MECHANICAL INFESTATION DEVICE USED IN FALL ARMYWORM PLANT RESISTANCE PROGRAMS[1,2,3]

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ABSTRACT

A mechanical device called the "Bazooka" was developed by an entomologist of the Centro Internacional de Mejoramiemto de Maiz y Trigo (CIMMYT) for manually dispensing lepidopterous larvae. Modifications have been made to fit individual plant-resistance programs for infestations of fall armyworm, *Spodoptera frugiperda* (J. E. Smith), southwestern corn borer, *Diatraea grandiosella* (Dyar), and the European corn borer, *Ostrinia nubilalis* (Hübner). The implementation of this mechanical larval dispenser allows its use in the laboratory for rearing insects, in the greenhouse for infesting seedlings, and in the field for large or small testing purposes.

Programs in plant resistance to insects have been greatly enhanced by artificial rearing of the insect (Wiseman et al. 1974, Davis 1976). A prerequisite to most initial searches for insect-resistant cultivars, but more especially for breeding programs for insect resistance, is the development and use of rapid, artificial infestation techniques (Wiseman and Davis 1979a, b).

Early methods of infesting plants for resistance testing with the fall armyworm, *Spodoptera frugiperda* (J. E. Smith), were described by Wiseman et al. (1974). Use of the very laborious camel hair brush technique to transfer larvae to plants made large-scale, rapid screening impossible. However, with other insects such as the southwestern corn borer, *Diatraea grandiosella* (Dyar), (Davis 1976) and the European corn borer, *Ostrinia nubilalis* (Hübner), (Guthrie et al. 1965), infestations were made rather easily with pinned egg masses placed into the whorls of corn plants.

However, it was not until recently that a technical breakthrough occurred and rapid infestations of lepidopterans could be made. Mihm et al. (1978) developed a manual larval dispenser (Fig. 1) called the "Bazooka" that could be pre-calibrated to deliver a uniform amount of larvae mixed with corncob grits. We wish to illustrate, in chronological order, the modifications that have been made to the Bazooka.

The Southern Grain Insects Research Laboratory (SGIRL) entomologist received a copy of the original Bazooka from Centro Internacional de Mejoramiemto de Maiz y Trigo (CIMMYT) in 1977. Roberson et al. (1978) modified it for use in evaluations of large numbers of sorghum seedlings. Problems still existed with breakage and poor dispensing until later modifications were made (Fig. 2). A stainless steel plate was placed below the slide mechanism and kept under tension by 2 springs. This procedure pro-

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[3]Mention of a proprietary product in this paper does not constitute an endorsement of this product by the USDA.

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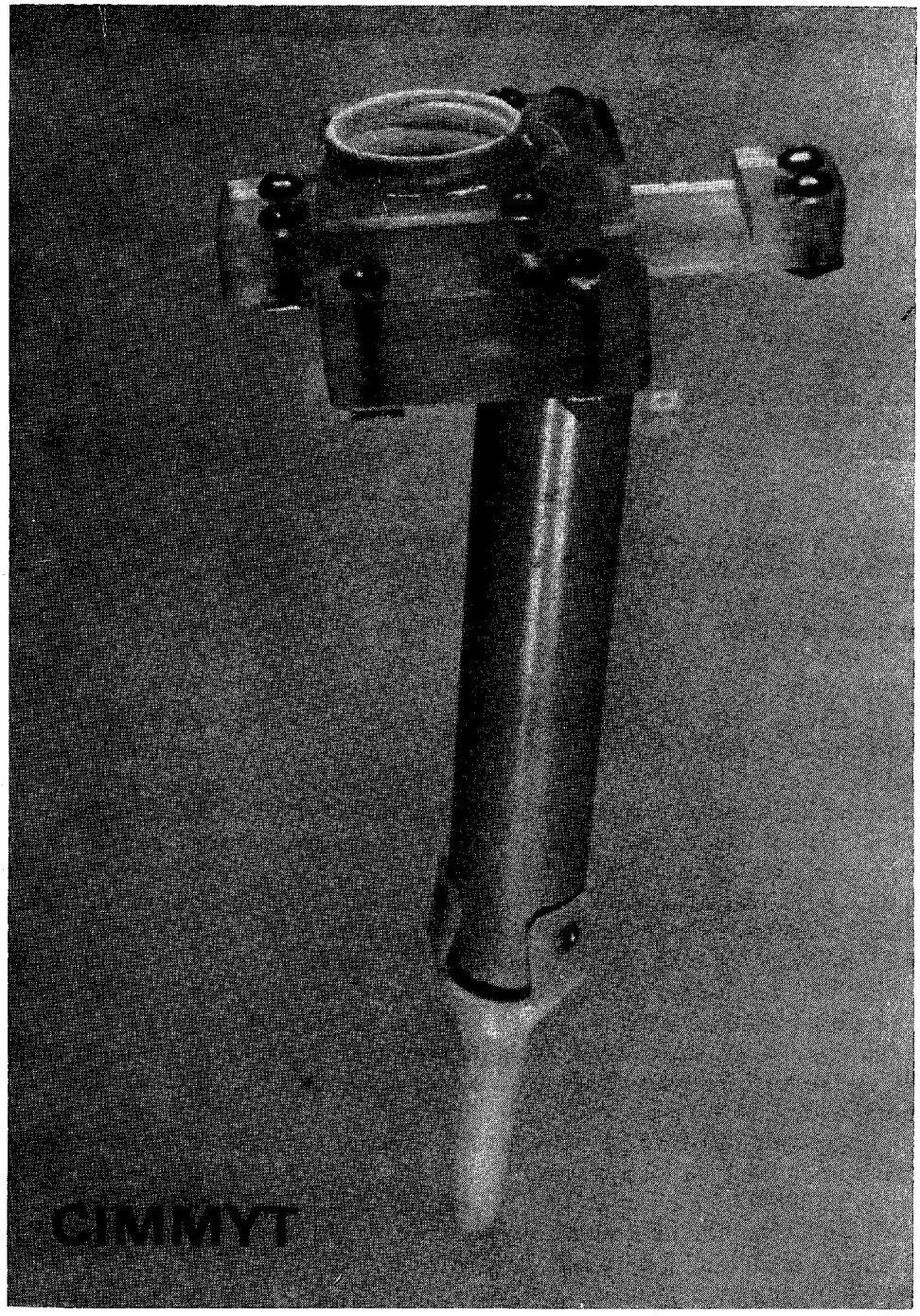

Fig. 1. Original Bazooka for rapid infestation of plants with insects.

vided an outlet for the grits that would sometimes accumulate between the slide and the upper plate. A metal cap was used instead of polyethylene because the summer heat melted the glue that held the polyethylene cap; thus, as the glue melted, the bottle and cap were easily dislodged from the dispenser, spilling grits and larvae over the plants. The outlet hole was re-

duced to 6.25 mm in diam. because of problems encountered with absorption of moisture by the grits, which resulted in a scalding effect on the sorghum leaves. This small hole allowed a delivery of 0.2 ml of #2040 grits and fall armyworm larvae. The rubber band was retained to return the slide to the loading position. The end spout was reduced to a 6.25-mm opening, and a small funnel was used for delivery into the whorls of small plants. The opening tip was beveled to prevent the grits and larvae from clogging the spout. This could happen when infestations were made before the dew evaporated. Wiseman and Widstrom (1980) have reported on a comparison of methods of infesting fall armyworm larvae in whorl-stage corn. They found that the Bazooka was the easiest and most efficient method tested. Also, they found that corn plants could be infested 3-4 times faster with the Bazooka than by pinning egg masses into the whorl.

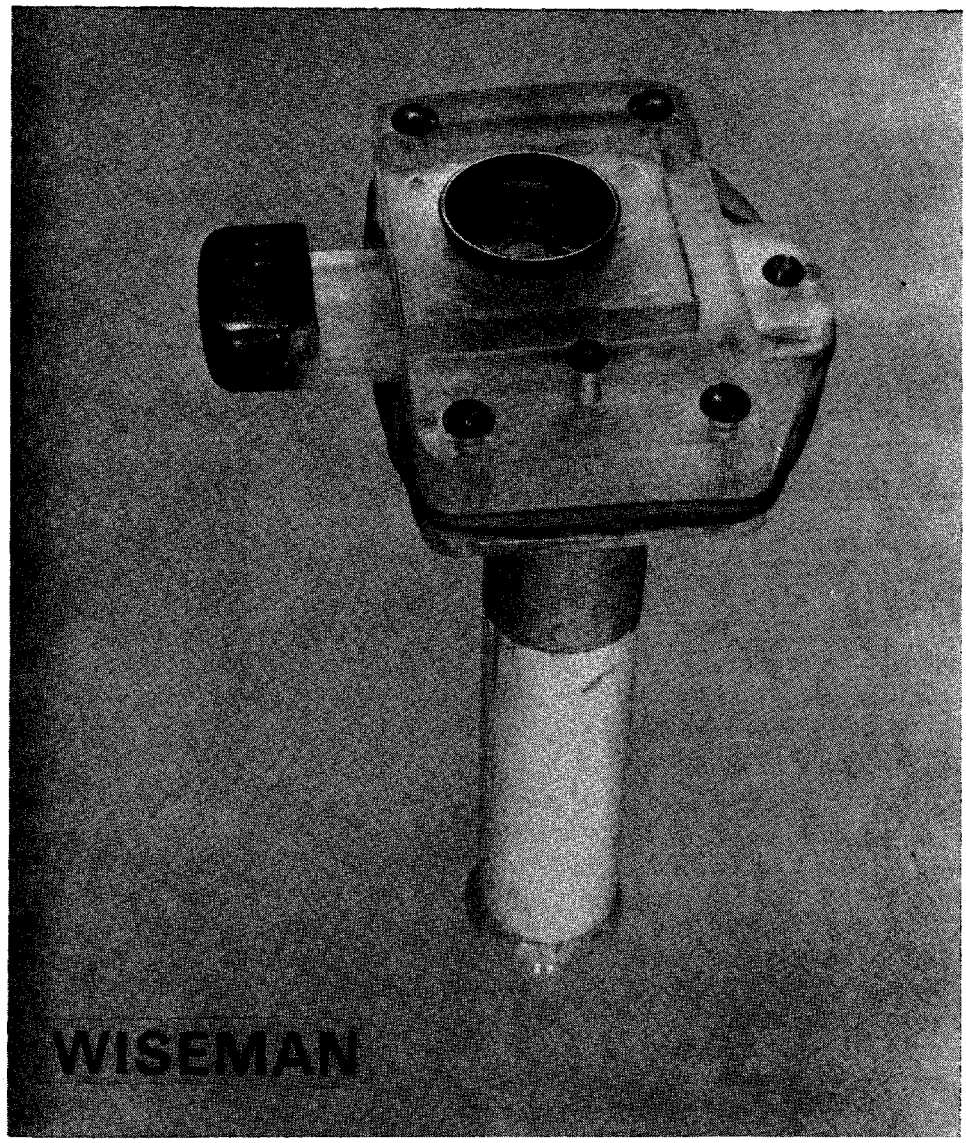

Fig. 2. Bazooka as modified by Wiseman for fall armyworm infestation.

At about the same time that the Bazooka was being modified at SGIRL, CIMMYT made a paddle version (Fig. 3) and sent it to the Corn Host Plant Resistance Research Unit at Mississippi State, MS, where Davis and Oswalt (1979) modified it as shown in Fig. 4. Davis and Oswalt called their new device an "inoculator." The inoculator uses a side-to-side paddle action instead of the slide-through action of the Bazooka. The delivery hole is 12.5 mm in diam. Davis and Oswalt (1979) illustrated the construction of the inoculator and estimated its cost at ca. $4.00 for materials and 6 hours of labor. The inoculator was a significant breakthrough for their southwestern corn borer resistance investigations for both the laboratory rearing (inoculating diet cups) and later for infesting larvae on the whorl and tassel stages of corn.

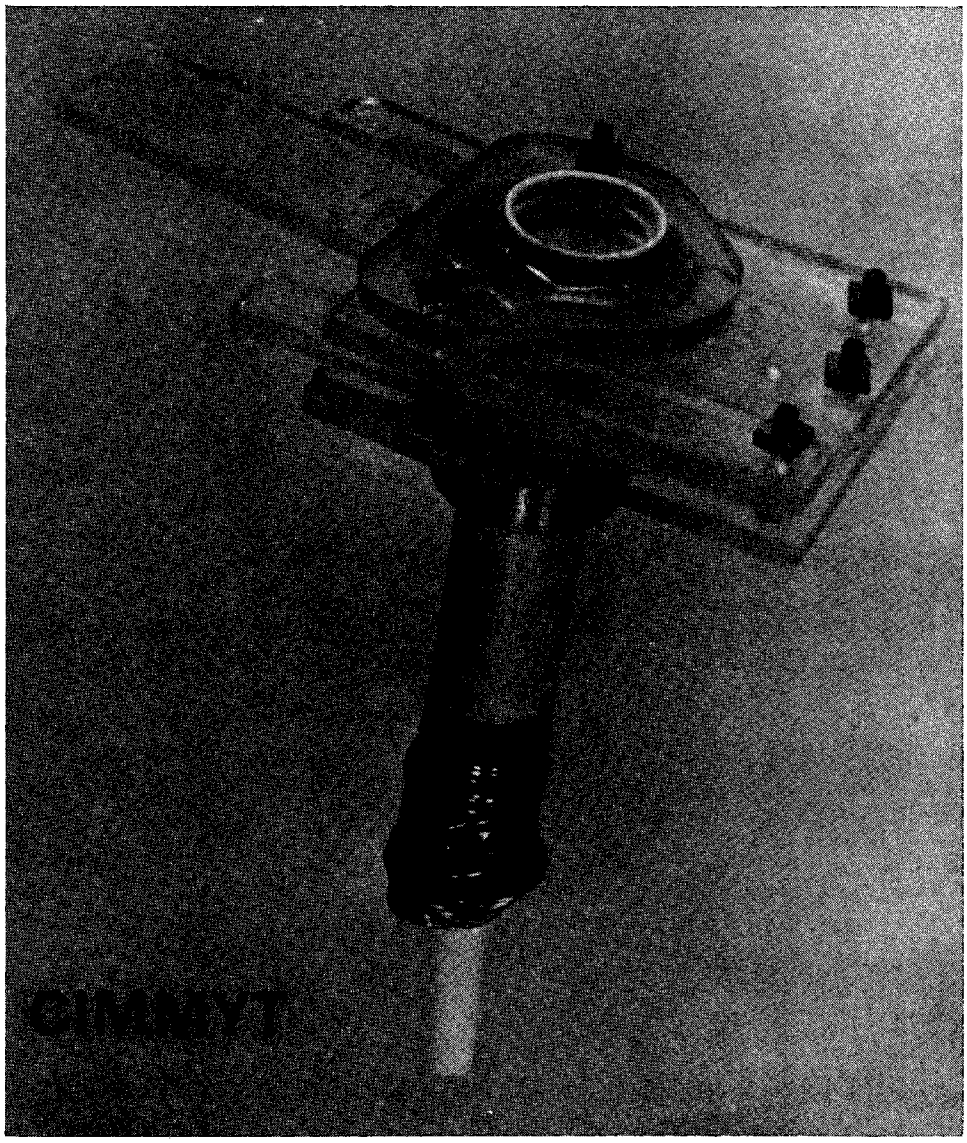

Fig. 3. Original paddle version of the Bazooka used to infest plants with insects.

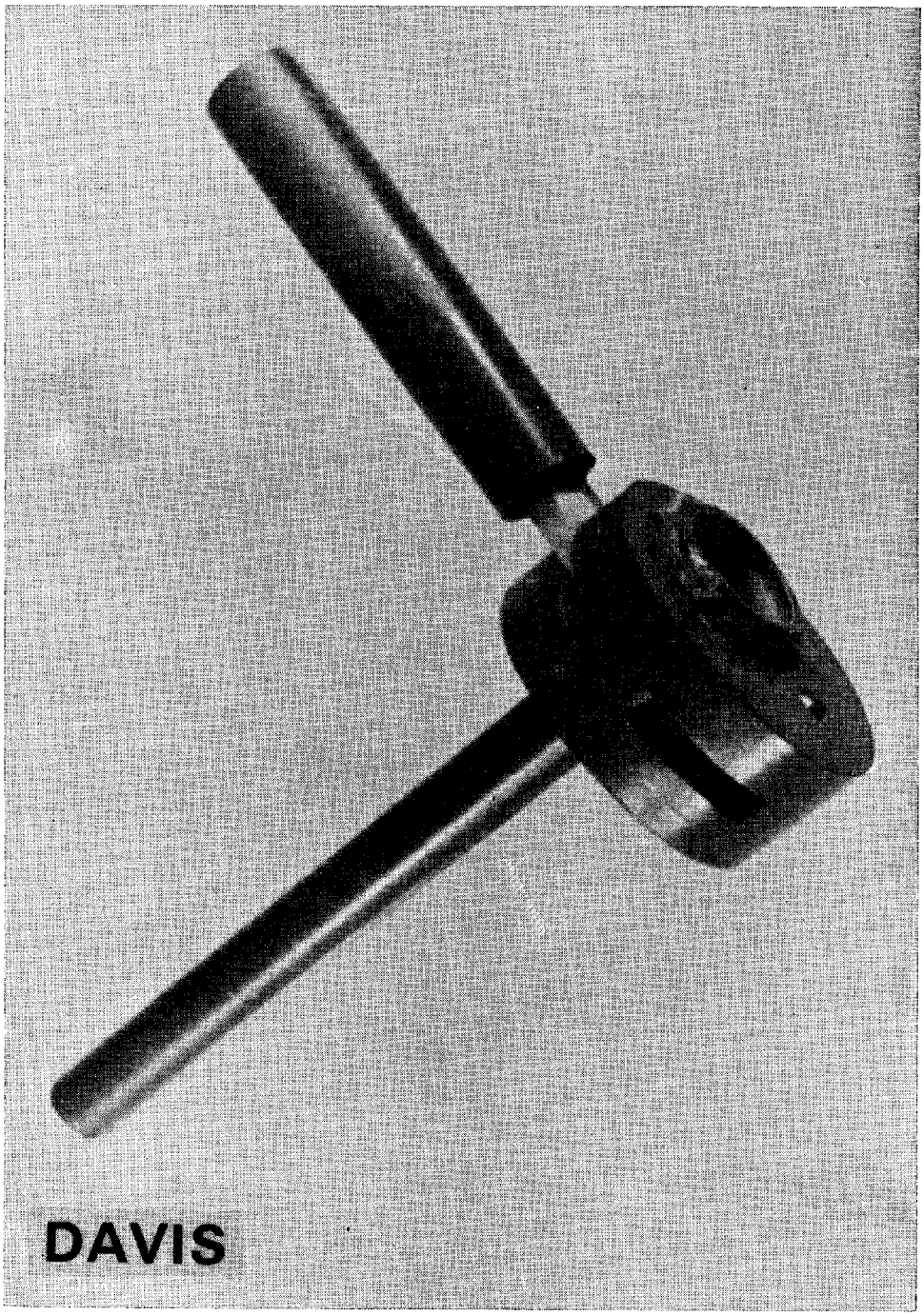

Fig. 4. Inoculator developed by Davis for inoculating diet cups with the southwestern corn borer.

In 1978, the entomologist at Pioneer Hi-Bred International received the Bazooka as modified at SGIRL and made additional streamlining modifications (Fig. 5). The stainless steel plate was eliminated by use of thicker pieces of plexiglas and the routing out of the slide groove to a close tolerance.

The use of the thicker plexiglas added balance to the dispenser, made manipulation with 1 hand easy, and simplified construction and cleaning by reducing the number of pieces of plexiglas and screws. The slide end was coated with a rubberized material for prevention of blisters on the fingers after prolonged use. The rubber band was retained to return the slide to the loading position. This modified Bazooka has been used successfully in dispensing European corn borers, fall armyworms, and southwestern corn borers in Pioneer's insect-resistance programs. For infestation of corn with these insects, the slide-mechanism outlet hole is 9.37 mm in diam., which allows a delivery of 0.35 ml of #2040 corncob grits. Cost per unit has been estimated at ca. $6.00 for materials and 2 hours for labor when built in lots of 50 or more.

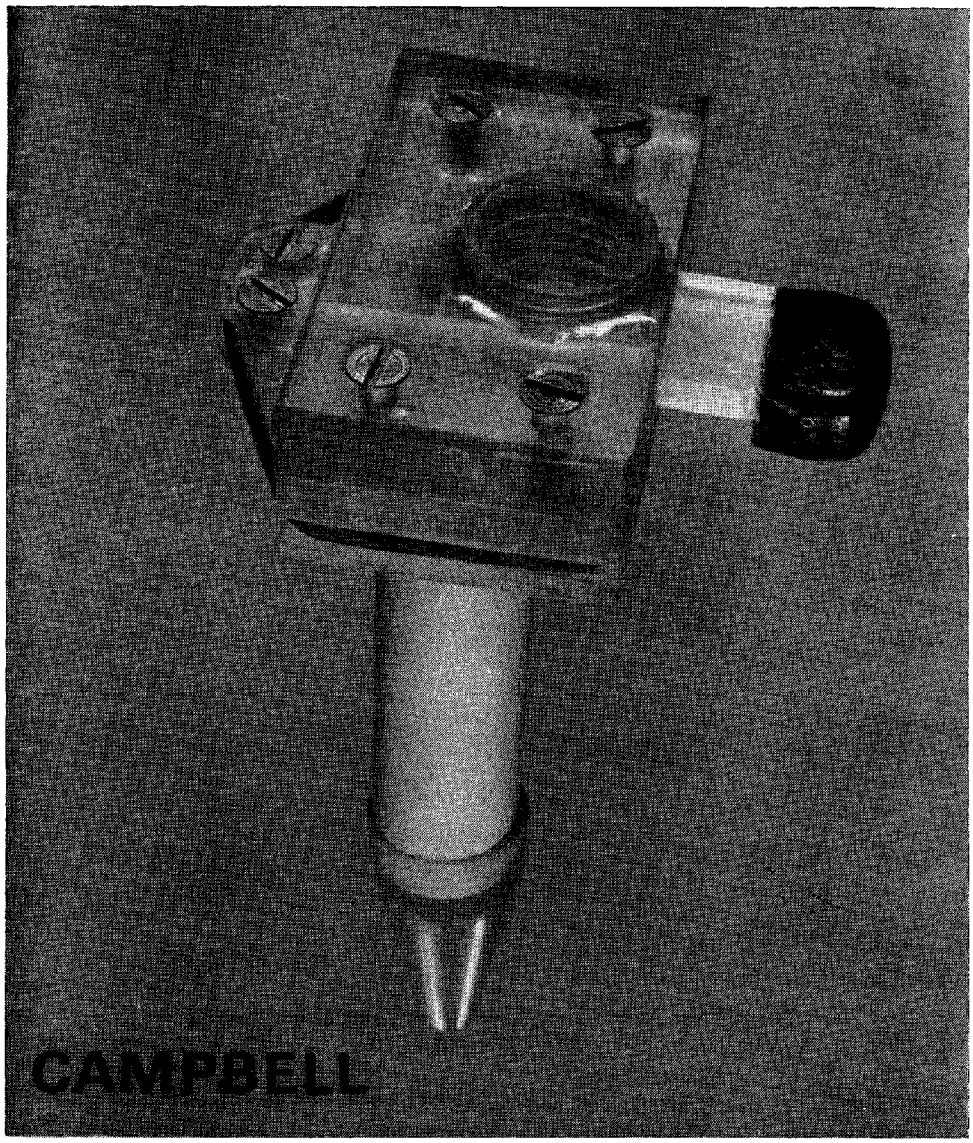

Fig. 5. The Bazooka as modified by Campbell to infest corn plants with the European corn borer and fall armyworm.

Figures 6 and 7 illustrate the various component parts of the inoculator and modified Bazooka. Dimensions of the various components may vary depending upon individual needs and characteristics. The inoculator will be commercially available in the near future.

In summary, we have made individual modifications of a mechanical lepidopteran larval dispenser in several forms that now allows us to expand insect-resistance programs in at least 3 different locations for 3 different lepidopteran pests.

ACKNOWLEDGMENT

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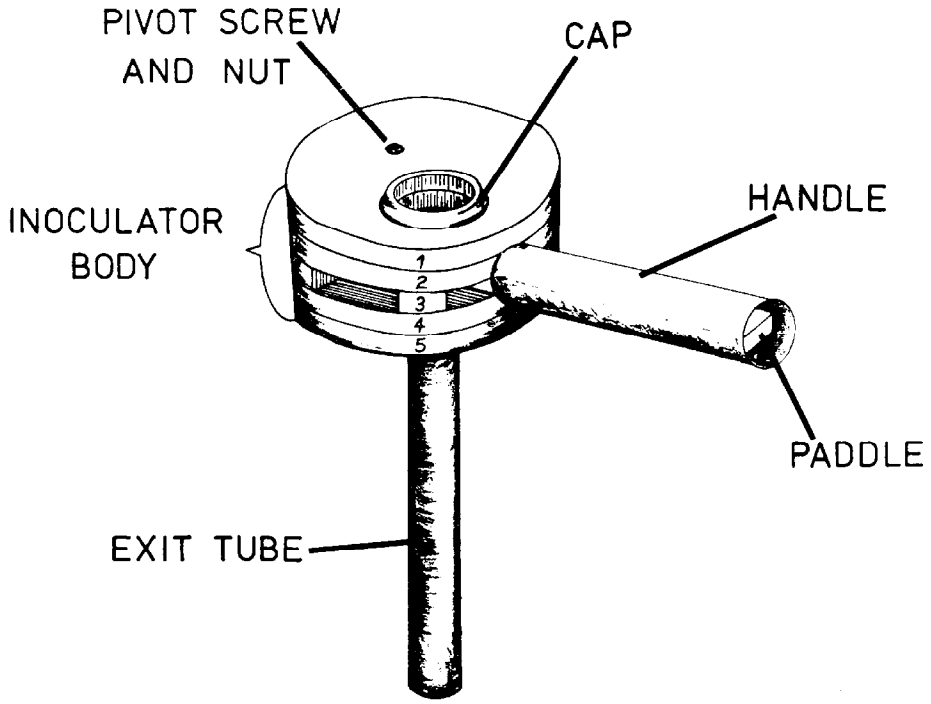

Fig. 6. Various components of the Inoculator.

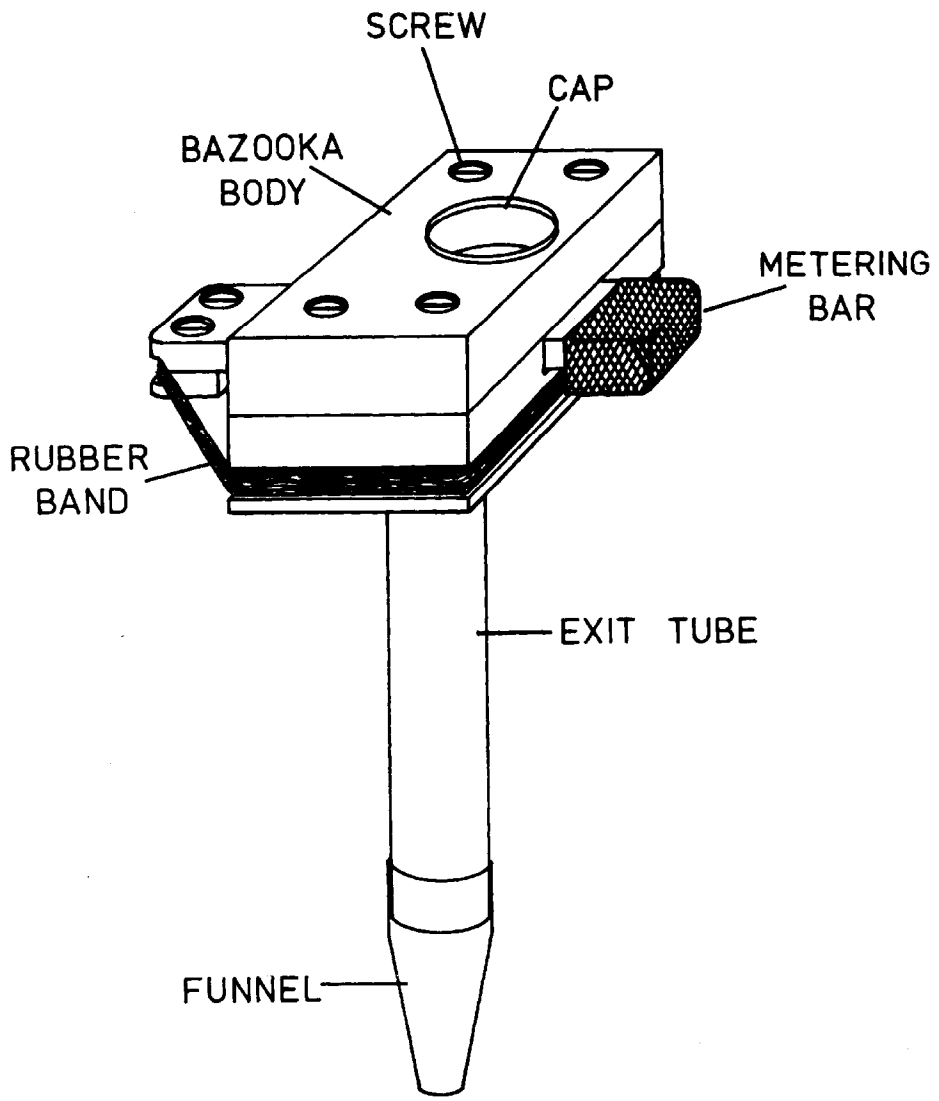

Fig. 7. Various components of the modified Bazooka.

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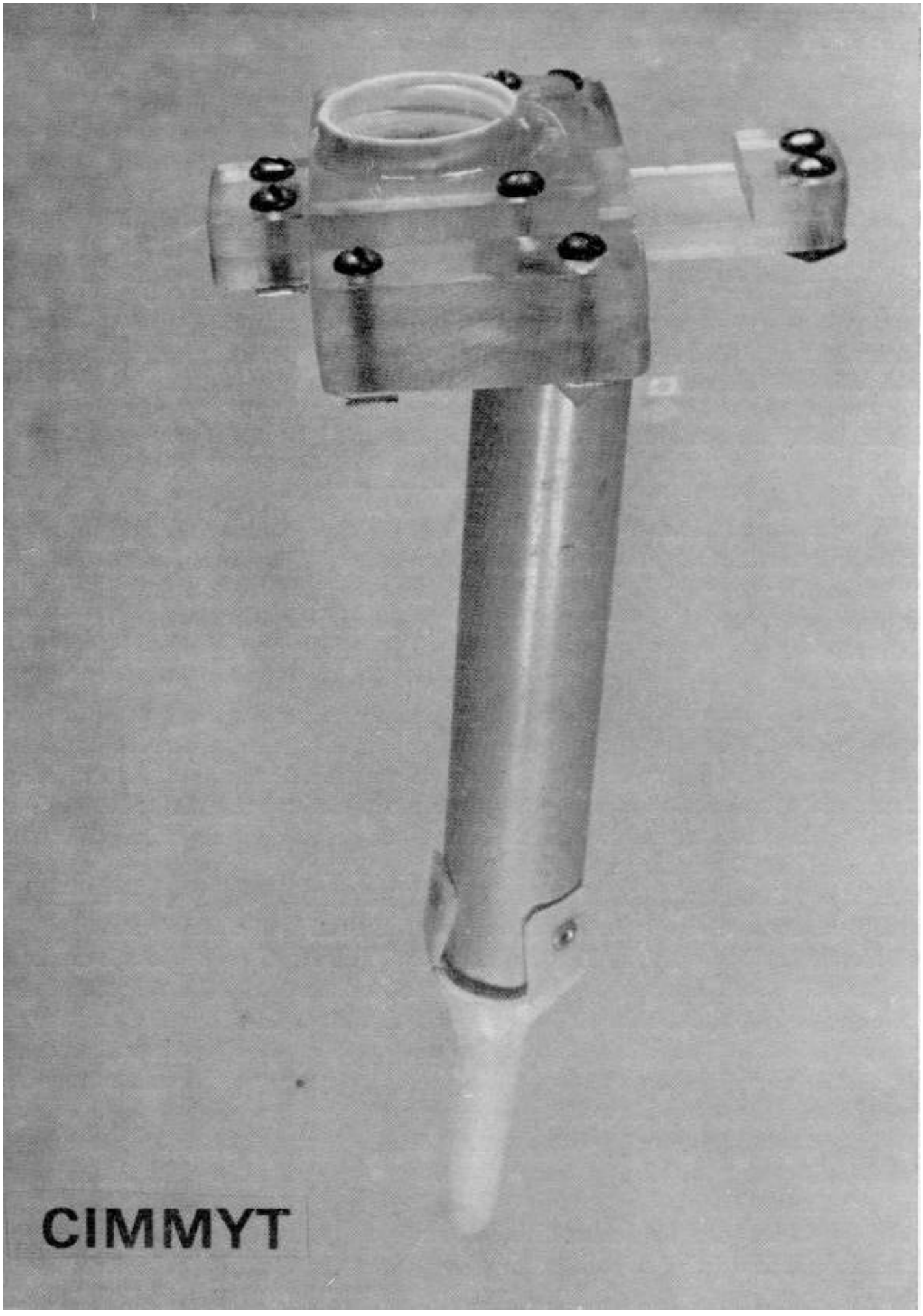
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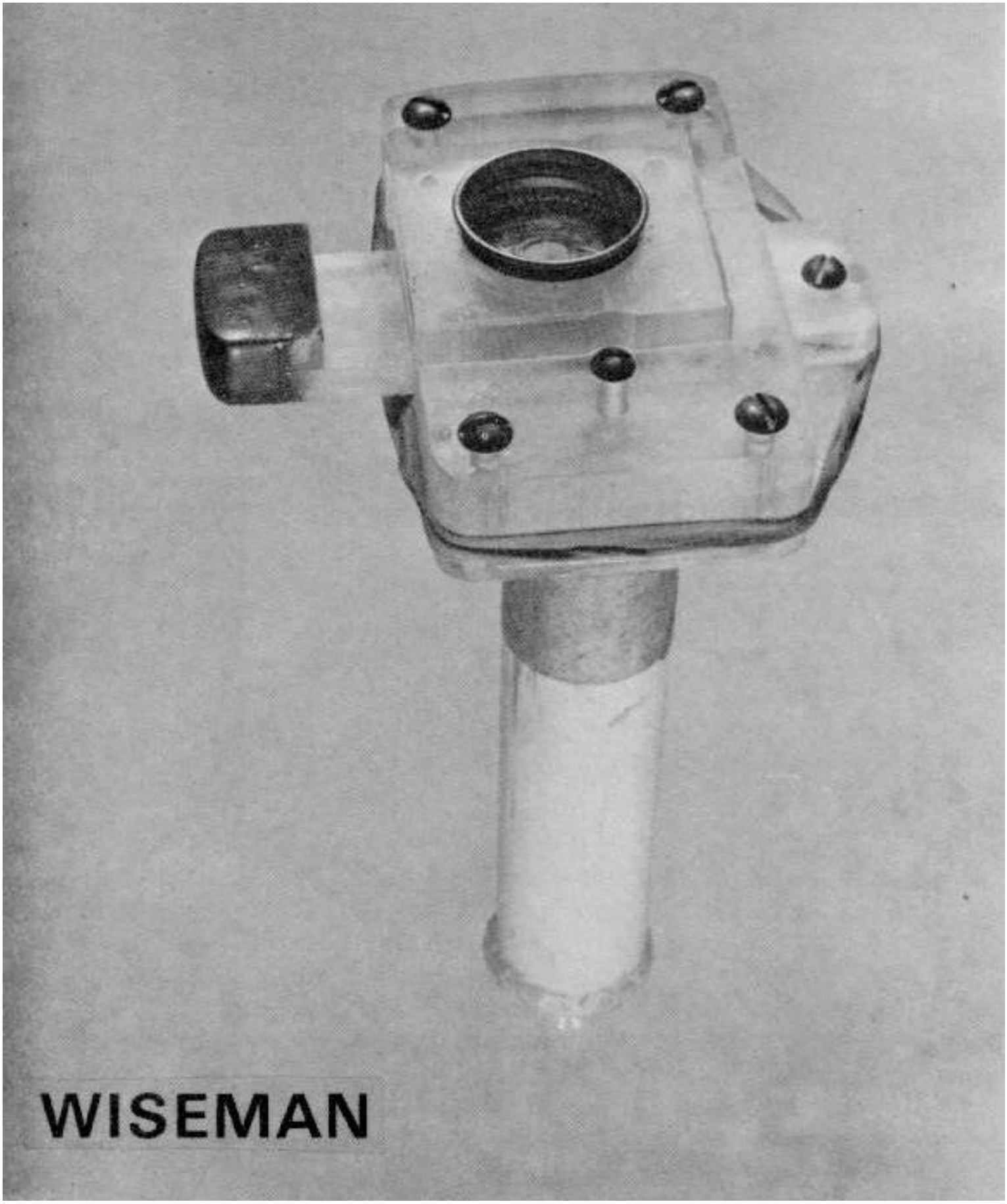
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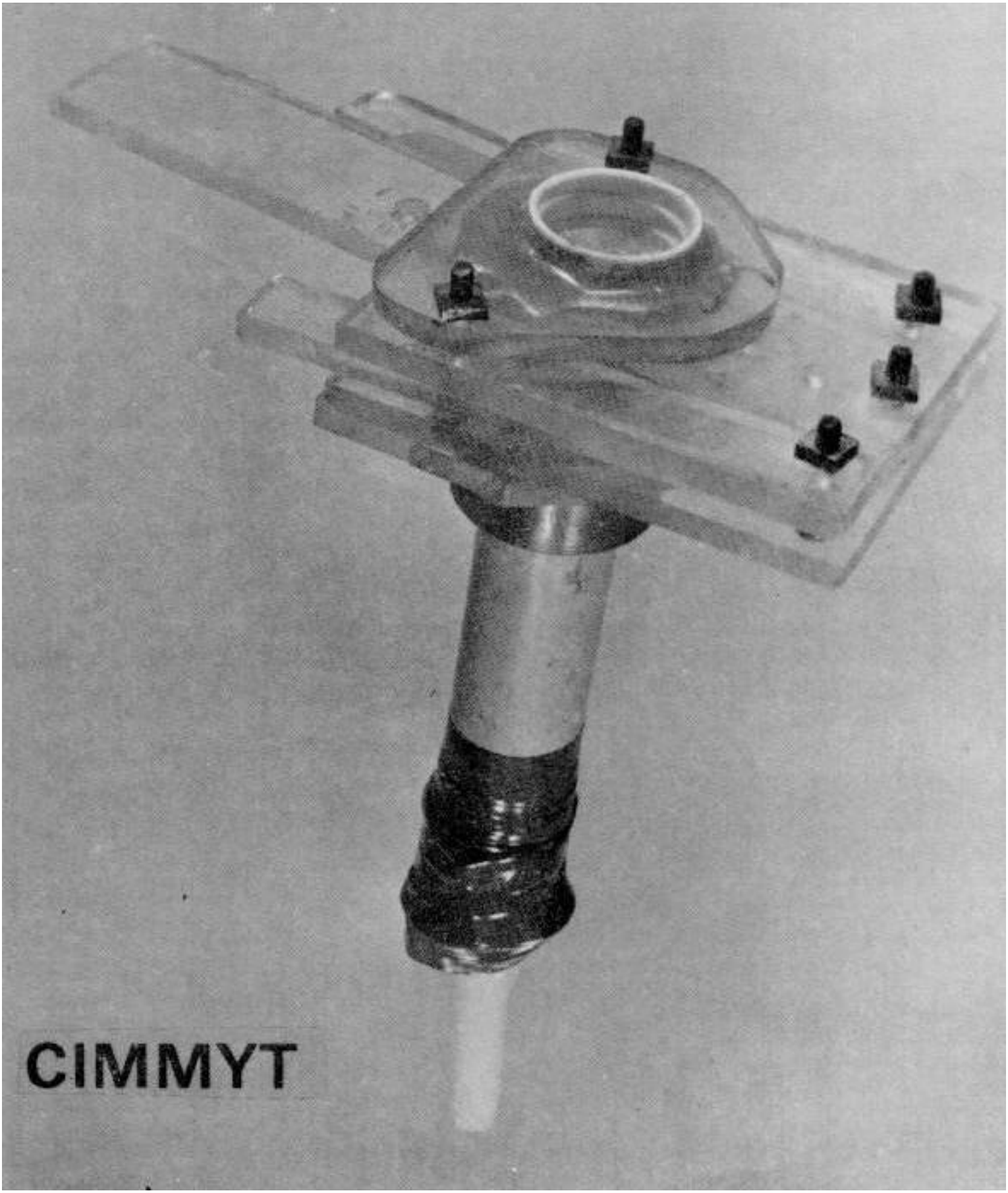
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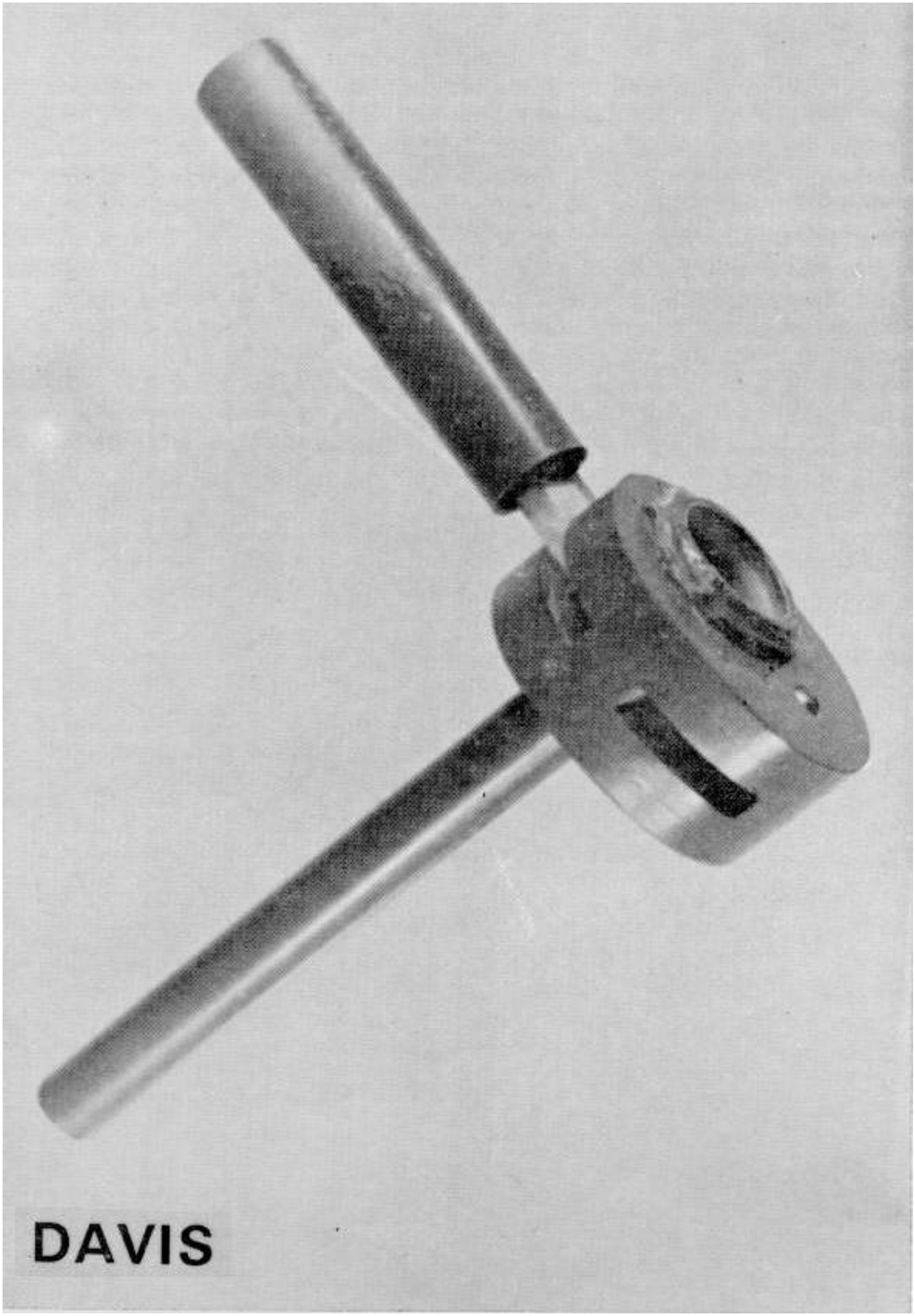
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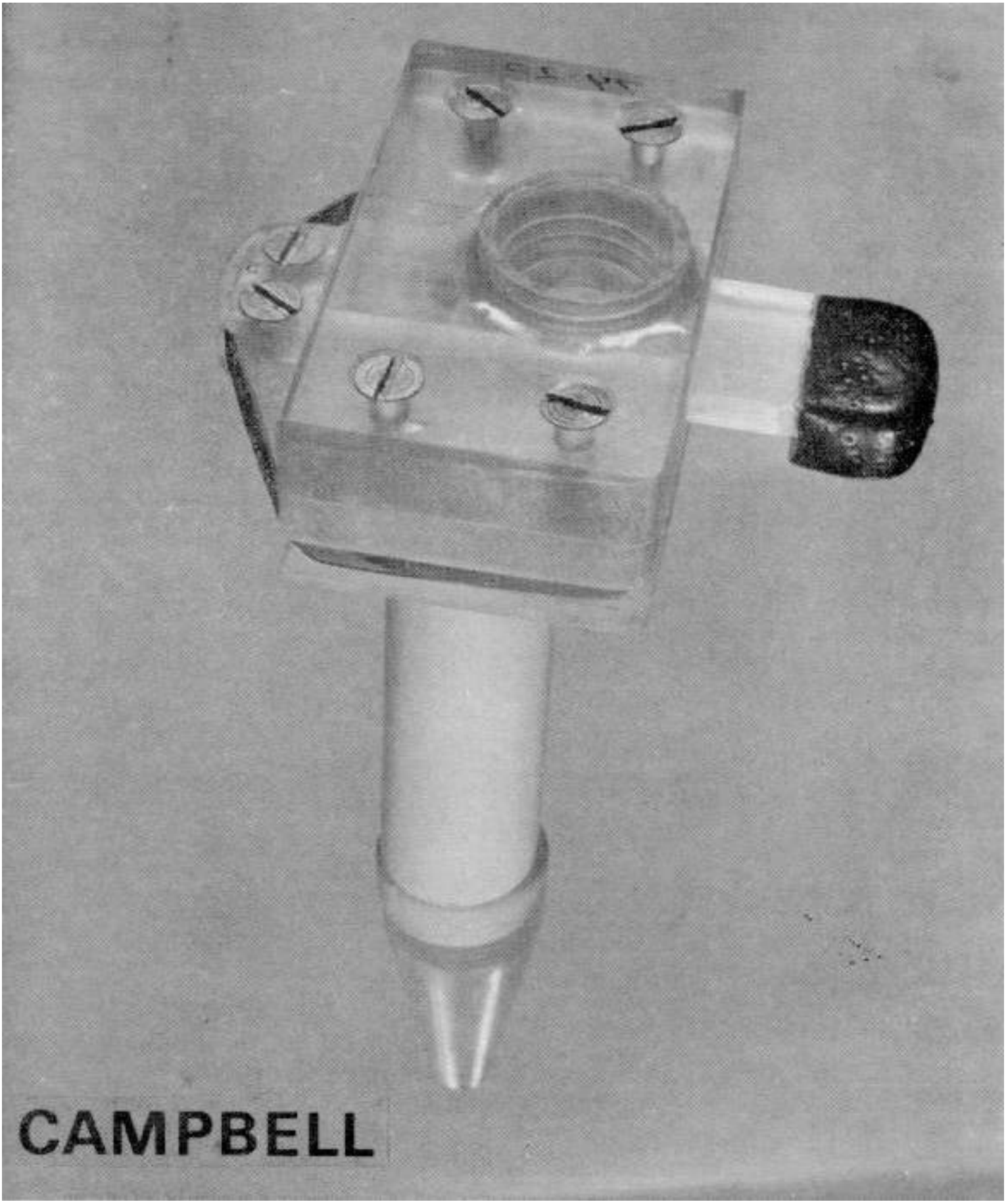
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