Nov. 18, 1969 E. W. HALE 3,479,093

INOCULATION FEEDERS

Filed April 27, 1967 3 Sheets-Sheet 1

Fig. 1.

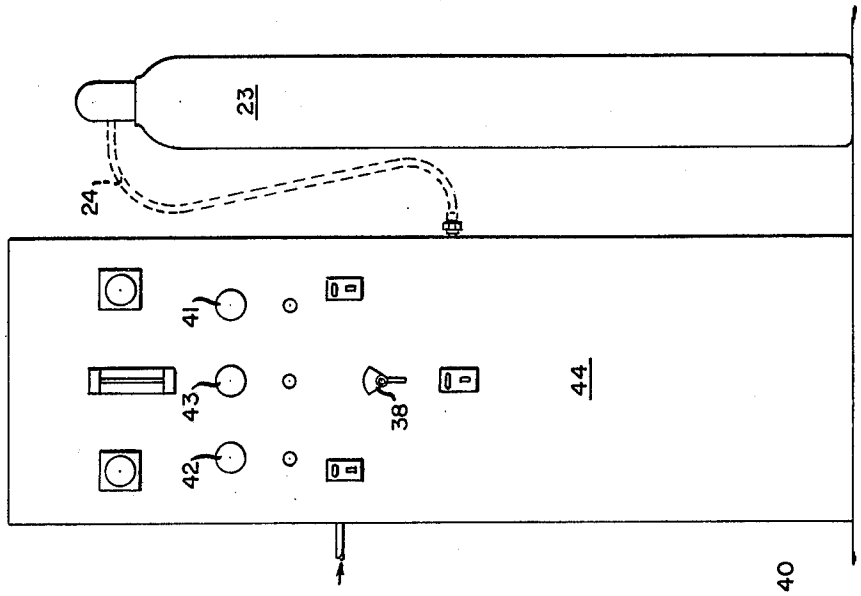


Fig. 2.

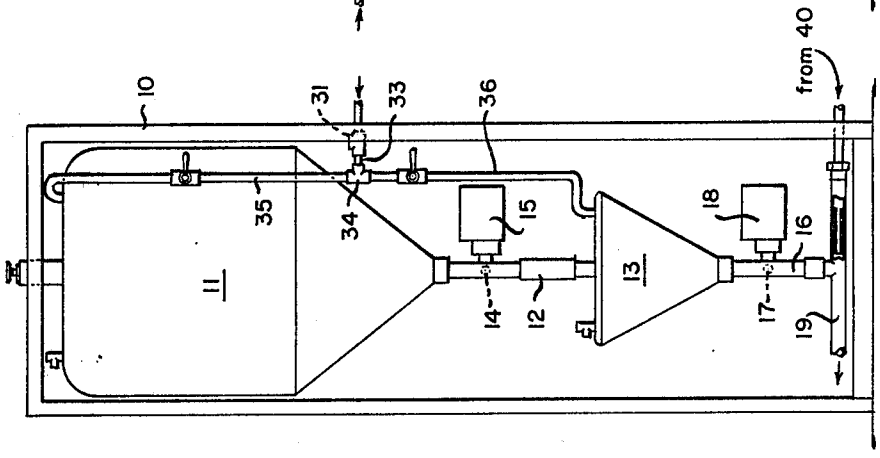
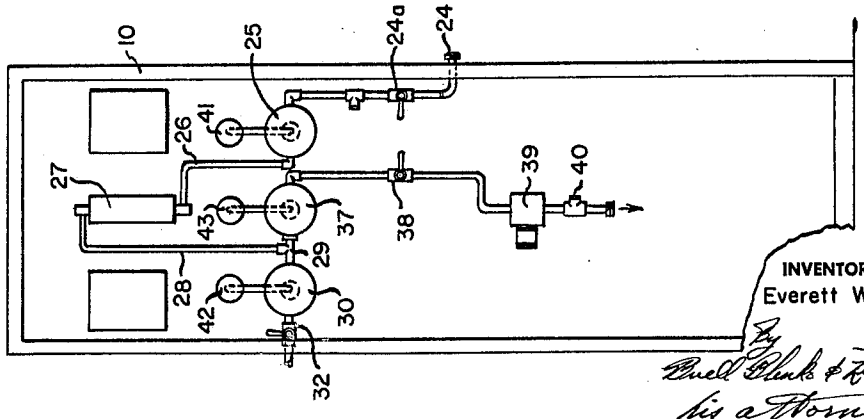


Fig. 3.



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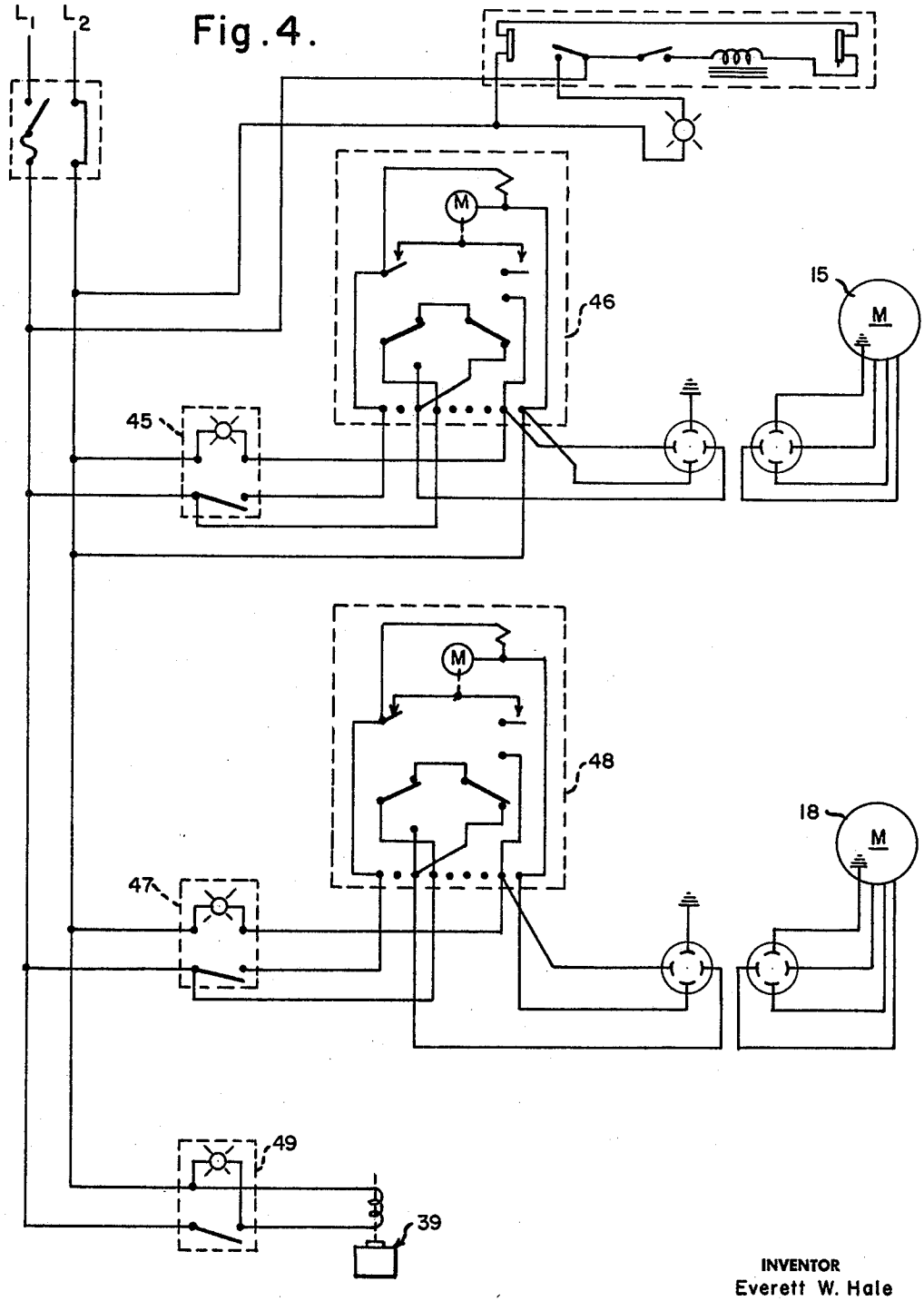
INOCULATION FEEDERS

Filed April 27, 1967 3 Sheets-Sheet 2

Fig. 4.



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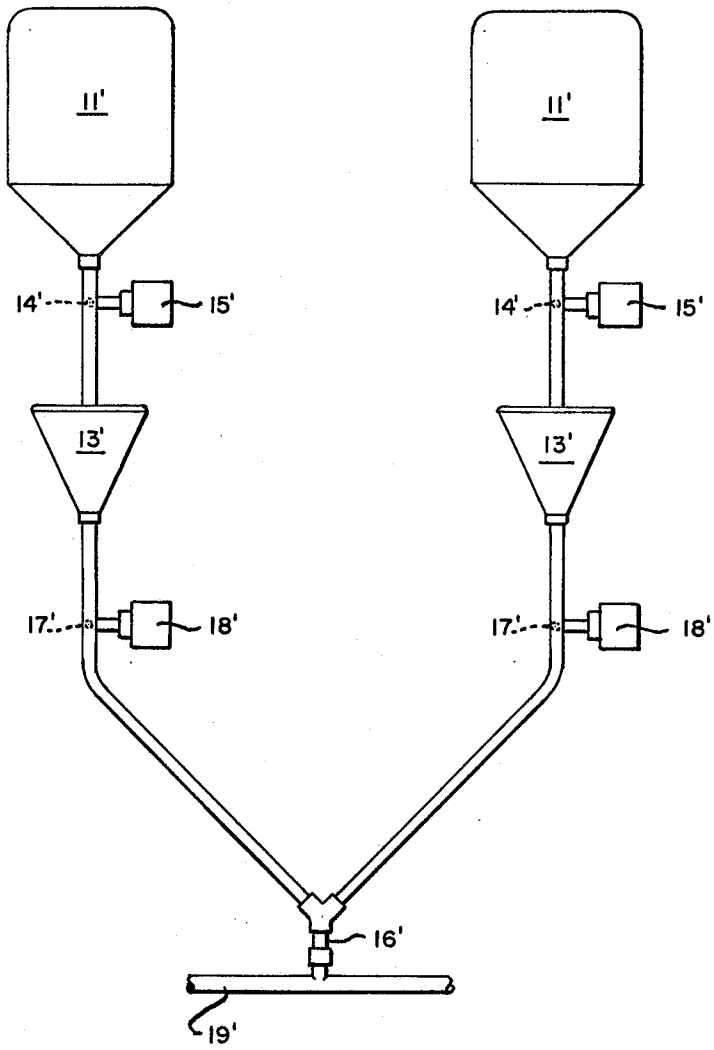
Nov. 18, 1969 E. W. HALE 3,479,093

INOCULATION FEEDERS

Filed April 27, 1967 3 Sheets-Sheet 3

Fig. 5.



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United States Patent Office 3,479,093
Patented Nov. 18, 1969

3,479,093

INOCULATION FEEDERS

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Filed Apr. 27, 1967, Ser. No. 634,171
Int. Cl. B65g 53/12
U.S. Cl. 302—40 8 Claims

ABSTRACT OF THE DISCLOSURE

An inoculation feeder for feeding solid finely divided materials into a molten metal bath including a storage receptacle for fine particle materials, a pressure batch injection receptacle connected to the storage receptacle and receiving particles from said storage, a first valve means between the two receptacles controlled by a timed valve controller to meter a preselected quantity into the batch injector, a second valve means at the outlet of the batch ejector connecting to an injection line, a source of fluid pressure connected to and acting to regulate the pressure of the two receptacles and a third valve between the source of fluid pressure and the injector line whereby material entering the injector line is carried by a moving stream of pressure fluid into the molten metal bath.

This invention relates to inoculation feeders and particularly to feeding apparatus for delivering solid finely-divided materials into a molten metal bath. The practice of feeding solid finely-divided materials into a molten metal bath has been followed for many years. For example, finely-divided inoculants such as magnesium, rare earth metals, calcium carbide, ferro-silicon and the like have been fed through a supply line and feeder pipe beneath the surface of a molten metal bath by means of gas pressure. This practice has suffered from several difficulties among which are lack of control over feeding rate, line stoppages and inability to provide truly automatic action.

In the present invention, I provide a feeder of solid fine particles which eliminates line stoppages, provides positive control over feeding rate, permits alternate or successive feeding of different particles and may be fully automated.

Preferably, I provide a regulated pressure storage receptacle for fine particles, a pressure batch injection receptacle connected to said storage receptacle and receiving fine particles from said storage, first valve means in the connection between said receptacles, second valve means at the outlet of said batch injector, a connection from said second valve means to an injection nozzle adapted to be submerged in a molten metal bath, a supply of pressure fluid connected to each of said receptacles and said connections to the injection nozzle, third valve means between said source of fluid pressure and said injection nozzle, and valve operator means selectively opening and closing each of said valve means in a preselected sequence. Preferably the first and second valve operator means are electric motors with timer controls and the third valve operator is a solenoid. Pressure regulator means are preferably provided in the connections from the source of pressure fluid to the receptacles and nozzle. A flow meter is preferably used in the connections between the source of pressure fluid and the receptacles and nozzle.

In the foregoing general description of my invention, I have outlined certain objects, purposes and advantages of my invention. Other objects, purposes and advantages of the invention will be apparent from a consideration of the following description and the accompanying drawings in which:

FIGURE 1 is a front elevation of the control panel of my invention;

FIGURE 2 is a side elevation of the apparatus showing the receptacles and nozzle;

FIGURE 3 is a front elevation of the control panel of FIGURE 1 with the control panel face removed;

FIGURE 4 is a schematic wiring diagram of the controls for the apparatus of FIGURES 1 and 2; and

FIGURE 5 is an elevational view of a double storage and batch receptacle arrangement.

Referring to the drawings, I have illustrated a frame **10** carrying a regulated pressure storage receptacle **11** having a conical bottom and discharge line **2** connecting to the top of batch injector receptacle **13** through valve **14** operated by motor **15**. The batch injector receptacle **13** is a closed pressure vessel having a conical bottom terminating in discharge line **16** through valve **17** operated by motor **18** into injector line **19** leading to an injection nozzle (not shown). The injection nozzle is preferably a graphite tube which may be immersed beneath a molten bath of metal in a ladle or other receptacle.

The storage receptacle **11** and injector receptacle **13** are under regulated pressure from a source of fluid pressure **23** such as a tank of liquid nitrogen. The fluid is carried to the two receptacles by means of line **24** through main valve **24*a*** to high pressure regulator **25**, line **26** to flow meter **27**, line **28** to T connection **29**, then from one side of the T connection through low pressure regulator **30**, check valve **31**, hand valve **32** and line **33** to T connection **34** where it is connected to the tanks **11** and **13** by lines **35** and **36** respectively. Fluid pressure from the other side of T connection **29** is delivered to low pressure regulator **37**, through hand valve **38**, solenoid valve **39**, check valve **40** to injector line **19**. Pressure regulators **25**, **30** and **37** are connected to pressure gauges **41**, **42** and **43**, respectively, on control panel **44** carrying the pressure regulators **25**, **30** and **37**.

The valve motors **15** and **18** and solenoid valve **39** are operated by an electrical circuit clearly outlined in FIGURE 4 and it will not be discussed in detail except in connection with the operation of the apparatus.

The apparatus of this invention is operated as follows: A finely divided additive such as magnesium spheres to be fed to a molten bath of metal is placed in storage receptacle **11** which is then closed. The main fluid pressure valve **24*a*** is opened to place the two receptacles **11** and **13** under controlled pressure. The valve motor **15** is then actuated by switch **45** and timer **46**. This opens valve **14** and permits a charge of additive to be delivered to injection receptacle **13**. When timer **46** stops, motor **15** closes valve **14**. Switch **49** is then actuated to open solenoid valve **39** which opens injector line **19** to the high pressure fluid which fluid flows through the nozzle into molten bath forcing any metal in nozzle out into the bath. Switch **47** is then actuated to start timer **48** which actuates motor **18** and opens valve **17** to injection line **19** discharging the charge into the moving high pressure fluid which carries the charge into the molten metal. When timer **48** stops, motor **18** closes valve **17**. Switch **49** is then manually closed; however, it is obvious that a separate timer (not shown) could be connected from switch **47** to actuate solenoid **39** at the same time as motor **18** is actuated and to de-energize solenoid **39** at the same or later time as motor **18**.

FIGURE 5 shows a double arrangement in which the parts bear the same numbers as shown in FIGURES 1–4 with a prime sign added.

I claim:

1. A feeder for delivering solid fine particles to a molten bath comprising a controlled pressure storage receptacle, a pressure batch injection receptacle connected to said

storage receptacle and receiving and holding a specific preselected measured batch of fine particles from said storage receptacle, first valve means in said connection between said receptacles, means controlling said first valve permitting a variable preselected measured amount of fine particles to flow from the pressure storage receptacle to the injector receptacle, second valve means at the outlet of said batch injector, means controlling said second valve means opening the same to discharge the content of the batch injection receptacle, a connection from said second valve means to an injection nozzle adapted to be submerged in a molten metal bath, a pressure fluid supply connected to each of said receptacles and to said connection to the injection nozzle, third valve means between said source of fluid pressure and said injection nozzle and valve operating means for selectively opening said third valve means prior to the opening of said second valve means and closing said third valve means after the closing of said second valve means.

2. A feeder as claimed in claim 1 wherein the pressure fluid supply is a container of pressurized nitrogen.

3. A feeder as claimed in claim 1 wherein the pressure fluid supply is a container of pressurized inert gas.

4. A feeder as claimed in claim 1 wherein the valve operating means are electric motors energized through timer circuits.

5. A feeder as claimed in claim 1 having pressure regulating means between the source of pressure fluid and each of said receptacles and the injection nozzle.

6. A feeder for delivering solid fine particles to a molten bath comprising a plurality of pressure storage receptacles, a presure batch injection receptacle connected to each said storage receptacle and receiving and holding a specific preselected measured batch of fine particles from said storage receptacle, first valve means in each said connection between said receptacles, means controlling said first valve permitting a variable preselected measured amount of fine particles to flow from the pressure storage receptacle to the injector receptacle, second valve means at the outlet of said batch injector, means controlling said second valve means opening the same to discharge the content of the batch injection receptacle, a connection from said second valve means to an injection nozzle adapted to be submerged in a molten metal bath, a pressure fluid supply connected to each of said receptacles and to said connection to the injection nozzle, third valve means between said source of fluid pressure and said injection nozzle and valve operating means for alternately selectively opening each said third valve means prior to the opening of said second valve means and closing said third valve means after the closing of said second valve means.

7. A feeder for delivering solid fine particles to a molten bath comprising a plurality of pressure storage receptacles, an equal number of pressure batch injection receptacles each connected to one of said storage receptacles and receiving and holding a specific preselected measured batch of fine particles from said connected storage receptacle, first valve means in each said connection between said receptacles, means controlling said first valve permitting a variable preselected measured amount of fine particles to flow from the pressure storage receptacle to the injector receptacle, second valve means at the outlet of each of said batch injectors, means controlling said second valve means opening the same to discharge the content of the batch injection receptacle, a connection from said second valve means to an injection nozzle adapted to be submerged in a molten metal bath, a pressure fluid supply connected to each of said receptacles and to said connection to the injection nozzle, third valve means between said source of fluid pressure and said injection nozzle and valve operating means for selectively alternately opening and closing said third valve means prior to the opening of said second valve means and closing said third valve means after the closing of said second valve means.

8. A feeder as claimed in claim 7 wherein there are two pressure controlled storage receptacles and batch injectors connected through second valve means to a bifurcated head on the connection to the injection nozzle.

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ANDRES H. NIELSEN, Primary Examiner

U.S. Cl. X.R.

302—53

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,479,093 November 18, 1969

Everett W. Hale

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 13, "2" should read -- 12 --.

Signed and sealed this 21st day of April 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents