To all whom it may concern:

Be it known that I, LIGON B. ARD, 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 Apparatus for Treating Shale and like Material, of which the following is a description, reference being had to the accompanying drawings, forming a part hereof.

My invention relates to apparatus for treating shale and like material containing volatile matter to extract such volatile matter, and my invention has for its object to provide an apparatus for this purpose which will be simple and relatively inexpensive in construction, efficient and economical in operation, and by use of which the or other material may be discharged into a bath of molten metal at such depth below its surface that in rising to the surface it will be heated to the temperature necessary to drive off the volatile matter. A particular object of my invention is to provide means by which the upward movement of the material to be treated through the molten metal will be positively controlled so that, on the one hand, its upward movement will be insured and, on the other hand, its upward movement will not be too rapid to prevent its being efficiently heated.

With the above described objects and other objects hereinafter described in view my invention consists in the construction and combination of elements hereinafter described and particularly pointed out in the claims.

Referring to the drawings,

Figure 1 is a central vertical sectional view on an enlarged scale, of the upper portion of the retort embodying my invention showing the mechanism by which the material to be treated is crushed and introduced into the conveyor by which it is carried to the lower end of the retort.

Fig. 2 is a detail perspective view of the device for crushing the material to be treated and forcing it into the upper end of the conveyor, and

Fig. 3 is a central vertical sectional view of a complete apparatus embodying my invention.

In the drawings 1 indicates a retort which may be of any usual construction but is here shown as comprising a cylindrical body portion having flanges at its ends to which are suitably secured a bottom 2 and a top or cover 3, the top or cover being removably secured as by bolts 4. The bottom 2 is provided at its center with a pin 5 projecting upward adapted to serve as a bearing for the conveyor. The top or cover 3 has a central opening 6, and surrounding this opening and extending upward therefrom is a tube 7. At the inner end of the central opening 6 the top or cover 3 is recessed at 8 to receive the upper end of a tube 9 which extends nearly to the bottom of the retort. Within this tube 9 is arranged a screw conveyor 10. At its lower end this conveyor is mounted to rotate on the pin 5 extending upward from the bottom 2 of the retort, and secured to its lower end is a disk 11 provided at suitable points on its periphery with uprights 12 and 13 which carry the lower end of a tube 15 which extends to the top or cover 3, surrounding the tube 9 and suitably spaced therefrom except near its lower end where it is provided with a shoulder 16 to form a support and bearing for the lower end of this tube 9.

This tube 15 is provided with a helix or helical vane 17 of relatively thin metal extending nearly to the walls of the retort. This helix terminates a substantial distance below the top or cover 3 and, between the upper end of the helix and the top or cover is arranged a disk 20 carried by the tube 15 which serves to protect the upper bearings of the tubes 9 and 15 from spent material which might tend to accumulate about them. In the plane of the disk 20 an opening 21 is formed in the wall of the body of the retort for discharge of the spent material, and an opening is provided in the top or cover 3 leading to a pipe 28 through which the volatile matter driven off from the shale or other material treated may be carried off to be condensed into oil in the usual way.

The lower end of the tube 15 and the disk 1 are spaced apart a sufficient distance to leave an opening 22 for the free discharge of the material treated from the lower end of the conveyor.

The screw of the screw conveyor 10 and the helix 17 carried by the tube 15 are oppositely pitched so that when rotated together the screw conveyor will carry the material downward and the helix 17 will carry the material upward.

The tube 7 formed on the upper face of the top or cover 3 is provided on one side
with an opening 24 and about this opening is secured the lower end of a chute or hopper 25 for the material to be treated. Within this chute 26 is arranged a lining tube 26 preferably of specially hard steel, having an opening 27 on one side registering with the opening 24 in tube 7. Within this lining tube 26 is arranged a rotary crushing and feeding device 30 having formed thereon a helix 31 of the shape shown having its helices relatively wide apart and of relatively small diameter midway between its ends and approaching each other toward its lower end where they are of substantially the full diameter of the interior of the lining tube 26 so that the material may enter freely opposite the openings 24—27 and in relatively large pieces and being caught by the helices, will be forced downward and be caused to pass through the narrow passages between the helices at the lower end of the device so that the material will enter the upper end of the conveyor 10 in finely divided condition and will, by the conveyor, be forced downward through the tube 9 to be discharged through the opening.

The crushing and feeding device is of relatively massive construction and the inner or lining tube 26 is made removable so that it can readily be replaced when worn. This crushing and feeding device is carried by a stub shaft 32 which extends upward through a cap 33 removably secured, as by screw threading, on the upper end of tube 7. On the upper end of this stub shaft 32 is secured a bevel wheel 34 with which meshes a bevel pinion 35 on a driven shaft 36 carried in a bearing on an arm 37 secured to the tube 7.

The retort may be heated by any convenient means, not necessary to be shown, and is filled nearly to the level of the opening 21 with melted lead, sufficient heat being maintained to keep the lead in molten condition. The shale or other material to be treated is supplied by the chute or hopper 25 through the opening 24—27 to the crushing and feeding device by which the lumps, if any, are crushed by the downward pressure causing the material to pass through the relatively small openings at the base of the device, the material thus comminuted passing from the crushing and feeding device through the opening 6 to the screw conveyor by which it is forced downward to be discharged through the opening 29 into the molten lead by which it is quickly heated to the temperature necessary to drive off the volatile matter carried by it. When the material to be treated is very finely divided this heating to the temperature necessary to the complete driving off of the volatile matter takes place quickly but when less finely divided the process is necessarily slower. The helices 17 serve to somewhat retard the upward movement of the coarser particles of material through the melted lead, through which they rise because of their being of less specific gravity than the lead, and so insure their being fully heated through. The helices 17 also serve to carry upward through the melted lead any particles of material which by losing their volatile matter may become so high in specific gravity that they would rise through the melted lead less rapidly than might be desirable.

The lower helices 17 are preferably, as shown, nearer together near the bottom of the retort and wider apart toward the top thus causing a greater retardation of the material when first subjected to the action of the molten metal and permitting it to rise more rapidly as it approaches the top and becomes nearly or quite freed from volatile matter.

I do not herein claim the method of treating shale and like material carried out by the apparatus herein described as that method forms the subject of a separate application for patent filed by me on February 3, 1921, Serial No. 442,142.

Having thus described my invention what I claim is:

1. The combination with a heated retort containing molten metal, of a conveyor and means for rotating it arranged to deliver the material to be treated at a point near the bottom of the retort below the surface of the molten metal, and means for retarding the upward movement of the material through the molten metal comprising a helical vane surrounding the conveyor.

2. The combination with a heated retort containing molten metal, of a screw conveyor arranged to deliver the material to be treated at a point near the bottom of the retort below the surface of the molten metal, and means for retarding the upward movement of the material through the molten metal comprising a helical vane surrounding the conveyor and arranged to rotate with it, the screw of the conveyor and the helical vane being of opposite pitch.

3. The combination of a heated retort containing molten metal, of a screw conveyor extending downward into the retort and adapted to deliver material at a point near the bottom of the retort below the surface of the molten metal, and means for retarding the upward movement of the material through the molten metal comprising a helical vane surrounding the screw conveyor and arranged to rotate with it, the screw of the conveyor and the helical vane being of opposite pitch and the helices of the screw being nearer together at the lower end than at its upper end.

In testimony whereof I affix my signature this 2nd day of February, 1921.

LIGON B. ARD.