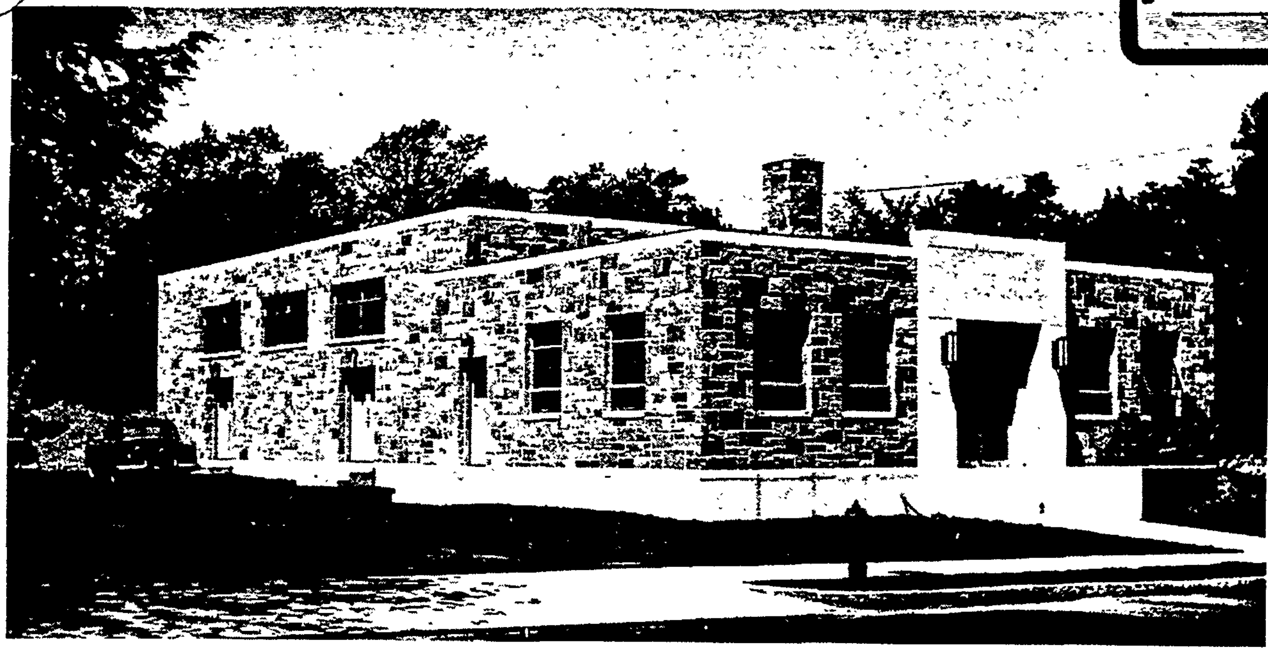

PUMPING station - - Brookline, Mass.

# Operation and Maintenance of Water Distribution Systems*

by WALLACE T. MILLER

Mr. Miller is Research Engineer of the Cast Iron Pipe Research Association in Chicago and a former water works superintendent. In this article, he presents a summary of modern tested practices.

THE GENERAL SCOPE of the term water distribution system is very broad and would normally include distribution mains, valves, hydrants, service connections, meters, booster pumping stations, storage facilities, maintenance shops, etc. This article will cover the major items under this classification and particularly in respect to the more important considerations rather than a complete coverage.

## MAINS

The specific locations of water mains are worthy of consideration in the early stages of planning. Many communities originally attempted to install water mains as near to the center of a street as possible, particularly in municipally owned utilities, and this no doubt developed from the thought of equalizing the cost of installing water service connections to property owners on each side of the street. As a result of a great preponderance of paved streets, it is very apparent that an effort should be made to keep water mains outside the limits of paved areas wherever possible. This general rule applies whether streets are already paved or are located within new subdivisions where paving will eventually be installed. The cost of removing and replacing of pavement can be a very considerable part of water main installation or maintenance cost and should be avoided wherever possible.

### Selecting the Location, Size, and Joints

The selected location for the water main should prevent close proximity to any existing or proposed sanitary sewer or storm sewer. Many State Health Departments desire at least 10 ft horizontal spacing. Wherever it is deemed necessary to install water mains in the same trench with a sewer main, the water pipe should be laid on an undisturbed earth shelf on one side of the sewer trench and at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer main.

In many cases, it can be determined that a two-main system can be installed on a street already paved at a cost which is no greater than the installation of a single main within the limits of the paving. In this case, a main would be located on each side of the existing street, one being sufficiently large to provide adequate flow

* An article based on illustrated talks on the subject given at water works short schools in South Dakota, North Carolina and Wisconsin.

duced fire insurance rates that are now in force throughout the areas that were annexed. Fig. 4 shows the National Board of Fire Underwriter's insurance classifications by areas before annexation and at the present time, after improvements; also the reduction in insurance premiums as a result of the classification being changed to Class 3. The reductions shown are for a brick veneered dwelling, which is the predominate type of home construction in Atlanta. The saving in insurance premiums on commercial and industrial buildings was considerably more than on dwellings.

It is impossible to determine exactly the amount of money that is being saved each year on insurance premiums as a result of these rate reductions in the annexed areas; however, the best conservative estimate is that the saving is over $1,000,000 per year for the citizen taxpayers.

During the last five years the Atlanta Water Works has spent approximately $1,000,000 per year to improve the water service, which is the principle reason for the insurance rate reduction. The improvements are complete and the expenditure will stop, but the citizen taxpayers in the annexed areas will receive a saving from now on of more than $1,000,000 per year on their insurance premiums. This saving alone, which is a result of improved water service, has made annexation a good investment for them.

### Acknowledgments

The author wishes to express grateful appreciation to W. D. Hudson, assistant Chief Engineer of The Pitometer Associates, who has been design and resident engineer on all this development project. Also to the following personnel of the Atlanta Water Works: Roy Ruggles, Chief Engineer of Construction; C. W. Cline, Assistant Chief Engineer of Construction; C. N. Davis, Superintendent of Maintenance and Distribution; J. Howard Bullard, Assistant Superintendent of Maintenance and Distribution; and all the others who have given tirelessly of time and effort to insure the success of this program. Also to the National Board of Fire Underwriters and the Southeastern Board of Fire Underwriters for their cooperation and council.

The author also wishes to express appreciation for the interest manifested in this important program by Mayor William B. Hartsfield of Atlanta; Alderman James E. Jackson, Chairman of the Water Committee; and the Board of Alderman of the City of Atlanta.

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## Ben Gotaas Moves To Northwestern Univ. As Dean of Engineering

Beginning with the second semester of the school year, Northwestern Technological Institute of Northwestern University will have a new Dean. He is Harold B. (Ben) Gotaas, who for the past ten years has been Professor of Sanitary Engineering at the University of California.

Inasmuch as Prof. Gotaas has long been identified with research at the University of California, he will strengthen the research facilities and activities at Northwestern. Until such time as present research projects which he had under his direction at California are completed, he will continue to participate in their direction.

Having spent most of his professional career in the field of sanitary engineering, Dean Gotaas may also be expected to expand the civil engineering field including water supply, sewage and waste disposal and air pollution. He also spoke of adding a department on area planning to round out the University's approach to the general problem of public works.

Dean Gotaas' professional career encompases teaching at three Universities, and service with the Army during World War II. A graduate of South Dakota he holds a Masters degree in Structural Engineering from Iowa State Univ., a Masters degree and an ScD. in Sanitary Engineering from Harvard. His first professional assignment was at South Dakota University before he went to Harvard for graduate study; his second teaching assignment was at the University of North Carolina where he became Professor of Sanitary Engineering.

In 1942, Dean Gotaas entered the Army and was assigned as Chief Engineer of the Institute of Inter-American Affairs at Washington, D. C. He later became Director of the Health and Sanitary Engineering Division and in 1945 was named President of the Institute. Following the war he became Professor of Sanitary Engineering at the University of California in Berkeley. For five years he served as chairman of the Dept. of Civil Engineering and he was also Director of the Univ. of Calif. Sanitary Engineering Laboratory.

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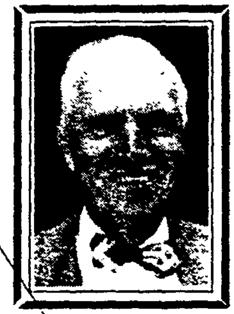
**Still a Miracle to Most**

Even with all of our scientific prowess and scientific understanding, this World of ours is still a Miracle to most of us—to those of us who believe that it takes more than science to explain it.

## Prof. Gifft of Cornell Died Suddenly

Prof. H. M. Gifft, Prof. of Civil Engineering and Dean-elect of the University Faculty of Cornell University died unexpectedly at his home last December 20. He had been Head of the Sanitary Engineering Department in the School of Civil Engineer-



ing for the past ten years. His appointment as Dean of Faculty had just been confirmed by the Board of Trustees two days before his untimely death.

Prof. Gifft was a graduate of Iowa State College in 1932. He received his graduate and professional degrees and was appointed to the Faculty of Cornell University. In 1946 he became head of the Sanitary Engineering Department.

Prof. Gifft was well known throughout the profession as a teacher, consultant and author. A number of his articles have appeared in *Water & Sewage Works*. He was a member of the consulting firm of Bogema, Gifft and Jenkins in Ithaca and among his consulting assignments were several summers spent in the Panama Canal Zone.

for fire protection and other large flow requirements. The other, furnishing domestic service only, would be a main no smaller than 2-in. in diameter and connecting to larger size mains at each end of the block. The avoidance of pavement cutting and other work within paved areas, except at street intersections, will frequently provide sufficient funds to cover the cost of the second small main. Future maintenance costs may be considerably reduced. (See Fig. 1)

The matter of adequate sizing of mains is of prime importance prior to original installation and due consideration of future needs will avoid many maintenance problems at a later time. A minimum size of 6 inch diameter should be provided for any mains serving fire hydrants; long lines of this size, however, are likely to provide inadequate service. Any mains less than 6 inch diameter should be considered water service lines. Sizing of mains is a matter which is worthy of an extensive engineering study by a qualified engineering staff and should not be approached on a casual basis.

Selection of the type of joint most suitable and desirable for particular installation should also receive due consideration. Not many years ago most cast iron installations involved bell and spigot joints utilizing lead, sulphur compound or neat cement for joint materials.

For some years, the use of mechanical joint pipe has been gaining in popularity and now represents the joint which is most frequently used on new construction. This joint is very simple to install, has definite advantages over the bell and spigot joint and usually represents no increased cost. The mechanical joint is bottle tight, provides greater flexibility, reduces labor costs, eliminates separate jointing materials and can be readily assembled in a wet trench.

The most recent development in cast iron pipe is the Roll-on joint involving a compressed rubber gasket in a bell and spigot type of joint and in general this is the joint with the lowest cost installed. Flange joints are generally used for pumping station piping and other above ground installations. A ball and socket joint, usually called a submarine joint, is most appropriate for crossing rivers or other bodies of water.

## Leak Repair

One of the most important maintenance operations in connection with water distribution systems involves repair of leaks. A very large percentage of leak repair work in the distribution systems, probably at least 90 per cent in most systems, is represented in service connection leaks. Most of the older service connections used lead, wrought iron or galvanized iron pipe and these are more susceptible to failure than most other parts of the system.

It is generally conceded that the replacement of an old service connection in its entirety through use of copper tubing or other satisfactory material, is much more economical than repairing an old service connection of unsatisfactory material. Where it is deemed advisable to repair an old service connection, several types of mechanical couplings are available for convenient repair.

Most leaks which do occur on mains are joint leaks. If sulphur compound has been used, the joint material may be cut out or burned out and the joint repoured. Lead joints can be recalked or clamps may be installed to provide a more permanent repair. It is somewhat common practice, where bell and spigot joints are used, to install joint clamps during the original installation on mains which may be located under railroads, superhighways or other vulnerable spots.

For the relatively small number of breaks which occur in water distribution system mains, a great variety of mechanical clamps or sleeves are available for permanent repair. Prior to World War II it was difficult to get water works operators to think in terms of mechanical clamps as being anything other than a temporary repair and it was not uncommon for them to be used on a temporary basis for a quick repair and later removed. Operators have now been convinced that a mechanical repair clamp is a completely permanent repair item and mechanical fittings and pipe are common on new installations.

## Mobile Radio for Leak Repair Operations

One of the most important tools in the repair of leakage on water distribution systems is to provide rapid and complete communications. All large water utilities, and many small utilities, have already provided communications through short wave radios or mobile telephone service. Invariably it is found that this type of service will pay for itself within a very short period of time through reduction of labor costs during periods of emergency. It also provides a considerable reduction in the time of disruption of service, which considerably improves public relations.

## Main Flushing

One of the frequent sources of difficulty in many distribution systems is the existence of red water and the need for flushing at least a portion of the distribution system. Many systems find it desirable to provide at least a routine seasonal flushing. A complete flushing of an entire system should always provide for reversing the normal direction of flow and an increase in velocity which can usually be accomplished through closing certain valves on the system. Treatment

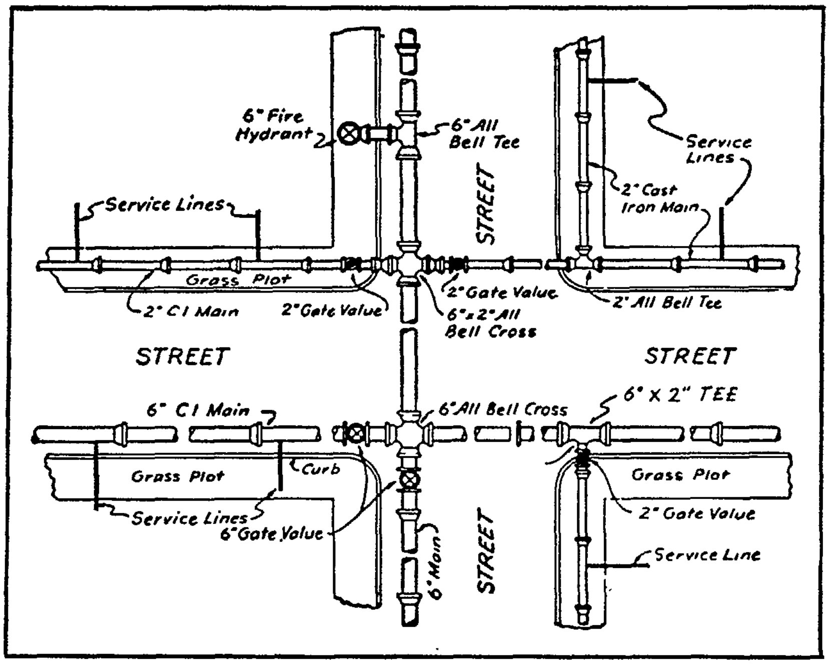



Fig. 1—DIAGRAM of two-main system

**INSTALLING** *mains—42-in. roll-on-joint C.I. Pipe—Chicago, Ill.*
Placing offset in 8-in. main

of water can be very effective in avoiding the creation of red water problems and cement lining of cast iron mains will prevent the development of red water in a piping system.

## Disinfecting Mains

One item of extreme importance in operating procedures which is not always undertaken is the need for disinfecting new mains before placing these mains in service. Chlorine should be applied at the rate of not less than 50 ppm and should have at least a 24-hr contact period.

Holding of such a main out of service after complete flushing, until bacteriological analysis can be completed, is often inconvenient but should always be provided. Invariably, there seems to be some customer waiting immediate service and frequently this time element is shortened in order to convenience the customer.

It is not desirable that the time element be shortened, the bacteriological analysis should be undertaken and state health department regulations should be literally followed in each state. The AWWA has published a standard procedure for disinfection of water mains and this is available in reprint form.

Occasionally it is desirable to use chlorine in relatively concentrated dosage to eliminate the formation of slime growths in mains. This procedure can be very effective and usually requires a high velocity flushing following the disinfection.

## Maintaining Capacity

The maintaining of adequate capacity may develop as a problem in many water systems and this situation has been extremely prevalent in too many systems during the past few years of heavy demand and extensive droughts. Many articles have been published on the procedures necessary for completely analyzing distribution system capacities. A project of this nature invariably requires engineering talent for a complete hydraulic survey and it is not desirable to delay such needs until inadequate service is experienced. An effort should be made to anticipate increased demands on the system and to provide reinforcements in time to meet such needs.

## Non-revenue Water losses

Of great importance in the operation of any water distribution system is the need to minimize losses through unaccounted-for or non-revenue water. Probably the best safeguard which can be undertaken to provide a high percentage of accounted-for water could generally be referred to as development of a good maintenance program. Water produced can become non-revenue water through inaccuracy of meter registration, leakage in the system, stolen water and from other causes.

Frequently this unaccounted-for water is extensive enough to warrant expending money for professional leak surveys which would cover all phases of the system. In the absence of undertaking a professional survey of this nature, simple leak surveys may be undertaken by any water department regardless of size. For example, there is a case on record of a municipal water district of some 500 customers where only one gallon of water was recorded on customer meters for each four gallons of water purchased through the master meter. This is an absurd as well as expensive situation and the exertion of nothing more than simple effort would result in saving a very large part of the unaccounted-for water.

More than 20 years ago the writer became associated with a municipal water utility which produced one million gallons per day and accounted for only 67 per cent of the water produced. Over a four year period a simple leak survey was diligently undertaken with the result that production of water remained at one million gallons per day, during a period of modest growth, and 87 per cent of all water produced was recorded on customer meters.

The procedure followed to increase accounted-for water by 20 per cent was very simple. An extensive meter maintenance program was undertaken. Repaired meters were required to meet a rigid test. Many very old meters were replaced with new meters.

A simple leak survey was undertaken which involved listening for leaks on every customers service, at the meter location and at the curb shut off. Listening devices were also used on every hydrant and every valve in the entire distribution system. During the course of the survey every curb shut off was operated and those failing to operate were promptly repaired or replaced. The entire increase in accounted-for water was the result of repairing leaks located in the distribution system and obtaining accurate registration of meters.

## Safety

In conducting operation and maintenance work as well as in new construction, definite effort should be made to prosecute the work under the best standards of safety practices which are known. This is a responsibility of the manager of any water utility and a safety program should be in existence in every utility regardless of size. The AWWA has recently published a manual on safety practices related to the water works industry.

# VALVES

One of our first concerns in respect to valves in a water distribution system relates to the location and extent of valve installations.

**WATER MAIN withstood ravages of 1955 flood and continued in service at Winston, Conn.**

## Number of Valves

The ideal installation might provide for four valves to be located at every water main intersection and, if blocks are unusually long, it may be desirable to install intermediate valves within a particular block. Most new main installations involve undeveloped areas or areas in the process of development as residential areas. Too frequently we think of present day need for valves and have a tendency to install an absolute minimum number. The same areas, when completely built-up, naturally present a greater need for valves and this should be borne in mind at the time of original installation. It would be difficult to find a water distribution system where a surplus of valves had been installed.

## Industrial Connections

Where industrial plants or other large and important customers are connected with a distribution system, it is good practice to encourage the customer to provide two connections to the main and to locate a valve between the two points of connection. In this way, it is possible to continue service to the customer regardless of the need to shut down a main in the particular block in which service is provided.

Loss of water service to an industry can result in a complete shut down of the plant and the loss of thousands of hours of labor. Even though such a shut down may occur very infrequently, the avoidance of complete loss of water service to industrial users is well worthy of consideration.

## Valve Operation

We hear a great deal as to the frequency of operation of valves. It is, of course, to be desired that each valve in the system be operated at least once a year but few small systems undertake a program of maintenance which will provide this. Some consideration should be given to the operation of valves, particularly important valves in the system.

Operators should be well trained to provide a reasonable time for closing and a definite avoidance of closing a valve too quickly. The number of turns required for complete opening and closing of every valve in the system should be known at the time of operation. Motorized valve operating equipment is becoming more common and represents an indispensable item of equipment in many departments. By-passes on large valves serve a very important function in connection with valve operation.

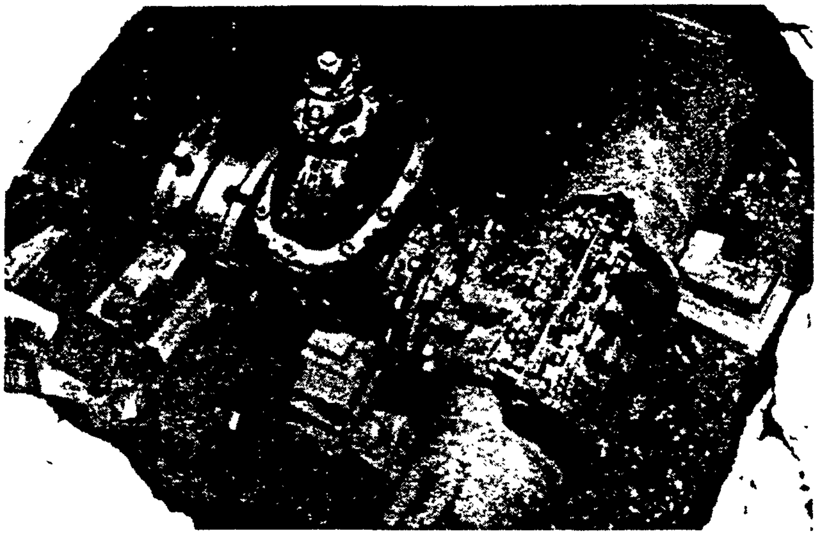
## Packing Glands

Probably the greatest source of annoyance in connection with valve maintenance arises from difficulty with packing glands. Unless valves are located within valve chambers it is not convenient to tighten packing gland bolts or to replace faulty packing. Some assistance has been provided through equipment which permits some lubrication of the packing through the valve box. Valve chambers are desirable on large major valves where such are located within the area of rigid pavement.

## Standardization of Valves

The matter of standardization of valves must be considered in any system in respect to the needs of that particular system. The same factors applied to valves will probably apply to meters, hydrants, and other items of material and equipment in any system. In ordering new parts for very old valves, it has been found desirable to purchase a complete set of internal replacement parts rather than procuring an individual item such as a stem, disc, etc. Use of a complete internal valve assembly will accomplish the most effective repair and will avoid difficulties which might be experienced in combining old and new operating parts.

A water works system should involve either right hand valves entirely or left hand valves entirely, but practically every system has a few valves which operate in what represents a reverse direction for that particular system. When that condition does exist, precautions should be taken to avoid assuming that the valve operates in the conventional direction. This may be accomplished in several ways. There are some systems where red paint is applied to the underside of the valve box cover to designate a particular valve as being unconventional in direction of operation. In other systems a similar precaution



**TIEING-IN 16-in. cement lined C.I. feeder main with 131 year old 10-in. pipe—Philadelphia, Pa.**

is undertaken through placing a piece of 2 x 4-in. timber in the valve box and the necessary removal of this calls attention to the reverse direction for operating that particular valve.

### Valve Boxes and Records

Valve boxes should be maintained to provide accessibility to the operating nut at all times, even though this sometimes involves a considerable expense. A valve in the system is of no value whatsoever if it is not accessible for operation. Plugged valve boxes may frequently be cleared by flushing out with high pressure water through a small nozzle or by a blast of air from a compressor. In recent years we have experienced the repaving of many concrete highways through the application of about 2½-in. of blacktop on top of the old paving. This represents a problem in the adjustment of valve boxes, but a small unit is available for placing in the top of an existing valve box to adjust to the height of the new pavement.

Valve record cards are probably the most important item of records relating to the distribution system. There are many ways of providing reference measurements to determine location of valves and a standard system should be adopted in each department. Records of this nature should always be developed from the point of view of convenient field use and not on the basis of an office record which is not immediately available in the field.

## HYDRANTS

### Location

The matter of spacing of hydrants is important in a system and there is a wide variation in the spacing used. In residential areas it is desirable that hydrants be no farther apart than 600 ft. In any case, every building should be within 500 ft. of a hydrant. Business and industrial areas require closer hydrant spacing. Wherever possible, it is most desirable to locate hydrants at or near intersections so that they may conveniently serve along blocks in each direction.

If hydrants are placed between corners, an effort should be made to locate the hydrant opposite property boundary lines. They must be protected from damage by vehicles. Most customers object to having a hydrant located in front of their property and it has been found desirable to stake the location in advance, with a stake clearly marked "hydrant", so that any difficulty with customers can be worked out prior to placing the hydrant. Be sure to avoid future driveway locations. A standardization of threads must be established and steamer connections should be provided.

Valves should always be located on branch connections to hydrants and location on the branch near the point of connection to the main is more desirable than any other location.

### Inspection

Hydrants should be inspected periodically to insure proper operation, adequate drainage and to provide necessary lubrication. Use of hydrants by persons other than department employees should be avoided due to possible damage through misuse, quick closing, etc. Where hydrants are used for sewer flushing, an auxiliary valve should be placed on the outlet and this valve operated rather than the hydrant valve, during the progress of such work. It has often been found practicable and desirable to furnish services of a department employee to operate hydrants rather than to permit operation by others.

### Painting

Painting of hydrants should be standardized in any department and should be applied frequently enough to maintain a completely satisfactory and attractive appearance. In most water systems, hydrants are the only part of the system which are in evidence to the public and a neat appearance will provide public admiration. Many departments have eliminated chain connections to outlet caps and when these caps are made wrench tight, little disturbance or loss of caps may be expected.

It is generally desirable to indicate the flow capacity of a particular hydrant through marking in some manner. Flow tests should be undertaken to determine flow capacities and hydrants marked accordingly. Some departments prefer to indicate the size of the street main and mark this information on the hydrant rather than indicating the capacity. Any information which can be provided will be of use to the fire department and help to establish good relations.

Wherever hydrants may be taken out of service for a temporary period, or have not yet been provided with service during the construction period, a burlap bag should be placed over the hydrant or the hydrant marked in some way to indicate it is out of service. Hydrants should not be used for water required in private construction projects.

Hydrant record cards should be provided and all maintenance work undertaken on each particular hydrant should be noted on a continuing record. It has often been found desirable to have maps placed in fire houses to provide information on location of hydrants for assistance to fire department personnel.

## SERVICES

Small service connections are generally made through installation of a fitting referred to as a corporation stop but it is difficult to establish the manner in which this name came into common usage. It is noted that plumbers in many areas of the country refer to water main piping as "corporation" pipe. Before the time when large private corporations were established, municipal governments were known as "the corporation". People who worked for the state, city, town or village on highway or other type of outside work, were generally referred to as "working for the corporation". The writer feels that this is the manner in which the designation of corporation stop came into common usage.

### Sizing the Service

Determination of proper size of service connections for any particular customer should be given consideration at the time of application. There are definite disadvantages to installation of a service connection which is too large or too small for the particular type of service. The size of the service generally determines the size of the meter to be installed and a meter larger than required is likely to result in under registration on small flows.

In most areas it is common practice to install meters one size smaller than the size of the service connection. A service connection which is too small for the service desired will, of course, result in complaints of inadequate service. Some departments, as long as 20 years ago, were installing a minimum size service connection of 1-in. copper in order to provide completely adequate service many years later.

Selection of material should be given adequate consideration. Copper tubing is by far the most popular material for small service installations. In most cases, the corporation stop is inserted at an angle of 45° above horizontal with sufficient piping material available to provide for some movement of the service connection piping without creating a strain at the point of connection.

When the corporation stop is not conveniently available for shutting off to undertake repairs, excellent results may be obtained through use of dry ice for freezing. It is often found desirable to replace old service connections rather than to accomplish a repair, once a failure has occurred.

Curb shut offs should be maintained in proper operating conditions at all times and this will require periodic inspection and operation. Lids for curb boxes have a tendency to become damaged but repair lids are readily available and easy to install. A plugged curb box may frequently be cleared through use of blowing out with high pressure air or washing out with a jet stream.

### Cost of Installation

In the majority of municipal operations, the cost of installation of a service connection is generally paid for by the customer and in some cases the department requires maintenance of the entire service connection at the expense of the customer. It is felt desirable that all work performance in maintenance of service connections, between the main and the curb shut off, be undertaken by department forces, even though the cost of such maintenance may be charged to the customer.

Care should be exercised to install service connections at sufficient depth to prevent freezing. The thawing of frozen services is not particularly difficult but has considerable nuisance value, develops poor public relations and requires a continuous flow of water being maintained after thawing until all danger of freezing is over for the season.

There are a variety of opinions as to the advantages of installing service connections in advance of building needs and this has resulted from the extra expense required for installation after pavement has been completed. Pipe pushing and boring equipment has effectively reduced the amount of open trench installation. Too frequently service connections installed many years in advance of building needs have resulted in the stub service being at the wrong location or of inadequate size. The particular factors related to each individual community would be of great importance in establishing a policy. The two main systems eliminate the need for such considerations.

As is true of all other distribution system appurtenances, service record cards are of great importance. They should effectively designate the particular location of the point of tap and curb shut off and should provide a convenient method of satisfactory measurement to locate the curb box rapidly. The record should also include installation details and any maintenance work performed on the service connection.

## METERS

Nothing is of more importance to good revenue production than an adequate meter maintenance program. All small meters should be brought into the shop, cleaned, repaired, tested and properly adjusted on a periodic schedule. Large meters require similar work in the field. The frequency of inspection and maintenance varies on small meters from five to ten year periods but should logically be based on the volume of water passing through the meter rather than time.

Many large utilities remove residential meters upon registration of one hundred thousand cubic feet. Average sized families would be expected to use this amount in approximately ten years. Privately owned utilities are generally regulated through state utility commissions and definite schedules for meter maintenance are established.

Meters should be located in such a manner as to provide convenient access for reading by meter readers. Any poor settings or locations should be corrected at the earliest opportunity.

**MOBILE radio phone aids communications—Cape Cod, Mass**

It is frequently found that municipal utilities require purchase of a meter by the customer even though control rests with the utility. Since the meter represents the cash register of the water utility, it is desirable that both ownership and control be vested in the water department. One of the great advantages is represented by the fact that ownership by the utility avoids the necessity of maintaining any particular meter at the same location at all times.

The meter maintenance shop should be adequately equipped to provide the complete requirements of testing and repairing. An excellent article on "Equipment and Layout of Meter Maintenance Shop" appeared in the June 1954 Journal of AWWA.

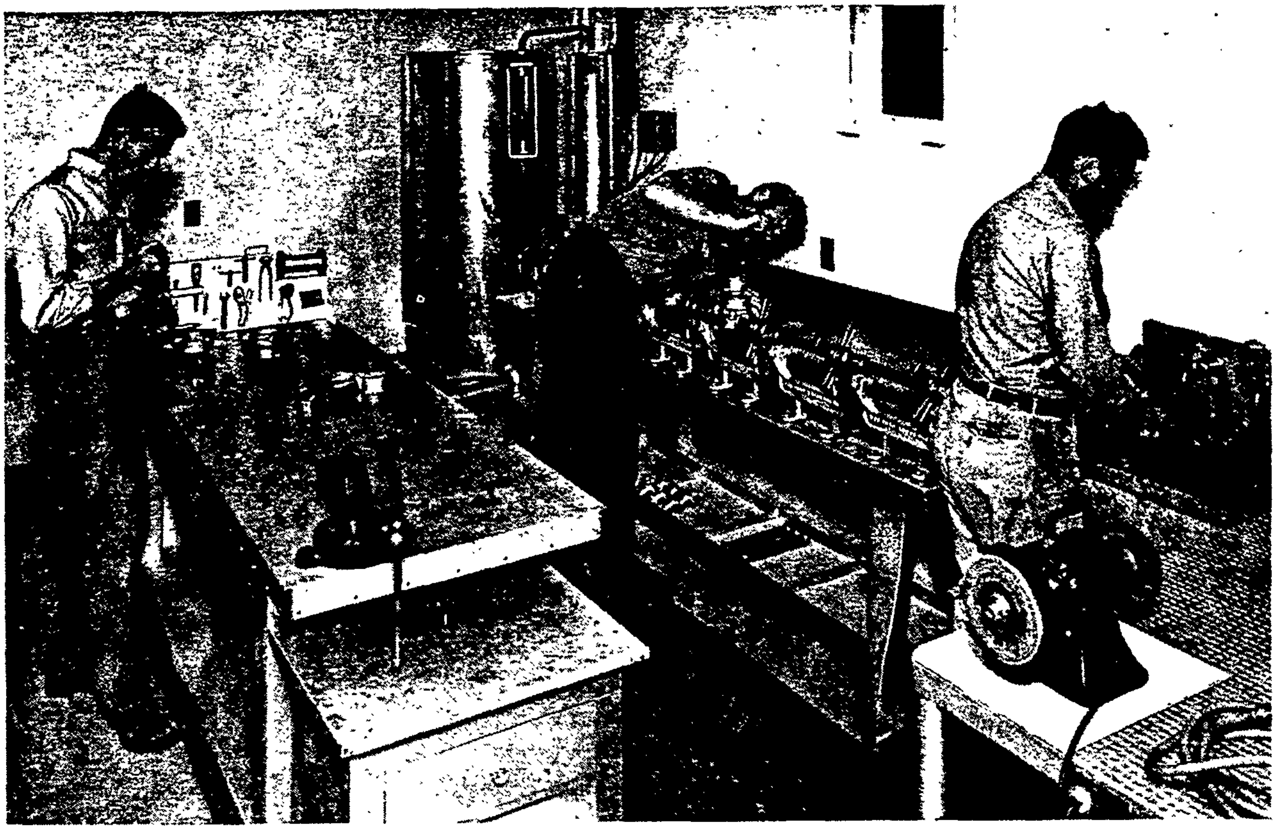
## STORAGE

Whether storage of water in the system is maintained as ground storage in open reservoirs or as elevated storage in tanks and standpipes, it is important that good housekeeping be maintained to set a pattern for the community. These facilities are in the same classification as city buildings and all other public property and should always be outstanding in appearance. Invariably good housekeeping of this sort will also provide more effective use for longer life.

There is a wide variation of opinion in respect to use of supply or storage reservoir property for recreational purposes. It is necessary to guard against misuse and recreational use might better be avoided unless adequate policing can be provided, rather than to permit a nuisance and possible source of pollution to develop.

## DEMANDS

During the past few years of frequent droughts in many areas of the



**METER test shop containing modern equipment—Colorado Springs, Colo.**

country, more than one thousand water systems throughout the U.S. have found it impossible to meet total demands on their systems at some time during the year. The developement of our high standard of living has resulted in continuing increased use of water by all consumers and the population of the country is growing by leaps and bounds.

Industrial demands have grown steadily and it is anticipated that they may more than double in the next 20 years. Air conditioning is developing a tremendous load on some water systems in commercial and industrial areas. Lawn sprinkling has frequently developed peak demands far in excess of adequate fire flow requirements in residential areas. Fire flow requirements were formerly used to determine peak capacity needs in many water systems but industrial and sprinkling loads may be expected to exceed these demands in many areas.

The operator of a water distribution system should be entirely familiar with what is taking place on the system during periods of peak use. Pressure tests under peak loads are of tremendous help in determining adequacy of service or need for reinforcement of any particular part of the system.

It is relatively simple to obtain hydrant pressures throughout the system during these periods. Pitot and fire flow tests must be undertaken periodically to develop information for necessary hydraulic study at frequent intervals. Major hydraulic grade study or similar investigation of conditions should be undertaken at regular intervals to provide long range planning on any system. A considerable amount of information may be obtained during the peak season by water department forces which will provide valuable information for both short range and long range planning.

## CUSTOMER SERVICE

The legal obligations related to water service on the part of a utility are generally within the limits of public property. The exception might be the meter, which may be located in the customers premises. However, the utility may well consider a moral obligation to extend service, but not necessarily responsibility or repairs, to include matters related to the use of water within the premises. This philosophy of service is rather extensively performed in the electric, gas and other utility fields.

No matter how well a water distribution system may be operated or maintained, the existance of unsatisfactory conditions within the customers premises may result in unwarranted criticism of the utility.

One of the most extensive problems of customer service in a water utility is the handling of complaints. These represent a tremendous variety but in general most complaints, regardless of the foundation, occur at a time when the consumer has just received or is proceeding with payment of a bill. Complaints should not be treated lightly, since the average customer may have some reason for complaining only once in 10 years or more time and yet this will likely be his only contact with the department during that period of time.

In order to perform the function of the department and maintain good public relations, it is necessary that adequate service be rendered to the customer. Every complaint is worthy of complete investigation and when complete investigation is undertaken, there is invariably a reasonable answer as to the cause of the condition which resulted in the complaint.

### Complaint Handling

The most frequent complaint from customers relates to what may be classified as an unusually large or at least an increased bill for water. In one particular municipal utility, an extreme effort was undertaken to definitely prove the reason for the increase in consumption which resulted in the complaint. In practically every investigation, a satisfactory answer was determined and it was rare to find a case where this was not true.

The procedure which was used provided for sending an inspector to the property with complete information as to meter readings, dates and consumption recorded for several periods prior to the current period under investigation. An additional reading at the time of investigation, which probably involved a relatively short period following the previous reading, was first obtained and all usage was converted into average daily requirements for each period in gallons or cubic feet per day. These units can easily be extended for 90-day periods for convenient comparison when discussing quarterly consumption with the customer.

Actual tests were made to determine exact requirements for water in the operation of each water closet at the property. A record was made of any appliances requiring water. The number of persons served at the property was of great importance and was used in establishing per capita uses for comparison to average demands by other customers. Every complaint resulted in a complete letter report to the customer from the manager or a conference between the customer and manager to discuss all of the factors involved.

It was generally found that the majority of complaints relating to increased billing resulted from leakage within the customer's property. It was determined that alertness on the part of the meter readers could determine this prior to the actual billing time and generally resulted in more prompt repair of leaks. Meter readers were trained to make comparisons with consumption during previous periods at the time of meter reading. If increase consumption were noted, they immediately listened on the service at the meter to determine whether water was running continuously. Wherever possible, the matter was discussed to some extent with the customer at that time. If the matter was not resolved immediately, the meter slip was designated by code number as requiring additional investigation by an inspector. In this way the majority of increased bills was investigated and resolved from one to three weeks prior to the actual rendering of the bill.

A continuing program with conscientious effort can result in tremendous improvements in public relations as well as considerable savings through reducing wastage of water.

**CAUSES of leaks. Assortment of service pipes—Glen Ellyn, Ill.**

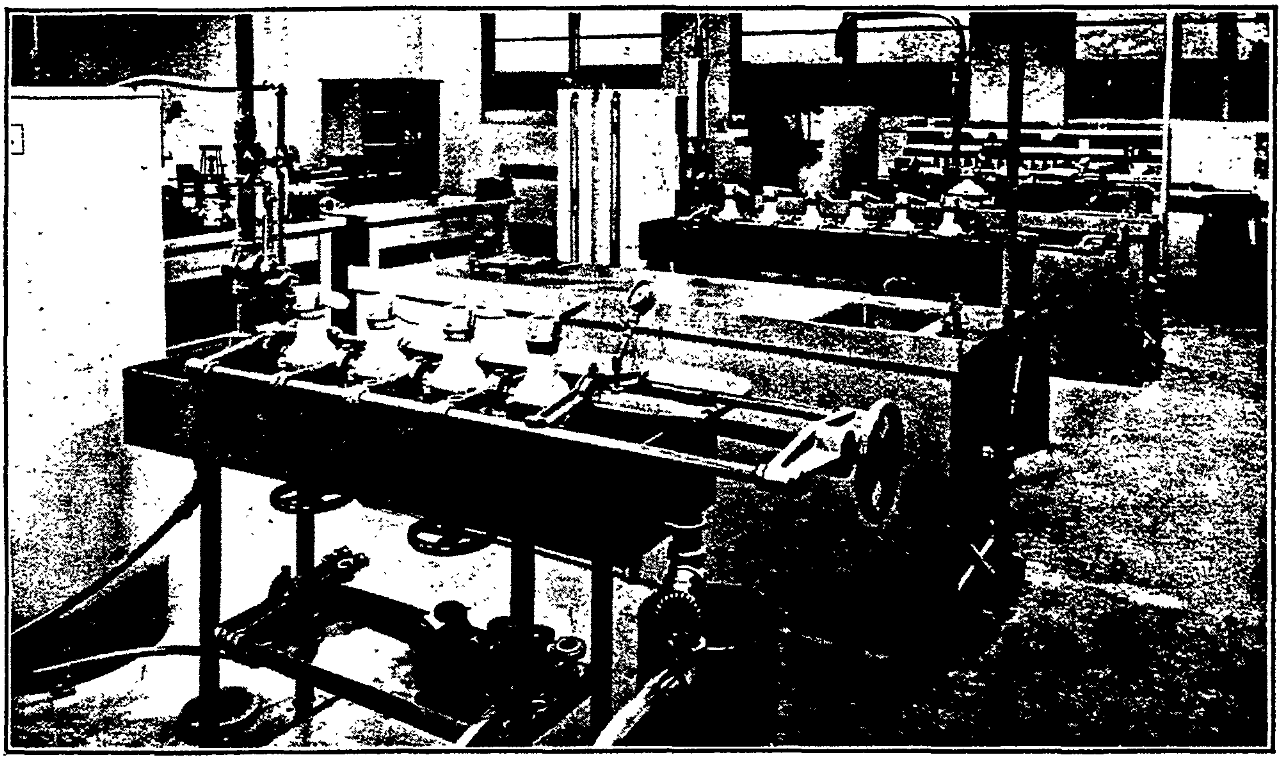
## Meter Reading

Wherever access for meter readings cannot be obtained, it is generally desirable to leave a post card to provide for convenient reading by the customer. Where this has not been found satisfactory, arrange to leave some notification that an effort has been made to read the meter. Efforts of this nature are always a safeguard against complaints which may result at some future time since many customers became very irritated when their regular billing period has been skipped, or estimated bills are established.

Capable and alert meter readers can be a most valuable asset. Too often their work has been limited to nothing more than a simple recording of a meter reading. Most meter readers are capable of using good judgment and should be encouraged to observe and report changes in rate of consumption, as well as any unusual or undesirable conditions. Many such conditions occur frequently and may be conveniently reported by code number. Any follow-up required may be undertaken by other employees. In one department, the following code was attached to each meter readers book to permit ease in reporting that he was aware of specific factors at the time of reading, or conditions which required some further effort.

1. Meter not registering
2. Was a leak—has been repaired
3. Water closet leaking
4. Bad faucet leak
5. Meter coupling leaking
6. Meter stuffing box leaking
7. Meter registering slowly—indicating leak
8. Meter registering slowly—water cooled equipment
9. Consumption high—reading correct
10. Consumption low—reading correct
11. Meter not accessible
12. Premises vacant—left card
13. Quarantined
14. Glass broken
15. Register broken
16. Frozen
17. Meter set backwards
18. Hear water running—meter not registering
19. Meter seal broken
20. Meter working O. K.

When attempting to provide an efficient operation of a water distribution system, nothing pays greater dividends than the exertion of a sincere, conscientious effort and the application of good common sense on the part of the manager.



METER test benches in water department—Edmonton, Alberta

# Why Water Meters are Advantageous*

Case histories show benefits of 100 per cent metering to water utilities

**by H. G. GREER**

**Mr. Greer is a sales engineer with Neptune Meters, Limited in Toronto, Ontario, Canada. In this article he cites examples to prove his thesis that water metering is good business.**

WATER—one of the essentials of life—should be free to all. Yes, as free as when quietly resting in a lake, running in a river or babbling in a mountain brook. That it is free in either place will not be denied, yet when we come to utilize it for domestic purposes it will cost either money, time or labor and will have a fixed value per gallon.

Water cannot be obtained from any source without an investment that has a money value, be it either time or labor. If we go to the lake, river or brook, where it flows as free as the air we breathe, we cannot procure it and carry it home without labor, and we find it does cost something.

Under no circumstances can we obtain water without it having a fixed value represented by money, including the cost of pumping, filtration, addition of chemicals to make it fit for human consumption and the vast delivery system of water mains throughout the municipality to deliver it to each and every fixture in every home and every industry twenty-four hours a day. Standing by whenever it is needed, be it a glassful or thousands of gallons to put out a fire.

## Metering is Equitable

Every good citizen will feel it a duty to pay his proportion of the cost for the convenience, the labor of taking care of the works, the chemicals to purify it and the interest on the money invested, etc. Theoretically, every consumer of water does assent to this, but practically he ignores it entirely. It is not infrequent for consumers to use many times the amount of water allotted to them, seeming to be utterly oblivious to the fact that they are doing a great moral wrong to their fellow citizens who are made to pay for their individual waste.

*A paper presented at the Western Ontario Water and Sewage Conference. Published here by permission.

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