areas known to cave in or wash out easily, more frequent manual tests are recommended. The manual test involves placing a marker such as carbide or colored rope material into the mud entering the drill stem. The system then tracks this marker, calculating when the marker would be injected about the drill bit into the bottom of the well and then tracking the marker on its trip up. If the marker does not appear at the surface when the systems3 calculation says it should, the system is adjusted for the number of additional pump strokes necessary until the marker actually does appear. With a system which includes gas identification and measurement equipment, the marker may conveniently be a pack of carbide granules in a material which dissolves in the drilling mud. The pack is placed in the mud and the material gradually dissolves releasing the carbide into the mud. The carbide reacts with the mud to produce acetylene which is detected in the mud reaching the surface as propane. Thus, when the gas detection equipment detects a sudden increase in propane, it indicates that the carbide marker has reached the surface. In this case, the monitor indicates by the zero at **68** that no manual tests of lag have been made to check the system.

The manual test of the system of the present invention provides a much more accurate indication of lag than does the normal manual test which merely times the travel of the marker through the well. This is because with the present system the marker travel is accurately measured in terms of pump strokes and volume of mud pumped into the well which compensates for pump speed, well drilling stoppage, or different pumps being used. Thus, the manual test is tracked by the system so lag is accurately measured and is accurately applied to further determinations of lag as calculated by the system.

Where gas measurements are performed by the system, the monitor may also display the results of such gas measurements. As shown, a bar graph is provided in the lower portion of the display as indicated at **69** to graphically show total gas detected, indicated as TG and the concentration of the five constituent gases usually measured indicated as C1 through C5. The scale of the graphs is indicated by the number at **70**. Here 1000 units is indicated as full scale for the graphs. The unit values of the gas detected and shown graphically are indicated at the bottom of the display in the line indicated as **71** along with the depth for which the measurements were taken indicated at **72** as 7,550 feet. Where total gas is measured by the system, it is preferred to include a gas alarm to alert well personnel if the gas level in the mud reaches a dangerous level. The number **1000** shown at **73** indicates that the gas alarm is set to go off if total gas detected reaches 1000 units. While a particular embodiment of monitor display has been shown, more or less information as desired by the user, can be included and various formats may be used.

An advantage the system of the invention has wherein a computer is used to store information obtained by the system is that such information may be displayed or printed out when desired and in any format desired. FIG. **4** shows a report that can be produced by the system indicating various samples that have reached the surface of the well, when the samples reached the surface, and the time lapse between the indicated collection times and the actual collection times. The first line of the report under the date indicates that the sample representing the depth of 12,510 feet reached the surface of the well and the sample collection indicator was activated at 16:56 or 4:56 p.m. The reset switch was activated one minute and seventeen seconds later which should mean that the sample for 12,510 feet was actually collected within about one minute and seventeen seconds from the time collection was indicated. This represents a generally reasonable time for collection of a sample. The second line of the report indicates that the sample of 12,520 feet reached the surface at 17:35, i.e., 5:35 p.m., and was collected within fifty-seven seconds. The third line indicates that the sample for 12,530 feet reached the surface at 17:57, i.e., 5:57 p.m., but was not collected until three minutes and forty-two seconds later. The fourth line indicates that the sample for 12,540 feet reached the surface at 18:31, i.e., 6:31 p.m., but that it was not collected at all. Thus, if a sample shows up marked 12,540, it is known that the sample is not correctly marked and the sample for 12,550, although collected within about fifty-seven seconds of when it reached the surface also probably included the sample that should have been taken at 12,540 so the 12,550 sample actually represents drill cuttings collected for the depths between 12,530 and 12,550 as opposed to merely those between 12,540 and 12,550 as it should. Therefore, if such sample shows anything unusual or different from the samples before or after, this collection information can be taken into account in evaluating the information obtained from the actual samples.

While any type of sample collection indicator may be used with the system, the indicator should be chosen so that it will alert well personnel when a sample should be collected. Therefor, audible indicators such as horns or similar devices may be used. In order to give time to a person to travel to the collection area and collect the sample, it may be desirable to operate such indicator on an intermittent bases. Also, while the reset switch may be located in any desired location, since operation of the reset switch is suppose to indicate that a sample has actually been collected, the reset switch should be located with that in mind. Ideally, the reset switch could be associated with the sample collecting apparatus itself so the switch would be operated when the sample collection bucket was removed from its collecting position to be emptied into a sample container, and further activated when the bucket was replaced to ensure proper sample collection. However, merely placing a hand operated switch in the sample collection area so that it can be operated by a person preparing to take a sample has generally been found satisfactory.

Whereas this invention is here illustrated and described with specific reference to an embodiment thereof presently contemplated as the best mode of carrying out such invention in actual practice, it is to be understood that various changes may be made in adapting the invention to different embodiments without departing from the broader inventive concepts disclosed herein and comprehended by the claims that follow.

I claim:

1. In a well drilling operation wherein a drilling fluid is pumped down the well to the bottom of the well during drilling of the well, wherein the fluid pumped down the well flows to the surface of the well carrying drill cuttings from the bottom of the well with it, and wherein well personnel are present at the well site during such drilling, an apparatus for determining when a sample of drill cuttings reaching the surface of the well should be collected to provide a sample of drill cuttings