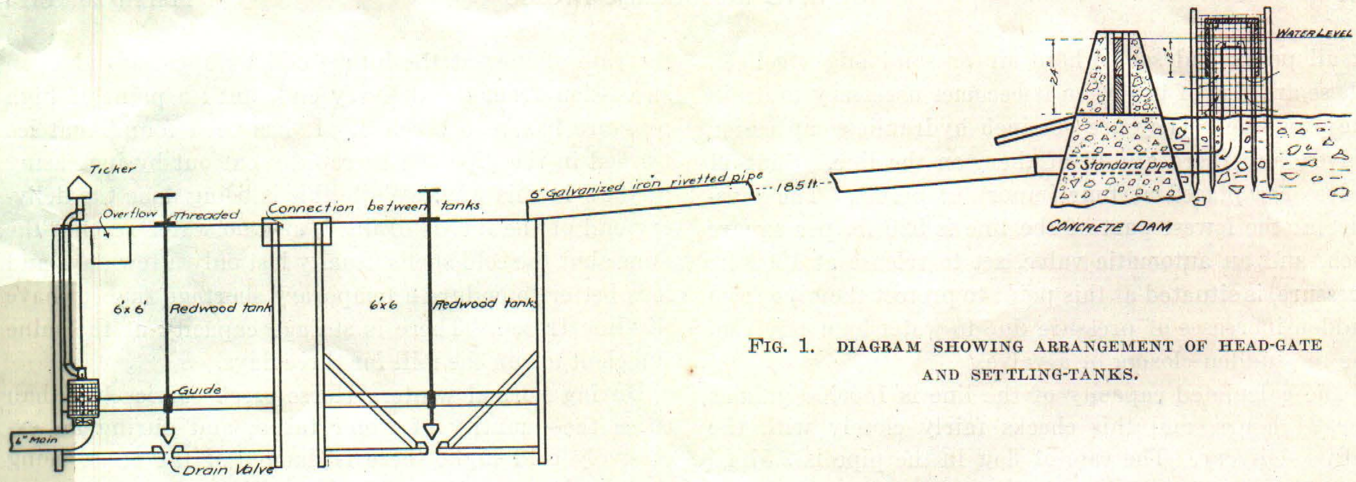

FIG. 1. DIAGRAM SHOWING ARRANGEMENT OF HEAD-GATE AND SETTLING-TANKS.

The Nevada Wonder Pipe-Line

Automatic Devices for Checking Interruptions to Service

By J. A. Burgess

A GEOLOGIST, in writing of the mineral resources of California, mentioned water as the most important mineral. It is not usual to think of water in this way, but the geologist's remark was strictly true, and would apply with equal force to the entire world. The truth that he stated is most appreciated in localities where water is scarce; and in the oases of the arid regions, where industry depends on a scanty water-supply, it is not uncommon to hear recognition of the fact openly expressed.

An ample supply of water is particularly necessary for mining and milling plants and in some localities it has to be brought for a great distance at big expense. Any interruption of the supply causes a corresponding cessation of milling operations, and therefore every possible precaution should be taken to insure against such a contingency. This paper describes the means used for this purpose at the Nevada Wonder mine, at Wonder, in Churchill county, Nevada.

The pipe-line was laid in the latter part of 1910. It conveys water by gravity-flow from Horse creek to the mine, a distance of 10 miles. It is in the form of a broad letter U. From the point of intake the course of the line leads downward through a valley until a point 2135 ft. below the intake is reached; thence it rises to the storage-tanks at the mine, where the elevation is only 465 ft. lower than the intake.

The line is built of standard, guaranteed full weight, steel pipe, with screwed joints. The same kind of couplings are used as on extra heavy pipe. The flanges and valves of the original equipment were of the type known as 'hydraulic,' but on all subsequent repair-work 'ammonia' flanges were used. The pipe was dipped in asphaltum before shipment by the manufacturer. The diameter at the intake is 6 in., reducing to 5 in. at 500 ft., and to 4 in. at 1000 ft. It has a covering of from 10 to 18 in. of soil. Air-valves and drain-valves are placed

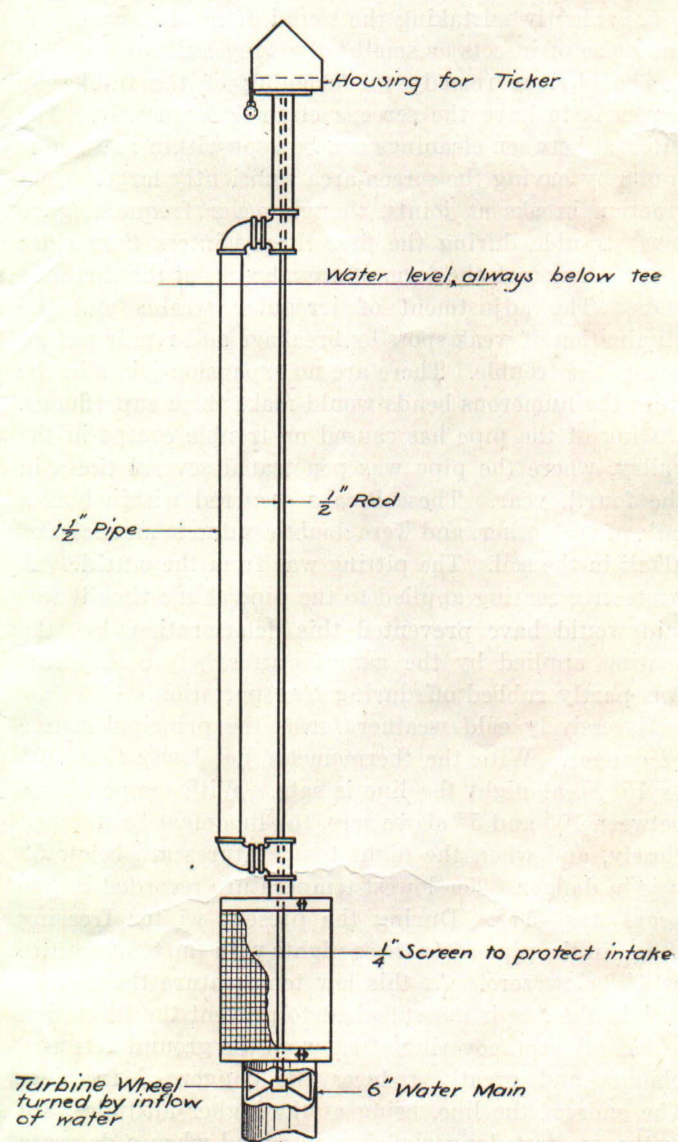

FIG. 3. TELEPHONE FLOW-INDICATOR FOR INTAKE OF WATER-MAIN.

at all peaks and sags where air or sand might collect. These are also of use when it becomes necessary to drain the pipe-line. They are one-inch hydraulic-compression valves, and there are 46 of them on the line. Shut-off valves are placed at four important points. The pressure at the lowest part of the line is 920 lb. per square inch, and an automatic valve, set to release at 1000 lb. pressure, is situated at this point to protect the pipe from sudden increases of pressure due to water-hammer from the too sudden closing of a valve.

The calculated capacity of the line is 185,000 gallons per 24 hours, and this checks fairly closely with the actual delivery. The rate of flow in the pipe is 2.57 ft. per second.

The chief sources of trouble are clogging of the intake-screens by leaves, breakage of the pipe at joints by longitudinal contraction in cold weather, pitting by corrosion, stoppage of the flow in the creek by freezing, and freezing of water in the pipe. Uncovering of the line is brought about by cloud-bursts, by cattle using the mound for a trail, and by badgers digging off the covering, evidently mistaking the sound of flowing water for the noise of insects or small burrowing animals.

The obvious remedy for clogging of the intake by leaves is to have the screens cleaned frequently. The interval between cleanings can be kept within reasonable limits by having the screen-area sufficiently large. Contraction breaks at joints, though never frequent, gave more trouble during the first three winters than since then. They took the form of cross breaks at the threaded ends. The adjustment of irregular strains and the elimination of weak spots by breakage and repair put an end to the trouble. There are no expansion-joints in the line; the numerous bends would make them superfluous. Pitting of the pipe has caused no trouble except in the valley, where the pipe was penetrated several times in the fourth year. These breaks occurred within half a mile of each other, and were doubtless due to an excess of alkali in the soil. The pitting was from the outside. A protective coating applied to the pipe at the time it was laid would have prevented this deterioration, but the coating applied by the manufacturer before shipment was partly rubbed off during transportation.

Excessively cold weather forms the principal source of danger. With the thermometer not lower than 10° or 15° F. at night the line is safe. With temperatures between 10° and 5° above zero, the line must be watched closely, and when the night temperatures are below 5° it is in danger. The lowest temperature recorded in five years was –11°. During the present winter freezing began in the pipe after three nights with the temperature at 4° below zero. At this low temperature the rate of flow in the line is not sufficient to prevent the formation of ice. A good covering of snow on the ground acts as a blanket and greatly reduces the danger of freezing. The ends of the line, being at the higher altitudes, are in the greatest danger of freezing; and when a decrease in the flow is observed during a cold snap, the means used to prevent a total closure of the line is to increase the rate of flow at the intake end by opening valves in succession from the delivery end, until a point of high pressure has been reached. It has been found that ice formed in the pipe can be rapidly cut out by increasing the flow in this way. While this is being done the delivery end of the line is drained, and no water reaches the mine; but the cold spells usually last only a few days and it is better to endure a temporary shortage than to have the line frozen. There is storage capacity at the mine sufficient to run the mill for three days.

During normal winters Horse creek carries less than twice the quantity of water taken, and during an excessively cold night there is danger of the creek being completely stopped by freezing. The only way to save the line in a case of this kind would be to drain it entirely.

During the unusually cold winter of 1912-'13 this line, like many others in the West, experienced disaster, and the experience of that winter suggested steps to prevent a repetition of the trouble. Considerations of expense and the necessity for maintaining a continuous water-supply prevented the deepening of the trench, but additional covering was mounded over the pipe. A telephone line was built from the head-gate to the mine, several permanent telephone stations were established, and two portable sets were provided. A flow-indicator was devised and placed at the intake, arranged so that the rate of flow could be approximately read at any telephone-receiver. A device was attached to the mine end of the line to give instant warning of a stoppage of the flow. Arrangements were made to keep a watchman at the head-gate during dangerously cold weather, and a type-written program covering every possible contingency was furnished to him, as well as to a rancher three miles below the intake, and to several employees at the mine. This program specified exactly the duties of each man in case of a threatened freeze-up, and provided for the complete draining of the line, if necessary, within an hour after receiving warning. All telephone-poles and valve-boxes were marked with consecutive numbers.

The arrangement of the head-gate and the mechanical protective devices are as follows: Fig. 1 shows the arrangement of the head-gate and the settling-tanks. The dam backs up water to a depth of two feet. Removable boards, set horizontally in grooves, afford a means of sluicing out gravel accumulated during freshets. The entire bottom of the canyon is formed of loose rock-debris and soil, and the grade is so steep that a storage-dam would be impracticable; and in addition to this the danger of cloud-bursts forms an objection to the erection of expensive headworks. For these reasons no improvements beyond those strictly necessary were made. The intake at the dam is arranged to give a constant water-level, and to take the water from a depth of 12 inches below the surface. By these means a considerable depth of ice on the dam does not interfere with the flow into the pipe, as long as there is running water in the stream. As an additional protection, the dam is boarded over in winter. Ample area of screen, ½-inch mesh, is shown sur-

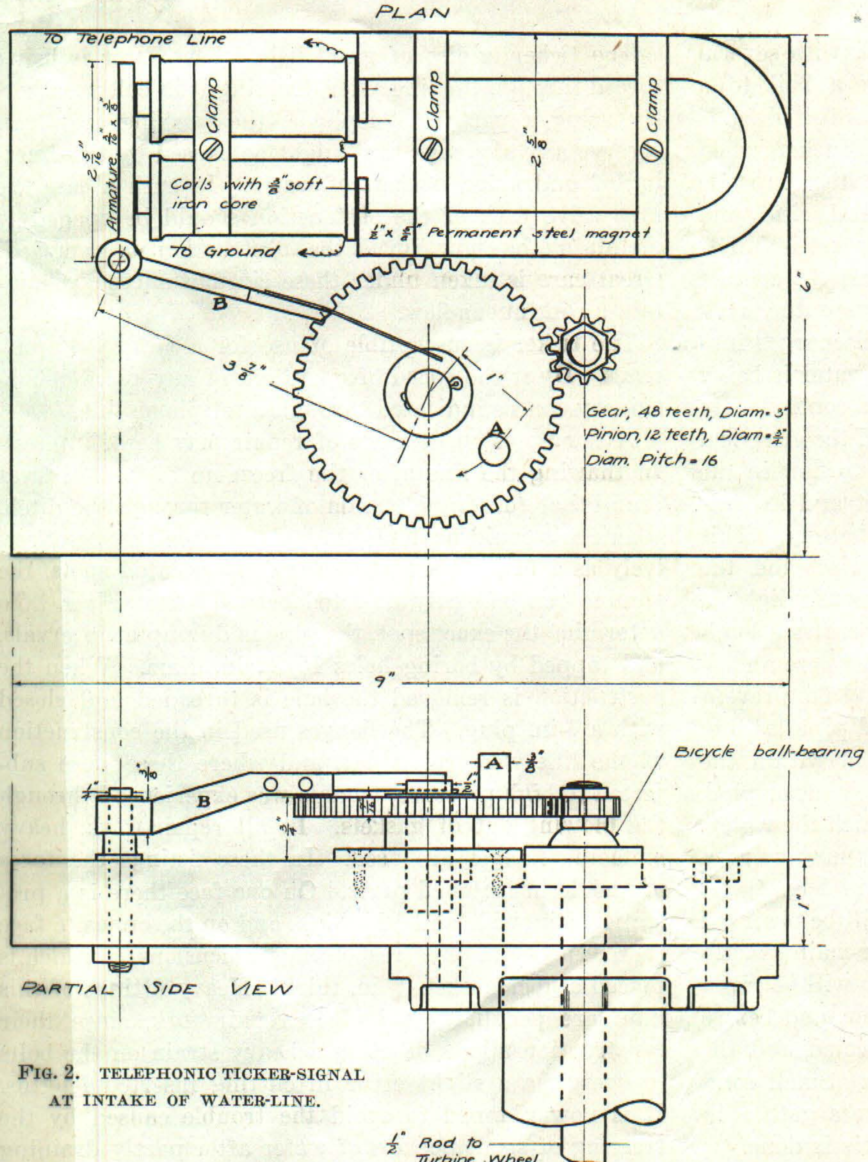

FIG. 2. TELEPHONIC TICKER-SIGNAL AT INTAKE OF WATER-LINE.

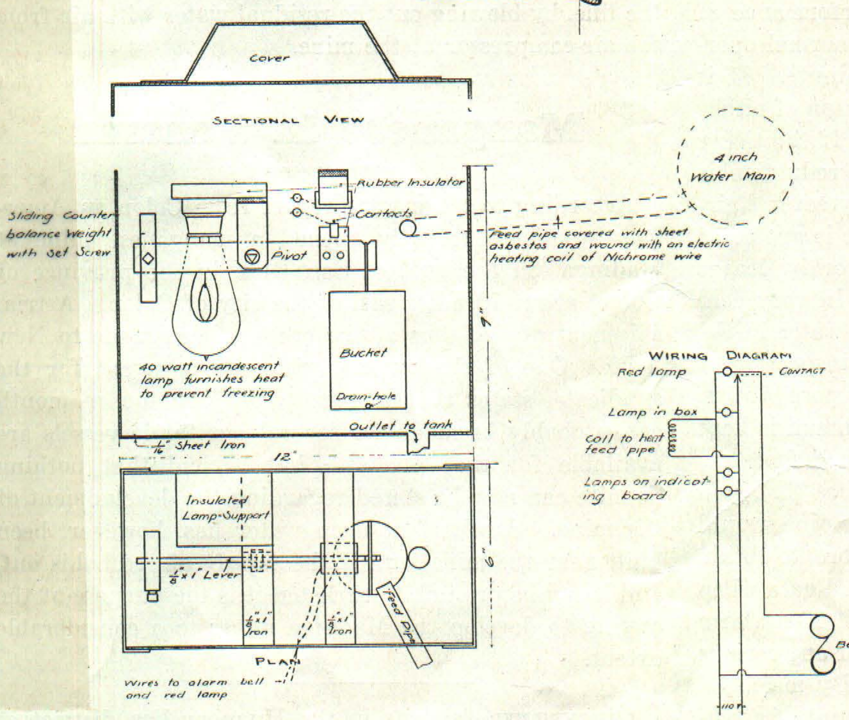

FIG. 4. SIGNAL ON WATER TANKS, NEVADA WONDER MINING CO.

rounding the intake. Two small tanks are provided for the purpose of trapping sand. The first has a conical bottom, and both are furnished with discharge plugs operated from above by threaded rods. Both tanks are covered. They are placed at the side of the canyon where only an unusually heavy cloud-burst would damage them. Delivery from the dam to the tanks was originally made through a square wooden flume, but when this became leaky, galvanized sheet-iron pipe was laid inside of it.

In Fig. 2 and 3, are shown the details of the telephonic flow-indicator, commonly called a 'ticker.' It consists essentially of a turbine-wheel just inside of the intake end of the water-main, by means of which the armature of a permanent magnet is periodically removed from its poles. The interruption of the magnetic flux induces an electrical impulse in a coil about the magnet. The coil is grounded at one end and attached to the telephone wire at the other, and each movement of the armature produces a clicking sound in the telephone receivers that is easily heard but is not sufficiently loud to interfere with conversation. The telephone line is connected with all the company telephones, so that the indicator may be heard in all offices and residences. The operation of the ticker is readily understood from the drawing. At each revolution the pin *A* displaces the arm *B*, which is integral with the armature. The bicycle ball-bearing forms a thrust-bearing that supports the entire weight of the rod and turbine-wheel, so that the lower bearing of the turbine-rod is simply a loose guide-bearing, and requires no lubrication. The only attention required by the ball-bearing for the past two years has been a few drops of oil occasionally. Its housing is kept locked. The support is made of pipe, but the drive-rod passes through only a part of its length. We ascertained that occasionally accumulations of air in the pipe-line bubbled back to the tank, and when a straight support was used, the gurgling air-bubbles entered the support and drove water upward through the bearing into the ticker. In cold weather this water froze and stopped the apparatus.

Fig. 4 shows the warning apparatus attached to the delivery end of the pipe-line at the storage-tanks. A small tin can with several punctures in the bottom is attached by a bail to a beam. The beam is supported by a pivoted axis like the beam of a pulp-balance. The bucket when empty is over-balanced by a weight at the opposite end of the beam, so that the bucket end rises and an electrical contact is made. When the bucket is full of water it over-balances the weighted end and the contact is broken. A bleeder pipe, ½-in. diam., taps the horizontal part of the water-main where it discharges into the tank, and leads to the bucket. When water is being delivered into the tank a small stream flows continuously into the bucket of the alarm apparatus, and the electrical contact is held open. If the water ceases to flow in the main pipe, none is delivered to the bucket and its contents leak out through the holes in its bottom. This permits the bucket end of the beam to rise, and the electrical contact thus established simultaneously lights a red incandescent lamp on the tank, and operates a loud-ringing polarized bell at a place in the mill where a mill-hand is always within hearing distance. To prevent freezing of the apparatus and of the small pipe leading to it, an incandescent lamp is kept lighted within the box, and a heating-coil is placed around the bleeder-pipe. Lights are maintained on the boards on which the water-level of the tanks is indicated, so that they may be read at night. The wiring diagram is shown in Fig. 4. A 110-volt alternating current is used. It will be observed that the bleeder-pipe does not tap the water-main exactly at the lower side. This is so that the alarm will be given when there is a serious decrease in the flow, and before it stops entirely. The apparatus is inspected and the bucket cleaned daily during cold weather. Small solid particles or scales from the pipe sometimes gather in the bucket and stop up the holes unless this is done.

The ticker is the pulse by which the performance of the water system may be watched. Under normal operating conditions it sounds 24 times per minute. If it works faster than this, it is a certain indication of either a break in the line or an open drain-valve. If the ticker sounds less than 24 times per minute, the reduction is due to decreased flow and may be caused by several circumstances. Except in freezing weather, it is apt to be caused either by air or sand in the pipe, or by leaves partly clogging the screens at the intake. In very cold weather it may be caused by a shortage of water in the creek or by freezing in the pipe. Only an inspection of the intake will distinguish between these possibilities, and it is partly for this reason that a watchman is kept at the head-gate during cold weather. At such times the temperature of the water in the stream is at 32°, and even a short stoppage of the flow in the pipe would result in a freeze-up. It is necessary, therefore, to obtain prompt information of conditions at the head-gate when there is any decrease of flow in the line. The alarm apparatus at the storage-tanks gives notice of any serious decrease of delivery, whatever the cause. By means of these two devices, and with a reasonable amount of attention, the danger of a freeze-up has been practically eliminated.

The ticker is also of great help when water is being forced through the line after draining it in cold weather. By using a portable telephone, the working crew can observe any stoppage that might be caused by the freezing of undrained pockets of water. In such a case the first valve back of the obstruction should be opened to maintain the flow until the obstruction is removed. Great care is taken under these circumstances to maintain a continuous flow.

The ticker is susceptible of use for a variety of purposes. By it the speed of operation of any piece of machinery can be indicated through a telephone line.

A few notes on methods of repair may be of interest. In thawing the line after the freeze-up of 1913, it was found that running a stream of water through the ditch, where this could be done, thawed the pipe just as effectively as a fire. When frozen only in isolated spots, the trouble can be easily detected between two valves. To determine the exact spot, the pipe is dug up at intervals, and tapped by boring holes 15/32 in. diam. When the obstruction is removed the hole is threaded and closed with a ½-in. plug. The flanges used in the construction of the line were faced flat, and where these were subjected to high pressure, trouble was experienced through the blowing out of gaskets. In all repair-work, heavy ammonia flanges are used. In these fittings the faces are made in matched parts. On one face there is a projection ½ in. wide and ¼ in. high, and on the opposite face there is a groove of corresponding dimensions, in which is placed a fiber gasket $\frac{1}{16}$ in. thick. Heavy fittings of this kind are peculiarly suited to repair-work, since their construction allows of using a heavy strain on the bolts to overcome a slight error in cutting inserted lengths. It is now planned to avoid the trouble caused by the freezing of small pockets of water after partly draining the line, by blowing out the residual water with air from the air-compressor at the mine.

Manganese in Panama

According to a Consular report from Colon an American syndicate recently opened a manganese mine at Madinga, on the gulf of San Blas, in the province of Colon, about 70 miles east of the city of Colon. A trial shipment of 900 tons of the ore has been made to New York. One of the owners, who acts as agent for the syndicate, states that shipments of 1500 tons a month can probably be made for several months if vessels are available for that purpose; but beyond that nothing definite can now be stated regarding the development of the mine. A wharf at deep water has, however, been built near the mine, and if the supply of ore holds out, and it can be profitably marketed it is the purpose of the owners to develop the Madinga mines to a considerable extent.

QUICKSILVER deposits in the Huancavelica district of Peru have changed hands, and mining is to be resumed by E. E. Fernandini of the American Vanadium Co.