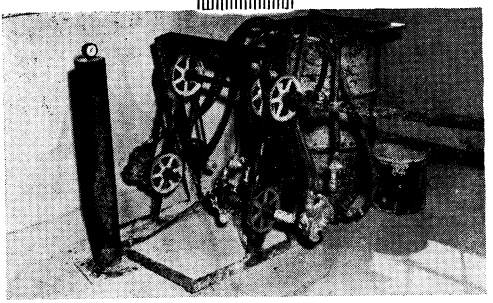

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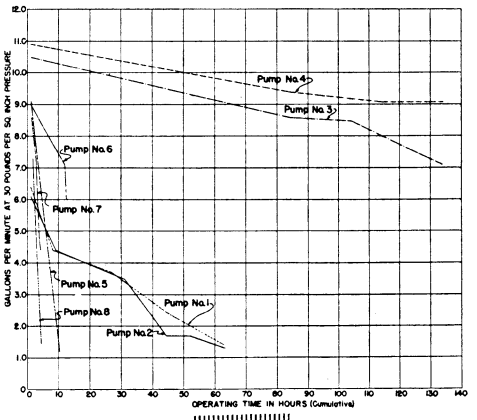

Wear Tests on Pumps for Agricultural Field Sprayers

By JAMES E. GARTON AND M. J. MORGAN*

One of the most important items to consider in selecting an agricultural field sprayer is the pump. The pump should deliver the desired discharge at the required pressure, and should have a reasonable service life.

Oklahoma farmers report considerable difficulty in obtaining satisfactory pumps at a reasonable cost. The problem is especially acute when using wettable powder spray mixes.

This publication reports a series of tests on the relative service life of rotary pumps generally used on field sprayers. Four types of pumps were tested:

Cast iron spur gear pumps with cast iron cases.

Pumps with Ni-Resist** cases and Nylon rollers.

Bronze gear pumps with bronze cases.

Spring-loaded vane pumps with cast iron cases.

Each type was represented in the tests by two pumps.

The tests were set up to determine the relative resistance to abrasion of the pumps. Chemical corrosion tests were not included. It is generally agreed that wear and ultimate failure of spray pumps is caused by the inert material rather than by the active chemicals.

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* Respectively, Assistant Agricultural Engineer and formerly Research Assistant in Agricultural Engineering.

** Ni-Resist is a nickel-copper-chromium ferrous casting.

Results of These Tests Indicate That:

1. Pumps with Ni-Resist cases and Nylon rollers showed much greater resistance to wear than any of the other pumps tested. Their resistance to abrasion recommends them for general field spraying of wettable powder herbicides and insecticides.

Caution: Nylon is dissolved by phenol, meta-cresol, xylenol, and formic acid.

2. Cast iron spur gear pumps with cast iron cases ranked second in endurance in these tests. However, their performance in these tests does not warrant recommending them for operation at high pressures if they are to be used with wettable powder insecticides or herbicides.

3. Bronze gear pumps with bronze cases, and spring-loaded vane pumps with cast iron cases, are not recommended for spraying wettable powder insecticides or herbicides. They would probably give fairly satisfactory results in spraying the emulsion types of herbicides or insecticides.

How the Pumps Were Tested

The liquid used in testing the pumps was a mixture of kaolin clay in water at the rate of one pound of clay to five gallons of water. This clay is a type used as a diluent in wettable powders.

The pumps were mounted on a test stand as shown in Figure 1. Each pump was driven by a V-belt from the central drive shaft at the top of the stand.

A pump was considered severely worn when it would no longer deliver 4 gallons per minute at 30 pounds pressure. This standard of performance was selected on the following basis: The average general-purpose sprayer will cover six 40-inch rows. Ground speed will average 4 miles per hour. Three to five nozzles per row are needed to insure complete coverage when spraying large cotton. Twenty-five gallons per acre is near the practical upper limit of spray applied. Under these conditions, the pump must discharge 4.04 gallons per minute. A pressure of 30 pounds per square inch was selected as the minimum pressure at which the nozzles are normally operated.

As unpublished research at this station indicates that the optimum operating pressure is somewhere near 80 pounds per square inch, the pumps were operated at 80 pounds per square inch until they would

no longer deliver 4 gallons per minute at that pressure. The pressure was then reduced to 30 pounds per square inch and the pumps were operated until they failed.

The pumps were operated for not more than one hour at a time to prevent the spray mixture from becoming too hot. The spray mixture was allowed to cool before the pumps were operated again.

During the capacity versus pressure tests, discharges were measured at approximately six pressures from 100 pounds per square inch down to 10 pounds per square inch. In obtaining the data, a five-gallon measuring can was used. The discharge of the pump being tested was turned into the can and the time required to pump 5 gallons was measured with a stop watch.

Details of the Results

Figure 2 shows the discharge of each pump at 30 pounds per square inch pressure after varying periods of wear.

Cast Iron Spur Gear Pumps. (Nos. 1 and 2).—These pumps had cast iron cases and sealed needle bearings. They discharged approxi-

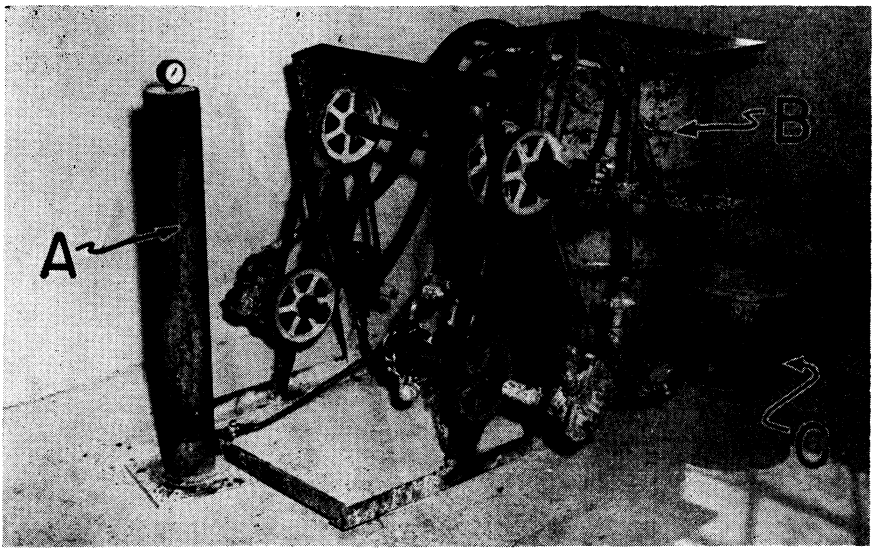

Fig. 1.—Test stand used in testing the pumps is shown above. . "A" is the surge tank; "B"—the reservoir; and "C"—measuring can. Each pump was driven by a V-belt from the central drive shaft at the top of the stand.

mately 3½ gallons per minute at 30 pounds per square inch after 30 hours of operation. After 60 hours of operation they discharged 1½ gallons per minute at 30 pounds pressure.

Testing was completed at 62.95 hours for Pump No. 1 and at 63.45 for Pump No. 2. Pump No. 1 was hard to prime after 9.1 hours and Pump No. 2 after 8.6 hours. Operating pressure was reduced to 30 pounds per square inch at 8 hours for Pump No. 1 and at 9 hours for Pump No. 2.

After the pumps failed, they were opened for inspection. The seals and bearings had failed.

Nylon Roller Pumps. (Nos. 3 and 4).—These pumps showed the longest relative life. They were equipped with sealed ball bearings

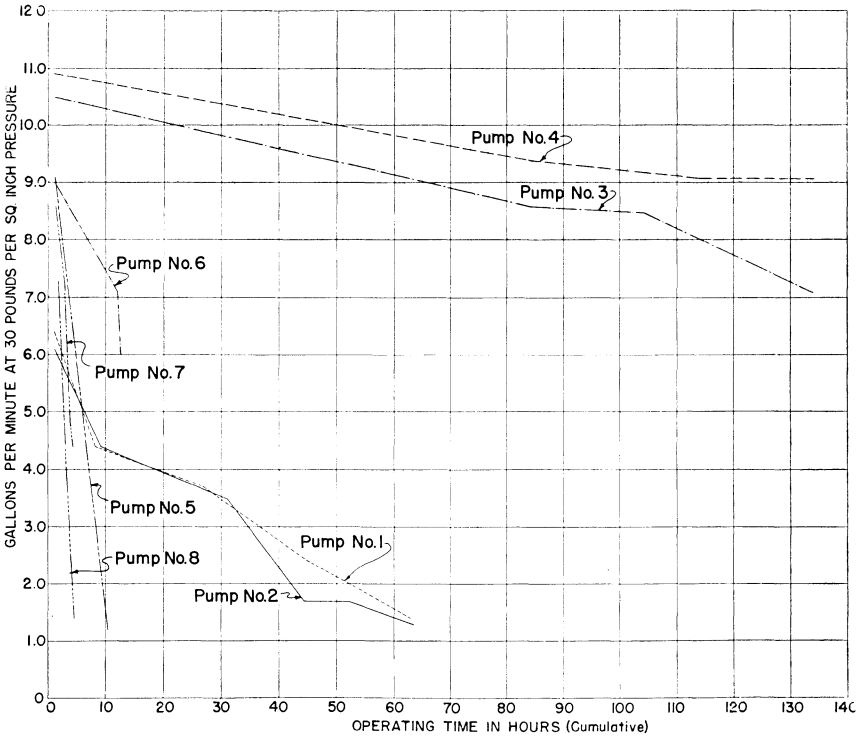

Fig. 2.—Graph shows discharge of each pump at 30 pounds per square inch pressure after varying periods of wear. Four types of pumps were tested: Nos. 1 and 2—cast iron spur gear; Nos. 3 and 4—nylon roller; Nos. 5 and 6—bronze gear; and Nos. 7 and 8—spring-loaded vane.

and Ni-Resist cases. At the end of approximately 134 hours both pumps would still discharge 7 gallons per minute at 30 pounds pressure.

At approximately 120 hours the rear seals on both pumps started leaking, but not enough to indicate complete failure of the seal.

Bronze Gear Pumps. (Nos. 5 and 6).—The bronze gear pumps had non-metallic bearings and bronze cases. When these pumps were disassembled after failure, the bearings were badly worn. As a result, the cases were deeply grooved. Priming was difficult early in the test period, and the pumps failed at 10.25 and 12.5 hours, respectively.

Spring-loaded Vane Pumps. (Nos. 7 and 8).—Both of these pumps had a relatively short life. They had cast iron cases and steel vanes. The bearings were bronze.

Testing was discontinued at 4.5 hours of operation. The cutoff pressure had dropped below 80 pounds per square inch at approximately 2.5 hours. Cutoff pressure after 4.5 hours of operation was 40 pounds per square inch.

These pumps were opened for inspection after completion of the tests, and all parts showed signs of wear.