Title
A Laboratory Size Induction Stirrer for Closed Systems

Authors
Tolbert, B.M.
Deuben, W.G.
Reid, J.C.

Publication Date
1948-07-01

UNIVERSITY OF CALIFORNIA

Radiation Laboratory

BERKELEY, CALIFORNIA

DISCLAIMER

UNIVERSITY OF CALIFORNIA
RADIATION LABORATORY

Cover Sheet
Do not remove

INDEX NO. UCRL-135
This document contains 7 pages
and 6 plates of figures.
This is copy 83 of 98. Series A
Issued to: UC Rad Lab

CLASSIFICATION CANCELLED BY AUTHORITY
OF THE PATENT ENGINEER
BY THE DECLASSIFICATION COMMITTEE
RESTRICTED
Classification

Each person who received this document must sign the cover sheet in the space below.

Route to	Noted by	Date	Route to	Noted by	Date

UCRL-135
Physics-Instrumentation

UNIVERSITY OF CALIFORNIA

Radiation Laboratory

Contract No. W-7405-eng-48

A LABORATORY SIZE INDUCTION STIRRER FOR CLOSED SYSTEMS

by

B. M. Tolbert, William G. Dauben and James C. Reid

Berkeley, California

Standard Distribution

Copy Nos.

Argonne National Laboratory	1-8
Armed Forces Special Weapons Project	9
Atomic Energy Commission, Washington	10-11
Battelle Memorial Institute	12
Brookhaven National Laboratory	13-18
Carbide & Carbon Chem. Corp. (K-25 Area)	19-22
Carbide & Carbon Chem. Corp. (Y-12 Area)	23-26
Columbia University (Dunning)	27
Columbia University (Failla)	28
General Electric Company	29-32
Hanford Directed Operations	33-39
Iowa State College	40
Kellex Corporation	41-42
Los Alamos	43-45
Massachusetts Institute of Technology	46
Monsanto Chemical Company, Dayton	47-48
National Bureau of Standards	49-50
Naval Radiological Defense Laboratory	51
NEPA	52
New York Directed Operations	53-54
Oak Ridge National Laboratory	55-62
Patent Advisor, Washington	63
Technical Information Division, ORDO	64-78
UCLA Medical Research Laboratory (Warren)	79
University of California Radiation Laboratory	80-84
University of Rochester	85-86
Western Reserve University (Friedell)	87
Chicago Directed Operations	88
Declassification Procedure	
Declassification Officer	89-92
Publication Officer	93
Patent Department	94-9
E. O. Lawrence	96
Area Manager	97
Information Division	98
Total	98

Information Division
University of California
Radiation Laboratory

A LABORATORY SIZE INDUCTION STIRRER FOR CLOSED SYSTEMS

By

B. M. Tolbert, William G. Dauben and James C. Reid

From the Radiation Laboratory and the Department of Chemistry,

University of California, Berkeley 4, California

June 22, 1948

ABSTRACT

A small size induction stirrer for use in closed systems is described; the design is simple and has the advantage that it can develop high speed and fair power and that it does not interfere with the use of cooling and heating baths.

This paper is based upon work performed under Contract #W-7405-Eng-48 with the Atomic Energy Commission in connection with the Radiation Laboratory, University of California, Berkeley.

To be published in Analytical Chemistry

A LABORATORY SIZE INDUCTION STIRRER FOR CLOSED SYSTEMS

By

B. M. Tolbert, William G.Dauben, and James C. Reid

From the Radiation Laboratory and the Department of Chemistry,
University of California, Berkeley, California (1)

June 22, 1948

Numerous internal stirrers have been devised for the agitation of liquids in closed systems. Most of the devices are of the magnetic type and are so designed that the mechanism required to establish a rotating or an alternating vertical field outside the reaction flask is cumbersome and impractical when the reaction flask must be immersed in a cooling or a heating bath. Most stirrers also have many other drawbacks such as the low power developed, the complex construction details, and the lack of versatility. A simple induction stirrer which circumvents many of the above difficulties has been used in this laboratory (2) and an improved design of this earlier model is described in this paper.

---

(1) This paper is based on work performed under Contract #W-7405-Eng-48 with the Atomic Energy Commission in connection with the Radiation Laboratory, University of California, Berkeley.

(2) Dauben,W.G., Reid. J.C., and Yankwich, P.E., Anal. Chem., 19, 828 (1947).

The induction motor consists of a three-phase Selsyn generator stator, a glass enclosed armature, and a bearing system (see Fig. 1). Various sizes and types of stirrers may be conveniently attached to the armature. The unit is particularly useful with small scale reaction vessels and sufficient power to stir viscous solutions is developed. The maximum speed of the stirrer is over 3000 RPM. The speed can be controlled with a variable transformer.

Two models of the stirrer have been developed which differ only in their bearing system. In Fig. 2 a sectional view of a unit which employs a ball bearing is shown. In Fig. 3 is diagrammed a corrosion resistant model in which a Teflon (3) bearing is used. The motor is designed to have good vacuum characteristics and to be easily cleaned. The rotor is solid, and outgassing from windings is thus avoided. Holes are provided in all solid bearings to permit rapid evacuation of otherwise enclosed spaces and gas volumes are kept small. Both models have been used routinely in a C^{14} synthetic laboratory and show no memory effects.

Armature: - The core of the armature (see Fig. 4) is turned from soft iron. The copper shell, which is made from 0.035 in. wall, 1-$\frac{1}{4}$ in. O.D. copper tubing, and the iron core are soft-soldered together and made vacuum tight at the edges. After the machining of the armature is finished, the entire armature, except for the area where the bearing fits on, is then painted with a corrosion resistant paint (4) and baked at 250° F. for 12 hours. The same armature is used with either the ball or Teflon bearing model.

---

(3) Polymerized tetrafluorethylene. Made by E.I. duPont de Nemours Co., Wilmington, Delaware.

(4) Plastic paint 4A. Interchemical Corp., 1073 Howard St., San Francisco, California

---

Cap: - The cap is machined from hard copper and should fit the glass shell loosely (see Fig. 5). The cap, with screws in place, is also painted and baked as is the armature. The Teflon bearings (made from 1/16 in. sheet) in the cap should fit loosely on the upper armature shaft, for Teflon expands when it is warmed.

The cap is sealed to the glass shell with a low melting sealing compound (DeKhotinsky cement, sealing wax, etc.). In this process, both the cap and the glass are warmed; the edges are covered with a thick layer of melted wax, and the parts are brought together. Enough wax should be used so that a definite fillet is formed on the inside surface of the stirrer; excess wax on the outside may be cut off.

Bearings (lower): - The ball bearing (open type, 1-$\frac{1}{4}$ in. O.D., 15/16 in. I.D.) (5) is centered in the glass shell by two or three small rubber bands or a metal ring and supported on an oil resistant, synthetic rubber washer; it is lubricated with a non-volatile, non-reactive oil (some types of diffusion pump oil are very good for this purpose). (6).

The plastic bearing is machined from $\frac{1}{4}$ in. Teflon sheet to give a slide fit inside the glass shell and a loose bearing fit on the armature. Rotation of this bearing is prevented by a "V" cut in the Teflon and an indentation on the lower end of the glass shell. Four 3 mm. holes (1/8 in.) bored slantwise through the body of the plastic permit evacuation of the upper chamber of the stirrer. A ring of 1/16 in. Teflon provides a horizontal Teflon to Teflon bearing that has less friction resistance than a plastic to iron bearing; even so, wear is appreciable and such bearings have a limited life.

---

(5) Ball bearing #6210, S.K.F. Industries, Inc., 440 East 34th St., New York, New York.

(6) For example, DC 703 Silicone Fluid, Dow Corning Company, Midland, Mich.

Stator: - The stator is the field coil of a Selsyn generator (1-$\frac{1}{2}$ in. I.D.) (7). When the unit is operated above 30 volts, a water-jacket or air blast should be provided to prevent overheating of the windings of the stator and loosening of the wax seal of the armature housing. The stator is supported in the usual manner or can conveniently be supported on a collar (a cork ring) which rests on the reaction equipment. No alignment problem is encountered when the stirrer is assembled in the latter fashion.

The power supply for the stator is conveniently made from a variable transformer and a 50 to 100 μF oil or paper condenser (see Fig. 3a).(8). This arrangement is a typical capacitor induction type motor circuit and permits operation of the motor on a 110 volt, 60 cycle, single phase line.

Stirrers: - Many types of stirrer assembly may be used with this motor. The stirrers are connected to the drive shaft of the motor by means of a ground joint and the joint held together with a low melting solid (such as DeKhotinsky cement or sealing wax). This method of connection allows for different stirrers to be attached without opening the armature housing.

---

(7) Selsyn generator, Model 2J55V1, 110 volt, 60 cycles, General Electric Company, Schenectady, New York.

(8) Pyranol capacitor, Cat. No. 67X18X, Model No. 9CE1A318, 330 volt, 60 cycle, 50 μF.

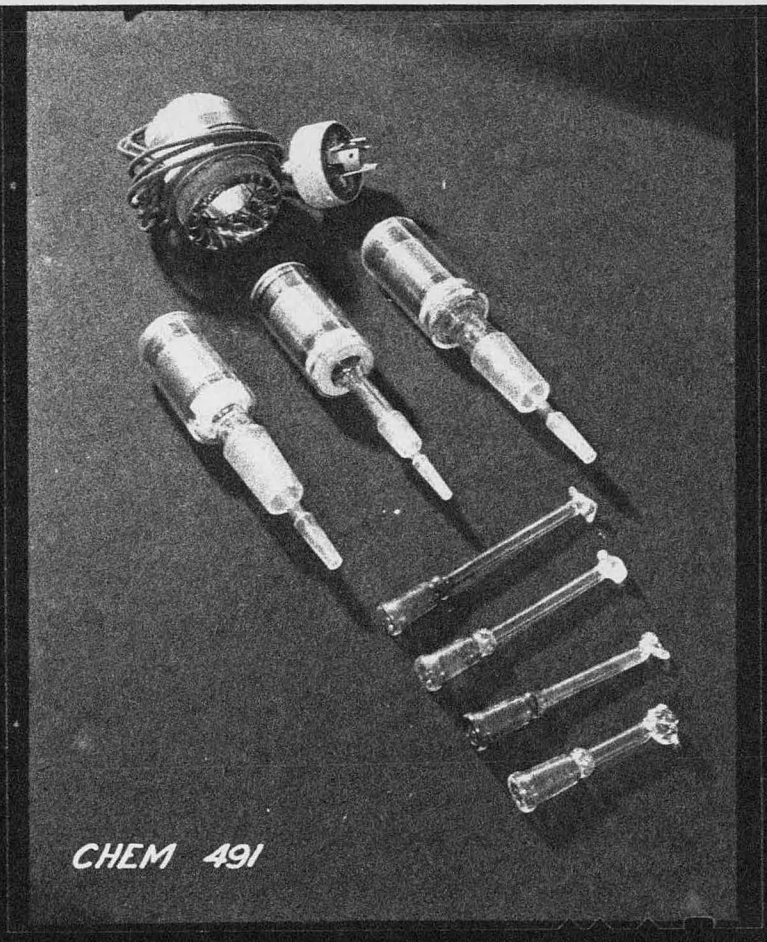


Figure 1. Induction stirrer showing stator, three enclosed armatures (the first one with a teflon lower bearing) and a number of different stirrers.

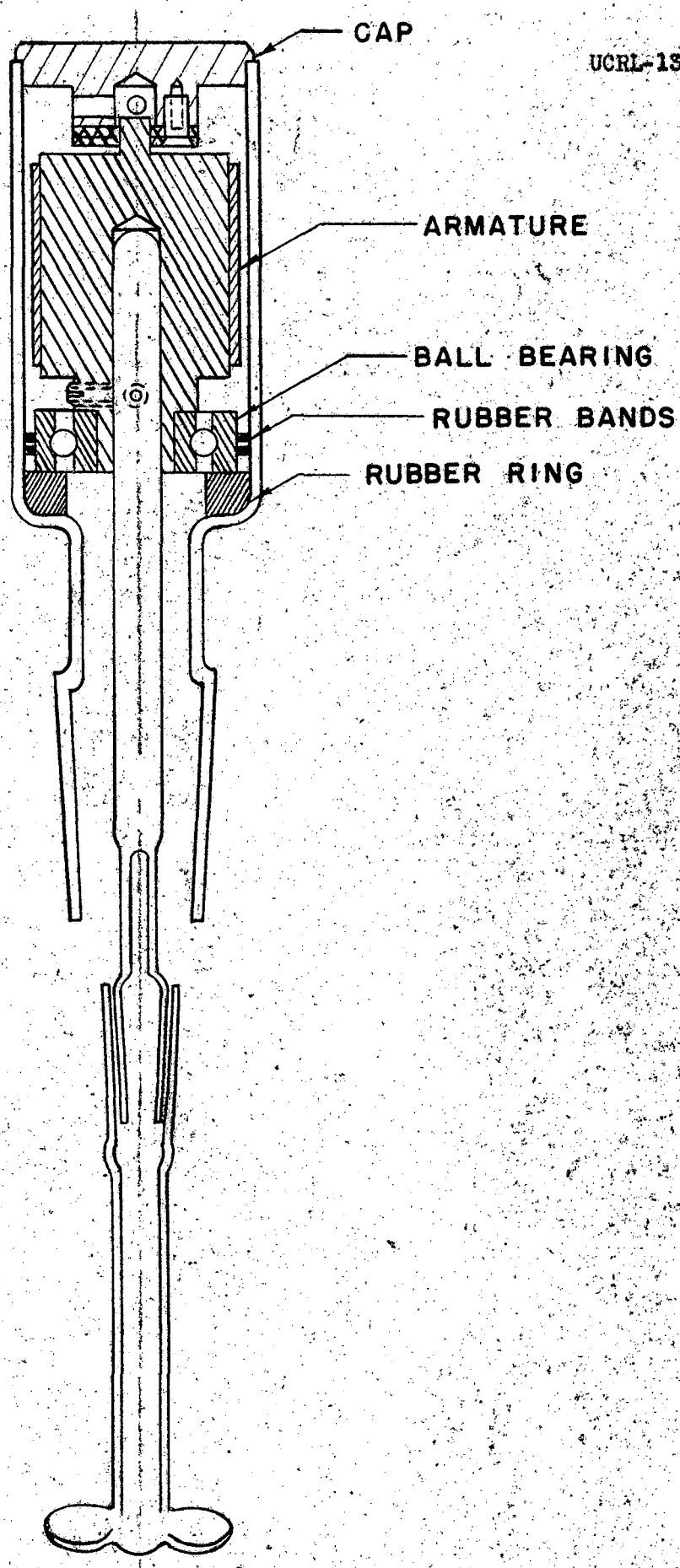
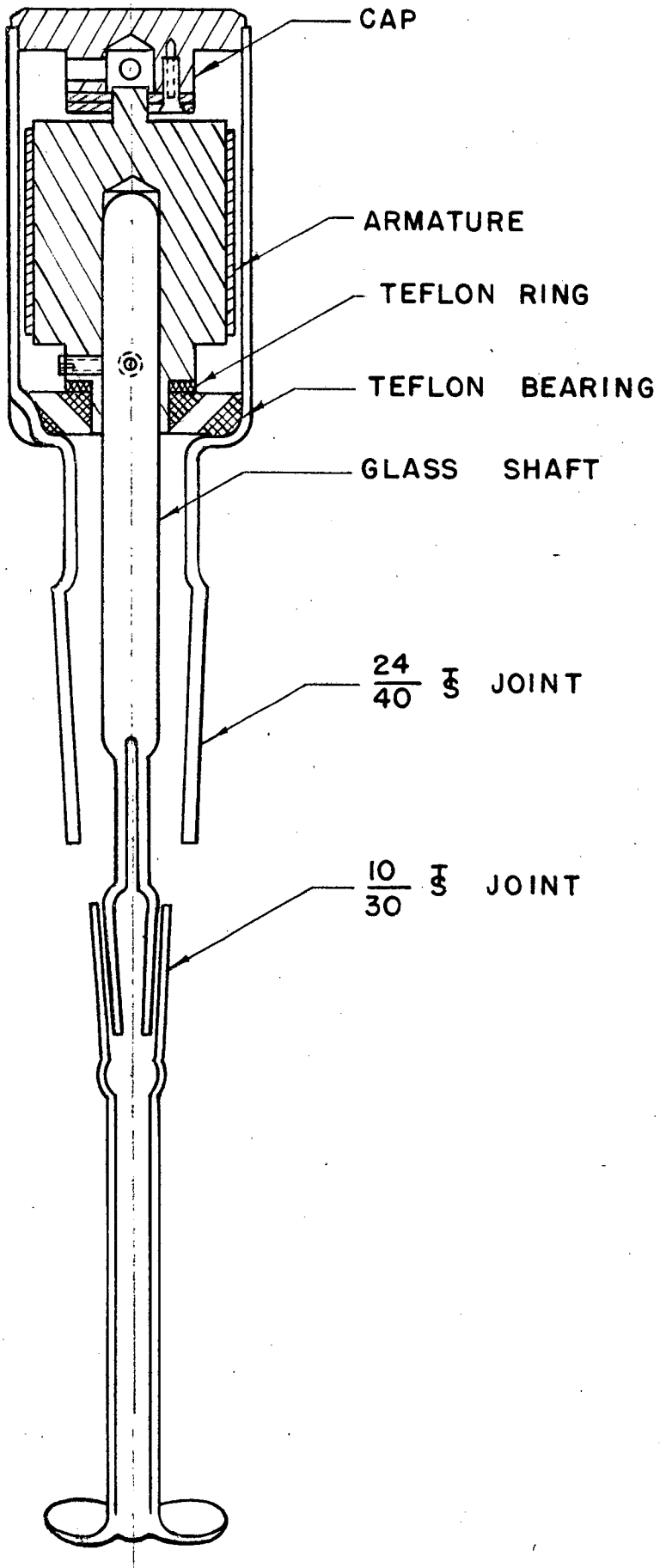


FIG. 2

Ball Bearing Induction Stirrer



Corrosion Resistant Model of Induction Stirrer
with Lower Bearing Made of Teflon

FIG. 3

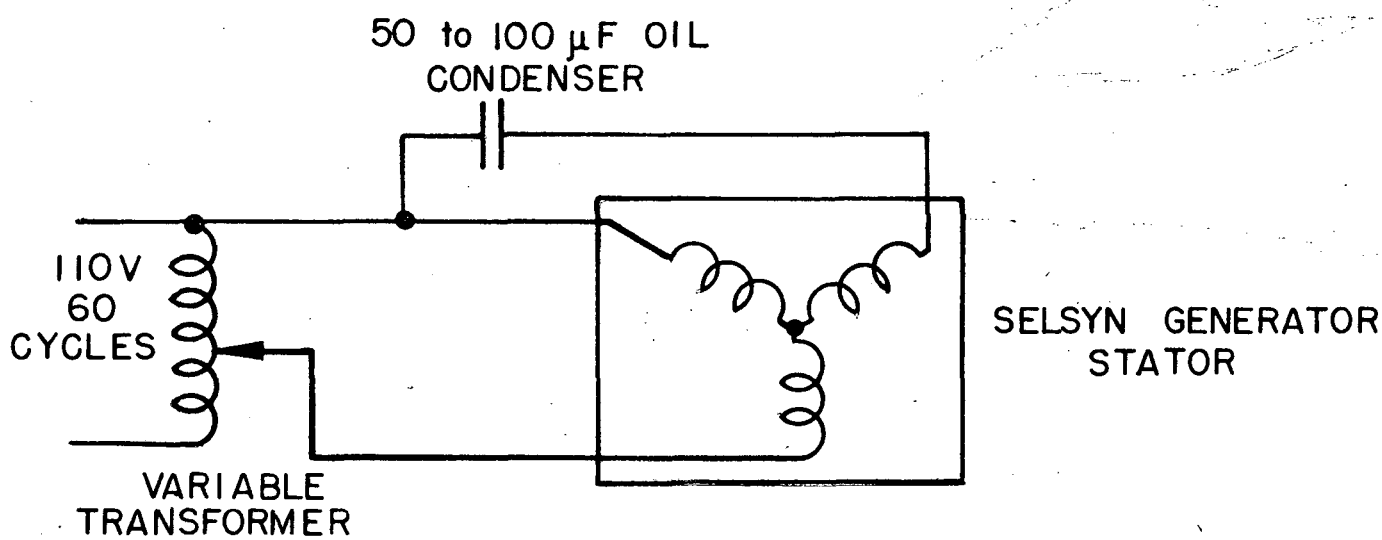


FIG. 3a

Induction Stirrer Wiring Diagram

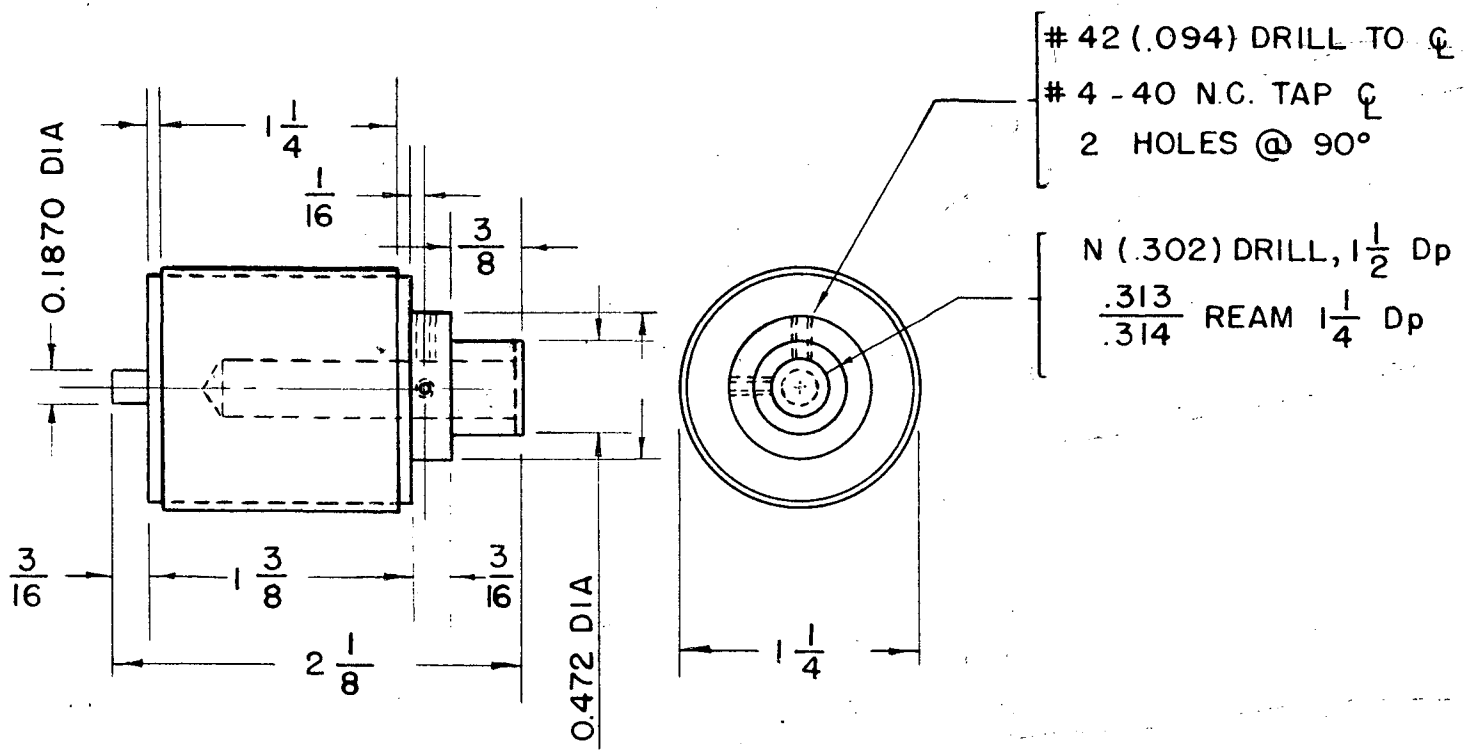


FIG. 4

Induction Stirrer Armature

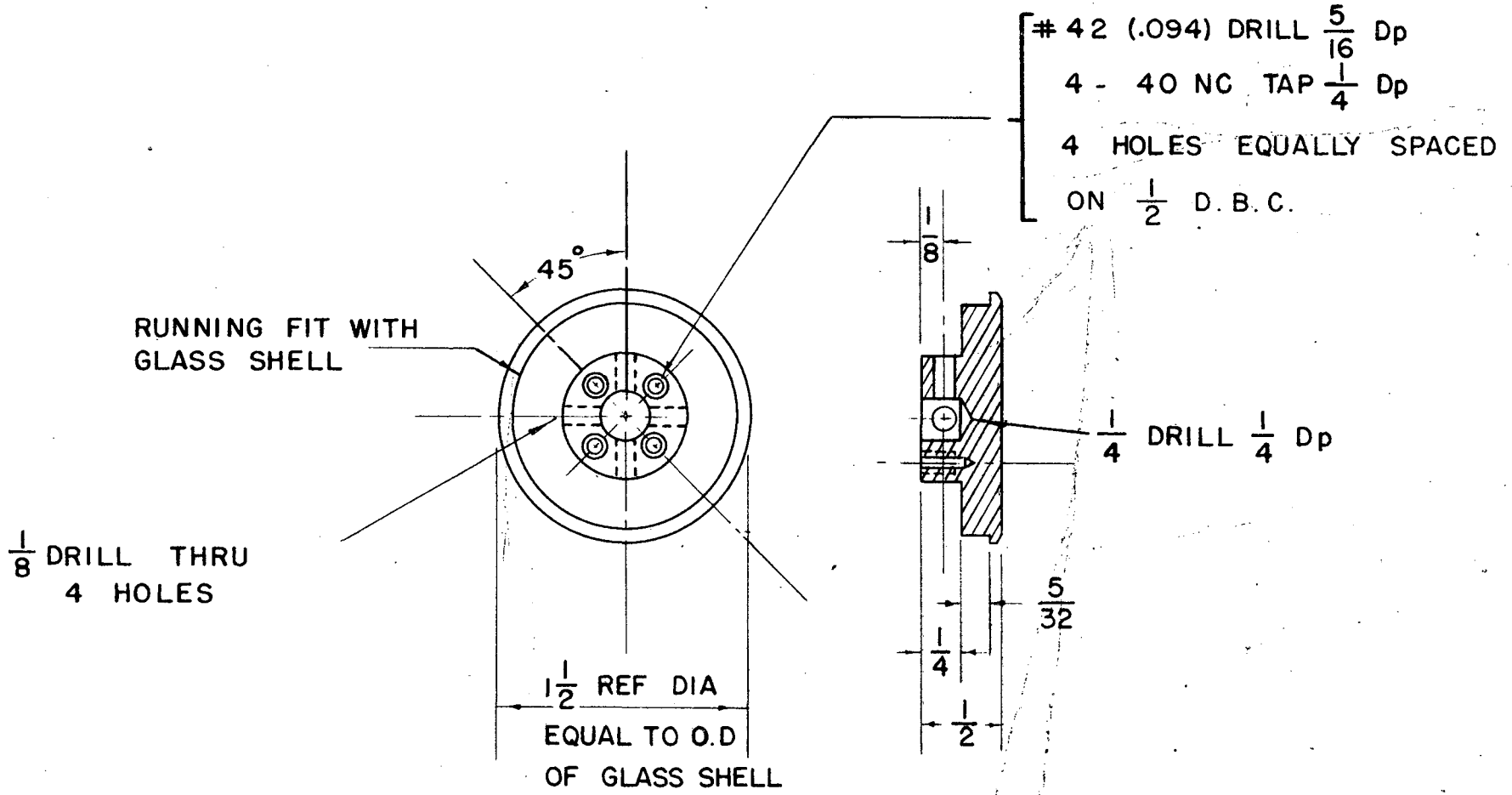


FIG. 5

Induction Stirrer Cap, Copper