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A SLIME LEVEL INDICATOR

by

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ABSTRACT

A simple method of detecting the slime level in a thickening tank is described. The detector uses optical transmission techniques and simple associated electronic circuitry. The unit has been tested and found to perform satisfactorily.

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Direction des mines

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UN INDICATEUR DE NIVEAU POUR LES BOUES

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RÉSUMÉ

On décrit une méthode simple permettant de déterminer le niveau des boues dans un réservoir de sédimentation.

Le détecteur utilisé mesure l'absorbance optique du milieu à l'aide d'un circuit électronique conventionnel.

Ce système s'est montré efficace au cours d'épreuves variées.

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INTRODUCTION

The proper operation of a thickener or a settling tank depends upon the occurrence of a definitive, sharp interface between the high density pulp and the clear liquid. The capacity of this type of unit is most fully utilized if the amount of clear liquid is small. Any contamination of this liquor with undeposited sediment will quickly foul the following filtering system. This paper describes a method of delineating this "slime level" interface.

PRINCIPLE OF OPERATION

The basis of the detection principle is the optical opacity of the slime compared to the liquor. As there was little known about the sharpness of the change in optical density across the interface, this was measured in a preliminary experiment, using the apparatus shown in Figure 1. The slurry used contained 20% of about 200-mesh limestone by weight.

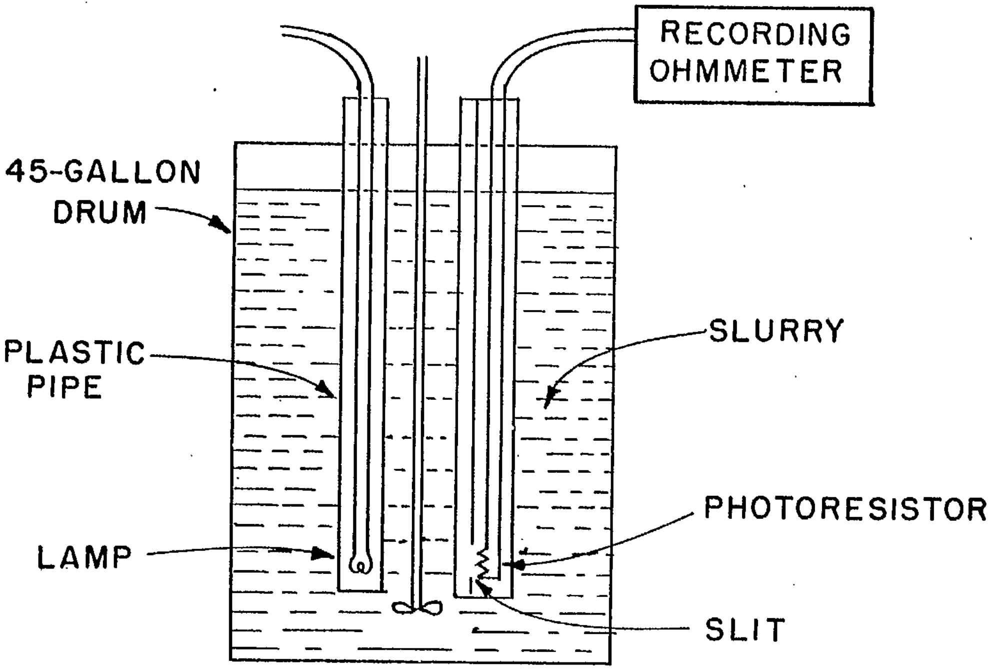

Figure 1. Equipment for measuring optical densitv of interface.

The slurry was thoroughly agitated and then allowed to settle. The settling generally required from 20 to 30 hours (the time could be reduced to 2 hours by the addition of a flocculant). As the interface moved across the slit, its density profile was traced by the recording ohmmeter. A typical graph, shown in Figure 2, indicates that the interface follows smoothly along the pipes and that little residue is deposited on them.

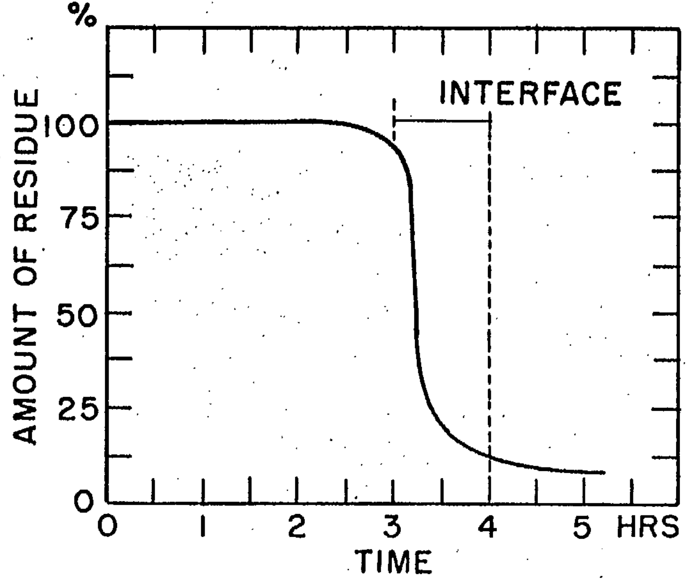

Figure 2. Optical density across interface.

After repeated experiments of this type, the total transmission of the plastic was approximately the same as for the initial experiment. As can be seen from Figure 2, the interface is extremely sharp, and thus the change in optical density provides a useful method of measuring the slime level.

THE SLIME LEVEL INDICATOR

A slime level indicator has been constructed and tested, using the variation of the optical density across the interface. The system is shown in Figure 3.

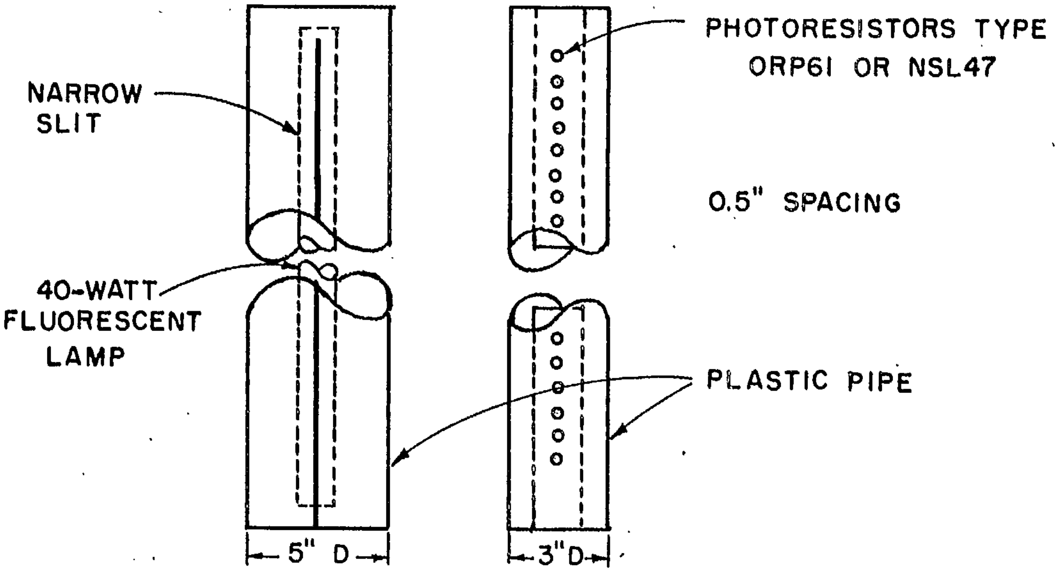

Figure 3. Arrangement of light source and photocells for slime level indicator.

The apparatus shown allows the monitoring of the slime level over a range of 6 inches, to an accuracy of half an inch, but this can easily be changed if desired. No provision for cooling the light source was made, since the tube in which it is contained will be immersed in a constant temperature liquid.

Initially, the photoresistors were used simply to activate lamps and thus the number of lamps operating indicated the level of the interface. This has the virtue of simplicity, but the indicating system is rather difficult to read rapidly. A more easily read system was developed, using an Electronic Engineering Model 10011-44-B readout indicator. This device has twelve lamps and an optical system which projects numbers onto a frosted glass screen. The symbols projected are +, -, zero, and the nine numerals. For a clear reading, only one lamp should be excited at a time. The electronic circuitry is shown in Figure 4 (a and b), and the printed circuit layout is shown in Figure 5.

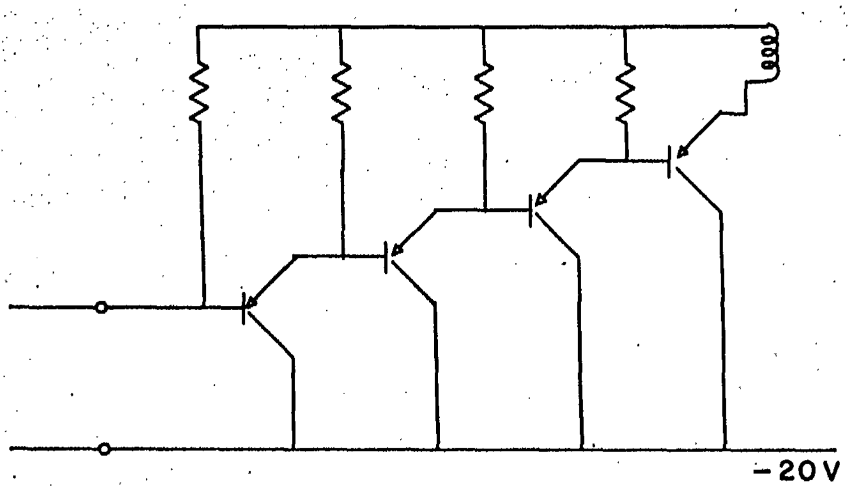

Figure 4a. Control circuit.

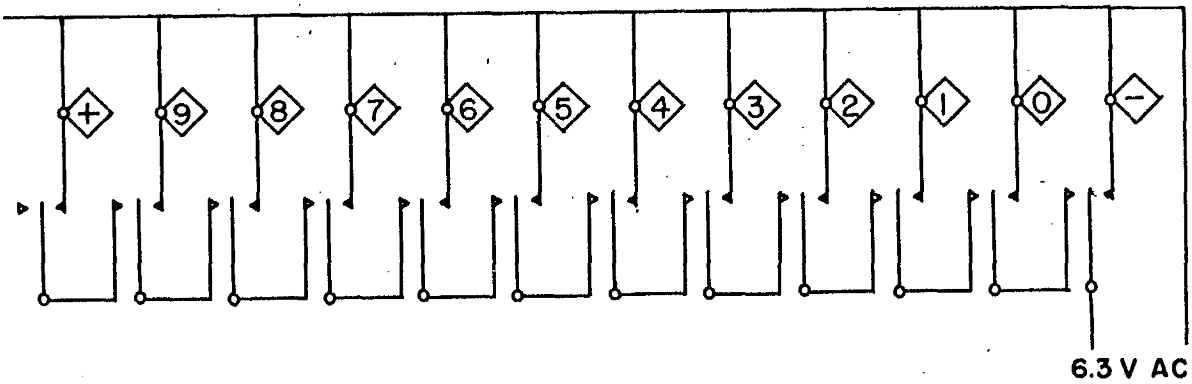

Figure 4b. Relay contact arrangement.

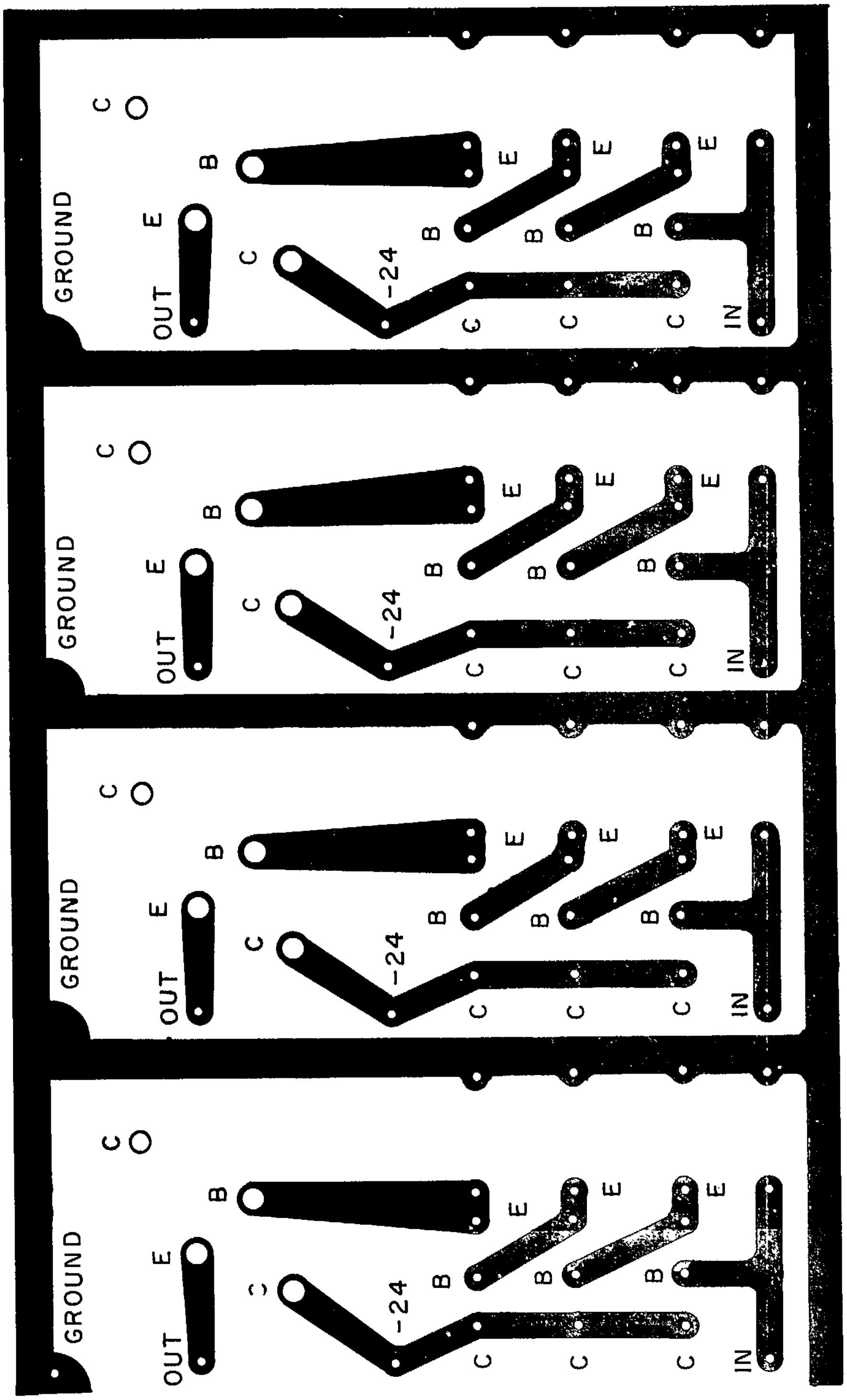

Figure 5. Printed circuit layout.

The operation of the circuit is extremely simple. When light strikes the photoresistor, its resistance changes from 10 megohms to about 0.1 megohm. This raises the base voltage of the first transistor, and consequently that of its emitter, and this process is repeated with the remaining transistors. This circuit thus matches the high impedance of the photoresistor to the low (200 ohm) relay resistance. The actual point of transistion is determined by the pull-in current of the relay. Since there is some hysteresis in the relay, that is, the fall-out current is lower than the pull-in current, the action is positive, and little jitter occurs. The relay contacts operate the lights in a definite sequence when connected as shown in Figure 4b. A second set of contacts is connected as shown in Figure 6 and serves as an output to a controller.

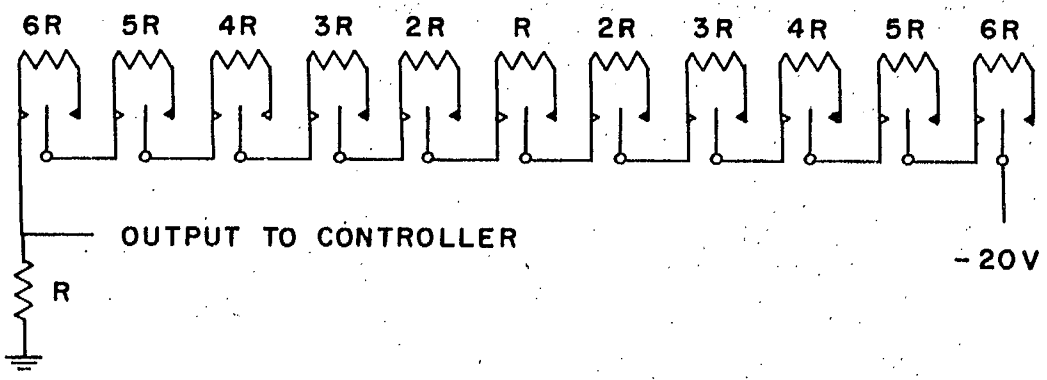

Figure 6. Contacts operated by relays controlled by circuit of Figure 4a.

The output voltage will depend on the position of the slime level and can be employed to stabilize the slime interface at a fixed height. The level may be adjusted by physically moving the photo-assembly. In the control system, the resistor values are so chosen that a large change in level will be more rapidly corrected than a small change. The values are only indicative and will clearly depend on the total characteristics of the feedback system.

OPERATION

The unit has been found to operate satisfactorily when tested with a 45-gallon barrel as a settling tank. A graph of such a settling curve is shown in Figure 7.

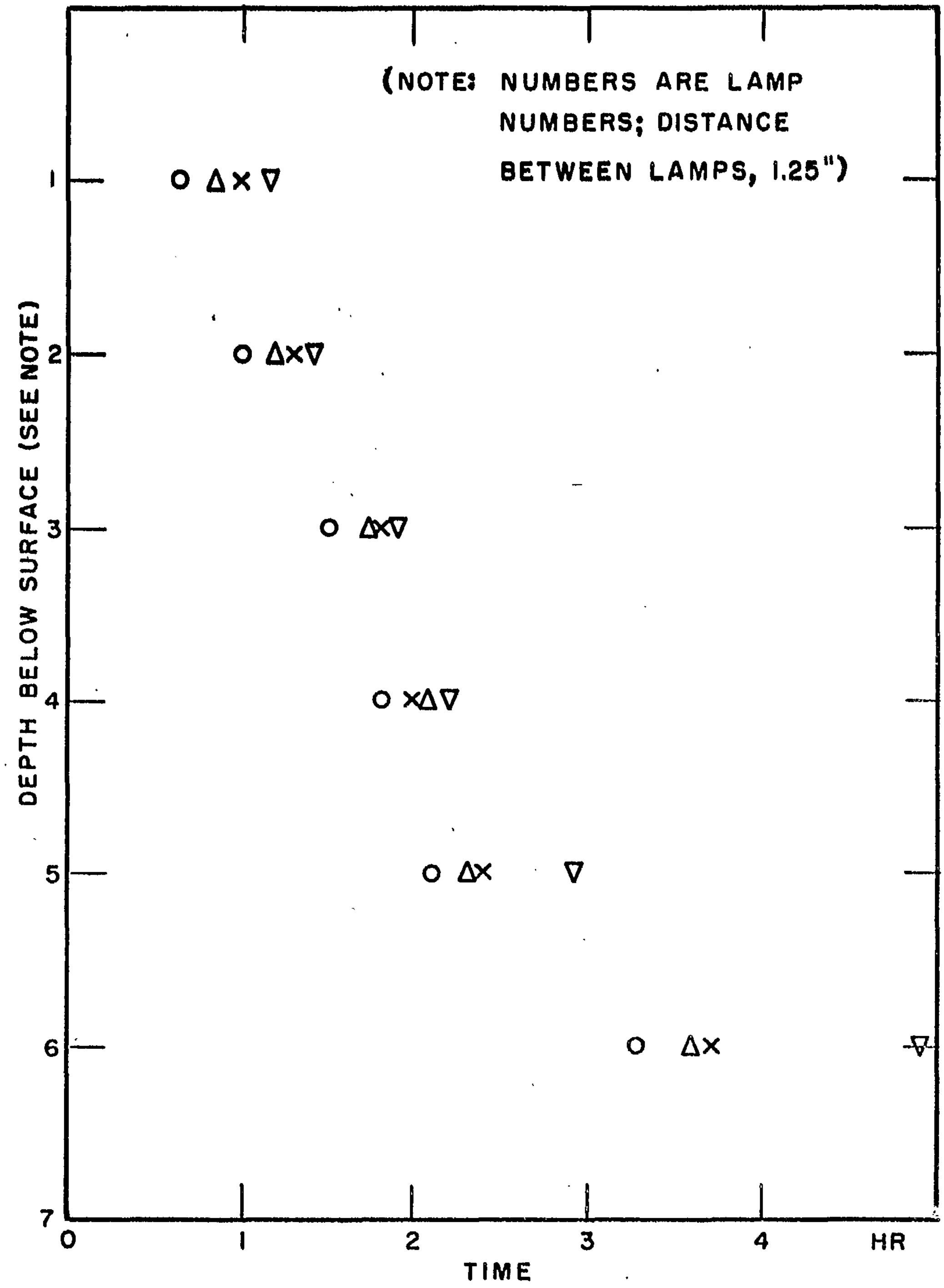

Figure 7. Rate of settling of a limestone slurry.

This graph shows the six topmost lamps, and represents the rapid initial settling period. After this time the slime settled very slowly, requiring 12 hours or more for a half-inch change; this portion is not shown in the figure.

The use of solid state components and printed circuit techniques has resulted in a rugged, reliable unit. The temperature range of operation is from 40°F to 110°F, although a somewhat higher temperature should cause no difficulty. The transistors will cause trouble above about 140°F.

ACKNOWLEDGEMENTS

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