

Sept. 8, 1942.

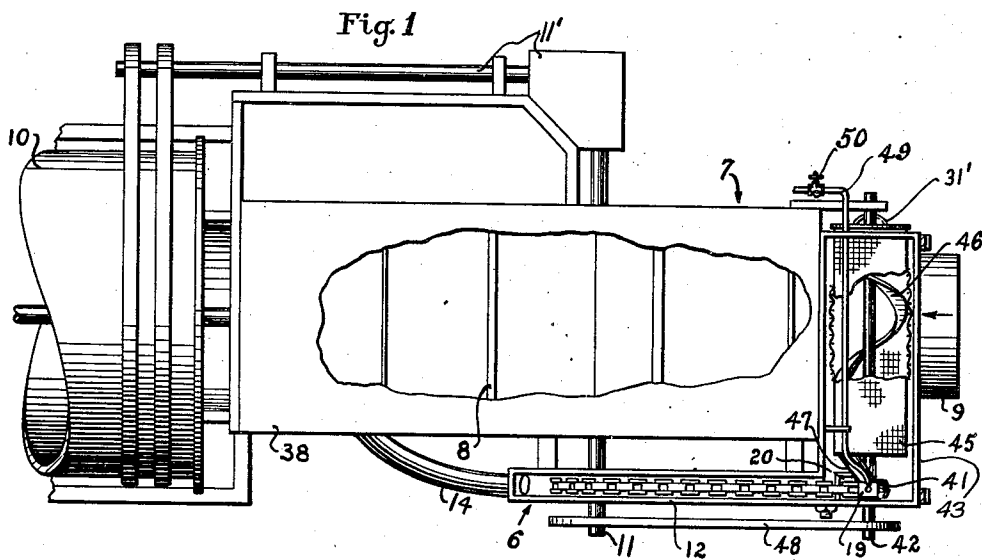
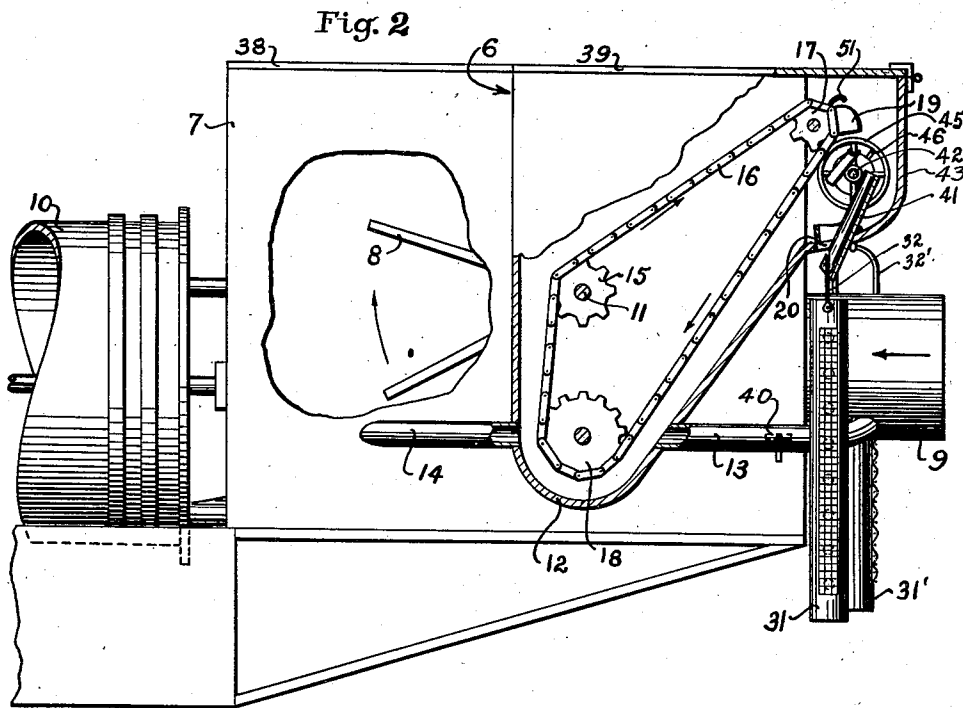
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2,295,437

SAMPLING DEVICE

Filed Oct. 21, 1938

5 Sheets-Sheet 1



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Fig. 3

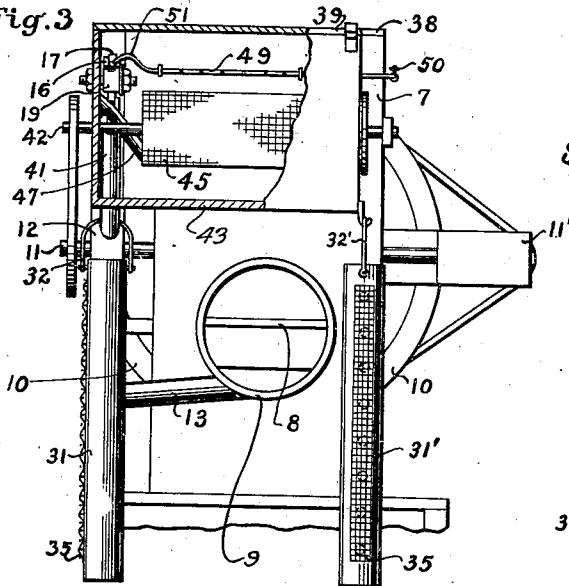


Fig. 5

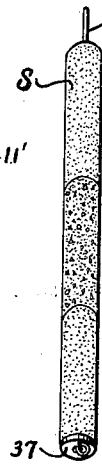


Fig. 6

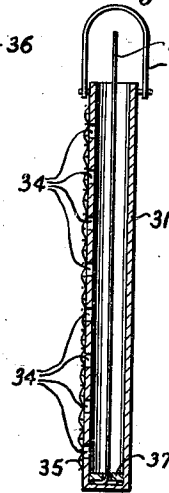
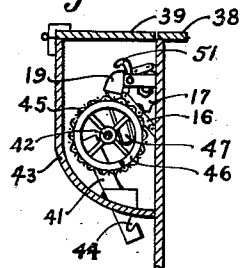
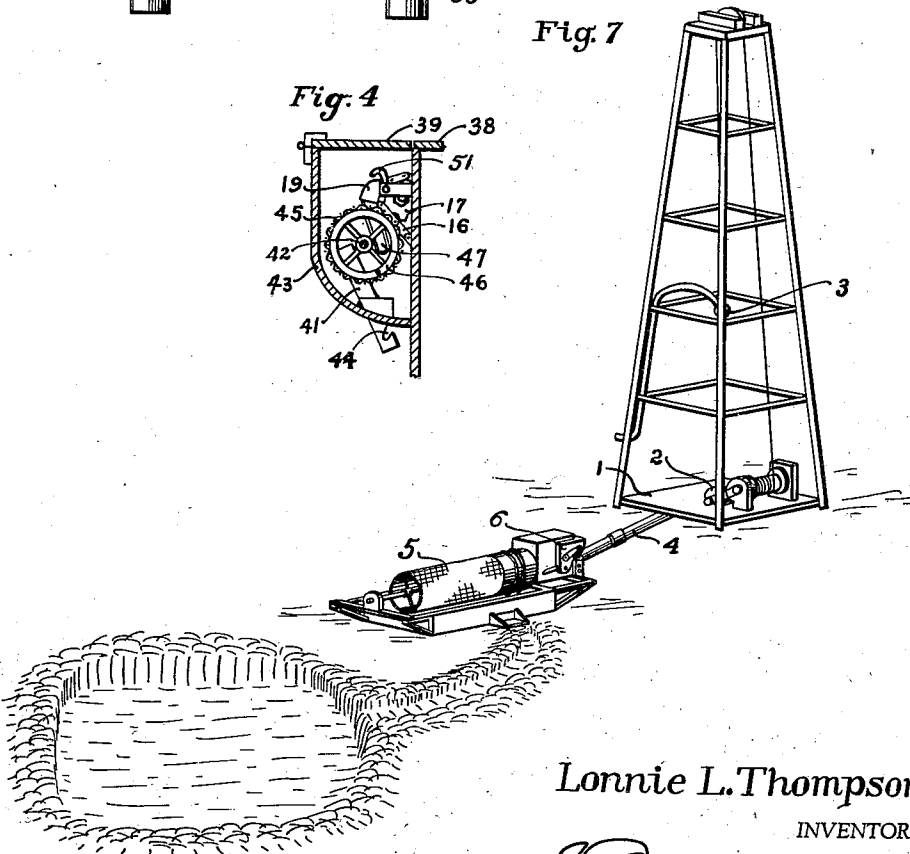


Fig. 7

Fig. 4



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Fig. 8

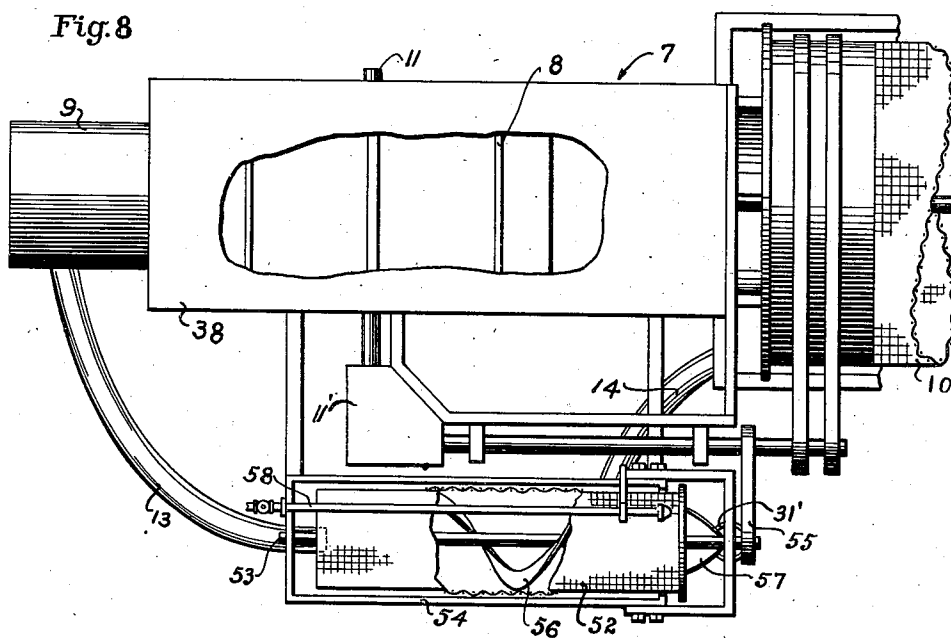
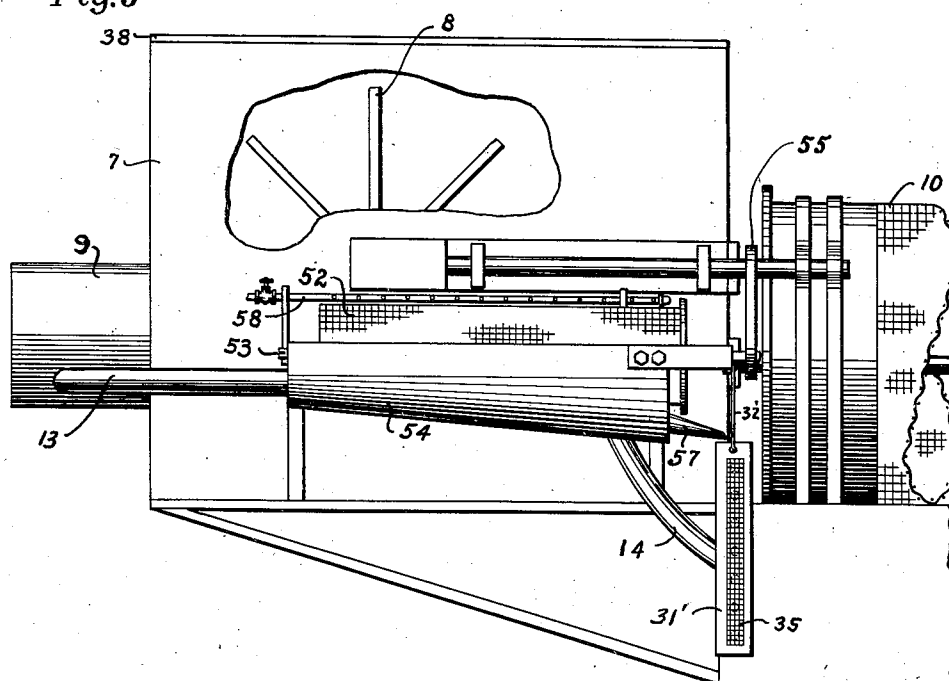


Fig. 9



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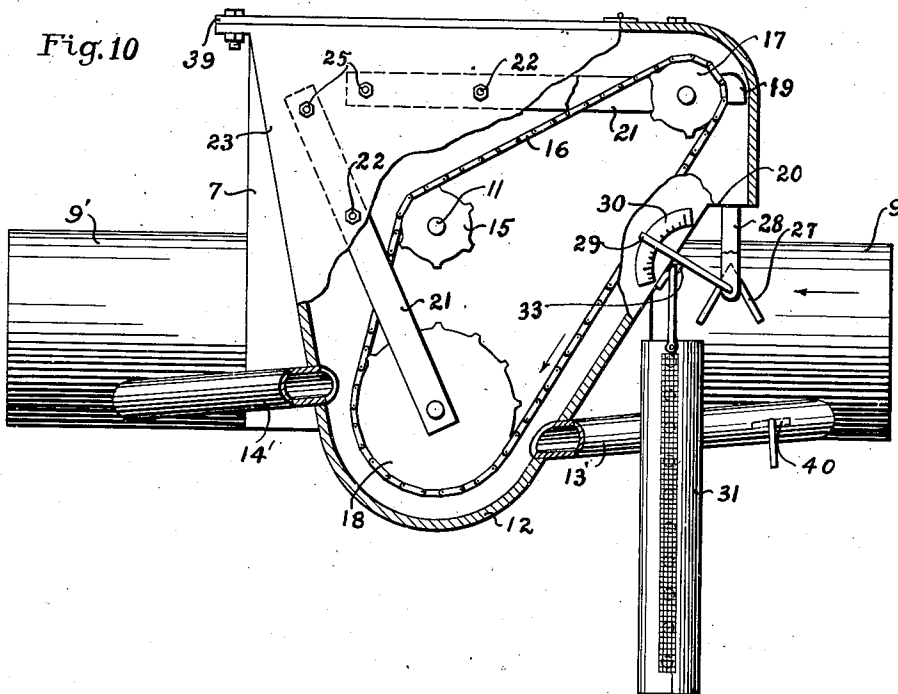
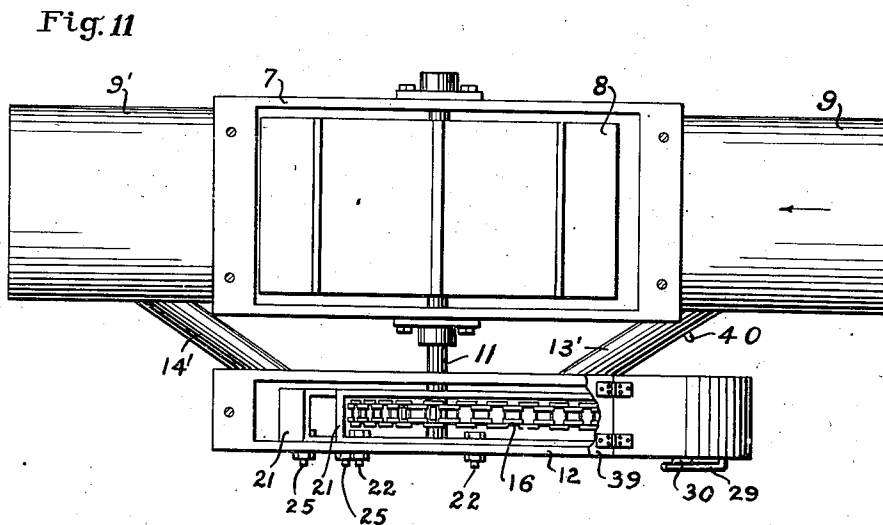
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Fig. 12

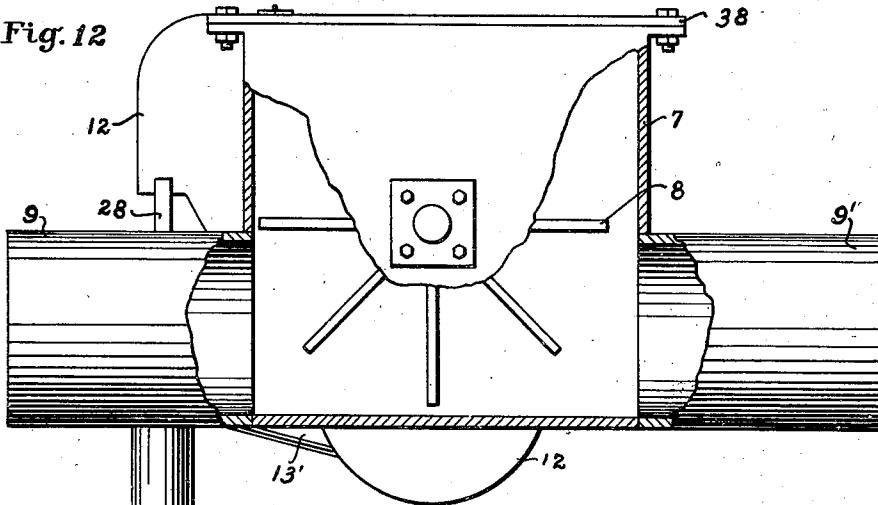


Fig. 13

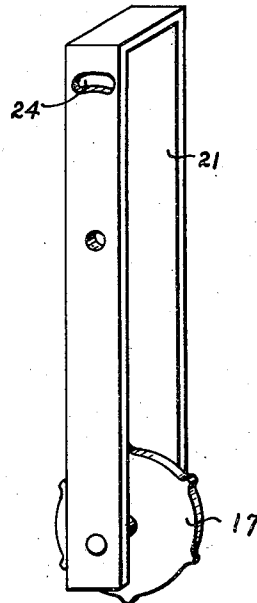
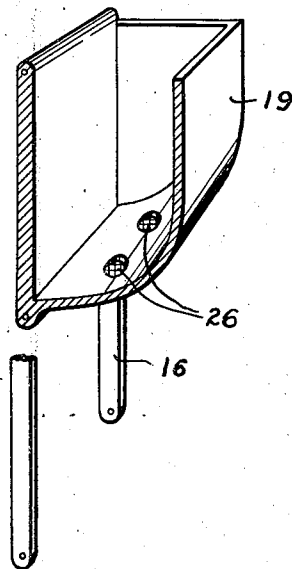


Fig. 14



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UNITED STATES PATENT OFFICE

2,295,437

SAMPLING DEVICE

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Application October 21, 1938, Serial No. 236,307

4 Claims. (Cl. 73—21)

This invention relates to an improvement in sampling devices of the type used primarily in connection with rotary well drilling rigs which circulate mud through a rotary bit in the well and then back to the surface into a slush pit.

It is desirable to take samples of the strata at frequent intervals as the drilling of the well progresses. It has been the practice heretofore, to obtain samples of the formation from the circulating fluid or mud by catching some of the fluid in a bucket or other receptacle at intervals, and separating the mud from the formation samples, which samples are then put into sacks. Inasmuch as the human element entered into this operation, samples might not be obtained frequently enough to show all the formations encountered during the drilling operation.

The primary object of this invention is to provide for automatically obtaining samples of the formation as the well is drilled and depositing these samples in a receptacle for further inspection and analysis. By the use of this invention, the human element is eliminated in the securing of these samples, as they are automatically deposited in a container from which they may be removed and inspected later at will.

Another object is to provide for washing the cuttings free of mud when desired and during the collecting thereof.

Still another object of the invention is to operate a machine for taking samples by the drilling fluid passing therethrough.

While the drawings illustrate a preferred embodiment of the invention, together with modifications thereof, it is to be understood that the design may be varied and changes made in the minor details of construction to meet specific needs and requirements, within the scope of the invention as claimed, without departing from the spirit thereof.

In the accompanying drawings:

Fig. 1 is a plan view of the preferred form of the invention with parts broken away and parts shown in section;

Fig. 2 is a side elevation thereof, with parts broken away and parts shown in section;

Fig. 3 is an end elevation, partly in section, of the preferred embodiment of the invention;

Fig. 4 is a vertical sectional view through the sample washing tumbler;

Fig. 5 is a perspective view of a molded core of a formation sample;

Fig. 6 is a vertical section through a bucket for catching sample formations;

Fig. 7 is a diagrammatic perspective view of a rotary rig having a shale separator and formation sampling device associated therewith;

Fig. 8 is a plan view of a modified form of the invention installed on a shale separator, with parts broken away;

Fig. 9 is a side elevation thereof with parts broken away;

Fig. 10 is a side elevation of a further modified form of a modification of sampling device, with parts broken away and in section;

Fig. 11 is a top plan view thereof, with parts broken away and parts shown in section;

Fig. 12 is a side elevation of the device opposite from Fig. 10, with parts broken away and parts shown in section;

Fig. 13 is a perspective view of the idler sprocket support showing the tightening arrangement therefor; and

Fig. 14 is a perspective view of a conveyor bucket and chain with parts broken away and in section.

Fig. 7 of the drawings shows generally a rotary rig 1, having a rotary table 2 from which is suspended a rotary drill unit having provision for circulating fluid or mud therethrough, thence out through a pipe 4 to the slush pit, usually passing through a shale separator 5 for removing foreign substances therefrom.

Instead of catching some of this recirculated fluid from the well in a bucket, to obtain samples of the formation, as heretofore, I have provided a sampling device 6 associated with the shale separator 5 or in the pipe 4 to obtain automatically samples of the earth formation in the fluid flowing from the well through the pipe 4.

The construction of the preferred embodiment of the sampling device 6 is shown more particularly in Figs. 1 to 3, in which the numeral 7 designates a housing of the shale separator which encases a paddle wheel 8, which paddle wheel 8 serves as a motivating element to drive the shale separator and the mechanism of the sampling device. The drilling fluid enters housing 7 from the pipe 4 by means of inlet pipe 9 and passes therethrough in the direction indicated by the arrows, thence directly into the cylinder 10 of the shale separator. This in turn rotates the paddle wheel or impeller 8 in the direction indicated by the arrow in Fig. 2. The pipe 9 and cylinder 10 are in axial alignment and are connected with respective opposite sides of the housing 7. The paddle wheel 8 is secured to a shaft 11 journaled in opposite sides of the housing 7, with opposite ends projecting outwardly from said housing, one end having driving connection with the cylinder 10 through driving means 11', while the other end drives sampling mechanism, as hereinafter described.

Spaced at one side from the housing 7 is a casing 12 having an inlet tube 13 extending from one side of the casing 12 to the inlet pipe 9 with which it communicates and which directs fluid from the inlet pipe 9 into the casing 12, and said casing 12 has an outlet tube 14 and which permits the fluid to pass outward from the cas-

ing 12 after it has deposited some of the cuttings and formation in the bottom of casing 12. The tube 14 preferably directs the mud or fluid into housing 7, being connected therewith, as shown in Figs. 1 to 3, or to a discharge pipe 9', when the invention is used in a discharge pipe 4 without the separator, as shown in Figs. 10, 11 and 12.

In the modified form of the invention shown in Figs. 10 to 12, the inner end of the outlet tube 14' is shown higher than the inner end of the tube 13' which causes the fluid to rise in the casing 12 before flowing out, which permits the heavy particles indicative of the earth formation to settle to the bottom of the casing 12.

The shaft 11 extends into the casing 12 and carries thereon a sprocket 15 over which a sprocket chain 16 extends, passing also over idle sprockets 17 and 18, operating in the direction indicated by the arrows in Fig. 2. The chain 16 carries a cup 19, in position to dip into the bottom of the casing 12 in passing around the sprocket 18 and scoop up the particles of earth formation that have settled to the bottom of said casing from the fluid flowing therethrough. The cup 19 then passes around the sprocket 17 to dump the scooped material through an opening 20 in the bottom portion of the casing 12. Only one cup 19 is shown, but additional cups may be used if desired, although it is preferred that they should be so spaced and operated at such slow speed as to permit the formation particles to settle in the casing 12 between successive dips of the cup or cups.

Each of the sprockets 17 and 18 may be journaled in the free end of a U-shaped frame 21, as shown in Figs. 10 and 13, which frame is pivotally supported at 22 on the outer wall 23 of the casing 12, for adjustment of the sprockets and regulation of the travel of the chain 16 and of the tightness thereof. To permit such adjustment and to hold each frame 21 in a set position, said frame has an arcuate slot 24 therein receiving a fastening bolt 25 extending through the wall 23 of the casing 12.

The cup 19 is constructed generally in the shape of a bucket for dipping up a sample of the material in the bottom of the casing 12, and as shown in Fig. 14, the cup 19 preferably is provided with one or more holes 26 in the bottom thereof to permit the escape of the liquid from the scooped up material during the upward travel of the chain 16 to the point of discharge. These holes 26 are preferably covered with screens when of appreciable size, to prevent the escape of the cuttings that have been obtained from the well.

As shown in Fig. 10, a wedge-shaped deflector 27 is pivotally supported at 28 on the casing 12, at a point immediately beneath the opening 20 in the casing in position for discharge of the material from the cup 19 through said opening directly onto the deflector 27. The deflector is arranged with its apex turned upwardly so as to divert the material to one side or the other thereof. To regulate the position of the deflector 27, it is provided with an arm 29 co-operating with a scale 30 provided on the front wall 23 of the casing 12.

At one side of the deflector 27 is a receptacle 31, shown in detail in Fig. 6, provided with a ball 32 adapted to removably engage a hook 33 on the casing 12 for supporting the receptacle 31 in proper position to receive the cuttings and particles discharged by the cup 19 when the de-

flector 27 is turned to a position where it will direct said material into the receptacle 31. The deflector 27 may be adjusted so as to direct any desired proportion of the material into the receptacle 31 as may be desired to prevent the filling of the receptacle too quickly, and the remainder of the material deflected to the opposite side of the deflector 27 may be discharged into the usual sacks or otherwise disposed of.

The receptacle 31 (Fig. 6) has a series of perforations 34 arranged vertically thereof and covered by a wire screen 35 which allows further draining off of the liquid and circulation of the air therethrough to facilitate drying of the sample into molded and compact form substantially as shown at S in Fig. 5. When the receptacle 31 has been filled to the desired height it may be removed from the sampling device and replaced by an empty receptacle and the filled one set aside for drying and molding of the sample therein. After the sample has dried sufficiently, it may be readily removed from the receptacle by sliding it out, and to facilitate this removal, the receptacle 31 is provided with a lifting wire 36 extending upwardly approximately at the axis thereof, which wire 36 carries a washer 37 at the lower end thereof normally resting at the bottom of the receptacle and tending to hold the wire in its central position in the receptacle. This wire 36 serves also as a stiffening element in the molded samples to prevent accidental breaking thereof since it becomes embedded in the sample as the latter sets.

In the form of the invention shown in Figs. 1, 2 and 3, the bucket 19 discharges the scooped up material into a chute 41 welded to a portion of the casing 12 and extending transversely thereof within an enlargement 43 thereof. The chute 41 projects downwardly in an inclined direction through the opening 20 and has a notch or hook 44 at the lower end thereof that receives the ball of the receptacle 31, as shown in Figs. 2 and 3, so as to suspend said receptacle from the chute 41.

The shaft 42 carries a screen tumbler 45 rotatably mounted within the enlargement 43 of the casing and open at opposite ends, being supported on the shaft by spiders arranged at suitable intervals therein and attached to the screen of the tumbler. The screen tumbler 45 has a spiral conveyor 46 extending lengthwise therein adjacent the inner periphery of the screen for feeding material lengthwise of the tumbler from the intake to the discharge ends thereof. This spiral conveyor 46 is supported also at intervals on the shaft 42 by spiders or other means. A chute 47 welded to a portion of the casing 12, has one end arranged in position to receive material from the bucket 19 at the point of discharge thereof and the opposite end of said chute is directed into the tumbler 45, so that part of the material scooped up by the bucket is directed into the tumbler 45 and the remainder is directed by the chute 41 into the receptacle 31.

The tumbler 45 is rotated by the shaft 42, which is driven by belt or other gearing 48 from the shaft 11. Thus when material is directed into the tumbler 45 by the chute 47, it is fed gradually through the tumbler and discharged at the opposite end thereof into a receptacle 31', shown in Figs. 1 and 3, which is similar in construction to the receptacle 31, shown in detail in Fig. 6, and which has been described above.

Extending longitudinally of the casing portion 43 over the tumbler 45 is a pipe 49 having lateral perforations therein in position to direct

spray jets of water onto the tumbler 45, thereby automatically washing the mud from the material passing therethrough. This spray is controlled by a valve 50, as shown in Fig. 1, so as to discontinue the washing operation whenever desired. One end of the spray pipe 49 is directed at 51 over the cup 19 when the latter is in the position shown in Fig. 2, so as to wash the cup clean each time that it reaches this position and causing the sample to drop readily therefrom into the respective chutes.

In this way, it is possible to obtain two types of samples simultaneously, one including the mud from the well with the formation particles being discharged directly into the receptacle 31, while the other sample is washed free of mud by the spray pipe 49 that leaves only the earth formation without mud or dirt, and this is collected in the receptacle 31'. The mud washed from the sample will flow downward through the casing 12, being discharged through the outlet pipe 14.

A further modification of the invention is shown in Figs. 8 and 9, in which the conveyor chain and cup are not used, but this employs a tumbler 52, which is journaled on a shaft 53 mounted in a trough 54 beside the shale separator and driven therefrom by a belt 55. The trough 54 has an inclined bottom and the tumbler 52 has a spiral screw conveyor 56 therein for directing the sample forwardly through the tumbler in the manner described above in connection with Figs. 1 to 3, the sample being discharged from a lip 57 into a receptacle 31' removably supported at the discharge end of the trough 54. Tumbler 52 has a spray pipe 58 extending thereover to wash the mud from the sample, as described above, but if it is desired to obtain a sample with the mud, this may be done by stopping the washing action and permitting the screw conveyor 56 to direct the entire material into the receptacle. The mud from the well enters the open end of the tumbler 52, directly from the inlet pipe 13, while the mud from the trough 54 is discharged through the pipe 14 into the shale separator, directly into the bottom trough thereof.

It will be apparent that the forms of the invention shown in Figs. 1, 2, 3, 8 and 9 are utilized in association with a shale operator either of the type illustrated or of any suitable type, while the form of the invention shown in Figs. 10 to 12 operates independently of a shale separator directly in the discharge pipe 4 from the well.

A cover 38 is provided for the housing 7 and a similar cover 39 is provided for the casing 12, these covers being hinged or otherwise removably secured thereto to facilitate gaining access to the interiors thereof. These covers 38 and 39 serve the additional useful purpose of aiding in determining the presence of gas because if the formation drilled contains gas the housing and casing serve as traps for the same, and this may be detected merely upon raising the covers and making the usual tests.

The operation of the sampling device will be obvious from the foregoing description, but it may be pointed out that an important characteristic of this invention is the operation of the sampling device automatically by the mud and fluid being pumped out of the well in the course of the drilling operation and utilizing the force

of this fluid for the accumulation of a sample of the formation encountered in the drilling. The accumulation of this sample automatically in the manner described enables the operator to obtain an accurate sample truly representative of the formation in the well. Any desired proportion of the fluid passing through the pipe 4 may be diverted into the casing 12 to obtain a sample therefrom, a butterfly valve 40 being provided in the tube 13, as shown in Figs. 2 and 10, to control the flow therethrough into the casing 12.

I claim:

1. The combination of well drilling apparatus having a discharge pipe for drilling fluid, and a sampling device operatively connected with said discharge pipe comprising means for diverting a portion of the fluid from the discharge pipe, a sample receptacle, means for separating solid particles of earth formation from said diverted fluid and directing the separated solids into said receptacle, and fluid driven means in the path of flow from said pipe for operating said separating means.

2. A sampling device comprising a casing having means for directing fluid therein for settling solid particles from said fluid, a receptacle associated with the casing, an endless device having a bucket carried thereby for dipping settled particles in the casing and directing the same into the receptacle, a rotatable tumbling device associated with the casing, means for directing particles from said bucket into said tumbling device, washing means for said tumbling device, and a second receptacle in position to receive particles from the tumbling device.

3. In apparatus for obtaining samples of cuttings in mud laden fluids used in well drilling, the combination with well drilling apparatus having a well casing and a fluid discharge pipe connected therewith for directing mud-laden fluids from the well, of a sampling device comprising a rotary screen having open opposite ends, a conduit having one end connected with said discharge pipe and having the other end thereof arranged to direct a proportionate share of the drilling fluid from the discharge pipe into one end of said screen, a receptacle arranged at the opposite end of the rotary screen in position to receive screened solids therefrom, said receptacle being constructed to retain the solids therein and to screen liquid therefrom, and fluid driven means in the path of flow from the fluid discharge pipe for operating said screen.

4. In apparatus for obtaining samples of cuttings in mud laden fluids used in well drilling, the combination with well drilling apparatus having a well casing and a fluid discharge pipe connected therewith for directing mud-laden fluids from the well, of a sampling device comprising a casing, a rotary screen mounted in the casing, means for directing a proportionate share of the drilling fluid from the pipe to the casing, means for directing said fluid into one end of the screen for screening solids from the fluid, a container connected with the screen casing at the opposite end of the screen to receive the solids therefrom, said container being constructed to retain the solids therein and to screen liquid therefrom, and fluid driven means in the path of flow from the fluid discharge pipe for operating said screen.

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