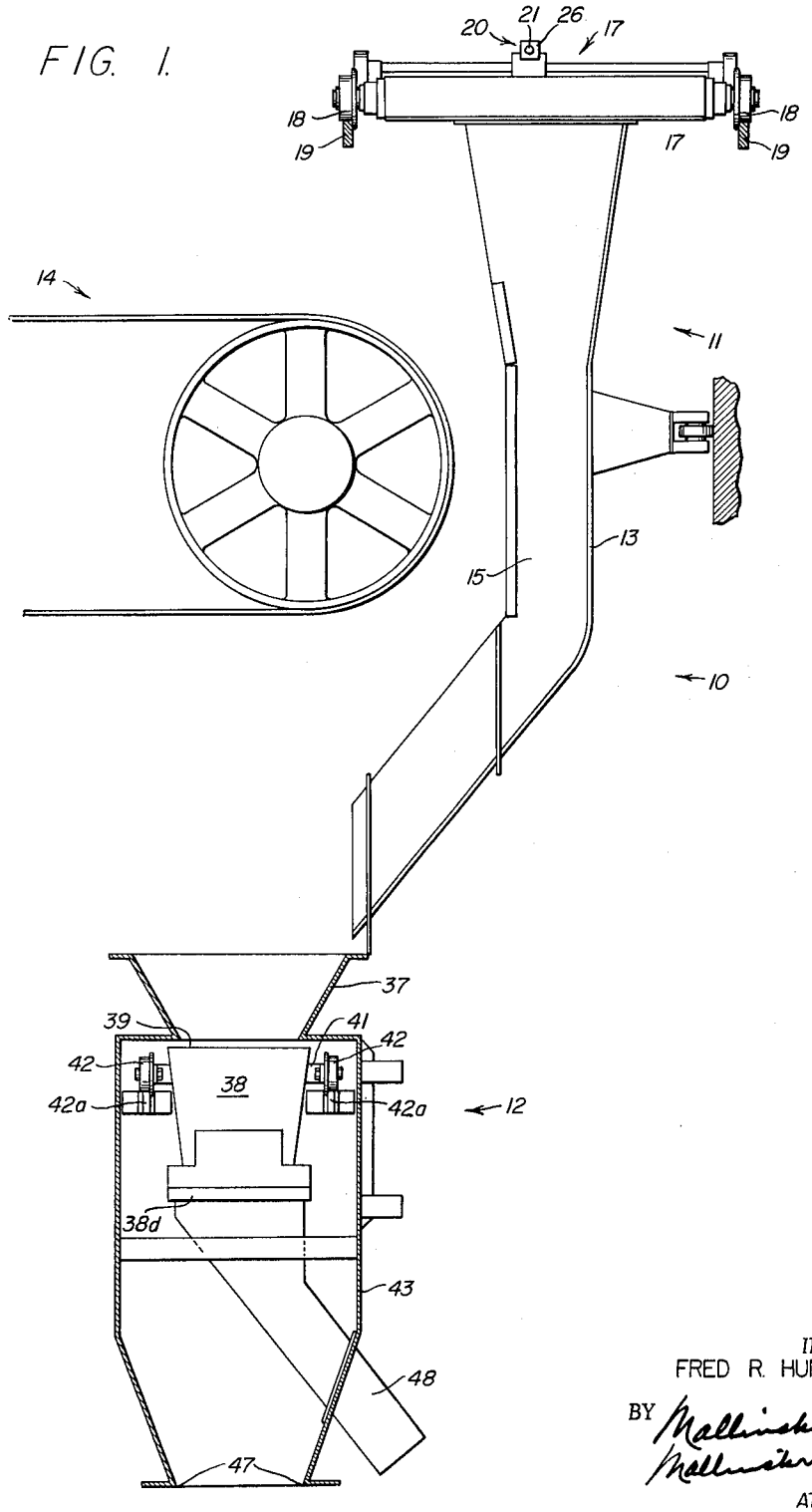
May 24, 1966 F. R. HUNTINGTON 3,252,328

MULTIPLE STAGE SAMPLER

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FIG. 1.



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MULTIPLE STAGE SAMPLER

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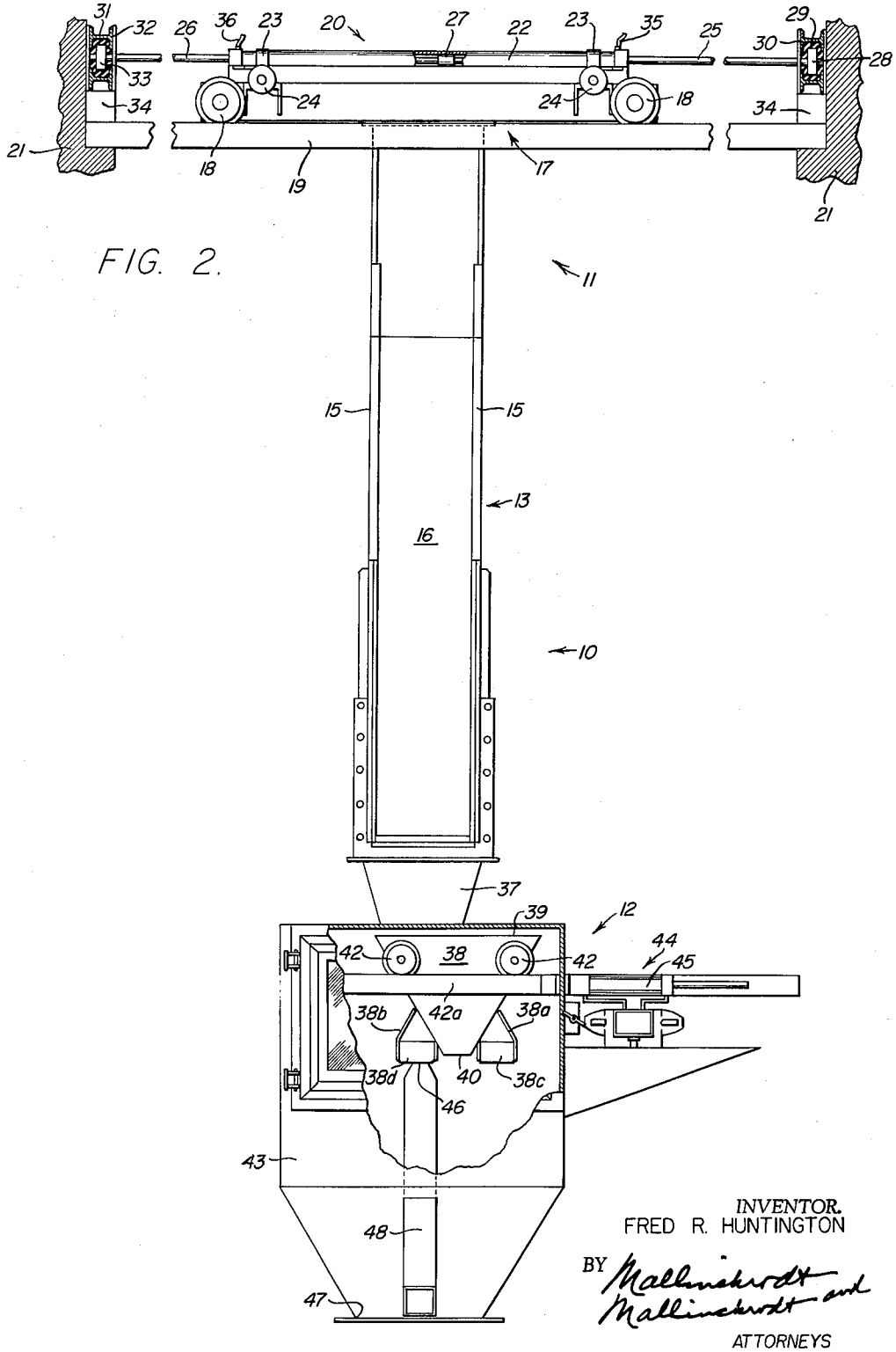


FIG. 2.

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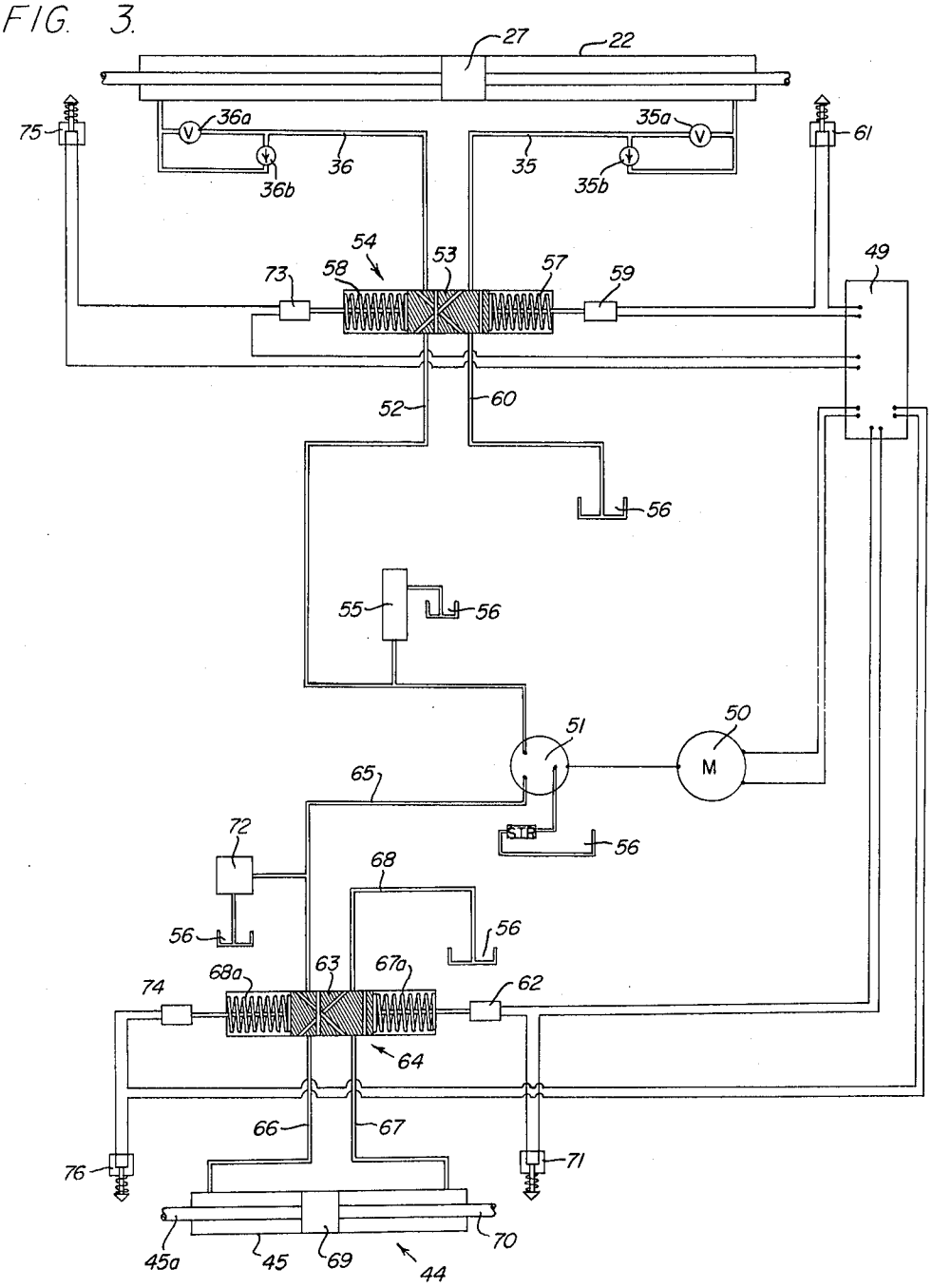
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MULTIPLE STAGE SAMPLER

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FIG. 3.



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MULTIPLE STAGE SAMPLER

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8 Claims. (Cl. 73—423)

This invention relates to multiple stage sampling devices for periodically obtaining samples of materials being transported by conveyors. More particularly, it relates to multiple stage sampling devices of a type having a movable cutter head that is periodically moved across a material flow stream to effectively "slice out" a proportionate amount of the material and having additional means to further proportionately reduce the sample size until a workable sample, truly representative of both quality and quantity of the material being conveyed, is obtained.

Known sampling mechanisms of this general type yield more accurate samples, based on a known volume relationship to the material being handled, than are obtainable by the hand methods previously used. This is especially true when the volume of material being handled is below approximately 3,000 tons per hour, so that the speed of travel of the cutter head of the sampler can be low, i.e., below approximately twelve inches per second, and still obtain an accurate sample.

With increased automation, it has become common for conveyors to carry upwards of approximately 3,000 tons per hour, and, under these circumstances, these prior samplers have proven quite unsatisfactory. Their deficiencies are even further emphasized by the continually increased need for more stringent quality control. When very large volumes of material are delivered, the slow moving cutter head becomes overloaded, causing such a backing up of material carried by the conveyor that the samples obtained are not always truly representative of either the volume or quality of the material conveyed.

Increased rates of material delivery have also magnified formerly unimportant errors. For example, slow acceleration and deceleration of the cutter head are not major problems where the volume of material being conveyed is low, but these become much more significant as the volume of material is increased and the cutter accumulates a much larger proportion of the sample from the sides of the material flow than is obtained from the center.

Errors created by the slow moving cutter heads of the first stage of these prior samplers are magnified as the sampled material passes through a chute to a feed hopper of a second stage, where a secondary cutter head moves back and forth beneath the feed hopper to further proportionately reduce the size of the sample. The error is increased, since, as the material moves through the moving chute into the large feed hopper, particles are segregated by size and the secondary cutter head does not always obtain a truly representative sample. If additional stage units are employed, the errors are even further magnified.

A principal object of the present invention is to provide a multiple stage sampler in which the cutter head of a first stage unit is moved rapidly, and with a minimum of acceleration and deceleration time, across a flowing stream of material, thus keeping to a minimum the size of sample obtained and insuring a sample truly representative as to both quality and quantity of the material being conveyed. Another important object is to prevent magnification of errors, introduced by the first stage unit, by providing a second stage unit that prevents size segregation of sample material particles as the sample is further reduced to a workable volume for test purposes.

Outstanding features of the invention include a fluid-driven cutter head, buffer means to prevent apparatus damage due to rapid acceleration and deceleration, a second stage unit having a fluid-powered, movable, tapered feed hopper cooperating with a fixed sample discharge opening, and a fluid control system for both the cutter head and the second stage movable feed hopper, means being provided in the control system for adjusting the rate of travel of the cutter head and second stage movable feed hopper as desired.

There is shown in the accompanying drawings specific embodiments of the invention representing what are presently regarded as the best modes of carrying out the generic concepts in actual practice. From the detailed description of these presently preferred forms of the invention, other more specific objects and features will become apparent.

In the drawings:

FIG. 1 is a side elevation of the multiple stage sampler of the invention, with the material conveyor shown fragmentarily;

FIG. 2, a vertical front elevation, partially broken away and shown in cross-section for clarity; and

FIG. 3, a schematic representation of the electrical and fluid control system of the invention.

Referring now to the drawings:

In the illustrated preferred embodiment, a multiple stage sampler is shown generally at **10**. It includes a first stage unit **11** and a second stage unit **12**.

First stage unit **11** includes a cutter head **13** positioned to be moved transversely across the path of materials being dumped off conveyor **14** (shown fragmentarily in FIG. 1). At its extreme positions, cutter head **13** is at one or the other side of the streamflow of material dumped off the end of the conveyor and completely out of the path of the material. Limited movement is required before the cutter head is moved into position where it deflects any of the material being conveyed.

Cutter head **13** is of channel configuration, having sides **15** and a recessed portion **16** that faces the conveyor **14** and extends downwardly to second stage unit **12**, as will be more fully explained. The cutter head is fixed to and carried by an overhead movable carriage **17**, having wheels **18** mounted thereon. The wheels ride on tracks **19** and the carriage is moved by a fluid motor shown generally at **20**.

Tracks **19** are fixed on supports **21** (shown fragmentarily) which may be of any desired configuration and which support the overhead movable carriage **17** and the cutter head.

Cylinder **22** of fluid motor **20** is fixed to movable carriage **17** by collars **23** bolted to supports **24**, and rods **25** and **26** extend outwardly from a piston **27** in cylinder **22** through the ends of the cylinder. Flange **28** at the other end of rods **25** is anchored in a rubber cushion **29** tightly held within split block **30**. A similar rubber cushion **31** within split block **32** securely anchors flange **33** at the other end of rod **25**.

The split blocks **30** and **32** are securely anchored, as by welding or the like, to supports **21** and to cross supports **34** interconnecting tracks **19**.

Supply and exhaust of fluid through conduits **35** and **36** at opposite ends of cylinder **22** will cause cylinder **22**, the carriage and the cutter head **13**, to move axially with respect to fixed rods **25** and **26**, as will be further explained.

As the cutter head cuts across the streamflow of material being dumped off the end of conveyor **14**, the material is deflected down the chute formed by sides **15** and depression **16** to the inlet hopper **37** of the second stage unit **12**.

Inlet hopper **37** guides the material to a feed hopper

38 having a wide mouth 39, some portion of which will at all times be beneath the outlet of inlet hopper 37. Feed hopper 38 tapers from mouth 39 to a reduced outlet 40, such that as material falls through the hopper it is forced into a central mass and segregation of particles, by size, is prevented. The outlet 40 is not reduced enough to restrict free flow of sampled material, however.

Feed hopper 38 is carried by carriage 41, having wheels 42 mounted thereon. The wheels ride on tracks 42*a* fixed to housing 43 of the second stage unit, and the carriage is moved by fluid motor 44, the cylinder 45 of which is fixed to the housing. Extension and retraction of piston rod 45*a* of fluid motor 44 will move the carriage and the feed hopper 38 back and forth beneath inlet hopper 37.

A sample discharge opening 46 is positioned beneath and intermediate the path of travel of the feed hopper 38 and is much smaller in size than the discharge opening 47 of second stage unit housing 43. As feed hopper 38 is moved over discharge opening 46, an amount of material dependent upon the size of opening 46 will be deflected and transported by chute 48 to an area where it can be recovered for testing purposes. The remainder of the material entering feed hopper 38 is discharged through opening 47 and preferably is returned to the stream by conventional means, not shown.

Dust build ups within housing 43 often increase the pressure within the housing, and this pressure tends to force excess dust particles out discharge opening 46 and to spoil sample quality accuracy. To prevent such difficulties, a pair of dust guards 38*a* and 38*b* are fixed to the outside of movable feed hopper 38 such that they surround discharge outlet opening 46 whenever the feed hopper 38 is moved beyond its position above the discharge outlet opening. The dust guards include rubber flaps 38*c* and 38*d* that allow them to pass over discharge outlet opening 46 and that insure an effective seal.

The operation of the unit is best explained with particular reference to the electrical and fluid control circuit, shown schematically in FIG. 3. A continuously operating timer 49 first starts motor 50 and pump 51. The pump then supplies fluid through conduit 52, valve spool 53 of solenoid actuated valve 54, and to hydraulic motor 20, or through relief valve 55 to reservoir 56, depending upon the position of the valve spool.

The valve spool is normally spring biased to a centered position by springs 57 and 58 at its opposite ends. However, energization of solenoid 59 retracts solenoid rod 60 fixed to spool 53 to move the spool to the right, as viewed in FIG. 3. This places conduit 52 in fluid communication with conduit 35 and supplies pressure fluid to the right side of piston 27, through manual contral valve 35*a* and check valve 35*b*, as viewed in FIG. 3, while exhausting fluid from the left side through conduit 36, manual control valve 36*a*, and conduit 60 to the reservoir. The setting of manual control valves 35*a* and 36*a* determines the rate of bleed of pressure from the cylinder and hence the rate of travel of piston 27. Since the piston rods are fixed, the cylinder 22 is moved to the right.

When the cylinder contacts limit switch 61, the circuit to solenoid 59 is broken, the solenoid is de-energized, and valve spool 53, under the influence of springs 57 and 58, is centered to prevent any further supply or exhaust of pressure to or from the fluid motor 20. Shortly after solenoid 59 is energized, solenoid 62 is energized to similarly move valve spool 63 of solenoid actuated valve 64 to the right. Pressure fluid is then supplied the left side of fluid motor 44 through conduits 65 and 66 and fluid in the right side is exhausted through conduits 67 and 68. Since cylinder 45 is fixed, piston 69 and piston rod 45*a* are moved to the right until piston rod 70 contacts limit switch 71 to break the circuit energizing solenoid 60 so that centering springs 67*a* and 68*a* can center valve spool 63 and prevent further fluid flow therethrough. When valve spool 63 is positioned to preclude fluid flow through the valve, any fluid pumped by pump 51 will be discharged through relief valve 72.

After both limit switches 61 and 71 have been opened and the cutter head 13 and movable feed hopper 38 have completed their movements in one direction, the circuit to motor 50 is broken at timer 49 and the motor and pump are stopped. The timer continues to run, however, and after a predetermined period of time the motor and pump are again started, after which solenoid 73 and then solenoid 74 are energized to respectively move valve spools 53 and 63 to the left, as viewed in FIGS. 2 and 3.

Movement of valve spool 53 to the left places conduits 36 and 52 and conduits 35 and 60 in fluid communication to supply pressure fluid to the left of piston 27 and to exhaust the cylinder chamber at the right of piston 27. Since the piston rods are fixed this moves the cylinder 22 and the carriage and cutter head carried thereby to the left, until limit switch 75 is opened, de-energizing solenoid 73 and allowing springs 57 and 58 to again center valve spool 53.

Similarly, energization of solenoid 74 moves valve spool 63 to the left to permit pressure fluid to be supplied the cylinder chamber at the right of piston 69 while exhausting the cylinder chamber at the left. Since the cylinder is fixed, piston rod 45*a* and the movable feed hopper 38 fixed thereto are moved to the left until the piston rod opens limit switch 76 to de-energize solenoid 74. Springs 67*a* and 68*a* then center the valve spool 63 to preclude further flow therethrough.

After both limit switches 75 and 76 have been opened, the circuit to motor 50 is again broken and the motor and pump 51 are stopped. Timer 49 continues to run and after a predetermined time interval it again actuates the motor and pump prior to energization of solenoids 61 and 71 to initiate another cycle of operation as above described.

Limit switches 61 and 75 are positioned to be contacted by cylinder 22 before the cylinder hits split blocks 30. Thus, valve spool 53 is moved to block flow from the cylinder and a fluid cushion is left in the motor cylinder to absorb shock as movement of the cylinder and the heavy carriage and cutter head carried thereby is quickly stopped. The rubber cushions supporting flanges 28 and 33 at the ends of rods 25 and 26, respectively, also absorb shock forces that would otherwise be transmitted to the carriage and other support structures, causing them to fatigue and fail, in addition to compensating for any vertical or horizontal movement of the carriage.

Limit switches 71 and 76 are also positioned to be contacted by piston rods 45*a* and 70 to insure creation of a fluid cushion in the fluid motor before damaging impact forces can be transmitted to the support structure.

Utilizing the above described apparatus, the cutter head can be easily transported at speeds of more than thirty inches per minute and acceleration and deceleration times are kept to a minimum. For example, with one apparatus constructed according to the invention, maximum speed of the cutter head was reached in .26 second. In this connection, it is noted that the motor 50 and pump 51 are always started before actuation of the solenoid valves in order to allow working pressures in the system to be built up. Furthermore, merely by changing the size of conduits used, or by using control valves to regulate the flow to and from fluid motor 44, the rate of travel of the piston 69 can be easily changed, as desired.

Although a single timer, motor, and pump have been disclosed as being usable to operate fluid motors 54 and 64 of both the first and second stage units, it should be apparent that under certain circumstances it may be desirable for each unit to be individually provided with one or more of these components. In addition, by changing timers or setting the timer as desired, the sequence of

operation of the motor and solenoids can be varied to fit specific conditions.

It should also be apparent that, under certain circumstances, additional crushing and/or conveying operations could be conducted on material as it is transported from the first stage unit to the second stage unit, the important thing being that the present unit readily isolates a test sample of a size that can be readily handled and that is truly representative of the larger mass from which it was obtained.

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 may be made and other constructions adopted without departing from the inventive subject matter particularly pointed out and claimed herebelow.

I claim:

1. A multiple stage sampler, including a first stage unit having a channel shaped cutter head; support means for said cutter head; fluid operated means for moving said cutter head transversely across a stream of material to be sampled; a second stage unit having a housing, an inlet hopper with a receiving opening positioned to receive material from said cutter head and a discharge opening, a movable feed hopper within the housing having an inlet opening at all times positioned to receive material from the discharge opening of the inlet hopper and an outlet opening, fluid operated means for reciprocating said feed hopper, a fixed discharge opening extending from a location within said housing intermediate the path of travel of the movable feed hopper whereby material in said movable feed hopper is directed into said fixed discharge opening when the movable feed hopper is thereabove, and into the housing when the movable feed hopper is at either side of the fixed discharge opening.

2. A sampler mechanism for obtaining samples of material from a stream of material, comprising a cutter head; means mounting said head for reciprocable movement transversely of said stream of material; and fluid operated means for moving said head, said fluid operated means including a fluid motor having a cylinder, a piston in the cylinder, a pair of piston rods each having one end fixed to said piston so that one rod extends through each end of the cylinder, means anchoring the other ends of said piston rods, means connecting said cylinder to the cutter head, a motor-driven pump, a control valve regulating supply and exhaust, a timer adapted to position the control valve, and circuit means, including limit switches positioned to be contacted by the cylinder adjacent its extreme travel positions, for actuating said pump and for repositioning said control valve.

3. The multiple stage sampler of claim 1, wherein the fluid-operated means for moving said cutter head and the fluid-operated means for moving said feed hopper are controlled by a timer.

4. A sampler mechanism according to claim 2, wherein the means connecting the cylinder to the cutter head includes a wheeled carriage; and wherein tracks are provided upon which said carriage will roll as the cylinder is moved.

5. A sampler mechanism according to claim 2, wherein the means anchoring the ends of the piston rods includes resilient cushions to absorb shock forces and to compensate for vertical and horizontal shifting of the carriage.

6. A sampler mechanism including a housing; a fixed inlet hopper having receiving and discharge openings and extending through a top wall of the housing; a movable feed hopper within the housing and having a top inlet opening at all times positioned beneath the discharge opening of the fixed inlet hopper, and having a bottom outlet opening; a fixed discharge opening extending from within said housing through the lower portion of the housing and positioned intermediate and beneath the path of travel of the movable feed hopper and means for moving said feed hopper between a position wherein its bottom outlet opening is at one side of the fixed discharge opening and a position at the other side, whereby material in said movable feed hopper is directed into said fixed discharge opening when the movable feed hopper is thereabove and into the housing when the movable feed hopper is at either side of the fixed discharge opening.

7. A sample mechanism according to claim 6, wherein said movable feed hopper is tapered from the top inlet opening to the bottom outlet opening.

8. A sampler mechanism according to claim 6, wherein a dust guard is fixed to said movable feed hopper such that it substantially covers the fixed outlet discharge opening when said movable feed hopper is not above the fixed outlet discharge opening.

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