

- [54] **MEANS FOR REGULATING THE FLOW-RATE OF MELT FROM A CONTAINER**
- [72] Inventor: **Yngve Sundberg**, Vasteras, Sweden
- [73] Assignee: **Allmanna Svenska Elektriska Aktiebolaget**, Vasteras, Sweden
- [22] Filed: **May 6, 1970**
- [21] Appl. No.: **34,988**

- [30] **Foreign Application Priority Data**
- May 21, 1969 Sweden7147/1969
- [52] U.S. Cl.**222/56, 222/383, 417/50**
- [51] Int. Cl.**B22d 37/100**
- [58] Field of Search.....222/56, 58, DIG. 15, 383; 164/49, 147; 417/50

- [56] **References Cited**
- UNITED STATES PATENTS**
- | | | | |
|-----------|---------|-------------|-------------|
| 2,224,982 | 12/1940 | Morin..... | 164/147 X |
| 2,743,492 | 5/1956 | Easton..... | 164/147 |
| 3,486,660 | 12/1969 | Heintz..... | 222/DIG. 15 |
- FOREIGN PATENTS OR APPLICATIONS**
- | | | | |
|---------|--------|--------------------|-------------|
| 728,145 | 4/1955 | Great Britain..... | 222/DIG. 15 |
| 712,672 | 7/1954 | Great Britain..... | 222/DIG. 15 |

Primary Examiner—Robert B. Reeves
Assistant Examiner—David A. Scherbel
Attorney—Kenyon & Kenyon Reilly Carr & Chapin

- [57] **ABSTRACT**
- A furnace or ladle for melt has an outlet tube extending upwardly from its bottom at an angle from the vertical. An electromagnetic valve around the tube controls the flow of melt through the tube to some desired value.

3 Claims, 2 Drawing Figures

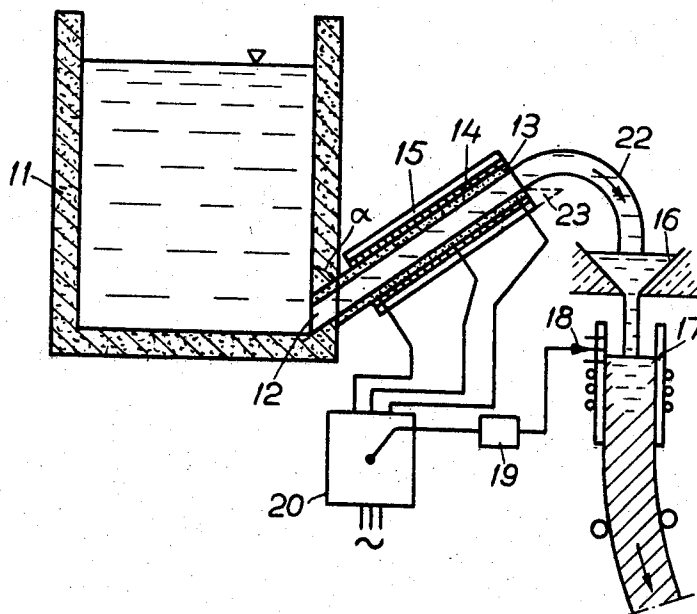


Fig. 1

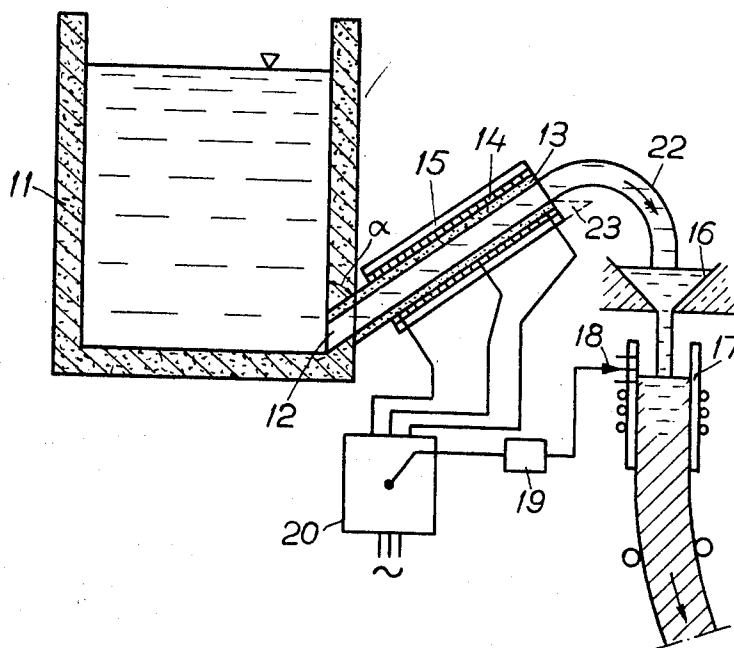
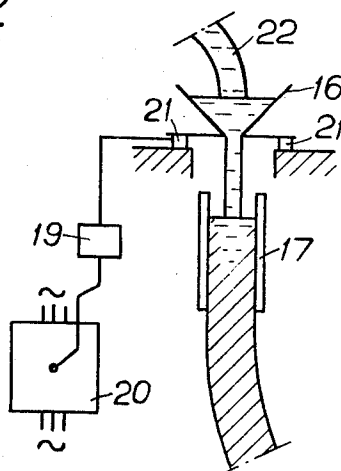


Fig. 2



INVENTOR.
YNGVE SUNDBERG
BY
Tengon & Tengon Kelly Carr & Chapin
ATTORNEYS

MEANS FOR REGULATING THE FLOW-RATE OF MELT FROM A CONTAINER

BACKGROUND OF THE INVENTION

The present invention relates to a means for regulating the flow-rate of melt from a container, comprising a multiphase electromagnetic valve arranged around an outlet in the container.

Such means is known per se through, for example, British Patent No. 728,145 which shows a container having a bottom tapping tube around which is an electromagnetic, multiphase-fed valve intended to effect a magnetic moving field in the melt stream, which effects a force in upward or downward direction for the melt of the same type as that activating the rotor in a multiphase-fed stator in an asynchronous motor. The force produced in this way is intended to regulate the tapping from the container and in certain cases completely stop this. However, it has been found that even when the level of the melt in the container is rather low, a very strong field is required. For example, with a melt level of 0.8m a pressure of 54,100 N/m² is required to stop the tapping, which makes a device of the above type impractical.

SUMMARY OF THE INVENTION

By means of a device according to the invention an arrangement as described in the first paragraph can be made practically advantageous. The invention is characterized in that the outlet is arranged in the form of a pipe leading from the lower part of the container and opening out at a level considerably above the bottom of the container and that the electromagnetic valve is arranged around the pipe and its coil or coils arranged to be fed with a voltage, the value of which is controlled by a transducer for a certain melt condition in the container, such as a level indicator in a casting mould or casting ladle or indicator for the weight of an intermediate ladle or the like intended to be filled from the container. By means of such an arrangement it is possible with a relatively reasonable field to regulate the tapping as desired and possibly to obtain an automatic tapping regulation from high to low levels of the melt in the container.

DESCRIPTION OF THE DRAWINGS

The means is further exemplified in the accompanying drawings in which

FIG. 1 shows tapping from a container where the tapping is regulated by a level-indicator.

FIG. 2 shows regulation by a transducer for weight in an intermediate ladle or container.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows a ladle 11 (or furnace) having an opening 12 in the lower part of the bowl of the ladle. A pipe 13 is connected to the opening at a certain upward angle in relation to the horizontal plane (or bottom surface). Around the pipe is a so-called electromagnetic valve (14-15) or pump, provided with at least one, two, three or multi-phase fed coils 14 around which may be arranged an iron stack or an iron core 15. The electromagnetic pump or valve is of the type known, for example from the above-mentioned patent specification, and

in which a moving field is produced having a direction dependent on the phase sequence, which draws with it or effects a force on the melt in the coil corresponding to the force on the rotor in an asynchronous motor with multiphase-fed stator. With the iron stack 15 a force increase of about 20 percent or more is obtained on the melt in the pipe 13 in comparison with that obtained with a coil having no iron core at the same current strength in the coil.

The ladle may possibly be provided with several pipes for multi-run casting, each one being surrounded by its own electromagnetic valve.

The melt from the ladle 11 is to be poured through the pipe 13 and by way of an intermediate ladle or tapping box 16 or in some other way into a casting mould 17, another ladle, etc., for example in connection with continuous casting (see FIG. 1). The tapping from the ladle should, for example, be regulated so that all the time a certain value is obtained during the casting, such as constant level in the mould 17 or constant weight in the intermediate ladle 16, or a value which varies in a certain way during the casting process, such as varying desired value for the weight of the intermediate ladle depending on the actual level in the mould 17.

The level in the mould 17 may be sensed in many ways, known per se, such as by means of a contact level gauge 18, an X-ray gauge, a photocell-controlled gauge, etc., and the output signal from this gauge 18 is supplied to a regulating device 19, the output signal (amplified) of which controls a voltage-regulating device 20 such as a regulator-transformer, an induction regulator, a potentiometer, etc., to feed multiphase alternating current to the coil or coils 14 of the electromagnetic valve.

FIG. 2 shows a weight indicator 21 for the intermediate ladle 16. The output signal (weight of ladle 16 plus temporary melt content) of the indicator 21 is supplied to a regulating device, as in the case of the level gauge according to FIG. 1.

When the melt level in the container or ladle 11 is high, a phase sequence and voltage is selected in the valve 14-15 so that a force is obtained towards the container 11 which counteracts the force of the melt itself. By reducing the voltage in this way the tapping from the ladle 11 (see 22) can be gradually controlled and by reducing the voltage to zero and after phase alteration again increasing it, the tapping can be increased. The choice of voltage and phase sequence (force direction) can be regulated so that, for example, a constant level is obtained at the measuring device 18, or constant weight in the intermediate ladle.

The weight indicator 21 may be of known type, such as a magneto-strictive transducer of the type shown in British Patent No. 767,791.

By altering the slant of the pipe 13 and the arrangement of the electromagnetic valve 14-15, it is possible with reasonably low power to control the tapping of the melt even when the level of melt in the ladle 11 is high. The angle α between the pipe 13 and a vertical axis should lie between 10° and 30°, suitably about 12°-23°, and the highest level of the pipe should be located at approximately half the maximum level of the melt. The force should operate downwardly during the start of the tapping and then be gradually reduced. It is then al-

tered and increased if constant level is to be obtained at the measuring device 18 in the mould 17.

The following example may be given:

Length of valve: 3.6 m

Angle $\alpha = 15^\circ$, frequency for three-phase feeding to the coil 14 = 50 Hz.

Apparent power at the coil = 2,720 kVA.

Active power = 450 kW.

Voltage (main) = 372 V.

During feeding toward the ladle 11 (downwards in the pipe 13) and a force of 26,000 N/m³, tapping can be stopped in the electromagnetic valve.

The length of the valve is 3.6m and a pressure is thus obtained of $26,000 \cdot 3.6 = 93,600 \text{ N/m}^2$, which in turn corresponds to a melt level

$$h = 93,600 / (9.81 \cdot 6,900) = 1.38\text{m}$$

It is thus possible with such a valve to counteract the tapping through the pipe 13 at a melt level of up to 1.38m above the melt surface in the valve when this is completely filled. If, when the ladle has been tapped out to the level of the valve opening, the direction is changed, the valve can suck metal out of the container to a level of 1.38m below the opening of the valve.

The pipe may be provided with a spout 23 or lip for the melt.

Of course when the level of the melt in the ladle 11 is below the highest level of the pipe 13, no force need be applied towards the ladle 11 even when tapping is en-

tirely stopped.

The means described above can be varied in many ways within the scope of the following claims.

What is claimed is:

1. Means for regulating the speed of melt flowing out of a container, comprising a multiphase electromagnetic valve pump arranged around an outlet in the container, said outlet being an upwardly directed tube, leading from the lower part of the container to a level below the highest possible melt level in the container, said valve pump being arranged around the tube and its coil being fed with multi-phase AC voltage with switchable phase sequence, the direction of the phase sequence being controlled from the output from measuring means for measuring the amount of melt in a device to be filled from the container.

2. Means according to claim 1, characterized in that the voltage is arranged to be regulated as to phase sequence in such a way that the resultant force of the valve on the melt can be varied from a direction towards the melt in the container to a direction from the container, for example to effect the desired tapping regardless of the level in the container.

3. Means according to claim 1, characterized in that the electromagnetic valve is given such a height that it extends from a level near the bottom of the container to a level at approximately half the effective height in the container.

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