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SAMPLING DEVICE

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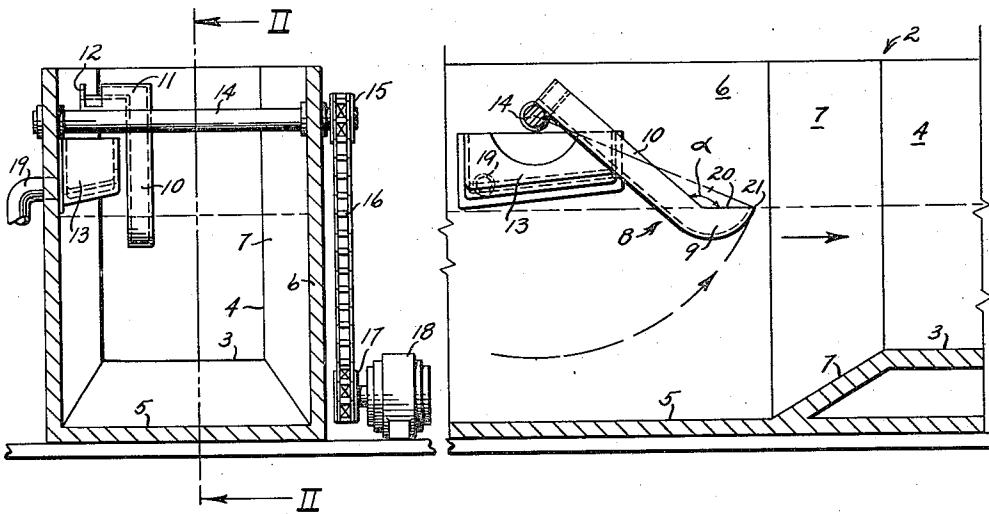


Fig. 1.

Fig. 2.

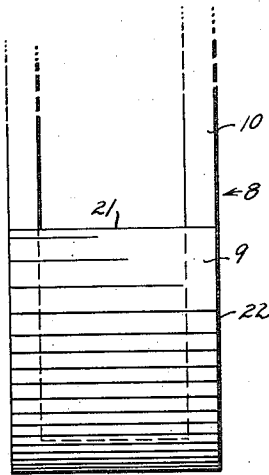


Fig. 3.

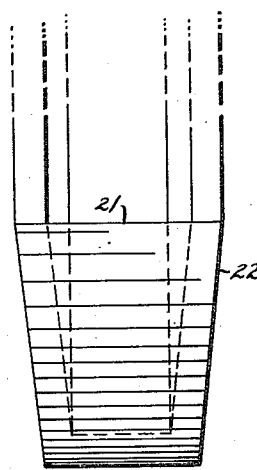


Fig. 4.

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SAMPLING DEVICE

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4 Claims. (Cl. 137-166)

This invention relates to a device for sampling flowing liquids, particularly for operation with streams of industrial wastes to determine the presence of recoverable values of constituents therein.

It is an object of the invention to provide a sampling device for obtaining a representative sample of the liquid over a period of time whether the flow of liquid during said period has been constant or has varied with respect to quantity and/or analysis. Accordingly, the device of the invention is constructed to obtain an individual sample the volume of which is proportional to the rate of flow of the liquid being sampled and the device is so operated as to repeatedly take such individual samples at equal intervals of time. The device of the invention is simple in construction and is substantially free of any tendency to gather or to be clogged by suspended matter, particularly fibrous material, which may be present in the stream being sampled. Other objects, features and advantages of the invention will be apparent from the drawing and the description thereof hereinafter.

In the drawing, illustrative of the invention,

Figure 1 is an elevation of the device arranged in a measuring flume shown in cross-section,

Figure 2 is a side elevation of the device of Figure 1,

Figure 3 is a view looking head-on at the sampling spoon of Figure 2, and

Figure 4 is a similar view of a modified shape of sampling spoon.

As shown in Figures 1 and 2, the sampling device is associated with a Parshall measuring flume 2, the upstream end of which is shown just to the downstream side of the sampling device. This measuring flume is of standard construction and comprises a floor 3 and two side walls 4 which are joined to the floor 3 and side walls 6 of the channel proper by suitably sloped sections 7.

The sampling device proper comprises a dipper 8 having a scoop 9 whose handle 10 is in the form of a trough which serves to direct the liquid to a short transverse trough 11 communicating therewith. This transverse trough is provided with an opening 12 at the back which allows the liquid to pour from the dipper 8 and trough 11 into a catch-box 13 secured therebeneath on one of the side walls 6 of the channel. The dipper is fastened along its transverse trough portion 11 to a shaft 14 which is suitably mounted for rotation about an axis transverse of the channel. This shaft 14 is provided with a sprocket

15 which is driven by a chain 16 operated by the sprocket 17 on the shaft of the motor 18. The scoop 9 is preferably rotated in the direction of flow so that any material of a fibrous nature caught upon it is washed off during its next dipping stroke. The catch basin is provided with a discharge pipe connection 19 which leads the samples to a suitable receptacle in which they may be allowed to accumulate for the desired length of time before analysis.

The shape of the dipper 8 is readily apparent from Figure 3 which is its appearance as seen by an observer looking upstream at the device in Figure 2. While the scoop portion 9 of the dipper is formed with its side edges 20 (see Figure 2) horizontal when they are in alignment with the level of liquid at its maximum expected head, this is not absolutely essential but merely makes the calculation of the other dimensions of the scoop somewhat simpler than would otherwise be the case. Similarly, the sides 21 of the scoop portion of the dipper need not be parallel since suitable adjustment of other dimensions of the scoop permit other cross-sectional shapes of the scoop to be used, such as that shown in Figure 4 where the sides 21 slope inwardly from the top to the bottom of the scoop.

The particular shape and relation of the scoop 9 and handle 10 of the dipper shown in Figures 1 and 2 were designed for a stream whose maximum liquid head would be about 6 inches below the center line of the rotating shaft which is about 18 inches above the elevated floor of the measuring flume. The angle α is about 145° , the extreme lip 21 of the dipper is 18 inches from the center line of the shaft so that no sample is obtained when the liquid does not exceed the level of the elevated floor of the measuring flume. The bottom of the scoop 9 is a continuation of the bottom of the trough handle 10 and is in the form of a circle having a three-inch radius centered along the line from the center line of the rotating shaft to the extreme tip of the scoop 9. The length of the sides of the scoop is of the order of the radius of the curved bottom. All of these dimensions are selected to give a quantity of sample proportional to the head of the liquid at the instant of sampling when the device is employed with a measuring flume whose characteristic equation is $Q = kH^{1.55}$. It will be readily appreciated that the various dimensions just cited which yield actual samples which are within 1% of the theoretical amount desired may be varied and adjusted as desired to give numerous shapes and sizes capable of giving an amount of

sample in direct proportion to the head of liquid flowing. For example, a further refinement with a consequent reduction in the percentage of error just cited may be obtained merely by building up a small portion of the inner curved surface of the scoop 9 to flatten it along about a one-half inch arc approximately one inch from the extreme lip 21 of the scoop.

The device may be employed with any measuring device, such as a measuring flume or weir in which the quantity of liquid flowing is proportional to some exponential function of the head of liquid in the channel, the shape of the scoop being changed to yield the appropriate sample with different exponential function of the head.

The sampling device of the invention has all of its operating mechanism outside the stream being sampled and is of relatively simple construction so that there is no clogging of the device or gathering of foreign matter on it. On this account, it is particularly satisfactory when employed for sampling waste liquids, solutions, and suspensions containing fibrous material, such as occur in all industries dealing with paper pulp or the manufacture of products, such as artificial filaments, therefrom. In the claims the expression "liquid" is intended to include simple liquids, solutions, dispersions, suspensions, and the like.

While preferred embodiments of the invention have been disclosed, it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. In combination, a channel, a liquid-measuring device for maintaining a definite relation between the height of liquid in the upstream side of the measuring device and the volumetric rate of flow thereof through the channel, a unitary dipper member comprising an arm terminating in a scoop having an open face to allow entrance of the liquid, means for swinging the scoop in a single direction through a cyclical path at constant frequency, the swinging means being so arranged with respect to the channel that the scoop in a portion of its path moves face-first down into, and then up out of, the channel adjacent the upstream side of said measuring device in a direction with the liquid current about an axis transverse of the channel, and a conduit formed in the arm and associated with the scoop for emptying it during a subsequent portion of its path of any liquid it receives during that portion in which it is swung down into the channel.

2. In apparatus for sampling a liquid flowing in a channel, a channel, a liquid-measuring device for maintaining a definite relation between the height of liquid on the upstream side of the measuring device and the volumetric rate of flow

thereof through the channel, a rotatable shaft having an axis transverse of the channel and above the liquid surface therein, a scoop having an open face to allow entrance of the liquid carried by the shaft for rotation therewith, a conduit communicating with the scoop having an outlet offset from the plane of rotation of the scoop, a receptacle beneath the outlet, and means for continuously rotating the shaft at substantially constant speed to swing the scoop face-first through a portion of the channel in a direction with the liquid current.

3. In apparatus for sampling a liquid flowing in a channel, a rotatable shaft having an axis transverse of the channel and above the liquid surface therein, a scoop having an open face to allow entrance of the liquid carried by the shaft for rotation therewith, means located downstream from the shaft for maintaining a definite relation between the height of liquid in the vicinity of the shaft and the volumetric rate of flow thereof through the channel, a conduit communicating with the scoop having an outlet adjacent the shaft and offset from the plane of rotation of the scoop, a receptacle beneath the outlet, and means for continuously rotating the shaft at substantially constant speed to swing the scoop face-first through a portion of the channel in a direction with the liquid current.

4. In combination, a channel, liquid-measuring means associated with the channel for maintaining a definite relation between the height of liquid adjacent the upstream side of the measuring means and the volumetric rate of flow thereof through the channel, said means having a floor elevated with respect to that of the channel adjacent the upstream side thereof, a unitary dipper member comprising an arm terminating in a scoop having an open face to allow entrance of the liquid, means for continuously rotating the member in a single direction through a cyclical path at substantially constant speed to swing the scoop in a portion of its path face-first down into, and then up out of, the channel adjacent the upstream side of the measuring means in a direction with the liquid current about an axis transverse of the channel, the member being constructed and arranged so that its axis of rotation is above the maximum expected liquid level and the deepest immersion of the scoop corresponds substantially to the floor level of the measuring means and so that it picks up an amount of liquid which is proportional to the height of liquid, and a conduit associated with the scoop for emptying it during a subsequent portion of its path of any liquid it receives during that portion in which it swings down into the channel.

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