July 4, 1933. F. B. ALLEN 1,916,402

METHOD AND APPARATUS FOR HANDLING MOLTEN MATERIALS

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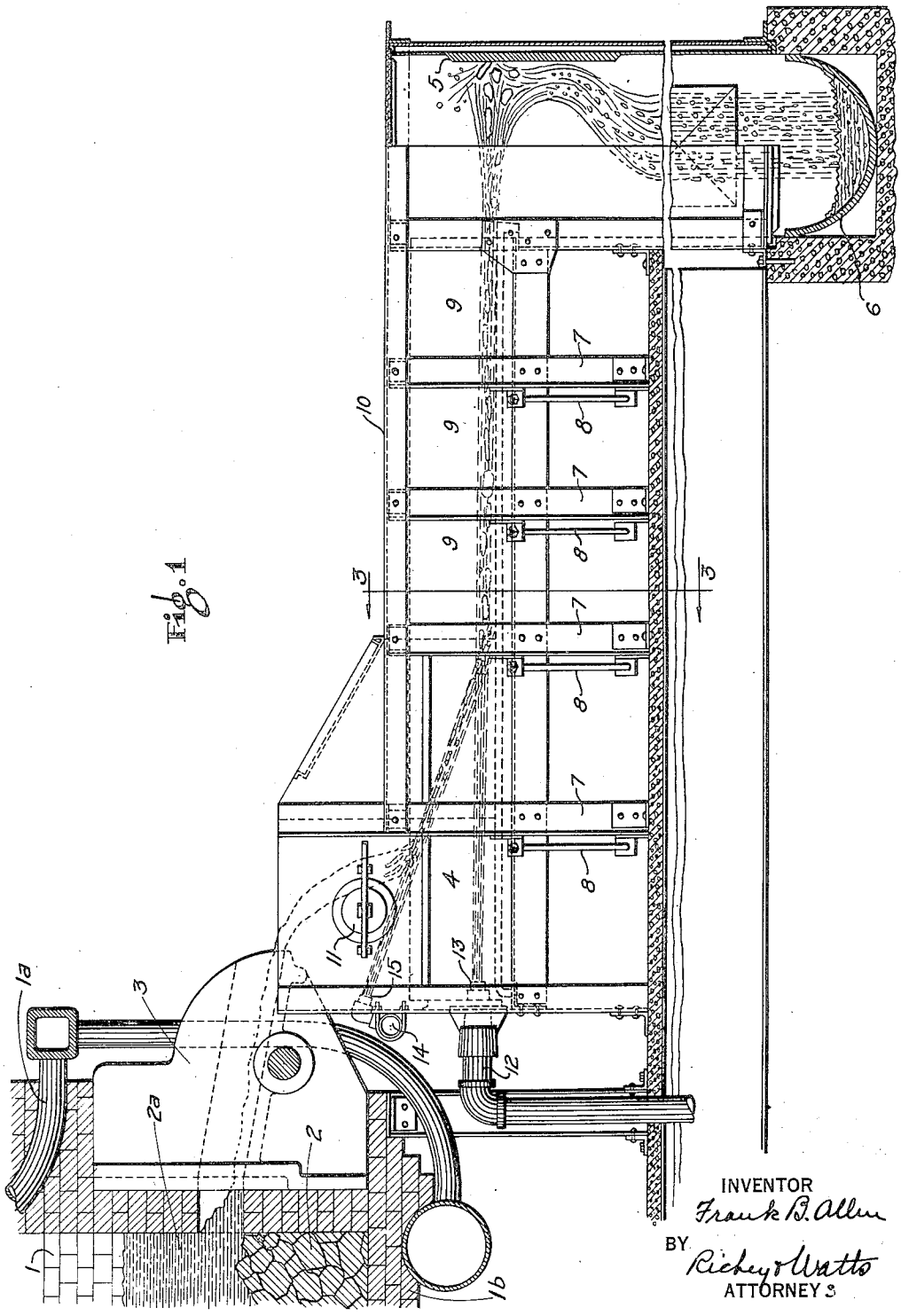


Fig. 1

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Fig. 3

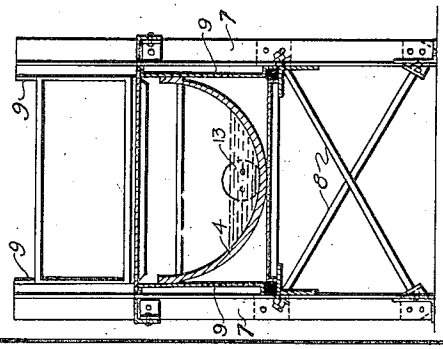


Fig. 2

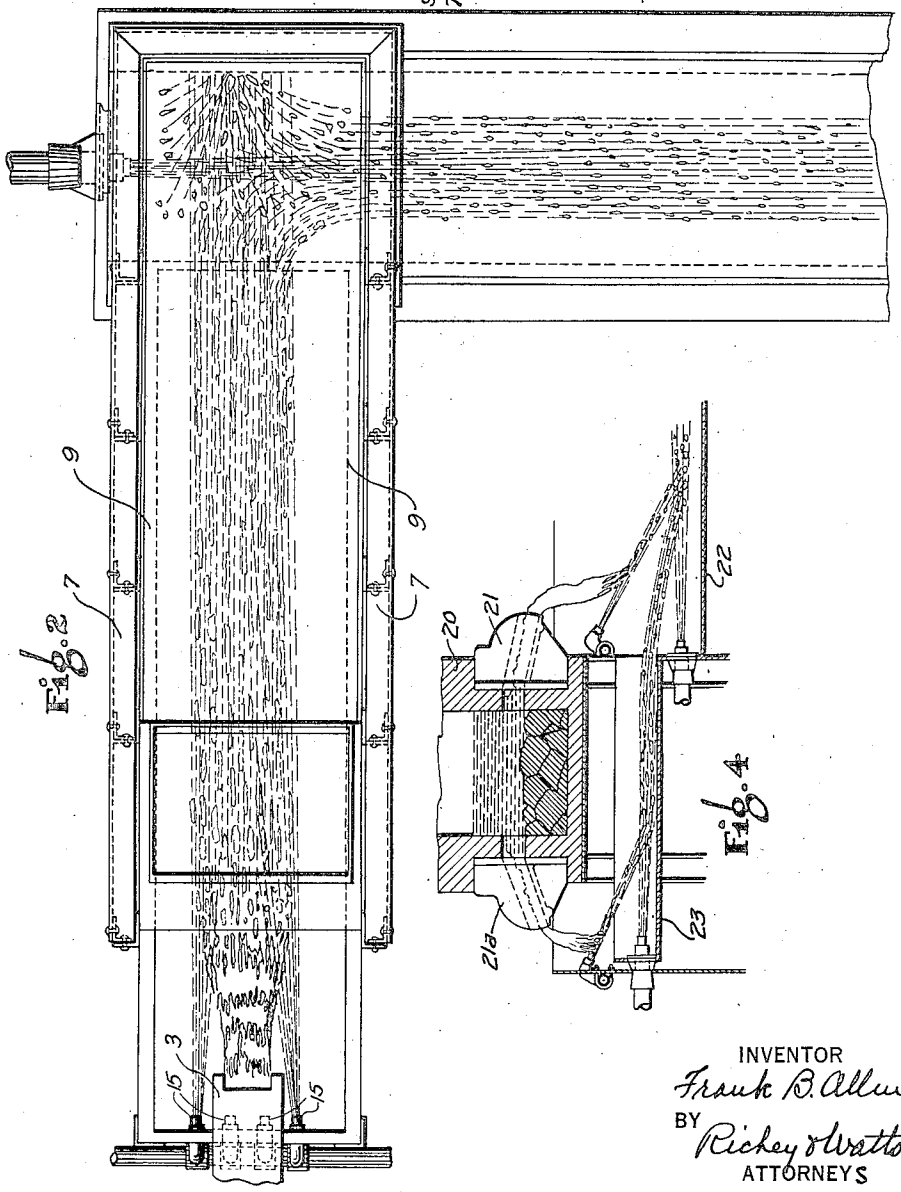


Fig. 4

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Fig. 5

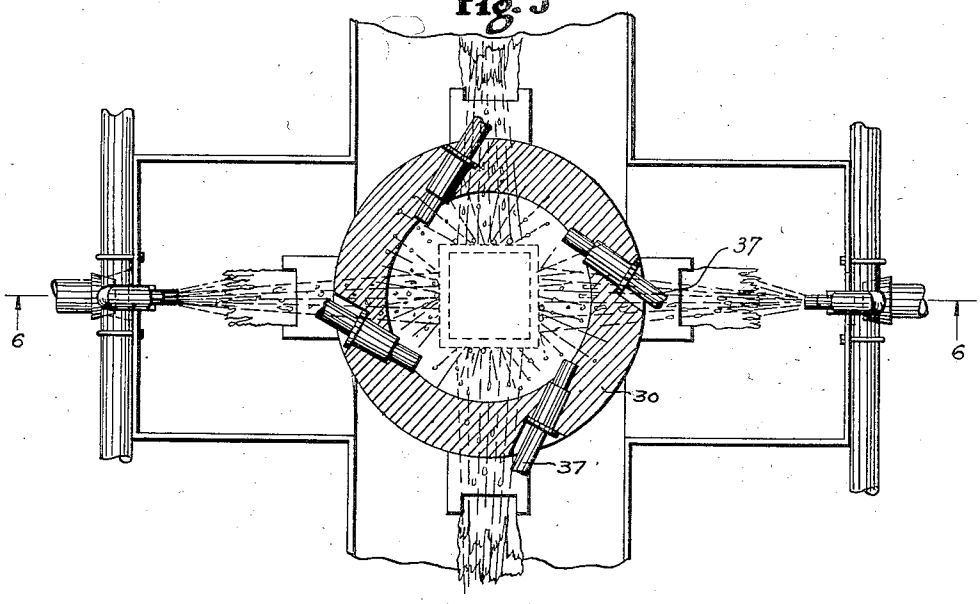
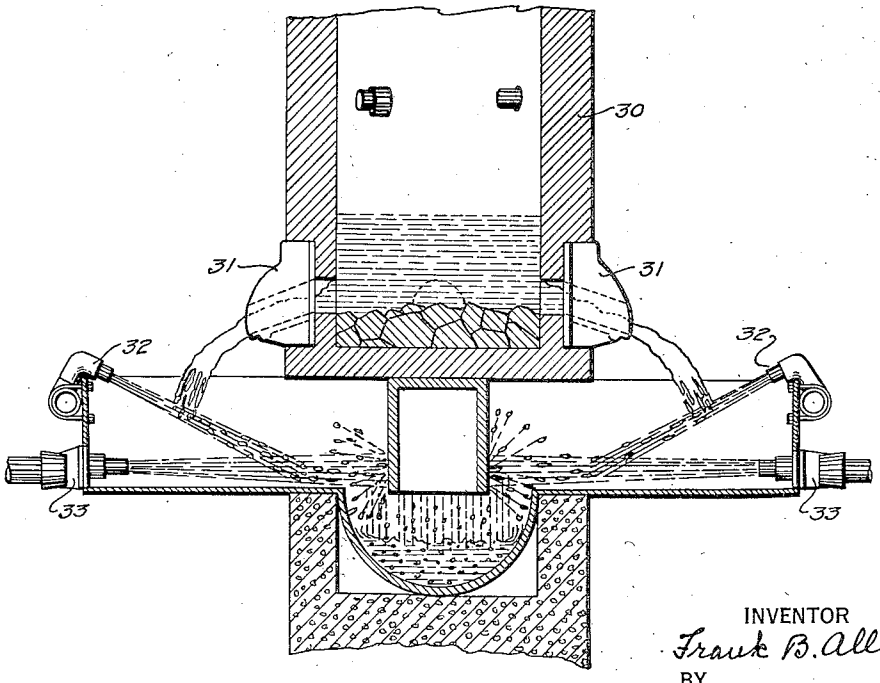


Fig. 6



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UNITED STATES PATENT OFFICE

FRANK B. ALLEN, OF LOWER MARION TOWNSHIP, MONTGOMERY COUNTY, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE ALLEN-SHERMAN-HOFF COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

METHOD AND APPARATUS FOR HANDLING MOLTEN MATERIALS

Application filed September 17, 1927. Serial No. 220,084.

This invention relates to the art of handling of molten materials. It relates particularly to the handling of incombustible residues including molten materials with or without solids which are frequently referred to as "slag".

One object of the invention is to provide a new and improved method of and means for handling materials of the class described by which the molten material may be converted into small-sized, solid particles, cooled and conducted to a place of disposal quickly and with a minimum of labor and equipment.

Prior to my invention the handling of molten materials such as slag from blast furnaces and powdered fuel burning furnaces and similar devices in which incombustible residues were encountered has presented difficulties. Often, the molten material has been tapped into a heated ladle and transported to a place of disposal. This is an expensive and slow method; it requires more or less labor and costly equipment which has to be maintained in serviceable condition at considerable cost; it is dangerous to laborers and moreover in many cases, for example more especially in powdered fuel burning furnaces, a considerable amount of head room must be provided beneath the combustion chamber to accommodate hoppers or the like to receive the material and to accommodate cars, ladles or the like to receive such material as it is discharged from the combustion chamber or hopper. Such head room is usually provided by elevating the combustion chamber which means a considerable cost in the cost of the furnace house construction.

Another expedient resorted to, especially in powdered fuel burning furnaces, has been to solidify the molten residues in the combustion chamber or in a hopper therebeneath and then periodically remove it. This expedient often requires considerable labor to remove the hardened "slag" from the walls of the chamber to which it has adhered and break it up into pieces of such size as may be conveniently handled for disposal. The necessity for some head room is present in such method and apparatus.

According to my improved method, the handling of such materials is much less expensive than such prior methods since the accumulation of several hours' furnace operation is removable in a few minutes with a very little labor or danger and with simple apparatus which requires only minor attention and maintenance, and without the necessity of providing hoppers in addition to the combustion chambers. Furthermore my improved method and apparatus not only enables me to dispense with such hoppers and associated parts as heretofore were required but results in a saving of the head room required for the same which in turn saves the cost of furnace house construction heretofore required by such prior devices which cost in many instances greatly exceeds the cost of my improved apparatus.

In the drawings accompanying and forming a part of this application and in which I have illustrated one form of apparatus embodying my invention and in which my improved method may be practiced

Fig. 1 is a side elevation showing one form of apparatus embodying my invention associated with a powdered fuel burning furnace.

Fig. 2 is a top plan view of the apparatus of Fig. 1.

Fig. 3 is a vertical cross sectional view taken on line 3—3 of Fig. 1.

Fig. 4 is a fragmentary showing of a modified form of apparatus embodying my invention.

Fig. 5 is a top plan view, partly in section, of another form of apparatus embodying my invention, and,

Fig. 6 is a vertical sectional view taken on line 6—6 of Fig. 5.

In the particular apparatus embodying my invention and illustrated, in Figs. 1, 2 and 3, fragmentarily, a portion of the cylindrical combustion chamber 1 of a powdered fuel burning furnace having water cooled side walls, parts of the water tubes for one of such walls being indicated by reference character 1*a* in Figure 1.

The combustion chamber is provided with tangentially disposed burners so as to project the flames into the chamber and to cause a whirling of the fuel around and around in

the chamber until substantially complete combustion is accomplished. During combustion the incombustible residues such as molten slag, ash and the like fall to the bottom of the chamber where they collect and where a quantity is allowed to solidify for the purpose of protecting the bottom wall 1*b* of the chamber from the flames because of the difficulty of efficiently cooling such wall. This accumulated and solidified refuse is indicated at 2, while the refuse in molten or fluid form that is to be removed is indicated at 2*a*. The chamber 1 is provided with a spout 3 through which molten material 2*a* may be tapped as and when desired. The residue including molten material passing out through the spout 3 is permitted to fall freely from the end of the spout under the influence of gravity in a substantially unbroken or continuous stream toward a substantially horizontal sluiceway 4 which is semi-circular in cross section. In the present embodiment of my invention the sluiceway 4 is open at the top adjacent said spout for all its remaining length. This sluiceway 4 may be extended to the place of disposal of the residues as will readily be understood, but as illustrated here it is intercepted by a transverse end wall 5 beneath which another substantially horizontal sluiceway 6 is disposed at an angle to the sluiceway 4 so that material passing along the sluiceway 4 may be intercepted by the cross wall 5 and deflected thereby into the sluiceway 6 along which it may then be moved to a place of disposal. Although the sluiceways 4 and 6 are shown as substantially semi-circular in cross-section they may be circular or may have other desired and cross-sectional configurations.

The sluiceway 6 is here shown as being disposed beneath the floor level of the boiler house and does not require any extra head room and it will be understood by those skilled in the art that the sluiceway 4 may be similarly placed below the floor level, if desired and permitted by the shape and location of the spout 3. As is shown, however, sluiceway 4 is carried above the floor on a structural framework consisting of uprights 7 in the form of angles suitably braced as by rods 8 and provided with the necessary side walls 9 and top walls 10 which as shown may take the form of cast iron plates. Adjacent to the spout 3 the side walls 9 are extended up to about the level of spout 3 and in this extended portion is provided with one or more hand holes 11 suitably covered to permit access to the interior of the sluiceway and to the end spout 3. In the end wall of the structure and sluiceway beneath the spout 3 is provided a pipe 12 having a nozzle 13 disposed to discharge fluid, and preferably water, under pressure into the interior of the sluiceway 4 close to the bottom thereof so as to form a fluid conveyor travelling at high velocity. When water or other liquid is used for this conveyor it is preferably discharged through nozzle 13 under pressures ranging from about 50 to 130 pounds pressure per square inch depending on the nature and amount of residues to be handled and the length of the sluiceway. When long sluiceways are used more than one nozzle similar to nozzle 13 may be employed. Also at the end wall is provided another pipe 14 having one or more nozzles 15 through which fluid under pressure may be discharged in the form of a jet of a width equal to or greater than the width of the stream of material flowing through the spout 3 and directed at an angle to the direction of the stream so as to intercept it. The pressure employed in nozzle 15 may be the same as that in nozzle 13 but usually is much less since it serves to break up the material into globules while the fluid from nozzle 13 serves to transport the material considerable distances.

In operation the residues of combustion in the combustion chamber are accumulated over a considerable period of time, for example, for several hours, and maintained in a more or less molten condition, that is, all the material may be molten or only a part of it with the unmelted part mixed therewith. Periodically this refuse is tapped out through the spout 3 and is permitted to fall freely in a stream toward the sluiceway 4. As it flows from the spout in a more or less continuous stream, jets of fluid under high pressure are delivered from nozzles 15 thereagainst, the stream being diverted thereby from its more or less vertical course, widened laterally with consequent thinning and is broken up into small globules with much of it being drawn out into fine threads which are partly cooled. The material consisting of these globules and threads and any solids that may be mixed therewith are received on the swiftly moving fluid conveyor formed in sluiceway 4 by the fluid discharged under high pressure from the nozzle 13, they are congealed, and all the material is rapidly cooled and transported along sluiceway 4 and into contact with the cross wall 5 which breaks it up into small pieces and deflects it down into sluiceway 6 where a fluid conveyor similar to that formed by the fluid discharged from jets 13 conducts it to a place of disposal at which time its temperature has been reduced approximately to or below 200° F. This cooled refuse material may then be used for fill or delivered to cars for transportation to a place of final disposal.

As the flow of slag from the furnace decreases, the stream often tends to solidify in or just below the spout. Such solidifying material may be detached from the spout and let fall into the sluiceway 4 where it will be

shattered into small pieces when it strikes cross wall 5.

It is often desirable to have more than one tap hole and spout for withdrawing slag from a furnace and accordingly I have shown in Figures 4 and 5 two alternative arrangements for such purpose.

In Figure 4, the furnace 20 has two spouts 21 and 21*a* on opposite sides of the furnace. Spout 21 discharges into a sluiceway 22 corresponding to sluiceway 4 of Figure 1. Spout 21*a* discharges slag in the opposite direction, the slag being intercepted and diverted by jets 23, and in disintegrated form or in the form of globules and threads is received on a fluid conveyor in a suiceway 24 which may be a continuation of sluiceway 22. The sluiceway 22 may discharge into a sluiceway such as 6 after contacting with a wall such as 5.

In Figures 5 and 6 the furnace 30 has several spouts 31 through which slag may be tapped. Jets 32 of considerable pressure disintegrate and divert the slag back under the furnace and jets 33, if needed, may be used to assist water from jets 32 to carry the slag along sluiceways 34. Obstructing walls 35 similar to wall 5 are provided to break up the globular and thread-like slag and divert it into sluiceway 36 which resembles sluiceway 6 of Figure 1. The burners of furnace 30 are shown at 37.

It will thus be seen that I have provided an extremely simple and expeditious method of handling the molten and/or solid residue of combustion which has heretofore been attended with considerable difficulty and danger; and also that my improved apparatus for handling such material is simple to construct and easy to operate with a minimum of labor since it is accomplished almost entirely by fluid under pressure, and which, due to its construction and its lack of moving mechanical parts requires substantially no maintenance.

Having thus described my invention so that those skilled in the art may be enabled to practice the same what I desire to secure by Letters Patent is defined in what is claimed.

What is claimed is:

1. The method of handling incombustible residues of combustion including molten material which comprises collecting such materials during a considerable period of combustion, periodically withdrawing such collected materials and permitting them to fall freely in a substantially continuous or unbroken stream, impinging a jet of liquid under pressure against the said stream thereby widening laterally and thinning the stream and breaking up the molten material into globules, directing a second jet of liquid under pressure into said first named jet, causing the material to strike an abutment and then receiving said material on a rapidly moving liquid jet conveyor thereby further cooling and conducting the material to a place of disposal.

2. Apparatus for handling molten residues resulting from the combustion of fuel which comprises in combination, means for collecting such material and maintaining it in a molten condition, means for withdrawing periodically such molten material in a stream, means for discharging liquid under pressure against a stream of the molten material in a manner to divide the stream of material into globules and threads in a partly cooled condition, means including a second high pressure liquid stream directed into said first named liquid stream and an abutment for further cooling and breaking up the said partly cooled material into a finely divided condition, and means for conveying said material to a place of final disposal including a swiftly moving fluid conveyor.

3. A method of handling viscous molten material resulting from the combust on of fuel comprising collecting the material during a considerable period of combustion, periodically permitting the material to fall in a stream, directing a high velocity stream of liquid against said falling stream of molten material to form partly congealed globules and threads of said molten material, d recting a second high velocity stream of liquid into said first named high velocity stream, breaking said globules and threads into smaller particles by impact with an abutment and conveying them to a place of disposal.

4. A method of handling viscous molten material resulting from the combustion of fuel comprising collecting the material during a considerable period of combustion, periodically permitting the material to fall in a stream, directing a high velocity stream of liquid against said falling stream of molten material to form partly congealed globules and threads of said molten material, directing a second stream of high velocity liquid into said first named stream of high velocity liquid, further cooling said molten material in said second stream of high velocity liquid, breaking the globules and threads into smaller particles by impact with an abutment and conveying them to a place of disposal.

5. A method of handling viscous material resulting from the combustion of fuel which comprises flowing the material in a stream, dividing the stream hydraulically into globules and threads and congealing the same in a series of successively impinging jets of liquid, reducing the congealed material to a finely divided condition by impact against an abutment and conveying the material to a place of disposal.

6. A method of handling molten material resulting from the combustion of fuel comprising directing a high velocity stream of

liquid against a falling stream of said molten material whereby said material is divided into partly congealed globules and threads, conveying said material in a second high velocity stream of liquid and further breaking up said partly congealed material.

7. A method of handling viscous molten material resulting from the combustion of fuel which comprises flowing such material in a stream, directing a jet of liquid under pressure into the stream and thereby dividing the stream into globules and threads and partly congealing the same, further cooling the divided particles of material in a second swiftly moving jet of liquid and reducing all of such material to a finely divided condition by impact against an abutment.

8. Apparatus for handling molten incombustible material resulting from the combustion of fuel which comprises in combination means for collecting and maintaining molten the said material, means for periodically withdrawing the molten material in a stream, means for directing a jet of liquid against said stream of molten material for breaking up the molten material into partly congealed particles and continuing the movement of the material, an abutment, means including a second high pressure stream of liquid directed into the path of said first named jet of liquid for further cooling said material and causing it to strike said abutment, and means for conducting the broken particles to a place of disposal.

9. Apparatus for handling molten residues resulting from combustion which includes in combination, means for collecting such molten residues, means for withdrawing such molten residues in a stream, means for discharging liquid under pressure against the stream of the molten residues in a manner to divide the stream into globules and threads in a partly cooled condition, means, including a second high pressure liquid stream directed into said first named liquid stream and an abutment, for further cooling and breaking up the said partly cooled material into finely divided condition, and means, including a swiftly moving fluid conveyor, for conveying said material to a place of disposal.

10. Apparatus for handling molten material which includes in combination, means for causing said molten material to flow in a stream, means for directing a jet of liquid against said stream of molten material for breaking up the molten material into partly congealed particles and continuing the movement of the material, an abutment, means including a second high pressure stream of liquid directed into the path of said first named jet of liquid for further cooling said material and causing it to strike said abutment and means for conducting the broken particles to a place of disposal.

In testimony whereof I hereunto affix my signature this 12th day of September, 1927.

FRANK B. ALLEN.