaces, which method comprises treating fresh solid fuel to separate it into lumps and dust, passing the lumps through a retort heated by a furnace, passing the hot lumps so treated from the retort and onto a traveling grate, adding fresh fuel dust to the hot lumps, and passing the mixture through the furnace and beneath the retort.

6. The method of firing retort furnaces, which method comprises treating fresh solid fuel to separate it into lumps and dust, passing the lumps through a retort heated by a furnace, passing the dust to the lower end of an inlet pipe for dust terminating adjacent a traveling grate, passing the lumps from the retort and while yet hot and discharging them about the lower end of the dust inlet pipe, and using the hot lumps with the fresh dust from the inlet pipe as the fuel for the retort furnace.

7. The method of firing retort furnaces, which method comprises treating fresh oil shale to separate it into fines and lumps, passing the lumps through a retort heated by a furnace, passing the fines to the lower end of a fines inlet pipe terminating adjacent a traveling grate, passing the lumps from the retort as hot spent shale and discharging it about the lower end of the fines inlet pipe and onto the traveling grate, releasing fines from the inlet pipe and into the hot spent shale, and using the mixture of hot shale with the fresh dust as the fuel for the retort furnace.

8. The method of firing retort furnaces, which method comprises treating fresh oil shale to separate it into fines and lumps, passing the lumps through a retort heated by a furnace, passing the fines to the lower end of a fines inlet pipe terminating in a fuel mixing zone, passing the lumps of shale while yet hot from the retort and into the fuel mixing zone, releasing fresh shale fines from the inlet pipe into the interior of a pile of hot spent shale, moving the material thus mixed away from the mixing zone and using it as the fuel for the furnace.

9. The method of firing retort furnaces, which method comprises treating fresh oil shale to separate it into fines and lumps, passing the lumps through a retort heated by a furnace and thus subjecting the lumps of shale to distillation, passing the lumps of shale while yet hot from the retort and into a fuel mixing zone, releasing fresh shale into the interior of a pile of hot spent shale, moving the material thus mixed from the mixing zone and using it as the fuel for the furnace.

In testimony whereof I affix my signature.

DAVID T. DAY.