The Ohio River Dam and Lock No. 37, Near Cincinnati, O.

One of the most important works now under construction for the improvement of the Ohio River for purposes of navigation is the dam situated a few miles below Cincinnati. This is a movable dam, and as shown in the general plan and profile, Fig. 1, it consists essentially of three parts: (1) the Chanoine movable wicket dam, 900 ft. long, for the navigable pass or channel; (2) three 80-ft. bear-trap dams on the Kentucky side; (3) a lock 100 x 600 ft. on the Ohio side. It has the distinction of being the longest movable dam in the world. Heretofore, a length of about 700 ft. has been considered the maximum that could be operated reliably, but in this case the movable portion will have a length of 900 ft.

The improvement of the Ohio River for navigation was described at some length in our issue of Oct. 8, and it was shown that the present scheme of improvement provides for a series of 54 dams and locks to maintain a minimum depth of 9 ft. at low water. The Ohio River traffic is peculiar in that it consists mainly of fleets of barges. Each fleet is composed of a number of barges lashed together side by side and end to end to form a floating mass that is handled by a single steamer or tow boat. During a considerable part of the year the river is available for open navigation, and the construction of fixed dams would involve serious trouble and delay in passing the fleets through the locks, while it would destroy the extremely low cost of transportation which has been obtained by this system of handling the traffic.

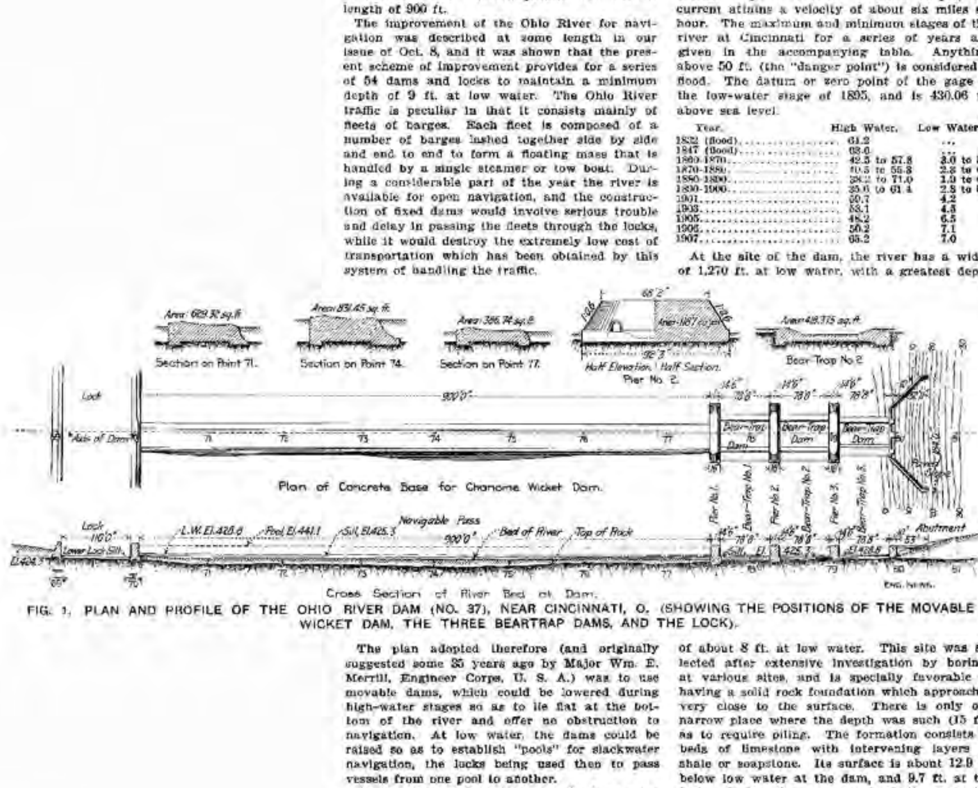

FIG. 1. PLAN AND PROFILE OF THE OHIO RIVER DAM (NO. 37), NEAR CINCINNATI, O. (SHOWING THE POSITIONS OF THE MOVABLE WICKET DAM, THE THREE BEARTRAP DAMS, AND THE LOCK).

The plan adopted therefore (and originally suggested some 35 years ago by Major Wm. E. Merrill, Engineer Corps, U. S. A.) was to use movable dams, which could be lowered during high-water stages so as to lie flat at the bottom of the river and offer no obstruction to navigation. At low water the dams could be raised so as to establish "pools" for slackwater navigation, the locks being used then to pass vessels from one pool to another.

At the present time there are six dams completed, while work is in progress on others. In each case there is a movable dam of the Chanoine wicket type for the navigable pass or channel, a weir of the wicket or bear-trap type for regulating the level of the upper pool, and a masonry lock for use when the dam is raised. The locks are made unusually large (110 x 600 ft.) in order to handle rapidly and economically the barge fleets mentioned above.

The largest of these dams is No. 37, situated opposite the town of Fernbank, O., about 12 miles below Cincinnati (and 481 miles below Pittsburg). It is about 7¼ miles above the mouth of the Big Miami River. The construction of this dam will form a pool extending about 23 miles up the Ohio River, and will greatly increase the importance of Cincinnati as a river port. Instead of an ever-varying water level, and interference with traffic by low water, there will be a slackwater pool with a minimum water level sufficient for navigation at all times. The surface of the upper pool will be 441.1 ft. above sea level, or about 11 ft. on the river gage. The low water elevation at the dam is 428.8 ft.

In view of the great variation in river level, the swift current, the amount of floating material (brush and ice), the amount of silt held in suspension, and the great volume of water passing at flood stages, it is important that the dam should interfere as little as possible with the natural conditions of the river. The movable dam meets this requirement, as well as the requirement for free navigation at high water.

The maximum range of water level in the Ohio River at Cincinnati is 69 ft. between the extremes of high and low water. The average annual range is 47.7 ft. At flood stages, the current attains a velocity of about six miles an hour. The maximum and minimum stages of the river at Cincinnati for a series of years are given in the accompanying table. Anything above 50 ft. (the "danger point") is considered a flood. The datum or zero point of the gage is the low-water stage of 1895, and is 430.06 ft. above sea level.

Year.	High Water.	Low Water.
1832 (flood)	61.2	...
1847 (flood)	63.6	...
1860-1870	42.5 to 57.8	3.0 to 5.7
1870-1880	40.5 to 55.8	2.8 to 6.2
1880-1890	38.2 to 71.0	1.9 to 6.1
1890-1900	35.6 to 61.4	2.8 to 5.5
1901	50.7	4.2
1903	53.1	4.5
1905	48.2	6.5
1906	50.2	7.1
1907	65.2	7.0

At the site of the dam, the river has a width of 1,270 ft. at low water, with a greatest depth of about 8 ft. at low water. This site was selected after extensive investigation by borings at various sites, and is specially favorable in having a solid rock foundation which approaches very close to the surface. There is only one narrow place where the depth was such (15 ft.) as to require piling. The formation consists of beds of limestone with intervening layers of shale or soapstone. Its surface is about 12.9 ft. below low water at the dam, and 9.7 ft. at the lock. Under the upper end of the lock the thickness of the rock is about 17 ft. All the foundation masonry is of concrete, with foundations carried down to the solid rock through from 1 ft. to 15 ft. of gravel and sand forming the bed of the river.

Buildings for the power plant and the lock attendants will be located on the Ohio side, and will be built on filled ground raising them above the highest flood stage. The grounds will be graded and covered with turf, but the lower parts of the slopes will be protected by an inclined retaining wall of concrete. At the lock chamber, a space 120 ft. wide (extending to the toe of the slope) will be paved with brick, as shown in Fig. 2. Concrete paving will also be laid on the slope of the backfilling extending from the Kentucky abutment to the top of the natural bank. All this paving and protective work is to prevent the river from cutting around the dam or lock during floods when the entire structure may be covered with water.

Compressed air will be used to operate the bear-trap dams, the lock gates, and the filling and emptying valves of the lock. An 8-in. wrought iron main is carried from the power-house to a well in the land wall of the lock, and thence to an 8-in. pipe embedded in the concrete base of the lock and dam. Wherever a pipe emerges from the concrete a heavy brass sleeve connection is used, having its lower end embedded in the concrete. This provides for pipe connections in the event of the embedded iron pipe corroding and leaving only a hole in the concrete. All pipes are tested to 200 lbs. pressure just before the concrete is laid over them.

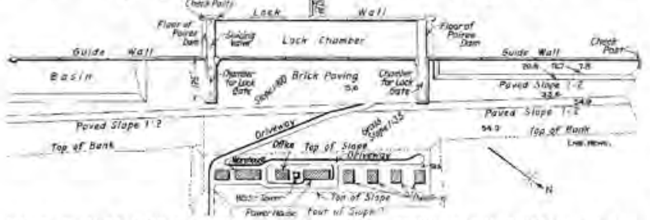

FIG. 2. PLAN OF LOCK AT OHIO RIVER DAM NO. 37. (SHOWING THE GUIDE WALLS AND THE BASIN FOR REPAIRING BARGES, ETC.).

There will be seven buildings, as shown in Fig. 2. They include the power-house, office, warehouse, and four dwellings. In order to raise them above the flood level of the river, an embankment has been built about 9 ft. above the natural surface of the ground. The concrete foundations were extended to a solid footing in the natural soil, the embankment being afterwards filled in around them. Above the grade line, the buildings will be of light buff brick, with terra-cotta trimmings and tile roofs. The power-house and warehouse will have steel roof trusses and floors of reinforced-concrete. The power-house will contain the boilers, air compressing plant, air receivers, electric light plant, pumps and repair shop, etc. There will be a sewer system and a water supply system, the water being taken from wells and pumped to an elevated tank.

The work is under the direction of Lieut. Col. Wm. T. Rossell, Engineer Corps, U. S. Army, who is in charge of the general improvement of the Ohio River. Mr. R. R. Jones is Chief Assistant Engineer. Mr. E. W. Buell is Junior Engineer and Principal Inspector in resident charge of the work. The estimated cost is $1,150,000. The dam was approved in 1902 by Congress, which has appropriated $1,150,000 for its construction. The work was commenced in 1905, and is expected to be completed in 1910.

The contract was awarded in 1904 to the Sheridan-Kirk Contract Co., of Cincinnati. This contract includes the main dam and lock (with both fixed and movable parts), the grading, road making and paving, sewers, and foundations of buildings. It does not include the steam and compressed air machinery, electric light plant, water supply and buildings. The government supplies the Portland cement. The contract aggregated nearly $800,000. Under the terms of the contract the construction was to be completed in 350 fair working days from the date of commencement. Allowance is made for a total suspension of work from Dec. 1 to June 1. Also for all other days when work is stopped by ice, freshets, etc., and for the removal and re-installation of the construction plant.

Wicket Dam for the Navigable Pass.

The length of this main portion of the dam is 900 ft., between the lock wall on the Ohio side, and the pier of the first bear-trap dam on the Kentucky side. This is the greatest length of movable dam yet built, the longest existing dam of this type being 700 ft. (Ohio River dam No. 2). The concrete base is about 45 ft. wide, and from 10 ft. to 15 ft. thick. Its surface extends but little above the bed of the river, and its sill elevation is 3.5 ft. below low-water level (Fig. 1).

As already noted, it is of the Chanoine type, consisting of a series of panels or wickets, the tops of which incline downstream 20° from a vertical plane when the dam is raised. Each wicket is pivoted horizontally at mid-height to a steel frame or "horse" whose lower end is pivoted in bearings or "horse-boxes" on the concrete base of the dam. To the upper end of the "horse" is attached the end of a wrought-iron bar or "prop" whose foot slides in a cast iron grooved guide or "hurter" embedded in the concrete. The general arrangement is shown in Fig. 3, while the details of the wickets and other parts are shown in Fig. 4.

Each wicket is 16 ft. 11 ins. long, and 3 ft. 9 ins. wide, composed of three 15-in. oak timbers, 12 ins. thick at the lower end and 8 ins. at the upper end. They are fitted together with pine tongues and secured by through bolts. At the back of each wicket are two journal bearings near the middle and two oak cushion blocks near the top. Near the lower end of the face is embedded an iron breech weight to sink this end of the wicket when closing the dam. Handle irons in sockets at top and bottom provide attachments for the hooks of chains or poles used to raise and lower the dam. When raised, a shoe plate at the back of the wicket bears against the chamfered upstream face of an oak sill capped with wrought iron plates. When lowered, the wicket lies horizontally behind the sill, with its cushion blocks resting on the concrete base.

There are 225 of these wickets. A 3-in. space is left between each pair of wickets, in order to allow free movement. These openings can be closed when necessary by inserting needles of 3-in. plank.

When the dam is raised, the foot of each prop rests in a step or seat formed in the channel of its hurter. To lower the dam, a derrick boat is floated close to the upstream side, and a man with a pole or boat hook attaches a wire cable to a handle in the top of the wicket. This cable is hauled in by a hoisting engine so as to pull the wicket slightly forward; the foot of the prop also moves forward, and is guided sideways by a groove so that it slides into the unobstructed return channel of the hurter. The cable being detached, the water pressure forces the wicket down, the prop sliding back in the hurter, and the wicket assuming a horizontal position. The water beneath the wicket prevents any shock or violent motion, and the wicket settles quietly to rest on the concrete base. In case of any failure to act properly, the foot of the prop can be lifted out of the hurter by means of a hook engaged with a notch in the underside of the prop.

To raise the dam, the derrick boat grapples for the handle in the head of the wicket, and then raises it. This causes the foot of the prop to slide forward in a groove of the hurter until it drops into the recess or pocket which forms the supporting step. When raised, the tops of the wickets are 12.3 ft. above low water level. When lowered, they are a few inches lower than the top of the sill.

The wickets in erected position (within the cofferdam) at Dam No. 4 (Ohio River) are shown in Fig. 5. The method of operating a wicket dam is shown in Fig. 6, which represents work at Dam No. 1. For these and the other photographs reproduced we are indebted to Mr. J. W. Arras, U. S. Assistant Engineer, Pittsburg, who used them in illustrating a paper on "The Ohio River" read before the Engineers' Society of Western Pennsylvania in May, 1908.

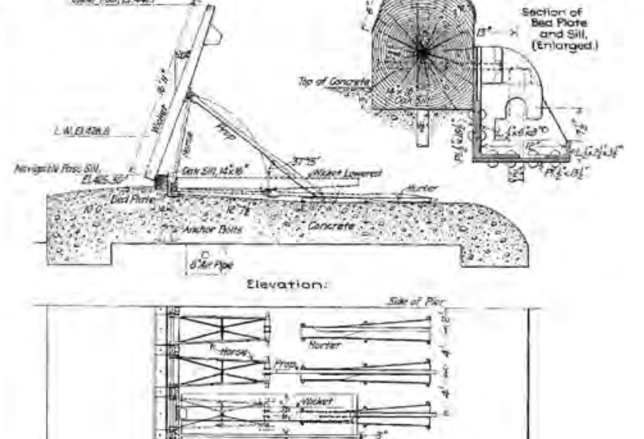

FIG. 3. CROSS-SECTION OF THE CHANOINE WICKET DAM FOR THE NAVIGABLE PASS OF OHIO RIVER DAM NO. 37.

Bear-Trap Dams.

The three bear-trap dams adjacent to the wicket dam of the navigable pass are for the purpose of regulating the level of the upper pool when the dam is raised. Each one is 80 ft. long. In these dams the buoyancy of closed chambers is employed to assist the raising and lowering. In many dams of this type, compressed air is admitted beneath the leaves in order to raise them, but in the bear-traps of Dam No. 37 the air is admitted to the interior of the downstream leaf, which is a steel box or caisson. Each bear-trap consists of two leaves pivoted at the bottom, and the upper edge of the upstream leaf rests against (and slides upon) the face of the downstream leaf. When raised, the two leaves and the concrete floor form a triangle. The base width is 47 ft. 2 ins. c. to c. of the hinge pins of the two leaves. The maximum height is 16 ft. 6 ins.

The upstream leaf is 25 ft. wide. It has a steel frame consisting of 15-in. I-beams 5 ft.

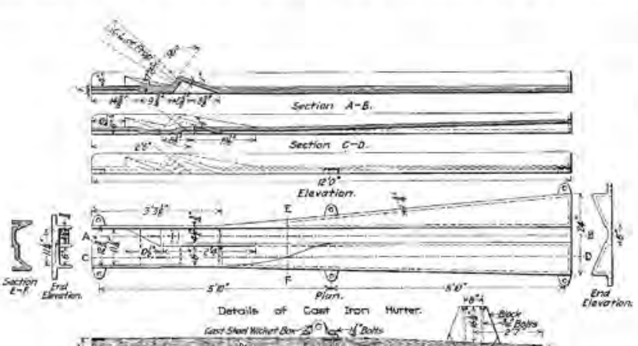

FIG. 4. DETAILS OF THE CHANOINE WICKET DAM.

apart, with longitudinal 6½-in. channels framed between to carry the white-oak timbers which form the face or sheathing.

The downstream leaf is a hollow box, of steel construction throughout. It has plate girders 32 ft. 2 ins. long, spaced 5 ft. apart, and connected by rows of lateral bracing. At each end also (that is, at the top and bottom of the leaf), they are connected by a longitudinal plate girder; this gives the necessary rigidity, and prevents any warping or distortion of the surface during operation. The framing is covered with a top and bottom skin plating of ⅜-in. steel plates, thus forming a watertight cellular structure. Manholes and limber holes are provided in the webs of the inner girders, to connect the several compartments. The I-beams of the upstream leaf and the plate girders of the downstream leaf are pivoted in pedestals anchored to the concrete floor. Fig. 7 shows the details of construction, and Fig. 8 shows the building of the downstream leaf of the bear-trap at Dam No. 3.

Both leaves have end packing to form a watertight joint with the concrete pier. That of the downstream leaf is a bent steel plate, attached to hangers suspended from the frame of the side of the leaf. Attached to the hangers are counterweights which tend to swing the plate outward, and thus hold it against the face of the pier. This is shown in Fig. 9. For the upstream leaf, the packing is a sliding timber at the back of the face. This is held against the face of the pier by coiled springs (Fig. 7).

When the dam is lowered, the downstream leaf lies horizontally in a chamber in the floor, with the upstream leaf resting upon it. The horizontal face of the latter is then level with an oak sill placed in front of its hinges. The downstream leaf is then full of water. To raise the dam, air at about 5 lbs. pressure is admitted to the interior of this leaf by means of two 4-in. pipes, which enter at points in line with the axis of the hinges and are extended nearly to the upper end of the leaf. These pipes have swivel and telescopic joints to allow for the movements of the dam, as shown in Fig. 9.

The air being delivered at the upper edge of the leaf tends to cause it to rise, the buoyancy increasing as the air pressure forces the water out through openings provided at the lower or hinged end of the leaf. At the same time, water under pressure due to the head above the dam is admitted to the chamber beneath the leaves and raises them from their seats. In this way the raising of both leaves is effected through the displacement of the lower leaf, without special regard to the head of water. Stops prevent the leaves from rising so high as to throw them out of contact. To lower the dam, the air pressure in the downstream leaf is released, and the water in the floor chamber is also released. Water being admitted to this leaf weights it so as to force it downwards, pushing the other leaf down with it.

The compressed air is conveyed from the power-house (on the Ohio side) to the bear-traps by an 8-in. wrought iron main embedded in the concrete floor of the dam. This has 4-in. branches at each pier and at the abutment, leading to the hand-operated valves by which the movements of the bear-traps are controlled. In each pier and in the shore abutment is a tunnel parallel with the river; this has a lateral opening to the river above the dam and another below the dam. It has also five filling and discharge conduits connecting with the chamber in the floor of the bear-trap. In the tunnel are two butterfly valves. When the dam is to be raised, the valve on the downstream side of the dam is closed, and that on the upstream side is opened, thus admitting water beneath the leaves of the dam. When the dam is to be lowered, the upstream valve is closed, and the lower valve opened, thus draining off the water from the chamber. The air valves and water valves are operated by hand gear on each pier and on the abutment.

Lock.

The lock is 110 ft. wide in the clear, with a length of 600 ft. between the gates. These dimensions have been adopted for all the Ohio River locks, with a view to the rapid and convenient handling of the large tows or fleets of coal barges, which are a feature of Ohio River navigation, as already noted. The outer or river wall of the lock is 690 ft. long. On the shore side, there is a guide wall extending about 600 ft. above and below the lock, making a total length of 1,851 ft. The walls have check posts or mooring posts for convenience in handling vessels approaching, entering and leaving the lock. At each end of the river wall is a signal tower for lights to indicate the location of the lock and to show whether the dam is raised or lowered. All the walls are stepped on the rear side, except that at the dam the back of the river wall is carried up vertically in order to make a joint with the end wicket of the movable dam. A plan of the lock is shown in Fig. 2, and cross sections of its walls are shown in Fig. 10.

Behind the guide wall on the upstream side of the lock is a basin 450 × 127 ft. (Fig. 2). This will provide accommodation for repair work on barges, etc., and at some future time it may be converted into a dry dock by fitting it with a gate. The land side and lower end of the basin are earth slopes paved with concrete.

The lock is filled and emptied by means of culverts in the river wall, there being 16 filling culverts above the dam and 16 discharge culverts below the dam. These are 12 ft. apart, and extend through the wall from the lock chamber to the river. Each culvert is 4½ ft. diameter, and is fitted with a balanced valve turning on a vertical axis. A shaft extends from the valve to the top of the wall, and each shaft is operated by a small compressed air engine or "jack." These 16 jacks are operated simultaneously.

At each end of the lock, provision is made for a needle dam to close the chamber in case of any accident to the gates. These dams are of the Poiree type (located as shown in Fig. 2). A row of steel bents is placed across the chamber, the bents being pivoted at their feet so as to swing laterally. These bents lie normally in a recess across the concrete floor. To close the opening, the bents are raised by chains, and are connected by rigid members at the top. Timber needles are then set in place by hand from a bridge laid upon the bents, the lower end of each needle resting against a sill and the upper end resting against the bridge. This is shown in Fig. 11.

FIG. 5. CHANOINE WICKETS IN RAISED POSITION (WITHIN COFFERDAM) AT DAM NO. 4, OHIO RIVER.

At high water, the lock chamber and its gate recesses become filled to a considerable depth with fine silt. This has to be removed by sluicing or hydraulic excavation when the water goes down. For clearing the upper end of the lock, a 4-ft. sluicing culvert is formed beneath it and the gate recess, and opening into the river. This has four inlet openings, in the floor of the recess and lock, through which the mud is sluiced into the culvert. The openings are closed by horizontal butterfly valves operated by chains leading to the wall of the lock.

Rolling Lock Gates.

At each end of the lock is a gate of the rolling type, which runs back into a recess at right angles to the lock chamber when the lock is opened. This gate arrangement (originally devised by Major Merrill, U. S. A.) has been adopted for all the Ohio River locks. The gates are built of structural steel, with watertight faces of planking. The upper gate weighs about 116 tons, and the lower gate 140 tons.

Each gate is about 118 ft. long, 19 ft. high and 9 ft. wide. The construction of the lower gate is shown in Fig. 12. It consists of a pair of trusses, with box-girder top and bottom chords which are made very wide in order to give great horizontal stiffness to resist the water pressure. The panel length is 12 ft. 8 ins. The posts of the upstream truss are composed of pairs of 10-in. channels, while the others are built up of angles and lacing bars. There are transverse struts at top and bottom, and horizontal and vertical bracing is fitted between the posts.

On the downstream side are vertical channels to support the horizontal timbers which form the face. These timbers are of white oak painted with carbolineum (imported from Germany) as a preservative. This timber sheathing is on the downstream face only of each gate. In the bottom of this face are 18 balanced rectangular butterfly valves 3 × 4 ft., for filling or emptying the lock in the event of any accident interfering with the operation of the filling and discharge culverts and valves in the river wall of the lock. Each valve in the gate is operated by a rod connected to a lever at the top of the gate (Fig. 11).

Each gate is carried on 12 pairs of 33-in. car wheels, which are outside the face of the gate. These have axles 7½ ins. diameter, with journals 7 × 8 ins. in phosphor-bronze boxes. The wheels run on two sills, with a gage of 11 ft. 6 ins. (Fig. 10). Each sill is composed of a heavy 12-in. channel riveted against steel pedestals anchored to concrete foundations. On the top of the channel and the pedestals is a 1¼-in. track plate 12 ins. wide.

The gate has swing-link connections to its axles, as shown in Fig. 13. When subjected to water pressure on its face, the gate is forced about 1½ ins. backward, so as to take a bearing against the seats in the walls and floor. The bottom joint is made watertight by a packing timber on the face of the gate, which is pressed against the steel channel of the wheel track. The end joints are sealed by vertical iron pipes which are pivoted eccentrically and are held against the seats by the water pressure. When the pressure on the gate is released, its weight returns it to the vertical position, swinging clear of its bearings against the sill and walls. When the lock is closed, the head of the gate rests in a recess in the river wall of the lock.

The gate is moved by means of a chain which is wound upon a drum across the mouth of the gate recess, and has its ends attached to opposite ends of the gate. The drum is 26 ins. diameter and 11 ft. long, and is operated by gearing from a two-cylinder engine driven by compressed air. If the chain was rigidly attached to the gate, a sudden jerk in starting would be liable to break the chain or its attachment. For this reason a tug lever is used. This hangs vertically from a pin in the gate framing, and has the operating chain attached to its lower end. It is held back by heavy springs which receive the pull of the chain and take up any shock or jerk. Fig. 14 shows the operating drum and chain of the rolling gate at Dam No. 6. The gate recess is roofed with cast-iron plates laid on transverse I-beams. The floor has a slope of 1% towards the lock.

Construction Plants and Methods.

The construction work has been done, of course, under the protection of cofferdams. The lock and its guide walls were first undertaken, and are practically completed. A space about 650 × 240 ft. is now laid dry for the first portion of the foundation of the wicket dam (at the Ohio end).

The cofferdam as built consists of two rows of round piles about 22 ft. apart, the piles in each row being 6 ft. apart. On the inner side of each row are lines of waling timbers, against which is driven a single line of tongued-and-grooved sheet piling. Tie-rods are placed across the top of the enclosed space, being secured by nuts on the outside of the piles. The 20-ft. space between the two lines of sheeting was filled with gravel dredged from the river, the material containing a considerable amount of large stone.

FIG. 6. DERRICK BOAT OPERATING MOVABLE DAM NO. 4.

This was deposited by dipper dredges and derrick buckets, being spread and leveled by men inside the cofferdam. The cofferdam was finally covered with a plank floor.

This work has proved to be very watertight, even under a considerable head of water, and very little pumping is required to drain the enclosed space. Ordinarily, any small leaks are soon choked by the silt contained in the water. During the recent remarkably low stage of the river, however, the water was so clear that it filtered through in places and this automatic closing of leaks did not occur. A little extra pumping was required before the leaks were stopped.

A generally similar style of cofferdam was used for the other parts of the work. On the outside, the dredged material is banked up against the sheeting, and is in some places paved with rip-rap stone to protect it from scour by the current. Protection against ice is afforded by large cribs filled with stone, and by a row of pile clusters (three piles in each group). The clusters are about 15 ft. apart, and the piles are bound together by wire cables. The cribs are 16 ft. square, rising to a height of about 18 ft. above low water. They are built of 8 x 10-in. timbers, put together with 20-in. drift bolts. Some of the cribs have been displaced by the great pressure of the ice, and additional work is required on these defenses before each winter begins.

During the construction of the cofferdam, dipper dredges excavated the loose material within the enclosed space, so that there was comparatively little dry excavation to be done after the cofferdam had been closed and the space pumped out. For this latter work, grab buckets handled by traveling derricks were largely used. Hand shoveling was also employed, the material being loaded into buckets which were placed on flat cars to be hauled by mules over a narrow gage railway to the traveling or fixed derricks. Concrete was distributed in the same way, steel dump buckets being used.

In the construction of the lock and guide walls, two cableways of 300-ft. span were employed. These were used to remove the excavated material, deliver concrete, handle material, and erect the steel work of the rolling lock gates. All work on the dam proper, however, is being done by the aid of stationary derricks in the pit and at the concrete mixing plant, and by traveling derricks which run on tracks laid along the cofferdams. All these derricks are of the stiff-leg type, and each has its own steam engine.

All masonry is of monolithic concrete, founded upon bed rock. The lock walls were built in 50-ft. sections, with vertical expansion joints. The faces of adjacent sections have tongued-and-grooved joints, but the surfaces are kept from uniting by means of a thin coating of clay. The base of the movable dam is made in sections, each section extending the full width of the base. Each of these sections, also, is built in two beds or layers. The lower or foundation bed has two parallel trenches in the top (parallel with the line of the dam). These serve to make a bond with the upper bed, but one of them is used also to carry the 8-in. main for compressed air. The upper bed is about 5 ft. thick.

The concrete is made with river gravel and sand, brought in mainly by barges and tow boats, but partly by dump cars on an electric railway. The material is washed and screened at the dam, and is so proportioned as to range from fine to coarse sand and from coarse sand to 2½-in. pebbles. Machine mixing is used throughout. All cement is furnished by the government. The proportioning, mixing and laying of the concrete are under close supervision by government inspectors. The mixture is made quite wet, in order to obtain a dense concrete, and the work has proved quite watertight in places where it has water at a considerable head along one side.

The work is carried on day and night. This requires three eight-hour shifts, as the law forbids contractors on government work to work

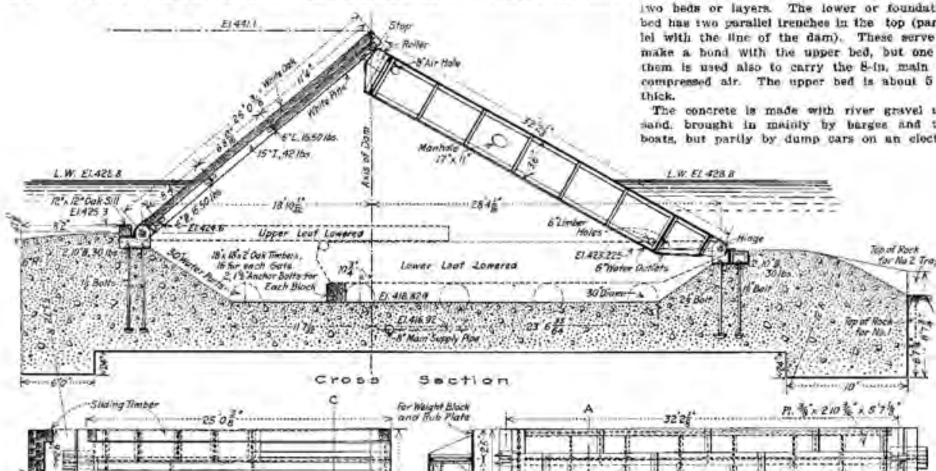

FIG. 7. BEARTRAP DAM FOR OHIO RIVER DAM NO. 37; NEAR CINCINNATI, O.

their men more than eight hours per day. About 300 to 400 men are now employed.

The work was commenced in 1905 by dredging and the building of cofferdams. Some grading and excavation (both loose material and rock) was also accomplished, and a small amount of concrete foundation was put in place. Work was resumed in the summer of 1906, but was interrupted by no less than four floods. At the close of that season, about half of the concrete

FIG. 8. CONSTRUCTION OF THE STEEL LEAF OF THE BEARTRAP AT DAM NO. 3, OHIO RIVER.

work on the lock had been completed, and all but a small portion of the excavation required for the lock chamber and wall foundation. In 1907 the work on the lock was continued, subject, however, to repeated interruptions from freshets. The upper gate was also erected, with the exception of a few details.

The season of 1908 proved to be much more favorable for work than any which preceded it. By Aug. 15, the lock walls were completed, the foundation for the lower gate was laid, and the work of erecting the gate itself was begun. By Oct. 15, the lock was complete, with its gates, Poiree dams and guide walls; the cofferdam for the first 600 ft. of the navigable pass was closed, and work was in progress on the concrete foundation. The abutment on the Kentucky side is practically complete. The concrete foundations for the buildings are finished and the sewers have been laid. With an equally favorable season this year it is hoped that the work may then be completed, although 1910 is the contract time set for the completion of the entire work.

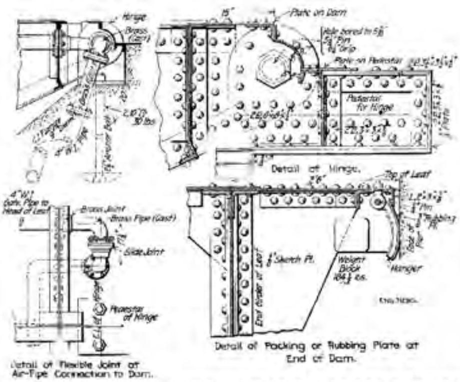

FIG. 9. DETAILS OF THE STEEL LEAF OF THE BEARTRAP AT DAM NO. 37, OHIO RIVER.

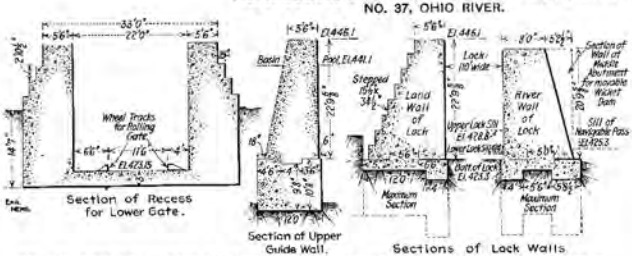

FIG. 10. CROSS-SECTIONS OF THE MASONRY WALLS AT THE LOCK AT DAM NO. 37

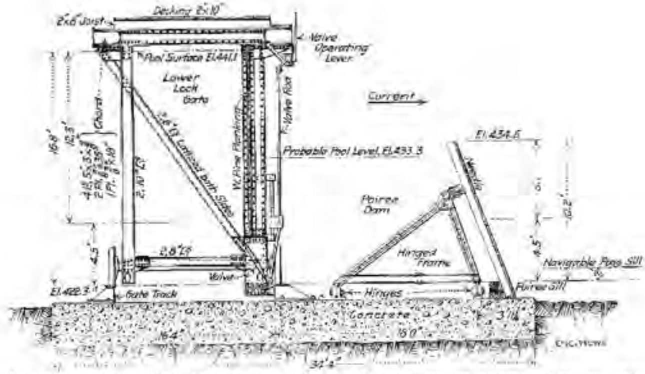

FIG. 11. LONGITUDINAL SECTION AT THE LOWER END OF THE LOCK, SHOWING THE ROLLING LOCK GATE AND THE POIREE NEEDLE DAM FOR CLOSING THE LOCK FOR REPAIRS.

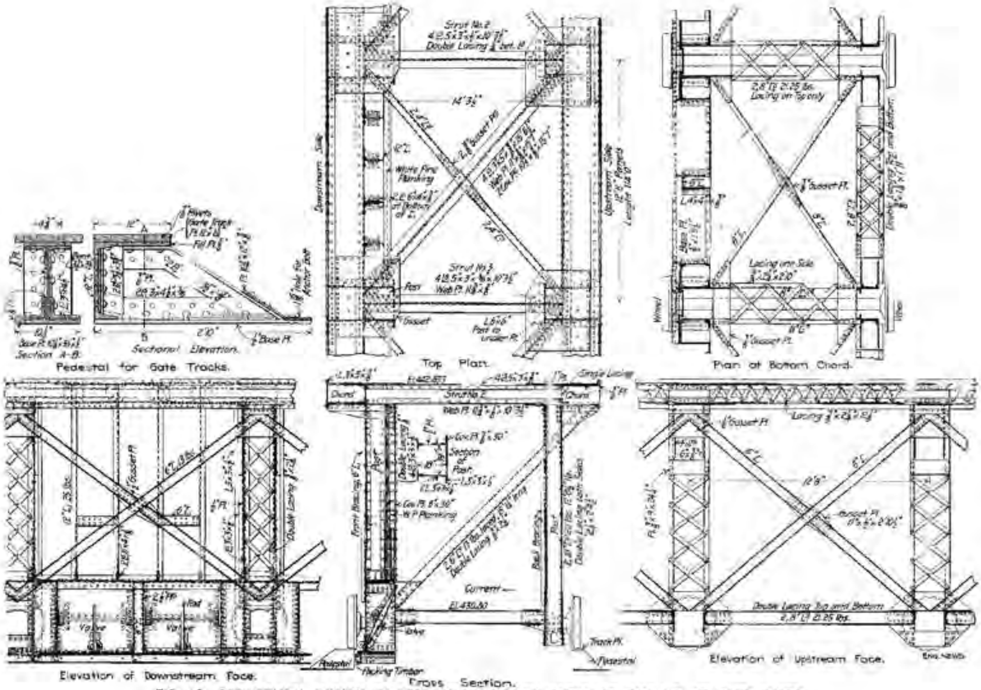

FIG. 12. STRUCTURAL DESIGN OF THE ROLLING LOCK GATES AT DAM NO. 37, OHIO RIVER.