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THE PRESENT DEVELOPMENT OF
THE
PAOLA KANSAS GAS FIELD,
with a complete description of tools used in its
development, manner of controlling pressure,
conducing, distribution and use for domestic and
manufacturing purposes.
THIRTY TWO ILLUSTRATIONS
AND ONE MAP
THE PLANT.

The tools used in sinking these wells were in all cases driven by steam. The entire plant consists essentially of a steam boiler for generating steam for all purposes, a steam engine with link for reversing, a heavy frame of timbers supporting a large belt wheel with an axle and iron crank, the crank by means of a connecting rod gives motion to a heavy walking beam at the upper part of the frame, a derrick sixty feet high supporting the pulleys and blocks necessary for the manipulation of the tools, and the drilling tools proper consisting of Drill bits, Auger stem, Sinkerbar, Jars and Ropesolet.

To these may be added, Drums for the proper manipulation of the cable and pump line and a set of Fishing tools for recovering any parts that may be by accident lost while sinking the well. These consist of a Spring Grapple, Spear, Spud Bar and Rope Knife.
The Boiler as now made and used is of the Locomotive type and so arranged as to be used either for solid or gaseous fuel; the general plan of this boiler is shown in figs. 1 and 2, the single peculiarity of construction being that for the use of gaseous fuel there is added to the lower inside rim of the fire box a flange partly covering the grate area and reducing it to a width of sixteen inches. By this securing the more complete utilization of the heat of the gas, there is also a hole put through the water lining of the fire box below the fire door for the purpose of inserting the gas pipe connecting with the burner.

The Burner is made from a piece of one inch gas.
pipe inserted through the opening in the front
water lining and extending to the opposite end of the
firebox. This burner is made by perforating the pipe
with three longitudinal rows of holes as shown in
Fig. 3. The holes being one inch apart and one tenth
inch in diameter set diagonally, the row of holes at
each side being placed at an elevation of 75° from the
horizontal plane passing through the axis of the pipe
the centre line of holes being midway between these.

The Engine used is of the ordinary double acting
centre crank class solidly built with a heavy fly
wheel on one side and a pulley of 24" diameter
and 10" face on the other. The engine is of a plain
neat pattern and heavily proportioned to resist the
constantly repeated change of strains and heavy
Service incident to the process of Drilling.

The ordinary slide valve is used with double excentric
and a drop link which is controlled by the person operating the drill through the medium of a cord attached to the top part of the link running over a pulley directly over the link and thence forward to a convenient position near the drill.

The throttle valve of the engine is also under the immediate control of the operator by means of a cord connecting two grooved pulleys one of which is situated within his reach and the other takes the place of the ordinary wheel of the globe valve throttle. By this means any movement of the grooved wheel by the operator will produce a corresponding movement of the throttle wheel.

Thus by means of these two cords the motion of the engine is under the complete control of the operator. Figs. 4 and 5 will show the construction described.

The foundation of the entire structure is built of heavy timbers, that supporting the several countershafts and
The walking beam is made of timbers 12 by 18 inches. Fig. 6 gives a general view of the construction drawn to scale in which B B &c. are the sills to which also the other parts are securely fastened. C is the walking beam pivoted at I and connected to the crank G by the connecting rod F. D is the temper screw having pivoted to its lower end the rope clamp E. The main wheel A receives motion from the belt wheel of the engine by means of the belt H. This wheel is 8 ft. in diameter and besides the belt surface contains also a groove for a 2 inch rope running forward to the derrick windlass hereafter described. J is a friction wheel secured to the shaft of the sand pump windlass which by means of the levers pivoted at K and N and the connecting rod I is brought in contact with the belt surface of wheel A by this means securing the most rapid movement of the sand pump.

The large derrick windlass is situated on the side
of the derrick opposite the engine and parallel to
the shaft carrying the large wheel of the frame so
that the hawser rope can be readily placed upon
the grooved wheels for the purpose of raising the
tools, for the purpose of raising the tools the connecting
rod E is removed from the crankpin thus allowing
a faster motion of the engine for that purpose.

Fig. 7 gives a general view of the arrangement of
the plant, the derrick being built of pine lumber
and is either nailed or bolted the plan of bolting
being considered the best as it can then be taken apart
and readily removed to another location. The corner
posts are made of 2" x 10" pine lumber set edge to edge
and at right angles, each alternate piece overlapping
the joint of the other side. The cross braces are bolted
at their ends to the joints of the corner pieces and
to the middle of the pieces on the other sides.
being fastened by a bolt at their point of crossing.

The top of the derrick supports two sheaves each twenty-four inches in diameter, one for the 2½" Hawser-Laid rope for the tools and one for the 1" Hawser-laid sand pump line.

The Drill proper consists of five pieces, the drill bit, auger stem, jars, sinker bar and rope socket.

Drill Bits are of various shapes depending upon the qualities of the stratum through which they are required to work. The different kinds of bits are shown in Figs. 1 to 3. Fig 1 shows the standard shape for all strata and is known as the chisel bit. The Spud Bit Fig 2 is used in drilling through the looser stratum of the upper part of the well. The 2-Bit Fig 3 is very rarely used in drilling deep wells. Fig 4 is the Spud Bar and is used in loosening the tools that may happen to be by accident lost in the well and become fastened.
by the settling of sediment about them, it is made of a bar of flat iron six inches wide by one-inch thick and ten feet long, pointed with steel and formed into a crescent shape so as to work more readily around the tool.

Fig 5 the Mud socket is used in removing rough mud or any material that can not be removed by means of the sand pump, it is usually made of a piece of 3½" casing 70 to 78 feet long fitted with a shoe and hinged valve at its lower end and having a part of a knuckle welded to its upper end, it has a small opening at its upper end serving as a vent. This tool is used in the place of a bitt and is driven into the material to be removed by means of the jars and sinker bar hereafter described, on removing it the valve closes by pressure from above thus retaining the material until raised to the surface.

The auger stem Fig 6 is made of iron 3½ inches diameter and fifteen feet long, it has a screw box on
Fig. 4

Fig. 5

Spear

Grapple

Rope Knife
one end and a screwed pin at the other. These screws being either cylindrical or conical. The standard screw is a conical one having a pitch of six threads per inch.

The Jars Fig. 7 are made very heavy weighing from three hundred and fifty to four hundred and fifty pounds and are fitted with box and pin connections as shown. Fig. 8 shows the Sinker Bar made of 3½ inch round iron with connections as in the auger stem and has a length of ten feet, to the top of this is screwed the Rope Socket of which there are several kinds as shown in Fig. 9. 10. 11. Fig. 9 shows the common two leaf socket in which the rope is fastened by means of rivets as shown. Fig. 10 shows the socket made of a piece of round iron with the end bored to the depth of twelve inches and slotted the rope being also held by rivets. Fig. 11 shows a form differing from the last only in having the hole drilled to the
Depth of twenty inches and without slotting, the rope being driven into the socket and all strain supported by friction alone. Fig 72 shows the rope knife.

Adding together the lengths of the different parts we have a total length of forty feet and an approximate weight of 7200 pounds.

The operation of drilling is begun with this string of tools the broad bit being attached if as is usually the case there is any earth to be passed through, this being quickly accomplished and a firmer substratum found the upper part of the hole is thus far secured by means of a heavy curb of wood usually being made of 2" by 12" pine, four pieces being spiked together leaving an ample opening for the subsequent operations of drilling and clearing out to be carried on.
If during the descent of the drill a stratum be found which
is of the nature of quicksand or will not retain the shape
of the hole the casing is sunk reaching from the top of
the ground to the bottom of the casing stratum and the
drilling is continued inside the casing with a smaller
drill, the first casing put in in such cases is the standard 5%
in casing inside measure. Any casing subsequently used will
necessarily be of smaller diameter unless as is sometimes
done the large casing be first removed and the small part
of the hole reamed to the standard size.

Fig. 78 shows the Reamer used in this operation.
The plant being in position the operation of drilling
may be thus described

The drill being suspended and touching the ground where
it is desired to begin operations, a rope is carried from the
crank A of the wheel A to a convenient point on the rope
The motion of the crank pulls the rope sideways and thus
raises the tools. The rotary action of the crank resulting in
the raising and lowering of the drill. This connection is
retained until the drill is lowered sufficiently to attach
the rope clamp and temper screw shown in fig. 6.

During the descent of the drill it is kept rotating by means
of the clamp shown in fig. 7. This being used until the rope
clamp and temper screw are attached. The amount of this
rotation is determined by local considerations and at each
stroke of the drill is 1/6 to 1/8 of a revolution. After it has been
turned six to ten times in one direction it is turned
in the opposite direction through the same number
of revolutions in order that the rope may not be too
much twisted in one direction. Fig. 75 shows the plan
of beginning operations in which A is the crank, AB
the connection to the working cable, B is the brake for
lowering the tools. After the stage of progress shown has
been reached the walking beam is attached by means of the
Connecting rod to the crank, the rope is placed in the clamp and by these connections the future operations of drilling are carried on. The hole is cleaned out as often as is found necessary to keep the drill in good working condition usually after a space of several feet has been passed, this is done by means of the sand pump and line shown in Fig. 8.

The drilling is continued with varying speed according to the consistency of the strata passed through until the gas bearing vein is found. This depth being in the Paula field from 350 to 500 ft. The well is then cased with the standard 5½ inch casing to the top of the ground and a connection made with the gas main leading to the city.

The tools used in the work of casing up the well are shown in Figs 16 and 17 to 19.

Fig. 16 shows the casing tongs used in screwing the pipe together. Fig. 17 shows the casing swivel. Fig 18 shows a section of casing to one end of which a coupling
Sand pump

Fig. 16

Fig. 17

Fig. 19

Fig. 18
is securely fastened. Fig. 19 shows the Casing clamp.

The operation of casing the well may be thus described.
The casing clamp is placed in position over the hole, the casing swivel screwed into the coupling, raised to swing clear of the floor, lowered through the clamp until it rests on the lower side of the coupling and is then securely clamped by means of the bolts passing through the clamp.

The swivel is then removed and another piece of casing hoisted to position and screwed snugly to the lower piece. The whole is then lowered and clamped as before. This operation is repeated until the entire well is cased.

After the well has been secured and the flow of gas is reasonably certain the well is connected to the main.

In some localities the gas and salt water are found so near together that the water rises to such a height as to seriously impair the flow of gas, or if surface veins of water are abundant the well may be so filled as to entirely obstruct
the passage of the gas. In such cases to secure the flow of gas and shut out the water, packers are used when the space between the water and gas veins is sufficient to allow their use. These packers are made of rubber or leather.

In packing against surface water the seed bag packer is sometimes used for shallow wells. It is simply a leather case 7 to 8 inches in diameter and 3 to 6 feet long secured firmly to the outside of the casing and filled with flaxseed. This is lowered to the position to be occupied a few inches above the gas bearing vein and left to swell thus closing out the water. If the water rises from below the hole is either plugged or a packer inserted below the gas vein.

Fig. 20 shows the seed bag packer fastened in position on the casing, being slotted at its lower end to admit the gas.

Fig. 21 shows a rubber packer described as follows. A piece of pipe is taken of smaller diameter than the
Casing, this is slotted at its lower end and has a heavy flange screwed to its base on which the casing rests when in position, at a suitable height above the bottom a flange is secured to which the lower end of a corrugated rubber tube is fastened by a riveted band. The smaller pipe extends high enough to pass the length of the corrugated tube and some distance into the casing above, to the upper end of the corrugated tube is secured a flange similar to the one at its lower end, into this flange the lower end of the casing is screwed the small inner pipe passing through it with an easy fit. This packer is secured in place by simply lowering the casing into position the weight of the casing being sufficient to force out the corrugations and secure a firm packing.

The pressure in these wells is from 40 to 725 pounds static when first made. The usual manner of testing pressures
is by means of a common steam gauge or other pressure gauge, for wells of 80 to 100 feet depth I have successfully used an open manometer and have found pressures (static) of 7 to 15 pounds, these pressures are found in wells of this city, Harrisonville Missouri 50 miles east of Paola Kansas.

In order that the gas may be used to advantage the pressure must be reduced to an average of five ounces, for this purpose a reducing valve is used which may be described as follows.

It consists essentially of a Balanced valve and a Diaphragm for operating the valve automatically. In the drawing A is the diaphragm and B the balanced valve C is a weighted lever by means of which the pressure in the main can be increased or diminished at will. The gas enters at B in the direction of the arrow. The normal position of the valve is such as to close the opening entirely. The weight of the lever being entirely removed, when it
becomes necessary to use the gas the weight is moved to such a position as will give the desired pressure. At first the gas enters with a rush but as the main gradually receives the pressure the space above the diaphragm communicating with it secures the downward motion of the diaphragm thus diminishing the flow as the pressure is increased until the desired pressure is reached.

A pressure gauge and safety valve are shown at D by means of which the variations of pressure if any may be noted and corrected.

The gas is conducted to the city from the wells through a 3½" main, the distance from the Westfalls group of wells is seven miles. Another group of wells has been made near the old pipeline and within two and one-half miles of the city. The Westfalls group was made during the years 1882—89 and consists of 74 wells & utilized.

The pressure [static] in these wells was 65 to 725 pounds
The pressure in the later group was 40 to 125 pounds. Through friction in the main which consists of 3 1/2 inch casing and reduction of pressure from the flow this pressure is reduced to 25 pounds at the regulating valve situated about 3 1/2 miles from the city square where it is further reduced to 5.02. to adapt it to the domestic and industrial uses in stoves and furnaces.

The number of stoves supplied by this company in the city is 600. Besides this, gas is furnished to the roller mill of T.S. McLachlin capacity 125 barrels, to one Handle Factory, 20 HP Engine, and to one Glass Bottle factory having six melting pots four Glory Holes [3 apertures each] and two annealing furnaces.

Gas is also furnished for lighting purposes to the principal parts of the city and to private houses. For street lighting the common 20 candle Tarabip and the Maxim burners are used. For interior lighting the Argand burner is preferred.
Stove Burners are of various patterns to suit the size and shape of the various stoves in use. A very good burner for all purposes is made of steam pipe and fittings as shown in Fig. 22, the pipe being perforated either by punching or drilling longitudinal rows of holes, of other patterns we may note a few that are supplied to the trade from eastern manufacturers. Figs. 22 and 25 are long burners for cooking stoves, the round burners Figs. 23 and 24 are for heating stoves.

To insure complete combustion Air mixers are used, these are also of various patterns. Each consists essentially of a small aperture for the admission of gas and a suitable opening for the admission of air in sufficient quantity to produce combustion.

Fig. 26 shows the Globe pattern. Fig. 27 the Kittanning pattern is the simplest and considered the best.

Fig. 28 shows the application of the Air mixer and
Burner to a heating stove and is sufficient to indicate their application to all classes of stove burners.

The construction of Boiler furnaces and modifications of plan for the purpose of using gaseous fuel may be shown in fig. 30. The case in point is that of the McDachlin Bros Mill, in the figure A shows the lead pipe consisting of 1¾ inch steam pipe connected to the gas main and having four adjutages like B attached, B is the boiler. C is a four inch glazed sewer pipe three feet long arranged as an air mixer. D is a combustion chamber arranged from the furnace proper by covering the grates with firebrick or a slab of Boiler iron covered with clay. E is a perforated wall of firebrick built hard against the boiler and taking the place of the bridge wall. It is built up as loosely as possible so as to allow of
Sufficient draught. The furnace front has two doors each of which is filled with firebrick but having each two pieces of sewer pipe [glazed] inserted at the height of six inches from the grate. Into the centre of the outer end of these tubes projects a tube of steam pipe whose opening at 6 is 1/4 inch diameter. These four jets under a pressure of 500 lbs give heat sufficient to run the mill.

The plant of this mill consists of one 125 horse power boiler. One Buckeye automatic Engine 92 horse power, Six and one half Sets Rolls, One Sett Burrs and the necessary cleaning and purifying machinery.

The mill has a capacity of 725 Barrels per day of 24 hours. There are other small furnaces in the city supplied by this company but the furnace described may be taken as a representative one.

The principal industry in the city however is
the Glass works situated in the North-East part of
the city whose furnaces are supplied from the
mains of this company.

The plant consists of one Hexagonal six pot melting
furnace, four Glory holes for finishing and two Annealing
furnaces. The entire arrangement is shown in the
drawing. A is the furnace with the opening B in the
centre which communicates with the pit below in which
the gas is controlled. Combustion takes place in the mouth
of this opening the products striking the arched top and
are then reflected to the melting pots arranged at the
sides. C, c.c.p. are Glory Holes. E, E. Annealing furnaces,
I shows the pit in which is situated the burners
and gas regulating valves of the main furnace. The
gas is conducted to the furnace through a three inch
main from this it is distributed to the different
furnaces as shown in fig. 37. The burners used are
shown in Fig. 32 being a modified form of the
Bunsen Burner used in our Laboratories and consists
in this case of a conical tip screwed to the end of
an inch and one quarter pipe, near the end of this
tip is made a series of oblong holes to match the
similar openings in the sliding tip that slips over
it, by simply turning the outer tip the supply of air
to the burner is regulated at will.

The accompanying map gives the approximate
positions and distances of the wells together with
pipe lines connecting with the city.