A PRECISION-TYPE RECIPROCATING STIRRER FOR LABORATORY USE

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In the physical chemistry laboratory there is frequent need for vertical stirring. This need arises particularly in connection with calorimetic measurements, freezing point depressions, transition point determinations and other experiments which typically involve a vacuum bottle and a differential thermometer. Often the experimenter must choose between two inconvenient arrangements: either a rotating propellor which is unwieldy to install in the narrow confines usually existing, and which is hazardous from a breakage standpoint, or a ring stirrer which is functionally sound, especially for mushy mixtures, but, if manually operated, very time consuming and laborious when equilibrium must be maintained for a considerable period of time.

Techniques used in the study of hydrates (Blankenship 1946, Sampson and Blankenship 1948), in the physical chemistry laboratories at the University of Oklahoma, required periods of as long as 8 to 12 hours of stirring with concurrent temperature measurement. The material to be stirred was sometimes of a mushy or viscous consistency. No suitable reciprocating device for mechanically driving a ring stirrer could be obtained from the usual laboratory supply houses. This lack is doubtlessly due to the fact that makeshift arrangements can be contrived which serve fairly well for temporary installations. But for research of the type mentioned above, manual operation did not give reproducible temperatures, and a sturdy, continuously operating vertical stirrer was considered essential. Accordingly the chemistry shop undertook the design and construction of a precision-type reciprocating stirrer.

The fundamental design requirements to be met for use with a differential thermometer in a one pint capacity vacuum bottle were as follows:

a. Electrically operated, continuous duty, without excessive vibration.
b. Driving mechanism displaced to one side in order not to compete for space with thermometer and other accessories projecting vertically.
c. Stroke length adjustable 6 or 7 cm. to accommodate various depths of liquid.
d. Stirring rod held rigidly and driven accurately in a narrow space to avoid breakage.
e. Rate of stirring adjustable to a maximum of 4 or 5 strokes per second to accommodate mixtures of varying consistency.

In addition to the above basic requirements, the chemistry shop was able to incorporate in the design, without sacrificing sturdiness or smoothness of operation, the following desirable features:

f. Compact dimensions, suitable for clamping to a ringstand when in use.
g. Length and speed of stroke continuously adjustable even while the stirrer is in operation so that there is no need to stop for resetting during the course of an experiment.
h. Stirrer always stops at the same position at the bottom of the stroke even though the length of the stroke is changed, thereby

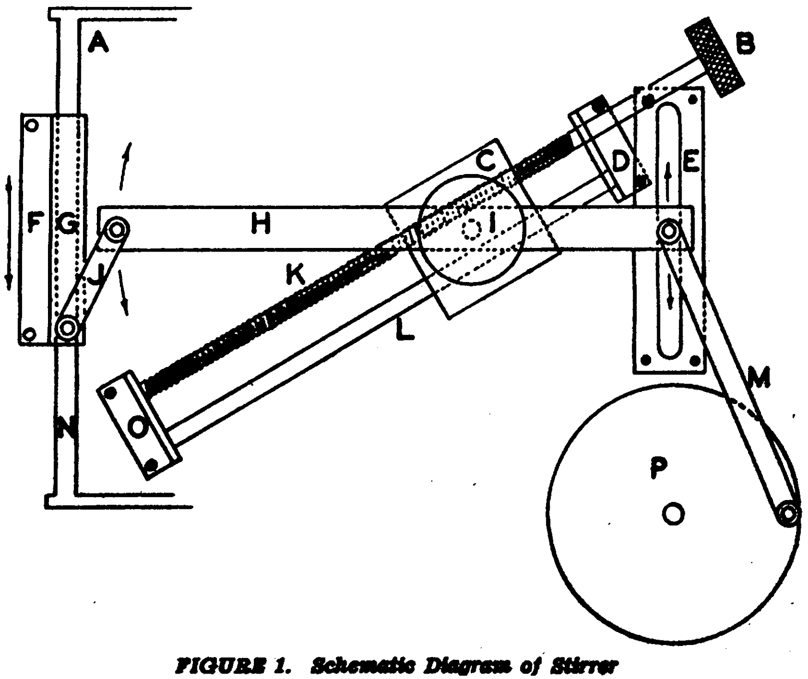

FIGURE 1. Schematic Diagram of Stirrer

permitting the operator to avoid the hazard of striking the bottom of the vacuum bottle, or of having the stirrer catch under the thermometer.

The last two features are thought to be somewhat unique, hence to make the mechanism of sufficient interest to merit explanation.

As shown in Fig. 1, the stirring rod driver (G) reciprocates on vertical guide rods (N), and is driven by a rocker arm (H) whose hub (I) is mounted on a traveling base (C). As this base (C) is moved by turning the knob (B) on the threaded shaft (K), the length of stroke is changed. The guide shaft (L) and the threaded shaft (K), which control the position of the base (C), are mounted on supports (O) and (D) in such a way that the center of the hub (I) will always lie on a line drawn from the upper limit of travel of the driven end of rocker arm (H) to the lower limit of travel of the driving end.

It is apparent from Fig. 2 that such an arrangement will cause the lower limit of the stroke to hold a constant position. The rocker arm always returns to the limiting position M L, no matter whether the axis is at A, B, or C. The lower limit of the stroke remains at L, even though the upper limit is A′, B′, or C′.

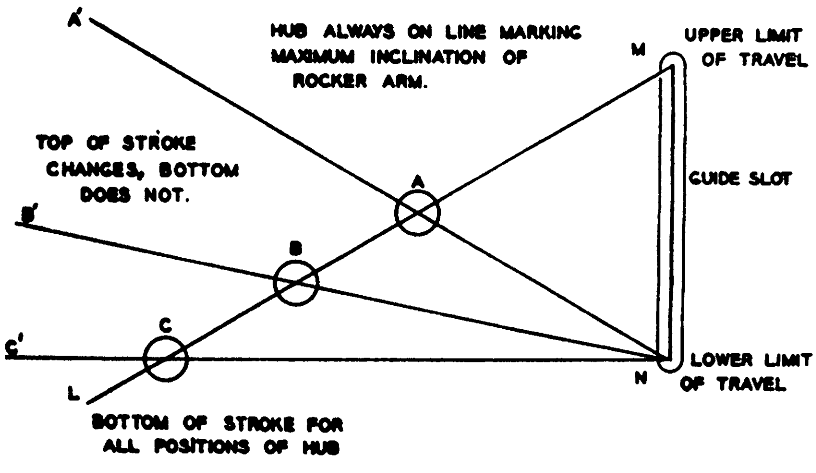

FIGURE 2. Principle of Stirrer

Referring to Fig. 1, the rocker arm (H) is driven by drive wheel (P) by means of a connecting rod (M) whose motion is confined by the guide plate (E). The drive wheel (P) is geared to a 1/50 h. p. laboratory model 1650 rpm stirring motor at a speed reduction of approximately 6:1. The speed is regulated by a small rheostat of conventional type.

The stirring rod proper is tightly held in the clamp (F). In the schematic diagram the guide rod assembly has been displaced in an outward direction for clarity, giving the connecting rod (J) an apparent deviation from vertical. In the actual apparatus, the connecting rod (J) holds an almost vertical position as the end of the rocker arm oscillates between a pair of guide arms. During operation the hub (I) executes rotary oscillation on an axle mounted through base (C). The bearing for this axle is supplied with an oil cup. This same lubrication cares for the relatively small amplitude longitudinal oscil-

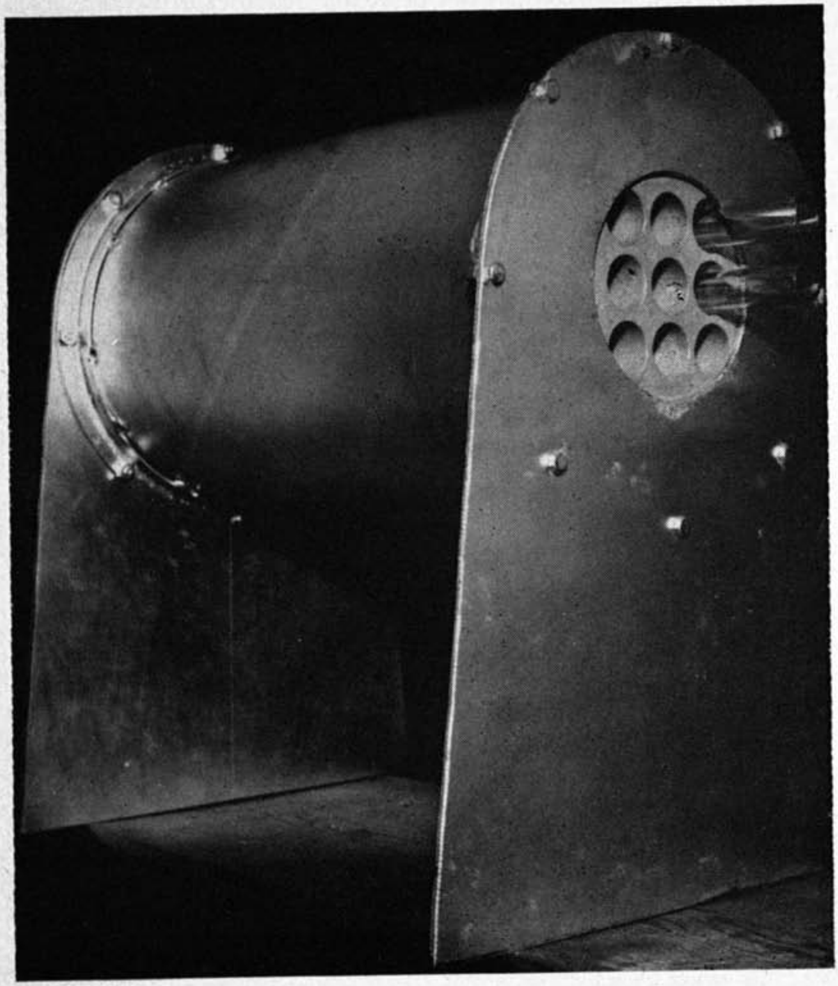

FIGURE 1. Multitubular Furnace for Pyrolitic Decomposition

latory slipping of the rocker arm in its slot through the hub. This slipping results from the straight line path, rather than circular arc, imposed by the guide plate (E).

The model constructed was housed, except for the electric motor, in a 6" x 8" x 1¾" case. Full speed was 4½ strokes per second and the length of stroke could be varied from 5/16" to 2½". All moving parts were made of suitably heat-treated tool steel.

SUMMARY

A precision-type reciprocating stirrer designed by Carl W. Starkey, Machinist, Chemistry Department, has been presented and its several novel features have been explained. Since the stirrer construction involves a certain amount of machine work, it is perhaps not feasible for individual student use in most school laboratories. But it can be highly recommended for advanced work, and for industrial laboratories where a large amount of vertical stirring is part of the routine.

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