June 11, 1968 F. R. HUNTINGTON 3,387,497

MATERIAL SAMPLING APPARATUS

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FIG. 1.

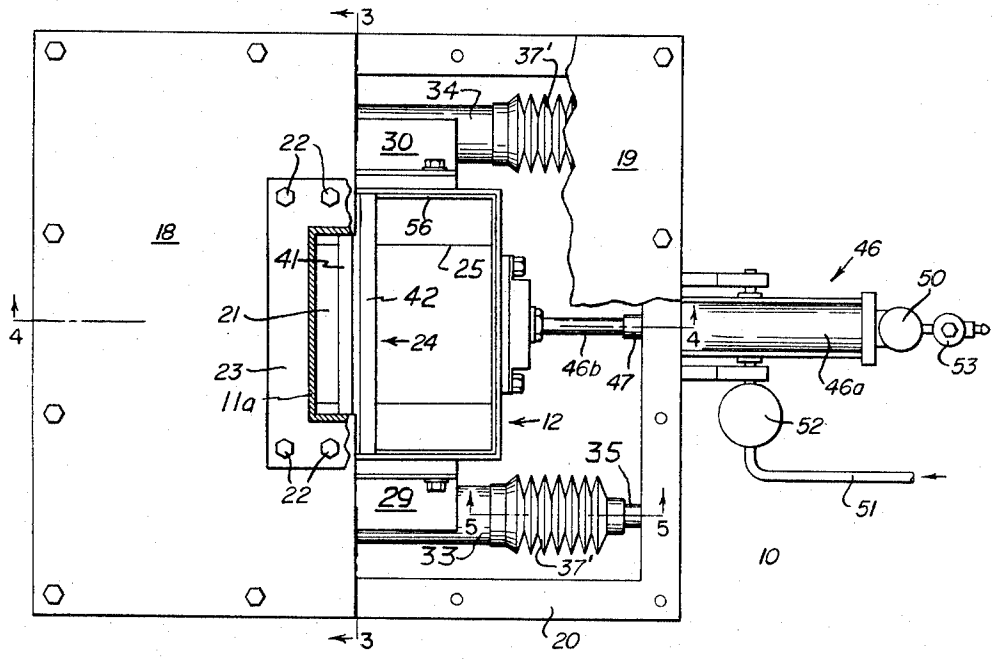

FIG. 2.

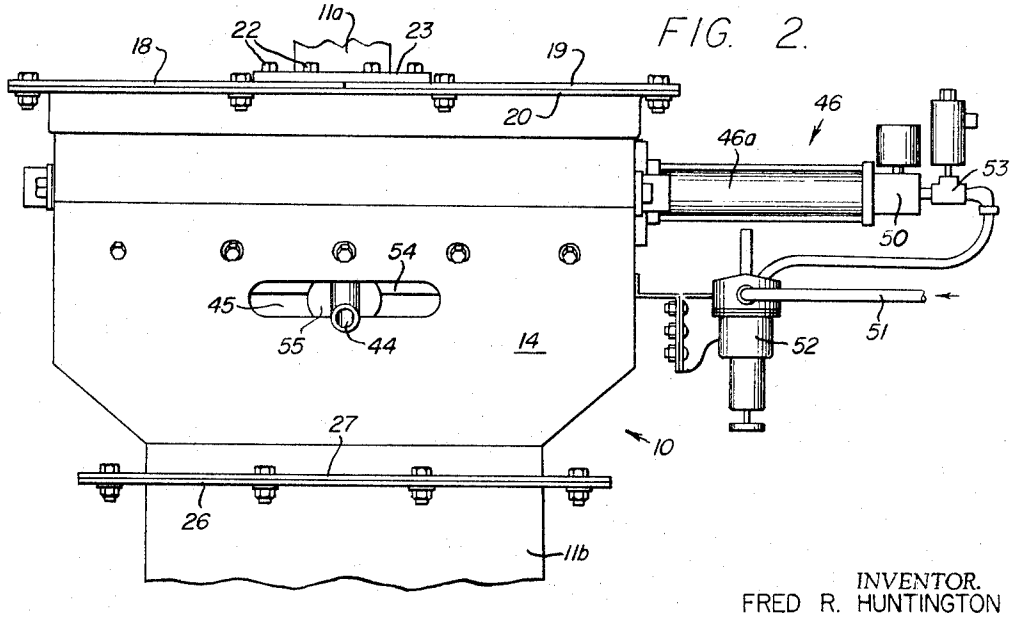

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FIG. 3.

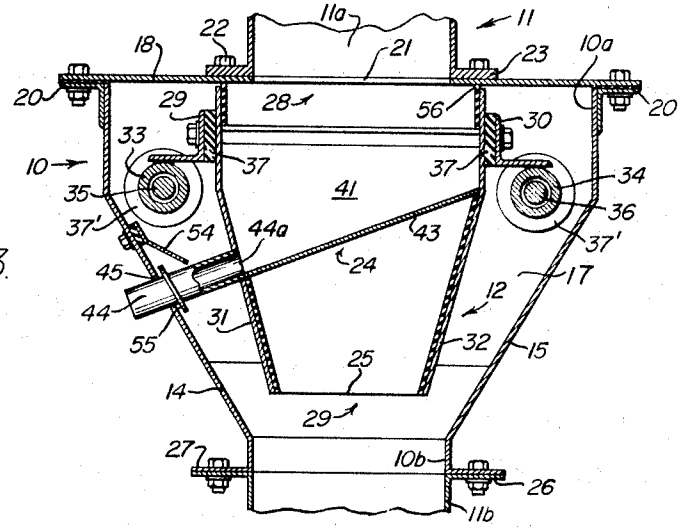


FIG. 4.

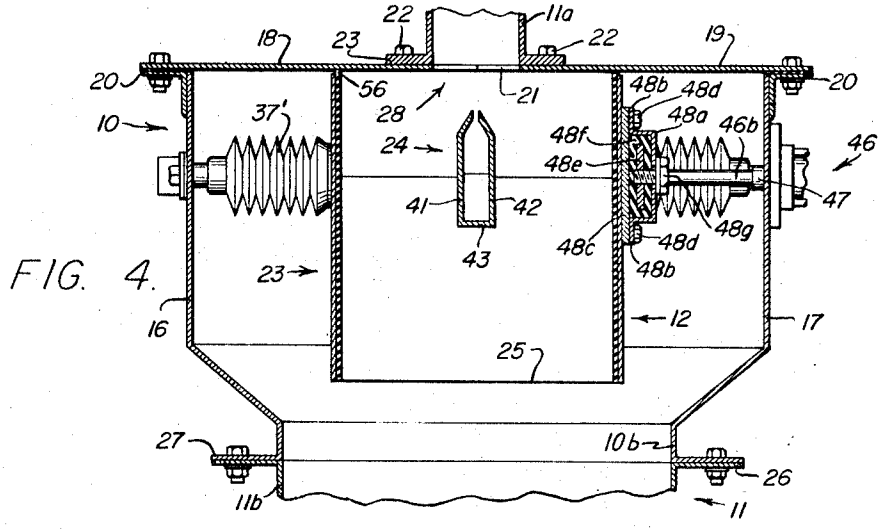
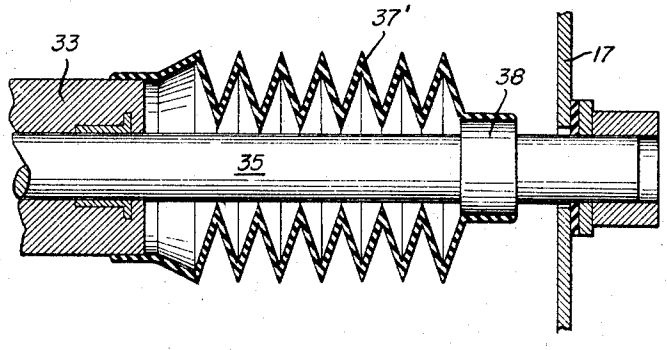


FIG. 5.



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MATERIAL SAMPLING APPARATUS

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10 Claims. (Cl. 73—423)

ABSTRACT OF THE DISCLOSURE

Apparatus for obtaining periodic samples from a flowing stream of material, while protecting the samples and sampling mechanism from splash. A sampling hopper is mounted in and under protective structure for reciprocation across an inlet opening through the cover of such structure in substantially sealing contact with the undersurface of such cover. A sample cutter is mounted in the sampling hopper, across the material receiving opening thereof, for cutting through material that passes from the inlet opening of the protective cover down through the sampling hopper. In its reciprocation, the sampling hopper carries the sample cutter entirely through the stream of flowing material, from one extreme position of such hopper to the opposite extreme position. The mechanism which mounts and reciprocates the sampling hopper in the protective structure is itself advantageously protected by flexible sleeves. The protective structure is preferably a housing enclosing the sampling hopper and its mounting mechanism, and the sample cutter has a discharge pipe that extends through and reciprocates along a slot in a wall of the housing. Splash deflection plates are provided for the pipe internally of the housing to prevent contamination of the discharged samples.

This invention relates to sampling devices adapted to periodically obtain representative samples of flowing materials, either dry, semi-liquid, or liquid, for example, various metallurgical materials, by cutting through streams of such materials at predetermined intervals. The samples so obtained are analyzed, and the analytical results are used to determine how processing and other material treatment and handling procedures are to be applied.

Many such sampling devices include cutters that are reciprocated rectilinearly through a flowing stream of material, so as to obtain truly representative samples.

The industrial materials involved often contain abrasive fines that settle upon or spill onto the guide structure for the cutter, causing excessive wear and preventing smooth and rapid travel of the sample cutter. Moreover, the material is often corrosive, and, if splashed or deflected during the sampling operation, as often happens, can similarly damage the guide structure. Movement of the sample cutter must be smooth and rapid if truly representative samples are to be obtained.

A common problem with such sampling devices in addition to the above is that dust and splashed or deflected liquids and semi-liquids can be discharged with the sample, thereby providing erroneous analyses and inaccurate control.

A principal object of the present invention is to provide material sampling apparatus that is substantially free of the aforementioned difficulties.

An outstanding feature of the invention is the provision of a sample cutter in fixed position within a funnel-like sampling hopper, which is, itself, mounted within a larger, funnel-like, support hopper for reciprocation across the flow passage thereof. The larger support hopper is adapted to be interposed in a flow system for the material to be sampled, so the material flowing through such system must enter the smaller sampling hopper. By reason of the reciprocative movement of the smaller hopper, the sample cutter fixed therein is passed into, through, and out of the stream of flowing material periodically.

The mechanism for reciprocating the sampling hopper extends through the support hopper, but is outside the sampling hopper, so as to be shielded from the flowing material at all times, even when the sample cutter is passing through the flow stream. Thus, there is practically no opportunity for splash of material onto the drive mechanism of the sampling apparatus.

In conjunction with the shielding afforded by this arrangement of hoppers, it is advantageous and a feature of the invention that seals be provided between the sampling hopper and the support hopper and around the guiding and supporting structure for the sampling hopper.

Although it is much preferred that the sampling apparatus be constructed so that the sampling hopper, and thus the sample cutter, is moved rectilinearly, this not necessarily so; other types of movement can be used if desired within the broader purview of the inventive concepts concerned.

There is shown in the accompanying drawings a specific embodiment of the invention representing what is presently regarded as the best mode of carrying out the generic concepts in actual practice. From the detailed description of this presently preferred form of the invention, other more specific objects and features will become apparent.

In the drawings:

FIG. 1 is a top plan view of the illustrated embodiment of the invention;

FIG. 2, a front elevation;

FIG. 3, a vertical section taken on the line 3—3 of FIG. 1;

FIG. 4, a similar view taken on the line 4—4 of FIG. 1; and

FIG. 5, a fragmentary vertical section taken on the line 5—5 of FIG. 1 and drawn to a larger scale, the view showing a typical boot seal advantageously used to provide maximum protection for the supporting guide rods employed to mount the sampling hopper for its reciprocative movement.

Referring now to the drawings:

In the illustrated preferred embodiment, the invention includes a support hopper **10** that is adapted to be connected between sections **11***a* and **11***b*, FIG. 2, of a conduit **11** that is part of a flow system for the material to be sampled. As shown, the conduit sections are of mutually similar rectangular configuration, but are oppositely oriented, so as to cross each other.

Support hopper **10** is formed to funnel material from conduit section **11***a* into conduit section **11***b* and, also, to house a smaller, sampling hopper **12**, as well as guide means which support such sampling hopper **12** for reciprocative movement within the confines of the larger hopper **10**. As so formed, support hopper **10** has a large inlet end **10***a* and a small outlet end **10***b* provided by opposed side walls **14** and **15** that have long sloping portions, see FIG. 3, and by opposed side walls **16** and **17** that have short sloping portions, see FIG. 4.

A pair of cover plates **18** and **19** are bolted to a flange **20** at the inlet end and are easily removed to allow access to the interior of the support hopper. A central inlet opening **21** is formed through the cover plates for registry with the interior of conduit section **11***a*, and such conduit section is secured to the cover plates as by means of bolts **22** passed through a flange **23** at the attachment end of such section.

The material to be sampled flows through conduit section **11***a* and opening **21** into sampling hopper **12**, where, depending upon the position of such sampling hopper

relative to its support hopper 10, it may partially pass into a cutter 24, carried by and in fixed relation to sampling hopper 12. When the sampling hopper is at either termination of its reciprocative stroke, i.e., in a reject position, the material entirely by-passes the cutter and passes on through the sampling hopper and out the lower end 25 thereof into conduit section 11*b*, as does that portion of the stream of material that does not enter sample cutter 24 during the sampling procedure. A flange 26 is fixed to the end of section 11*b* and is bolted to a mating flange 27 surrounding the outlet end 10*b* of the support hopper 10.

Sampling hopper 12 is considerably smaller than support hopper 10 but, preferably, is also tapered from a receiving end 28, that is considerably larger than the central inlet opening 21 formed between plates 18 and 19, to the lower discharge end 25.

Parallel angles 29 and 30 are respectively fixed to oppositely facing side walls 31 and 32 of the sampling hopper and to sleeve members 33 and 34 that slidably telescope over guide rods 35 and 36. A resilient pad 37 is provided between each of the angles 29 and 32 and its respective side wall 31 or 32 to absorb shock and to compensate for any slight misalignment of the parts.

Guide rods 35 and 36 extend between and have their ends fixed to the oppositely facing side walls 16 and 17 of the support hopper and are substantially parallel with the undersurfaces of top plates 18 and 19.

An expansible boot 37 is sealed to each of the ends of the sleeve members 33 and 34 and the other end of each boot is sealed to a bushing member 38 tightly fitted on the corresponding guide rod 35 or 36 adjacent to the side wall of the support hopper.

Sampling hopper 12 and sleeve members 33 and 34 are so dimensioned that as they are reciprocated and the sleeve members move back and forth on rods 35 and 36 respectively, between the limits imposed by their bushing members 38 and the expansible boots 37, the cutter 24, which bisects and extends between the side walls 31 and 32 of the sampling hopper, is moved from an extreme position beneath plate 19 across the central inlet opening 21 to another extreme position beneath plate 18 and back again.

Cutter 24 has a narrow inlet opening, the size of which is governed by the material to be sampled. The opening is formed between walls 41 and 42 that extend completely across central inlet opening 21 of the support hopper, between the side walls 31 and 32 of the sampling hopper, and from adjacent the receiving end 28 downwardly to an inclined discharge plate 43. An outlet pipe 44 is fixed into an opening 44*a* through the side wall 31 of the support hopper, between walls 41 and 42 of the cutter, and protrudes downwardly at the same angle as inclined discharge plate 43 through a slot 45 in the corresponding side wall 14 of the support hopper.

Slot 45 allows the pipe 44 to move freely as hopper 23 is reciprocated.

Although other drive means could be used, the pneumatic cylinder 46 provides an excellent drive means for the sampling hopper 23. Thus, the cylinder housing 46*a* is fixed to the exterior of side wall 14 of the support hopper and the cylinder rod 46*b* passes through the wall and a wiping seal 47 carried thereby before being connected at 48 to a side wall 49 of the movable hopper. The rod 46*b* is wiped by a seal 47 each time it is reciprocated so that no dust particles or splash can accumulate thereon. Connection 48 includes a cover plate 48*a*, having flanges 48*b* adapted to be held against a plate 48*c* on the side wall 49 by bolts 48*d*. The rod 46*b* then extends freely through the cover plate and is threaded into a collar 48*e* that is surrounded by a resilient cushion 48*f*. In this manner any binding or undue wear of the rod 46*b* that might result from a mis-alignment of the sampling hopper and the cylinder 46 is avoided. A nut 48*g* on rod 46*b* is tightened against plate 48*a* to hold the sampling hopper on the rod.

The pneumatic cylinder is of conventional, double acting type, wherein air pressure applied through a solenoid valve 50 to one side of a piston in the housing 46*a* will bias the rod 46*b* to its retracted position, thereby moving hopper 12 until the cutter 24 is beneath plate 19. Supply of air through conduit 51, moisture trap 52, pressure regulator 53, and the solenoid valve 50 to the other side of the piston in housing 46*a* expels rod 46*b* and moves hopper 12 to position cutter 24 beneath plate 18.

A conventional timer control, not shown, can be used to regulate solenoid valve 50 to provide for proper supply and exhaust of pressurized air that will periodically expel or retract rod 46*b*, carrying with it the sampling hopper and the cutter and thereby diverting a sample of the material flowing through conduit 11 through the cutter each time the hopper is moved to one of its extreme positions.

To further prevent dust particles or splash being discharged with the sample carried from the support hopper, a shield 54 (FIGS. 2 and 3) is fixed to the interior of the wall 14 containing slot 45. This shield extends out and downwardly toward pipe 44 to deflect material away from the slot and towards the outlet end 10*b* of the support hopper and overhangs a plate 55 fixed as a collar on pipe 44. Thus, any material deflected by shield 54 onto pipe 44 is prevented by plate 55 from running down the pipe and out slot 45.

A flexible liner 56 on the inside of the sampling hopper extends upwardly beyond the ends of its walls to form a seal with plates 18 and 19 as the hopper 20 is reciprocated. This seal, which may be made of rubber, greatly reduces the amount of dust particles and splash that can get outside the sampling hopper and inside the support hopper. However, should any such material get through the seal formed by liner 56, it will be deflected by shield 54 and plate 55 to pass through the outlet end 13 of support hopper 10 and it will not mix with and contaminate the sample that is taken by cutter 24 and discharged through pipe 44.

In operation, the rod 46*b* will normally be retracted, with the sampling hopper 12 moved to one of its extreme positions wherein cutter 24 is out of the flow of material through the hoppers and is positioned beneath plate 19. The material flowing from section 11*a* through the hoppers to section 11*b* of line 11 then falls freely past one side of the cutter.

Solenoid valve 50 is actuated, as by a timer, not shown, to allow air to be supplied to cylinder 46 such that rod 46*b* is expelled and sampling hopper 12 is rapidly driven to its other extreme position wherein the cutter 24 is beneath plate 18 and is again out of the path of flow through the hoppers. As the sampling hopper is moved from beneath plate 19 to beneath plate 18 the material entering the narrow cutter opening formed between walls 41 and 42 is directed by inclined discharge plate 43 and pipe 44 through wall 14 of support hopper 10 and into a receiving vessel, not shown, but positioned for the purpose.

When valve 50 is again actuated by the timer, air is supplied to and exhausted from cylinder 46 to retract rod 46*b*. This again moves hopper 12 between its extreme positions, and moves cutter 24 from beneath plate 18 through the path of material flowing through conduit 11 and the hoppers to its position beneath plate 19. During this movement of hopper 12 the material entering cutter 24 is again discharged through wall 14 of hopper 10 and into a receiving vessel positioned to catch material discharged from pipe 44.

With pressure regulator 53 governing the air pressure applied and the cylinder being selected such that the areas acted on by the air on both sides of the piston are equal, the same rate of travel of the sampling hopper is maintained during both expulsion and retraction of rod 46*b*.

Although it has been convenient to refer to the housing

10 for the sampling hopper 12 as a "support hopper," it is quite apparent that the "hopper" or "funnel" configuration of the housing 10 is, as illustrated, merely an advantageous arrangement for protectively supporting the sampling mechanism.

Actually, it is clear from the foregoing description and from the drawings that housing 10 does not serve as a hopper or funnel in a functional sense. No material flow is "funnelled" through it. Accordingly, it will be clear that "support hopper" or housing 10 serves merely a supporting and protecting function with respect to the sampling mechanism and that any equivalent structure can be used for those purposes, a principal feature being the cover along whose undersurface the sampling hopper 12 moves in close sliding relationship.

Whereas there is here illustrated and specifically described a certain preferred construction of apparatus which is presently regarded as the best mode of carrying out the invention, it should be understood that various changes can be made and other constructions adopted without departing from the inventive subject matter particularly pointed out and claimed herebelow.

I claim:

1. A sampler for flowing material, comprising
a protective support which includes a cover having an inlet opening therethrough intermediate its margins, and structure depending therefrom;
a sampling hopper smaller than said cover and having a receiving opening at its top and a discharge opening at its bottom;
means mounting said sampling hopper in said depending structure so as to move in close, sliding relationship with the undersurface of said cover and across said inlet opening thereof, from one extreme position within the path of material flow through said inlet opening to an opposite extreme position also within the path of material flow through said inlet opening;
a sample cutter carried by the sampling hopper and having an elongate opening extending transverse of the direction of travel of the hopper intermediate of and across the said receiving opening thereof, so as to be in sample reject position whenever said sampling hopper is in one or the other of said extreme positions;
means for discharging, from the sample cutter, material entering the elongate opening thereof; and
means for moving the sampling hopper between its extreme positions.

2. A sampler according to claim 1, further including
a flexible seal surrounding the receiving opening of the sampling hopper, said seal protruding upwardly from the sampling hopper to be in sweeping engagement with the undersurface of the cover.

3. A sampler according to claim 1, wherein the means mounting the sampling hopper for movement comprises
guide rods fixed in the protective support;
sleeve members slidably mounted on said guide rods; and
means rigidly interconnecting said sleeve members and the protective support.

4. A sampler according to claim 3, further including
expansible seals fixed to the respective sleeve members and to the respective guide rods, whereby the guide rods are completely sealed along the lengths travelled by the sleeve members.

5. A sampler according to claim 1, wherein the protective support is an enclosing housing, and the means for discharging material entering the elongate opening of the cutter includes,
an elongate slot in the housing; and
a discharge pipe carried by the sampling hopper, protruding through said slot, and adapted to be reciprocated therein.

6. A sampler according to claim 5, wherein the sample cutter includes
an inclined bottom; and
the discharge pipe extends from the lowest level of said inclined bottom on substantially the same slope as the said inclined bottom.

7. A sampler according to claim 6, further including
a plate forming a collar on the pipe, inside of the housing; and
a shield fixed to the interior of the housing and positioned to extend outwardly from the housing and downwardly toward the discharge pipe to overlap said collar on said pipe.

8. A sampler according to claim 7, wherein the means mounting the sampling hopper for movement comprises
guide rods fixed in said housing;
sleeve members slidably mounted on said guide rods; and
means rigidly interconnecting said sleeve members and the sampling hopper.

9. A sampler according to claim 8, further including
expansible seals fixed to the respective sleeve members and to the respective guide rods, whereby the guide rods are completely sealed along the lengths travelled by the sleeve members.

10. A sampler according to claim 9, further including
a flexible seal surrounding the receiving opening of the sampling hopper, said seal protruding upwardly from the sampling hopper to be in sweeping engagement with the undersurface of the cover of the housing.

References Cited

UNITED STATES PATENTS

1,642,337	9/1927	Gray et al.	73—423
2,738,679	3/1956	Senkowski	73—423
3,298,235	1/1967	Platzer	73—423 X

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