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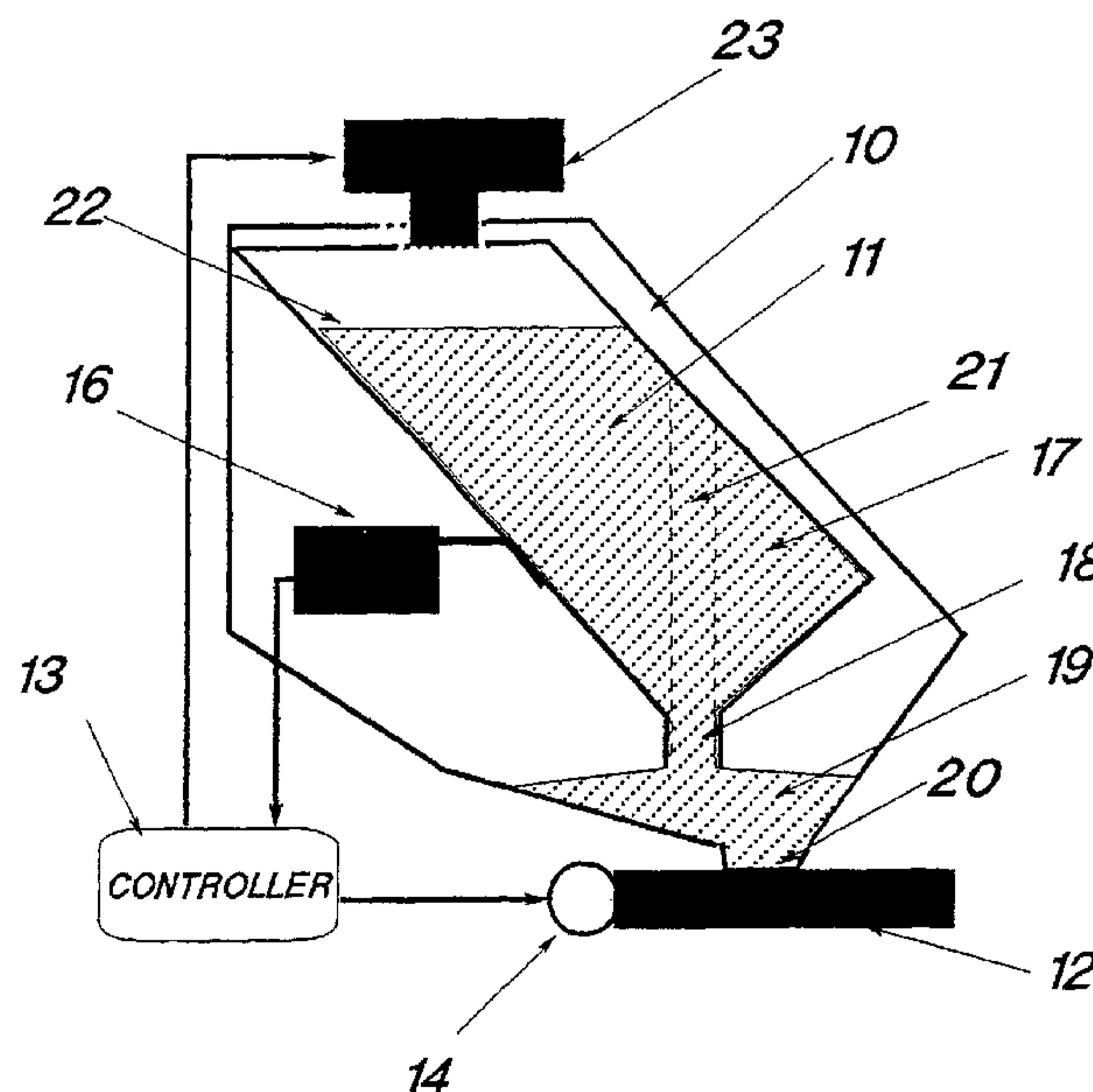
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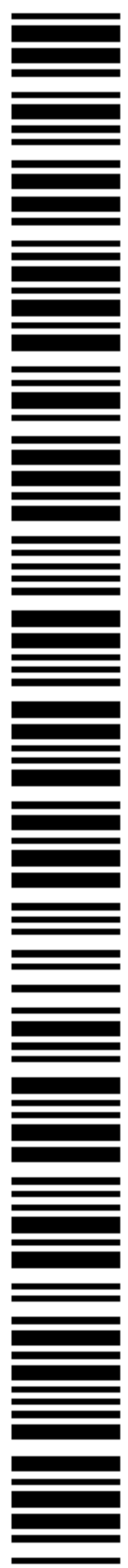
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(54) Title: A SYSTEM FOR FEEDING PORTIONS OF MATERIAL TO AN INJECTION MOLDING MACHINE



(57) **Abstract:** The present invention is a system for feeding portions of material to an injection molding machine including a feeding means that can be a screw feeder (12), an external container (10), a material hopper (11) with inclined and parallel walls located inside the container, a load cell (16) that is coupled to the material hopper (11) and a controller (13). The system dispenses portions of material in a given time and for given duration. The system dispenses accurate weight portions. The system controls the portion weight by weighing a number of dispensed portions using loss-in-weight of the hopper, divides the weight to the number of portion and when it need, control the spin of the screw feeder motor (14).



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A SYSTEM FOR FEEDING PORTIONS OF MATERIAL TO AN INJECTION MOLDING MACHINE

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to a field of a molding machine and, in particular, concerned to a system for feeding portions of material to a plastic-injection molding machine.

Several weight feeding apparatus and systems are known. These apparatus and systems are for feeding a large quantity of material. When a small quantity is needed, e.g., coloring material, in a producing system, volume methods are used to achieve the needed weight. Volume methods are used for feeding small quantities because of the difficulty of weighing a few grams in the production area, which is very noisy and shaky.

Volume feeding methods, which use to achieve weight feeding, have some disadvantages. The specific gravity of a material can be changed e.g., in a new production batch, and therefore a new scaling is needed. The volume-weight scaling is a long process and requires skilled workers. Moreover, since the fed volume cannot be controlled

the volume-feeding method assumes that the feeding means dispenses equal portions permanently and therefore ignores the material streaming problems.

Feeding hopper usually has an outlet to feed the material. Part of the material, the material in the shaft that is perpendicular to the outlet, does not press on the hopper. This "outlet-shaft" causes an error in the hopper weighing since the material in the outlet-shaft or at least part of this material is not weighed. Load cells are calibrated when weighing such hoppers.

There is therefore a recognized need for, and it would be highly advantageous to have, a system for feeding portions of material to an injection-molding machine with the ability to accurately weigh feeding of small quantities of material.

SUMMARY OF THE INVENTION

The present invention is a system for feeding portions of material to an injection-molding machine with the ability to accurately weigh feeding of small quantities of material.

According to the teachings of the present invention there is provided, a system for feeding portions of material to an injection molding-machine including (a) a feeding means; (b) a container, with a fill opening and an outlet, and the container is installed with the feeding means; (c) a material hopper, with a fill opening and an outlet, and the material hopper is located inside the container; (d) a load cell that is coupled to the material hopper, and (e) a controller operative for: (i) calculating the weight of fed material, using the load cell and loss-in-weight method, and (ii) controlling the feeding means.

According to further features in the described preferred embodiments, the material hopper of the system has a funnel shaped lower part and an upper part and wherein the upper part has the same cross-section-area in each vertical level. The upper part of the material hopper can have inclined parallel-walls.

According to further features in the described preferred embodiments, the controller of the system is further operative for command the feeding means to dispense at least one portion of material from the material hopper, wherein each portion is dispensed in a given

time and for a given interval of time in order to dispense portions with a predetermined weight.

According to further features in the described preferred embodiments, the controller is further operative for it calculates the weight of the dispensed portion by (1) dispensing a number of portions; (2) calculating the weight of the number of portions, using loss-in-weight method, and (3) dividing the weight of the number of portions to the number of the portions.

According to further features in the described preferred embodiments, the feeding means is a screw feeder and the controller is further operative for adjusting the weight of the further portion by increasing or decreasing the spin speed of the screw feeder, if the weight of the portion differs from the predetermined weight.

According to further features in the described preferred embodiments, the outlet of the material hopper is shifted and elevated from the outlet of the container.

According to yet another aspect of the present invention there is

provided a material hopper for accurate weighing including (a) a funnel shaped lower part with outlet, and (b) a parallel or cylinder walls upper part wherein the walls can be inclined.

According to yet another aspect of the present invention there is provided a method of accurate weighing of a fed portion including (a) storing the material in a material hopper that its upper part is an inclined cylinder or an inclined parallel walls; (b) feeding a predetermined number of portions; (c) calculating the weight of the number of portions, using loss-in-weight of the material hopper using a load cell, and (d) calculating the weight of each portion of the number of portions by dividing the weight of the number of portions to the number of the number of portions. The predetermined number of portions can be calculating by dividing the sensitivity of the load cell to the estimated weight of the fed portion.

The present invention successfully addresses the shortcomings of the existing technologies by providing a system for feeding portions of material to an injection-molding machine with the ability to accurately weigh feeding of small quantities of material.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Figure 1 is an illustration of a schematic block diagram of the system.

Figure 2 is an illustration of a systems' cross-section while material is in the material hopper and the system is in a work or ready to work position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is a system for feeding portions of material to an injection-molding machine with the ability to accurately weigh feeding of small quantities of material.

The principles and operation of the system according to the present invention may be better understood with reference to the drawings and the accompanying description.

As used herein in the specification and in the claims section that follows, the term "weight-in-loss" refers to a known method for weighing the material that has been dispensed or spent from a hopper,

by weighing the hopper before taking from it having a pre-dispensing weight and secondly weighing the hopper after taking from it having an after-dispensing weight then obtaining a weight-loss of the hopper, which is the weight of the taken material, by subtracting the after-dispensing weight from the pre-dispensing-weight.

As used herein in the specification and in the claims section that follows, the term "outlet-shaft" refers to the part of the material in a hopper that is located in the shaft that perpendicularly to the outlet of the hopper and do not press on the hopper walls.

Referring now to the drawings, Figure 1 illustrates a schematic block diagram of the system. The system includes a container **10**, a material hopper **11** located inside the container **10**, a load cell **16** coupled to the material hopper **11**, a controller **13** that calculates weight according to the load cell **16** information and commands the motor **14** of the screw feeder **12** to dispense portions of material into the molding-machine **15**.

The upper part of the hopper **11** has inclined walls. This shape enables to keep the material in the outlet-shaft, constant by keeping

minimal level of material in the hopper. Moreover, the walls of the upper part of the hopper **11** are parallel, for this reason the shape of each new space in the hopper **11** that is created by each dispensed portion. Therefore the profile of the material-pressure, in the hopper **11**, remains constant. The inclined and parallel walls of the hopper **11** minimize the weight errors and facilitate the weight calibration.

The material must be fed to the molding machine in accurate-weight portions and each portion must be fed in a given time and in a given duration. To achieve this target the controller **13** commands the motor **14** of the screw feeder **12** to start rotating in a specific spin in the given time for a given duration. Since the given time and duration of feeding are given by the molding machine **15**, the screw feeder **12** spin is the only variable that can be used to control the weight of the fed portion. In the first time, the controller **13** gets a first weight of the hopper **11** from the load cell **16** and commands the motor **14** to rotate the screw feeder **12** for the given duration and a given spin that is predetermined by the system operator. After dispensing a predetermined number of portions the controller **13** gets a second weight of the hopper **11**. The controller **13** obtains the total weight of the fed portions using the first weight of the hopper **11**, the second weight of the hopper **11** and

loss-in-weight method. The controller **13** obtains the portion weight by dividing the total weight to the number of fed portions. If the portion weight differs from a predetermined weight, the controller **13** adjusts the portion weight by increasing or decreasing the spin of the motor **14** of the screw feeder **12**, in the next set of portions. This process can be done sequentially or in a predetermined time.

Figure 2 illustrates the systems' cross-section while material is in the material hopper and the system is in a work or ready to work position. The material **17** fills the material hopper **11**. The material **17** is fed through an outlet **18** of the material hopper **11** to a space **19** created between the material hoppers' outlet **18** and an outlet **20** of the container **10**, from this space **19** the material **17** is fed through the containers' outlet **20** to the screw feeder **12**. The material hoppers' outlet **18** is shifted from the containers' outlet **20** to enable keeping the outlet-shaft **21** constant as long as the material level **22** is higher than the upper end of the outlet-shaft **21** and isolates the material hopper **11** from noise and shaking which is coming from the screw feeder **12** and its' motor **14**. The controller **13** commands a refill means **23** to refill the material hopper **11** when the material level **22** reduced to a threshold level. Part of the material **17** is located in the space **19** and acts as a buffer. This

buffer isolates the material hopper **11** and prevents noises and shakings of the screw feeder **12** and its' motor **14**, to enable an accurate weighing of the material hopper **11** by the load cell **16**.

It will be appreciated that the above descriptions are intended only to serve as examples, and that many other embodiments are possible within the spirit and the scope of the present invention.

WHAT IS CLAIMED IS:

1. A system for feeding portions of material to an injection molding machine comprising:
 - (a) a feeding means;
 - (b) a container, with a fill opening and an outlet, and said container is installed with said feeding means;
 - (c) a material hopper, with a fill opening and an outlet, and said material hopper is located inside said container;
 - (d) a load cell that is coupled to said material hopper, and
 - (e) a controller operative for:
 - (i) calculating the weight of fed material, using said load cell and loss-in-weight method, and
 - (ii) controlling said feeding means.
2. The system of claim 1, wherein said material hopper has a funnel shaped lower part and an upper part and wherein said upper part has same cross-section-area in each vertical level.
3. The system of claim 2, wherein said upper part of said material hopper has inclined parallel-walls.
4. The system of claim 3, wherein said controller is further operative for:
 - (iii) Command said feeding means to dispense at least one portion of material from said material hopper, wherein each said portion is dispensed in a given time and for a given interval of time in order to dispense portions with a predetermined weight.

5. The system of claim 4, wherein said controller is further operative for:
 - (iv) calculates the weight of said portion by:
 1. dispensing a number of portions;
 2. calculating the weight of said number of portions; using loss-in-weight method, and
 3. dividing said weight of said number of portions to the number of said portions.
6. The system of claim 5, wherein said feeding means is a screw feeder.
7. The system of claim 6, wherein said controller is further operative for:
 - (v) adjusting the weight of the further portion by increasing or decreasing the spin speed of said screw feeder, if said weight of said portion is differ said predetermined weight.
8. The system of claim 7, wherein said outlet of said material hopper is shifted from said outlet of said container.
9. The system of claim 8, wherein said outlet of said material hopper is elevated from said outlet of said container.
10. A method of accurate weighing of a fed portion comprising:
 - a. storing the material in a material hopper;
 - b. feeding a predetermined number of portions;
 - c. calculating the weight of said number of portions, using loss-in-weight of said material hopper using a load cell, and:

- d. calculating the weight of each portion of said number of portions by dividing said weight of said number of portions to the number of said number of portions.
11. The method of claim 10, wherein said predetermined number of portions is calculated by dividing the sensitivity of said load cell to the estimated weight of said fed portion.
 12. A method of accurate weighing of a fed portion comprising:
 - a) storing the material in a system as defined in claim 1;
 - b) feeding a predetermined number of portions;
 - c) calculating the weight of said number of portions, using loss-in-weight of said material hopper using a load cell, and:
 - d) calculating the weight of each portion of said number of portions by dividing said weight of said number of portions to the number of said number of portions.
 13. The method of claim 12, wherein said predetermined number of portions is calculated by dividing the sensitivity of said load cell to the estimated weight of said fed portion.

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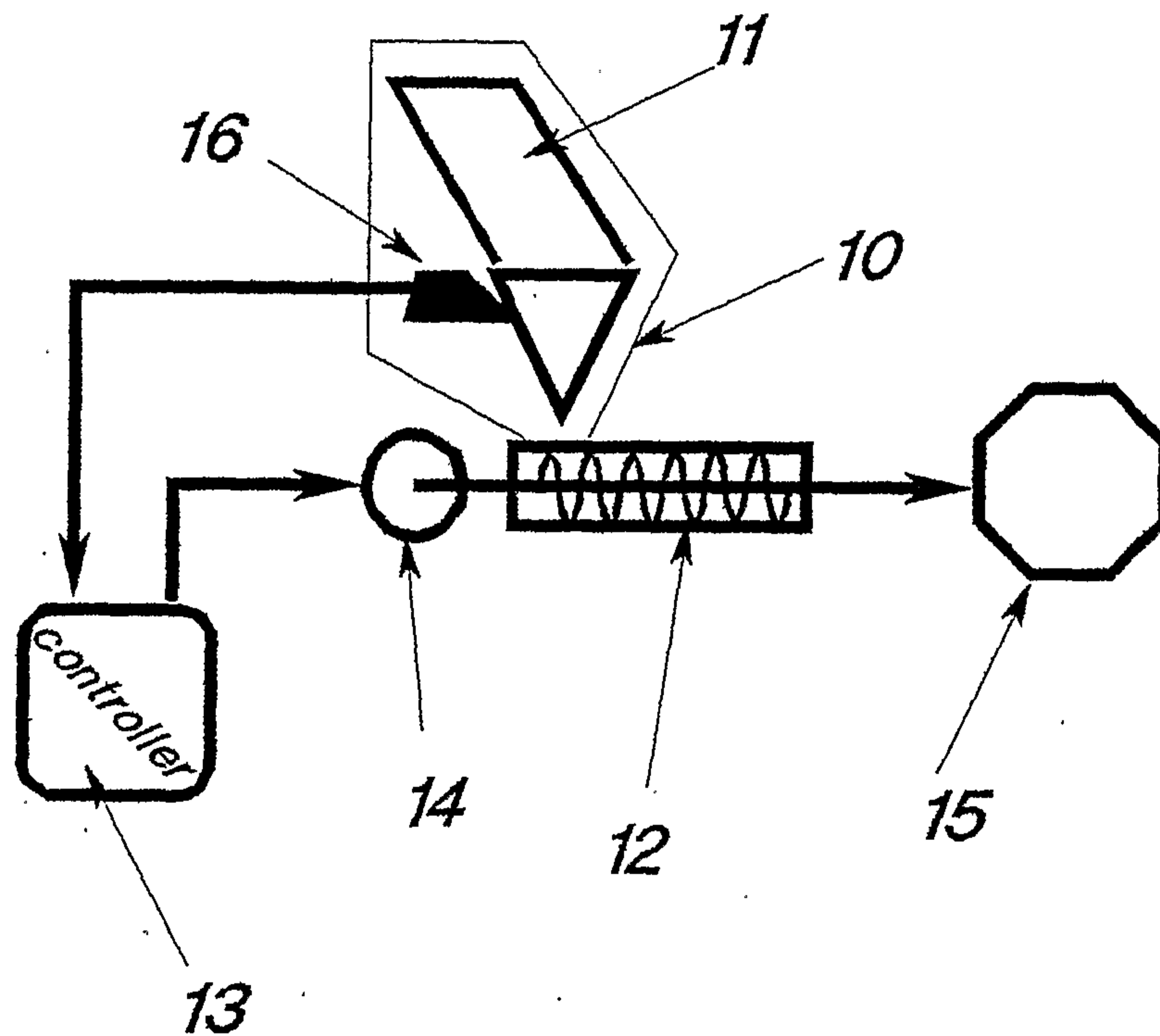


FIGURE 1

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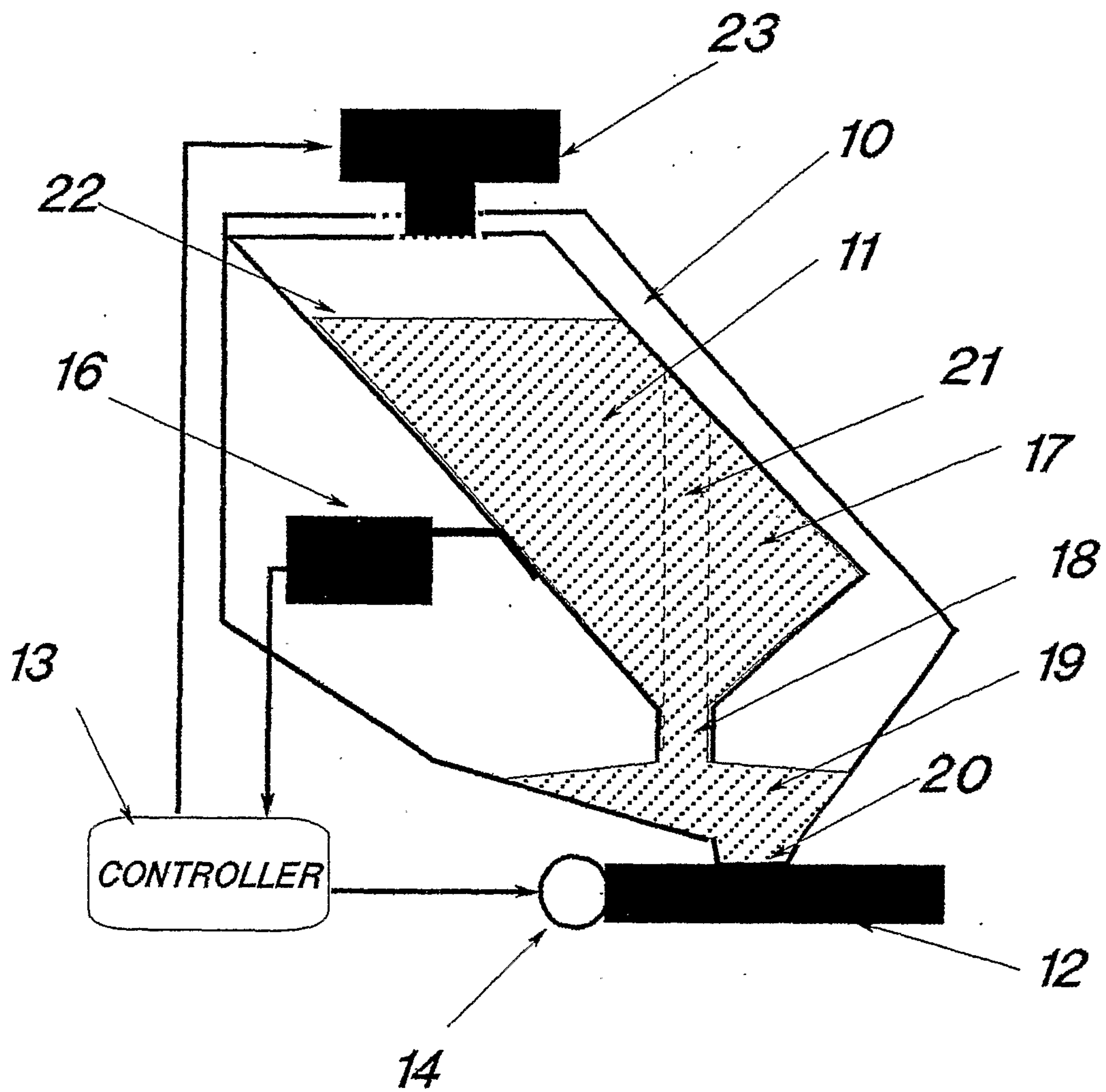


FIGURE 2

