CANADA

SIMPLE, LOW-RATE FEEDER FOR WATER-INSOLUBLE FLOTATION REAGENTS

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SIMPLE, LOW-RATE FEEDER FOR WATER-INSOLUBLE FLOTATION REAGENTS

by

L. L. Sirois* and T. Takamori**

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ABSTRACT

A simple feeder to deliver water-insoluble flotation reagents in very small quantities was built. The action of this feeder is based on the regulated production of gases from the hydrolysis of water, to exert a positive pressure on a reagent and thus expel it at the required rate through a suitable feed arrangement.

The accuracy of the feeder depends on the stability of the direct current produced, on the large quantities of minute gas bubbles formed at the electrodes in the hydrolysis cell, and on the formation of small drops of reagent at the feeding end.

This feeder will deliver from 0.026 to 0.250 cc of solution or liquid per minute, with actual reagent-feed rates depending on dilution or specific gravity of liquid reagents.

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Direction des mines

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Appareil pour alimenter à faible débit les réactifs de flottation insolubles dans l'eau

par

L. L. Sirois* et T. Takamori**

RÉSUMÉ

On a construit un appareil très simple pour alimenter en très petite quantité les réactifs de flottation insolubles dans l'eau. Le principe de ce distributeur consiste à produire, par l'électrolyse de l'eau, des gaz qui exercent une pression positive sur les réactifs afin de les expulser à un taux déterminé.

La précision de l'appareil dépend de la stabilité du courant continu, de la quantité de bulles miniscules produites par les électrodes de la cellule électrolytique, et, enfin, de la dimension des gouttelettes de réactifs formées.

Le distributeur peut alimenter des réactifs liquides ou en solution à un débit variant de 0.026 cc/min à 0.250 cc/min. Les quantités réelles de réactifs dépendent de leur gravité spécifique ou de leur dilution.

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INTRODUCTION

The concept of using electrolysis of water as a means of gas generation to exert a positive pressure on a reagent and expel it at a required rate, and thus creating a reagent feeder, is not novel and has been used previously (1).

This feeder was built along the lines of the apparatus described in Reference 1 , to complement ordinary cup-feeders used in flotation pilot-plant runs when very small quantities of water-insoluble reagents were required.

In the process of assembling the feeder, various improvements were added which permitted the development of a compact, easy to assemble, stable, economical and portable piece of equipment which will deliver reagents at a very low rate.

DESCRIPTION OF APPARATUS

The apparatus may be divided into three main components: the power supply, the hydrolysis cell, and the reagent bottle. A general view of the apparatus appears in Figure 1. Figures 2 and 3 show the components as mentioned, although they are enclosed in protective envelopes.

Batteries were first used as a source of power for the electrolysis cell. They were rejected because the small ones drained too quickly and the large ones were costly, cumbersome to carry, and had to be recharged. A simple power supply was then designed and is illustrated in Figures 4 and 5. It consists of a Hammond 167E transformer, 2 diodes, 1 N 2071, and a 1000 μf, 25 volt capacitor. The wiring diagram is shown in Figure 5. This power supply can be wired by anyone. The chassis on which the parts are mounted is 5 x 7 x 2 in. A pilot light and a 25-milliampere meter, which are mounted on the sloping front cabinet, are connected to the power supply which plugs into a Variac. It was decided not to incorporate a permanent rheostat in the system, so that the Variac could be used elsewhere when the feeder was not needed. The choice of the milliammeter was determined by the range of feed rates deemed necessary. Also mounted on the chassis are two banana plugs, through which the electrolysis cell is connected to the power supply.

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(1) Engineering and Mining Journal, Vol. 151, No. 4 (April 1950), pp. 98-100.

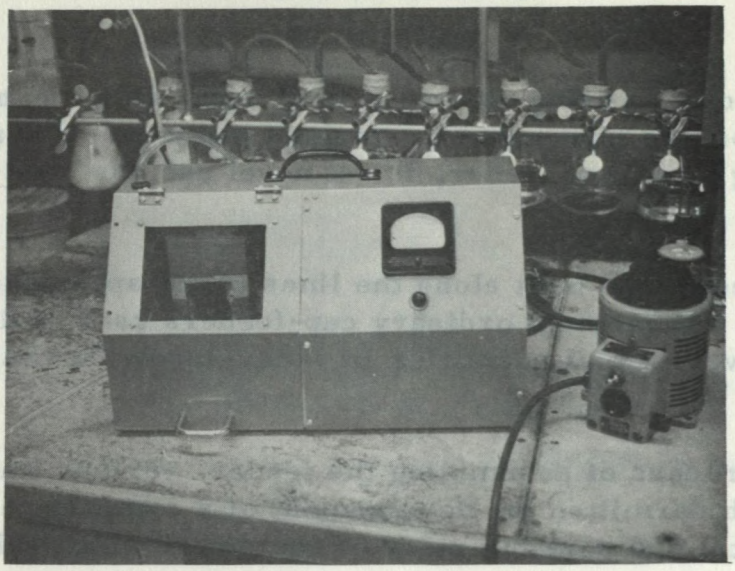

Figure 1. General View of Feeder with Variac.

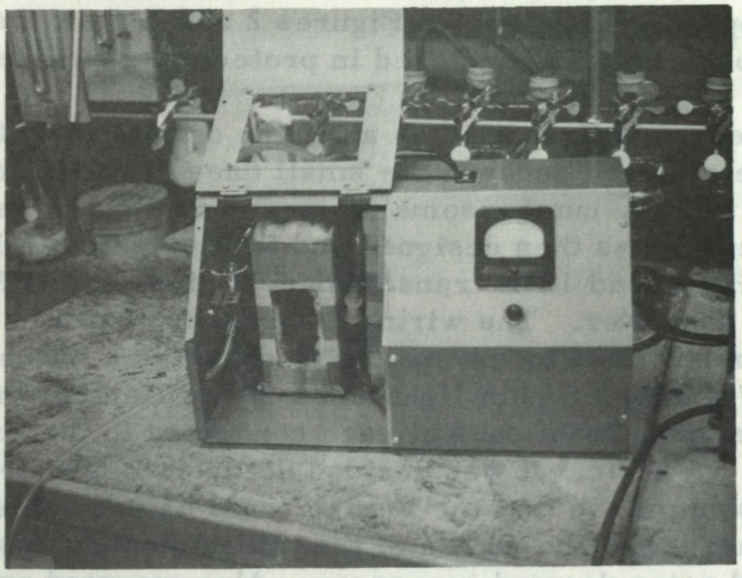

Figure 2. Feeder with Door Open, Showing Box Containing Reagent Bottle, Hypodermic Needle, and Funnel.

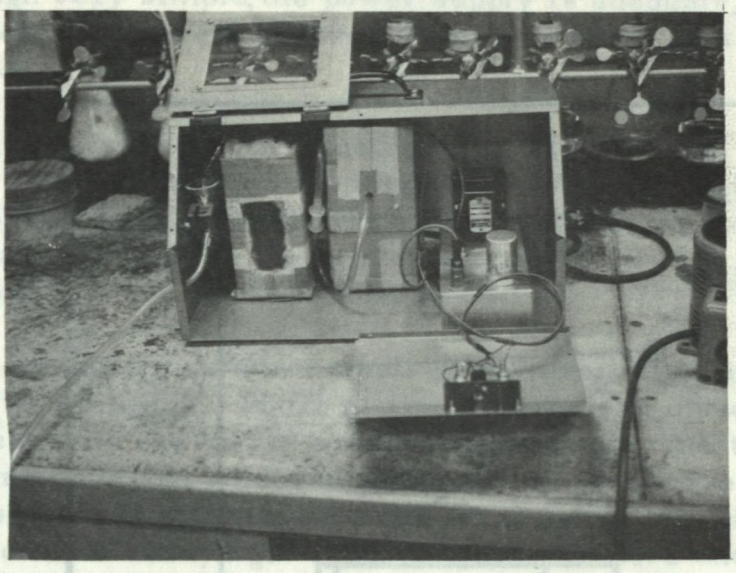

Figure 3. Feeder with Front off, Showing Box Containing Hydrolysis Cell and Power Supply.

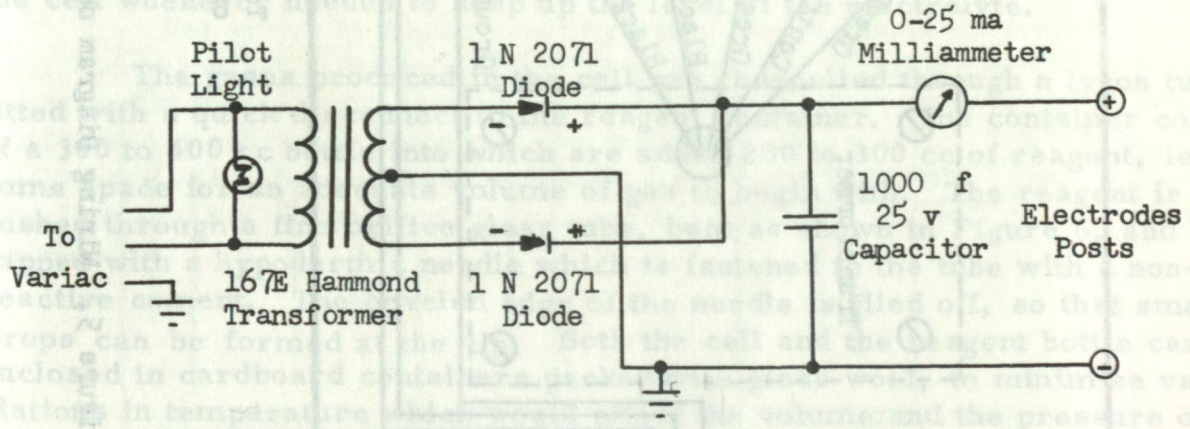

Figure 4. Schematic Diagram of Power Supply.

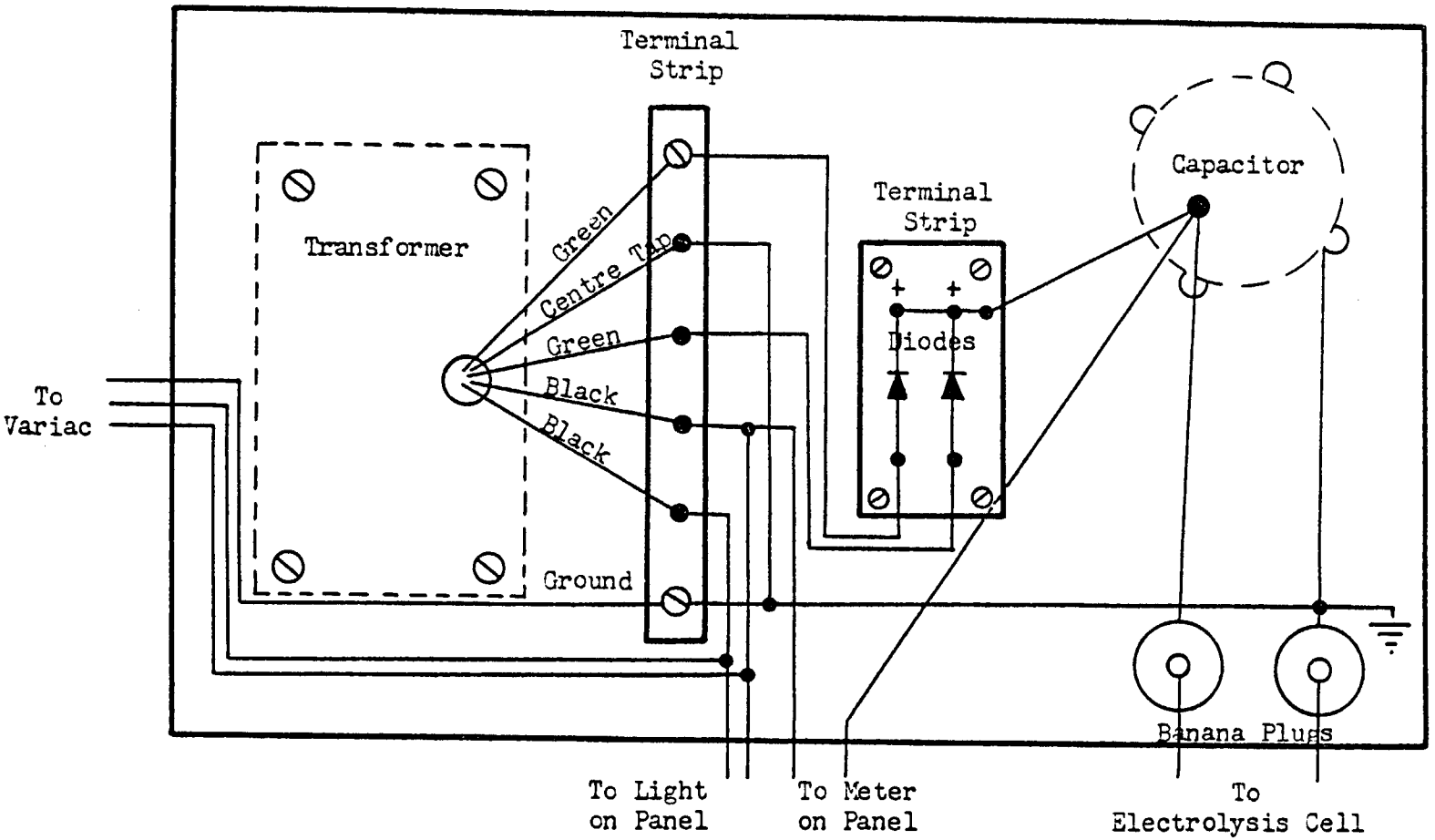

Figure 5. Wiring Diagram on Underside of Chassis of Power Supply.

Although very simple, the power supply is adequate, as line fluctuations do not affect the current adversely and thus there is a relatively constant rate of gas production.

The electrolysis cell is illustrated in Figure 6 and consists of a glass container approximately 6 in. long and 1 1/4 in. in diameter. On the upper portion of the cell, a small glass tube is connected to permit the escape of the gases. The two electrodes are fitted through a neoprene stopper and dip into a 10% H_2SO_4 solution.

The electrodes consist of small glass tubes, approximately 6 in. in length, filled with mercury. Short platinum wires are fused into the bottom ends of the tubes, with the inside ends making contact with the mercury. To the protruding ends are soldered one-centimetre-square pieces of platinum foil. These pieces of platinum were cut from an old, discarded crucible once used in chemical assaying. Only the platinum wire and squares need be immersed in the H_2SO_4 solution and the distance between the squares may vary from a few millimetres to over a centimetre without affecting the production of gases. Into the mercury, from the top of the open tubes, are inserted two nickel wires to which are attached the leads, by means of clips, connecting the electrodes to the power supply. Other, less expensive metals were tested as well as platinum but all seem to be unsuitable due to formation of large bubbles, coatings, and impurities.

It was found that the production of a large quantity of small bubbles ensured a constant pressure in the cell and the reagent container, and that the platinum electrodes provided such a feature. Water should be added to the cell whenever needed to keep up the level of the electrolyte.

The gases produced in the cell are channelled through a tygon tube fitted with a quick disconnect to the reagent container. The container consists of a 300 to 400 cc bottle into which are added 200 to 300 cc of reagent, leaving some space for an adequate volume of gas to begin with. The reagent is then pushed through a fine orifice glass tube, bent as shown in Figure 6, and capped with a hypodermic needle which is fastened to the tube with a non-reactive cement. The beveled edge of the needle is filed off, so that smaller drops can be formed at the tip. Both the cell and the reagent bottle can be enclosed in cardboard containers packed with glass wool, to minimize variations in temperature which would affect the volume and the pressure of the gases. A small opening in the cardboard box containing the reagent bottle may be cut and fitted with a piece of plexiglass so that the level of the reagent may be observed. At the rate at which the reagent is being dispensed, from 0. 026 cc/min to 0. 250 cc/min, a 200-cc volume of reagent will last from 130 to 13 hours.

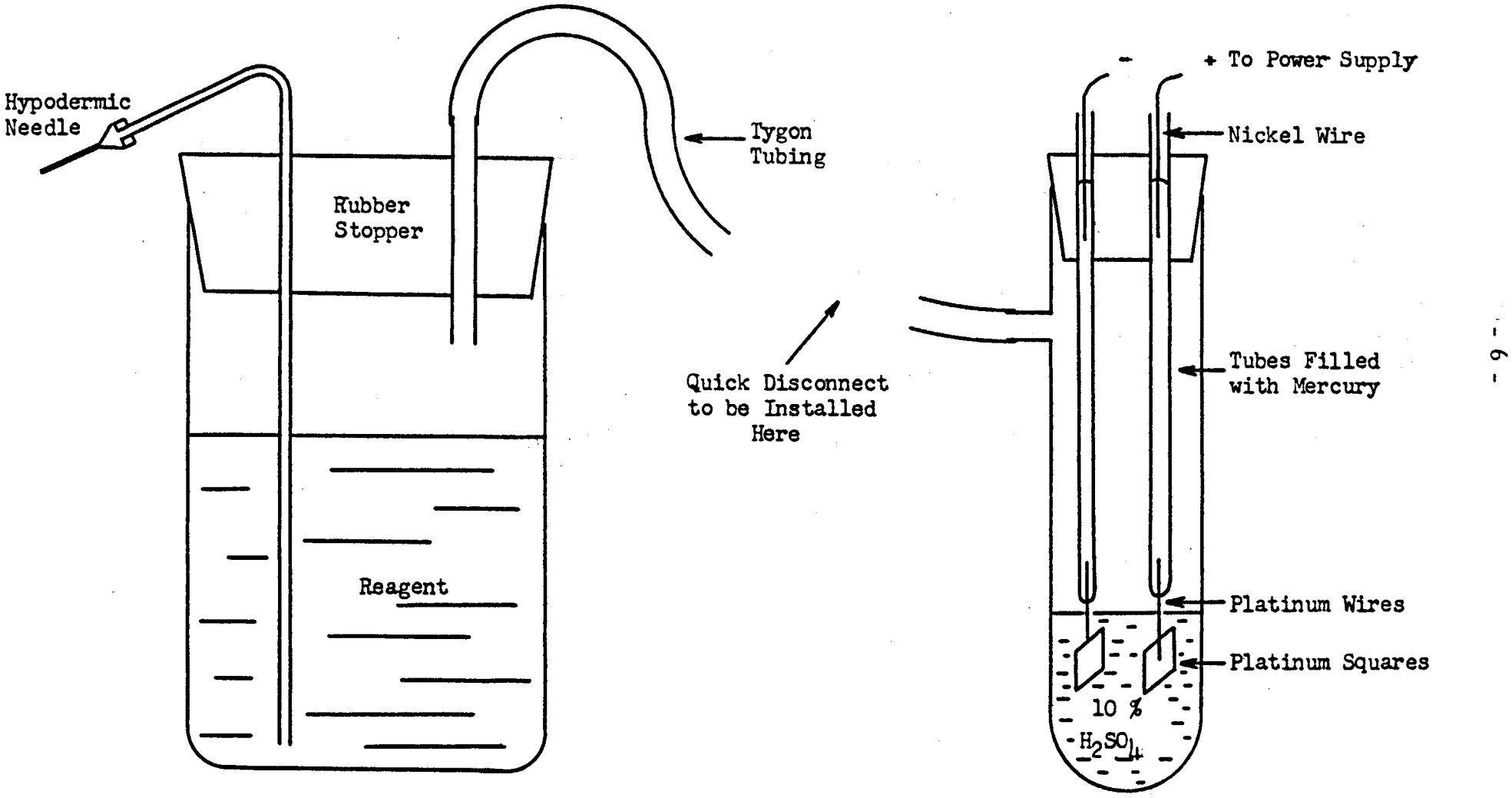

Figure 6. Hydrolysis Cell and Reagent Dispenser.

The production of small drops of reagent with the hypodermic needle permits better control and more accurate setting of the feed rate.

The reagent drops into a small funnel connected to a tygon or rubber tube leading to the flotation cell. Water can also be led to this funnel through another tube, passing through the top of the cabinet as shown in Figure 1, to help speed up the delivery of reagent to the flotation cell.

All components excepting the Variac are housed in a sloping front cabinet, 8 x 9 x 17 in., as illustrated in Figures 1, 2 and 3. The front of the cabinet is cut and a portion is hinged, to give ready access to the reagent bottle and the other components when required. A plexiglass window is also added to the door, so that viewing of drop formation and reagent level is possible without exposing the components to dust and dirt. A carrying handle bolted to the top of the cabinet makes it easy to carry.

The feeder is a very simple instrument to operate. The current is turned on and raised to maximum, to promote the fastest rate of gas production. Once the reagent has reached the needle, the current is cut back to the desired value to obtain the feed rate required. The pressure will adjust itself within five to ten minutes to give a reproducible and reasonably accurate feed rate. Small cleaning rods are usually provided with hypodermic needles. If a rod is inserted in the needle when the feeder is not in use, it will prevent formation of deposits in the needle and retain a column of reagent in the tube. This will permit a faster start-up when the feeder is reactivated. The milliammeter setting on the meter should be checked often, to detect any drift.

The curve in Figure 7 was plotted for an insoluble collector used in sulphide flotation. Taking into account current variations and pressure changes in the system, the two dashed lines on either side of the curve indicate the calculated error in the milliammeter setting, $\pm$ 2 drops. The accuracy of the feeder thus increases for higher currents. Once a curve has been drawn for a new reagent, the settings determined will give reproducible results.

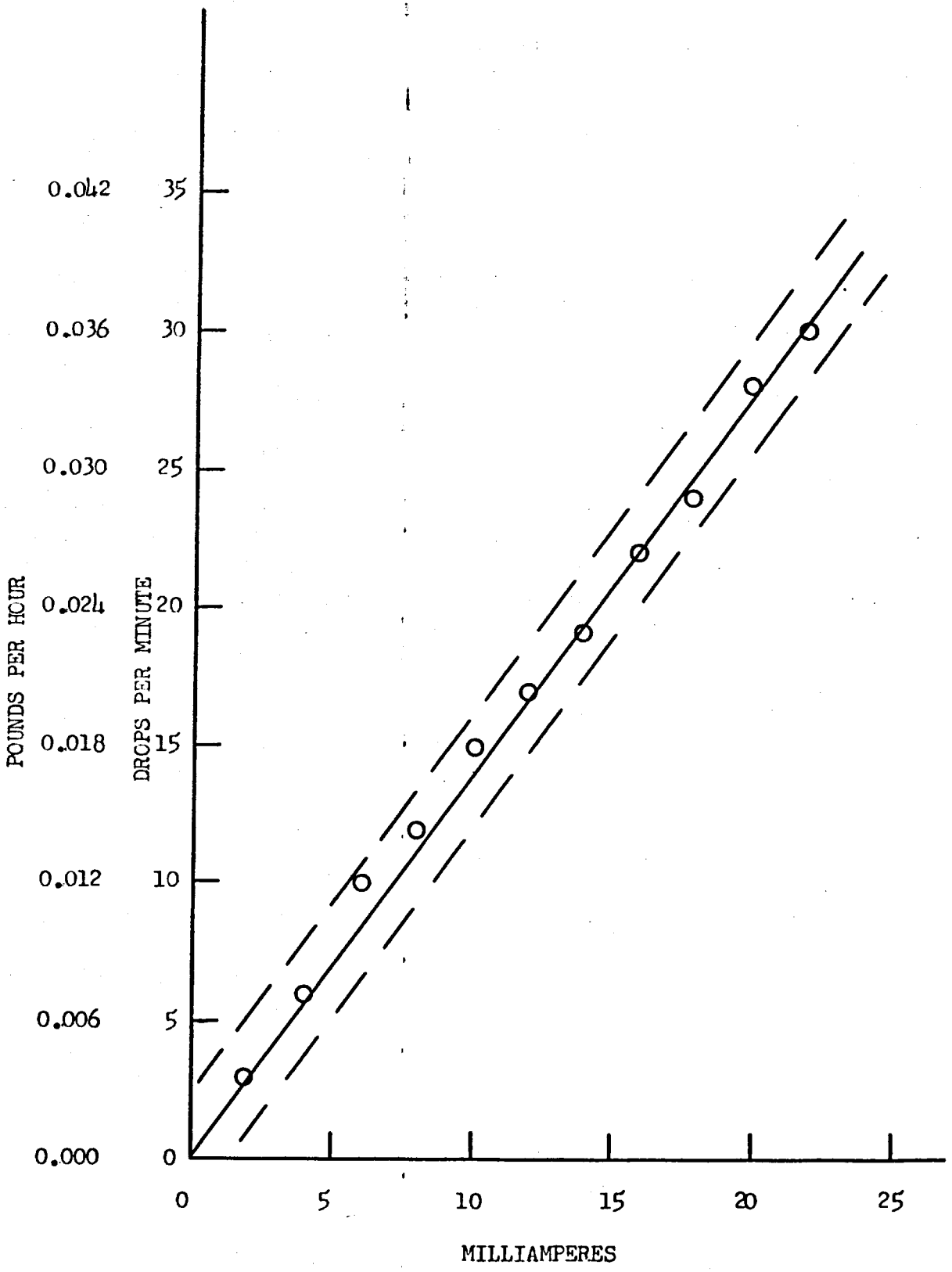

Figure 7. Feeding Rate vs Current.

DISCUSSION

This feeder was employed on two flotation pilot-plant runs and proved satisfactorily accurate.

By inserting a longer-scale milliammeter the feed rate of the present feeder can be increased, as the power supply is capable of providing higher currents and a higher rate of bubble production. A larger feeding tube would give larger drops and thus increase feeding rates.

The easiest method to determine the feed rate is to plot drops/min against milliamperes. The size and weight of the drops do not vary with feed rate; so the feed rate can be easily calculated.

To compensate for hydrostatic pressure the reagent-bottle diameter should be as large as possible in relation to its height so that the reagent level will drop very slowly.

Explosion of the oxygen-hydrogen mixture is very unlikely to occur, since a spark would be necessary to originate the synthesis of water. In any case, both the gas generator and the reagent feeder are covered by glass wool and are in a container.

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