INSTALLING A WATER SYSTEM

FOR

OAK CITY, MILLARD CO., UTAH

THESIS FOR DEGREE OF C. E.

ERNEST DE ALTON PARTRIDGE

1915

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INTRODUCTION

The problem of installing a water system for a town among the mountains is vastly different from that of installing a system with stand-pipes, pumping plants, etc., which is so often used in the East and Middle West. Here among the mountains, a pipe line is laid from the town or city usually up a canyon bed to a clear mountain stream, or even to the springs at the source of the stream, and the water taken from below the surface, conducted by a gravity line, with little loss of coolness and purity, to the people in the valley below. Such a system, installed at Oak City, Utah, in 1913, is the subject of this thesis.

No attempt has been made to present the matter in the form of a scientific argumentation. The aim has been rather to make an exposition of the facts and conditions as they have presented themselves. Apology is made here for the appearance in the thesis of a few Western words and phrases.

THE NEED FOR A WATER SYSTEM

In this desert country the source of water for culinary purposes has usually been the water from irrigation canals or ditches. Most attempts to obtain good water by digging, boring or driving, have proved futile. This has been the case in and around Oak City. The mountain stream which issues from the mouth of Oak Creek Canyon, would sink into the porous ground and entirely disappear within two miles below the mouth of the canyon from which it emerges, even during the high water period, if it had not been conducted away from its old channel by means of "puddled" canals. This was the water available to the people of Oak City for

culinary purposes.

While this water came to the town in a fairly pure condition, it became very much befouled while passing through the streets, down each of which a small stream was allowed to flow in ditches just out from the sidewalks. From these streams, drinking water was dipped into barrels kept in front of each house.

Thirty years of experience had taught the people to dip their water as early as possible in the morning. It was then coolest and clearest. There are no bridges over the streams and hence all wagons, teams, dogs, sheep, cows, calves, etc., fresh from the barnyards and corrals, pass through them when going to the fields and pastures in the morning, and also when returning in the evening. When the wind blows, thousands of particles of straw, sticks, dirt and dust, are blown into the ditches. Upon one occasion a sudden storm swept over the foot-hills east of the town. Soon a man came running down the street calling, "Flood, flood, fill your water barrels." The people rushed out and hardly had time to fill their barrels before there came a flood of black water and mud. It was several days before good water could be obtained again (See note 1, page 18.) Deposits of black mud and humus were made all along the sides of the ditch; and in some of the fields below town a covering over several acres was made from four to eight inches deep. Sometimes in August the stream does not reach the town, and then all the stock must be driven up to where water can be found, and drinking water must be hauled in barrels.

Enough, perhaps, has been said to show that a steady flow of clear, cool water from the mountain springs was a necessity at almost any cost.

OBSTACLES

Incredible as it may seem, it was a fact however that the people could not all be converted to the necessity of installing a new water-system. For a time it seemed as though it would be impossible to get them to unite on the matter. Meeting after meeting was held and speeches were made both for and against. All the leading citizens were of course in favor of it; but many heated discussions were held before a safe majority could be convinced that the benefits obtained would be worthy of the sacrifice. As soon as sufficient number had been converted, the Oak City Irrigation Company, which included all those who had any rights in the irrigation system, by its board of directors bonded the company's water rights for the necessary money. A managing committee was appointed to consult with an engineer, and to prepare plans to install a water system.

SOURCE OF SUPPLY

Two sources of supply were open. (a) The water from the stream to be taken at the mouth of the canyon, or (b) the water from a series of twelve small springs which are located in what is known as Dry Canyon and its tributaries. (See note 2, page 1.) The latter source was chosen because cattle and sheep are pastured in the mountains in the summer time, and it was feared that the water of the streams might, at some time, be polluted. Though the springs were so small that the water seldom reached the main canyon stream, yet there was plenty of water if it were collected, at the springs. It was decided to do this by means of a pipe line which will be discussed later.

FINANCING THE PROJECT

No citizen had money enough to finance the system. Neither would any number of them do so and take the system as security. It happened that

the board of directors of the Oak City Irrigation Company were all in favor of the new movement, and after an election was held at which a majority of the stockholders voted to bond the irrigation company's property, the bond was sold and the necessary money raised. It was decided that all who could do manual labor would be permitted to do so, and they were to be credited on the books as if cash had been paid. The result was that there was plenty of capital and labor to put the project through. The total cost of the system was $11,000.00, of which $7,000.00 was cash and $4,000.00 was labor. After the completion of the project, the people holding the bond/relinquished the same and the pipe line was taken as security for the money.

SIZE OF PIPE

The aim was, in choosing the pipe, to get one which would carry all of the water of the springs, and allow for increasing if necessary, the flow from the springs. The total flow at present is sixty gallons per minute. A three inch pipe could carry this amount easily, but a four inch pipe was decided upon for the main line. There are fifty-four families in the town and a total of three hundred twenty five people. It is customary to allow twenty gallons per day for each individual where all modern improvements are installed; six gallons per horse, six gallons per cow and three gallons for each sheep. Each family averages six people and have four horses, three cows and eleven sheep which requires two thousand five hundred gallon. At sixty gallons per minute, there is a total supply of eighty-six thousand four hundred gallons for twenty four hours, or over eight times what is necessary. Allowing for lawns, flower gardens, and a small vegetable garden, it was estimated that the supply could be

about twice the demand; which has proved to be practically correct.

The increase in population is practically nothing since the amount of irrigation water is fixed, which determines how much land may be cultivated, which in turn fixes the number of people for which food can be supplied. (See note three, page 17.) At any rate a four inch pipe will carry all the water that will be needed for many years in the future.

SPRINGS

The supply springs are located as follows: (1) On the north side of Dry Canyon, four springs in the first right-hand fork and three springs in the Log Party fork just above; on the north side of the canyon, five springs opposite the Log Party springs.

Upon testing for purity, one of the springs on the north side was found to contain a dangerous percentage of arsenic, and therefore was abandoned. All the rest were found to be absolutely pure. It was decided to collect, at present, the water from the south row springs and leave those on the north until necessity required. (Fig. 1, page 18, shows a map of the method of collecting, pipe lines, sizes of pipe, etc.)

PIPE

The pipe line is laid out as follows; (See fig. 1, page 18.)

Sec. 1. From town to the settling basin, 4275 ft. of four inch galvanized pipe. This comprises the pressure pipe and has a fall of 165 feet.

Sec. 2. From the settling basin to the junction, 5673 ft. of four inch vitrified pipe, bell joints.

Sec. 3, From the junction to the collecting tank in the first right hand fork, 2753 ft. of 2½ inch galvanized pipe.

Sec. 4, From the junction to the collecting tank at the Log Party springs, 2847 ft. of 2½ inch galvanized pipe.

Sec. 5, From the collecting tank in the right hand fork, four lines of 1½

inch galvanized pipe of 105, 74, 70, and 90 ft. respectively.

Sec. 8. From the connecting tank at Hay Derby springs, three lines of 2 inch pipe; 19, 63 and 150 ft. respectively.

OWNERSHIP OF SPRINGS.

Up to the present time the question of the ownership of these springs had never been brought up. The water had been used by stock pastured by the municipal service for drinking purposes. So when the people decided to put in a water system, one of the citizens who owned some land above the town, went to Salt Lake City and made filings on all the springs in the first right he found free, and at once began to work to get the water onto his land. It cost the city $225.00 to buy the man off. (See note 4, page 11.) A clear title to the right to use all of the springs was at once secured by one of the citizens who turned the right over to the city.

RIGHT OF WAY.

The preliminary survey was now made and line suggested. About half of this line is on government land and a right-of-way for this part was easily secured. After leaving the mountains a proposed line passed over two farms and some small tracts near town. The owner of the first farm demanded such exorbitant conditions that the company could not accept them; hence a detour was made to the south which would pass through but one corner of his land. This would necessitate the building of two inverted siphons, the greater of which was twenty feet high.

The second farmer asked only that a hydrant be placed near his house, which was gladly permitted. Since this was above the pressure pipe a valve had to be installed in the line for his use. The understanding was that the valve should be used only for the purpose of filling his watering trough and barrels. (See note 5, page 11.) All other land owners readily

have their consent for the line to cross their property.

TRENCH

A complete right-of-way having been secured, a permanent survey was made and a drill made for men and teams to dig the trench. Nearly every man and boy turned out and in a very few days the trench was completed to a depth of three and one half feet, which insure us against trouble by freezing. (See note 1, page 10.)

The four inch galvanized iron pipe, the pressure pipe, from the town to the settling or overflow basin was laid by the citizens. The contract for the laying of the vitrified pipe was given to the lowest bidder, the requirements being that each joint be so thoroughly cemented as to stand the pressure of the pipe itself. All the rest of the pipe was laid by the citizens.

COLLECTING THE WATER

The springs were located on what proved to be about the same level along the mountain side, and it was thought that there was a bed of clay or stone practically level under the surface, which caused the water to come out as it did. Upon investigation it was found that the water was held in a gravel bed with an almost vertical face, and against which, in some remote age, a clay dike had been thrust; it is holding the water back to the level of the top of the clay dike. (See fig. 2, page 8.) The water in coming to the surface made such a bog in the clay that often stock, in searching for a drink would sink into the bog and had to be helped out. A twenty foot piece of pipe, by nearly being pressed by the hands could be thrust down its entire length. Breaking now the conditions under the surface it was a very easy matter to collect the water. In digging the trench the men struck the gravel at a depth of about two feet below

the issuance of the original spring. (See fig. three, page 3.) The supply of water at this point was almost double that at the surface. This suggested a method of increasing the supply of water if necessary. It being the plan to perforate the pipe at the end of the pipe and this was to be driven into a hole which had been dug back into the gravel. (See fig. 3, page 10.) The hole in the gravel was then filled with rocks and gravel and the trench was filled with the clay, care being taken to tamp the clay thoroughly. This was entirely successful as no water has yet come to the surface.

The water in all the springs was collected in the same way and conducted to the collecting tanks. One of the springs was in the bottom of the canyon. Hence to insure against the pipe line being washed out by flood or freshet, the trench was dug along the side hill and the water taken out about twelve feet above.

WATERING TROUGHS

The water of these springs having been used for water rough stock, the government demanded that troughs be placed near each of these groups of springs. Accordingly a cement trough was made the bottom of which was six inches below the level of the outlet pipe of the collecting tank. A pipe joining the two as shown in figure 4, page 11, would allow the water to stand six inches deep in the trough all times. To prevent the water from re-entering the collecting tank a check valve was placed in the trough. (See fig. 4, page 11.) This however is necessary only when the collecting tank has been removed so that the tank may be cleaned.

TESTING THE PIPE-LINE

Up to this time no water had been allowed to enter the system below the collecting tank. When everything was in readiness for testing, the

plugs were pulled from the pipes in the collection tank and the system was soon filled with water. The only fear that was needed was at the two siphons in the vitrified pipe, and these were relieved with interest. The contractors were overjoyed to find practically no leak in either of the siphons. (While perhaps not necessary, a shut-out valve was placed on the lowest point of each of the siphons.) The settling basin was filled and a brief test of the pressure line made. The whole line was now tested and found to be acceptable to the board.

CONTROL

To enable the complete control of the water, shut-off valves were placed as follows; at the upper and lower end of the pressure pipe and at the outlet of the distributing system. These valves were each inclosed in a proper cement box and were easily accessible.

DISTRIBUTION

The distributing system is not a very common one but it is very satisfactory. The town is small and has a gradual slope from southeast to northwest. The pipe-line enters at the southeast corner. (See fig. 5, page 14.) It was decided to run a three inch pipe from the main line north and west around the outside of the city and a three inch pipe west and north to join the otherone in the northwest corner of the city; and a two and one half inch pipe along the middle of each street of the city. Each of these pipes was to be joined to the other with a double T at all the crossings. T's with stop and waste cocks and reducers were placed in the main lines four to the block throughout the city to allow for connections. Each taker is controlled by a curb box with stop and drain cocks placed at the side of the road.

DRAINAGE

To facilitate complete drainage of the system, should necessity demand, an air valve was placed just below the cut off valve at the point at which the pressure pipe joins the distribution system. When this air valve, and the drain valve which is below town in the outlet pipe, were open and the supply shut off, the system could be completely drained in a very few minutes. This water was made to empty into the irrigation ditches below town. Four fire hydrants were placed as shown in fig. 5, page 11.

PROVISIONS FOR THE FUTURE

In case the supply water becomes insufficient there are three courses open to increase the supply. (1) Enlarge the settling basin and use it as a reservoir to store water during the night for use in the day. (2) Connect the four pure springs on the north side of Dry Canyon with the system at the junction. (3) Restrict the time for using water on lawns and flower beds and charge a certain rate per square yard and allow a fixed number of minutes for each one hundred square yards.

MAINTENANCE

The cost of keeping the system in repair is practically nothing. Every family applied for water when the system was completed. Since no more than one or two new families per year are apt to apply for water there is no need of a city water master, but the irrigation company handles the matter without pay.

PAYING OFF THE BONDS

Provisions have been made to pay off the bonds as follows. Each family is charged fifty cents per month for a hydrant, and a little more for the inside improvements. Three cents per head per month for horses,

cows, and sheep and a small field for lawn, flower beds, and vegetable garden completes the family bill. The net income is a little over nine hundred dollars per year, which as is seen, will pay off the bonds in eight years. After that time they will have practically a free water system. (See note 2, page 12.)

CONCLUSION

The system is a complete success, and when compared with what they have had to use for many years is very highly appreciated. In the past, though they lived under unsanitary conditions, their health has been comparatively good.

Forty years ago there was hardly a good home in the place but about ten years ago some of the most energetic citizens began improving their homes until at the present time the modern home has crowded out the old adobe low ceilinged, small windowed, shacks. Five years ago they applied to the Rocky Mountain Bell Telephone Company for a line through their town, but were refused. They put in a local system and run a line twelve miles to the nearest bell company's station. As a result they have a good home system at a rate of about twenty cents a month and can talk from their once isolated berg to any town in the state for the same cost at which other people can, less the charge of the twelve miles of their own line. The "big company" tried to buy them out but they are not ready to sell. The reason is evident.

Last year they have used the power of the lower part of their irrigation canal and have installed a splendid modern electric lighting plant.

The writer of this thesis is very glad indeed to have been in a measure way, the means of assisting them in their growth and development.

NOTES

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Note 2. Called Dry Canyon because it was dry during the whole year except in times of quick thaw or sudden storms. The water from the springs as a rule, never reached more than a few hundred feet down the canyon.

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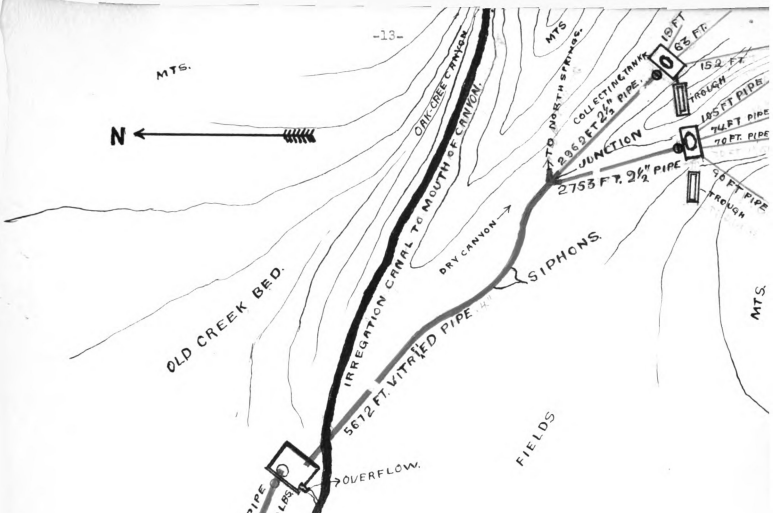
Note 6. Most of the cities in this country are heavily bonded for twenty years for water supply and though the cities are larger than Oak City, the cost is a great deal higher per capita. This will require a heavy water rate for twenty years, and before that time, extensions will be made which will probably call for more bonds.

Note 7. There is practically no change in the temperature of the water during its journey down the canyon. The temperature was 10 degrees above freezing, hence no inconvenience was found by ice in the overflow tank.



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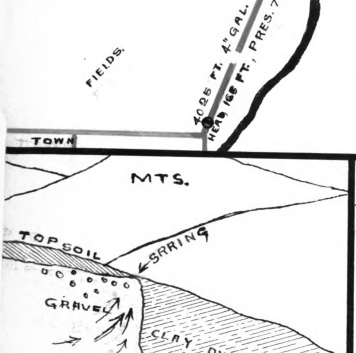

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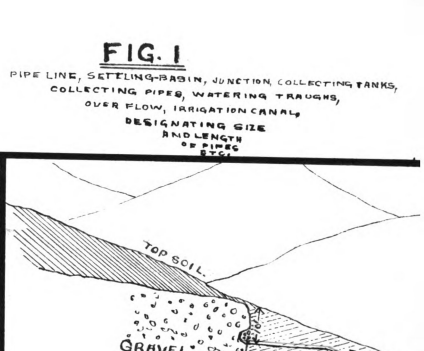
SHOWING SECTION THRU SPRING ⊥ TO CONTACT OF GRAVEL & CLAY.



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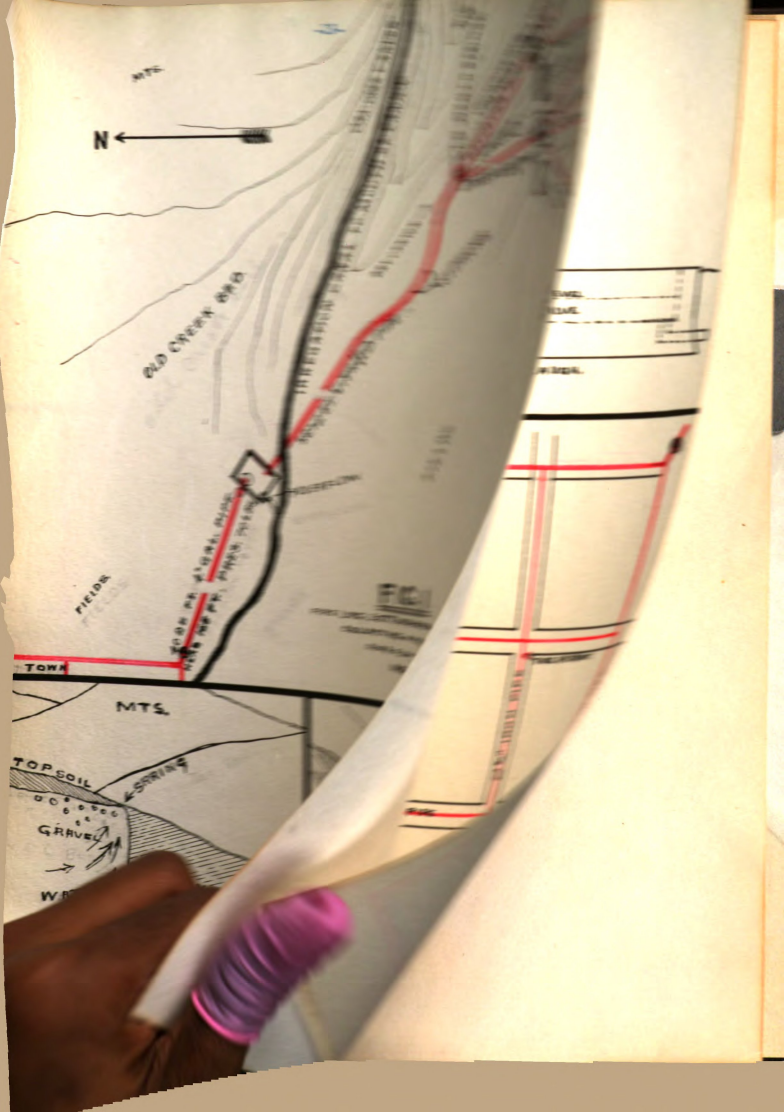
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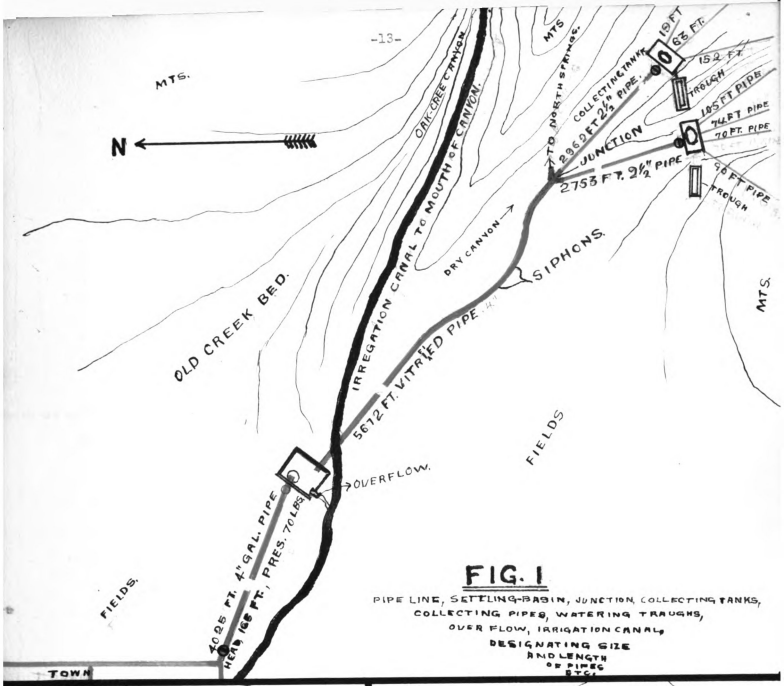

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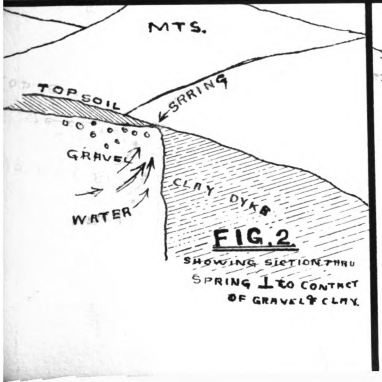

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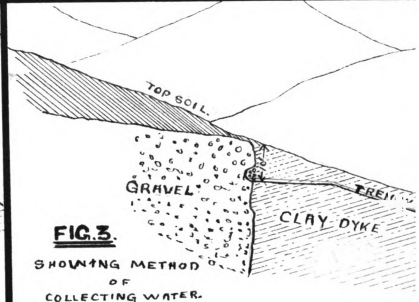

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SHOWING METHOD OF COLLECTING WATER.

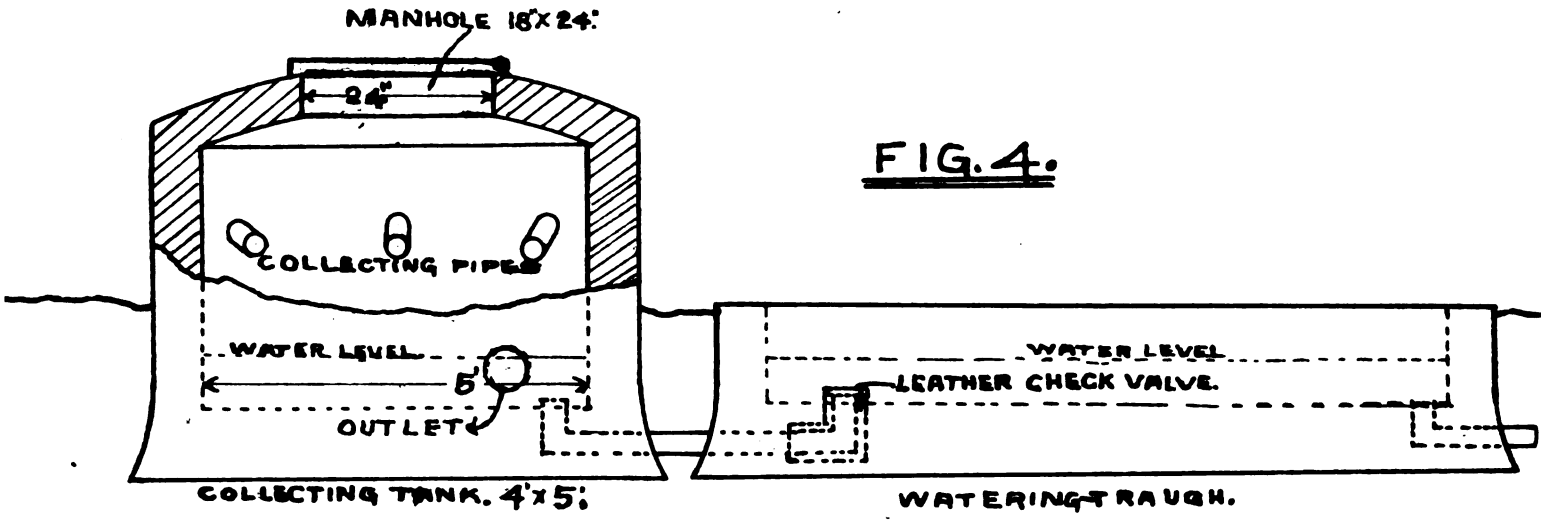

FIG. 4.

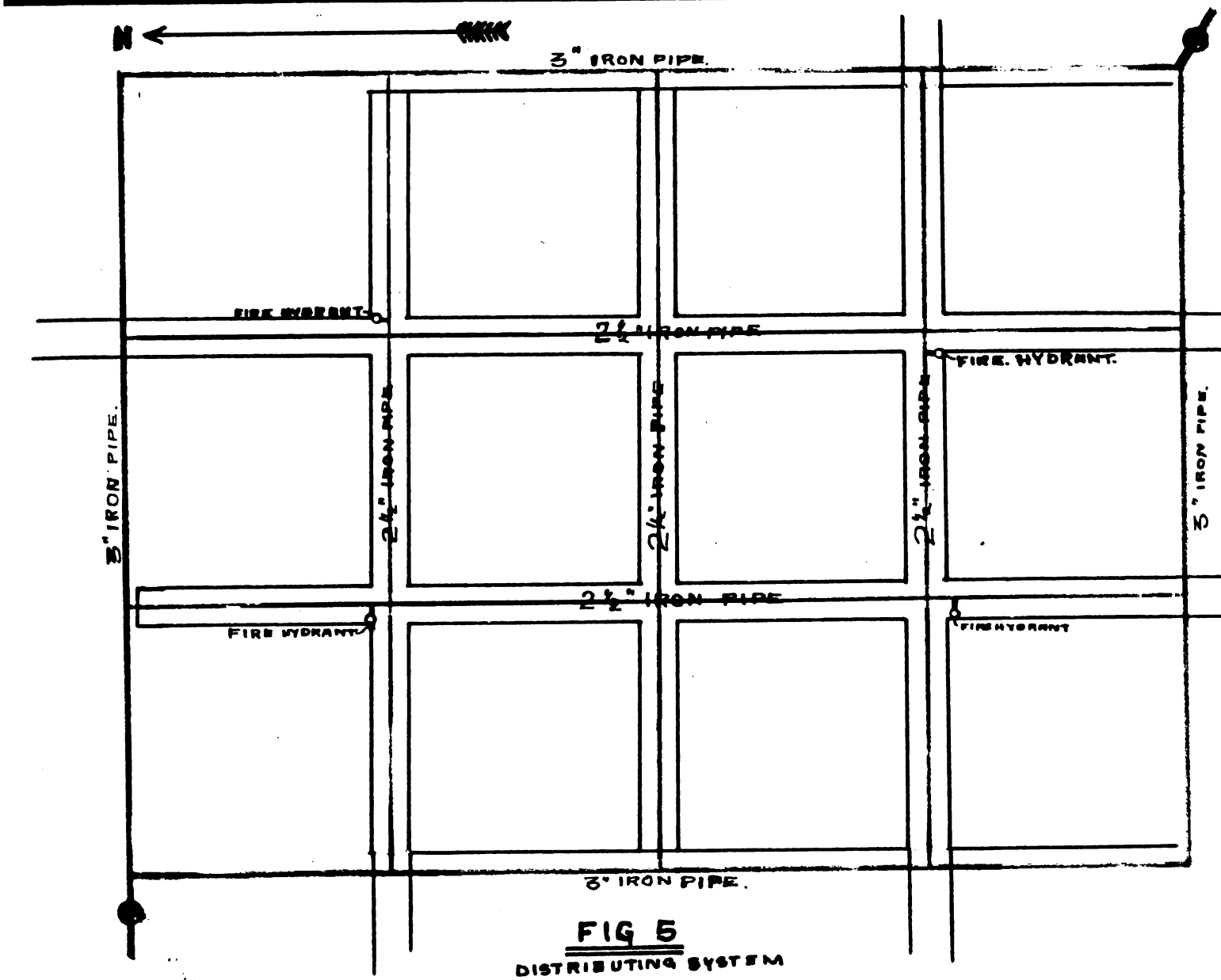

FIG 5

DISTRIBUTING SYSTEM

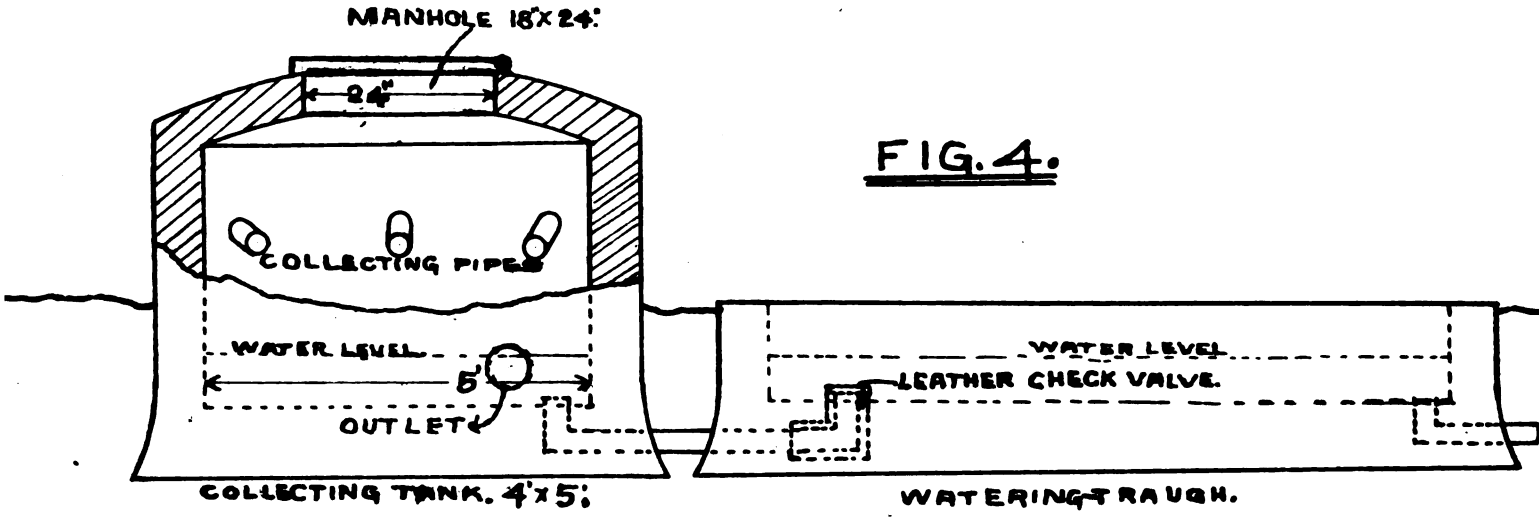

FIG. 4.

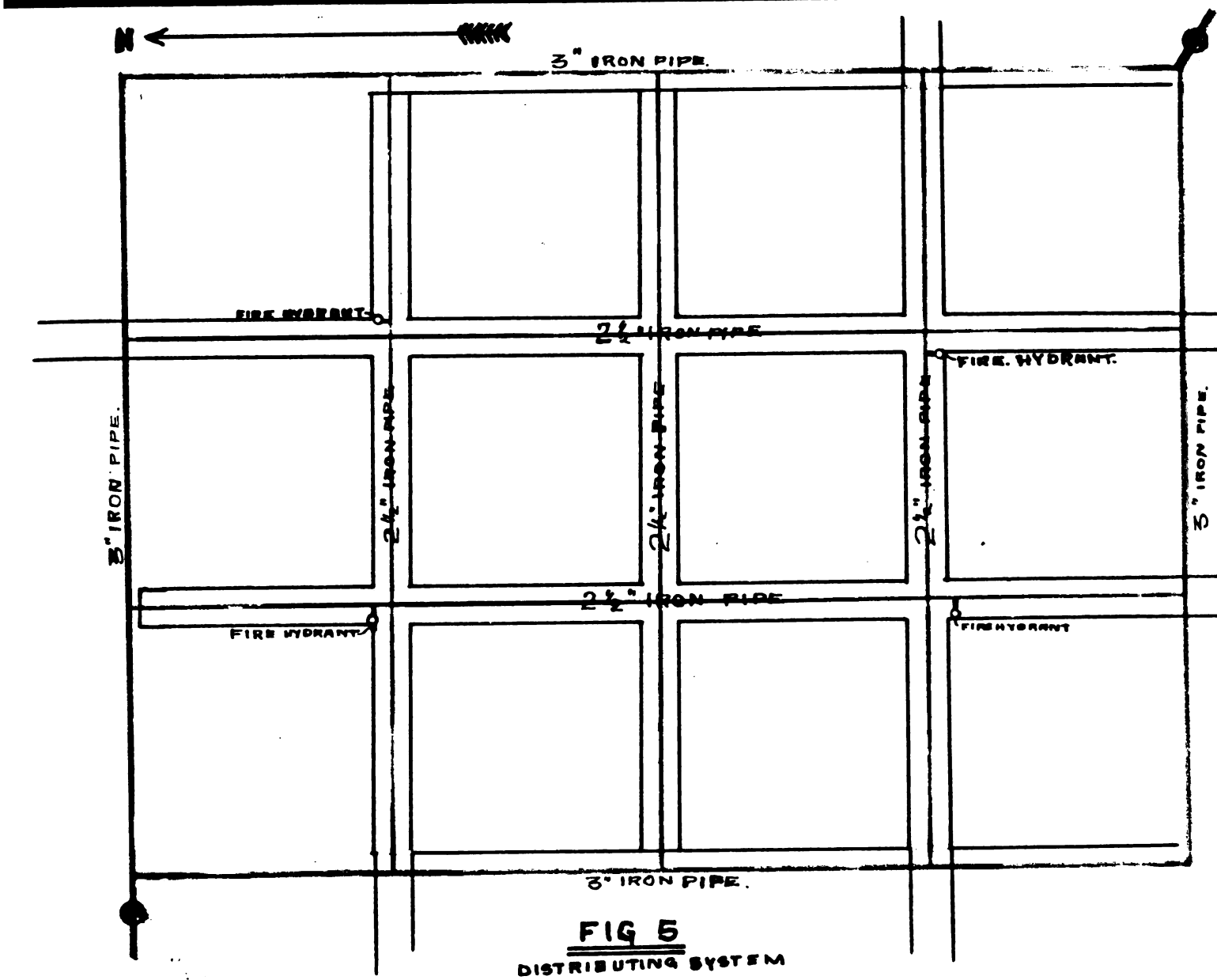

FIG 5

DISTRIBUTING SYSTEM