United States Patent [19]

Ivanovich

[11] **3,797,709**

[45] **Mar. 19, 1974**

[54] **VOLUMETRIC METERING APPARATUS**

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[22] Filed: **July 12, 1972**

[21] Appl. No.: **271,189**

[30] **Foreign Application Priority Data**

July 12, 1971 U.S.S.R. 1675700

[52] **U.S. Cl.** **222/194,** 222/334

[51] **Int. Cl.** **B67d 5/54**

[58] **Field of Search** 302/49; 222/194, 373, 334, 222/361

[56] **References Cited**

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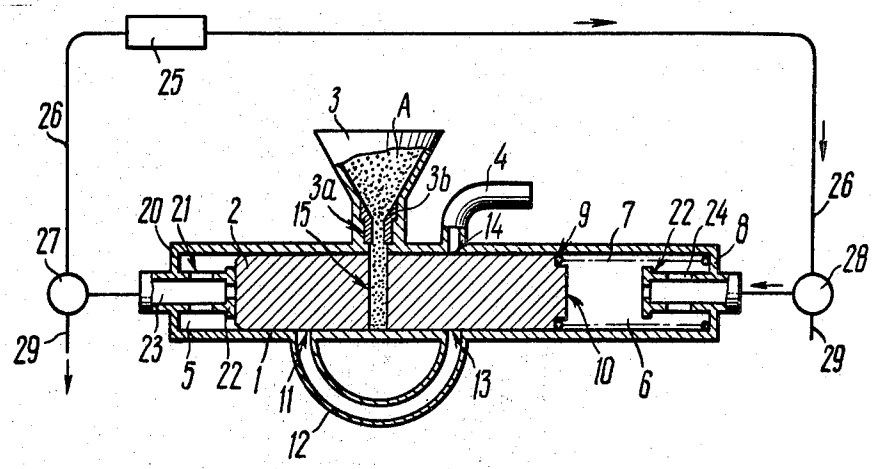
Primary Examiner—Evon C. Blunk
Assistant Examiner—H. S. Lane
Attorney, Agent, or Firm—Holman & Stern

[57] **ABSTRACT**

An apparatus is disclosed comprising a cylindrical body housing a plunger having a measuring space which, as the plunger is moved by compressed gas, in one of its extreme positions communicates with a feed hopper, while in the other extreme position of the plunger, the measuring space communicates simultaneously with a discharge standpipe and a plenum space in the body in order that the metered material may be blown out of the measuring space by compressed gas.

5 Claims, 4 Drawing Figures



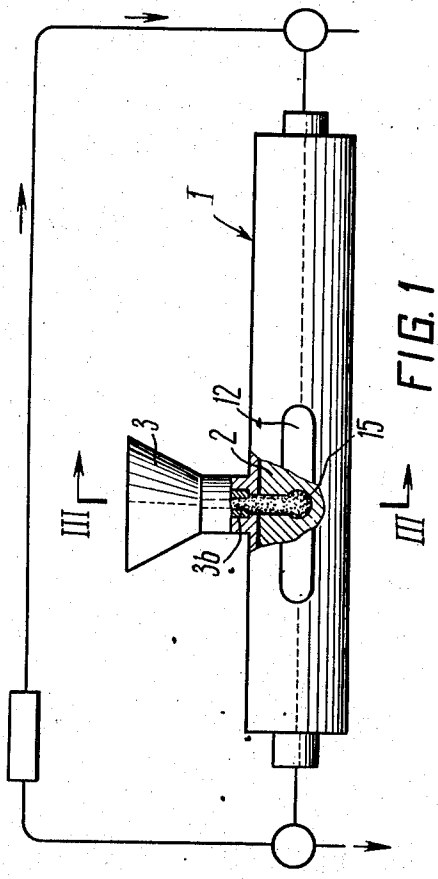
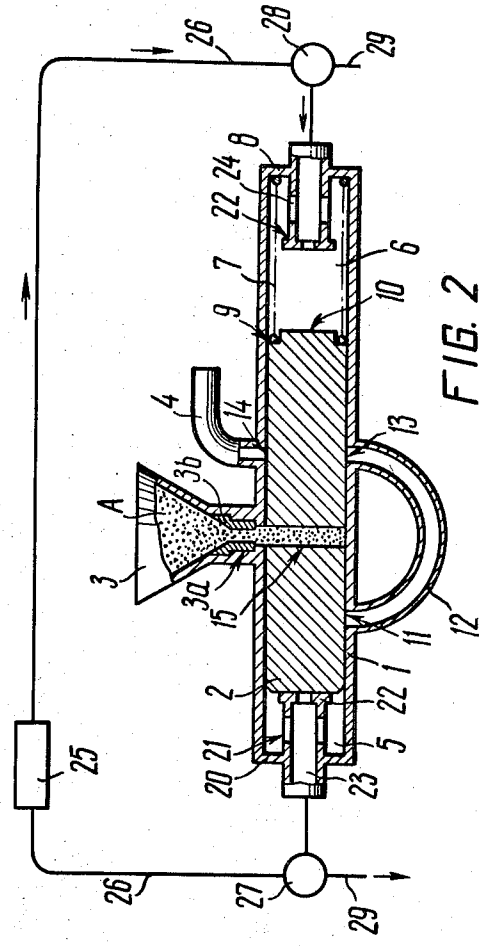

I
12
3
2
15
III
III
3b

FIG. 1


26
28
29
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3b
A
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FIG. 2

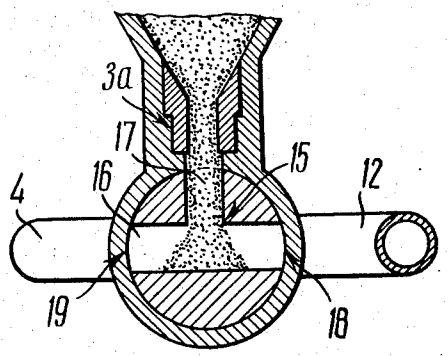

FIG. 3

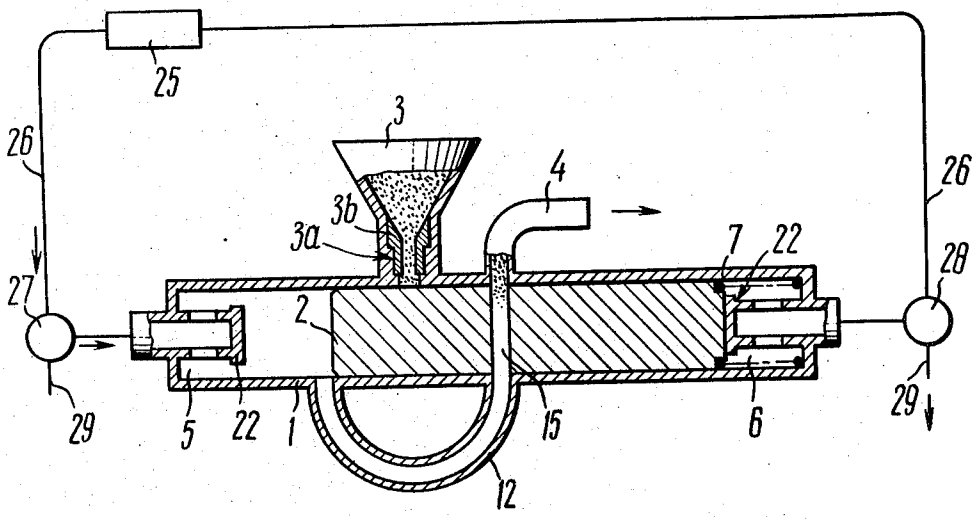

FIG. 4

VOLUMETRIC METERING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates generally to an apparatus for transferring, in metered quantities and at a high rate, liquid and finely divided solid materials from one pressure-temperature zone to a zone of higher pressure and temperature, and more particularly to a volumetric metering apparatus.

There are numerous physical, chemical and other processes which are operated at elevated pressures and temperatures and require stringent metering of liquid or finely divided solid materials utilized either as raw material or as a catalyst for the reaction, or else as a regulating vehicle to obtain some specified properties of the product.

In some cases, as while polymerizing synthetic rubber, solid materials (raw material and catalyst) are to be blended with a suitable liquid regulator and agitated to form a desired paste which is then injected in metered amounts into the reaction zone of high pressure and temperature.

This invention may be most successfully employed in apparatus for explosion treatment of materials, in particular for applying by explosion protective coats of both refractory and low-temperature materials.

Those skilled in the art know metering devices of various purposes, such as star feeders, multiple high pressure lock hoppers, all of which supply the material in metered quantities to the reaction zone.

Thus, there exist apparatus for transferring finely divided solids, as for example coal powder.

Such devices comprise a casing wherein there is a plunger member coupled with a mechanical or other type of drive means by way of a coupling member. The charged material is fed by compressed air to a measuring space defined between the end of the casing and the end of the plunger member.

Thus, the transfer of a metered amount of the finely divided solid material to the reaction zone consists in a longitudinal displacement of the plunger, with air from a separate source being simultaneously blown in through annular passages disposed between the casing and the plunger. The plunger is retracted to its feed (or discharge) position by a special drive means (cf U.S. Pat. No. 3,400,985).

A serious disadvantage of such apparatus is their inability to provide an adequate degree of precision in material metering insofar as the measuring space design features permit a certain quantity of material to stay in it after discharge in spite of an arrangement for additional scavenging of the measuring space.

Besides, typical of such devices is a considerable loss of driving power to overcome friction between the sealing and the plunger arising while the plunger is in motion, as well as a considerable rate of compressed air consumption, which adversely increases power requirements.

Yet another disadvantage of such devices is their complex design which includes additional intermediate members to compensate for the coupling rod displacement arising while the plunger is in motion.

Still another disadvantage consists in that the considerable number of mechanical elements required by the construction of such devices reduces their overall reliability.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a volumetric metering apparatus having a measuring space such that would ensure precise metering of material with a minimal consumption of power for the transfer of the metered material to a zone of high pressure and temperature.

Accordingly, there is provided a volumetric metering apparatus comprising a hollow cylindrical body communicating with a feed hopper and with a discharge standpipe, wherein compressed air imparts a reciprocal motion to a plunger transferring thereby a quantity of the material which fills the measuring space.

According to the invention, the measuring space is provided in the plunger such that in one of the latter's extreme positions it communicates with the feed hopper and is charged, while in the other extreme position of the plunger stuffing box the measuring space communicates simultaneously with the discharge standpipe and with a plenum space of the cylinder, wherefrom compressed air is supplied to blow the material from the measuring space into the discharge standpipe.

Such a design, on the whole simplifying the apparatus embodiment, permits precise metering of the material.

It is preferred that the plenum space of the clylinder should communicate, via a conduit, with a through passage in the cylinder body aligned with the discharge standpipe hole.

It is also preferred that the measuring space should be T-shaped, with one end thereof communicating at the instant of charging with the feed hopper, while the other two ends of the T-shaped measuring space communicate at the instant of discharging with passages in the body of the cylinder communicating, one with the plenum space, the other with the discharge standpipe.

Such an embodiment allows precise material metering, strict fixation of a batch in the measuring space, as well as displacement and blowing out of the batch into the discharge standpipe with compressed gas from one source.

There may be bushings fitted into the cylinder ends to limit the extreme positions of the plunger and having passage means for the supply and venting of compressed gas.

The cylinder space opposite the plenum space may be fitted with a spring retracting and fixing the plunger in the charging position.

Such an arrangement provides for a reliable operation of the apparatus.

In order that the plunger should be speedier retracted to the charging position, the cylinder space housing the spring may periodically communicate with the compressed air source.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood from the following description of one of the possible embodiments thereof taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a schematic representation of a volumetric metering apparatus in accordance with the present invention;

FIG. 2 is a longitudinal section of the apparatus of FIG. 1 in the charging position;

FIG. 3 is a sectional view taken along the line III—III of FIG. 1; and

FIG. 4 is a longitudinal section of the apparatus of FIG. 1 in the discharging position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The apparatus is intended for volumetric metering of, above all, finely divided powdered materials in installations requiring accurate batching and subsequent transfer of the batch to the reaction chamber of high pressure and temperature.

The apparatus according to this invention comprises a gas-tight hollow cylindrical body **1** closed at both ends (FIG. **1**) housing a plunger whereto compressed gas imparts a reciprocal motion.

A feed hopper **3** and a discharge standpipe **4** (FIG. **2**) which communicate in common with the inner space of the body **1** are mounted on the cylindrical part of the body **1**, with the standpipe **4** being disposed in a plane normal to the axis of the feed hopper **3** (in FIG. **2** the standpipe **4** is shown superposed on the drawing plane).

The plunger **2** divides the inner space of the body **1** into two spaces: A plenum space **5** whereto compressed gas is supplied, and an opposite space **6** which houses a spring **7** one end whereof rests against an end **8** of the body **1**, while the other end of the spring rests against an annular recess **9** on end **10** of the plunger **2**.

The plenum space **5**, via an annular conduit **12** fitted in a hole **11** of the body **1** (conduit **12** in FIG. **2** is shown turned), communicates with a through passage **13** in the body **1** which is aligned with an inlet hole **14** of the discharge standpipe **4**.

A changeable bushing **3***b* is fitted in a feed line **3**a of the hopper **3**. The batch size can be varied by choosing bushings **3***b* of an appropriate diameter.

A T-shaped measuring space **15** (FIG. **3**) defined by two intercommunicating passages: a diametrical through passage **16** and a radial passage **17** perpendicular thereto, is formed in the plunger **2**.

The radial passage **17** of the measuring space **15** at the charging instant communicates with the feed line **3***a* of the hopper **3**, whereas the diametrical passage **16** of the measuring space **15** at the instant of discharging (FIG. **4**) communicates by way of one end **18** thereof (FIG. **3**) with the passage **13** (FIG. **2**) in the body **1** and via the annular conduit **12** with the plenum space **5**, while communicating by way of the other end **19** thereof (FIG. **3**) with the inlet hole **14** (FIG. **2**) of the discharge standpipe **4**.

Ends **20** and **8** of the body **1** are fitted with bushings **21** and **22** which define with their inner end faces the extreme positions of the plunger **2** and which have passages **23** and **24** for the supply and venting of compressed gas.

As can be seen from FIG. **2**, when the plunger **2** is in the extreme left position the distance between the feed hopper **3** and the inner end face of bushing **22** is equal to twice the length of the stoke of the plunger. This distance is shown to be $2h$ (h indicates the length of the stroke). Also, the distance between the discharge standpipe **4** inner end face bushing **22** is equal to 3 times the length of the stroke which is shown to be $3h$.

Further, in FIG. **2** the hole **11** of the annular conduit **12** can be seen to be located at a distance equal to the length of the stroke from the inner end face of bushing **22**. This distance is indicated by h. Passage **13** of the annular conduit **12** is also located at a distance equal to 3 times the length of the stroke of the plunger from the inner end face of bushing **22**.

The apparatus is actuated by compressed gas supplied from a source **25** through pipes **26** fitted with electromagnetic control valves **27** and **28**.

The feed delivery pipes **26** carry compressed gas to the plenum space **5** and to the space **6** of the body **1**, while through vent pipes **29** exhaust gas escapes into the atmosphere.

The volumetric metering apparatus disclosed herein operates on the following principle.

In the initial position (at the instant of charging), the plunger **2** is in the extreme left position (FIG. **2**) at the end **20** of the body **1** wherein it is fixed by the spring **7**. In this position, the measuring space **15** is aligned by way of its passage **17** with the feed line **3***a* of the hopper **3** and is filled with a batch of material A.

As the electromagnetic control valve **27** is opened, compressed gas is fed from the source **25** through the feed delivery pipe **26** to the passages **23** and **24** of the bushing **21** and therefrom to the plenum space **5**.

Acted upon by compressed gas, the plunger stuffing box **2** starts moving to the right until it leans against the end of the bushing **22**, thereby compressing the spring **7** and letting the gas from the space **6** of the body **1** escape into the atmosphere through the electromagnetic valve **28**.

As the plunger rests against the bushing **22** with its end **10**, the measuring space **15** will get aligned by way of its passage **16** with the annular conduit **12** and the discharge standpipe **4**.

In this position, the plunger **2** opens the hole **11** in the body **1**, compressed air will rush at a great velocity into the annular conduit **12** and blow the powder from the measuring space **15** into the discharge standpipe **4**.

After that the valve **27** closes, switching to a draining mode, while the valve **28** opens, thereby letting compressed gas into the space **6** of the body **1**.

Under the pressure of compressed gas in the space **6** and acted upon by the spring **7**, the plunger **2** returns to its extreme left position until it rests against the end of the bushing **21**. From the plenum space **5** the gas is forced to escape to the atmosphere through the vent pipe **29**.

The measuring space **15** is again aligned by way of the passage **17** with the feed line **3***a* of the hopper **3**, whereupon the above-described cycle is repeated.

Such a working cycle can be repeated several times per second. What is claimed is:

1. A volumetric metering apparatus comprising:

a hollow cylindrical body closed at both ends;

a plunger disposed in the inner space of said body and dividing the same into two plenum spaces communicating with a source of compressed gas, said plunger being reciprocated within the inner space of said body under the effect of the compressed gas applied into said plenum spaces of said body;

a feed hopper communicating with the inner space of said body and mounted thereon at a distance from one of the inner end faces thereof which is equal to twice the length of the stroke of said plunger;

a discharge pipe communicating with the inner space of said body and mounted thereon at a distance from said inner end face which is equal to 3 times the length of the stroke of said plunger stuffing box;

an arcuate pipe having both ends thereof communicating with the inner space of said body, one of said

ends being disposed with respect to said inner end face of said body at a distance equal to the length of the stroke of said plunger, the other end being disposed at a distance equal to 3 times the length of the stroke of said plunger said discharge pipe and said arcuate pipe being disposed in a common plane normal to the axis of said hopper; and

a measuring space defined in said plunger so that in one of its extreme positions at said inner end face that communicates with said feed hopper wherefrom it is charged, while in the other extreme position of said plunger it communicates similtaneously with said discharge pipe and, via said arcuate pipe, with said plenum space located at said inner end face of said body, wherefrom compressed gas is supplied to blow the material from said measuring space into said discharge pipe.

2. An apparatus as claimed in claim 1, wherein said measuring space has a T-spaced configuration and is defined by two interconnecting passages, one of which being a diametrical passage and the other being a radial one, said diametrical passage being of a through-type communicating at the moment of discharging with the plenum space located at said inner end face of said body by means of said arcuate pipe at one end, while the other end communicates with the discharge pipe, said radial passage of said measuring space being disposed normally through said diametrical passage and communicating with said hopper at the moment of charging.

3. An apparatus as claimed in clain 1, wherein both end faces of the body are fitted with bushings defining the extreme positions of the plunger and having passages for supplying and discharging compressed gas.

4. An apparatus as claimed in claim 1, wherein the plenum space located opposite the inner end face of said body houses a spring facilitating the return of the plunger and its retention in the charging position.

5. An apparatus as claimed in claim 4, wherein the plenum space of said body space housing said spring communicates periodically with the compressed gas source to accelerate the return of the plunger to the charging position.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3797709 Dated March 19, 1974

Inventor(s) Anatoly Ivanovich Zverev

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

[75] Inventor:

ANATOLY IVANOVICH ZVEREV

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

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* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334