June 22, 1965 C. JACKLIN 3,189,944

PELLET FORMING APPARATUS

Filed July 6, 1962 3 Sheets-Sheet 1

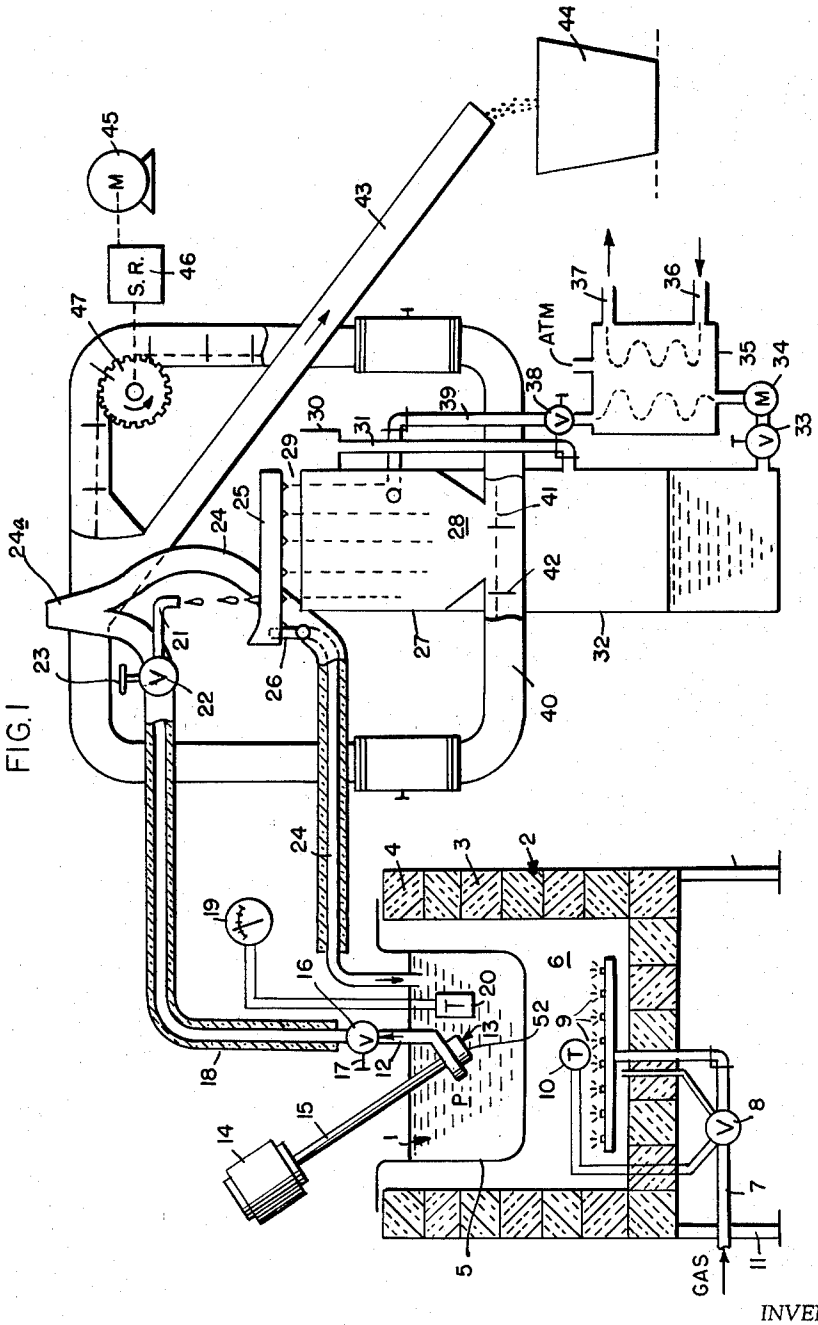


FIG. 1

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PELLET FORMING APPARATUS

Filed July 6, 1962 3 Sheets-Sheet 2

FIG. 2

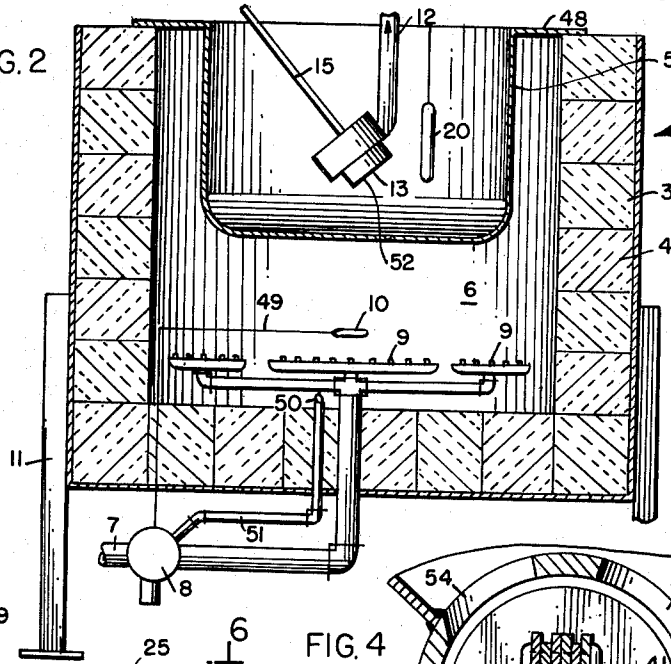


FIG. 3

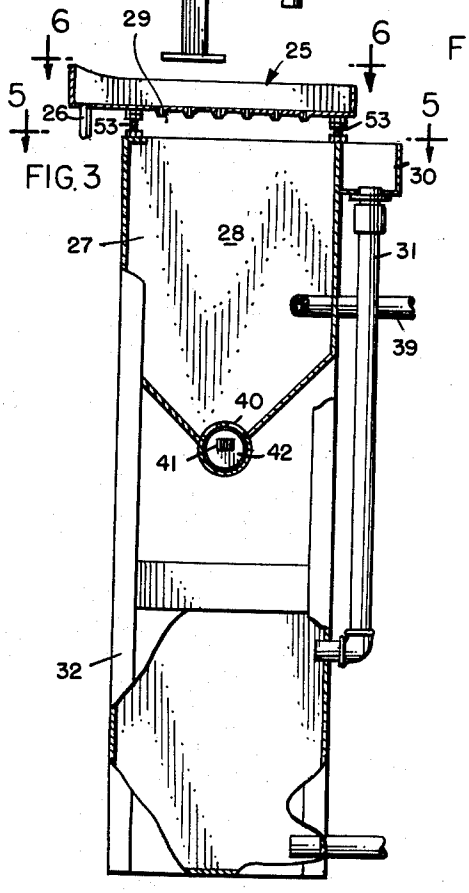


FIG. 4

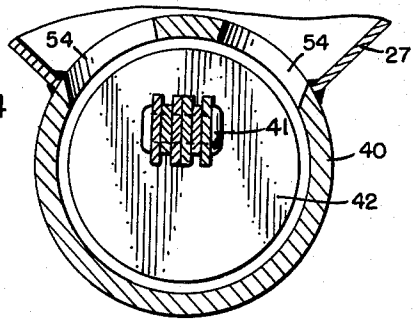
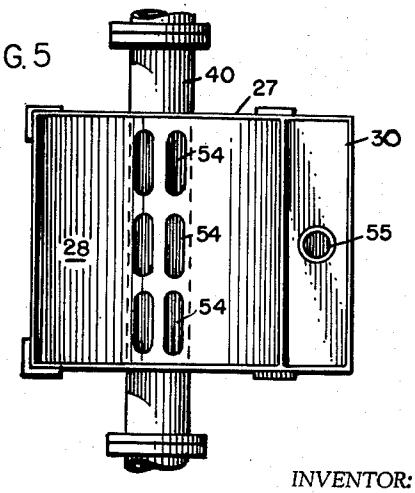


FIG. 5



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June 22, 1965 C. JACKLIN 3,189,944

PELLET FORMING APPARATUS

Filed July 6, 1962 3 Sheets-Sheet 3

FIG. 6

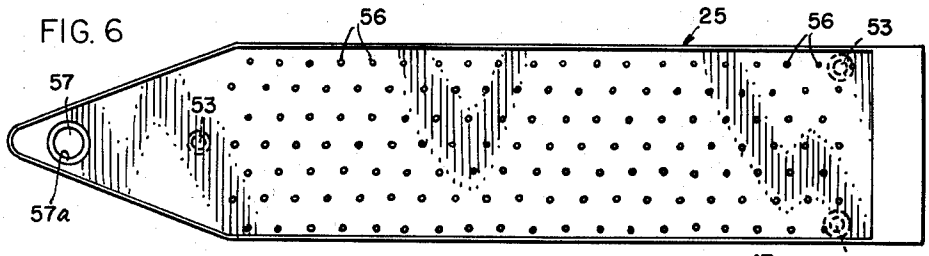


FIG. 7

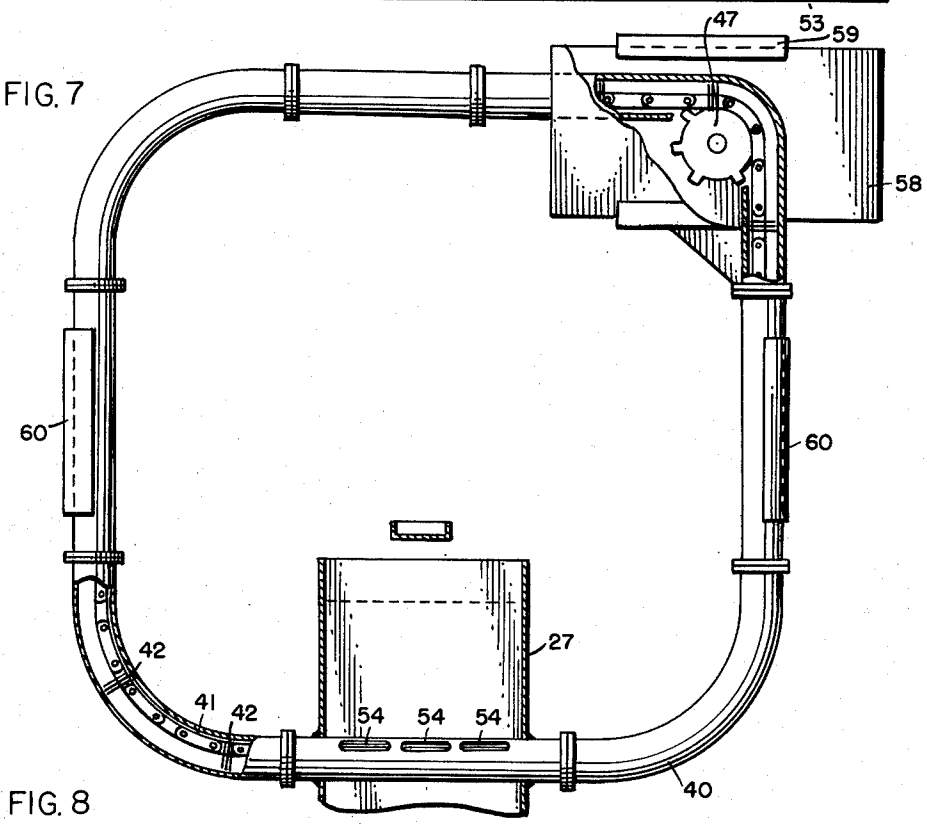


FIG. 8

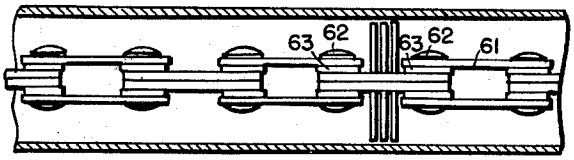
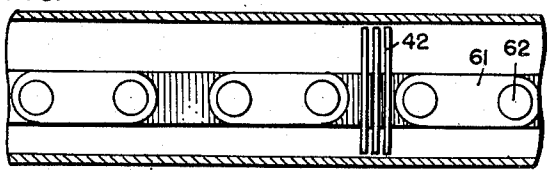


FIG. 9



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3,189,944

PELLET FORMING APPARATUS

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Filed July 6, 1962, Ser. No. 207,982
4 Claims. (Cl. 18—2.7)

The present invention is directed to apparatus for forming lead pellets. More particularly, the invention is directed to improved apparatus for forming lead pellets having smooth surfaces, which pellets are satisfactory for use in most commercial operations.

In the conventional method of forming lead pellets molten beads of lead are dropped from shot towers into quenching tanks. The height of such towers generally is from about 85 to 125 feet. The beads solidify in the air before entering the quenching liquid. Towers of this type were used in order to form pellets having desirable shapes and smooth surfaces. Although such shot towers produce satisfactory pellets, this equipment takes up a considerable amount of space and represents a substantial capital outlay. Furthermore, such equipment is not adaptable for use in a continuous operation.

The principal object of the present invention is to provide improved apparatus for forming lead pellets.

A more specific object of the invention is to provide apparatus which can be used to carry out a continuous pellet forming operation.

Another object of the invention is to provide apparatus for forming lead pellets which is highly efficient.

Still another object is to provide relatively inexpensive apparatus which is capable of producing highly satisfactory lead pellets.

The invention can best be understood by reference to the attached drawing in which

FIGURE 1 is a schematic view of the pellet forming device;

FIGURE 2 is a schematic cross-sectional view of a melting plot which can be used in maintaining the lead in a fluid condition;

FIGURE 3 is a detailed cross-sectional view of the lead forming tray and quench tank of FIG. 1;

FIGURE 4 is a detailed cross-sectional view of the quench tank and conveyor pipe assembly shown in FIG. 3;

FIGURE 5 is a top view of the quench tank and conveyor pipe assembly shown in FIGS. 3 and 4;

FIGURE 6 is a top view of the pellet forming sieve tray which is used to form the lead pellets;

FIGURE 7 is a detailed elevational view partly in section of the conveyor pipe shown in FIG. 1;

FIGURE 8 is a top detailed view of the conveyor chain which is used to carry the pellets from the quench tank to the discharge vessel; and

FIGURE 9 is a side view of the conveyor chain assembly shown in FIG. 8.

In FIG. 1, lead 1 is kept in a molten condition by means of gas-fired, thermostatically-controlled, melting furnace 2. Furnace 2 includes an outer jacket 3 which is lined with firebrick 4. The lead is maintained within metal pot 5 at a temperature of from about 650° F. to about 800° F., and preferably from about 700° F. to about 750° F. The pot is separated from firebrick 4 by gas space 6. Gas flowing through pipe 7 is regulated by valve 8 whereupon it passes to burners 9. Thermostat 10 controls the amount of gas passing through valve 8. The furnace structure is supported by legs 11.

Lead within pot 5 is pumped through discharge line 12 by means of pump 13 which is set in motion by motor 14 acting through shaft 15. Lead restricting valve 16 within line 12 controls the lead flow without a shutoff.

The valve is adjusted by valve stem 17. Discharge line 12 is wrapped with a suitable insulating material 18. The temperature of the lead is controlled by regulator 19 which acts in accordance with stimuli received from temperature control bulb 20. Lead flowing from pot 5 through line 12 passes to tray filling nozzle 21. The amount of lead entering nozzle 21 is controlled by valve 22 which in turn is regulated by valve handle 23. Lead overflows from line 12 into return line 24. A constant head is maintained on valve 22 regardless of the particular lead flow rate by means of stand pipe 24*a*. The stand pipe is open to the atmosphere. The vertical distance between the valve 22 and the Y juncture between line 12 and line 24 can be from about 4 to 8 inches, and preferably is about 6 inches. In a specific embodiment, the discharge line is an iron pipe having an internal diameter of 5/8", and the return line is an iron pipe having an internal diameter of about 1". The stand pipe is a continuation of the return line which has been curved to form an inverted Y.

Lead from nozzle 21 fills dropping tray 25 to a predetermined level. Overflow from the tray flows through tube or line 26 and into lead return line 24. Tube 26 extends into tray 25 to a height of from about 1/8" to about 3/8", and preferably about 1/4". Within the tube is a movable sleeve (to be shown in a later figure) by which the height of the lead in the tray can be controlled. This overflow system makes it possible to hold a constant head on the drop forming holes. Lead within tray 25 passes through drop forming holes in the bottom of the tray and into quench tank 27. The preferred temperature of the lead in the dropping tray is from about 625° F. to about 700° F. The drops of lead are hardened into smooth and substantially spherical pellets by contact with quench liquid 28 within tank 27. The temperature of the quench liquid generally will be from about 0° C. to about 50° C., and preferably from about 15° C. to about 25° C. The uniformity and smoothness of the pellets decreases when the quench liquid temperature is above 50° C. The distance 29 between the exit opening of the holes in the bottom of tray 25 and the surface of quench liquid 28 can be varied from about 1 inch to about 4 inches, and preferably from about 2 to 2¼ inches. Suitable quench liquids would include hexylethyl carbitol and other carbitols and Cellosolve type hydroxy ethers having the general formula

$$RO(—CH_2CH_2O—)_xH$$

where R is a lower alkyl radical having from 1 to 4 carbon atoms or a phenyl group, and x is 1 or 2.

Quench liquid 28 is circulated by means of overflow trough 30, pipe 31, to reservoir tank 32. Liquid within the reservoir tank is pumped through valve 33 into heat exchanger 35 by means of pump 34. The quench liquid is cooled in the exchanger by means of water which passes through inlet pipe 36 and outlet pipe 37. Cooled quench liquid flows through valve 38 and line 39 to quench tank 27.

The pellets which are hardened by quench liquid 28 are funnelled from the bottom of tank 27 into conveyor pipe 40. The pipe is open at its contact point with tank 27. Conveyor chain 41 and discs 42 (which are to be shown in detail in subsequent figures) carry the pellets through the pipe to lead pellet discharge line 43. The pellets are collected in receptacle 44. Conveyor chain 41 is operated by motor 45 acting through speed reducer 46 and sprocket 47.

In FIG. 2, furnace 2 is schematically shown in detail. Outer jacket 3 is lined with firebrick 4. Metal pot 5 which includes lip 48 is separated from firebrick 4 by space 6. Gas passes through pipe 7 and valve 8 to gas burners 9. The flow of gas is controlled by safety thermostat 10 act-

ing through thermostat lead 49. Pilot flame 50 is kept burning by gas flowing through line 51. Centrifugal pump 13 is immersed in lead 1 within pot 5. Lead from pot 5 passes through pump inlet 52 and out discharge line 12. Temperature control bulb 20 is attached to a temperature control means which is not shown.

FIG. 3 is a detailed view of the quench tank and dropping tray assembly shown in FIG. 1. The quenching apparatus includes quench tank 27 and reservoir tank 32. Quench liquid 28 within tank 27 overflows into trough 30, passes through pipe 31 and into reserve tank 32 from which it is conveyed to heat exchanger 35 by means of pump 34 as is shown in FIG. 1. Lead is dripped from tray 25 into quench liquid 28. The distance 29 between the exit opening of the holes of tray 25 and the surface of quench liquid 28 is adjusted by means of levelling screws 53 which are located at both ends of tray 25. Pellets that are formed in the quench liquid pass to the bottom of tank 27 and into conveyor pipe or tube 40. Within the tube the pellets are moved along by conveyor chain 41 and conveyor discs 42.

In FIG. 4, a detailed view of the conveyor pipe assembly of FIG. 3 is set forth. Conveyor pipe or tube 40 includes pellet openings 54 (three on each side), disc 42, and chain assembly 41.

FIG. 5 is a schematic top view of the quench tank and conveyor pipe assembly. Tank 27 is attached to overflow trough 30 which includes opening 55 to pipe 31 which is not shown. Quench liquid in tank 27 overflows into trough 30 and opening 55. Conveyor pipe 40 includes spaced openings 54 for receiving pellets which are hardened within quench liquid 28.

FIG. 6 is a detailed view of dropping tray 25. The tray includes spaced holes 56, the size of which can be adjusted in accordance with the needs of the particular operation. In a specific embodiment, holes having a diameter of 0.035" are drilled in an equilateral triangle pattern in such a manner as to be ½" apart from each other. Holes having a diameter range of from about 0.030" to about 0.045" will be satisfactory in most instances. The tray includes overflow opening 57 which is used to regulate the amount of lead within the tray. The opening is formed by movable sleeve 57*a* which is within line 26. Levelling screws 53 are used to level the tray.

FIG. 7 is a detailed view of the conveyor pipe assembly of FIG. 1. Conveyor pipe 40 includes openings 54 which are in communication with quench tank 27. Pellets are moved through the pipe by means of conveyer chain 41 and discs 42. Sprocket 47 is acted upon by the power pack shown in FIG. 1. Slideable mounting plate 58 and housing 59 protect the sprocket and power pack. Recesses 60 are located on pipe 40 in such a manner as to make it possible to inspect the chain and to remove pellets which may be clogging the chain assembly.

FIGS. 8 and 9 are detailed views of the conveyor chain assembly shown in FIGS. 1 and 7. In FIG. 8, links 61 are held together by pins 62. Washers 63 separate the sets of links and discs 42 are attached at spaced intervals to the links. FIG. 9 shows the chain assembly turned 90° from the view set forth in FIG. 8. The chain assembly includes links 61, pins 62, and discs 42.

In operation, molten lead is passed from metal pot 5 through conduit 12 and nozzle 21 to dropping tray 25. In a preferred embodiment, a sliding sleeve is contained within overflow line 26 which extends into the liquid in the tray to control the liquid level. It has been found that a liquid level of one-half inch in depth is fully satisfactory. The flow of lead from pot 5 to tray 25 is controlled so that there is a constant overflow from the tray to return line 24. In a preferred embodiment, from 5% to 10% of the lead is returned to the melting pot. From the tray the lead is dripped into quench liquid 28. In my preferred embodiment hexamethyl carbitol is used as the quench material. The number of pellets formed per minute will depend upon the number of holes in the dropping tray. With approximately 100 holes in the tray, it is estimated that from 400 to about 800 pounds of pellets will be formed per hour. The pellets pass from the quench tank to conveyor tube or pipe 40. The chain assembly includes links and discs. In a specific embodiment, 1½" discs spaced about 4 inches apart are passed through a two inch pipe. The discs are laminated from 5⅜2" thick pieces. The chain assembly is moved through the conveyor tube by means of a drive sprocket and conveyor motor. In a preferred embodiment, the chain drives the sprocket at a rate of 25 feet per minute. The formed pellets are passed through discharge pipe 42 and are collected in a suitable receptacle.

Obviously many modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. Pellet forming apparatus which comprises in combination: a vessel; heating means for maintaining lead in a molten condition within said vessel; drop forming means; conveying means for circulating molten lead between said vessel and said drop forming means; valve means associated with said conveying means for restricting the flow of said molten lead to said drop forming means; control means for maintaining a constant head on said valve means; liquid overflow means associated with said drop forming means for maintaining a constant head on said drop forming means; and quench means operatively associated with said drop forming means.

2. Pellet forming apparatus which comprises in combination: a vessel; heating means for maintaining lead in a molten condition within said vessel; drop forming means; conveying means for circulating molten lead between said vessel and said drop forming means, said conveying means including a discharge line, a pump operatively connected to said discharge line to force lead from said vessel through said discharge line, a lead restricting valve positioned within said discharge line, a nozzle operatively associated with said lead restricting valve and said drop forming means to provide a supply of lead to said drop forming means, and a lead return line, said lead return line being joined with said discharge line to form an inverted Y tube, said Y tube terminating in a stand pipe open to the atmosphere, said Y tube and stand pipe serving to maintain a constant head on said lead restricting valve, said return line being operatively associated with said vessel; and quench means positioned beneath said drop forming means.

3. Pellet forming apparatus which comprises in combination: a vessel; heating means for maintaining lead in a molten condition within said vessel; drop forming means, said drop forming means including a substantially horizontal tray, said tray including a base having a plurality of drop forming holes; conveying means for circulating molten lead between said vessel and said drop forming means; valve means associated with said conveying means for restricting the flow of said molten lead to said drop forming means; control means for maintaining a constant head on said valve means; a sleeve within said drop forming tray, said sleeve defining a lead overflow line which communicates with said conveying means, said lead overflow line providing a constant head on said drop forming holes; and quench means operatively associated with said drop forming means.

4. Pellet forming apparatus which comprises in combination: a vessel; heating means for maintaining lead in a molten condition within said vessel; drop forming means, said drop forming means including a substantially horizontal tray, said tray including a base having a plurality of drop forming holes; conveying means for circulating molten lead between said vessel and said drop forming means, said conveying means including a discharge

line, a pump operatively connected to said discharge line to force lead from said vessel through said discharge line, a lead restricting valve positioned within said discharge line, a nozzle operatively associated with said lead restricting valve and said drop forming means to provide a supply of lead to said drop forming means, and a lead return line, said lead return line being joined with said discharge line to form an inverted Y tube, said Y tube terminating in a stand pipe open to the atmosphere, said Y tube and stand pipe serving to maintain a constant head on said lead restricting valve, said return line being operatively associated with said vessel; an adjustable sleeve within said drop forming tray, said adjustable sleeve definiing a lead overflow line which communicates with said lead return line, said lead overflow line providing a constant head on said drop forming holes; and quench means operatively associated with said drop forming means.

References Cited by the Examiner

UNITED STATES PATENTS

773,473	10/04	Cassell	210—195
959,844	5/10	Dargin	210—195
1,938,219	12/33	Eckerbom	222—276
2,323,147	6/43	McKinnis	214—17
2,399,546	4/46	Edge	137—563
2,570,423	10/51	Batchelder et al.	18—2.7
2,582,802	1/52	Terrell	137—563
2,738,548	3/56	Kassel	18—2.7
2,903,166	9/59	Kuljian	222—478
2,907,480	10/59	Vincent	214—17
2,921,335	1/60	Bowers et al.	18—2.7
2,931,067	4/60	Delaloye et al.	18—47.2
2,934,141	4/60	Ikavalko	162—339

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