WATER AND SANITATION FOR HEALTH PROJECT

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EVALUATION OF LOCALLY AVAILABLE HANDPUMPS IN HONDURAS

WASH FIELD REPORT NO. 103

MARCH 1984

Prepared For:
USAID Mission to the Republic of Honduras
Order of Technical Direction No. 85

WATER AND SANITATION FOR HEALTH PROJECT

WASH

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March 8, 1984

Mr. Anthony Cauterucci
Mission Director
USAID/Tegucigalpa
Honduras

Attention: Mr. William Smith

Dear Mr. Cauterucci,

On behalf of the WASH Project I am pleased to provide you with ten copies of a report on Evaluation of Locally Available Handpumps in Honduras.

This is the final report by Terrence L. Moy and is based on the work of the Georgia Institute of Technology in Honduras during several trips between April 19, 1982 and February 1, 1983.

This assistance represented the second stage of a two-stage program originally requested by the Mission on January 7, 1981. The work of the first phase was undertaken by the WASH Project by means of Order of Technical Direction No. 29 and reported on in the September 1983 WASH Field Report No. 85. The work of the second phase was undertaken by the WASH Project on February 22, 1982 by means of Order of Technical Direction No. 85 authorized by the USAID Office of Health in Washington.

If you have any questions or comments regarding the findings or recommendations contained in this report we will be happy to discuss them.

Sincerely,

David Donaldson, P.E.
Acting Director
WASH Project

cc: Mr. Victor W.R. Wehman, Jr.
S&T/H/WS

DD:tg

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Water and Sanitation for Health Project
Contract No. AID/DSPE-C-0080, Project No. 931-1176
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U.S. Agency for International Development
Washington, DC 20523

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LIST OF ACRONYMS

AID	U.S. Agency for International Development
BANMA	Municipal Development Bank
CEDEN	Comite Evangelico de Desarrollo Nacional (National Evangelistic Development Committee)
CEVER	Centro Evangelico de Educacion Vocacional Rural (Rural Evangelistic Vocational Education Center)
CDI	Centro de Desarrollo Industrial (Industrial Development Center)
CDM	Camp Dresser and McKee, Inc.
COSUDE	Comite Suiszo de Desarrollo (Swiss Development Committee)
DW	Deep Well
EEC	European Economic Community
FUNYMAQ	Fundicion y Maquinado, Inc.
GIT	Georgia Institute of Technology
GOH	Government of Honduras
ICAITI	Instituto Centroamericano de Investigacion y Tecnologia Industrial (Central American Institute of Industrial Research and Technology)
IIAA	Institute for Inter-American Affairs
IRWRDL	International Rural Water Research Development Laboratory
MOH	Ministry of Health
OTD	Order of Technical Direction
PRASAR	Rural Water and Sanitation Project
PROSABA	MOH Basic Sanitation Program
SANAA	National Autonomous Water and Sewer Agency
S&T/HEA, AID	Bureau for Science and Technology, Office of Health, AID
S&T/H/WS, AID	Bureau for Science and Technology, Office of Health, AID Division of Water and Sanitation, AID
SW	Shallow Well
WASH	Water and Sanitation for Health Project

EXECUTIVE SUMMARY

The Government of Honduras (GOH) included in its five-year plan for 1979 to 1983 the improvement of water supply and sanitation for up to 75 percent of its rural population. The AID Mission to Honduras, in keeping with a long history of U.S. assistance in Honduran water and sanitation projects, executed a loan agreement with the GOH to undertake the Rural Water and Sanitation Project, PRASAR.

Among many other water and sanitation improvements, PRASAR was to install 3,000 handpumps on existing and newly dug, drilled or driven wells. The PRASAR project paper had called for the purchase of U.S.-made Dempster handpumps, but it was later decided that locally-manufactured pumps should be considered for this project. Accordingly, the PRASAR loan agreement included a provision of AID to assist the GOH by developing the capability to manufacture a reliable, community-level handpump in Honduras.

In the beginning of the project the GOH ordered 1,120 model 23F Dempster handpumps in order not to delay project implementation while waiting for the local pump to be developed. At the same time it requested the AID Mission and the Mission, in turn, requested AID in Washington to provide technical assistance to develop a local handpump manufacturing capability. This request included the comparative testing of several handpumps so that the GOH would have reasonably objective criteria on which to base its selection when it places its second order for pumps.

AID in Washington responded to the request by issuing Order of Technical Direction (OTD) 29 in February 1981 and OTD 85 in February 1982 to Camp Dresser and McKee, Inc. (CDM) under AID's centrally funded Water and Sanitation for Health (WASH) Project. CDM, in turn, authorized its subcontractor, the Engineering Experiment Station at the Georgia Institute of Technology, to undertake the work because of its extensive experience with the AID-design handpump in other developing countries.

In accordance with the Mission's request, the work was carried out in two phases. The Phase I work was carried out under OTD 29. It consisted of selecting manufacturers for the AID-design handpump and roboscreen (a PVC well screen), providing them with technical assistance, and purchasing from them 150 pumps and 200 feet of well screen. The work also involved selecting sites to field test various handpumps and purchasing the other pumps and materials needed for the field test. The U.S. made Dempster Model 210F, Robbins and Myers Moyno, and the locally-manufactured Sanpar handpumps were the other pumps to be compared with the AID-design pump. (The Moyno handpump was later eliminated due to supplier problems.) The entire Phase I work program was carried out successfully as described in WASH Field Report No. 85, May 1983.

Upon completion of the Phase I and Phase II work, an updated unit price quote from the manufacturer (FUNYMAQ) was requested for an unspecified number of AID pumps. The new revised price estimate given by Mr. Mata of FUNYMAQ is US$250 per pump. The dramatic price increase is due to FUNYMAQ's improved knowledge of what it takes to manufacture the AID pump plus cost increases in materials and labor. It was suggested, however, that for large orders there could be a significant reduction in price.

The Phase II work was carried out under OTD 85. It called for:

A. Directing GOH health promoters in methods of proper installation, maintenance and repair of 30 AID pumps, 10 Sanpar pumps, 10 Dempster 210F pumps, 10 Moyno rotor/stator pumps, and roboscreen.

B. Monitoring and evaluation of the pumps and roboscreen, feedback to manufacturers for quality controls and, if necessary, the correction of defective components.

C. Providing GOH Ministry of Health with progress data for simultaneous evaluation of handpumps installed in test sites.

D. Ten (10) copies of an appropriately written and tested manufacturer quality control training manual and sixty (60) copies of an appropriately written and tested installation, operation, and maintenance training manual.

E. A report, prepared at the end of Phase II summarizing the whole project and providing the results of the tests and the reception and reaction of GOH personnel to the project.

The Phase II work program developed a local understanding for installing, operating, and maintaining a reliable multi-family handpump. Based on the results and conclusions of this work, several recommendations were made for future projects of this nature as follows:

A. In the process of providing direction and instruction for the installation and maintenance of handpumps the use of a transparent demonstration cylinder proved to be a valuable aid in teaching caretakers and promoters troubleshooting and repair techniques because the participants were able to view the actual operation of the cylinder in action. This improved understanding was demonstrated in the field by the lack of difficulties encountered by the participants during repair operations.

It is therefore recommended that transparent demonstration cylinders be used as training aids in any future training of this nature.

B. Monitoring, evaluating and assisting in correction of defective pump components showed that the problem with the product pump was interchangeability of parts and a second problem involved the design of the pumps foot valve.

It is recommended that jigs and fixtures be authorized for all future handpump programs. The use of jigs and fixtures was not originally authorized for the manufacturing activities of this program. As a result, varying dimensional differences from pump to pump and a lack of interchangeability of spare parts showed up very quickly during the field testing of the AID handpump. Separately from the project, project personnel and the AID handpump manufacturer FUNYMAQ absorbed the cost of designing, fabricating and testing jigs and fixtures. Subsequent pumps produced using the jigs and fixtures eliminated all previously observed problems.

It is further recommended that the leather flapper valve be replaced with a metal poppet foot valve. While the leather flapper type foot valve of the AID handpump is inexpensive and very easy to change in the shallow-well pump, it is extremely difficult to change in the deep-well pump. Though inexpensive in cost, the leather flapper valve also has a short useful life compared to many other foot valve designs. For only a modest increase in cost, alternative metal valves of long useful life are available.

C. During the collection of progress data, transmitting them to GOH Ministry, and certain other activities an adequate level of cooperation and coordination was maintained. However, it was felt that there could have been a better degree of coordination and certain communication problems could have been averted if all parties had a better understanding of the program in its initial stages. Actually the following recommendation is applicable to all programs in all countries.

It is recommended that a comprehensive action planning meeting be held at the beginning of a handpump program among the AID contractor, the AID Mission staff, AID/ Washington, and the host country agency under which the program is to be implemented.

D. The testing and pump evaluation undertaken and the perceived reaction of GOH personnel to the project leads to the following two recommendations.

Continue efforts to find Honduran markets other than PRASAR for the AID handpump. Due to a lack of counterpart funds and complex government procurement procedures, severe logistical problems have developed that resulted in a delay of project goals. AID and MOH have reduced the project goals for wells with handpumps. Thus, the market for AID handpumps appears to be diminishing unless other areas of Honduras (outside the PRASAR project area) accept and adopt it for use. Because of its good performance and acceptance it is strongly recommended that AID continue its efforts to find markets other than PRASAR for the AID handpump.

Use the handpump in future handpump programs in Honduras. While costs have increased, the AID handpump continues to maintain an overall advantage as a cost effective solution to rural water needs in Honduras. Local reception of the AID pump was extremely favorable. Both users and promoters were pleased with the operation of the pump. From a national perspective the benefits of locally manufactured pumps, such as the AID and/or SANDPAR design, include: stimulating local employment, reducing foreign import exchanges and providing a ready source of in-country spare parts.

Under Phase I, 200 feet of 2" diameter roboscreen had been produced for use in the installations scheduled for Phase II of the contract. Due to the lack of open well sites discovered during the site selection process (most wells were existing driven wells and could not use the roboscreen), only Comayagua sites

[redacted]

were fitted with roboscreen. No problems were reported. Due to the relatively short monitoring period, however, and because none of the sites presented aggravated sedimentation conditions, improved wear characteristics of the pumps could be verified

Although the effort to produce an installation and maintenance manual was deferred and combined with a training program in another Latin American country, it is planned to forward the final draft of this manual for AID Mission-Honduras comments.

ACKNOWLEDGEMENTS

The tasks undertaken during this project would not have been completed without the assistance given by many individuals. While their organizations provided the general framework for implementing this project, the initiative and understanding shown by key individuals was invaluable in helping to shape and guide the program effectively. To these ends the efforts and sincerity of the following MOH personnel deserve special recognition:

Ing. Efrain Giron - Director of the PRASAR Project, MOH
Ing. Jorge Flores - Regional Engineer, San Pedro Sula
Prof. Victor Palacio - Regional Bacteriologist, San Pedro Sula
Mr. Jacobo Herrera - Regional Coordinator, Comayagua

Appreciation is also extended to ICAITI and the AID Mission in Tegucigalpa for the time and assistance given by their staff. Ing. Porfirio Sanchez of ICAITI, and Messrs. Peter Deinken, William Smith, Richard Dudley, and Ray Baum of AID, and Ing. Edmondo Madrid, PRASAR Project Coordinator were extremely helpful in coordinating project activities and providing valuable cultural insights.

While it is impractical to list all the remaining in-country individuals who contributed their time and energy, it is hoped that those mentioned will pass along the author's gratitude for their involvement in the project.

Finally, special thanks should be made to Ms. Carol Aton, Mr. Phillip Potts, and Mr. Ben James, Jr. of Georgia Tech for the numerous contributions, and long hours of review and support given in assisting in the preparation of this report.

PREFACE

The AID handpump is a single-action, reciprocating, positive displacement pump designed in 1976 by Battelle-Columbus Laboratories for the U.S. Agency for International Development (AID). Specifications for the design included long life under severe operating conditions, easy maintenance using simple tools and unskilled labor, potential for manufacture in developing countries, and easy operation by women and children. The shallow-well (SW) version with the piston and cylinder assembly incorporated into the pump stand is suitable for wells where groundwaters are located at depths of less than 26 feet. For the deep-well (DW) version the piston and cylinder are positioned below the water level allowing pump operation to depths in excess of 100 feet.

The AID handpump was initially manufactured and field tested in Nicaragua and Costa Rica. After recommended design changes, it has been introduced in the Dominican Republic, Indonesia, the Philippines, Haiti, and Sri Lanka. A handpump program is currently in progress in Ecuador.

Chapter 1

INTRODUCTION AND BACKGROUND

1.1 Current Water Program in Honduras

Much of the high mortality and morbidity in the rural areas of Honduras can be attributed to poor conditions of water and sanitation. To improve these conditions, the Government of Honduras (GOH) has a five-year plan, ending in 1983, to provide 75 percent of the rural population with easy access to safer water and to provide 38 percent with improved sanitation systems. Meeting these goals means installing new water and sanitation systems for 1,200,000 people and repairing water systems for another 170,000 people.

Three government agencies are responsible for implementing programs under the five-year plan: the Ministry of Health (MOH) Basic Sanitation Program (PROSABA), the National Autonomous Water and Sewer Agency (SANAA), and the Municipal Development Bank (BANMA): Their responsibilities are as follows:

> PROSABA was established in 1974 to administer and promote rural environmental sanitation outreach programs. Its main activities are the installation of handpumped wells and the promotion and construction of latrines in dispersed rural communities with populations of fewer than 200 inhabitants. These activities are coordinated by the MOH at the central level and implemented by rural health promoters at the village and municipal level. As part of the community to which they are assigned, the promoters utilize their knowledge about local customs to stimulate community participation and develop self-help potential.
>
> SANAA was created in 1961 to respond to the needs for piped water systems and sewers. SANAA's main rural activity is the construction of gravity flow aqueduct systems in communities having populations of more than 200 inhabitants. Responsibilities include project financing, design, supervision of construction, and maintaining the completed systems. Community volunteers perform all unspecialized construction work. With external financial assistance, SANAA is constructing or supervising the installation of over 510 aqueduct systems under the Rural Water Supply Project. SANAA is also gradually applying user fees to support rehabilitation of existing nonfunctional rural systems, which includes the installation of chlorination and filtration units where needed. Upon upgrading, these will be incorporated into SANAA's maintenance program.
>
> BANMA finances the development of municipal infrastructure and services, including water systems. The municipalities operate and maintain the systems and repay BANMA from user fees or other revenues. Since 1975, systems have been built or repaired in medium sized communities, the smallest of which had a population of 6,000. This activity is expected to continue as viable opportunities for BANMA financing arise.

Since 1942 the United States Government has been active in supporting Honduran water supply activities by financing the installation of rural systems. Through the services of the Institute for Inter-American Affairs (IIAA) and successor agencies, these programs have concentrated on construction and installation of gravity flow aqueducts. While exact figures are not available an estimated 125 rural aqueducts were constructed under these programs between 1942 and 1959. From 1964 through 1967, the United States Agency for International Development (AID) worked with SANAA on a $1.1 million Rural Water Pilot Project (Loan 522-T-008) that financed the construction of 62 gravity flow aqueduct systems benefitting some 13,000 rural inhabitants. An AID Nutrition Project (Loan 522-T-029) included $1.5 million for PROSABA to promote the construction and use of latrines, low cost wells, and a few gravity flow aqueduct systems. An AID Fund for Special Development Activities project has given priority to financing construction materials required to complete rural aqueduct systems at a rate of approximately 10 per year through SANAA.

Initiated in October 1980, PRASAR, the Rural Water Supply and Sanitation Project (522-0166), seeks to improve the health status and practices of rural families in five northwestern departments of Honduras through full community participation in all aspects of their own water supply and sanitation installations. The project originally consisted of the construction of 180 water supply systems, 21 sewerage systems, 3000 wells with handpumps, rehabilitation of 50 water supply systems and 800 wells, and the installation of 18,000 pit privies, 14,000 Colombia type water-seal latrines and 25 windmills (for investigation). The project has a strong health education program designed to reinforce the impact of the construction program by teaching rural Hondurans the importance of good hygienic practices. On July 30, 1983 the project was doubled in size and geographical focus.

In preparing the project paper for the PRASAR project, questions arose as to the type of handpump to be used for the multi-family wells. The questions involved the use of an imported handpump versus one manufactured in Honduras. If the in-country option was chosen, additional questions arose on whether to use a pump already being manufactured or to introduce another pump.

In general, it is considered highly desirable that projects such as PRASAR have as much of the hardware as possible produced within the country not only to facilitate the logistics of supply but to stimulate the economy of the in-country manufacturing sector. In addition, by producing this hardware in-country, the problems related to the shortage of hard currency could be avoided. However, some problems had been experienced with the handpump already being produced in Honduras, and there were concerns regarding the viability of producing another. Nevertheless, it was decided to develop the capability of manufacturing the AID-design handpump in Honduras. The Water and Sanitation for Health (WASH) Project was asked to assist AID Honduras in developing this capability. Subsequently, the European Econommic Community (EEC) has provided technical assistance to the manufacturer of the pump already produced in Honduras (SANPAR). This pump has been improved considerably and is being purchased by the MOH for use in the EEC project in the country.

1.2 WASH Handpump Project in Honduras

1.2.1 Events Prior to OTD 85

Discussion with the AID mission in Honduras about implementing an AID handpump program in Honduras began back in 1977 when similar programs in Costa Rica and

Nicaragua were underway. In the fall of 1979, a project paper for the Honduras Rural Water and Sanitation Project (PARASAR) was completed. Although this paper recommended exclusive use of the U.S.-manufactured Dempster handpump, AID in Washington felt that developing local manufacturing capabilities would be worthwhile despite the estimated two-year development period. After discussions between AID in Washington and the Mission in Honduras, the AID/Honduras capital development officer agreed to consider locally manufactured pumps if their price, quality, and performance were equal to or better than those of the Dempster pump.

These discussions eventually led to the request for a feasibility study which was completed in August 1980. The purpose of the study was to investigate local manufacturing capabilities for the AID-designed handpump and three related devices--roboscreen (a low cost plastic well screen), robovalve (a self-closing plastic faucet), and robometer (a user-activated water meter).

In evaluating five foundries and three plastics manufacturers, information was gathered on the types and quality of products manufactured, the types of equipment utilized in the facilities, and the technical acumen of the employees and managers.

Based on these results, a pilot AID handpump program was recommended as follows:

1. Encourage healthy competition by placing orders of 50 to 75 AID pumps each with two or three of the capable foundries in Honduras.

2. Install these pumps in the field.

3. Monitor and evaluate them for any defects that should be corrected by tightening quality control procedures at the foundry.

4. Compare the field operating characteristics of the AID pump with those of the locally manufactured Sanpar pump and the imported Dempster pump.

5. Include the manufacture of roboscreen in the pilot program.

6. Do not include the manufacture of robovalve and robometer in the pilot program.

In January 1981 AID/Honduras requested assistance from AID/Washington in developing local Honduran capability to fabricate handpumps and well screens (such as roboscreen). In response to this request, AID/Washington (Bureau of Science and Technology, Office of Health, Division of Water and Sanitation) contacted the Water and Sanitation for Health Project (WASH), which is administered by Camp Dresser and McKee, Inc., who in turn authorized the Georgia Institute of Technology, as its subcontractor, to carry out the development of local manufacturing capability and to obtain comparative pump performance data.

In order to facilitate the work in Honduras, a contract was signed with the Instituto Centroamericano de Investigacion y Tecnologia Industrial (ICAITI) for consulting services. (A copy of the contract is included in WASH Field

Report No. 85.) ICAITI, headquartered in Guatemala City, Guatemala, has a field office headed by a Honduran engineer in Tegucigalpa, Honduras. It was felt that a Honduran representative not only would facilitate translations but would also expedite many facets of this project. ICAITI had the capability to provide technical assistance to the program participants and to act as liaison between Georgia Tech and the participants during Georgia Tech's absence. ICAITI was also to make major purchases in Honduras (e.g., pumps, roboscreen, etc.) because its local office had purchasing and payment mechanisms already functioning.

The goal of the two-phase project subsequently initiated in May 1981 was to provide the Ministry of Health and the AID Mission with information to evaluate which handpumps to acquire for the PRASAR project being conducted in Honduras. The handpumps to be evaluated would include:

- AID handpump: local manufacturing and installation capabilities to be developed in-country.

- Dempster handpump: recommended by the project paper and purchased by the GOH for early use in the PRASAR project.

- Sanpar handpump: an existing locally manufactured pump.

- Moyno handpump: considered one of the more maintenance-free pumps on the market.

By introducing the AID handpump, AID and the GOH hoped to stimulate competition resulting in better quality handpumps at competitive prices in Honduras.

The major objective of the first phase of the project, which began in May 1981, was to develop the production capability for the AID-designed handpump and roboscreen and to select well sites suitable for comparison testing of the AID pump and its alternatives. A secondary objective was to establish good working relationships with the AID Mission, the Ministry of Health, and other organizations that might be interested.

An extensive evaluation of the five most promising foundry and machine shop operations in Honduras led to the recommendation that FUNYMAQ (Fundicion y Maquinado, Inc.) be selected as the AID pump manufacturer. After helping FUNYMAQ build a working deep-well prototype, Georgia Tech provided extensive technical assistance in the areas of casting, machining, heat treating, assembly (including the design of jigs and fixtures to provide interchangeability of pump components), and testing. By June 1982 FUNYMAQ had successfully manufactured 150 AID-designed handpumps that passed all inspection and testing procedures.

Concurrently, work was done with Industrias Novatec S.A. de C.V., a PVC tubing extruder in Tegucigalpa, and FUNYMAQ to produce 200 feet of acceptable roboscreen. Because the lathe tool post grinder recommended by the University of Maryland was not available in Honduras, a different slotting method had to be developed using a simple engine lathe.

Site selection procedures, hindered by a strike of the health promoters, were completed in May 1982. Four areas were selected for the pump comparison testing (Bajamar, Traesia, La Lima, and Comayagua) with a total of 48 sites designated for Phase II installation.

Good working relationships were developed with MOH personnel at all levels and with the AID Mission in Honduras. Regular briefings were also conducted on the status of the project, exchanged information and feedback on field activities, and arranged formal and informal tours of the manufacturing facilities and the field sites.

1.2.2 Scope of Work for OTD 85

Phase II of the Honduras Project, begun in February 1982, consisted of the installation and field testing of the AID handpump and its alternatives as well as the training of pump program participants in the installation, maintenance, and repair of the installed pumps. The scope of work in Phase II, as set forth in OTD 85 and subsequent amendments is summarized below:

(A) Direct GOH health promoters in methods of proper installation of 30 AID pumps, 10 Sanpar pumps, 10 Dempster 210F pumps, 10 Moyno rotor/stator pumps, and roboscreen. Instruct the same promoters in the testing and disinfecting of the wells for each test site. Provide instructions on maintenance and preventive maintenance and repair of test pumps.

(B) Monitor and evaluate the pumps and roboscreen. Provide feedback to manufacturers for quality control and, if necessary, the correction of defective components.

(C) Provide GOH Ministry of Health with progress data for simultaneous evaluation of handpumps installed in test sites.

(D) Insure that ten (10) copies of an appropriately written and tested manufacturer quality control training manual and sixty (60) copies of an appropriately written and tested installation, operation, and maintenance training manual are provided to the appropriate parties in Honduras during project effort.* (Due to delays in receiving the Moyno pumps from the manufacturer, as specified in Part A, no Moyno pumps were included in this program.)

(E) Prepare a final report which summarizes the whole project and provides the results of the tests and the reception and reaction of GOH personnel to the Project.

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* Part D was later combined with the manual production efforts for Ecuador (OTD 82) by request of Dr. John Austin (S&T/HEA, AID). Because these efforts are currently in progress, a discussion of this portion of the scope of work will be included in the final report on OTD 82.

concurred that the program should be integrated into existing MOH activities and pledged their active support and participation.

At the conclusion of these briefings, the Georgia Tech team, investigated the support capabilities of the existing MOH infrastructure. As shown in Figure 1, a well established organization was operating as the result of prior MOH handpump programs. Included in this organization were national and regional level administrators and engineers supported by coordinators and rural health promoters in the field. This organization also included an existing network of designated village handpump caretakers.

In assessing the capabilities of MOH field staff, reference manuals were reviewed for the certification of health promoters and they were found to be very comprehensive and to include topics such as maintenance, well drilling techniques and standard construction plans. AID mission staff also reported that additional courses and certification in the development of wells had been given to promoters in the program region. To assess field experience and capabilities, procurement records were reviewed for the construction of 534 wells and they were found to be well documented, including standard materials lists for driven, tube, and excavated wells (see Table I) as well as current inventories of materials.

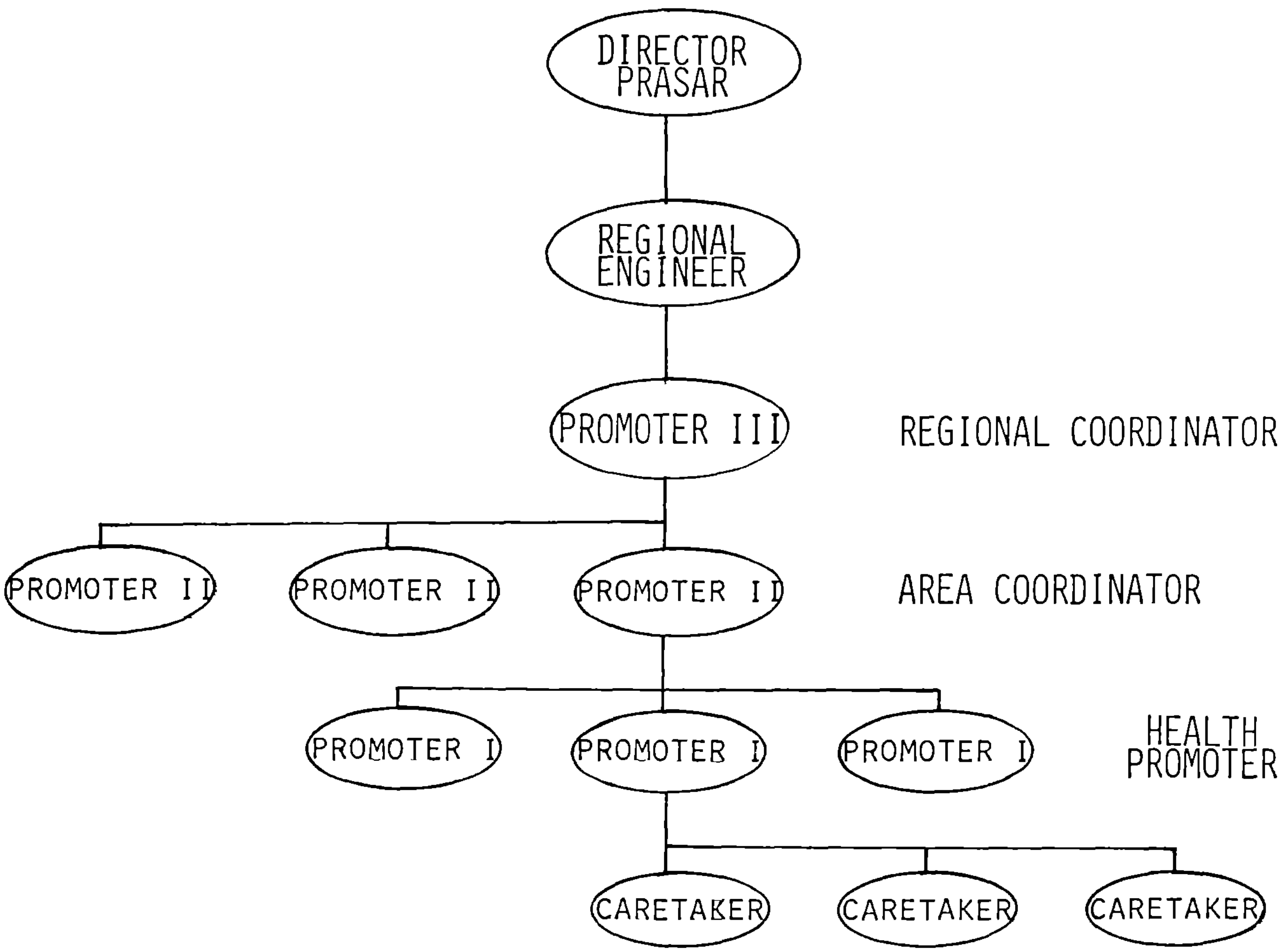
A tour of the regional health center in San Pedro Sula revealed adequate facilities, equipment and experience in the monitoring and evaluation of water quality. During the visit lab technicians were observed operating bacteriological and chemical analysis equipment and testing data were reviewed. In later conversations the regional engineer indicated that water quality testing was on-going and in conjunction with all water programs sponsored by the MOH.

To complete the investigation a survey of locally available tools was conducted, as well as of equipment and materials to aid in the preparation of a construction schedule. Though few of the items required were locally manufactured, all items necessary to develop and maintain handpump sites were readily available.

In evaluating the information collected, it was determined that adequate capabilities were available within the existing MOH infrastructure to implement Phase II activities. Based on this evaluation, a plan was developed for the training of promoters and caretakers as well as for the installation and monitoring of the handpumps. As shown in Figure 2, ICAITI's involvement complemented Georgia Tech's presence in Honduras by providing continuity of project coordination throughout the 12-month period. Upon review and approval of this plan by the MOH, the implementation of the project was begun with the delivery of the pumps from FUNYMAQ (the AID pump manufacturer) to the MOH warehouse in San Pedro Sula.

Figure 1.

PRASAR INFRASTRUCTURE
MINISTRY OF HEALTH



PROMOTERS III ARE LOCATED IN: SAN PEDRO & SANTA ROSA DE COPAN

PROMOTERS II ARE LOCATED IN: SANTA ROSA DE COPAN, GRACIAS, DULCE NOMBRE, ERANDIQUE, CANDELARIA, GUARITA, SAN MARCOS, OCOTEPQUE, CUCUYAGUE

Figure 2

PROJECT SCHEDULE FOR HONDURAS HAND PUMP PROGRAM

PHASE II

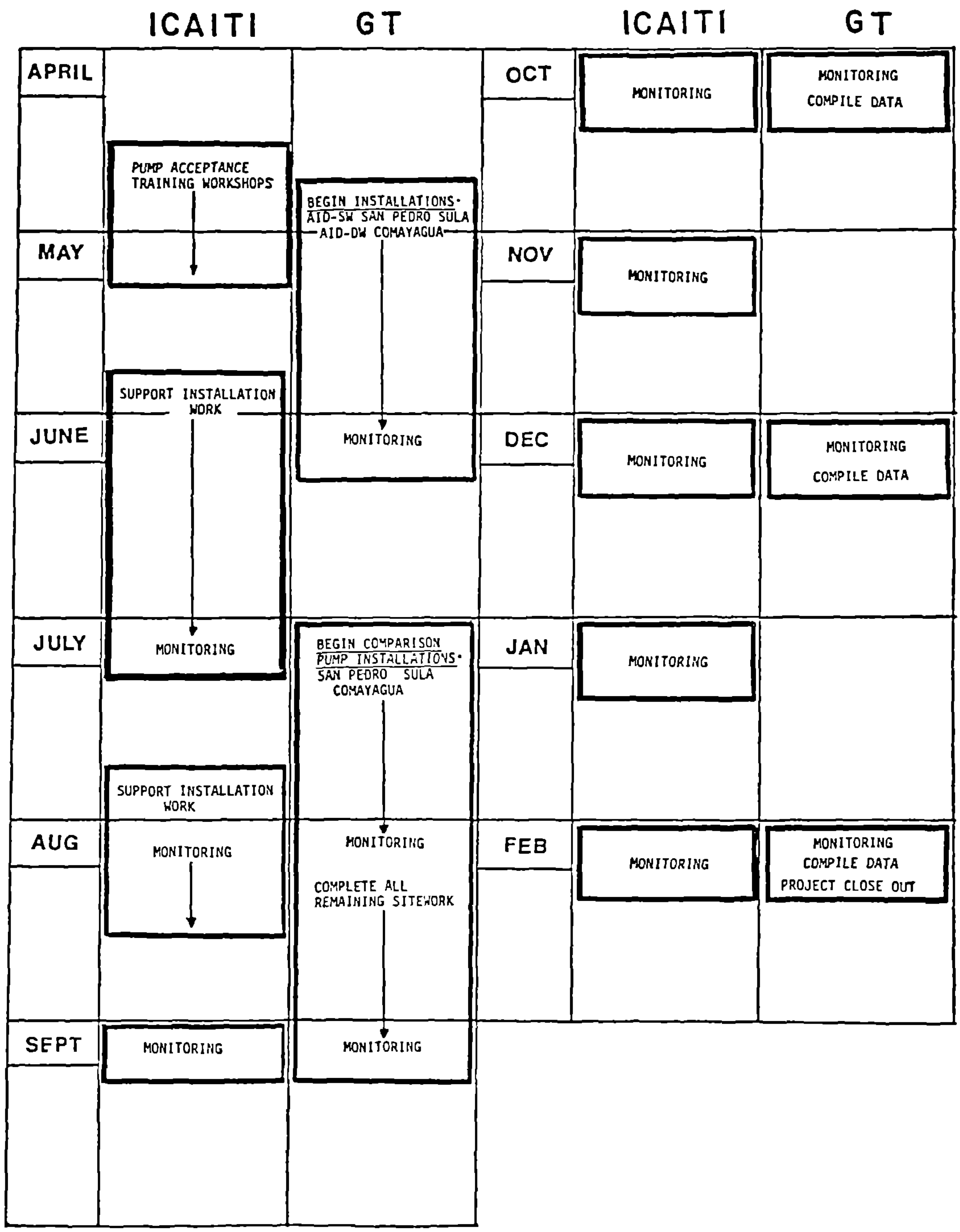


TABLE 1

TYPES OF WELLS

Well Type	Characteristics
Driven	Access to groundwater is made by driving the complete well point/screen/ drop pipe assembly into the water bearing strata. This method is both time and materials efficient where the groundwater table is shallow and soils do not permit tube or excavated well construction.
Tube	Also referred to as "drilled" or "borehole", wells are generally small diameter wells with diameters that range from 1" to 10". They are drilled by hand or by motor-driven augers and are usually cased with metal or PVC pipe.
Excavated	Also referred to as "hand dug" or "open", excavated wells have diameters much larger than tube wells and are constructed when skills and materials are limited, the water table is accessible and/or the recharge rate is too low to permit adequate flow from tube wells. This method is much more labor intensive than driven or tube wells.

2.3 Implementation

2.3.1 Site Location

Though site selection for the handpump installations was originally scheduled to be completed under Phase I of the program, a national strike by the MOH health promoters delayed the identification of specific sites until after Phase II of the program had begun. However, this delay did not adversely affect the implementation of Phase II. Four areas had been identified as being suitable for handpump installations--Bajamar, La Lima, Travesia and Comayagua (see Figure 3). The first three areas were located in the program region; the fourth area, Comayagua, was outside the program region because of the lack of available sites for deep well installations. All four areas met the key criteria for selection: availability and clustering of sites, year-round access for installation and monitoring and future incorporation into existing MOH program areas. A total of 56 pumps were installed in these four areas as shown in Table 2. (This number differs from the 48 sites originally approved in Phase I to accommodate the increase in Dempster and AID pumps and the elimination of the Moyno pumps. Additional pumps were installed in response to requests from local villagers and MOH personnel.)

2.3.2 Training

The purpose of the training program was to teach MOH health promoters and village caretakers to develop well sites as well as install, maintain, repair, and monitor the AID handpump. A series of one-day workshops were held in each of the four project areas. In Bajamar, Travesia and La Lima, workshops were held on March 19, 20 and 22, 1982 respectively. In Comayagua a one-day session for deep well handpumps was held on May 14, 1982.

During each workshop the participants were familiarized with the operation and repair of the pump using a transparent demonstration model and an illustrated maintenance and repair guide (see Appendix C) in Spanish. By replacing various pump components in the model with damaged or worn parts and by assemblying it, participants gained valuable firsthand experience in troubleshooting and repair procedures. After each participant demonstrated an understanding of the pump's operation, training in the installation and routine maintenance of the pump continued by having the participants break down and install a pump at a prepared site. The regional MOH bacteriologist then demonstrated how to disinfect the well using a chlorine compound and testing the chlorine residual. At the conclusion of the workshop each caretaker and promoter in the project was given a set of tools, a supply of spare parts and grease, a maintenance and repair guide and a monitoring log and pen.

In addition to the village caretaker and MOH health promoter from the respective project areas, each workshop was also attended by other MOH health personnel including regional engineers, promoter coordinators, and promoters from adjacent areas outside the project area. In all, 14 MOH engineers, coordinators, and health promoters attended the four workshops.

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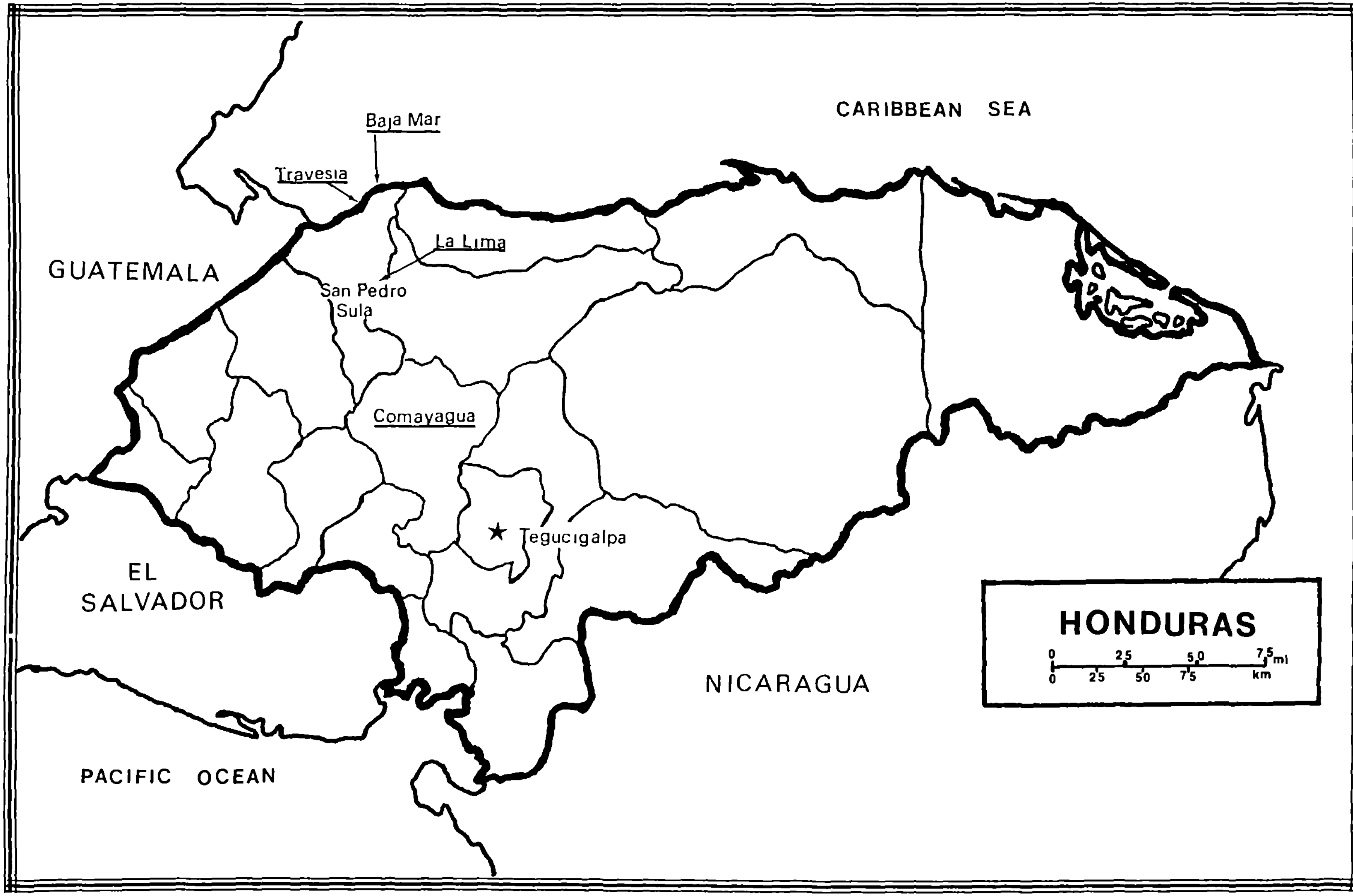


Figure 3

AREAS SELECTED FOR HAND PUMP INSTALLATION

TABLE 2

SUMMARY OF PUMP INSTALLATIONS

SITE	HAND PUMP TYPE		
	AID	Sanpar	Dempster 210F
Bajamar	8 (sw)		5
Travesia	8 (sw)		2
La Lima	9 (sw)	2 (type #4)	6
Comayagua	9 (dw)	2 (type #4)	3
		2 (type #1)	
TOTALS	34	6	16

Additional training was performed as necessary during the remainder of the contract period when, during the course of monitoring, deficiencies in maintenance techniques were observed by Georgia Tech or ICAITI staff.

2.3.3 Installation

At the conclusion of the March training sessions, work began on installing the AID handpumps in the project areas. A list of the equipment, materials and supplies donated to the Government of Honduras is presented in Appendix C.

For each of the approved sites, materials lists prepared by health promoters in the four project areas were reviewed. This involved the promoters as much as possible with the program and also provided a check to verify their skills as construction managers. Georgia Tech and ICAITI personnel then assisted MOH health promoters by expediting procurement and transport of the necessary supplies and equipment to the sites.

Health promoters were given responsibility for coordinating and scheduling community participation in each area. They already had similar responsibilities in other MOH sanitation and health education programs, so they were able to integrate their AID activities. They organized local villagers at each site to supply the necessary labor and, in some cases, materials and equipment to develop the well sites and install the handpumps. Since the majority of the sites selected were existing wells, preparation for the installations primarily involved rehabilitating the sanitary features of the well site (well apron and drainage structures) and making the modifications necessary to accommodate the various types of pumps used in the AID program.

Installation of the AID and other handpumps proceeded simultaneously in each of the four program areas until all sites had been completed. (A list of the completed sites appears in Appendix E.) During this period, supervision, support, and additional technical assistance were provided to health promoters. As each site was completed, Georgia Tech and ICAITI began gathering and compiling monitoring data from the field. Depending on the type of information collected, feedback, such as problems related to manufacturing or administrative or logistical difficulties, was then directed back to the manufacturer, MOH or the AID Mission personnel.

2.3.4 Monitoring

The monitoring program was designed to allow input from as wide a user audience as possible. Monitoring log books were issued to health promoters and village caretakers so that any type of comments regarding the pump's operation could be recorded. Intended to be included in these comments were any irregularities encountered in operating the pumps and any repairs or maintenance performed. Georgia Tech, ICAITI, and health promoters also recorded the status of the pumps during any visits to the sites. In addition to these records, monitoring logs were maintained by health promoter coordinators, the regional MOH engineer, the office of the regional MOH director, and the AID mission.

All of these logs were periodically updated and reviewed to provide feedback to Georgia Tech and the pump manufacturer. These logs provided the additional benefit of keeping all the individuals and organizations involved with the program up to date. Log book activities for Site #1, Carmela Saravia, Bajamar, are shown in Appendix E as an example of the records collected during the monitoring activity.

2.4 Evaluation of Handpumps and Roboscreen

At the conclusion of the monitoring period, copies of the monitoring log books kept by MOH promoters, caretakers, ICAITI and Georgia Tech were compiled in order to evaluate the performance of the pumps. In addition to this data, comments taken from interviews and field discussions with local villagers were summarized to determine the extent of user acceptance.

In determining the criteria to be used to evaluate the pumps, actual performance in the field and user acceptance were established as the primary considerations. Under the heading of performance, durability of design/ manufacture, and frequency/extent of repair and maintenance were the major areas to be investigated. To determine the extent of user acceptance the ease of operation and maintenance demands were established as the areas of focus.

Figure 4 shows the volume of water discharged per stroke as determined from calculations made by Georgia Tech. Figure 5 compares the costs of the four pumps evaluated under this program as determined from manufacturers' literature or quotes obtained by Georgia Tech. (Additional information on the pumps is presented in Appendix F, Handpump Literature.) However, on February 28, 1983, the AID Mission requested through Dr. Henry Van of Georgia Tech an updated unit price quote from FUNYMAQ for an unspecified number of AID pumps. Mr. Mata of FUNYMAQ stated that his bid for the 150 pumps ordered had been low. Also, after completing the manufacturing of the 150 pumps Mr. Mata had a better understanding of the costs involved in manufacturing the AID pump. The updated unit price quote given by Mr. Mata was US$250. He indicated that for large quantity orders some reduction in price could be worked out.

A summary of comments made by village caretakers, health promoters, and other program personnel as well as observations made by Georgia Tech and ICAITI, shown in Table 3, indicated to Georgia Tech personnel that the AID pump exceeds the Dempster and Sanpar pumps in durability, volume, accessibilty for repairs and low cost. The problems described, hereinafter, pertaining to the leather foot valve of the shallow and deep well AID pumps is only one item in an overall evaluation of pump durability. Georgia Tech feels that a rating of "good" for these pumps, as appears in Table 3, is appropriate in spite of this problem.

2.4.1 AID Handpump

The AID handpump, described in detail in Appendix A, is a single-acting, positive displacement piston pump that comes in two models, one for shallow wells and one for deep wells. In all, 25 shallow well and 8 deep well AID pumps were installed during the evaluation period. (See Appendix G for disposition of the remaining 116 pumps manufactured under Phase I.) All of the pumps were routinely inspected at least twice each month. Additional visits to

Figure 4

HAND PUMPS

COMPARISON OF DISCHARGE VOLUMES

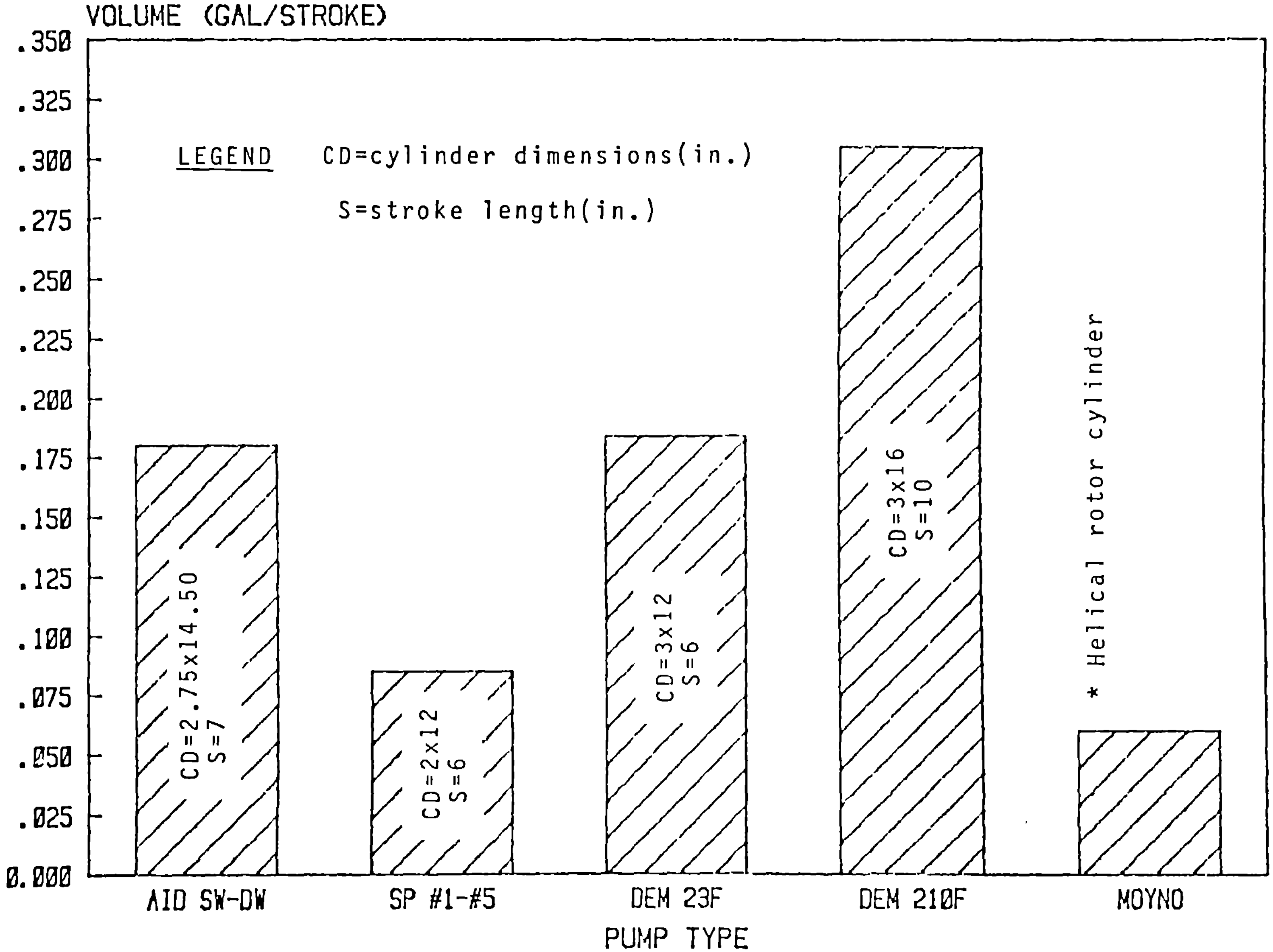


Figure 5

HAND PUMPS
COMPARISON OF COSTS

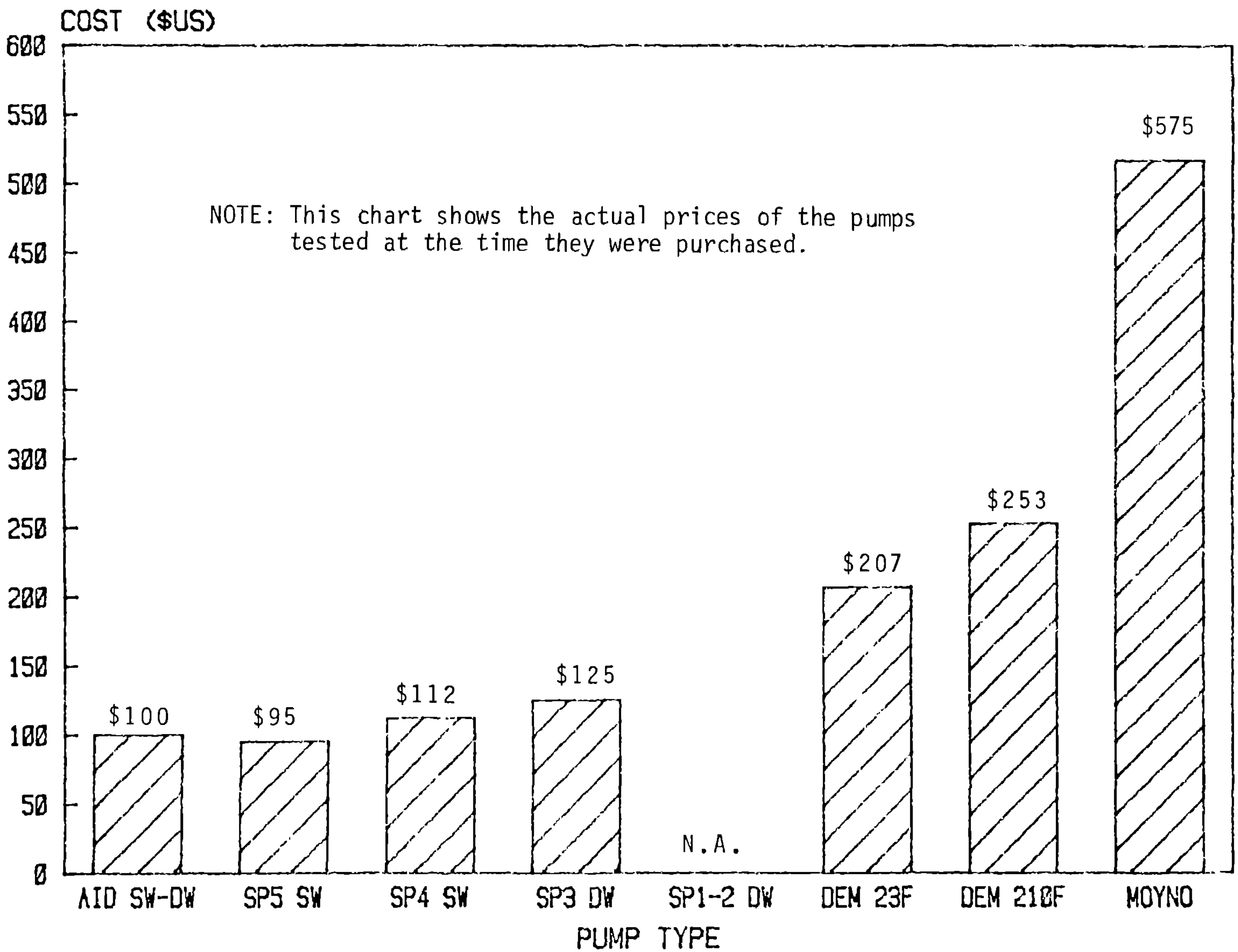


TABLE 3

PUMP EVALUATION SUMMARY

PUMP INSTALLATIONS			END-OF-PERIOD STATUS	PROBLEM AREAS	REMEDIES IMPLEMENTED		USER COMMENTS			USER ACCEPTANCE
Type	Required	Actual				Durability*	Volume	Repair Access	Other	
AID	30	25 SW	25 working	head assembly and fulcrum pins	jigs and fixtures introduced	good	good	excellent	--	excellent
		8 DW	8 working	spout joint and leather valves	technical assistance given	good	good	fair	--	good
Dempster	10	15	15 working	body/head connection	none	good	good	fair	additional time and materials for installation	good
Sanpar	10	4 Type #4	1 working	fulcrums, spares	pumps replaced	fair	small	fair	difficult to pump	poor
		2 Type #1	2 working	fulcrums	fulcrums replaced	poor	small	fair	--	fair
Moyno	10	0	--	--	--	--	--	--	--	--

*Based on comments of users and community caretakers. See discussion in last paragraph of section 2.4, page 16.

the sites were made whenever problems were reported and, since the sites were closely clustered, many observations of existing sites were made in the course of installation. At the conclusion of the monitoring period all of the AID pumps were working satisfactorily.

As shown in Table 4, some problems were encountered during the initial field installations. Although the majority of these problems did not inhibit the pump operation, they did reduce the convenience of installation (Problem 1) and access for future maintenance and repairs (Problems 2 and 3). Problems 1, 2, and 3 occurred to some degree in all the pumps.

Corrective action was taken on all pumps with these problems. Problems 1 and 2 were eliminated with the introduction of jigs and fixtures to the manufacturing process, and Problem 3 was remedied with additional technical assistance. Problem 4 was reported to have caused frequent interruptions in the operation of the pumps. Although Georgia Tech provided additional technical assistance to FUNYMAQ to improve the quality of the leather foot valve, all pumps required at least one foot valve replacement during the 12-month monitoring period. Based on the performance of this valve in Honduras as well as in previous AID handpump programs, this part of the pump continues to be its weakest feature. It is particularly troublesome in the deep well pump installations when complete removal of pump, drop pipe, and pump cylinder is necessary to replace the valve.

Of particular note was the widespread acceptance of the shallow well pump both by villagers and local government health promoters. Because of experiences with other handpumps, all of the health promoters and village caretakers were quick to recognize the durability of the design of the AID shallow well pump over other locally available pumps of similar price. During the maintenance and repair workshops, promoters and caretakers frequently commented on the comparative ease of access of the internal components of the AID pump. Local users consistently said they preferred the AID pump because it delivered more water more easily than other available pumps. In comparing the features and capabilities of this pump to others locally available, the durability, volume of water discharged per stroke, ease of access for repairs, and competitive cost were consistently noted as major advantages. While the foregoing was Georgia Tech's understanding at the end of the monitoring period, the AID Mission reports that this is in conflict with their understanding of the actual preference of the MOH health promotors.

2.4.2 Dempster 210F Handpump

The Dempster handpump is a single-acting, positive displacement piston pump. The basic design of this pump is almost identical with that of the AID handpump. Sixteen Dempster handpumps were installed and evaluated in Honduras. Of this total, seven were placed in shallow well sites by installing the pump cylinder directly under the pump stand. Although the volume of the cylinder used in this pump was larger than the AID pump, the abbreviated stroke performed by most users prevented this capability from being identified as an advantage. At the end of the monitoring period all the pumps were operating normally.

TABLE 4

SUMMARY OF FIELD MONITORING FEEDBACK

Problem Reported	Action Taken
1. Pump head assembly could not be mounted in alternate directions.	1. Jigs and Fixtures introduced. Uniformity of bolt hole pattern allows positioning of pump head in all directions.
2. Difficulty encountered in removing fulcrum pins for lubrication and/or replacement.	2. Jigs and Fixtures introduced. Improved parallel alignment of all fulcrum axes eliminates removal problem.
3. Threaded joint between cast pump spout and 3" G.I. pipe became loose hampering access to foot valve in shallow well pump.	3. Additional technical assistance given to factory personnel. Technique of "freezing" (a process of partially deforming threads with a cold chisel to prevent connections from coming apart) threads introduced to eliminate reported problems.
4. Inconsistent performance of leather foot valve due to irregular quality of leather material.	4. Additional technical assistance given to improve quality control of leather produced.

No major repairs or problems were reported during the monitoring period. However, some minor difficulties were encountered in maintaining a tight connection between the pump head and pump body. Because the flange bolts at this connection frequently became loose, possibly due to cyclic loading from pumping, flange bolts at four sites were missing and had to be replaced.

Health promoters and village caretakers also noted that additional time and materials were required to construct sites to accommodate access for repairs to the well cylinder for the Dempster pumps when installed on shallow wells. This additional work involved constructing a subgrade chamber under the slab and required up to 50 percent more concrete than the simpler slab-on-grade apron required by the AID pump. (This comment was also frequently made in comparing other pumps to the AID shallow well pump.)

Although evaluation of the Dempster 23F (with 3" x 14" brass cylinder) was not required, regular observations of this model were made routinely because of its use by the MOH in Honduras and because comparison sites were available within the program areas. A total of four 23F's were observed during the monitoring period. Installation, operation, and maintenance characteristics are essentially identical to those of the 210F.

2.4.3 Sanpar Handpump

The Sanpar pump is also a single-acting, positive displacement piston pump. The types available and their costs are presented below:

Type	Description	Cost
#1	Heavy duty-deep well	N.A.*
#2	Heavy duty-deep well	N.A.*
#3	Jet type-deep well	$125
#4	Shallow well	$112
#5	Shallow well	$ 95

* Note: Production prices were not available.

Models #1 and #2 are made primarily of cast iron. Models #3, #4, and #5 are fabricated from steel and welded at connection points. All of the Sanpar models are considerably lighter in weight than either the AID pump or the Dempster pump. The Sanpar pumps are at present the only other locally manufactured handpumps in Honduras.

Unfortunately, no printed or promotional material is available for Sanpar pumps. Of the five models currently available, four of the type #4 and two of the type #2 were included in the evaluation. Type #4 has had widespread use in prior MOH pump programs as a shallow well pump. Type #1 has only recently been introduced and is being promoted by the manufacturer as a heavy-duty deep well pump. Pricing and retail information for types #1 and #2, which are the result of European Economic Community (EEC) technical assistance, is not available due to their relatively recent introduction. Of particular note is the fact that most of the iron castings for these pumps are being supplied by FUNYMAQ, the AID pump manufacturer, since Sanpar has no foundry facilities.

At the conclusion of the monitoring period, only one of the four type #4 pumps (pump S1 Tomas Campos, La Lima) remained in service. The other type #4 installed in La Lima was removed and replaced by a different type of pump purchased by the local villagers after the handle and fulcrum assembly of the Sanpar pump had broken and could not be repaired or replaced. The two remaining type #4's installed in Comayagua were replaced by type #1's in August because users claimed they were too difficult to pump. Both of these sites also had AID pumps installed on the wells. This resulted in the Sanpars being rarely used because of the relative ease of pumping and greater volume of water pumped per stroke of the adjacent AID pumps.

2.4.4 Moyno Handpump

The Moyno handpump is a rotary, progressing cavity pump manufactured in the U.S. It is operated by turning crank handles on the above-ground pump stand. A sealed gear box transmits the rotation to a stainless steel rotor which turns in a hard rubber, helical stator in the pump cylinder which is set below the water level in the well. Water is gradually pushed upward from one cavity to the next as the rotor turns in the helical stator and then through the drop pipe to the pump spout. The initial cost of the pump is two to three times that of most lever-operated handpumps available. Because of the difficulties of maintaining pumps in rural areas, AID thought it would be worthwhile to include this pump in the Phase II testing.

In June 1982, Georgia Tech ordered 10 Moyno pumps at the request of WASH based on verbal authorization by AID:S&T/H/WS. Amendment No. 3 of OTD 29 was issued in August 1982 to authorize this purchase (see WASH Field Report No. 85.) Because of severe production problems, however, the sole manufacturer, Robbins and Meyers, was not able to meet several promised shipping dates. As a result, the order was cancelled in October 1982.

2.4.5 Roboscreen

Roboscreen is a helically-slotted, internally-ribbed PVC well screen (strainer) developed at the International Rural Water Research Development Laboratory (IRWRDL) at the University of Maryland under World Bank sponsorship. Its principal advantage over other plastic well screens is its larger percentage of open area which permits freer movement of water and less closing of the screen.

Under Phase I, 200 feet of 2" diameter roboscreen had been produced for use in the installations scheduled for Phase II of the contract. Due to the lack of open well sites discovered during the site selection process (most wells were existing driven wells and could not use the roboscreen), only Comayagua sites were fitted with roboscreen. No problems were reported. Due to the relatively short monitoring period, however, and because none of the sites presented aggravated sedimentation conditions, improved wear characteristics of the pumps could not be verified.

2.5 Sequel

The PRASAR project has encountered hydrogeological, institutional, and administrative difficulties in installing the Dempster handpumps of the project. Because of this, the total scope of the installation effort has been scaled down from 3,000 to 1,600 pumps. As a result it may be some time before the work done under OTD's 29 and 85 yields practical results in influencing pump selection when future orders are placed. The GOH and AID Mission are taking positive steps to overcome these difficultues, and it is hoped that it will not be too long before the Phase I and II work will be put to practical, long-term use as these difficultues are resolved. The problems which the GOH has encountered, along with suggestions for dealing with them, are documented in WASH Field Reports 65 (for OTD 115), 69 (for OTD 101), and 81 (for OTD 135). Photographs of the various aspects of the Honduras handpump project are presented in Appendix H.

Chapter 3

DISCUSSION OF RESULTS AND CONCLUSIONS

3.1 Working Relationships In-Country

Working relationships with the MOH were established at various levels. An initial meeting in February 1982 with Ing. Giron, Director of the PRASAR project, and his administrative staff in the central government paved the way for cooperation throughout the duration of the Honduras handpump project. As a result of this meeting, letters were sent to regional MOH personnel asking that a portion of their promoter time be committed to the AID handpump program. Georgia Tech and ICAITI held formal briefings for these administrators and other key personnel two additional times during the project. In June 1982, a mid-project status report summarized the training activities and installation work. In October 1982, preliminary monitoring data and comparative data on pump installations were presented to the administrators and the regional MOH coordinators. As a result of the favorable relationships developed by the Georgia Tech team, other organizations (see Appendix G, Disposition of Pumps Produced under Phase I) became interested in the program after being introduced to it by MOH program personnel.

Because of close working relationships and daily interactions, briefings between the Georgia Tech team and regional level MOH personnel took place on a more frequent and less formal basis than those with central government staff. MOH personnel including promoters and coordinators routinely accompanied the Georgia Tech team in the field, allowing the exchange of project information to proceed in a more detailed and relaxed manner. Other field personnel including the regional engineer and bacteriologist provided active support of the program, in addition to their administrative roles, by donating warehouse space for the storage of handpumps and coordinating the stockpiling of supplies in San Pedro Sula. They also expedited the transportation of supplies and equipment to the well sites.

Besides the formal and informal briefings, Georgia Tech also assisted in identifying other potential handpump users for the AID Mission as well as providing background information on the handpump program to interested persons. These activities were highlighted by an agreement that was developed to utilize the locally manufactured AID handpump in conjunction with a windmill locally manufactured by Centro Evangelico de Educacion Vocacional Rural (CEVER).

Working relationships were also established with AID Mission personnel. Georgia Tech provided formal and informal briefings to the Mission and identified and briefed other potential handpump users. AID Mission personnel furnished, in turn, information to Georgia Tech about previous training programs in well development and pump installation as well as background information on how this pilot program fit into their overall water program for Honduras.

In summary, the MOH was quite pleased with the results of the program, and the efforts put forth by Georgia Tech to establish good working relationships with the MOH and the AID Mission resulted in a handpump program in Honduras that met the needs of the GOH, despite some minor communication problems. The MOH has stated, however, that the improved Sanpar pump would be their choice over the AID pump.

3.2 Effectiveness of Training

In evaluating the effectiveness of the technical training given for the installation, maintenance, and repair of the handpumps, discussions (working on the project from January-March 1983) were held by Dr. Henry Van of Georgia Tech with the promoters and caretakers involved to determine their understanding of and satisfaction with the training given. Direct observations of the sites were also made to assess the skills exhibited by the promoters and caretakers as the result of the training.

In discussions held with the MOH promoters and village caretakers, a high degree of satisfaction was expressed. The promoter coordinator in Comayagua said that he was very satisfied with the training given and added that promoters had never received instruction related to specific pumps before and had always had to learn and work out problems related to new pumps by themselves. The caretaker in Bajamar also said he had never received formal training in the maintenance of pumps and appreciated the opportunity to learn in a workshop atmosphere with others. In comments related to prior handpump programs and experiences, the promoters noted that the illustrated maintenance and repair guides were very helpful and were not available for other pumps (see Appendix B, Maintenance and Repair AID).

The key aid in helping village caretakers to understand the pump's operation was the transparent demonstration cylinder used during the training sessions. Whenever it was used, the demonstration model made a great impact on the trainees in illustrating the dynamic relationships of the various internal components of the pump. When it was in operation, the model was always the center of attention and created excitement among the trainees.

In reviewing the actual performance of the pumps in the field, few if any shortcomings were observed with respect to the training given. Monitoring records collected and actual on-site reviews made by various personnel involved have shown that maintenance and repairs of all the pumps were completed in a satisfactory manner.

Inviting other MOH personnel to participate in, rather than merely observe, the training provided an additional outreach opportunity for the handpump program. Regional engineers were able to handle the hardware for themselves rather than hearing about it from the promoters. In fact, engineers from another branch of the MOH solicited more information about the AID pump after a regional engineer talked with them about his participation in the training program.

3.3 Impact of Problems Encountered During Installation

During the course of the installation period, some unanticipated difficulties and delays were encountered that may have diminished the impact of the program. In November 1981, a national strike by the health promoters suspended all MOH field operations. One of the key issues in this dispute was the government's inability to pay field per diem to the promoters. As late as June 1982 none of the AID handpump program promoters in the San Pedro Sula region had been reimbursed for their travel expenses for the previous six months.

While no further strikes occurred during the course of the installation period, the per diem issue never appeared to be completely resolved. As a result, the AID handpump program was viewed negatively by many promoters because it added to their work obligations. As a result, a fragile relationship developed between the Georgia Tech team and the promoters, evidenced by many delays in construction, complaints about workload, and friction over priorities.

Another problem that occurred involved the quality of site work completed. In implementing the program the MOH required working with the existing community participation system by which the local villagers supply the necessary labor as their contribution to the program. As a result of this policy, the completed site work did not reflect the level of uniformity and consistency considered acceptable by AID/Washington, who had envisioned a "model" site condition (see Table 5).

After meetings in Washington to discuss this conflict, Georgia Tech, at the direction of AID/Washington, proceeded to secure the services of local contractors in Honduras to upgrade the sites. Even though their purpose was explained beforehand, the appearance of these contractors initially brought strong resentment from local villagers and promoters who took the action as an insult to their efforts. This resentment also extended to Georgia Tech, ICAITI, and local AID staff. Problems included verbal confrontation, reduced levels of coordination in the field, and sporadic follow-up on maintenance procedures.

3.4 Effectiveness of Monitoring

Log books (see Appendix E, Log Book Sample) were very effective in recording pump operation in the field. Although logs were issued to both promoters and village caretakers, only the promoters kept regular records. Because of the nature of the maintenance/reporting infrastructure, however, most promoters incorporated caretakers' comments into their records. Some improvement in reports might be made by using a checklist format so that repetitive observations might be made more efficiently.

3.5 Pump and Roboscreen Evaluation

A statistically conclusive evaluation of the handpumps and roboscreen could not be made for a number of reasons. The total number of each type of pump and the conditions encountered at each site varied. A total of 34 AID and 16 Dempster handpumps were installed in tube and dug wells. These numbers differed from those specified in the OTD to address the requests of the communities in the program areas. Due to communities' previous experiences with the Sanpar pump, lack of community approval restricted the installation of this pump to four sites. Because of prior bad experiences with the Sanpar pump only four sites for these pumps could be secured in the program area. Another factor which prevented a direct comparative evaluation of the pumps was the monitored time-in-operation. Since the AID pumps were installed directly after the training workshops, the majority of these pumps were monitored for a period of almost one year. The remaining pumps were installed after the AID pumps with the last Dempster pump being installed almost one year after the first AID pump.

Although these variables prevented a direct comparison of the pumps, a significantly favorable response to the AID pump over the other pumps included in the evaluation was expressed both by user communities and program personnel. A summary of the local response to the AID pump in comparison to the Dempster and Sanpar is as follows:

Comparing AID to Dempster

- o Competitively priced
- o Locally manufactured
- o More convenient to repair and maintain
- o No difference in volume pumped as perceived by users

Comparing AID to Sanpar

- o Interchangeable parts
- o More durable design
- o Competitively priced
- o Less difficult to operate and repair
- o The design of the AID pump causes an ill-defined discharge at the pump orifice. The Sanpar discharges is more defined, allowing filling of bottles as well as pails.

Because of these advantages, the AID pump was widely accepted by health promoters and villagers in the areas of Honduras where it was used.

The use of the roboscreen was limited to approximately 20 percent of the testing sites, because the majority of test sites in Honduras were existing "driven-type" wells. No major problems or difficulties were encountered during the installation or monitoring of the roboscreen. No special training or tools were required to install the roboscreen, and no reports of repair or replacement were noted in the monitoring logs. However, further testing of roboscreen with an emphasis on sites that could determine its filtering capabilities would be required before improved pump wear characteristics can be evaluated.

3.6 Maintenance Schedules for Handpumps

Regular maintenance in the form of routine lubrication and inspections are recommended for all the handpumps included in the evaluation. However, determining the rule-of-thumb interval that these procedures should be scheduled for is difficult.

TABLE 5

QUALITY OF SITE WORK

Difficulties Identified	Adverse Effect on Pump Performance
1. Loose anchor bolts	yes[a]
2. Difficult pump operation due to awkward mounting location	yes[b]
3. Insufficient drainage slope	no
4. Non-uniform apron dimensions	no

a. Anchor bolts were reinstalled at problem sites.
b. Pumps were remounted and additional improvements (steps, platforms) were made at problem sites to eliminate difficulties.

Environmental conditions such as weather and intensity of usage play a major role in establishing the maintenance requirements at any given site. While it would be easy to specify a routine lubrication schedule of once a day or once a week to accommodate worst condition scenarios, experience has shown that such an arbitrary interval is less effective and can be more costly than a performance-based specification such as lubricating the pump when the pins squeak or appear dry.

The organization of the maintenance infrastructure also plays an important role in affecting maintenance routines. In a situation where a handpump caretaker has a wider district responsibility, an overly-excessive maintenance schedule is counterproductive.

In Honduras, each handpump caretaker was responsible for pumps located within an area square mile or less. Because of this and because usage and weather conditions were not particularly harsh, a weekly visual inspection was recommended and maintained during the monitoring period. Lubrication was specified on an as-needed basis. While this procedure was followed it proved to be quite satisfactory.

Chapter 4

RECOMMENDATIONS

Even though that AID handpump technology transfer effort has been successful in establishing manufacturing capabilities in Honduras there are areas which need attention if the technology transfer is to be complete. The following recomendations are made specifically for Honduras. However, their applicability should be considered in future AID handpump programs as well.

4.1 Recommendation No. 1

4.1.1 Background

The original production of Honduran AID handpumps were produced at a cost of US$100 each (the comparative prices for the Sanpar, Dempster, and Moyno pumps are shown in Figure 5). Since that time rising material and labor costs have increased. On February 28 of 1983, the AID Mission requested through Dr. Henry Van an updated unit price quote for an unspecified number of AID pumps. At that time, Mr. Mata of FUNYMAQ responded with a revised price estimate of US$250. He also indicated that for large quantity orders there could be some reduction in price. During this period the unit cost of the Dempster pump also increased from US$253 to $282, while the Moyno pump remained unchanged in price at US$575. Though no quotes could be obtained, it is expectd that the price of Sanpar pumps have also increased proportionately since FUNYMAQ produces the majority, if not all, of its cast iron. While the relative cost differential between the various types of pumps has decreased, the overall advantage remains with the AID pump.

Local reception of the AID pump was extremely favorable. Both users and promoters were pleased with the operation and features of the pump.

From a national perspective the benefits of the AID handpump remain unchanged. Production of the locally manufactured pump stimulates local employment, reduces foreign import exchanges, and provides a ready source of spare parts.

4.1.2 Recommendation

It is strongly recommended that the AID handpump be utilized for future handpump programs in Honduras.

4.2 Recommendation No. 2

4.2.1 Background

The use of jigs and fixtures was not originally authorized for the manufacturing activities of this program. As a result, pump stroke (vertical piston travel) varied from pump to pump because of dimensional differences between bushing holes in handle fulcrums and handles, caps could not be mounted in alternate directions, there was unparallel alignment of fulcrum axes that made removal or insertion of fulcrum pins difficult, and spare parts were not interchangeable. These problems showed up very quickly during the field testing of the AID handpump. Separately from the project, project personnel and the AID handpump manufacturer FUNYMAQ absorbed the cost of designing, fabricating and testing jigs and fixtures. The manufacturer subsequently remachined, at no additional cost to the project, all handpumps not installed in the field using the jigs and fixtures for a much more satisfactory product.

4.2.2 Recommendation

It is strongly recommended that the use of jigs and fixtures be authorized on all future AID handpump programs.

4.3 Recommendaton No. 3

4.3.1 Background

While the leather flapper type foot valve of the AID handpump is inexpensive and very easy to change in the shallow-well pump (by merely unscrewing the pump body from the pump base, removing two screws that hold it to the pump base, and replacing the leather flapper, screws and pump body), it is extremely difficult to change in the deep-well pump because the pump cylinder has to be pulled up from the bottom of the well. Morever, though inexpensive in cost, the leather flapper valve also has a short useful life compared to many other foot valve designs. Government of Honduras engineers recognize the short life of this foot valve and feel it is a major disadvantage. For only a modest increase in cost, alternative metal valves of long useful life are available.

4.3.2 Recommendation

It is recommended that the leather flapper foot valve design be discarded and replaced with the metal poppet foot valve design shown in Figure 6. This metal foot valve is an improved version of one used successfully in the manufacture of the AID handpump in the Philippines.

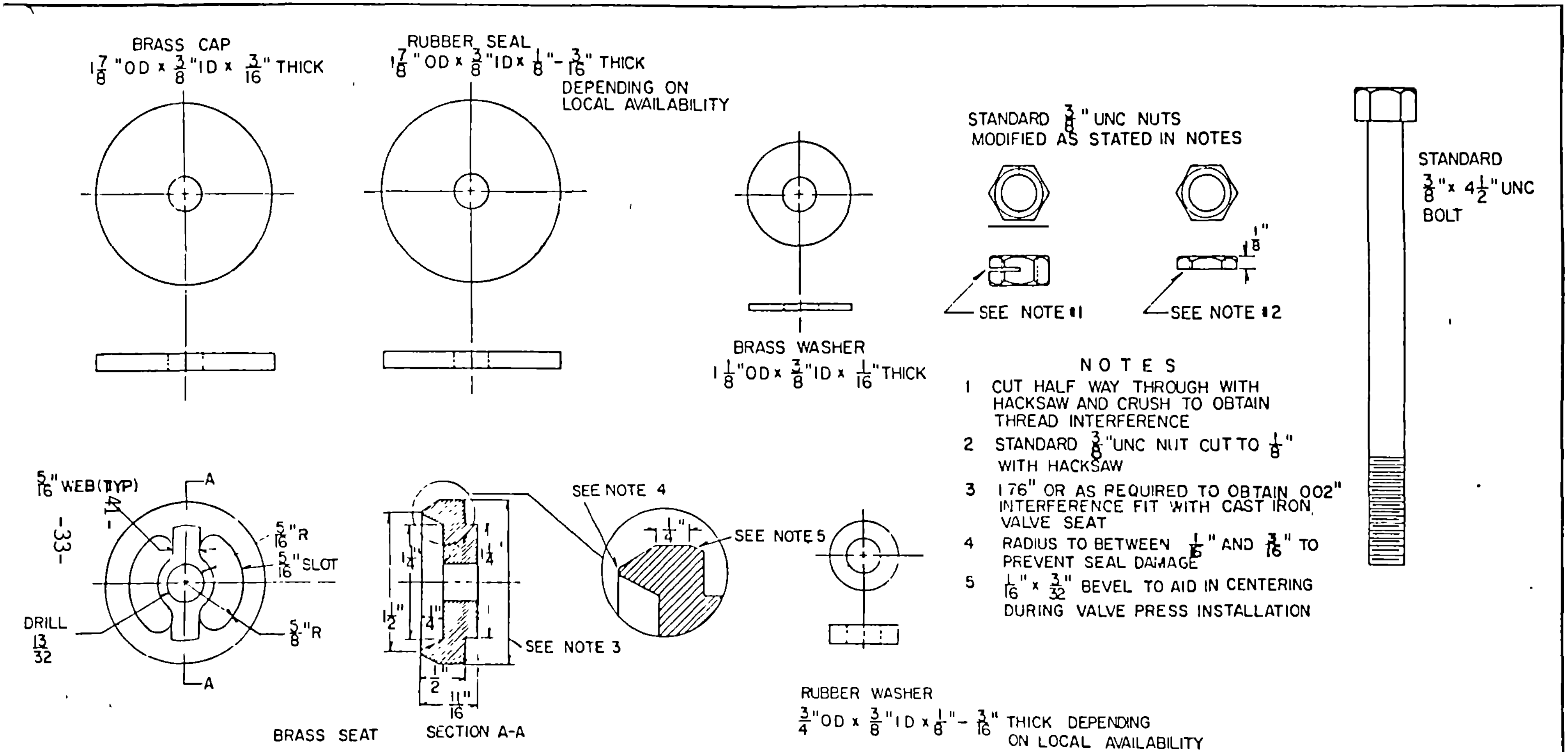
4.4 Recommendation No. 4

4.4.1 Background

When the AID Mission in Honduras first requested that AID handpump manufacturing capability be established in Honduras, it had in mind evaluating the AID pump for possible use in the Rural Water and Sanitation Project (PRASAR) and using Dempster handpumps while the manufacturing capability for producing the AID handpumps was being developed. Unfortunately, due to a lack of counterpart funds and complex government procurement procedures, severe logistical problems have developed that resulted in a delay of project goals. AID and PRASAR are now considering reducing the project goals and extending the date of completion. For example, the goal of installing 3,000 handpumps may be reduced to 1,600 or even to the number of Dempster handpumps ordered at

Figure 6

POPPET-TYPE FOOT VALVE



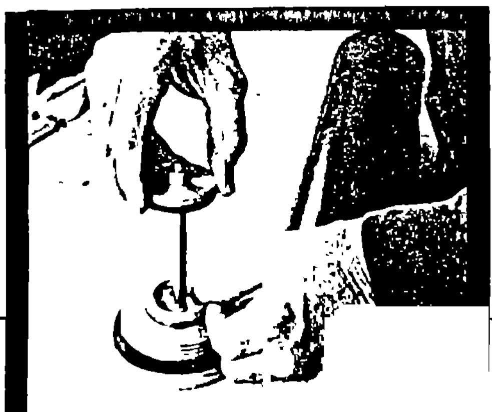


Photo inset shows poppet-type foot valve in open position attached to test fixture.

the beginning of the project (1,120). Thus, the market for AID handpumps appears to be diminishing unless other areas of Honduras (outside the PRASAR project area) accept and adopt it for use, a matter that AID Mission personnel are pursuing.

4.4.2 Recommendation

It is strongly recommended that AID continue its efforts to find markets other than PRASAR for the AID handpump because of its good performance and acceptance.

4.5 Recommendation No. 5

4.5.1 Background

The use of a transparent demonstration cylinder during training and monitoring proved to be a valuable aid in teaching caretakers and promoters troubleshooting and repair techniques. Prior to the introduction and use of this working model workshop participants were required to conceptualize the operation of the pump's internal components through the use of pictures and other abstract methods. With the advent of the see-through model, the participants were able to view the actual operation of the cylinder in action and as a result were better able to understand the relationships of valve operation and the implication of proper and faulty repair procedures. This improved understanding was demonstrated in the field by the lack of difficulties encountered by the participants during repair operations and was further exemplified in discussions in which participants recounted the logic they used in troubleshooting field problems.

4.5.2 Recommendation

It is recommended that the use of transparent demonstration cylinders be included as training aids in future AID handpump programs.

4.6 Recommendation No. 6

4.6.1 Background

Although the level of coordination achieved in the Honduras handpump progam was adequate, communications problems could be averted in future programs. For example, AID/Washington wanted "model" sites rather than the lower quality sites that utilized community labor, and Ministry of Health officials claimed that if they had known this program was a pilot for AID's planned countrywide program, they would have placed more emphasis on the pilot by mobilizing additional material and manpower resources.

4.6.2 Recommendation

It is recommended that future programs incorporate at the beginning of the program a comprehensive action planning meeting among the AID contractor, the AID Mission staff, AID/Washington, and the host-country agency under which the program is placed. Inputs from each representative should be combined into a workable but flexible plan for the program. Issues to be addressed should include current government program needs; cultural and political issues; incorporation of the handpump program into national and regional plans; purpose, goals and objectives of the handpump program; scheduling; level and types of involvement of each participant; and forms and frequency of feedback to be utilized.

APPENDIX A

DETAILED DESCRIPTION OF THE AID HAND PUMP AND GENERAL TECHNOLOGY TRANSFER ACTIVITIES

AID Hand Pump Design and Operation

The AID-design hand pump (see Figures 1 and 2) is a single-acting, positive displacement piston pump for community or multi-family use consisting of an above-ground pump stand made of cast iron and galvanized steel, a drop pipe and a PVC or PVC-lined pump cylinder containing a brass piston or plunger assembly with leather cup seals. It can be mounted on tube wells or on a platform built over dug wells. The pump has been found to provide a reliable water supply for 50 to 100 families per pump. Its average pumping capacity is approximately five gallons per minute (gpm) and it can pump from depths of up to 100 feet. The pump produces approximately one half liter of water per stroke of the handle. The pump has not been in use long enough to determine its average useful life before replacement, but some have estimated its useful life to be 20 years. It is most likely that, rather than replacing an entire worn-out pump, its component parts would gradually be replaced as needed; and it may be that after 10 years of use the pump would no longer contain any of its original parts.

The pump comes in two models, one for shallow wells and another for deep wells. The shallow well pump lifts water by suction from wells in which the lowest water level is no more than eight meters (approximately 26 feet) below the ground. The pump cylinder in this model is in the pump stand above the ground.

The pump cylinder in the deep-well pump is located down the well. It either pushes water up to the surface from below the water level or, if the pump cylinder is set above the water level, it lifts water by suction just as the shallow-well model does. In the latter case the cylinder must be no more than seven or eight meters above the static water level.

Figure 1.

AID HAND–OPERATED WATER PUMP
SHALLOW WELL

(For Wells less than 7–8 meters in depth)

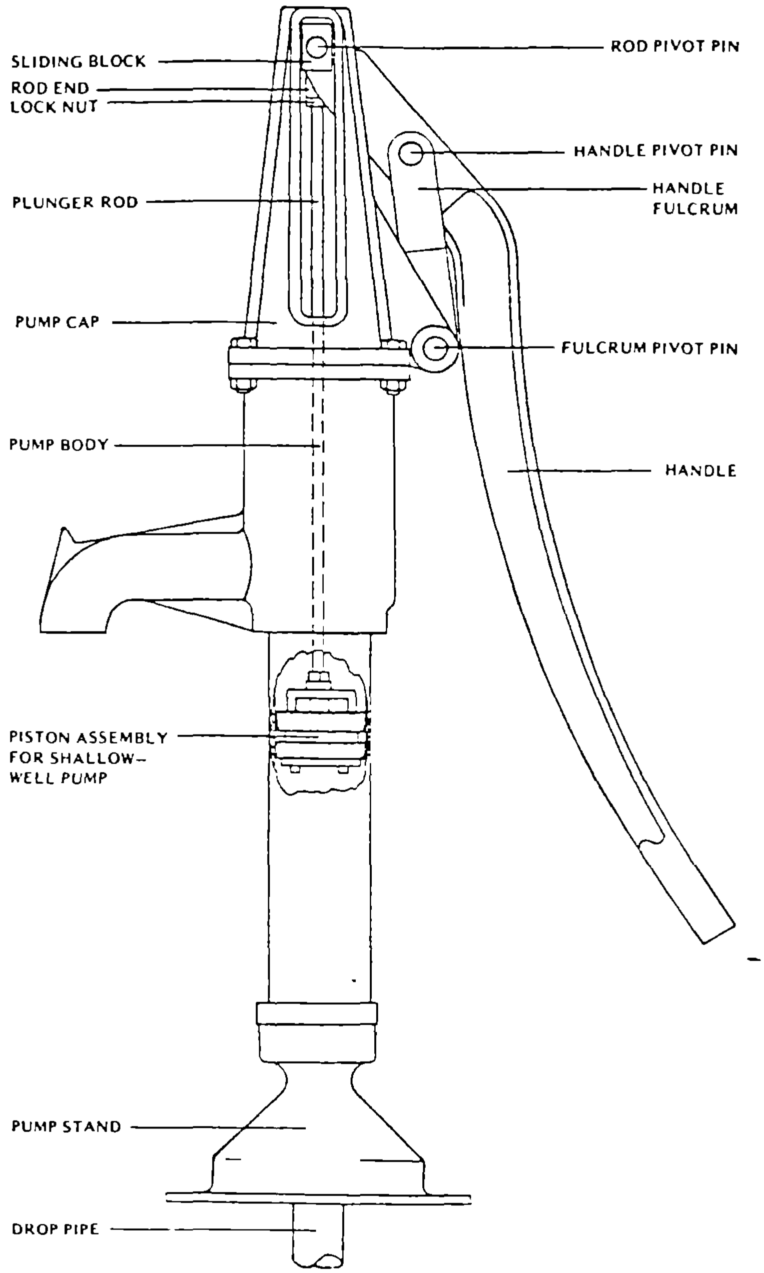
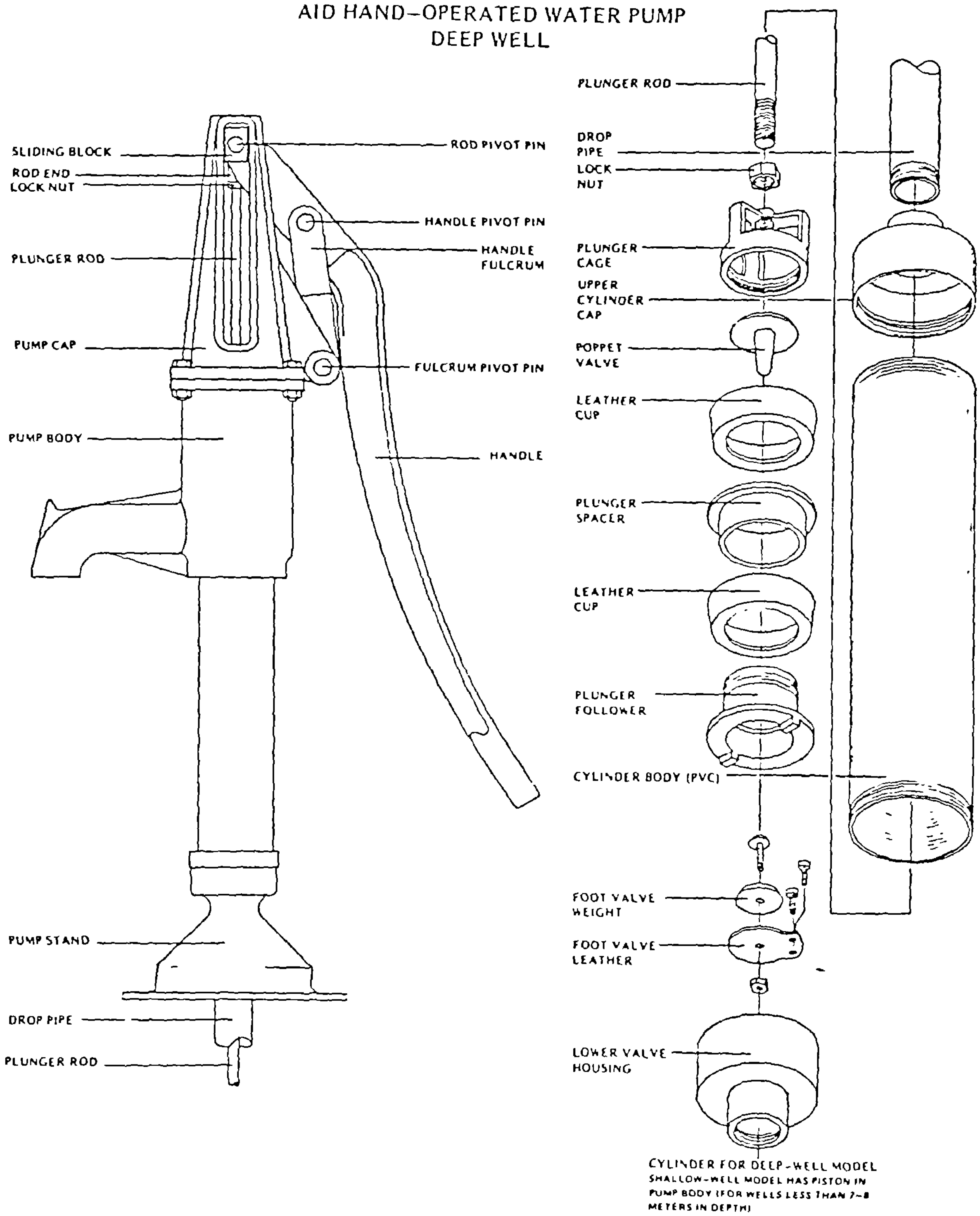


Figure 2.

AID HAND-OPERATED WATER PUMP
DEEP WELL



The pump is operated by moving the handle manually. If the pump is to lift water by suction, it must be primed initially. If it is to push water up from below the water level it does not require priming. When the handle is lifted, the piston or plunger moves down and water pushes up through a poppet valve in its assembly. A foot valve at the bottom of the pump cylinder is closed during this action and prevents the column of water from draining out the bottom of the cylinder. When the pump handle is lowered, the piston or plunger moves up. The poppet valve closes and the piston or plunger assembly pushes water upward. The upward motion sucks open the foot valve and water passes up into the pump cylinder below the piston or plunger. Repeated operation of the handle brings water to the pump spout.

AID Hand Pump Maintenance

Like all mechanical devices, the AID pump requires maintenance and repair. The most frequent maintenance item is lubricating the pins at the three mechanical linkages in the pump cap and the guides for the sliding blocks. This should be done once a week. It is expected that persons from the community where the pump is located can be trained to do this. The next most frequent item is replacing worn leather cups. This may have to be done as often as every six months or as infrequently as every two years. This is a relatively simple task for the shallow-well pump but is very laborious for the deep-well pump because it requires removing the pump cylinder from down in the well. In the latter case, therefore, a regional maintenance crew may have to do this work.

In any case, regional crews must be established to perform more difficult maintenance and repair work. These crews must be supported by a national infrastructure capable of managing this operation. The principal management concerns include the logistics of providing spare parts, tools, materials, fuel and supplies; maintaining vehicles; scheduling work; personnel administration and training; budgeting and financing. Experience in many countries has shown that if such an infrastructure does not exist or cannot be developed, a hand pump program will not remain viable for very long.

In order to be effective in reducing water-related diseases, a program involving hand pumps should include an element of user education so that people will use clean containers to obtain water at the pump, will store it in clean containers in the home and will be careful to use water in a sanitary manner. The well site should be drained so as to prevent water from pooling, and the users should keep the site clean and free from mud.

General Approach to Technical Assistance

In carrying out technology transfer programs involving the AID hand pump, the Georgia Institute of Technology follows a sequence of activities that is outlined below:

1. Georgia Tech assesses the pump production capability of several manufacturers and recommends one or more of these manufacturers for selection by AID to furnish this pump for host country use.

2. Georgia Tech provides mechanical drawings and a prototype pump to the selected manufacturer(s) and discusses in detail the manufacturing of each pump component and the assembly and finishing of the pump.

3. The manufacturer fabricates the pump. This process involves casting and machining iron and brass components and procurement or fabrication of other materials and parts. The machining involves cutting, grinding, turning on a lathe, milling, drilling, and threading. The fabrication process also involves hardening and tempering steel pins and bushings for the pump's mechanical linkages.

   As the manufacturer completes some initial pumps, Georgia Tech personnel inspect them very carefully, using this opportunity to orient and train the manufacturer in quality control, product inspection and testing.

4. Based on inspection of the initial pumps, Georgia Tech personnel identify the principal difficulties encountered by the manufacturer,

discover the reasons for the difficulties and work out a mutually-acceptable program of intensive technical assistance. Executing this specific technical assistance program is the major component of Georgia Tech's program and is the most time consuming.

5. The manufacturer completes the order of pumps and Georgia Tech personnel conduct final inspection and acceptance testing. Again, Georgia Tech uses this opportunity to train the manufacturer in these last but critical steps in the pump production process.

6. If a host-country agency is purchasing the pumps, Georgia Tech trains the agency's personnel in the pump acceptance procedure so that they will be able to carry out this first step in ensuring that only reliable pumps reach the field. The agency's personnel will be the ones responsible for accepting or rejecting the pumps and approving or holding back payment to the manufacturer.

   If Georgia Tech is purchasing the pumps on behalf of AID, Georgia Tech personnel may be called in at a later date to train agency personnel when the host-country agency places its own order for pumps.

7. In order to obtain information on the performance of the locally-manufactured pump and the acceptance and use of the pump by the local people, Georgia Tech personnel assist host-country personnel in selecting field test sites and in installing the pumps. This involves sanitary survey, site selection and characterization, constructing a slab (for dug wells) or an apron (for tube wells), installing the pump and disinfecting the well. The occasion of carrying out these activities is also used as an opportunity to train host country personnel.

8. Together with host-country personnel, Georgia Tech maintains and monitors the field test sites and provides feedback on the pump's performance, acceptability and maintainability to the AID Mission, the host country agency and the pump manufacturer.

9. If necessary, additional technical assistance is provided to the manufacturer or in-country personnel based on any difficulties revealed by the field testing.

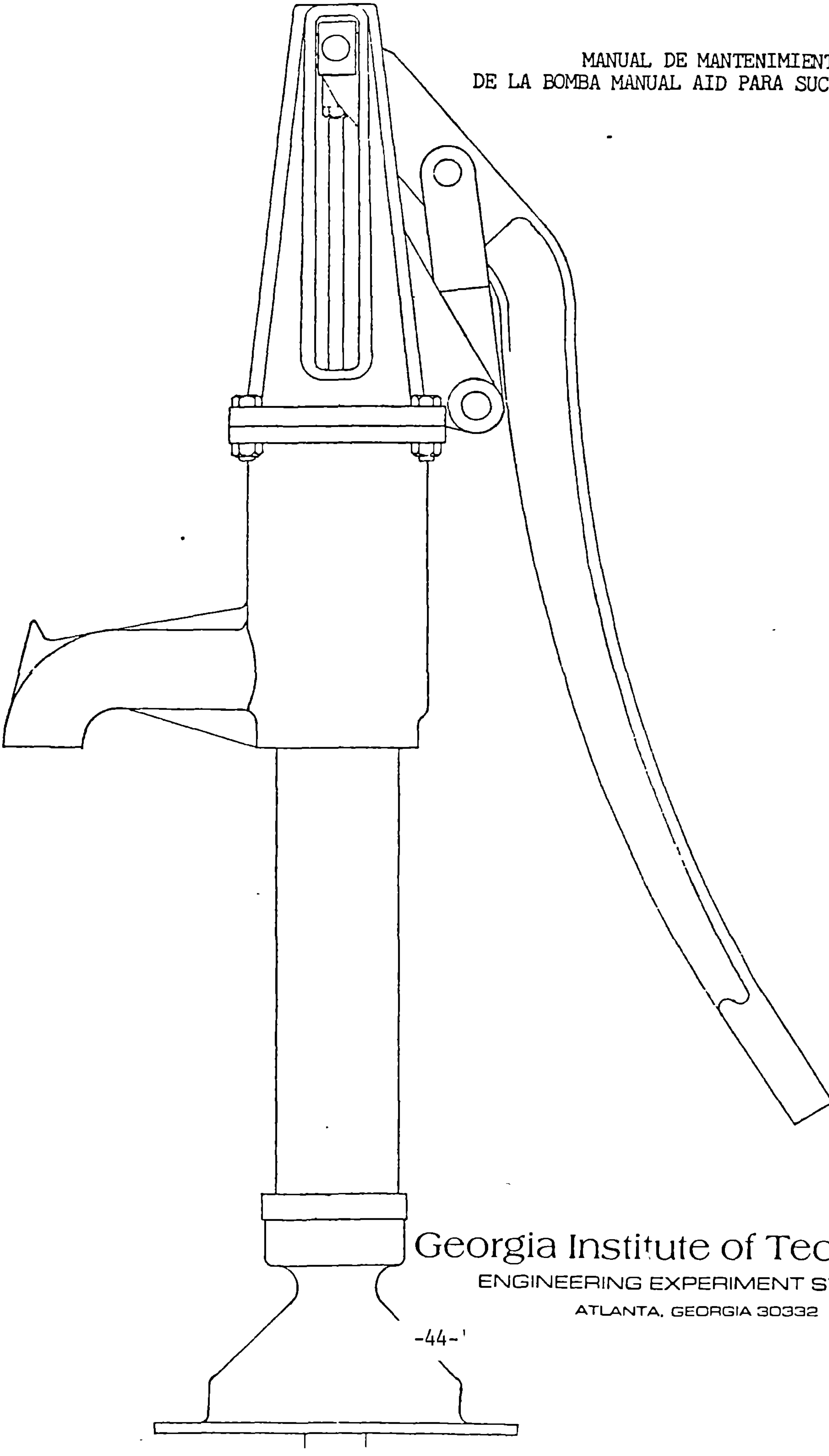
10. Finally, Georgia Tech prepares a report documenting its activities and drawing from the experience, formulates conclusions which are either specific to the activity and/or are applicable to AID's overall hand pump technology transfer program. Recommendations are made concerning both the specific country's water supply programs and future activities under AID's technology transfer program.

The initial program of technical assistance is usually a pilot program in that a relatively small number of pumps is involved and its purpose is as much for demonstration and data collection as it is for developing local manufacturing capability. A follow-up program of technical assistance is sometimes recommended to help AID, the host-country government and the manufacturers not only with the same problems as those dealt with in the pilot program but also with problems associated with the increased size and complexity of large scale, full production programs that involve thousands of pumps.

APPENDIX B

Maintenance and Repair Aid

MANUAL DE MANTENIMIENTO
DE LA BOMBA MANUAL AID PARA SUCCION DE AC



PUMP CARETAKER ____________

SITE NAME ____________

Georgia Institute of Technolog
ENGINEERING EXPERIMENT STATION
ATLANTA, GEORGIA 30332

ENGINEERING EXPERIMENT STATION
Georgia Institute of Technology
A Unit of the University System of Georgia
Atlanta, Georgia 30332

PROGRAMA DE BOMBAS AID

Hay un creciente conocimiento de la importancia que juega el proveer bombas para succión de agua acceptables en los países en desarrollo. Muchos cientos de millones de personas dependen en la actualidad de las bombas manuales para succión de agua, cuyos programas de bombas manuales están actualmente en vias de desarrollo o planeadas en muchos de estos países.

Aunque la demanda para bombas manuales en muchos países ha sido suplido por los fabricantes o importadores, la experiencia nos ha demostrado que muchas bombas se convierten en inoperables o son abandonadas por el mal diseño de operación, manufactura, instalación o por un pobre mantenimiento.

En 1980, un estudio hecho por la Organización Mundial de la Salud en Indonesia, demostró que despues de seís meses de haber terminado la instalación de una bomba, el 80% de las bombas instaladas eran inoperables por la necesidad de reparación o por la pobreza de mantenimiento.

Reconociendo la necesidad de una bomba manual para succión de agua de bajo precio que pudiera ser manufacturada localmente, la Agencia para Desarrollo Internacional AID, comenzó en 1966 una serie de contratos con el Instituto BATELLE MEMORIAL, para diseñar y probar en laboratorio una bomba manual para succión de agua para pozo profundo y para pozo poco profundo. - Un diseño final fué desarrollado y, a finales de 1976, AID contrató a la Oficina de Programs Internacionales del Instituto Tecnológico de Georgia para evaluar el comportamiento y aceptabilidad de la manufactura local de bombas manuales AID para succión en Honduras.

El Instituto Tecnológico de Georgia se encuentra trabajando conjuntamente con el Instituto Centroamericano de Investigación de Tecnología Industrial (ICAITI), en la manufactura y coordinación del proyecto, del cual la empresa FUNDICION Y MAQUINADO, S.A. FUNYMAQ es el fabricante.

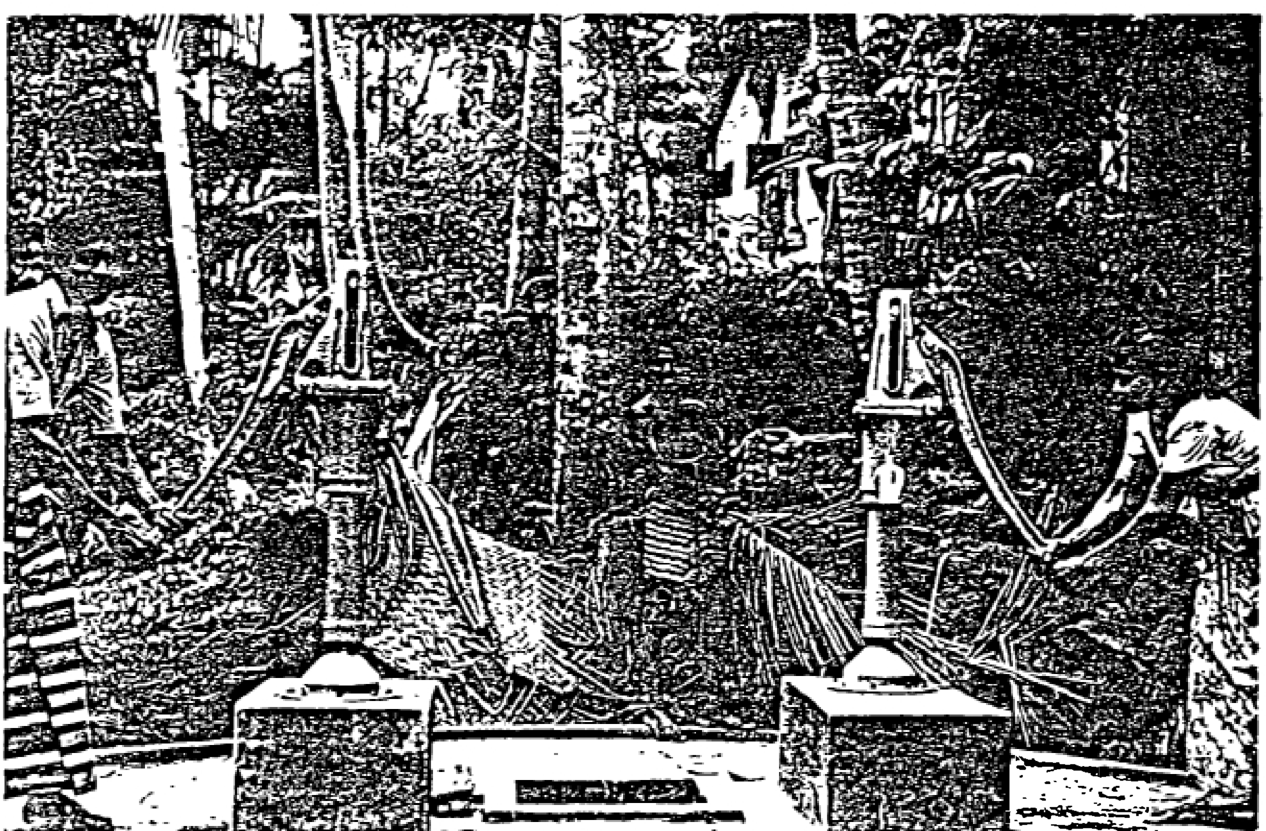
El objecto del programa de manufactura de bombas manuales consta de dos partes:

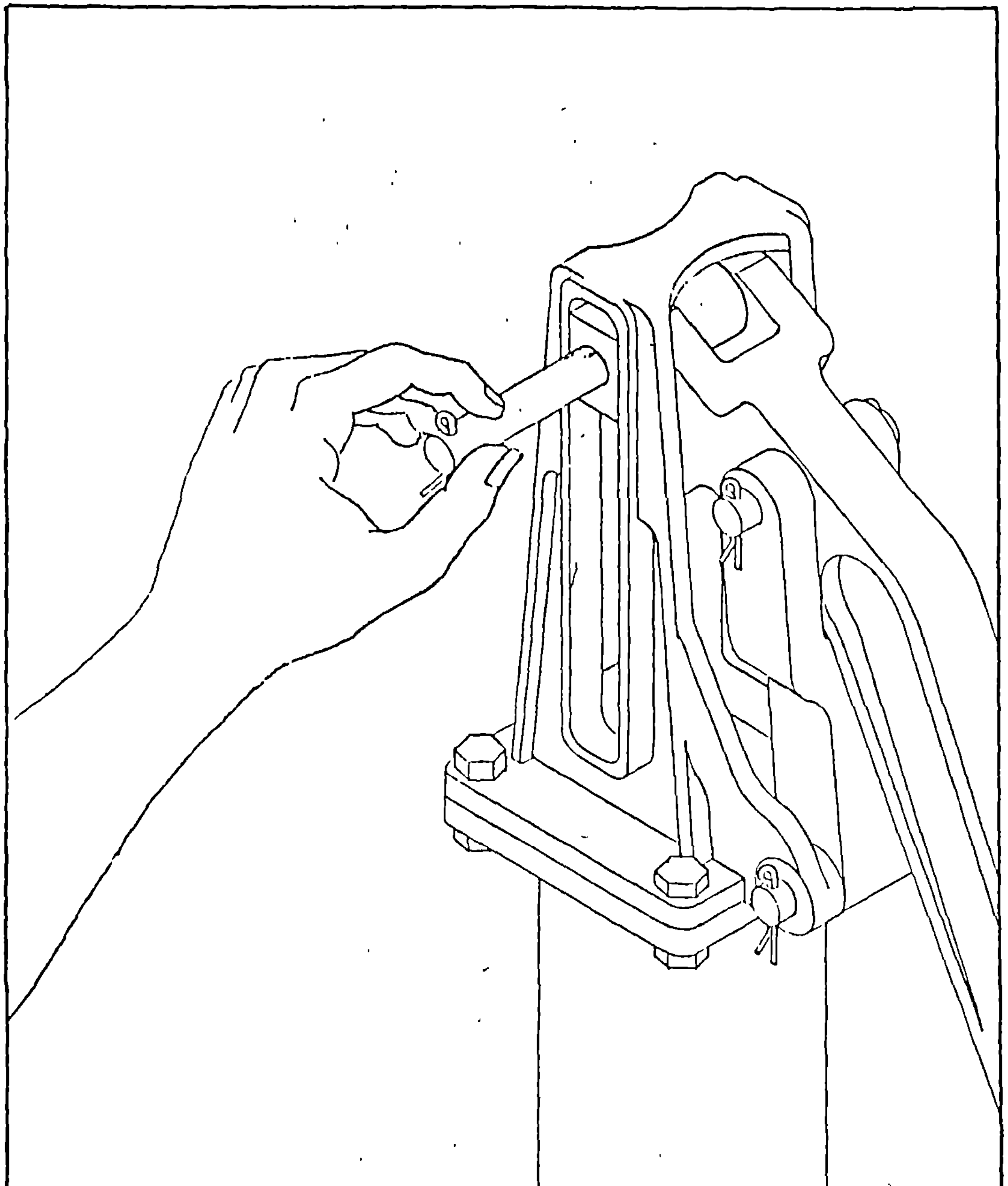
1. Localizar un fabricante local y proporcionarle la asistencia técnica necesaria para ayudarle a producir localmente las bombas manuales para succión de agua AID.

2. Instalar un número de bombas entrenando y usando personal de la contra-parte para demostrar y evaluar, el comportamiento útil de la bomba manual en el país.

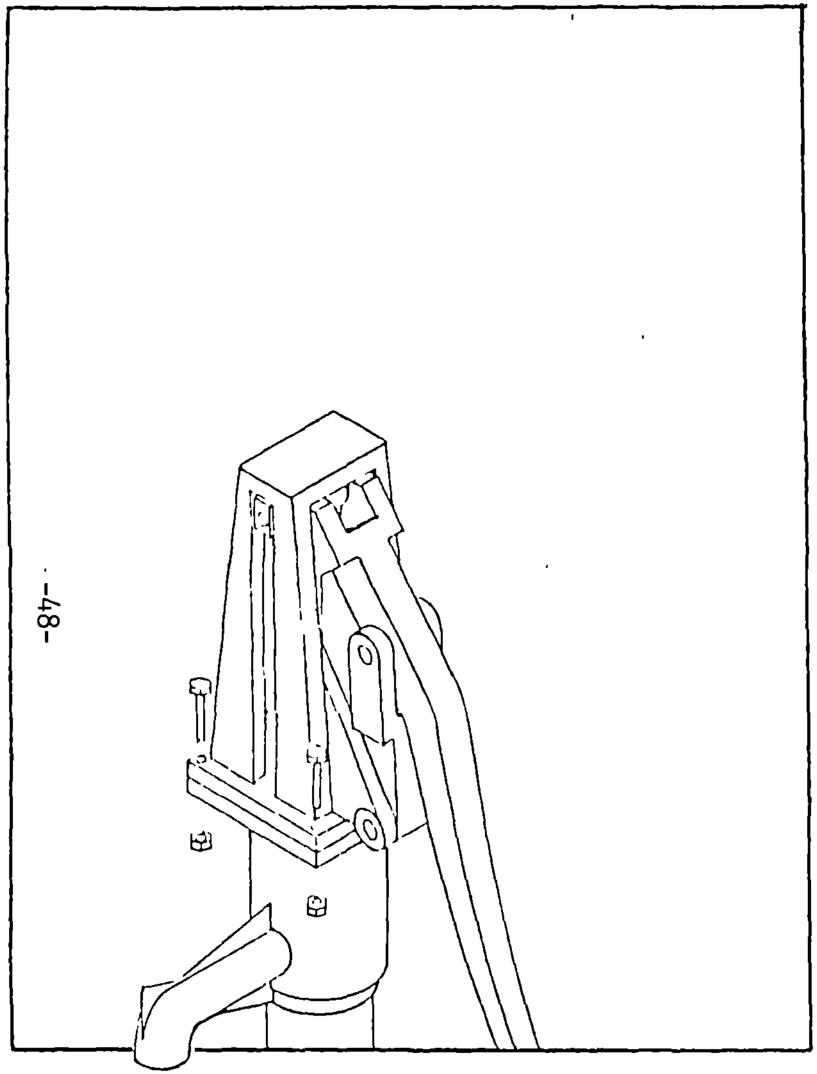
Durante el proceso de manufactura se espera una guía técnica del liderazgo para incrementar los niveles de calidad en las operaciones de fundición y control de calidad.

En la etapa de la instalación, personal de la contra-parte recibirá entrenamiento en la construcción apropriada, instalación y procedimientos de mantenimiento, beneficios generales potenciales incluyendo la generación de empleo local, reducción de importaciones de alto costo y transferencias de conocimientos técnicos valiosos.



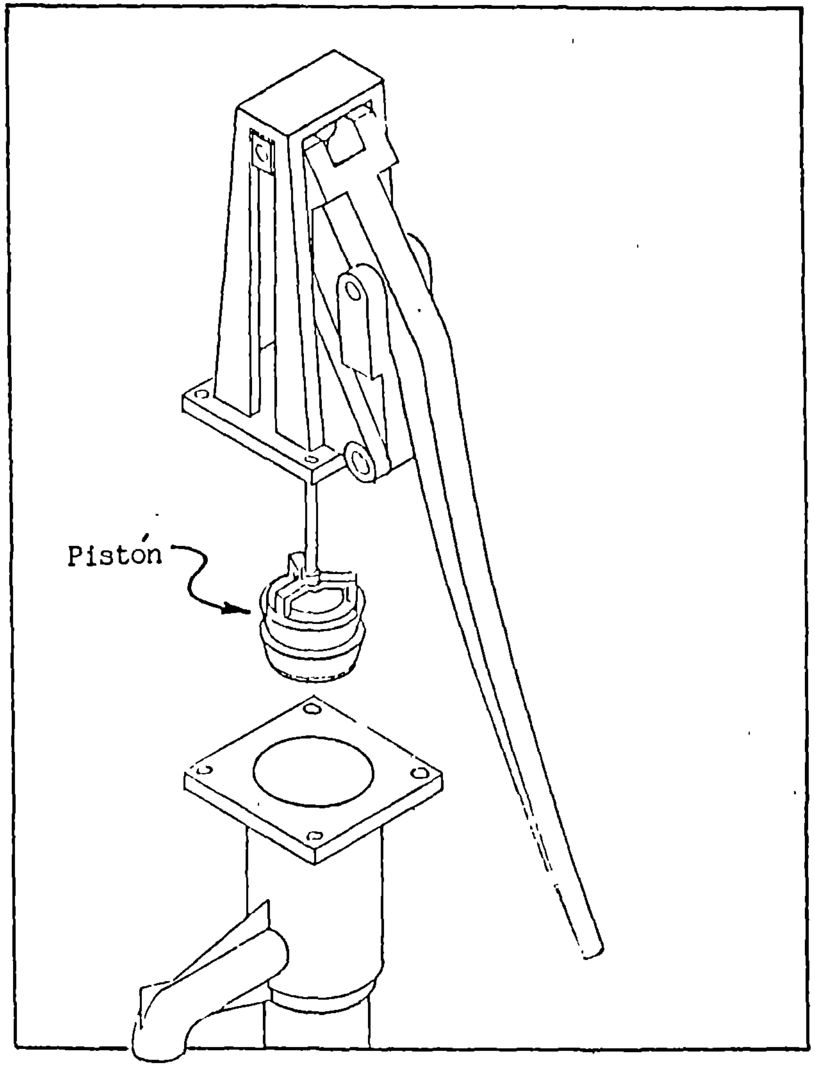


Lubrique los pasadores de acoplamiento o conectores antes de insertarlos. No use martillo para instalarlos. Inserte los pasadores con la mano.

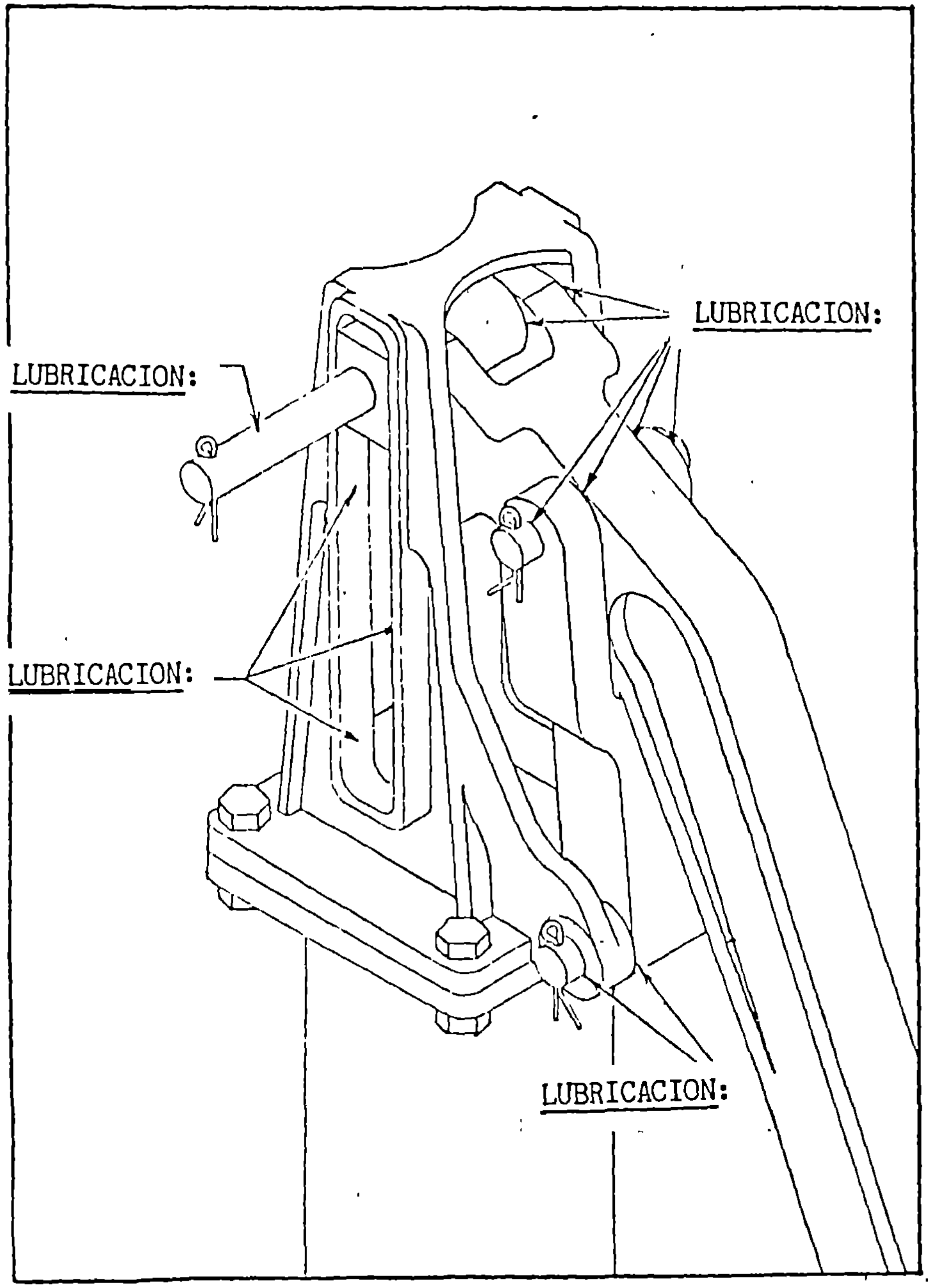


REEMPLAZO DE COPA DE CUERO

Remueva los cuatro tornillos manteniendo la bomba en posición normal.



Levante la cabeza de la bomba y separela del cuerpo de la misma.



LUBRICACION:

Para esegurar una vida larga de su bomba, varias partes necesitan ser lubricadas semanalmente. Estas partes son las siguientes:

1. El carril o guía por donde deslizan los bloques.

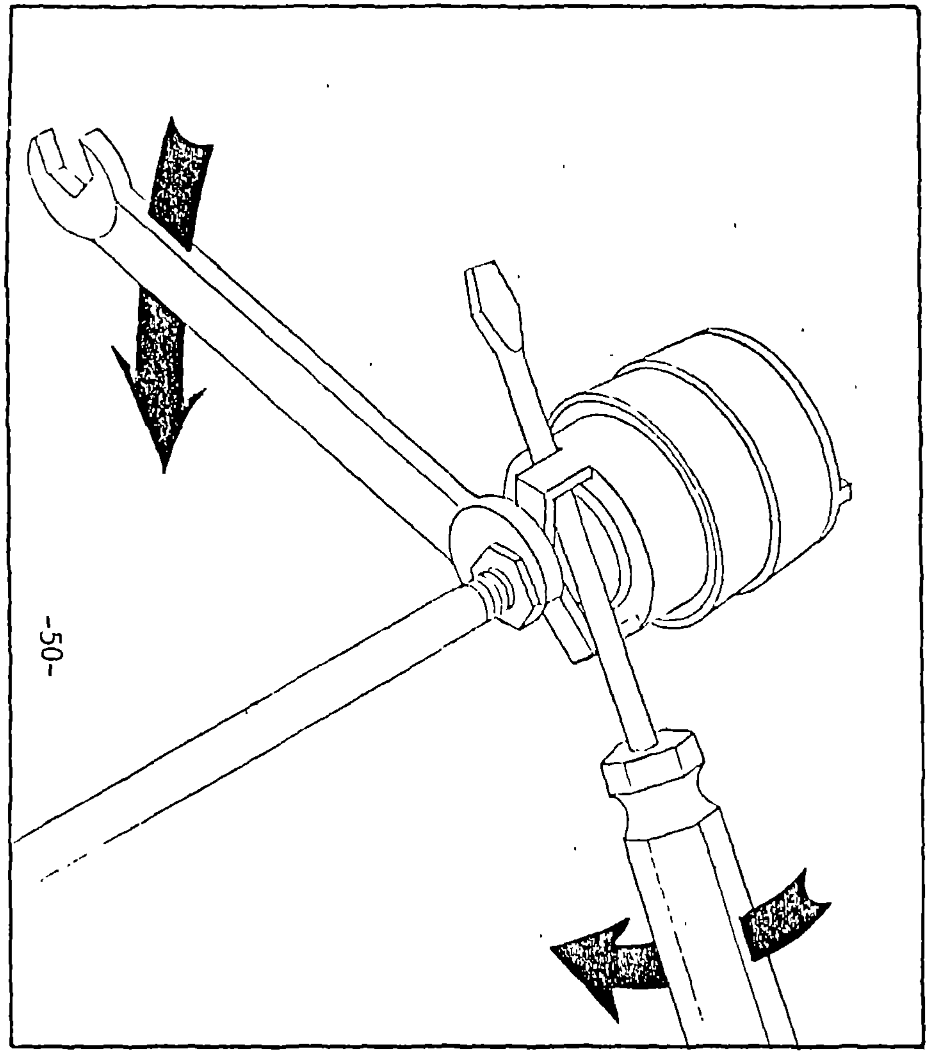
2. La varilla y pasadores

3. La manivela o palanca, maneral y pasador.

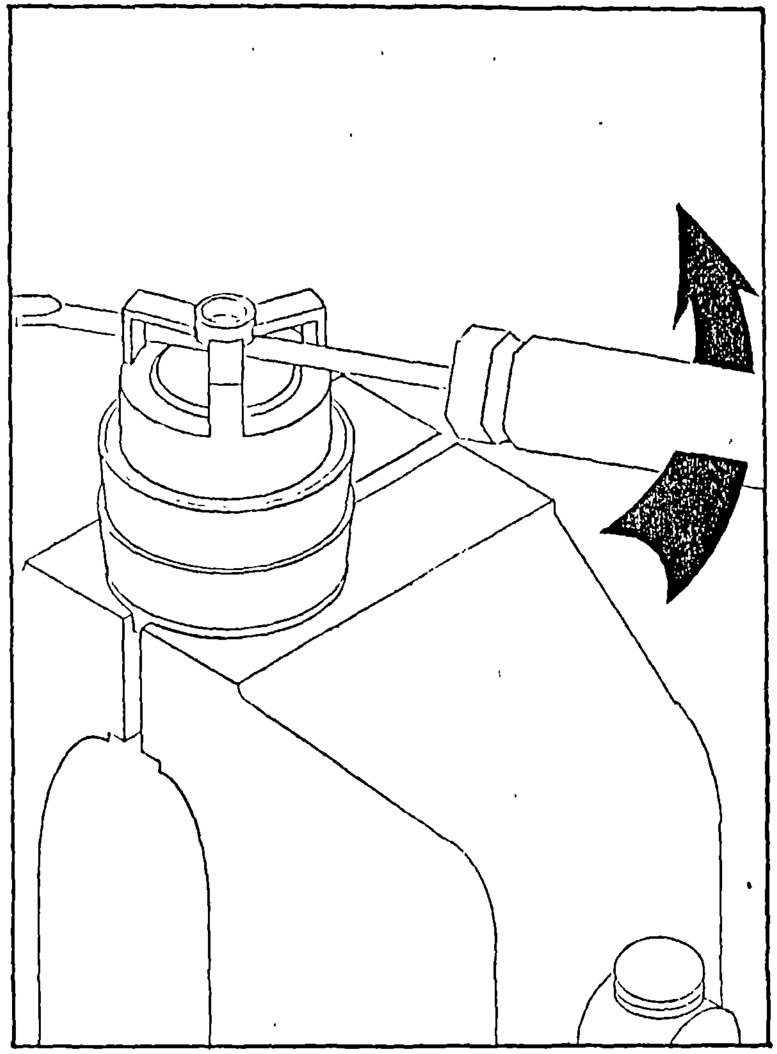
4. La pieza que permite el movimiento a la palanca, la que está en forma de herradura y los pasadores de la parte superior de la bomba (cabeza).

Ninguna pieza dentro de la bomba necesita ser lubricada.

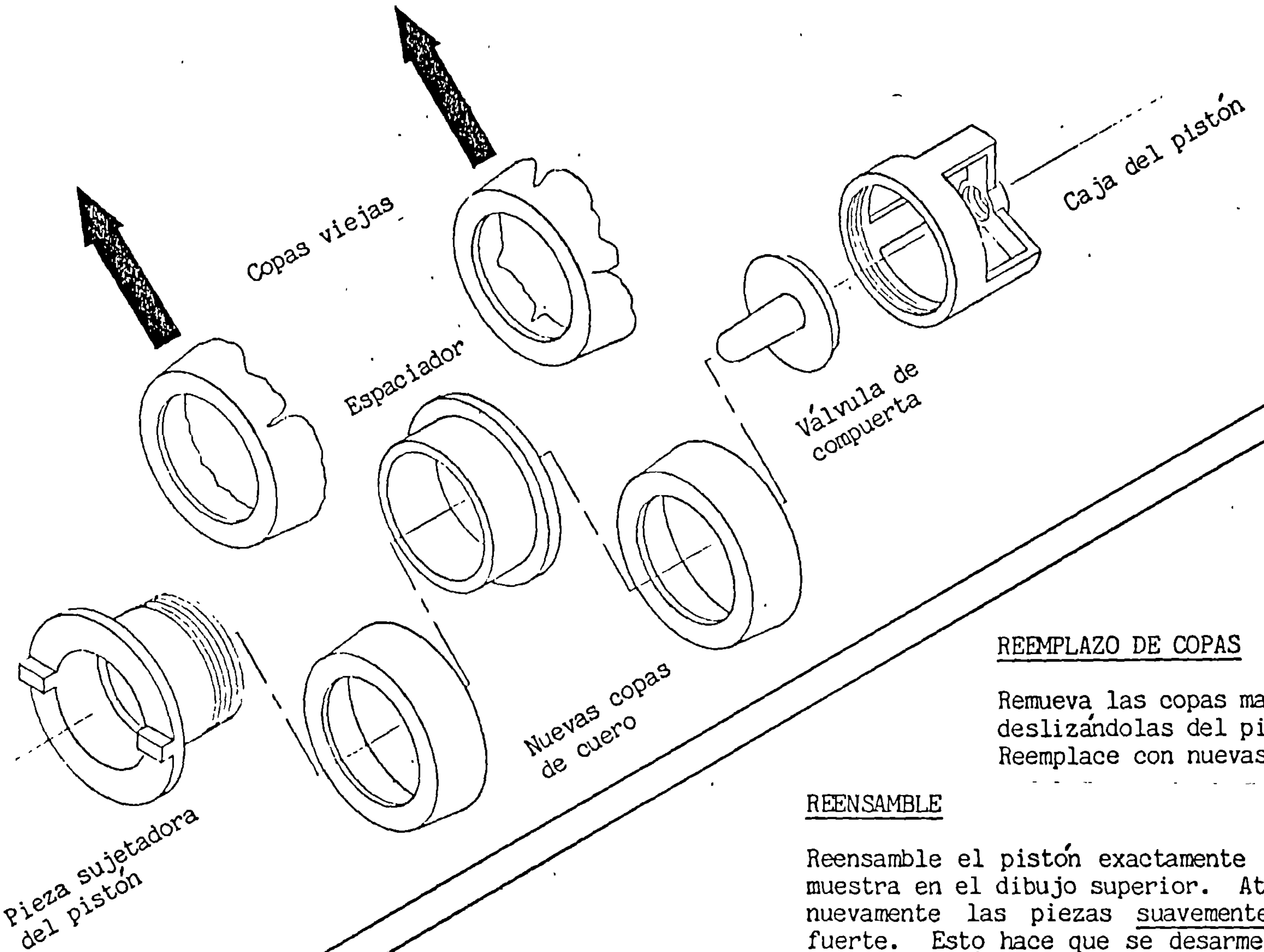
*Cuando los pasadores sean removidos por alguna razón, éstos deben ser lubricados.



Las piezas de bronce del pistón que sujetan las copas de cuero deben ser desatornilladas y también la varilla debe ser desatornillada del pistón.



Al desatornillar el pistón utilice una llave como muestra la figura.

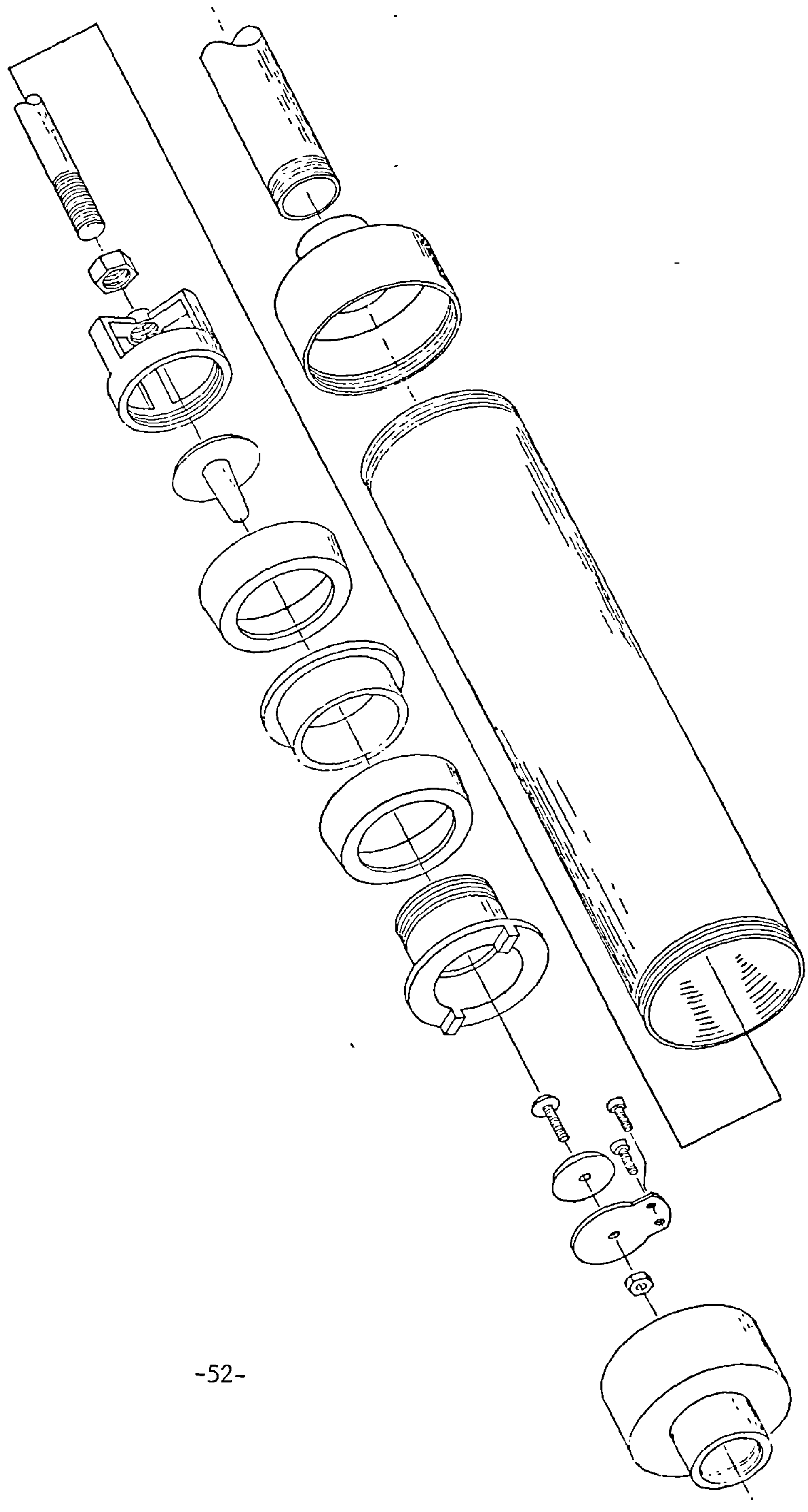


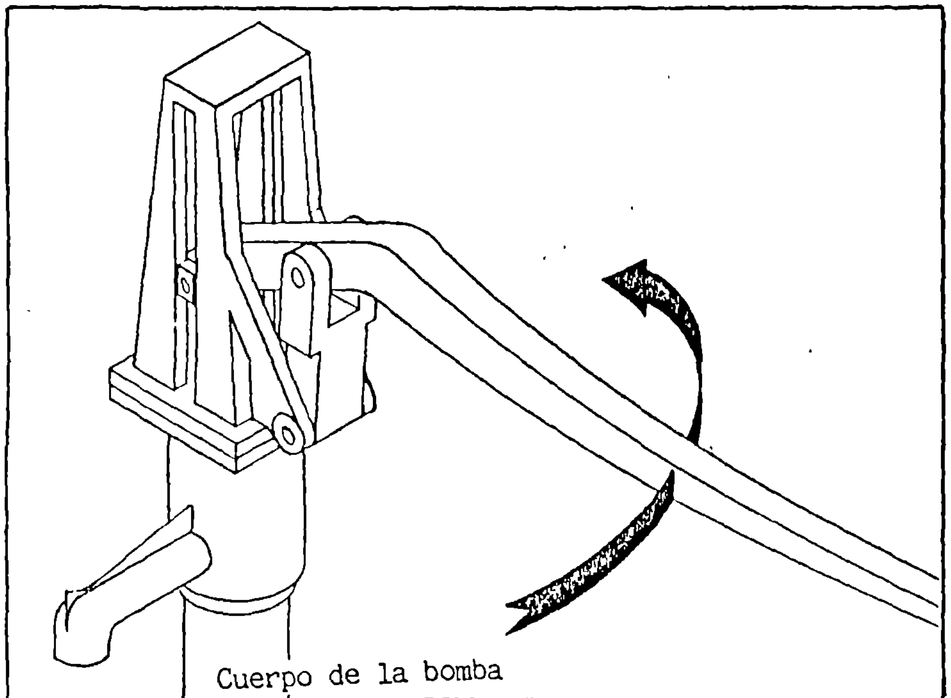
REEMPLAZO DE COPAS

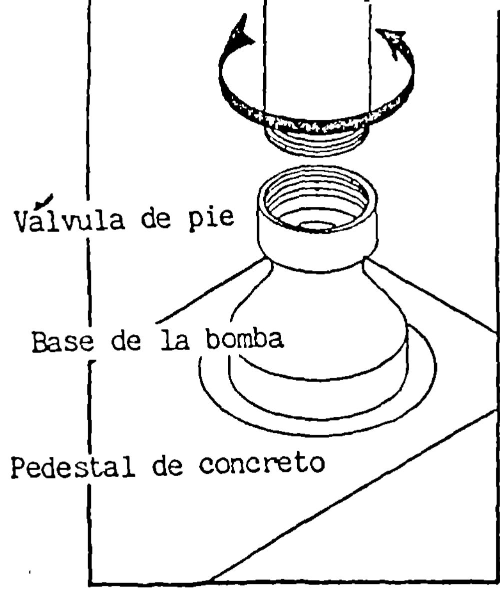
Remueva las copas malas deslizándolas del pistón. Reemplace con nuevas copas.

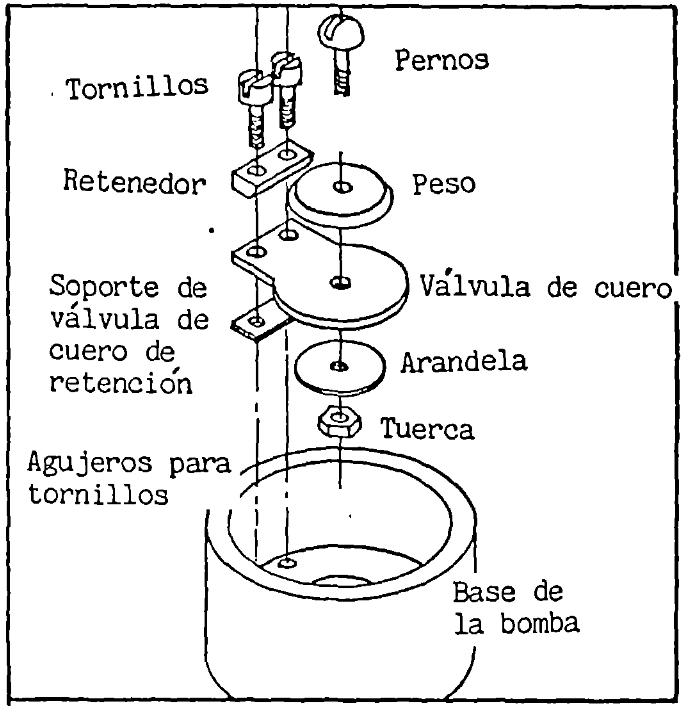
REENSAMBLE

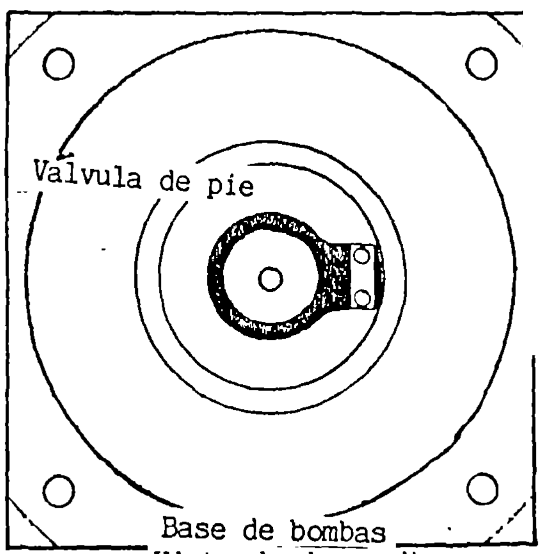
Reensamble el pistón exactamente como se muestra en el dibujo superior. Atornille nuevamente las piezas suavemente y no fuerte. Esto hace que se desarme facilmente la próxima vez. Asegúrese que la tuerca de seguridad esté firmemente instalada a la varilla.











Base de bombas
Vista desde arriba

A. Desatornille el cuerpo de la bomba de la base de la misma. Si no se dispone de una herramienta grande, entonces, el maneral o palanca puede ser usado para separar las piezas.

B. Reemplace la vieja valvula de retencion de cuero. Limpie cualquier aceite o suciedad que encuentre. Arme como muestra la figura.

C. La valvula reensamblada debe estar centrada como se muestra en la figura superior.

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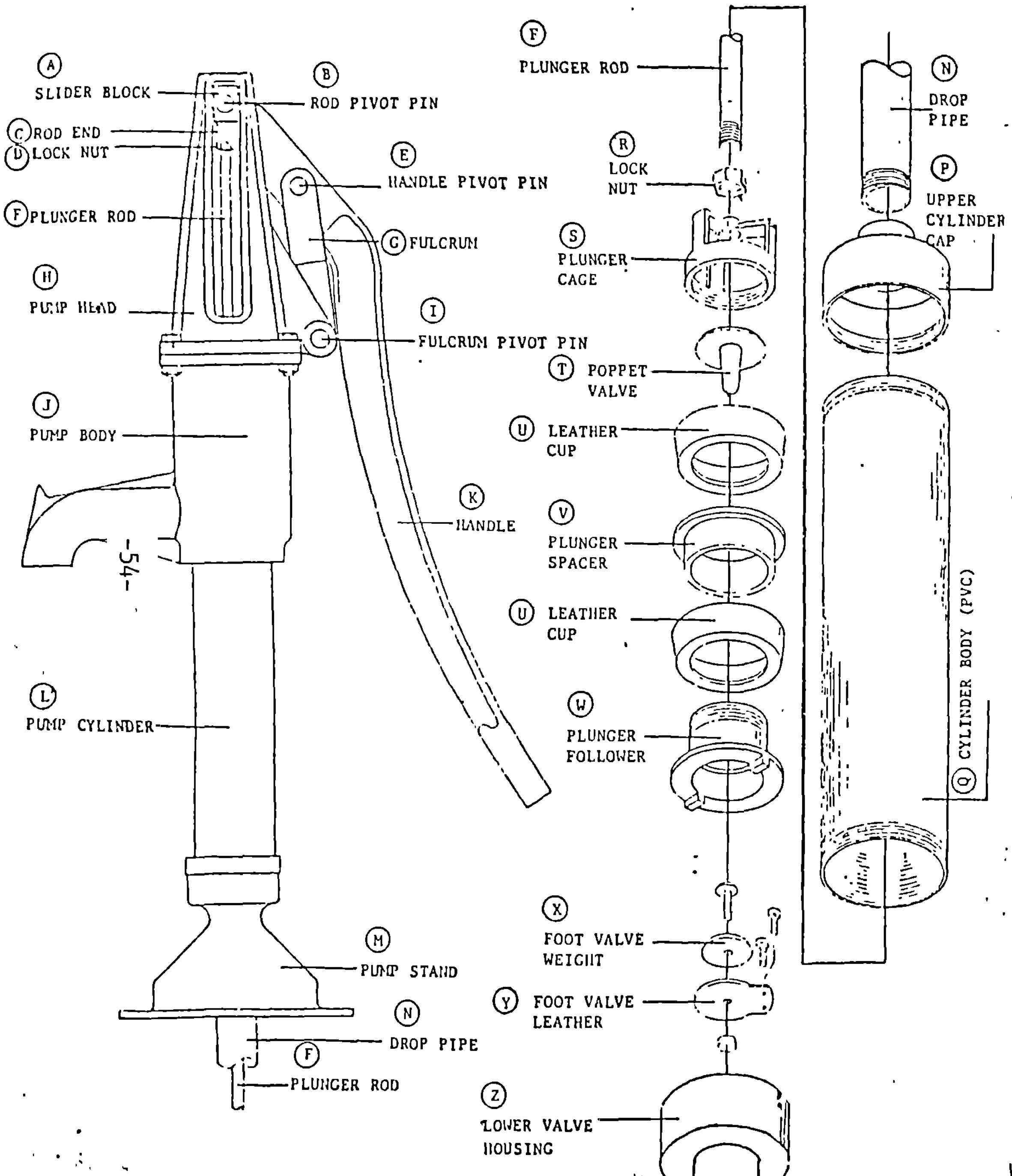

DATE	WORN PARTS	COMMENTS

APPENDIX C

EQUIPMENT, MATERIALS AND SUPPLIES DONATED TO THE GOVERNMENT OF HONDURAS

The following equipment, materials and supplies were donated to The Ministry of Health in Honduras during the course of Phase II activities. The following list includes materials and supplies donated in addition to the cement, drop pipe, rod and other materials used for the installation of the hand pumps.

Chemicals for Bacteria Tests (Millipore)

96 MF ENDO Ampoules
100 Petri Dishes
100 Sterile Petri Filters

Chemicals for Water Quality Analysis (HACH)

FerroVer Iron Reagent, 25 ML (100 powder pillows)
Brom Thymol Blue Indicator Solution (118 ML)
Nessler Reagent APHA (118 ML)
Chloride 2 Indicator (100 powder pillows)
Chloride Titrant (118 ML)
Univer 3 (100 powder pillows)
Hardness 3 Solution (118 ML)
Nitra Ver 5 (100 powder pillows)
Nitra Ver 3 (100 powder pillows)
Phos Ver 3 (100 powder pillows)
Demineralizer Bottle (6 oz)
Demineralizer Resin (113 g)
Thermometer, Double Scale

Tools and Equipment

8	screwdrivers
8	pliers
8	6" adjustable wrenches
2	36" pipe wrenches
1	pipe cutter
1	hack saw
5	3 meter measuring tapes
2	30 meter measuring tape
4	hand levels
2	hammers
2	concrete floats
3	plumb bobs

Spares and Other Supplies

2	Cole-Parmer Chlorine Residual Test Kits
100 lbs	Hth Chlorine powder
100	leather flapper valves
200	leather cups
600	zinc-plated cotter pins
30 lbs	grease
4	oil cans
30 rolls	teflon pipe tape
10 sets	fulcrum pins
3	clipboards

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Atlanta, Georgia 30332

SITE INDEX SHEET BAJAMAR

SITE NAME	TYPE	PUMP #	DATE INSTALLED	TYPE OF WELL	DEPTH (ft)	NO. OF PUMP USEI (families)
1. Carmela Saravia	AID-SW	1	3-19-82	Driven	13	5
2. Pedro Reyes	AID-SW	10	4-16-82	Driven	13	5
3. Mariana de Fernandez	AID-SW	17	4-19-82	Driven	11	5
4. Cecilia de Fernandez	AID-SW	25	4-21-82	Driven	11	7
5. Senovia Estrada	AID-SW	18	4-26-82	Driven	11	7
6. Anastasia de Bernardes	AID-SW	19	4-26-82	Driven	11	7
7. Horacio Colon	AID-SW	11	5-15-82	Driven	11	5
8. Antonio Colon	AID-SW	8	4-19-82 Relocated 7-15-82	Driven	11	5
9. Eustacio Tomas	Dempster	D1	6-23-82	Driven	11	12
10. Fuastino Ramos	Dempster	D2	8-5-82	Driven	9	6
11. Carlos Romero	Dempster	D3	9-82	Tube	26	8
12. Teodoro Avila	Dempster	D4	9-82	Tube	42	6
13. Santiago Lizandro Fjardo	Dempster	D5	9-82	Tube	44	7

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SITE INDEX SHEET TRAVESIA

SITE NAME	TYPE	PUMP #	DATE INSTALLED	TYPE OF WELL	DEPTH (ft)	NO. OF PUMP USE[illegible] (families)
1. Reyes Bonilla	AID-SW	2	3-19-82	Driven	15	5
2. Luis Moreira	AID-SW	16	4-26-82	Driven	11	6
3. Asario Mariano	AID-SW	24	4-26-82	Driven	11	6
4. Exequiel Mariano	AID-SW	5	5-4-82	Driven	11	6
5. Froylan Lamber	AID-SW	15	5-1-82	Driven	11	7
6. Escuela Miguel Paz	AID-SW	13	5-28-82	Driven	13	100 childr-
7. Norberto Morales	AID-SW	88	6-29-82	Driven	11	6
8. Chifia	AID-SW	23	7-8-82	Driven	11	6
9. Alberto Lamber	Dempster	D2	8-9-82	Driven	13	7
10. Valentin Arzo	Dempster	D1	8-2-82	Driven	11	6

SITE INDEX SHEET LA LIMA

SITE NAME	TYPE	PUMP #	DATE INSTALLED	TYPE OF WELL	DEPTH (ft)	NO. OF PUMP USEF (families)
1. Clemente Ortiz	AID-SW	3	3-22-82	Driven	42	15
2. Thomas Rivera/ Santos Vallavares	AID-SW	14	3-28-82	Driven	62	15
3. Blanca Lidia Barahona	AID-SW	21	4-6-82	Driven	38	23
4. Graciela Lima	AID-SW	4	4-14-82	Driven	48	22
5. Mabel Maria Escobar	AID-SW	9	4-16-82	Driven	54	25
6. Teodora Osorio	AID-SW	12	4-19-82	Driven	48	28
7. Rutilia Hernandez	AID-SW	6	4-18-82	Driven	56	25
8. Paula Morales	AID-SW	22 46	4-24-82 7-12-82	Driven	44	18
9. Marcela Escalante/ Maria dela Cruz Escalante	AID-SW	22	7-18-82	Driven	38	8
10. Carlos Lagos	Dempster	D1	7-21-82	Driven	48	10
11. Arturo Ramos	Dempster	D2	7-17-82	Driven	35	20
12. Juan Ramos	Dempster	D3	7-24-82	Driven	38	20
13. Thomas Campos	Sanpar	S1	7-12-82	Driven	41	20
14. Juan Pastora	Sanpar	S2	7-12-82	Driven	39	18
15. David Espinoza/ Ramon Mantaya	Dempster	D4	9-82	Tube	36	30
16. Antonio Portillo	Dempster	D5	9-82	Tube	38	20
17. Ambrosio Ramos	Dempster	D6	9-82	Tube	36	36
18. Francisco Osorto	AID-SW	7	10-82	Driven	10	15

Georgia Institute of Technology
ENGINEERING EXPERIMENT STATION
Atlanta, Georgia 30332

SITE INDEX SHEET COMAYAGUA

SITE NAME	TYPE	AID PUMP #	DATE INSTALLED	TYPE OF WELL	DEPTH (ft)	NO. OF PUMP USER (families)
1. Escuela Palmeiola	AID-SW	3	5-27-82	Excavated	37	14
	Sanpar		5-27-82	Excavated	37	
2. San Nicolas - carretera	AID-DW	14	5-26-82	Excavated	33	12
3. San Nicolas-campo balompie	AID-DW	8	5-24-82	Excavated	40	20
	Dempster		5-24-82	Excavated	40	86 childr
4. San Nicolas-escuela	AID-DW	19/151	5-25-82	Excavated	49	19
5. San Nicolas - abajo	AID-DW	5/152	5-25-82	Excavated	34	4
	Sanpar		5-25-82	Excavated	34	
6. Carretera-frente aldeas sos	AID-DW	12	5-28-82	Excavated	54	13
	Dempster		1-28-83	Excavated	54	
7. aldeas sos - taller	AID-DW	11	5-27-82	Excavated	48	12
8. San Jose-Villa San Antonio	AID-DW	6	5-13-82	Excavated	63	13
9. Canas	AID-DW	-	4-2-83	Excavated	39	20
10. San Isidro	Dempster	-	4-21-83	Excavated	43	7

APPENDIX E

Log Book Sample

Georgia Institute of Technology
ENGINEERING EXPERIMENT STATION
ATLANTA, GEORGIA 30332

SITE DATA SHEET

PUMP TYPE AID-SW # 1

LOCATION Carmela Saravia
Barrio Contarrana - Baja Mar

PROMOTER Carlos Hernandez

CARETAKER Pedro Reyes

WELL DATA

WELL TYPE Driven

DIAMETER (~~FT/M~~) 1¼" / ______ DEPTH (FT/M) 13 / 4 H_2O @ 10'

EXISTING STRUCTURE 8' □ concrete pad w̄ sub grade chamber for cylinder access – replaces broken Monitor

ESTIMATED USAGE 5 families

INSTALLATION DATE 19 / March /82

DISINFECTION DATE 19 / March /82

CHEMICAL USED Hth 30% QTY wash

CHLORINE RESIDUAL TEST DATE 29 / March /82 RESULTS <.2 (visible pin[redacted]

BACTERIOLOGICAL TEST DATE ___/______/82 RESULTS 0

LABORATORIO ANALISIS DE AGUA
REGION DE SALUD No.3
MINISTERIO DE SALUD PUBLICA
SAN PEDRO SULA

Tipo de Análisis **QUIMICO Y BACTERIOLOGICO** Lugar y fecha de recolección de muestra de agua **BAJAMAR POZO # 1** ? date

Hora recolección de muestra **12 PM.**

Nombre vecino mas cercano **LUCIANA MARTINEZ**

Pozo con bomba **DEMSTER** Pozo sin bomba ______ Acueducto ______

Indique cualquier medio de contaminación cercano ______

Temp.Amb. ______ Temp. Agua ______ Profundidad Total ______

Profundidad Nivel de agua ______ Profundiad Agua ______

Diámetro interior del pozo ______

RESULTADO ANALISIS QUIMICO

	PH.	O_2 Mg/L	SO_4 Mg/L	Ortho Fosfato Mg/L	NO_2 Mg/L	NO_3 Mg/L	Fe Mg/L	NaCL Mg/L	Mn Mg/L	D.Ch Mg/L	D.T Mg/L	Mg MG/L	Mg/L
	7.3						0.1	250		17			0.2
OMS Max Des	7.0 8.5		200				0.1	330	0.05	25	100	30	
Max Adm	6.5-9.2		400			45	1.0	990	0.5	200	500	150	

OBSERVACIONES **EL AGUA EN REFERENCIA QUIMICAMENTE ES APTA PARA EL CONSUMO HUMANO.**

RESULTADO ANALISIS BACTERIOLOGICO ANTES DE APLICACION H.T.H.

Cantidad de agua filtrada ______ Hora y fecha ______
Cantidad de colonias encontradas ______
Coliformes totales /100 Ml ______
OBSERVACIONES: ______

RESULTADO ANALISIS BACTERIOLOLICO DESPUES DE LA APLICACION H.T.H.

Cantidad de agua filtrada **25 ml.** 0 Hora y fecha ______
Cantidad de colonias encontradas 0
Coliformes totales /100 Ml
OBSERVACIONES **EL AGUA EN REFERENCIA ES APTA PARA EL CONSUMO HUMANO**

ANALISTA
VICTOR MANUEL PALACIOS.

NOTA: ______

PUMP LOG SHEET

DATE	?	DESCRIPTION/REMEDY
19 Marzo		En esta fecha fue instalada la Bomba sobre
		la infraestructura para una bomba Dempster
26 Marzo		No ha exsistido problemas de funcionami
26 marzo		En esta fecha se descontamino con HTH
28 Marzo		El (HTH) Hipoclorito de Calcio desgasto el
	Y	por lo cual se le instalo otro nuevo
4 Abril		No ha exsistido problemas de funcionami
11 Abril		No ha tenido problemas de funcionamien
18 Abril		No ha tenido problemas de funcionamien
25 Abril		No ha tenido problemas de funcionamie
5 Mayo		No ha tenido problemas de funcionamien
14 Mayo		No ha tenido problemas de funcionamie
21 Mayo		No ha tenido problemas de funcionamie
28 Mayo		No ha tenido problemas de funcionamie
4 Junio		No ha tenido problemas de funcionamie
11 Junio		No ha tenido problemas de funcionamien
18 Junio		No ha tenido problemas de funcionami
25 Junio		No ha tenido problemas de funcionami
30 Junio		No ha tenido Problemas de funcionamie
7 Julio		No ha tenido Problemas de funcionamie
14 Julio		No ha tenido Problemas de funcionami
21 Julio		No ha tenido Problemas de funcionam
27 Julio		falta grasa, pero funciona sin mayor pro
4 Agosto		Se engraso las partes que faltaban no
		tenido problemas de funcionamiento
11 Agosto		No ha tenido problemas de funcio

PUMP LOG SHEET

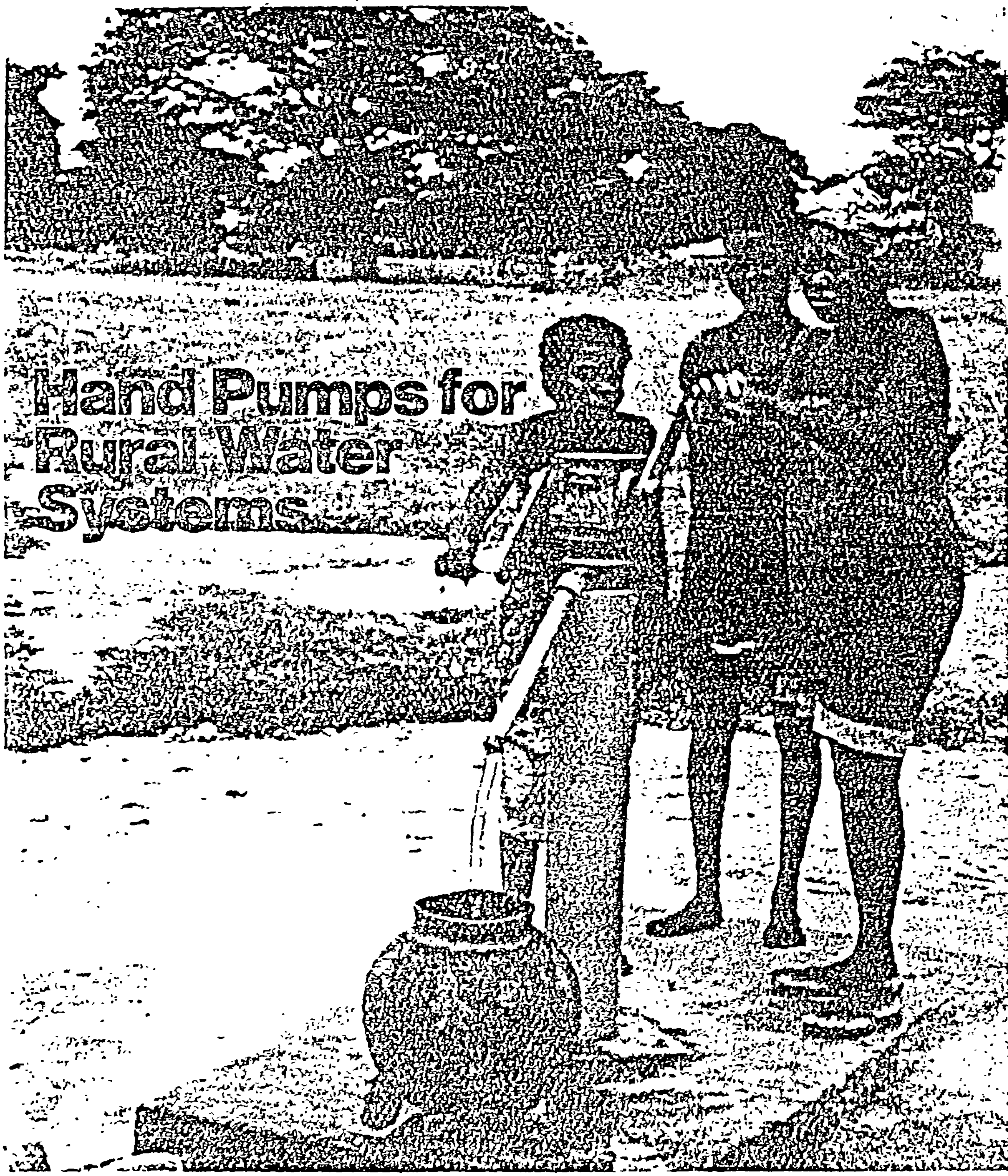
DATE	?	DESCRIPTION/REMEDY
18 Agosto		No ha tenido problemas de funcionamie
25 Agosto		No ha tenido problemas de funcionamiento
1 Sept		No ha tenido problemas de funcionami
8 Sept		No ha tenido problemas de funcionamie
14 Sept		No ha tenido problemas de funcionamie
21 Sept		No ha tenido problemas de funcionam
28 Sept		No ha tenido problemas de funcionamie
3 Octub.	J. E.	No ha tenido problemas de funcionami
		solo chavetas se quiebran rapido por
		agujeros quedan muy ajustados

PUMP LOG SHEET

DATE	?	DESCRIPTION/REMEDY
		Pump #1
19 March		Pump installed and well shock chlorinated
29 March		Chlorine residual tested.
27 April		No problems.
5 May		N.P.
19 May		N.P. - needs grease
25 May		N.P.
15 July		N.P.
28 July		N.P. - needs grease - new base
2,3,5,6 Aug		N.P. -
9,10,12		N.P.
7 Oct		N.P. Well greased, water on first stroke, canal broken access hatch still not sealed.

APPENDIX F

Handpump literature



ROBBINS
MYERS

Performance You Can Depend On

When you are in a remote environment where pumping clean water is a means to survival, the pump you select has got to measure up to your expectations.

This is a situation that calls for the unique design characteristics of a Robbins & Myers hand pump. Our pumps utilize a progressing cavity principle specifically engineered for long life and maximum dependability. The Robbins & Myers progressing cavity pump offers performance capabilities that simply are not available in conventional pumps.

SIMPLICITY OF DESIGN
Since there is only one moving part in the pumping elements, there is nothing to break down. The simple design eliminates problems often found in conventional hand pumps.

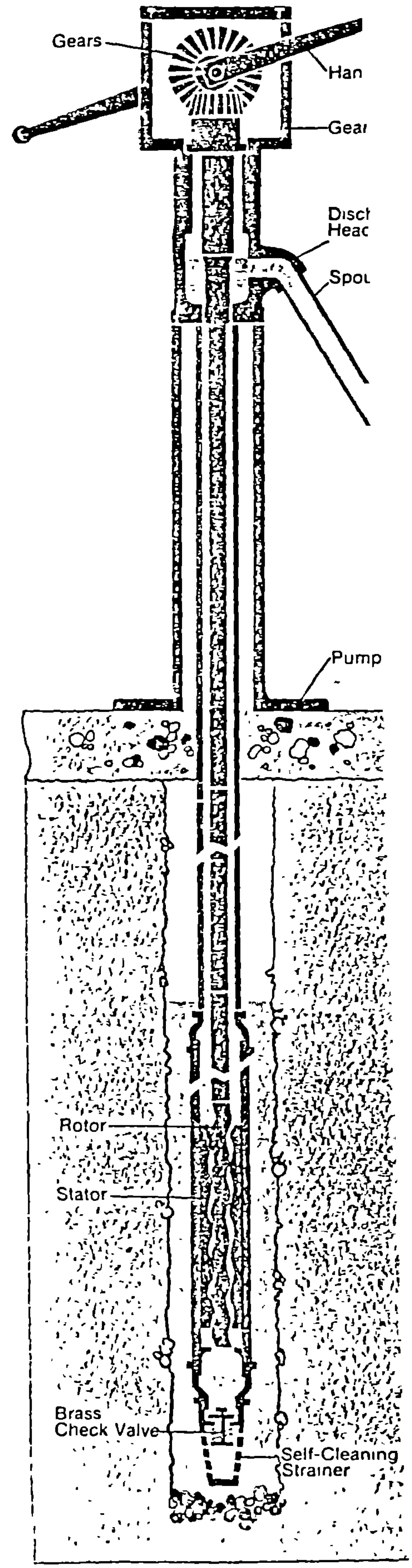
No stuffing boxes to cause contamination.
No packing to deteriorate.
No gaskets to replace.
No pins or pin bushings that can be destroyed.
No valves or valve seats to repair.
No cup leathers or cylinder seals to wear out.

POSITIVE DISPLACEMENT
The progressing cavity pump operates with a single screw-like helix rotor, turning eccentrically within a double helix stator, producing sealed cavities that are positive displacing and self priming.

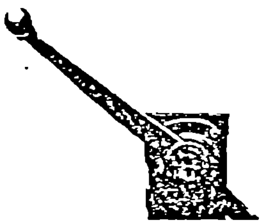
ABRASION RESISTANT
The stator is made of resilient material which allows passage of abrasive sand or silt particles without damage to the pumping elements. Test results showed more than 17 million liters of water were pumped with only a slight reduction in flow.

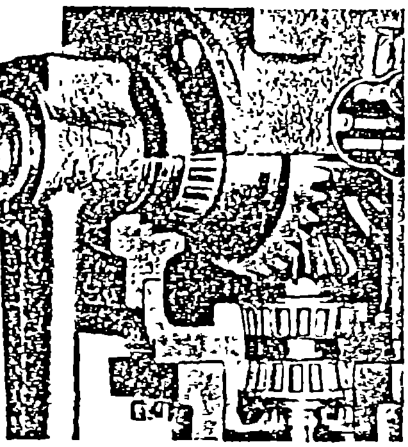
STEADY FLOW
Progressing cavity pumps deliver immediately when pumping action begins, with a steady, non-pulsating flow. There is no wasted motion. Every turn of the handle delivers water.

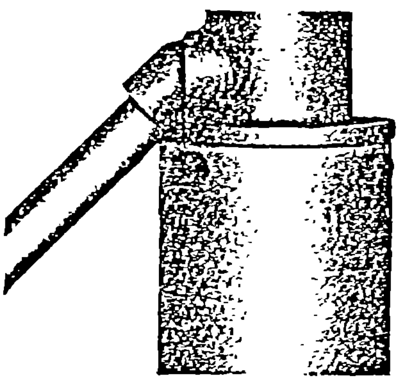
MINIMUM MAINTENANCE
Since there is nothing to break down, the Robbins & Myers hand pump is virtually maintenance free. The modular design simplifies preventative maintenance procedures that can add years of additional service.

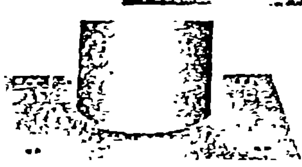


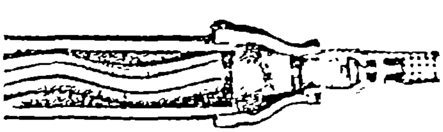
Special Features











HANDLES
of cast iron are double keyed to the gear box cross shaft and locked in place with a pilfer proof button head screw.

GEAR BOX
is heavy duty, incorporating a right angle gear arrangement in a rugged cast iron housing. Gears are machined and hardened, mounted on a high strength steel shaft. Tapered roller bearings are designed to support the water column and maintain precise gear alignment. Lubricant leakage is prevented by the sealed housing. The box is pre-packaged with long lasting grease for reduced maintenance.

DISCHARGE HEAD
is equipped with an anti-rotation device to prevent the possibility of unthreading the rod couplings by rotating in the wrong direction. The mechanical face seal guards against water leakage and eliminates packing maintenance. The design permits discharging to an elevated storage tank. The heavy duty cast iron housing with angled discharge spout prevents contaminated water from entering the well. Special socket head bolts are used throughout to minimize vandalism or pilferage.

PUMP STAND
with an inside diameter of 14cm permits placement directly over the well casing. Fabricated from heavy steel plate and pipe, and coated for rust prevention, it is engineered for long life in the mos rugged operating conditions.

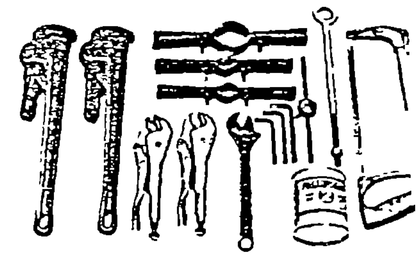
PUMPING ELEMENTS
are designed to provide years of trouble free operation. The rotor is machined from alloy steel and plated for additional abrasion resistance and longer life. The stator utilizes a special low water swell elastomer, permanently bonded to a steel tube.

FOOT VALVE
is made of brass with a strainer to prevent larger particles from entering the pump. It is designed to maintain maximum water leve in the pump.

DROP PIPE AND ROD
are galvanized for long lasting protection from corrosion.

Easy To Install

Because of its simple design principle, the Robbins & Myers hand pump is simple to install, which is a major consideration in remote regions. Our illustrated, fully detailed manual provides step-by-step instructions on installation, as well as operation and maintenance, to assure maximum performance. Proper installation prevents such problems as flooding, interrupted water delivery and unsanitary conditions.



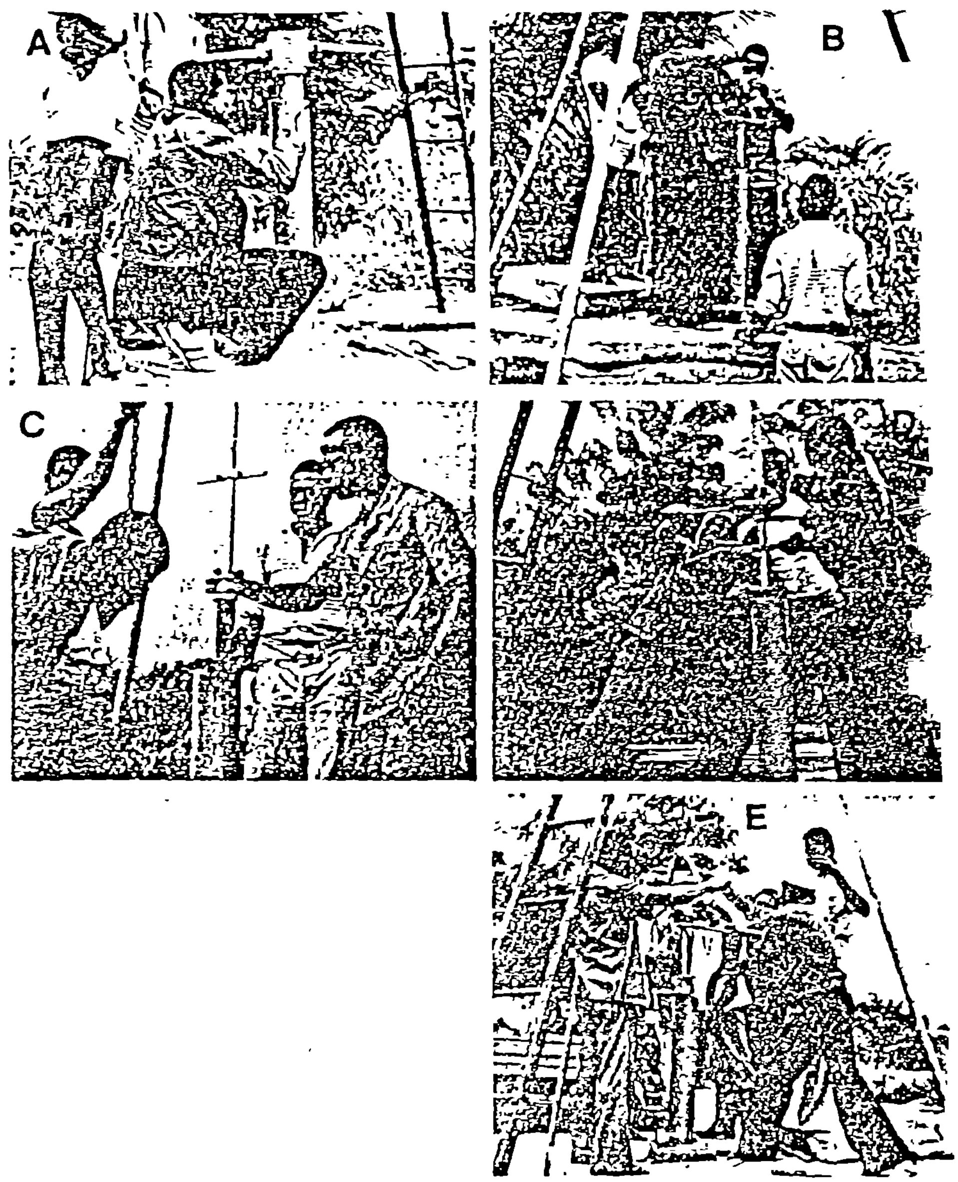
A - Remove drive assembly from pump stand.

B - With clamp on top, lower pump cylinder into pump stand.

C - Attach first section of pump rod and drop pipe to cylinder.

D - Add subsequent well extension assemblies.

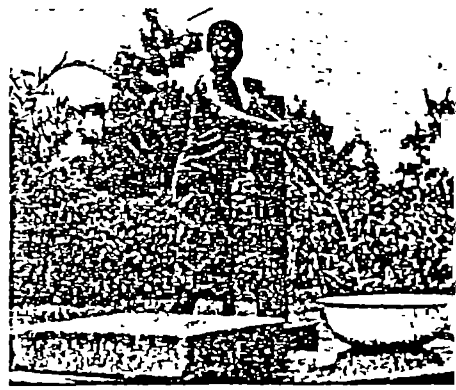
E - Lower drive assembly and attach last sections of pump rod and drop pipe.



More Economical

The Robbins & Myers hand pump is designed for low "total life cycle" cost. One of the most common mistakes in hand pump programs throughout the world has been selecting a pump solely on the basis of initial price. The resulting failure rates of 30% to 80% increase costs and defeat the primary objective of providing a dependable source of clean water. True cost is determined by realistically projecting replacement parts and maintenance costs over a ten to twenty year period, as well as the inestimable value of reliability.

The unique design of the Robbins & Myers hand pump provides years of maintenance-free service, making it one of the most cost effective methods of supplying water on the market today.



SPECIFICATIONS

Pump Type:
Progressing cavity, crank operated.

Capabilities
Can be used as lift or force pump without modifications Suitable for pumping to elevated storage tanks.

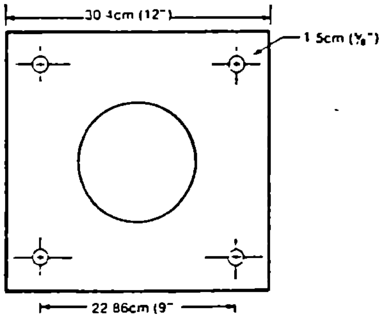
Models:
1V12 Single stage for lifts to 45m (150 ft.) One person operation (25cm handles)
2V12 Two stage for lifts to 90m (300 ft.) Two person operation (30cm handles)

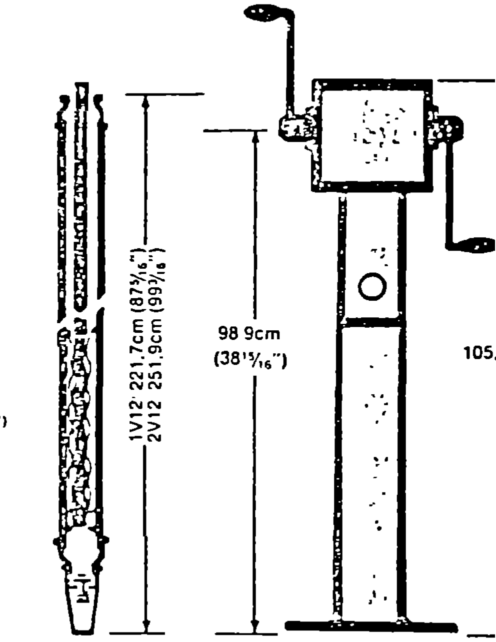
Turning force required on each handle:
Model 1V12: 3.6 kg. (8.5 lbs.) at 45 meters.
Model 2V12: 9 kg. (20 lbs.) at 90 meters.

3-Meter-Well Extension:
Drop pipe 3.18cm (1¼") diameter galvanized pipe
Pump rod 12.7mm (½") diameter steel rod with ½-13 threads.

Weight:
Pump stand & drive assembly 45.5kg (101 lbs.)
Pump cylinder — Model 1V12 16.5kg (36.7 lbs.)
Pump clyinder — Model 2V12 19.4kg (43 lbs.)
3m well extension 13kg (29 lbs.)

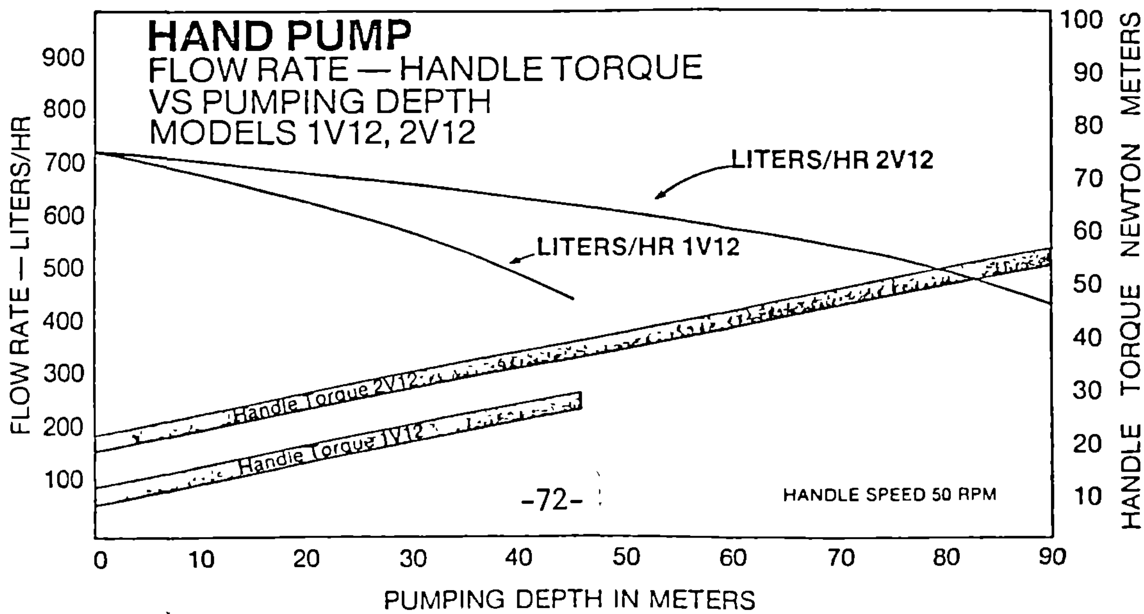
Well Diameters:
8cm diameter and larger.
Suitable for drilled or dug wells.





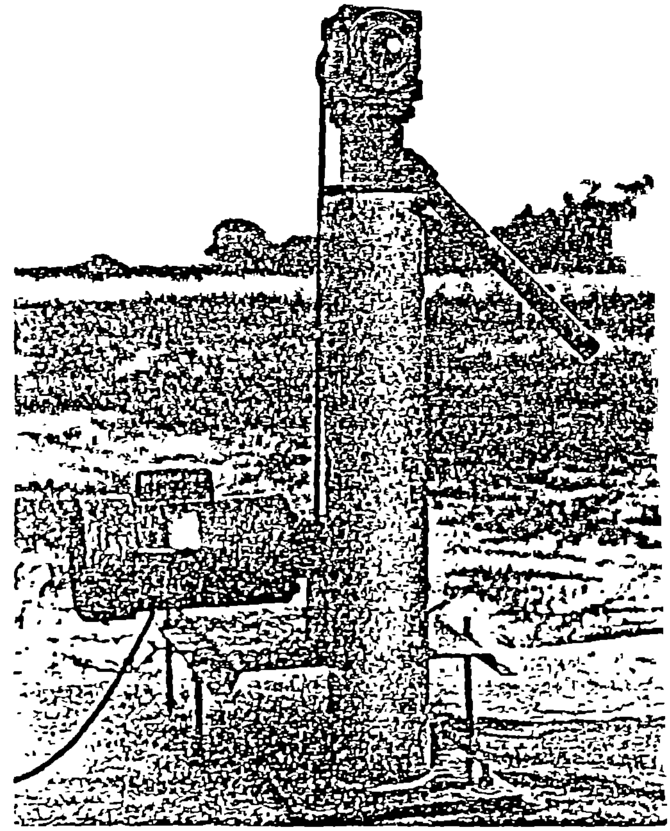
Pump Cylinder

Pump Stand



CONVERTS EASILY TO ALTERNATE POWER

The Robbins & Myers hand pump is designed to convert readily to alternative sources of power. Because we utilize a rotary motion instead of reciprocating action, the hand pump drive is particularly suited for use with an electric powered motor. Few other hand pumps offer such adaptability.



YOUR ASSURANCE OF QUALITY

Robbins & Myers progressing cavity pumps were pioneered in 1936. Our hand pumps are built to the same exacting standards and rigid quality control procedures as the pumps manufactured for diversified industrial use. We maintain one of the most extensive engineering laboratories in the industry, developing the technology to handle any type of fluid under wide ranging conditions. Our innovations in production include whirling-head rotor lathes, specially designed stator compounds for difficult fluids, and hardened tool steel internals, to name a few examples. Since we are constantly improving our product, we reserve the right to make engineering changes in the pump.

HOW TO ORDER

Robbins & Myers hand pumps are manufactured at the following locations. Replacement parts and components may also be ordered through these sources. You will find a complete parts list in the instruction manual.

Robbins & Myers, Inc.
1400 Winters Bank Tower
Dayton, Ohio 45423, USA
Phone (513) 222-2610
Telex 288-359, RM Corp. DTN

The Robbins & Myers Co. of Canada Ltd.
Brantford Ontario N3T 5N6 Canada
Phone (519) 752-5447
Telex 061-81131 R and M Btfd

6-80 - 2M - Ken Gasque and Associates Columbia S C

ROBBINS MYERS

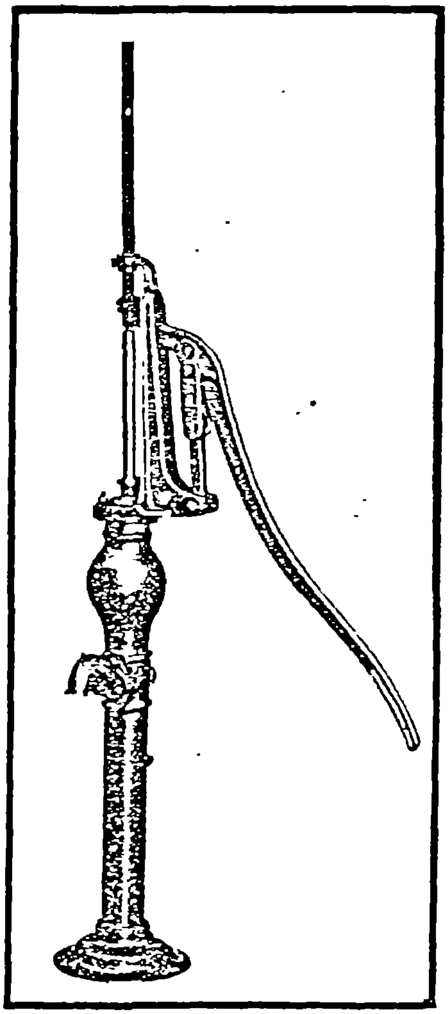
PUMPS and CYLINDERS

DEMPSTER®

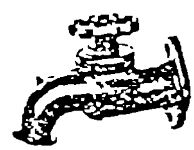
CONSTRUCTION

DATA SHEET 380·
ISSUE DATE 197

CAST IRON



Dempster hand and windmill pumps are adapted for wells of any depth. Neat in design and substantially built, equipped with a 4-bolt adjustable flanged top, extra long handles and heavy steel bearer pins. Tops fitted with stuffing box and packing for tight seal on the piston rod. 4-position handle adjustment for up to 10 inch stroke. Large capacity air chamber for smooth force pumping. Furnished with syphon or compression spout. Syphon spout furnished unless otherwise ordered. 2 x 1-1/4-inch suction bushing furnished with each pump.



MODEL 36
Compression Spout
Furnished at slight Additional Cost

MODEL 210F

MODEL 210F is a heavy-duty hand or windmill force pump. It has a 1-1/16-inch polished steel piston rod securely threaded to the flat bar. For wells of extreme depth, with large cylinders or continuous operation.

Type	Hand & Windmill
Suction Tapped	2 in
Piston Rod Threaded for,	
Rod	7/16 in.
Pipe	3/8 in
Tapping in Rear	1¼ in.
Approx Weight	71 lbs

MODEL 210F(CS) same as Model 210F except equipped with Model 36 Compression Spout

MODEL 2'

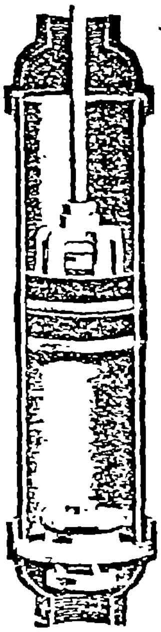
MODEL 226F is normal duty hand or windmill : pump. It has a 11/16 inch steel piston rod f. to the flat bar with a heavy cast set screw cor tion. For wells of shallow to moderate deptl normal farm and ranch operation.

Type	Hand & Windmil
Suction Tapped	2 in
Piston Rod Threaded for,	
Rod	7/16 in
Pipe	3/8 in.
Tapping in Rear	1¼ in.
Approx Weight	70 lbs.

MODEL 226F(CS) same as Model 226 F except equipped with Model 36 Compression Spout

DEMPSTER INDUSTRIES INC., Beatrice, Nebraska 68310 [402] 223-402

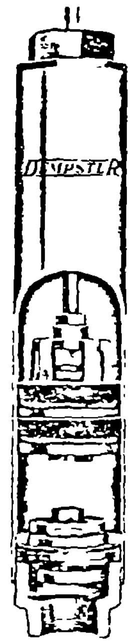
DEPENDABLE PUMP CYLINDERS



MODEL 81

Peerless Iron, Brass Lined – Brass Plunger and Check Valve

Brass-Lined Peerless Cylinder. A cylinder of recognized quality The shell is made of close-grained gray cast iron, into which is fitted heavy-gauge, seamless brass tubing. The ends of the tubing are flanged to hold the lining in place The bottom cap is fitted with the famous Dempster Peerless Check Valve. This Peerless cylinder is fitted with an all-brass plunger and check valve.



P.V.C. MODEL

Flush Cap – Brass Plunger and Check Valve

A lightweight cylinder with the s· plunger and check valve used in Model 81 A. The extremely smooth m: al is 25% more efficient than a sta ard cylinder, is completely non-co sive and highly abrasion resista Odorless and tasteless, this mate is approved for use in potable w systems. It is deposit-resistant non-electrolytic.

All Cylinders Tapped 1 1/4" Top and Bottom							
Inside Diam. and Shell Lgth.	Model 81	PVC Model	Length of Stroke In.	Capacity per Stroke Gals.	GPM @ 30 Strokes/min	Approx. Wt. Model 81	Approx Wt. PVC
2x12	2x12		6	.082	2.5	10	
2 1/2x12	2 1/2x12		6	.128	3.8	13	
3x12	3x12		6	.184	5.5	17	
2x16	2x16	2x16	10	.136	4.1	11	5
2 1/4x16	2 1/4x16		10	.172	5.2	13	
2 1/2x16	2 1/2x16	2 1/2x16	10	.213	6.4	14	7 1/2
3x16	3x16	3x16	10	.306	9.2	19	10

Model 1610

ALL-BRASS DEEP WELL CYLINDERS

with Spool or Ball Valves

Designed to withstand severe service in either shallow or deep wells. Valves are of extra strong, high-grade brass Lower cap is tapered so as to fit taper of check valve stub. Lower check is seated with a heavy leather packer. Spools used in plunger and check are leather faced. Top cap is threaded slightly larger than inside diameter of cylinder, making it possible to withdraw valves up through drop pipe without disturbing the cylinder. Specify spool or ball valve

				Pipe Size		Plunger	
Inside Diam.	Out-side Diam.	Lgth. Body	Lgth. Stroke	Top Cap	Bottom Cap	Thread Pin Size	Apx. Wt Each Lbs
1 7/8"	2 15/16"	24"	14"	2"	1 1/4"	5/8"	11 lbs
1 7/8"	2 15/16"	30"	20"	2"	1 1/4"	5/8"	12 lbs

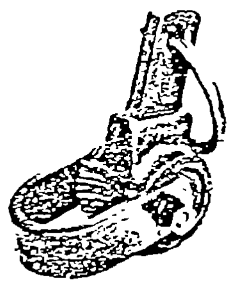
ALSO AVAILABLE IN 2-1/4" & 2-3/4" SIZES

SEE GENERAL CATALOG

PIPE CLEVISES

For Lifting, Lowering and Holding Pipe

MODEL 681

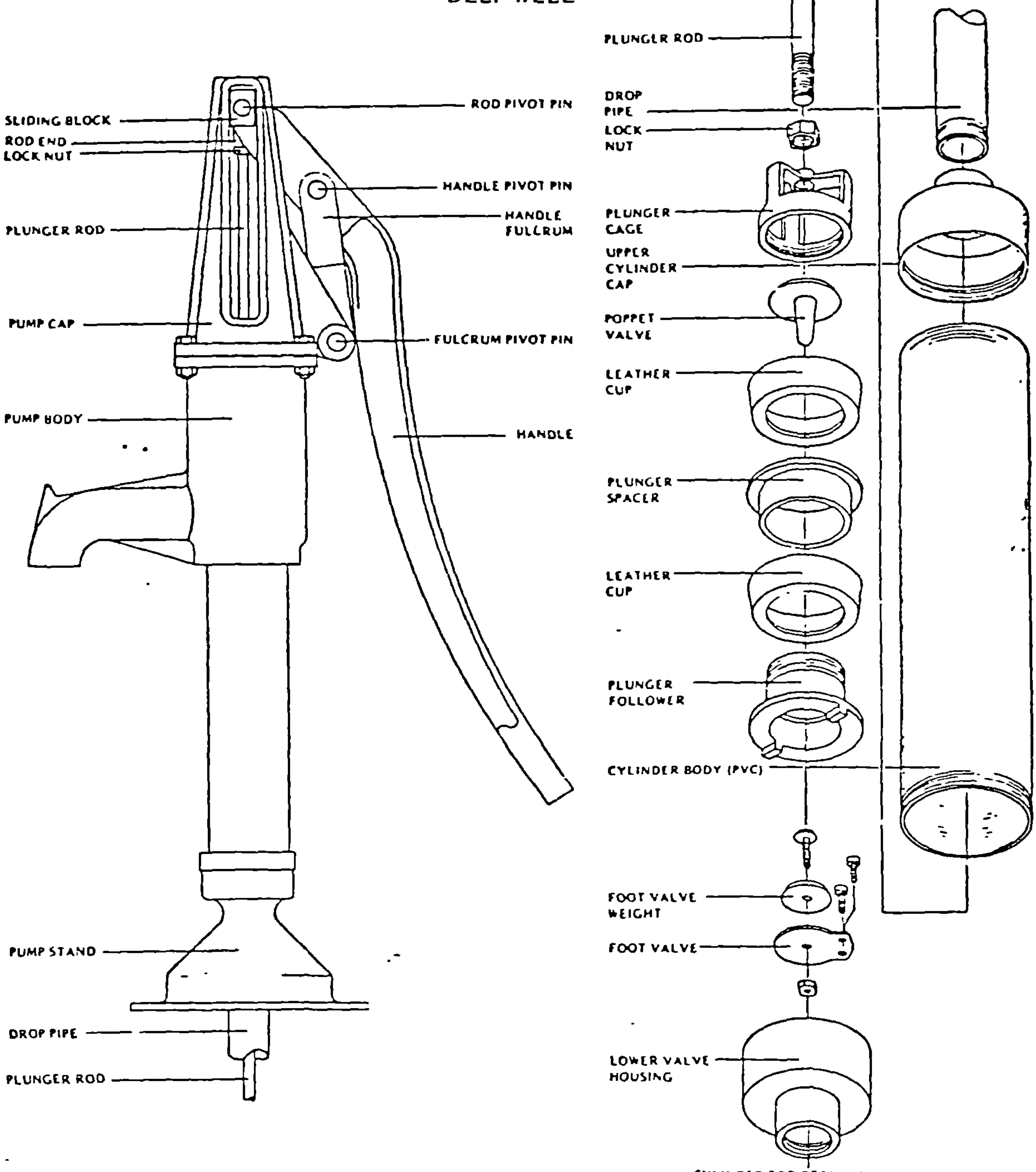


Model 681 is built for heavy service. Positive grip, will not slip Easy and quick to attach. Heavy corrugated eccentric dog. The heavier the load, the tighter it grips. Made in one size only for handling 1, 1¼, 1½ and 2-inch pipe Approx. weight 8 lbs.

More than 100 years of manufacturing, engineering and field experience go into the making of each Dempster pump.

Precision workmanship and highest quality materials go into each Dempster product—to give you more for your pump dollar A complete line of pumps, windmills, water systems and accessories—for farm, ranch or suburban home

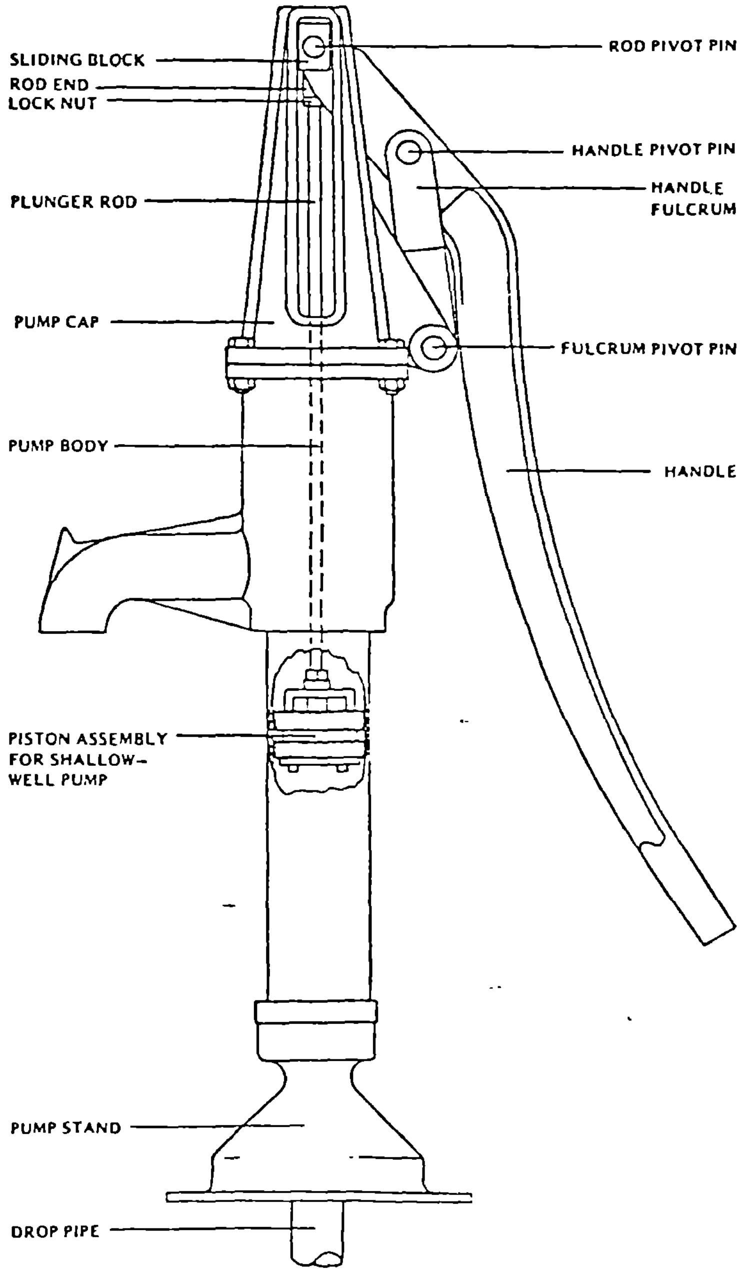
AID HAND–OPERATED WATER PUMP
DEEP WELL



CYLINDER FOR DEEP-WELL MODEL
SHALLOW-WELL MODEL HAS PISTON IN PUMP BODY (FOR WELLS LESS THAN 7–8 METERS IN DEPTH)

AID HAND–OPERATED WATER PUMP
SHALLOW WELL

(For Wells less than 7-8 meters in depth)



APPENDIX G

DISPOSITION OF PUMPS PRODUCED
UNDER PHASE I

SW	DW	STATUS
25	9	Installed at test sites under OTD 85
53	1	At MOH warehouse in San Pedro Sula
1		Presented to Dr. Benjamin Riveria, MSP.
1		Sent to Jay Morris, Deputy AID Administrator, Washington, D.C.
5	5	Sent to Choluteca for incorporation in the Swiss sponsored water project (COSUDE) with Ministry of Health.
	5	Given to World Relief for placement in new communities near Mocoron, Gracias a Dios. Nicaraguan refugees are being moved from Mocoron to the following nearbycommunities: Brus Laguna, Cocobila and others along theRio Patuca.
1	1	Being sent to Paul Cohen in AID (Health) Guatemala
1		(Along with shop drawings) Released to Orlando Paramo of SALUD pump manufacturing, Tegucigalpa. The SALUD pump is being utilized in the European Economic Community (EEC) Ministry of Health project of 2,000 pumps in the Department of Olancho.
1		(Along with shop drawings) Released to Mr. Coronado Henriquez E., Manager of COHEN, S. de R.L. foundry in Tegucigalpa. Mr. Henriquez has expressed interest several times in the pump and his manufacturing it.
1		Released to Efrain Giron, Ministry of Health, Director for the Rural Water and Sanitation Project for display in project office.
1		(Polished Model) In AID Tegucigalpa Engineering Office. Will hold for appropriate distribution.
1		Delivered to AID Honduras Engineering Office for display.

DISPOSITION OF PUMPS PRODUCED
UNDER PHASE I
(continued)

SW	DW	STATUS
1		Delivered to AID Honduras for Jay Morris.
1		Released to CEVER (Centro Evengelico de Educacion Rural Vocacional) to be coupled with one of their locally fabricted windmills.
1		Released to CDI (Centro de Desarrollo Industrial) for display in showroom at Tegucigalpa headquarter.
5		CEVER for installation in appropriate visible places.
10	15	Ecuador
114	36	TOTALS

APPENDIX H

Photographs of the Honduras Hand Pump Project

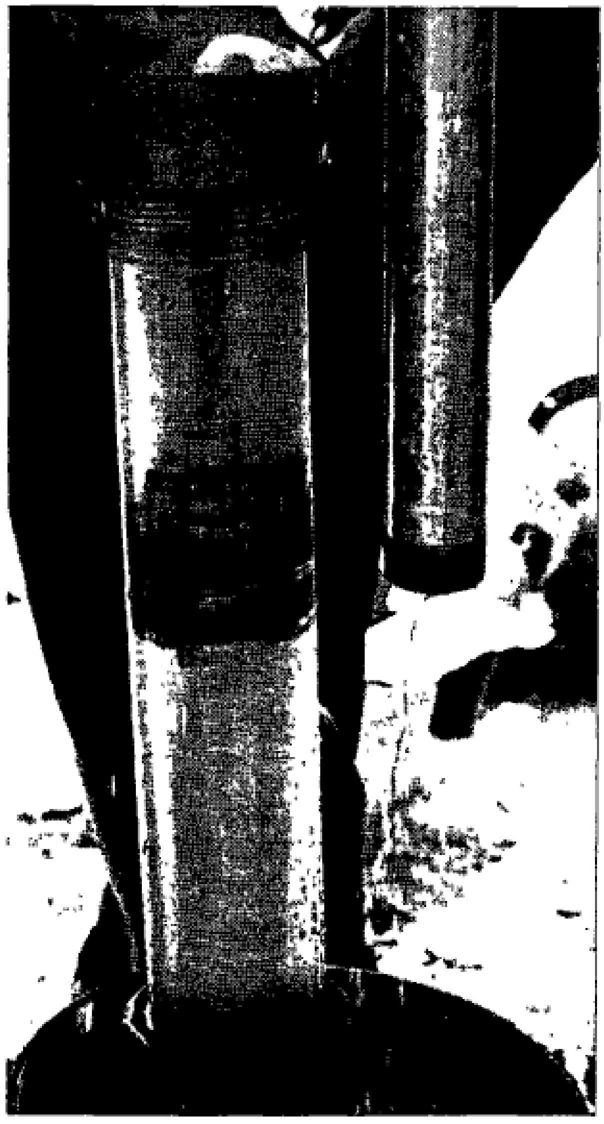
ACCEPTANCE INSPECTION

HANDPUMP ACCEPTANCE INSPECTION IS NORMALLY DONE BY A REPRESENTATIVE OF THE AGENCY RESPONSIBLE FOR PURCHASING THE PUMP.

In addition to the health promoter and village caretaker, coordinators, engineers and other promoters took part in the four workshops given by Georgia Tech staff.

The workshops were designed with an emphasis on "hands-on" training. In this photo MOH personnel attach a section of drop pipe at site #6 - San Jose, Comayagua.

Use of the demonstration cylinder proved to be a valuable aid in training caretakers and promoters in troubleshooting and repair techniques.



This close-up view of the demonstration cylinder shows lift valve operation in detail.

MOH personnel attach the Roboscreen
to the deep well cylinder as part of their
hands-on training during the workshop
held in Comayagua in May 1982.

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to the deep well cylinder as part of their
hands-on training during the workshop
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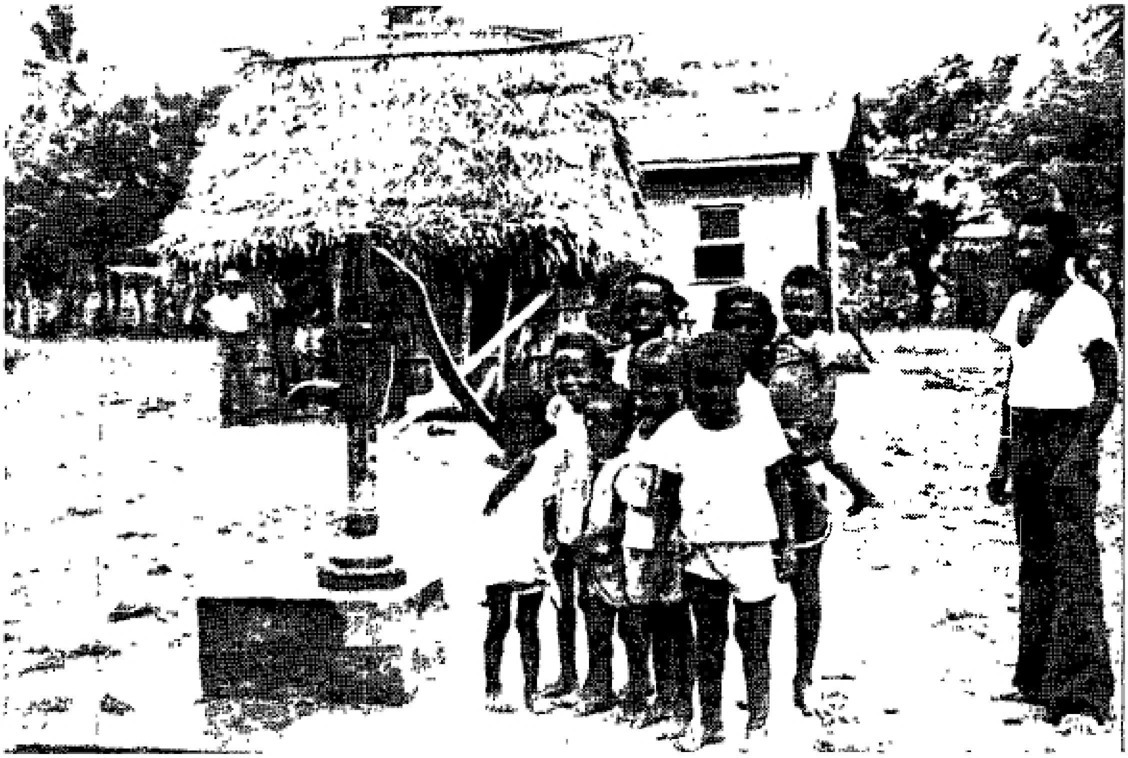
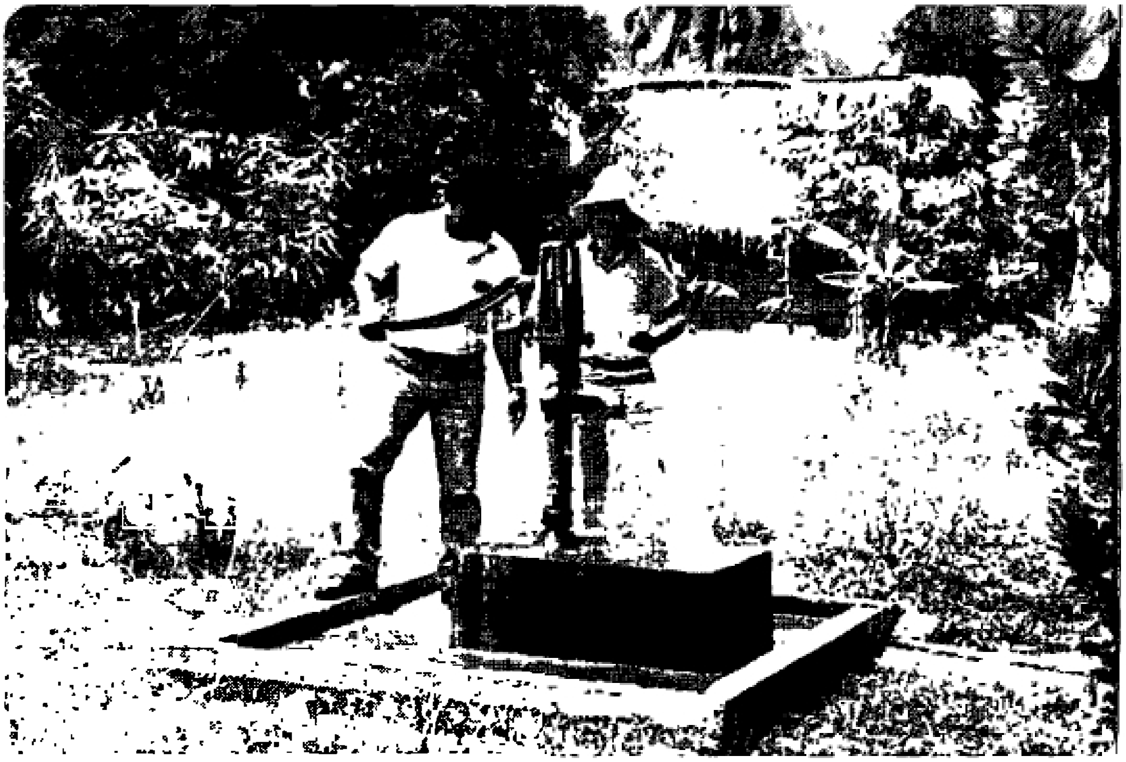


The Aid hand pump at site #23 - Chifia, Travesia, was installed on July 8, 1982, and provided water for six families.

At the conclusion of each installation the well was shock chlorinated. Later a chlorine residual test and bacteriological analysis was performed. In this photo the MOH regional bacteriologist prepares a field sample for bacteriological analysis taken from AID shallow well site #23 - Chifia, Travesia.



The ICAITI team member and the MOH promoter for Bajamar make a routine monitoring check at AID shallow well site #11 - Horatio Colon.

During the monitoring program, ICAITI and MOH staff examine the fulcrum failure of Sanpar site #5 - San Nicolas (abajo), Comayagua.

Difficulty in pumping due to the design of the narrow-edged metal handle was a problem frequently reported by the users and promoters for the Sanpar type #4 shallow well pumps. In this photo Sanpar site #1 - Thomas Campos, La Lima, is primed for use.

WASH