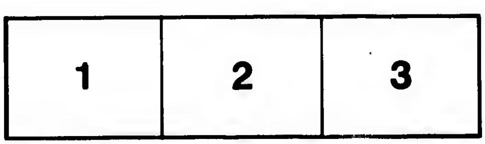
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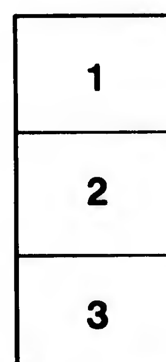
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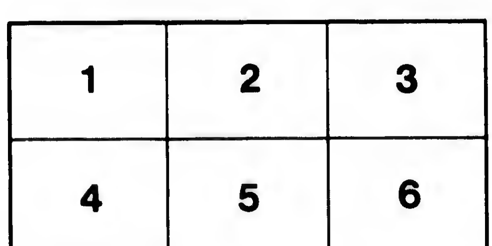
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CITIES OF

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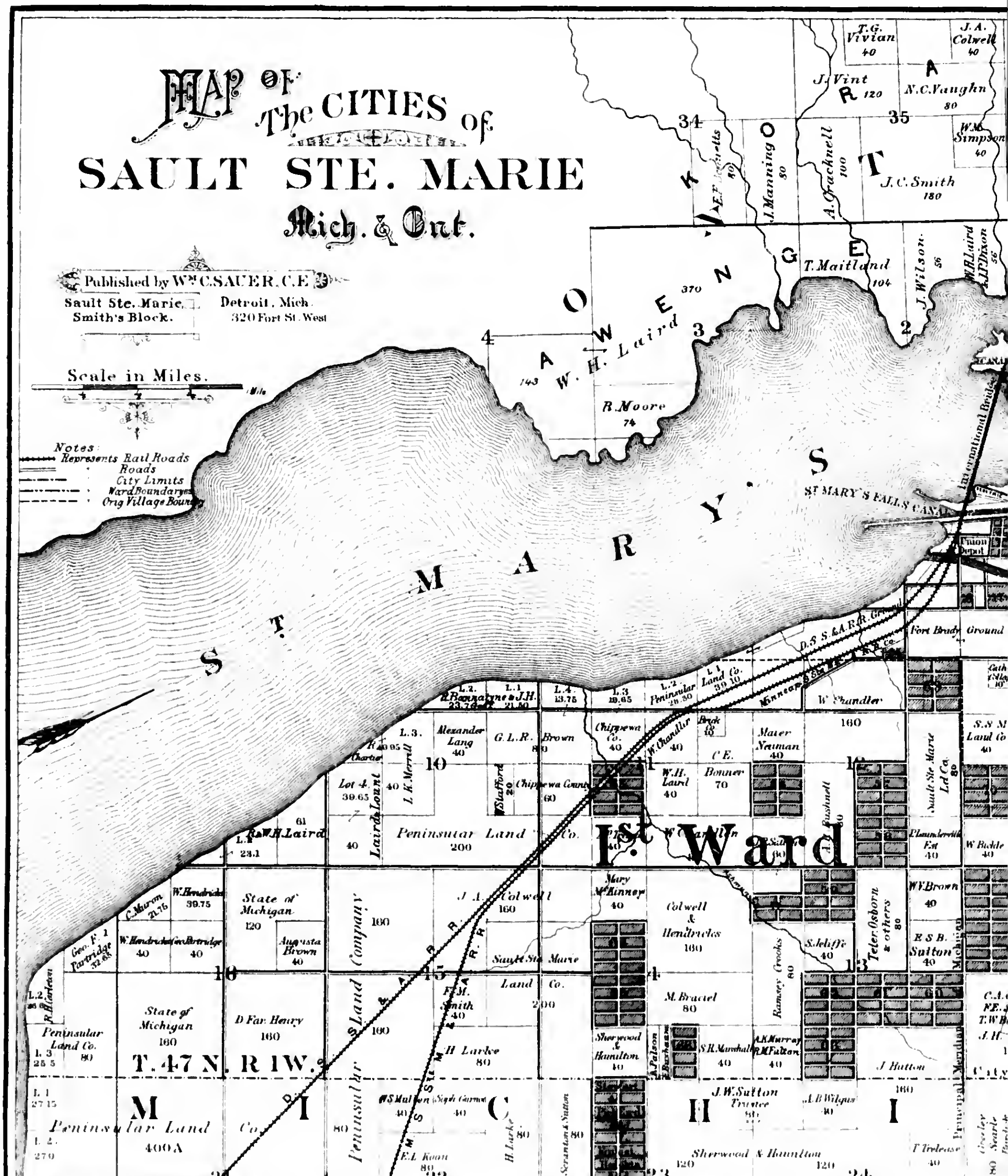
MAP of The CITIES of
SAULT STE. MARIE
Mich. & Ont.
Published by Wm. C. SAUER, C.E.
Sault Ste. Marie, Smith's Block.
Detroit, Mich. 320 Fort St. West
Scale in Miles.
Notes:
Represents Rail Roads
Roads
City Limits
Ward Boundaries
Orig Village Boundary
ST. MARY'S
ST. MARY'S FALLS CANAL
International Bridge
Union Depot
Fort Brady Ground
1st Ward
W. H. Laird
R. Moore 74
T. Maitland 104
J. Wilson 56
J. C. Smith 180
J. Vint 120
T. G. Vivian 40
J. A. Colwell 40
N. C. Vaughn 80
J. Manning 80
A. Cracknell 100
Peninsular Land Co. 200
Alexander Lang 40
G. L. R. Brown 80
Chippewa Co. 40
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F. M. Smith 40
H. Larke 80
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Sherwood & Hamilton 120
R. S. B. Sutton 40
W. V. Brown 40
Teler, Osborn & others 80
Ramsey Crooks 80
E. L. Koon 80
T. 47 N. R. 1 W.
MICHIGAN
Principal Meridian
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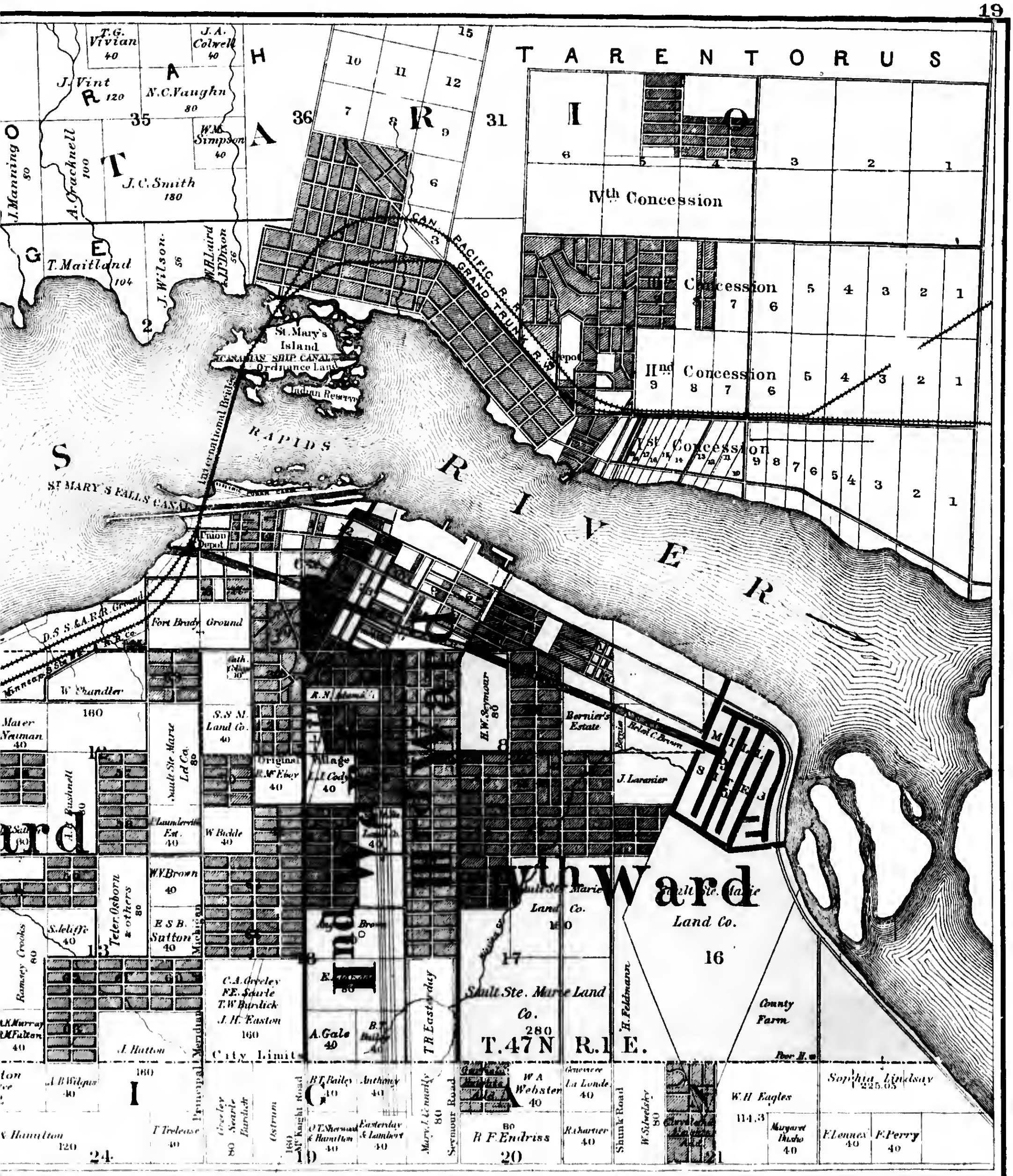
T A R E N T O R U S
IVth Concession
IIIrd Concession
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J. Manning 80
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T. Maitland 104
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W.H. Laird
J.P. Dixon 56
CAN. PACIFIC R.R.
GRAND TRUNK R.R.
W. Chandler
160
Mater Neuman 40
S.S.M. Land Co. 40
Sault Ste Marie Ld Co. 80
R.N. Adams
Original Village
R. McEboy 40
L.L. Cody 40
H.W. Seymour 80
Bernier's Estate
J. Laranier
A.E. Bushnell 80
W. Buddle 40
W.V. Brown 40
Teler Osborn & others 80
S. Jeliffe 40
Ramsey Crooks 80
R.S.B. Sutton 40
Michigan
A.K. Murray
C.A. Greeley
F.E. Sayrle
T.W. Burdick
J.H. Easton
160
Principal Meridian
City Limits
A. Gale 40
T.R. Easterday
Sault Ste. Marie Land Co.
280
Sault Ste. Marie Land Co. 160
17
Ward
Sault Ste. Marie Land Co.
16
H. Feldmann
County Farm
T. 47 N. R. 1 E.
J. Hatton 160
A.B. Wilgus 40
Bailey 40
Anthony 40
Mary J. Connolly 80
Seymour Road
W.A. Webster 40
Genevieve La Londe 40
W. Shelsley 80
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114.3
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I
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O.T. Sherwood & Hamilton 40
Easterday & Lambert 40
R.F. Endriss 80
R. Chartier 40
Shunk Road
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F. Lennex 40
F. Perry 40
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DESCRIPT

—OF—

Saint Mary's Falls Ca

WITH DETAILS OF THE LOCKS, THEIR OPERATING M

OLD CANAL AND LOCKS.

(1853–1855.)

Ground was broken for the building of the old canal and locks on June 4, 1853. The certificate of its completion was signed by the commissioners on May 21, 1855, and the first boat was locked through on June 18, 1855. The entire cost of the work was $999,802.46.

The old locks are two in number. They are each 70 feet wide, 350 feet long, have a depth of 11½ feet of water on the miter-sills, and a lift of 9 feet each. The walls are of limestone masonry, and are shown in elevation, plan, and section in Figs. 1, 2 and 3, Plate 3. The floor is shown in Fig. 4, Plate 3. It consists of longitudinal timbers 1 foot square and 1 foot apart, bolted to the solid rock. On these, transverse timbers 1 foot square and 1 foot apart are bolted to the solid rock, the interstices being filled with sand and gravel well rammed. On the transverse timbers is spiked a flooring of plank 3 inches thick.

The middle gate is shown in Fig. 3, Plate 3. The sheathing is left off from the north leaf, so as to show the plan of the frame-work. Each leaf is worked with a boom, as shown at B, Fig. 3. The boom is moved backward and forward by means of a wire rope and hand capstan, shown at A, Fig. 3.

The water is admitted to the locks, through the leaves, by means of butterfly valves, shown at C, Fig. 3, Plate 3. The valves are worked with a rack and pinion, shown at D, Fig. 3, Plate 3.

CANAL IMPROVEMENT AND NEW LOCKS.

(1870–1881.)

The first contract for the improvement of the canal, which resulted in its enlargement and the building of the new lock (of 1881), was dated October 20, 1870; the first stone of the new lock was laid July 25, 1876, and the first boat locked through on September 1, 1881.

The total amount appropriated for the work at different times was $2,405,000. The total cost of the canal improvement and lock was $2,150,000, the balance of the appropriation being used in the improvement of the Saint Mary's River.

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New lock:
Excavatio
Lock floor
Culverts .

Masonry:
Backing, c
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Snubbing-hook
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The expenditure for the canal improvement and building of the new lock was as follows:

Enlargement of prism:		
Excavation	$700,000	
Pier revetment	220,000	
		$920,000
New lock:		
Excavation	170,850	
Lock floor and foundation	85,000	
Culverts	57,000	
		318,850
Masonry:		
Backing, cement, sand, and setting stone	251,000	
Cut stone	233,500	
		484,500
Snubbing-hooks and gate anchors	3,300	
Earth filling	22,000	
Gates and sills	42,700	
Machine house	21,500	
Machinery, pipes, etc	59,000	
		148,500
Movable dam:		
Foundation and pier	45,800	
Swing bridge and wickets	49,700	
		95,500
Purchase of land, engineering, superintending, office expenses, etc		182,650
Grand total		$2,150,000

CANAL.

The geographical position of Saint Mary's Falls Canal is shown in Plate 1.

The length of the canal is 7,000 feet. Its width is variable. The outlines are shown in Plate 2. The least width is 108 feet, at the point opposite the movable dam. The depth of water is 16 feet. The general height of the pier revetment is 4 feet above mean water surface.

COFFER-DAM.

A coffer-dam about 1,700 feet long was built during the season of 1880, across the head of the canal and back of the piers down to the shore lines. Its position is shown in dotted lines, Sketch 1, Plate 2. Two rows of sheet piling, about 8 feet apart, were driven with a small pile-driver. The space between the rows was then filled with well puddled clay. A gap of 70 feet was left adjacent to the northwest pier till the close of navigation, on November 15, 1880. The gap was then closed by sinking cribs and making a bank of puddled clay on the up-stream side of them. The canal was drained and the old curved pier on the south side removed, the canal widened and deepened to a uniform grade of 16 feet of water. The following spring that part of the dam between the canal piers was dredged out.

PIER REVETMENT.

The banks of the canal are protected by a revetment of pier work of the form shown in cross-sections, Sketch 2, Plate 2, the manner of construction being shown more in detail in Figs. 1 and 2, Plate 13.

The material is pine timber 1 foot square. For that part of the work outside of the coffer-dam, cribs were first built as shown in Fig. 2, Plate 13. They were then floated into position and sunk by filling with broken stone. Spuds were placed at each corner of the crib, to which blocks and falls were attached, as shown at I, Fig. 2, Plate 13. These were used to keep the crib level and in line until the filling was put in.

The cribs are from 30 to 70 feet in length, and from 18 to 30 feet in width, varying with the depth of water. After the cribs were in position their tops were made even with the water surface by adzing off the high places and spiking leveling pieces on the low ones. The superstructure was then built, as shown at J, K, Fig. 2, Plate 13. It is composed of five courses of timber overlapping each other, so as to be continuous from one crib to another.

Between the coffer-dam and the locks most of the revetment was built on the rock. The two lower courses of timber were framed like the cribs, and the remainder the same as the superstructure, shown in Fig. 1, Plate 13. The canal face of the revetment has a batter of 1 to 12. There are 12,000 linear feet of piers.

NEW LOCK.

(1870–1881.)

The relative positions of the new and old locks are shown at F and E, E, Sketch 2, Plate 2. The chamber of the new lock is 515 feet long between hollow quoins, 80 feet wide, narrowed to 60 feet at the gates; the depth is 39½ feet. Its capacity is 1,500,000 cubic feet. The lift of the lock is 18 feet, the depth of water on the miter-sills 17 feet. The sills are placed 1 foot below canal bottom, so as to be protected from injury by vessels. A guard-gate is placed at each end of the chamber, making the length of the walls 717 feet.

The walls for 14 feet from each end are 13 feet wide from top to bottom; then for 121½ feet at the west end and 133½ feet at the east end they are 25 feet wide from top to bottom. Between the wide walls the width is 18 feet for 10 feet up from the foundation, then it narrows in 2 feet for 4 offsets 5 feet apart, vertically, until the wall is 10 feet wide, at which width it is carried up to within 6 inches of the top of the coping. The coping is 5 feet wide, as shown in Figs. 2, 3 and 4, Plate 4.

The walls are of limestone, shown in elevation, plan, and cross-sections in Figs. 1, 2, 6 and 7, respectively, Plate 4. The cut stone was obtained from Marblehead, Ohio, and Kelley's Island; the backing from Drummond's Island, Saint Mary's River. The face stone are laid in regular courses, with a bond of 1½ feet. There are 20 courses, each 2 feet thick, except the coping, which is 1½ feet thick. The stones have bush-hammered faces, with a 2-inch margin draft and ¾-inch chamfer edge. The headers are 3 by 2 by 6 feet, and the stretchers 6 by 2 by 3 feet; the hollow and angle quoins, 6 by 2 by 6 feet, and are set with the bed and vertical joints ¼ of an inch thick. The backing is set with 1-inch bed and 2-inch vertical joints, with a bond of 9 inches at least.

The face stone, the miter and breast walls, and portions of the wall adjacent to springs of water are laid in English Portland cement. The remainder of the wall is laid in American cements, generally that obtained from Louisville, Kentucky. All the cements were mixed with sand in the proportion of 1 to 1.

There are about 34,207 cubic yards of masonry, in the construction of which about 35,000 barrels of cement were used, every barrel of which was tested before it was taken on the wall.

In the miter walls for the upper lock and guard-gates there are 9 courses of cut stone, each 2 feet thick. The walls are 14 feet wide at the miter angle, are arched to resist the pressure on the gates, and are bonded into the lock walls, as shown at Figs. 2, 3 and 7, Plate 4.

The top course of stone is set back 1 foot, so as to leave an offset on which the oak miter-sills rest. The oak sills project 2 inches above the masonry. A flat arch, 4 feet high, is built in the upper lock-gate miter wall, where it crosses over the culverts at A, Fig. 7, Plate 4. To prevent vessels from knocking the coping back out of line, the walls were made 10 feet wide at the top, and also a groove 1 foot wide and 4 inches deep was cut in the top of the nineteenth course, 1 foot back from the face of the wall, and a corresponding shoulder left on the lower bed of the coping-stones, which fitted in the groove, Figs. 4, 6 and 7, Plate 4.

The recesses shown at A, Fig. 1, Plate 4, contain iron snubbing-hooks.

The foundation is on rock throughout, which is a Potsdam sandstone of different degrees of hardness. In excavating the lock pit, rock was reached at from 1 to 15 feet above the grade of the lock floor. A floor of timber and concrete extends across the bottom of the lock and 5 feet under each wall; the rest of the foundation for the wall is concrete ½ to 2 feet thick on the rock. All the timbers used in the foundation are of pine 1 foot square. The longitudinal courses are 10 feet apart, shown at T, Figs. 3, 4 and 5, Plate 4. They are laid in concrete and fastened to the rock with bolts 3 feet long, which are fox-wedged and cemented in the rock, as shown in Fig. 4, Plate 4. The transverse timbers U, Fig. 3, Plate 4, are laid across the pit with spaces of 6 inches between them, and are bolted through the longitudinal timbers with bolts 5 feet long. The interstices are filled with concrete. Two courses of 3-inch pine plank 6 inches wide are spiked to the transverse timbers U, Fig. 3, Plate 4.

The miter-sills are oak timbers 12 by 18 inches, and fastened in place by bolts 10 feet long, fox-wedged and concreted in the rock, and also by timber braces bolted to the rock.

GATES.

There are four gates, designated as upper and lower lock-gates and upper and lower guard-gates. Their positions and miter-sills shown are at P, Q, R and S, respectively, Fig. 2, Plate 4. The south leaf of lower lock-gate is shown in plan, elevation, and section in Figs. 1, 2 and 3, respectively, Plate 6. The frame-work is of white oak and the sheathing of Norway pine. The system of anchorage is shown at C, Figs. 1, 2 and 3, Plate 6. The weight of one leaf of the upper lock-gate is 40 tons, and of one leaf of the lower lock-gate 76 tons. The south leaf of upper guard-gate is shown in plan, elevation and section, in Figs. 1 to 7, Plate 7. The system of anchorage is the same as for the lower lock-gate. The guard-gates are only used when repairs are being made to the lock. They are opened and closed by means of temporary block and tackle, operated by a power capstan. Both leaves of the upper guard-gate are provided with valves, with which to fill the lock after it has been pumped out. The positions of these valves are shown at G, Fig. 1, Plate 7. The valves are worked with a hand wrench from the top of the leaf. The lock can be filled through these valves in about one hour. The details are shown in Figs. 2, 3, 5 and 7, Plate 7.

The leaves of the upper lock-gate and the lower guard-gate are the same as this, except that they have no valves.

CULVERTS.

The water is let into the lock from culverts under the floor. These culverts extend from the well X above the upper lock-gate to the well Y above the lower lock-gate, Fig. 2, Plate 4. They are cut off from the well Y by a transverse bulkhead, shown in Fig. 8, Plate 4. The water is admitted into the culverts through the well X, which is covered with a grating. The two culverts are separated by the longitudinal bulkhead shown in Fig. 1, Plate 4. Each culvert is 8 feet square. The floor of the culverts is similar to that of the lock, previously described. It is shown in plan at W, Fig. 3, and in section at Figs. 1, 5 and 8, Plate 4. The bulkhead and walls are made of timbers 1 foot square, bolted together and to the rock bottom, as shown in Fig. 1, Plate 4. The interstices between the timbers and the solid rock are filled with concrete.

The covering of the culverts is the floor of the lock. Planks are bolted between the transverse timbers of the lock floor where they cross the culverts, so as to leave an even surface on the under side and facilitate the flow of water. The water passes into the lock chamber through 58 apertures in the lock floor, shown in Figs. 2 and 3, Plate 4. They are constructed as follows: The planking is [illegible] for a space of 2 feet by 1½ feet. This uncovers three of the transverse timbers, which are 6 [illegible]. Each aperture, therefore, consists of three parts, each 6 inches wide and 2 feet long, mak[illegible] total area 3 square feet, and of the 58 apertures, 174 square feet. This area is increased to 190 square feet by the man-holes left in the bulkhead at the lower end of the culverts, and shown in Fig. 8, Plate 4. The total area of the cross-sections of the two culverts is 128 square feet. Therefore the area of the inlet is considerably less than that of the outlet. This tends to diminish the velocity of the water when projected upwards into the lock chamber.

There are two other short culverts which connect the wells Y and Z, Fig. 2, Plate 4. These culverts are also separated by a longitudinal bulkhead. One culvert is shown in section at A, Fig. 6, P[illegible]

The water, in passing out of the lock, goes down through the well Y, which is covered with a grating, thence through these short culverts and up through the well Z, Fig. 2, Plate 4. The floor, walls, bulkhead, and system of bolting in these culverts are similar to the ones previously described.

FILLING AND EMPTYING VALVES.

The filling valves, through which the water enters the lock, are two in number, and are located in the well just above the upper lock-gate, and shown at A, A, Figs. 2 and 4, Plate 5. Each valve, when shut, closes the entrance to one of the culverts. Each valve is 10 feet wide and 8 feet deep. The entrance to each culvert is also made 10 feet wide, as shown by the dotted lines in Fig. 3, Plate 4. When the valve is open it gives a clear aperture greater than the cross-section of the culvert. The details of the valves are shown in Figs. 1 and 2, Plate 10. A heavy iron frame, shown at J, Figs. 1 and 2, Plate 10, is bolted to the wood work at the culvert. The axle of the valve has a bearing in this iron frame, as shown at D, Fig. 1, Plate 10. The aperture in the frame is about ½ inch larger than the valve, so as to leave a space of ¼ inch all around the edges. There are no stops on the frame. The valve (when detached from its engine) is free to revolve on its axis. The valves are made with cast-iron axles and frames, to which a covering of boiler iron is bolted.

The emptying valves, through which the water escapes from the lock, are two in number and are located in the well just above the lower lock-gate, and are shown at A, A, Figs. 1 and 3, Plate 5. Their construction is similar to that of the filling valves just described. Each culvert is complete in itself, being provided with separate filling and emptying valves and engines. If an accident should occur to one culvert, or to its valves or engines, the other culvert could still be used.

MACHINERY FOR OPERATING GATES AND VALVES.

The power is obtained from two turbines. Water is brought to them through a supply pipe from the canal above the lock. They are geared to a main shaft. A belt from the main shaft runs two force pumps which pump water into an accumulator loaded so as to give a pressure of about 120 pounds to the square inch. Water is taken from the accumulator to the engines which open and close the gates and valves. There are four gate engines, one for each leaf of the upper and lower lock gates, and four valve engines, one for each of the filling and emptying valves. Such is a general outline of the train machinery. The details will follow.

MACHINE HOUSE.

The machine house is of stone. It is shown in elevation at D, Fig. 1, Plate 4, and in section and plan in Figs. 1 and 3 respectively, Plate 5. There is a cellar, ground floor and upper floor. The main shaft, accumulator, pumps, etc., are on the upper floor; the pen-stock, dynamo, tool-room, etc., are located on the ground floor, and the pump for emptying the lock is in the cellar. The accumulator passes from the cellar up through the upper floor.

TURBINE SUPPLY PIPE.

The turbine supply pipe lies on the south side of the lock. The inlet is shown at B, Fig. 1, Plate 4, and B, Figs. 2 and 4, Plate 5. It is about 7 feet below the surface of the water and is covered with an iron grating. The general course of the pipe is shown by the dotted lines in Fig. 2, Plate 4, and is more definitely shown in position at C, C, C, Figs. 1, 2, 3 and 4, Plate 5. It enters the machine house as shown at D, Fig. 3, Plate 5, and the pen-stock as shown at E, Figs. 1 and 3, Plate 5, and D, Fig. 2, Plate 8. It has a cut-off valve about 9 feet from the inlet, shown at D, Fig. 4, Plate 5. Its interior diameter is 36 inches.

TURBINE DRAFT TUBE.

The draft tube leaves the pen-stock, as shown at F F, Fig. 2, Plate 8, and Fig. 1, Plate 5. The two parts are united in one, as shown by the dotted lines in Fig. 1, Plate 5. A section of the united tube is shown at K, Fig. 1, Plate 5. The general course of the draft tube is shown by the dotted lines in Fig. [illegible] Plate 5, and by Fig. 2, Plate 4. The outlet is shown at F, Figs. 1 and 3, Plate 5, and at C, Fig. 1, Plate 4.

TURBINES AND MAIN SHAFT.

There are two 30-inch turbines. They are placed in the pen-stock, shown at E, Figs. 1 and 3, Plate 5, and on a large scale in Figs. 1, 2 and 3, Plate 8. The computed effective energy of the two wheels combined is 50 horse-power. The hand wheels, for operating the turbine gates are shown at G, G, Figs. 1, 2 and 3, Plate 8, and at G, G, Figs. 1 and 3, Plate 5. Both turbines are connected by spur gearing to a main shaft, as shown at H, H, Figs. 2 and 3, Plate 8, and at H, H, Figs. 1 and 3, Plate 5. The power for operating the different parts of the machinery is taken from the main shaft by means of pulleys and belts in the usual manner.

ACCUMULATOR PUMP AND ACCUMULATOR.

The accumulator pumps are two in number. Their position in the machine house is shown at J, J, Figs. 1 and 3, Plate 5. The details are shown in Plate 9. They are force pumps with safety valves and have three plungers each. The power which runs them is transmitted from the main shaft with a belt. Both pumps can be run with one turbine at one-quarter gate. The drawings sufficiently explain themselves.

The position of the accumulator in the machine house is shown at K, Fig. 3, Plate 5. The details are given in Figs. 3 and 4, Plate 10. It stands on a foundation of masonry not shown in the drawings. The cylinder is shown in partial section at A, Fig. 3, Plate 10. Its interior diameter is 21 inches and its length 124 inches. The area of its cross-section is, therefore, 346 square inches, and its capacity is 49,949 cubic inches, or 1,859 gallons. The plunger is shown in partial cross-section at B, Fig. 3, Plate 10. It carries a heavy cross-head, shown at E, E, Figs. 3 and 4, Plate 10, which moves up and down on the guides C, C, C, C, Fig. 3, Plate 10. These guides are fastened to the iron girders of the machine house as shown at D, Fig. 3, Plate 10. The weight case is suspended from the cross-head by the suspension rods, shown at F, F, F, Fig. 3, Plate 10. The weights are shown at G, Figs 3 and 4, Plate 10, and are cast-iron plates made to fit the weight case. Since the area of the cross section of the cylinder is 346 square inches, it requires 69,200 pounds of weight to produce a pressure of 200 pounds to the square inch. The water from the accumulator pumps enters the accumulator at H, and leaves it at I, Fig. 3, Plate 10.

When the accumulator is full, the belts which run the accumulator pumps are thrown on the loose pulleys automatically by the apparatus shown at K, Figs 3 and 4, Plate 10. The accumulator was tested for a pressure of 200 pounds to the square inch. For ordinary use 120 pounds is sufficient.

GATE ENGINES.

The position of the four gate engines is shown at J, J, J, J, Fig. 2, Plate 4. The details are shown in Figs 9 and 10, Plate 7. The cylinder is shown at D, Figs. 8, 9 and 10, Plate 7. Its exterior diameter is 18 inches, interior diameter 15 inches, and its length 132 inches. Each engine rests on a heavy cast-iron bed piece shown at C, C, Figs. 9 and 10, Plate 7.

The piston is double acting: that is, the piston-rod projects from both ends of the cylinder as shown in Figs. 1, 2, 3 and 4, Plate 5.

Water is taken under pressure from the accumulator and is admitted through pipes to either end of the cylinder, and controlled by hand valves. The system of pipes and valves (for both gate and valve engines) is shown in Figs. 9 and 10, Plate 7, and is sufficiently explained by the drawings. The apparatus shown at K, Figs. 9 and 10, automatically closes the valves.

The cross heads at both ends of the piston-rod are constructed with two sheaves as shown in E, Figs. 9 and 10. There are three stationary sheaves, shown at F, G, and H, Figs. 9 and 10. A wire rope passes around them as shown in the drawing. One end is fastened with an adjustable screw at I, as shown in Fig. 9, Plate 7. The other end passes down through the well in the lock wall and around the drum shown at Q, in Figs. 1, 2, 3 and 4, Plate 5, and is attached to the leaf as shown in Plate 5. The plane of revolution of the sheave F, Figs. 9 and 10, Plate 7, is inclined to the vertical sufficiently to bring the wire rope into the planes of revolution of the sheaves E, Figs. 9 and 10, Plate 7. The sheave H, Figs. 9 and 10, is used simply to change the direction of the wire rope.

When the engine makes a stroke the end of the wire rope, which is attached to the leaf moves over a space four times as great as the length of the stroke. The diameter of the piston is 15 inches, its area is therefore 176.7 square inches. When there is a pressure of 200 pounds per square inch, the total pressure on the piston is 35,340 pounds, and the total pull on the end of the wire rope which is attached to the leaf of the gate is 8,835 pounds (less friction and rigidity of rope). The smallest angle which the wire rope makes with the plane of the leaf is 53 degrees. Therefore the least resultant at right angles to the leaf is 5,319 pounds. When a pressure of 120 pounds is used on the gate engine the least resultant at right angles to the leaf is 3,191 pounds.

It is shown in Plate 5, that the wire rope at the upper or western end of an engine opens the leaf on the side nearest the engine; the wire rope at the other end closes the opposite leaf. This makes it necessary to work the two engines simultaneously.

Hand-power capstans, shown at I, Figs. 1, 2, 3 and 4, Plate 5, and Fig. 10, Plate 7, can be used in case the gate engines are disabled.

The four gate engines are similar.

FILLING AND EMPTYING VALVE ENGINES.

The position of the engines which operate the filling and emptying valves is shown at L, L, Figs. 1, 2, 3 and 4, Plate 5.

The details are shown at 1, 2 and 5, Plate 10. Each engine is supported by a heavy cast-iron frame shown at I, Figs. 1, 2 and 5, Plate 10. The cylinders are shown at F, F, Figs. 1, 2 and 5, Plate 10. Water, under pressure from the accumulator, is admitted through pipes to either end of the cylinder, and controlled by hand valves. The valves are shown in Figs. 9 and 10, Plate 7. The pipes are shown in Figs. 1 and 2, Plate 10, Figs. 9 and 10, Plate 7, and Figs. 1, 2, 3 and 4, Plate 5. The interior diameter of the cylinder is 15 inches, therefore when the pressure is 200 pounds to the square inch, the force of the piston is 35,340 pounds. The piston rod is shown at E, E, Figs. 1 and 2, Plate 10. The pitman is shown at H, H, Figs. 1 and 2, Plate 10. One end is attached to the cross-head, and the other to a lug on the valve, which is shown at G, Figs. 1 and 2, Plate 10. The lug is used to avoid approaching too near the dead point while the valves (by one full stroke of the piston) are being revolved through 90 degrees of arc. The four emptying and filling valve engines are alike.

PUMP FOR EMPTYING LOCK.

The pump which empties the lock is placed in the cellar of the machine house, and is shown in position at T, Figs. 1 and 3, Plate 5. It is a centrifugal, and is run by a belt connected with the main shaft, as shown in the drawings. It is about 8 feet below the surface of the water. When the water is to be pumped out of the lock, the guard-gates above and below it are closed, and the orifice shown at O, Fig. 1, Plate 5, is also closed. At first the water enters the pump through the orifice shown at M, and is discharged through the orifice shown at N, Fig. 1, Plate 5. The position of the discharge pipe is shown by the dotted lines, Figs. 1 and 3, Plate 5. When the water has been pumped out so that its surface is below the orifice O, a suction pipe is attached, as shown by dotted lines in Fig. 3, Plate 5. This pipe extends 20 feet horizontally from the wall, and then goes down to the bottom of the culvert at the point P, Fig. 3, Plate 5. The orifice at M, Fig. 1, Plate 5, is closed with a metal plate. The suction pipe, when in use, is supported on temporary trestles, and when not in use is entirely removed from the lock. The diameter of the suction pipe is 16 inches. The full power of both turbines is used on this pump. It will pump the water out of the lock so as to lower the surface 1 foot per hour until the floor is reached. Below this depth its effective work rapidly diminishes, and the limit of its capacity is reached when the water in the culvert is lowered to a depth of 2½ feet.

THE DYNAMO.

The dynamo for the electric lights, used in lighting the locks, is shown at R, Figs. 1 and 3, Plate 5. It is a 10-arc-light machine of the "Brush" patent. It is run by a belt from the main shaft, as shown in the drawings. The force required is eight horse-power.

THE POWER CAPSTAN.

The power capstan is on the lock wall near the machine house. It is run by belts from the main shaft. The belts and pulleys are shown at S, Fig. 1, Plate 5, and in Figs 1 and 2, Plate 8. The capstan is used for warping vessels into and out of the lock. A system of lines and snatch-blocks extends around the lock, so that vessels can be warped in from either end and to either side.

MOVABLE DAM.

The movable dam is designed to check the flow of water so that the upper guard-guates can be closed in case the lock-gates are accidentally carried away.

It is about 3,000 feet above the locks. Its location is shown at G, Sketch 2, Plate 2. It consists of an ordinary swing-bridge, one end of which can be swung across the canal. A series of wickets are suspended side by side from a horizontal truss hung beneath the bridge, and abutting, at either end (when the bridge is closed), against heavy buffers securely anchored to the masonry, as shown in Figs. 1, 2, 4 and 5, Plate 11, and Fig. 1, Plate 12. One end of each wicket can be let down until it rests against a sill in the bottom of the canal. When the wickets are all down they form a vertical bulkhead or dam. The details are given in Plates 11 and 12. The truss and revolving apparatus are similar to many swing-bridges in common use. They are shown in Plate 11, and do not require further description. The wickets are 23 in number, and are shown in Fig. 1, Plate 11. Each wicket is supported in an iron frame. Several are shown in Plate 12. The one at G, G, Figs. 1 and 2, Plate 12, will be taken as an example. The wicket is made of several pieces of timber, as shown in the drawing. It turns on an axle at H, Fig. 1, Plate 12, and is let down and drawn up by chains at each end, as shown at I, Fig. 1, Plate 12. The wicket frame is suspended at one end and turns about the shaft shown at J, Fig. 1, Plate 12.

The windlasses on which the cables are wound, shown at K, ... K, Figs. 1 and 2, Plate 12. They are all provided with pawls and friction brakes. A wicket fully drawn up is shown at L, another in the act of dropping into position is show at G, and another after it has been dropped, and the upper end drawn into place is shown at M, Figs. 1 and 2, Plate 12.

In dropping a wicket the down-steam end is first let go until it strikes the water, the up-stream end is then let go by the run, and the frame swings down until this end strikes the sill, the wicket lying horizontally in the water and presenting only its end surface to the current. The wicket is then drawn into a vertical position by the chain at its down-stream end. After the wickets are in position there remains a space of 1-inch between the wicket frames as shown in Fig. 2, Plate 12. The axle shown at H, Fig. 1, Plate 12, is so placed as to leave the pressure of water on the upper and lower parts of the wicket nearly equal.

The hoisting chains have been replaced by 1½-inch wire rope.

The bottom of the canal under the movable dam is covered with a floor, sections of which are shown at N, N, Figs. 1 and 2, Plate 12. The construction of the floor is similar to that of the lock previously described. The concrete is not shown in the drawings. The sill is shown at O, Figs. 1 and 2, Plate 12. There is a second sill, not shown in the drawings, which can be used in case a coffer-dam is necessary. The dead weight on the truss, due to the wickets and frames, is 1,600 pounds per running foot. This is counterpoised by brick work at the opposite end of the truss. The girders which support the brick work are shown at C, ... C, Fig. 1, Plate 11, and sections of brick work are shown in Figs. 3 and 4, Plate 12. The lateral pressure, due to the pressure of water against the wickets, is 3,400 pounds per running foot.

DETAILED DRAV

of

ST. MARY'S FALLS CA

MICHIGAI

Made under the directio

Lieut. Col. GODFREY W

Major F. U. FARQUHAR and Lieu

Corps of Engineers U.

by

W. C. SAUER;

1882-3-4.

.ED DRAWINGS

of

LLS CANAL & LOCKS,

ICHIGAN.

under the direction of

;ODFREY WEITZEL,

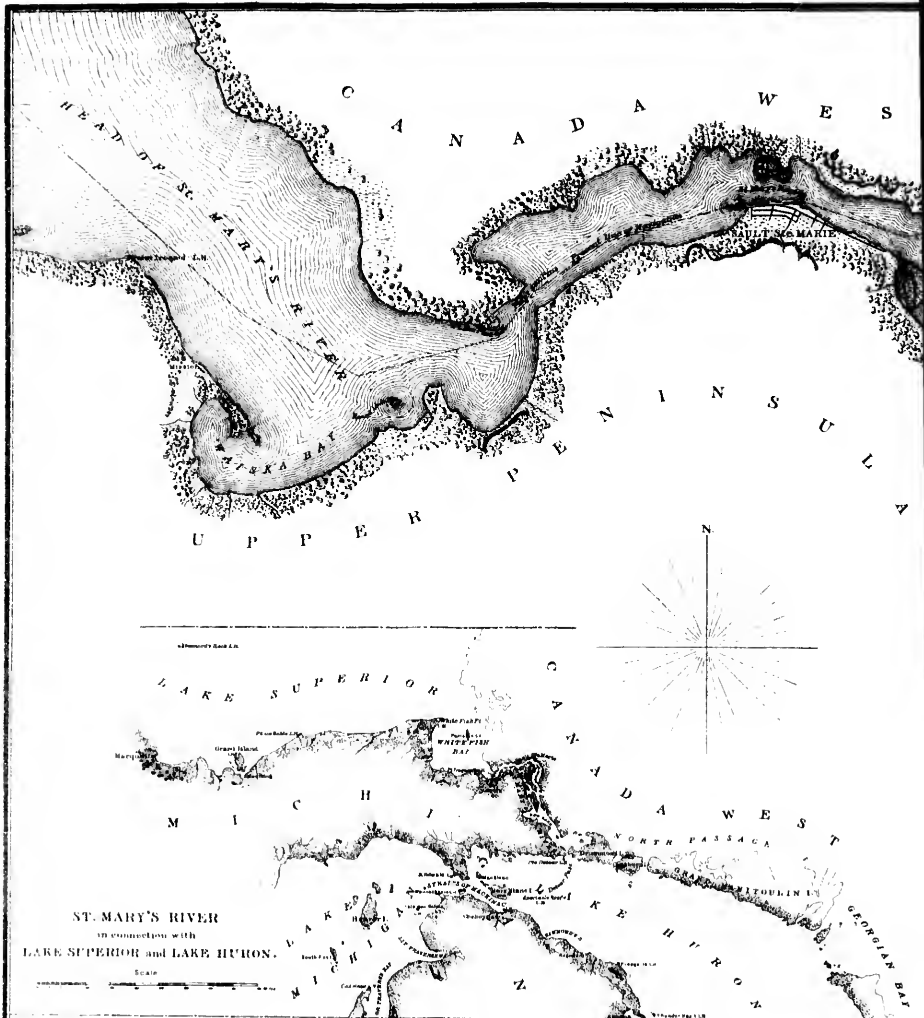
HAR and Lieut.Col. O.M.POE,

f Engineers U.S.Army,

by

W.C.SAUER;

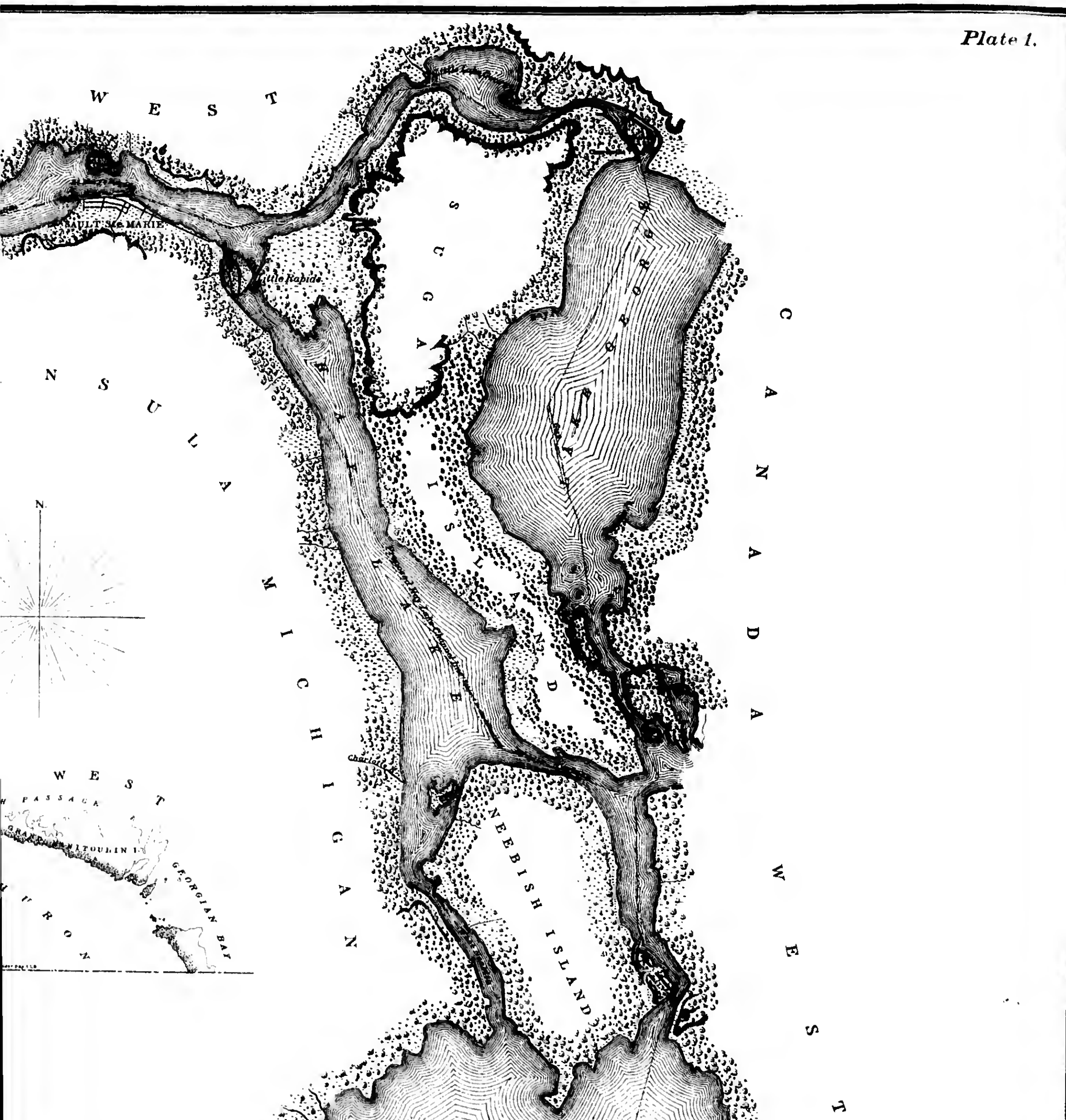
1882-3-4.



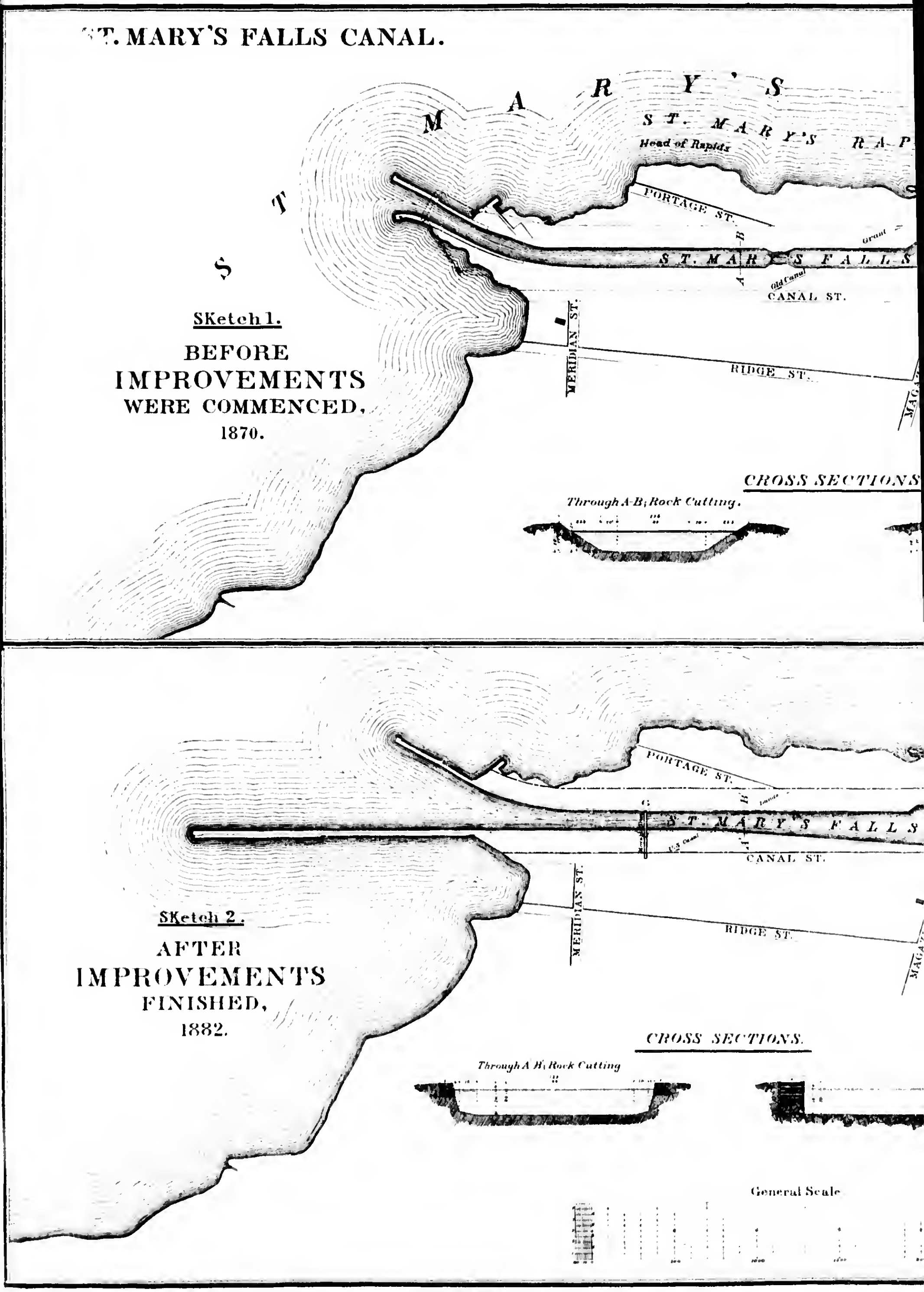
ST. MARY'S RIVER
FROM WAISKA BAY TO MUD LAKE.

Scale.

Plate 1.



W E S T
SAULT Ste MARIE
Little Rapids
S U G A R
I S L A N D
C A N A D A
W E S T
M I C H I G A N
NEEBISH ISLAND
M U D
L A K E
N.
W E S T
GEORGIAN BAY


ST. MARY'S FALLS CANAL.
S T M A R Y ' S
ST. MARY'S RAP
Head of Rapids
PORTAGE ST.
ST. MAR S FALLS
Old Canal
CANAL ST.
MERIDIAN ST.
RIDGE ST.
SKetch 1.
BEFORE
IMPROVEMENTS
WERE COMMENCED,
1870.
CROSS SECTIONS
Through A-B; Rock Cutting.
PORTAGE ST.
ST. MARY'S FALLS
U.S. Canal
CANAL ST.
MERIDIAN ST.
RIDGE ST.
SKetch 2.
AFTER
IMPROVEMENTS
FINISHED,
1882.
CROSS SECTIONS.
Through A B; Rock Cutting
General Scale

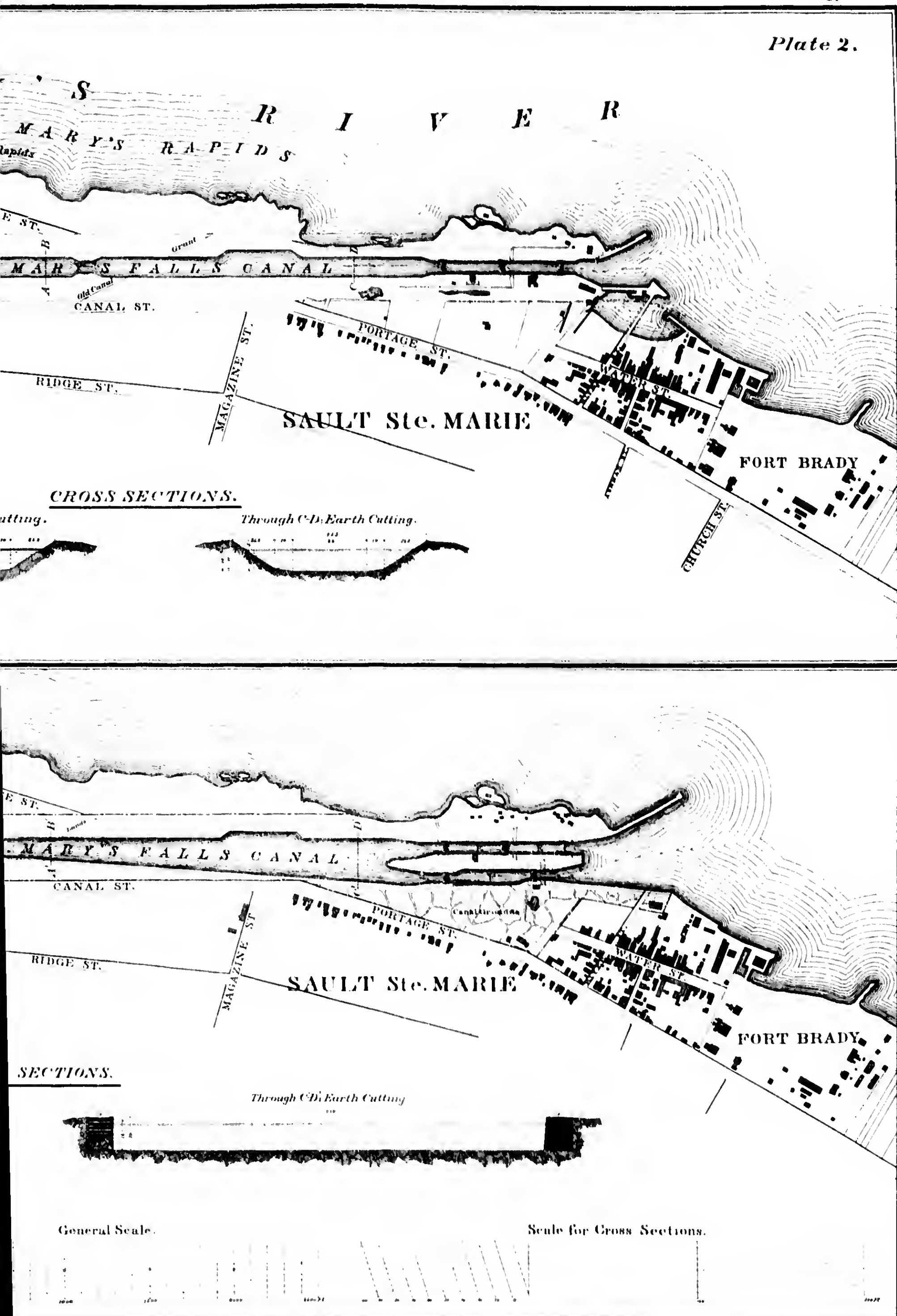


Plate 2.
S
R I V E R
MARY'S RAPIDS
E ST.
MAR'S FALLS CANAL
Old Canal
CANAL ST.
PORTAGE ST.
MAGAZINE ST.
RIDGE ST.
WATER ST.
SAULT Ste. MARIE
FORT BRADY
CHURCH ST.
CROSS SECTIONS.
Through C-D; Earth Cutting.
E ST.
MARY'S FALLS CANAL
CANAL ST.
PORTAGE ST.
MAGAZINE ST.
RIDGE ST.
WATER ST.
SAULT Ste. MARIE
FORT BRADY
SECTIONS.
Through C-D; Earth Cutting
General Scale.
Scale for Cross Sections.

ST. MARY S FALLS CANAL.

THE OLD

(1853-1

General

Detail S

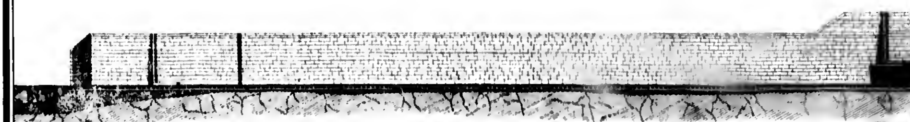
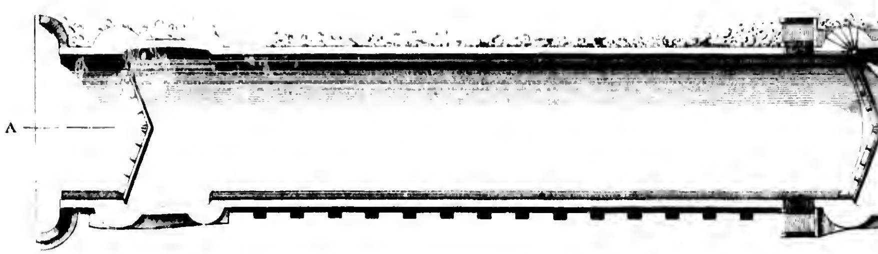


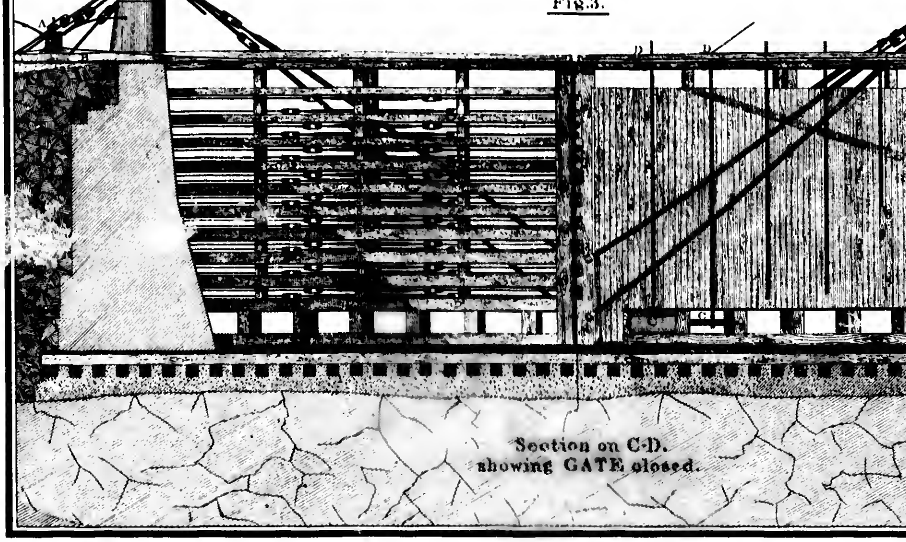
Fig.

Elevation of
and Longitudinal



DETAI

Fig.3.



Section on C-D.
showing GATE closed.

THE OLD LOCKS.

(1853-1855.)

General Scale.

Detail Scale.

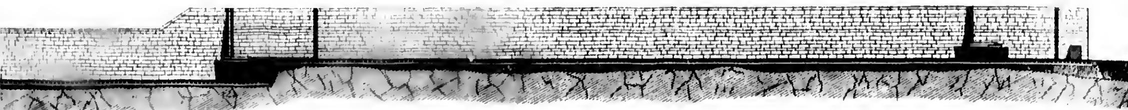
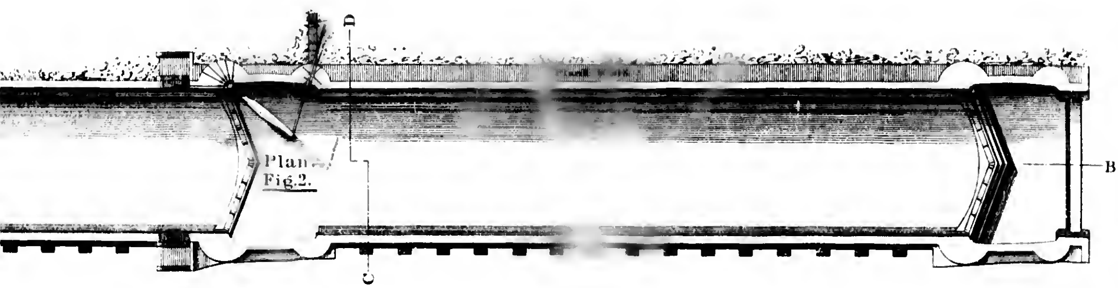
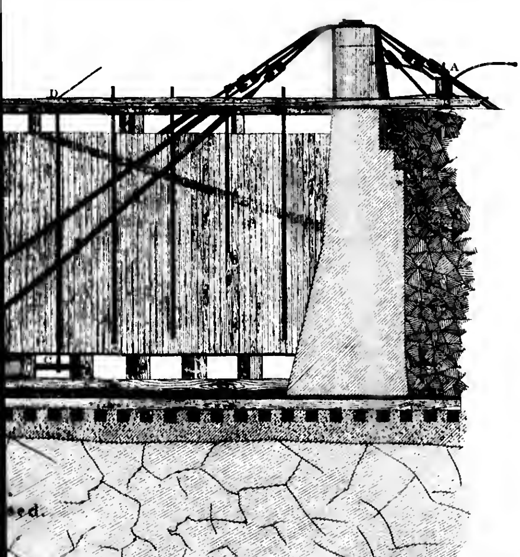


Fig.1.

Elevation of South Wall
and Longitudinal Section on A-B.



DETAILS.



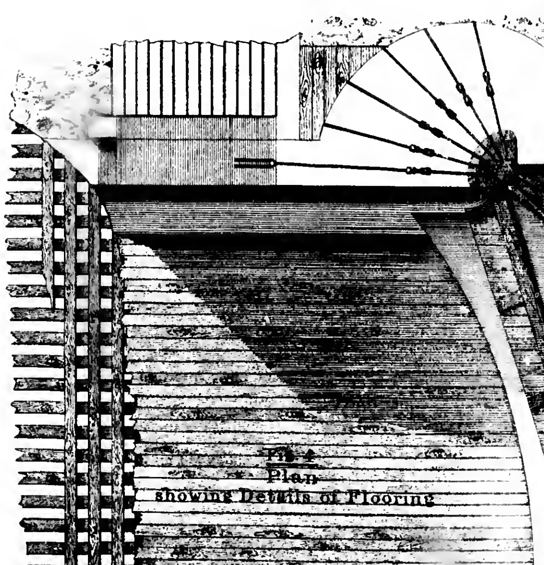


Fig. 4
Plan
showing Details of Flooring

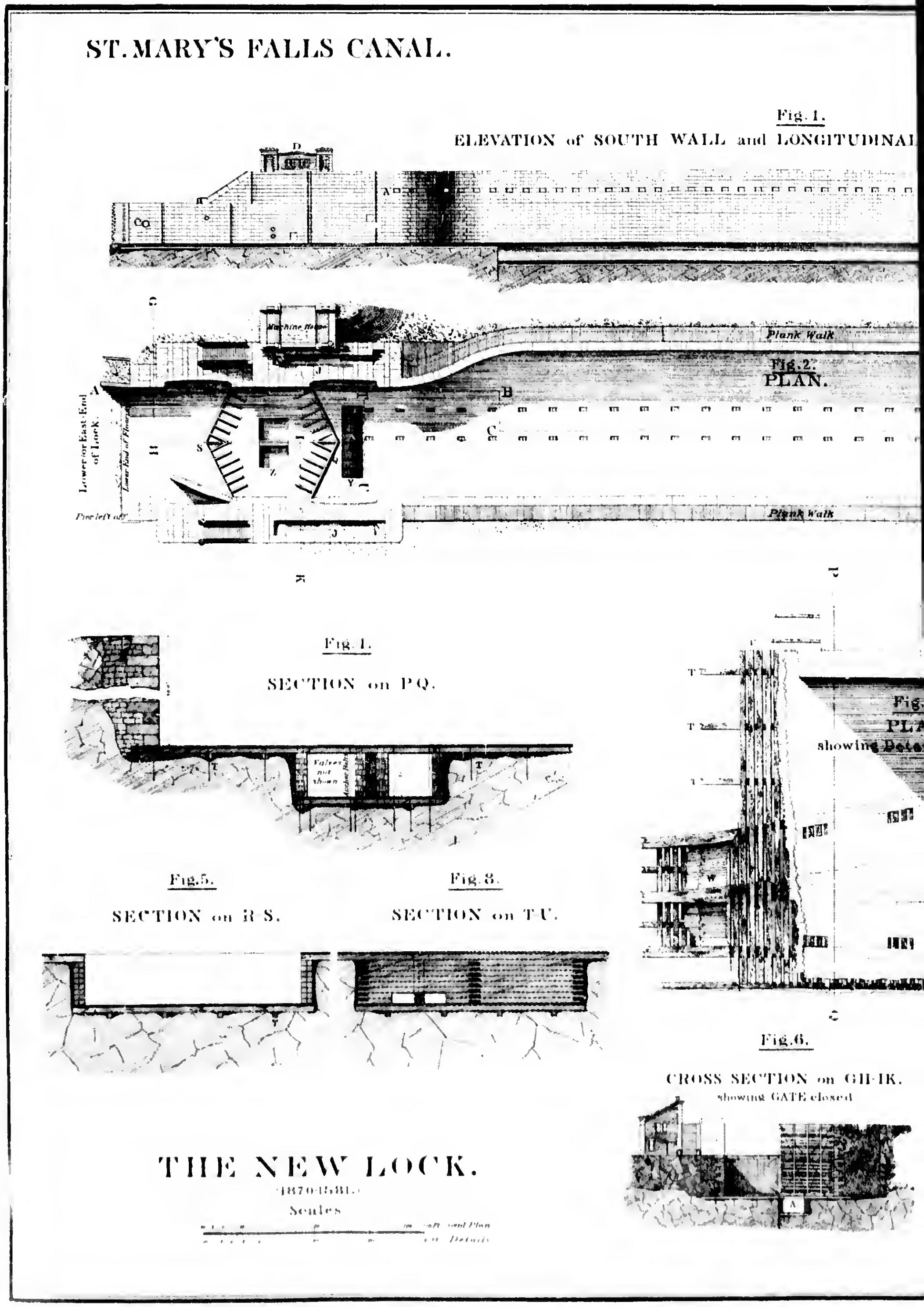
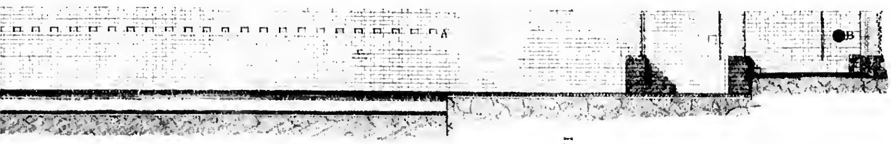
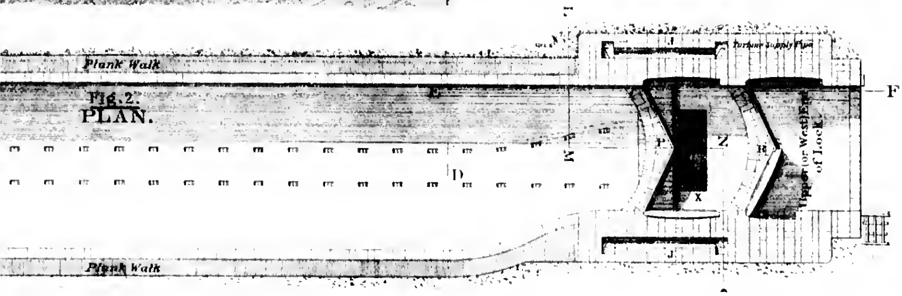

ST. MARY'S FALLS CANAL.
Fig. 1.
ELEVATION of SOUTH WALL and LONGITUDINAL
Machine House
Plank Walk
Fig. 2.
PLAN.
Lower (or East) End of Lock.
Plank Walk
Fig. 4.
SECTION on P.Q.
Fig. 5.
SECTION on R S.
Fig. 8.
SECTION on T U.
Fig. 6.
CROSS SECTION on GH-IK.
showing GATE closed
THE NEW LOCK.
Scales

Plate 4.

Fig. 1.

ALL and LONGITUDINAL SECTION on AB-CD-EF.





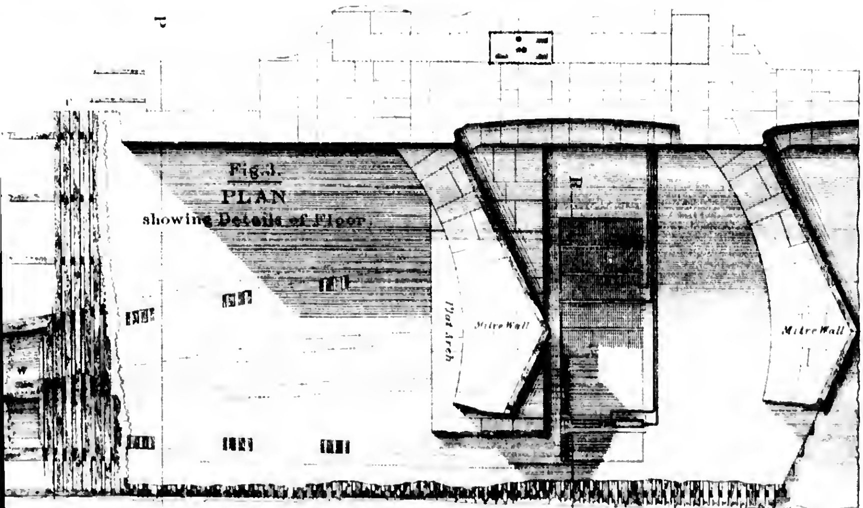


Fig. 6.

OSS SECTION on GH-IK.
showing GATE closed

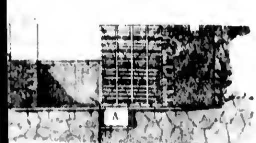
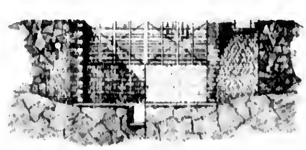


Fig. 7.

CROSS SECTION on LM NO.
showing GATE closed



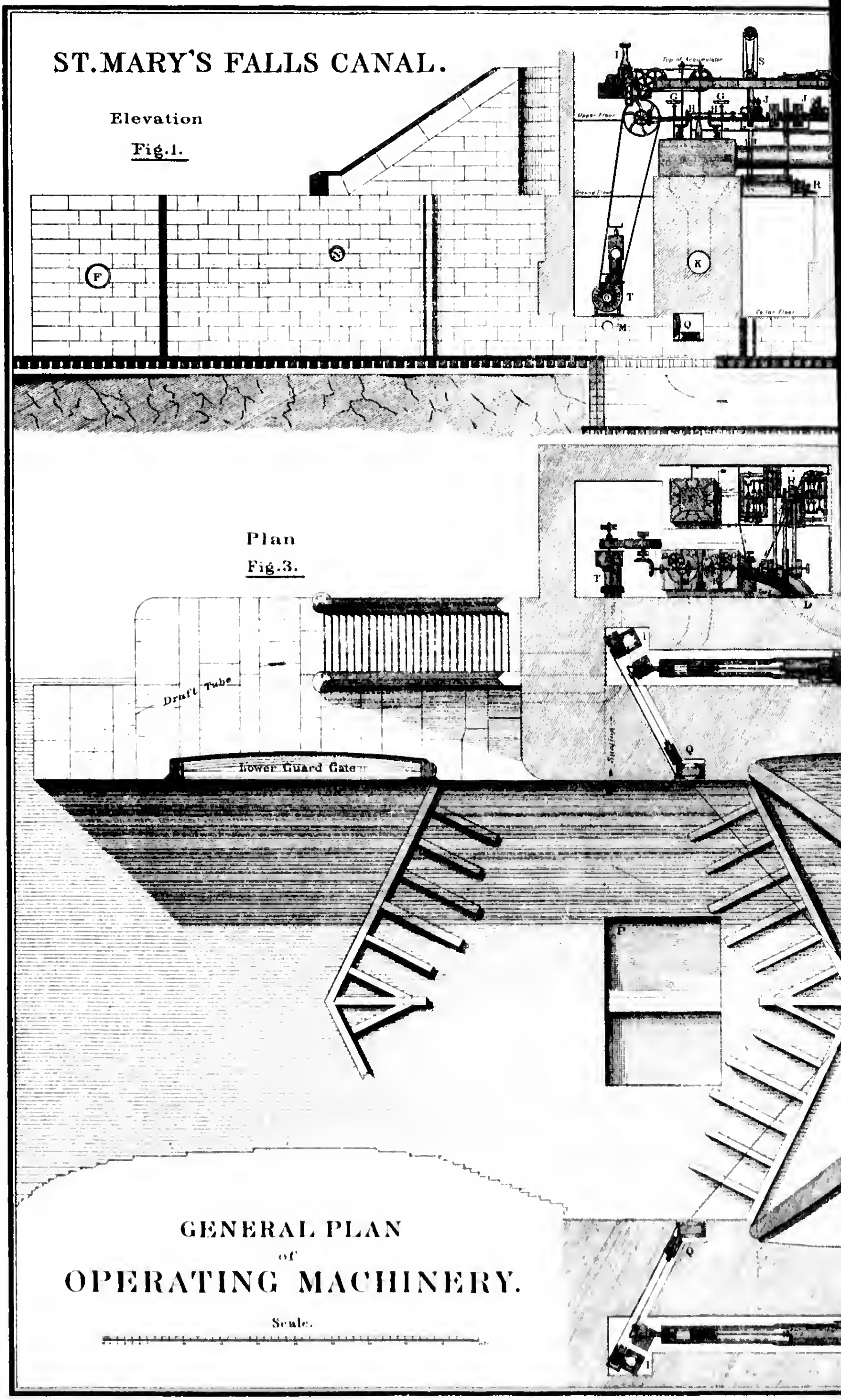
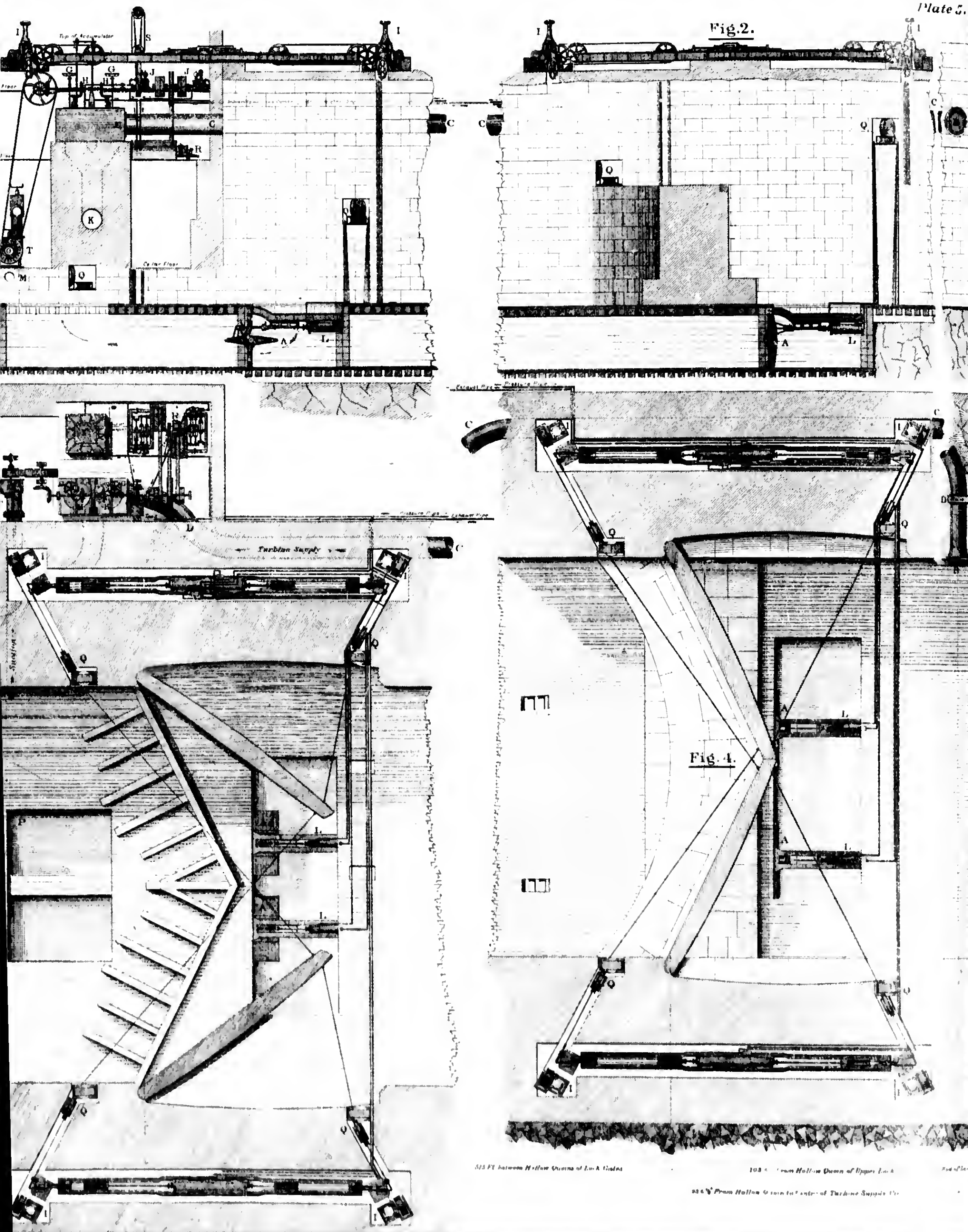
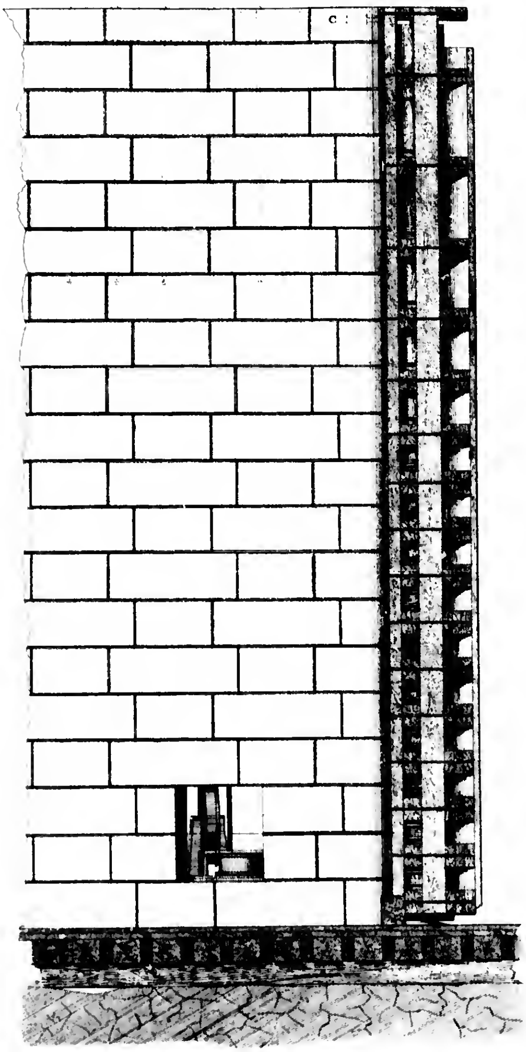

ST. MARY'S FALLS CANAL.
Elevation
Fig.1.
Plan
Fig.3.
Draft Tube
Lower Guard Gate
GENERAL PLAN
of
OPERATING MACHINERY.
Scale.

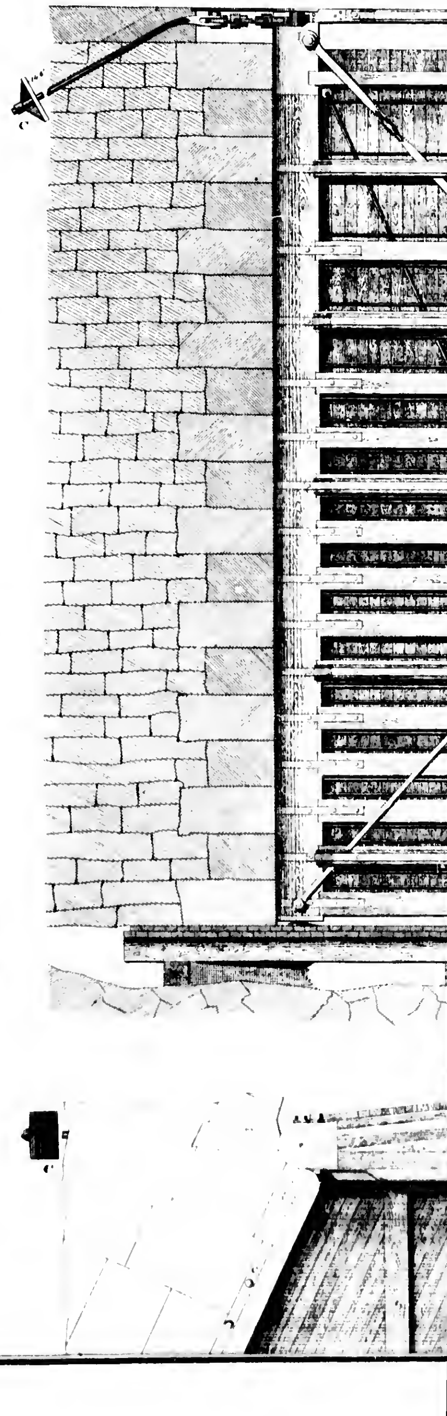
Plate 5.



ST. MARY'S FALLS CANAL

Fig. 3.
Section on A-B.





SOUTH LEAF OF
THE LOWER LOCK GATE.

Scale.

Plate 6.

Fig. 1.
Elevation.

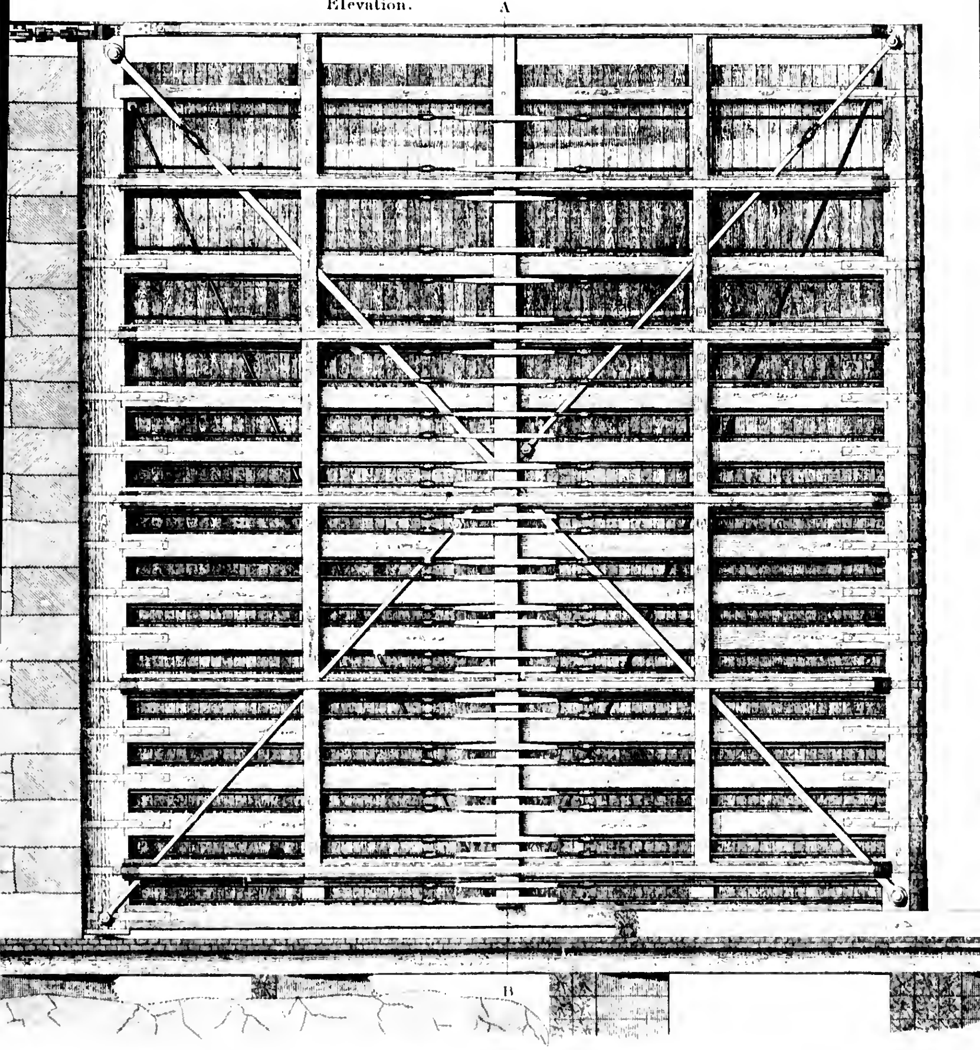
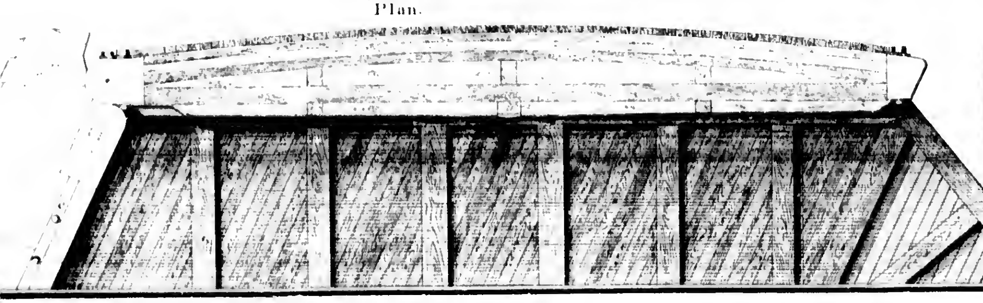
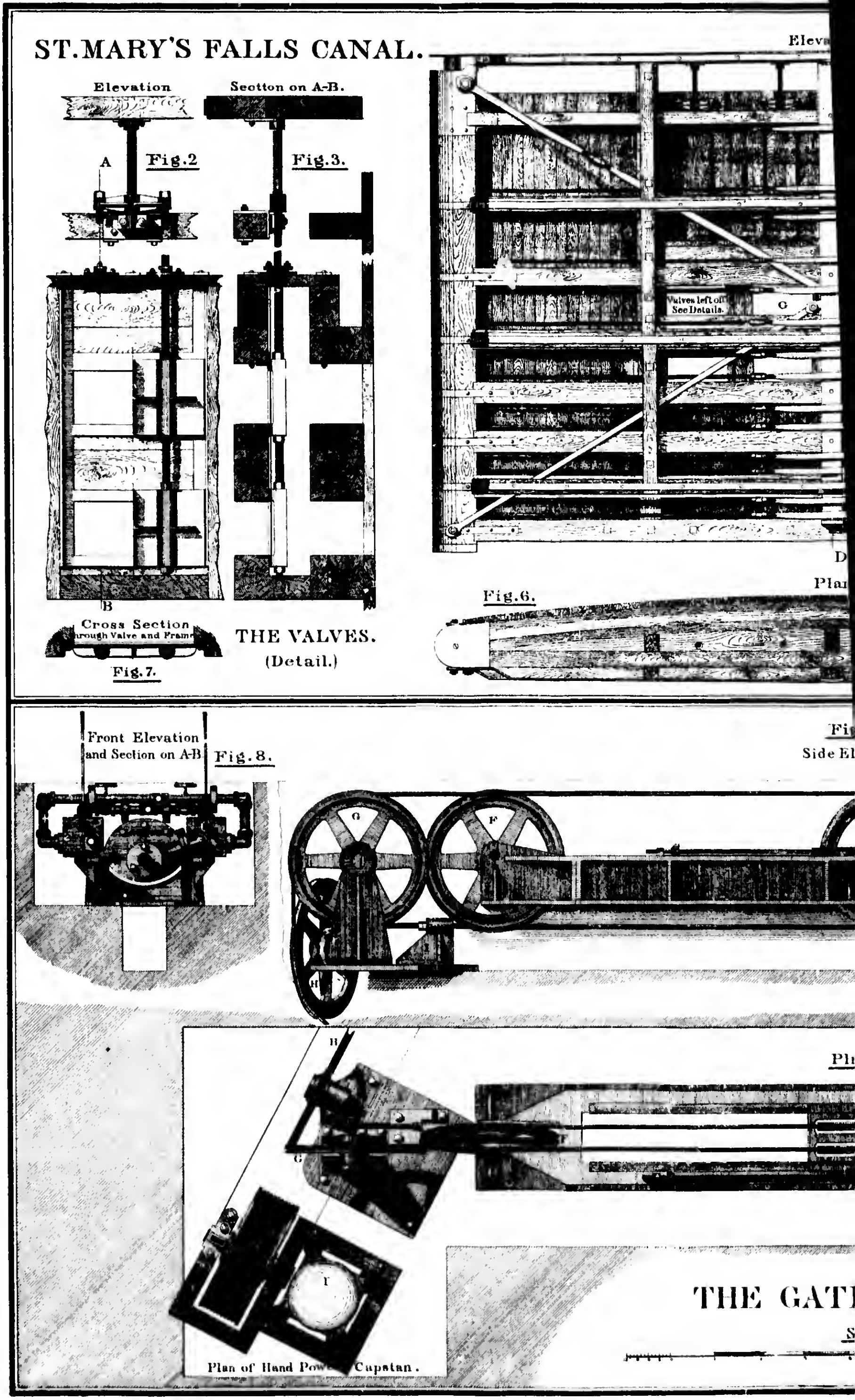


Fig. 2.
Plan.




ST. MARY'S FALLS CANAL.
Elevation
Section on A-B.
Fig. 2
Fig. 3.
A
B
Cross Section
through Valve and Frame
Fig. 7.
THE VALVES.
(Detail.)
Elev
Valves left off
See Details.
G
D
Plan
Fig. 6.
Fi
Side El
Front Elevation
and Section on A-B
Fig. 8.
G
F
H
Pl
H
G
I
Plan of Hand Power Capstan.
THE GAT
S

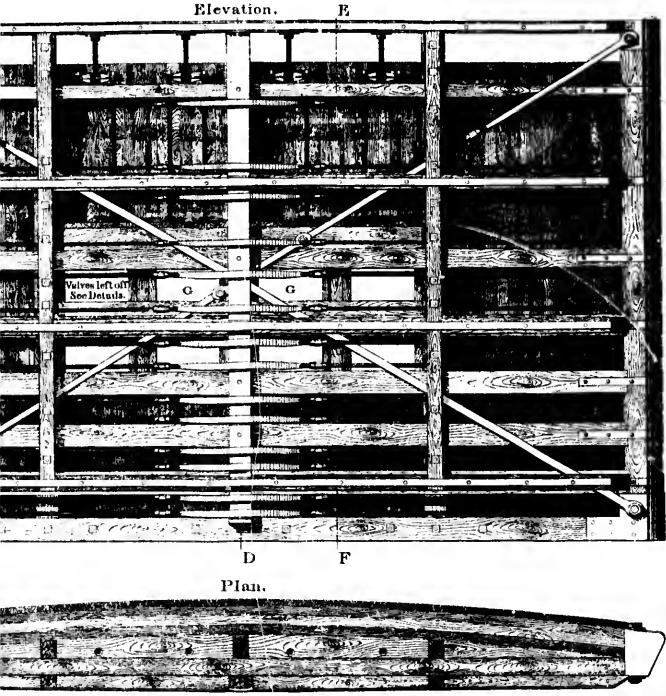


Fig. 1.

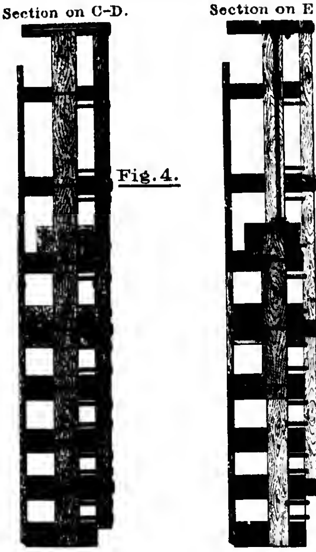


Fig. 4.

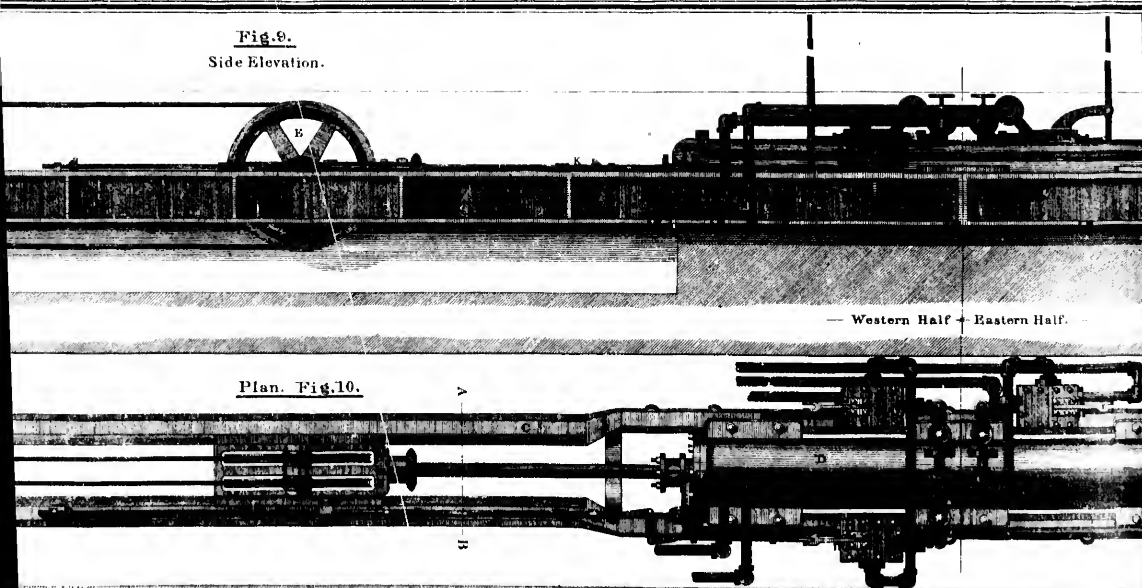
Fig. 5.

THE SOUTH LEAF OF THE UPPER GUARD GATE.

Scales.

General Scale —

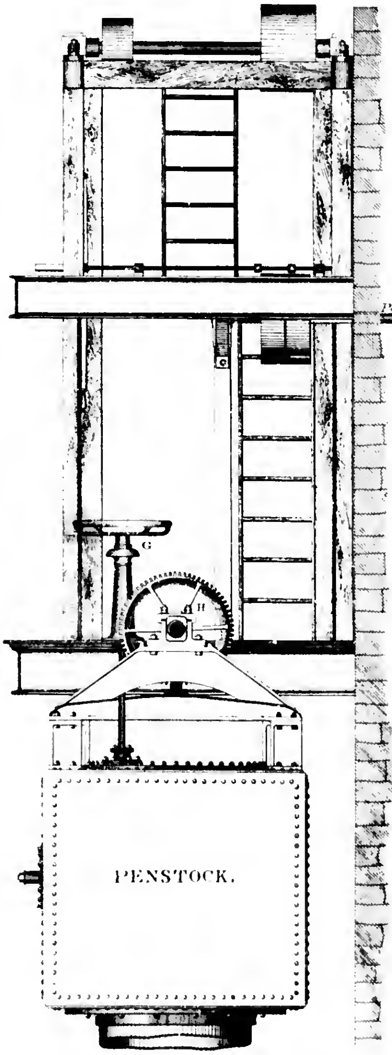
Details —



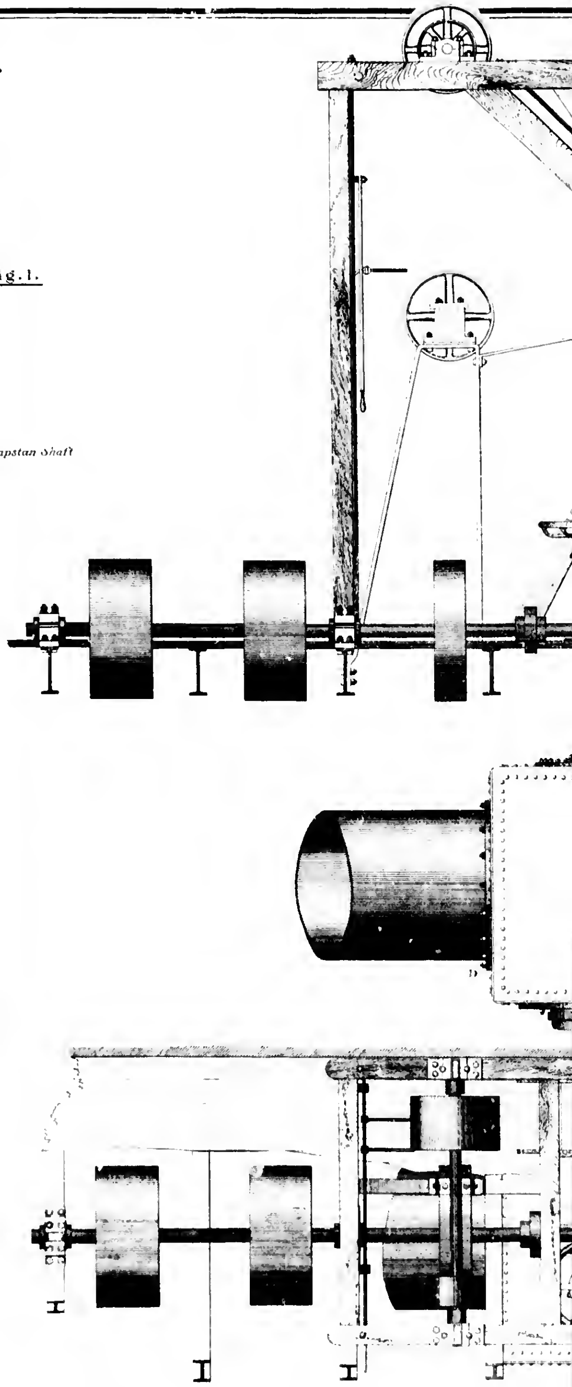
THE GATE ENGINES.

Scale.

ST. MARY'S FALLS CANAL.



Front Elevation and Section on A-B-C.



TURBINE CASING AND GEARING.

Scale.

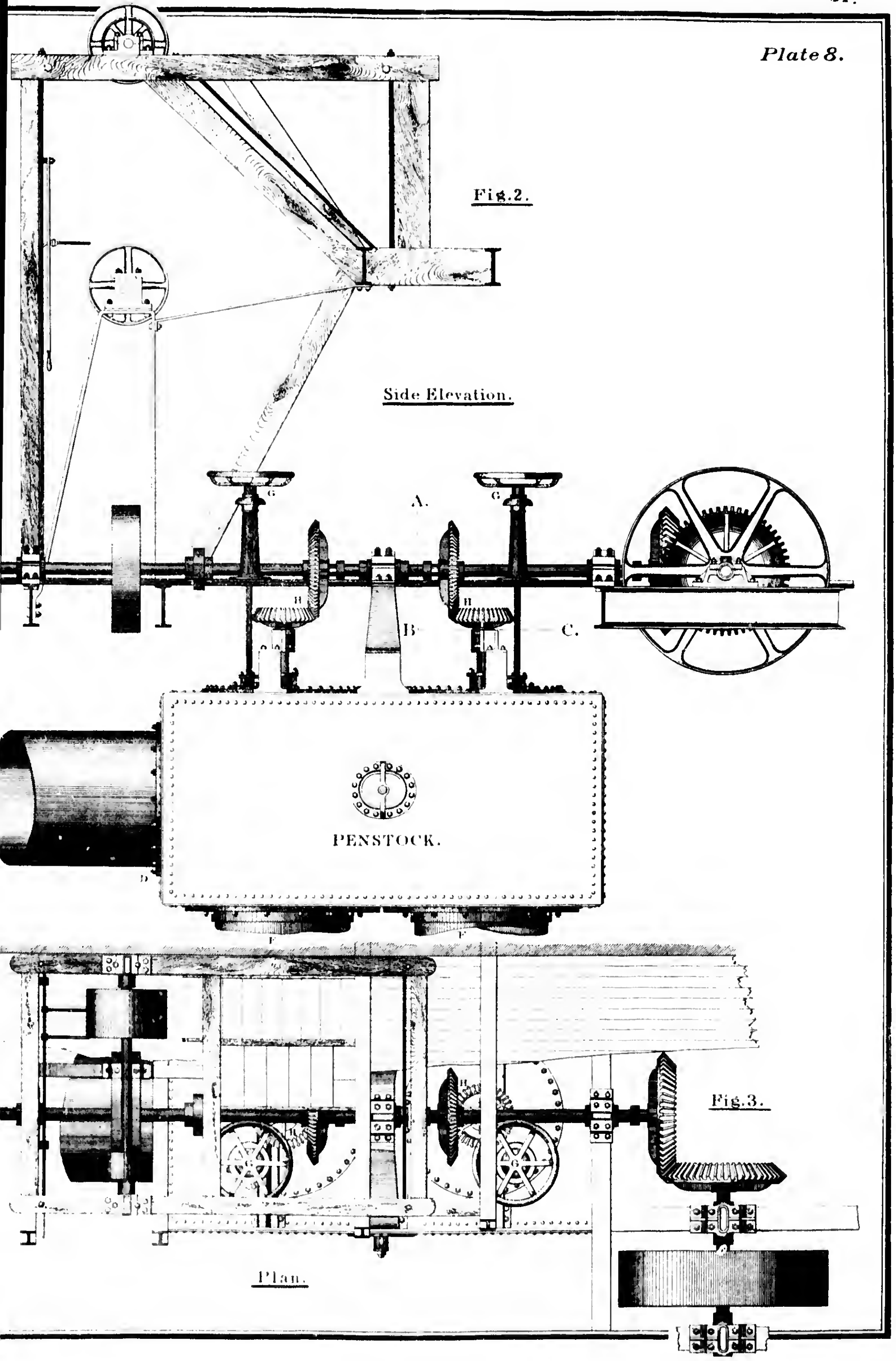
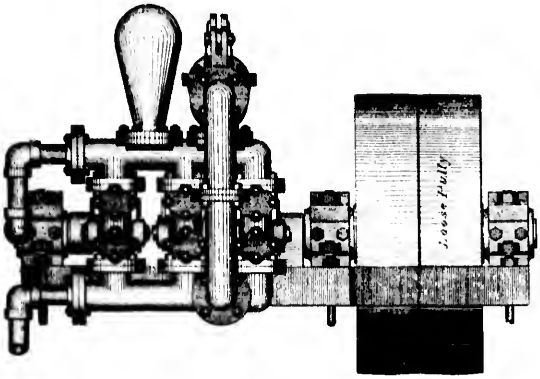
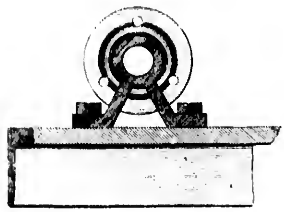


Plate 8.
Fig. 2.
Side Elevation.
A.
B.
C.
G
H
PENSTOCK.
Fig. 3.
Plan.

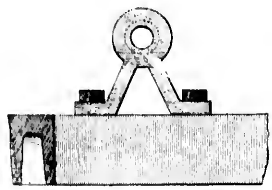
ST. MARY'S FALLS CANAL



Front Elevation



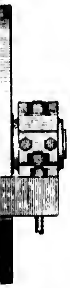
Section on E-F.(Details.)

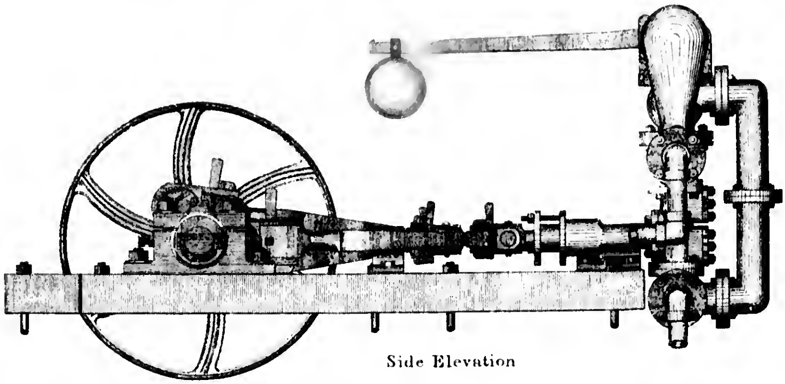


Section on C-D.(Details.)

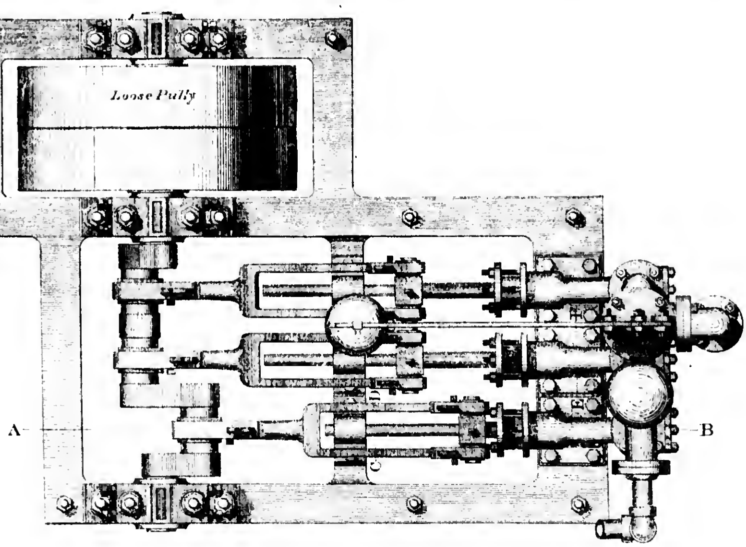
THE ACCUMULATOR PUMPS.

Scales.
General Scale.
Details.



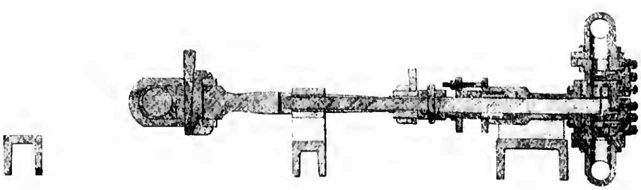


Side Elevation



Plan.

PS.



Longitudinal Section on A-B.

ST. MARY'S FALLS CANAL.

Fig.1.

Elevation.

Fig.5.

Section on A-B.

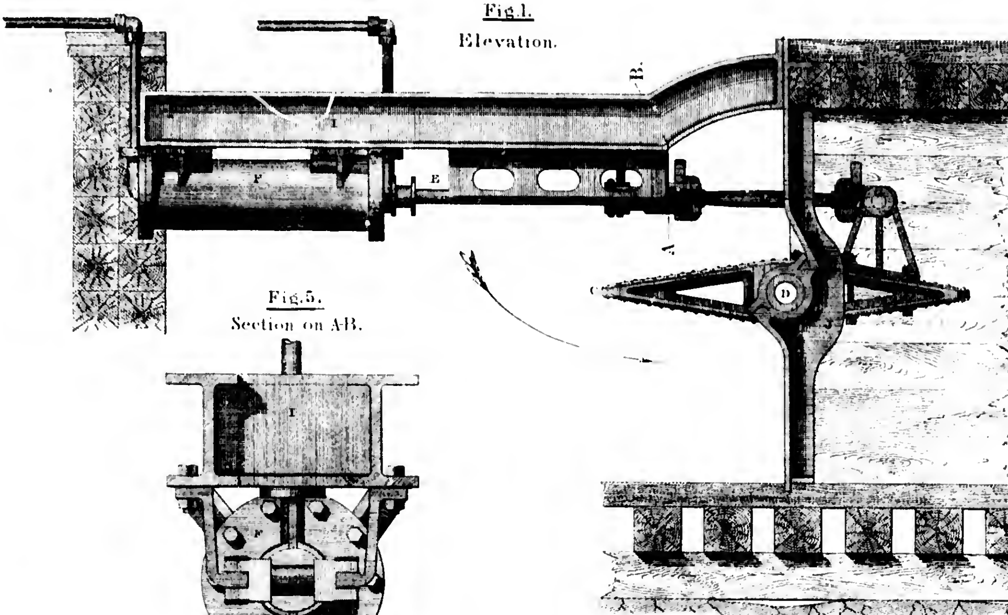
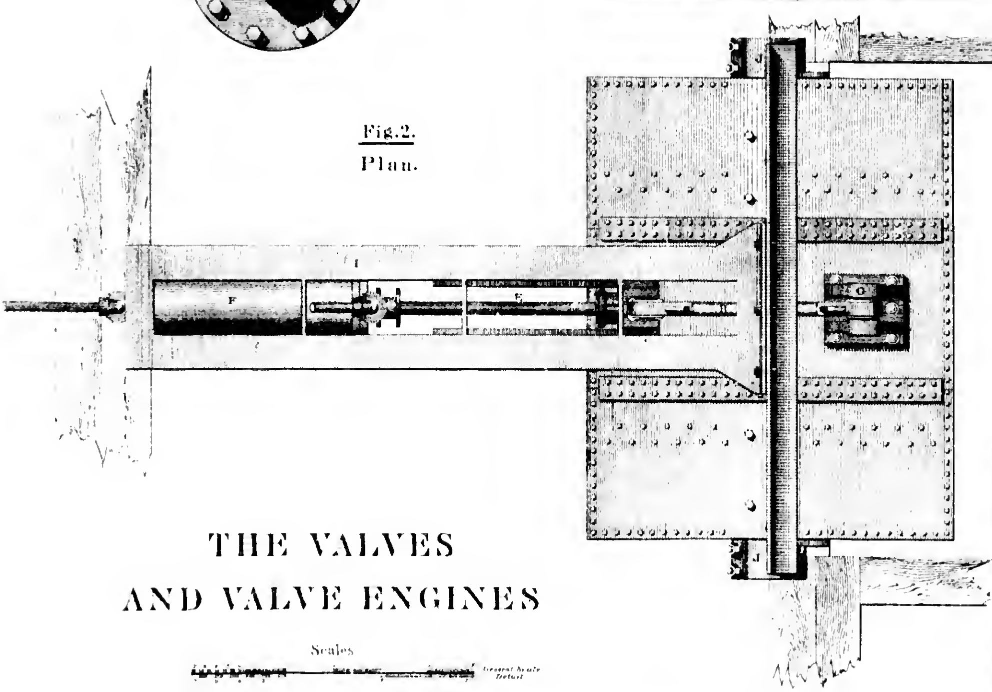


Fig.2.

Plan.



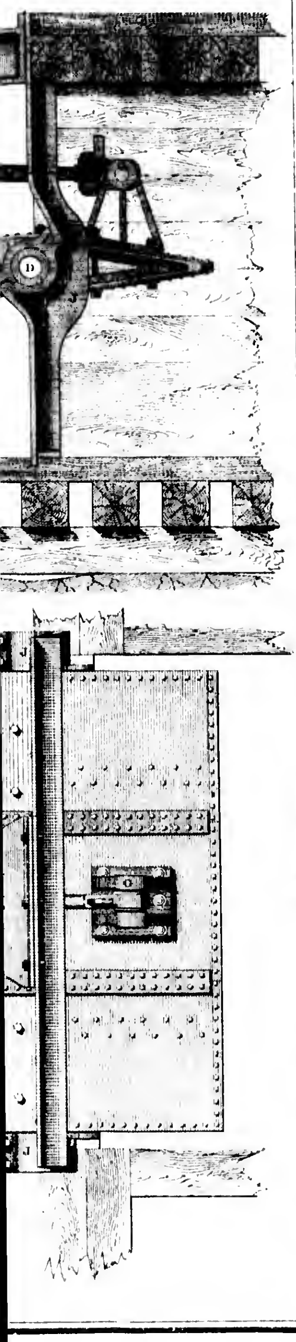
THE VALVES AND VALVE ENGINES

Scales

General Scale

Detail

Plate 10.



THE ACCUMULATOR

Scale.

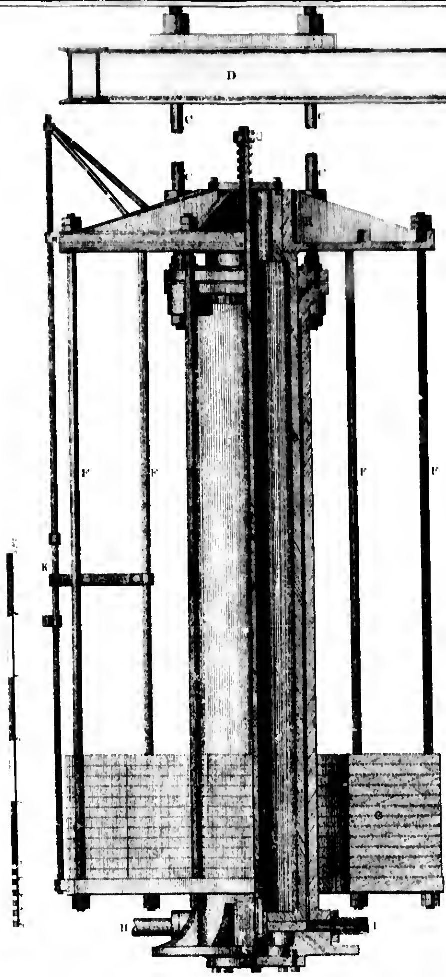


Fig.3.

Half-Elevation and Section

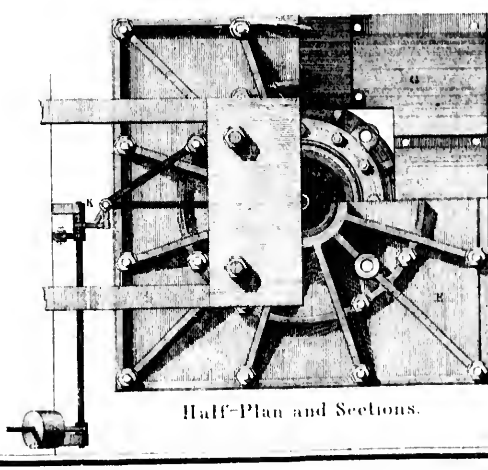


Fig.4.

Half-Plan and Sections.

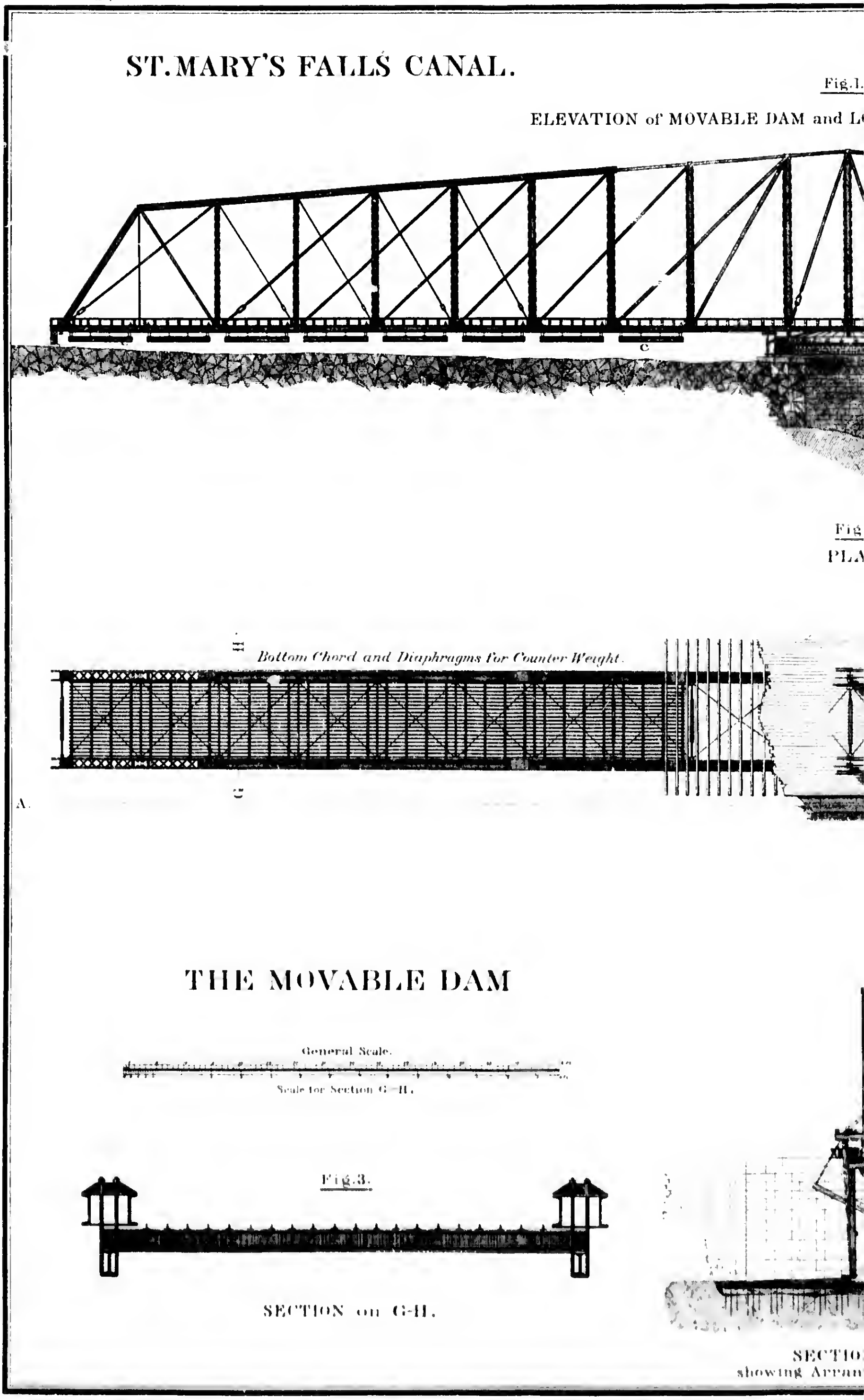

ST. MARY'S FALLS CANAL.
Fig.1.
ELEVATION of MOVABLE DAM and L
C
Fig
PLA
H
Bottom Chord and Diaphragms for Counter Weight.
G
A.
THE MOVABLE DAM
General Scale.
Scale for Section G-H.
Fig.3.
SECTION on G-H.
SECTIO
showing Arran

Plate II.

Fig. 1.

ON of MOVABLE DAM and LONGITUDINAL SECTION on A-B.

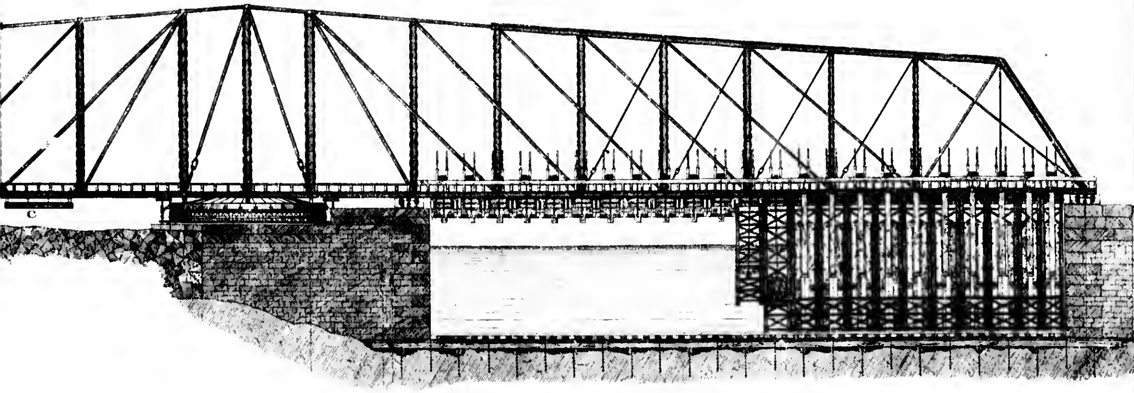


Fig. 2.

PLAN.

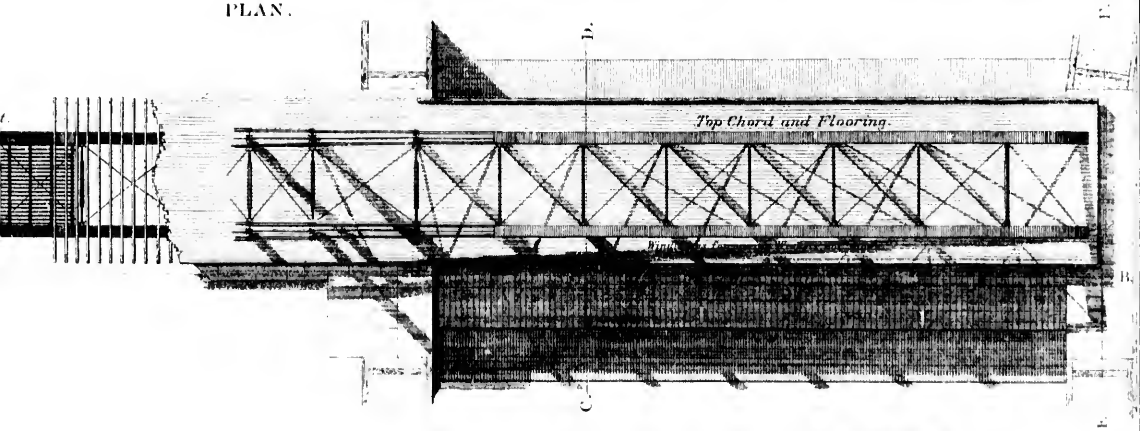
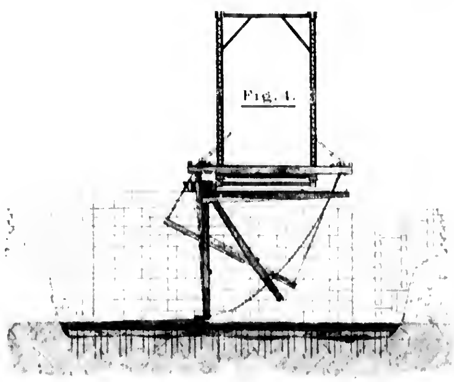
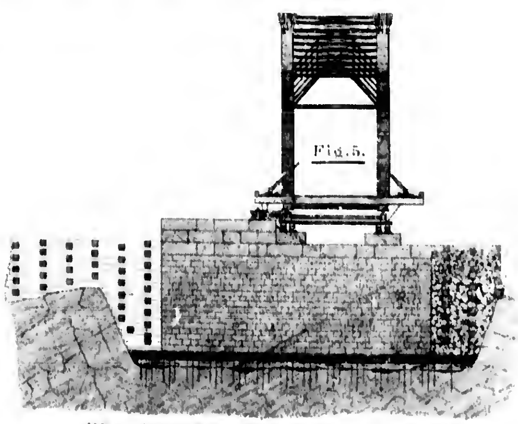


Fig. 4.

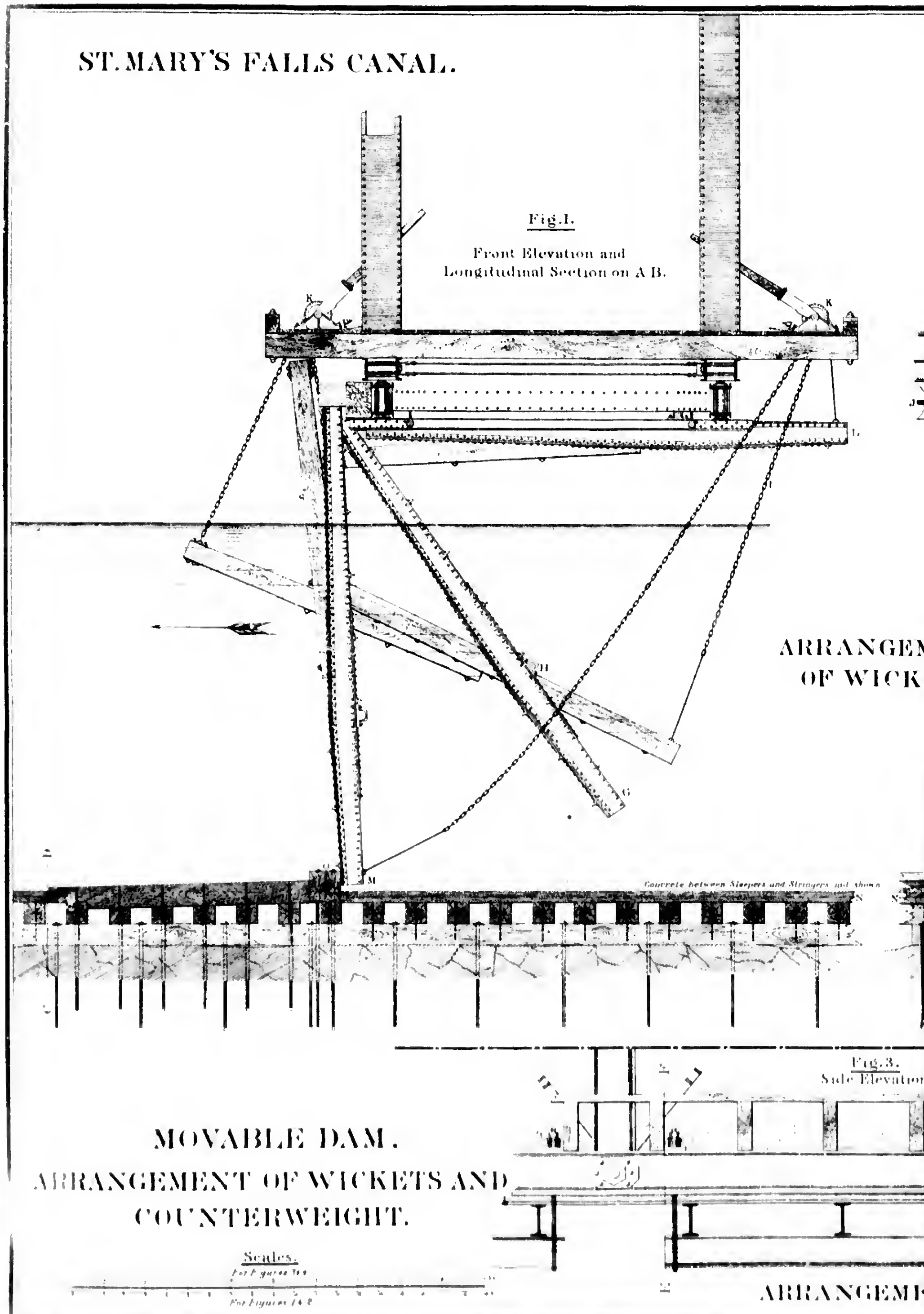


SECTION on C-D.
showing Arrangement of Wickets.

Fig. 5.



FRONT ELEVATION of MOVABLE DAM and
SECTION on E-F.


ST. MARY'S FALLS CANAL.
Fig.1.
Front Elevation and
Longitudinal Section on A B.
ARRANGEM
OF WICKE
Concrete between Sleepers and Stringers not shown
Fig.3.
Side Elevation
MOVABLE DAM.
ARRANGEMENT OF WICKETS AND
COUNTERWEIGHT.
Scales.
ARRANGEME

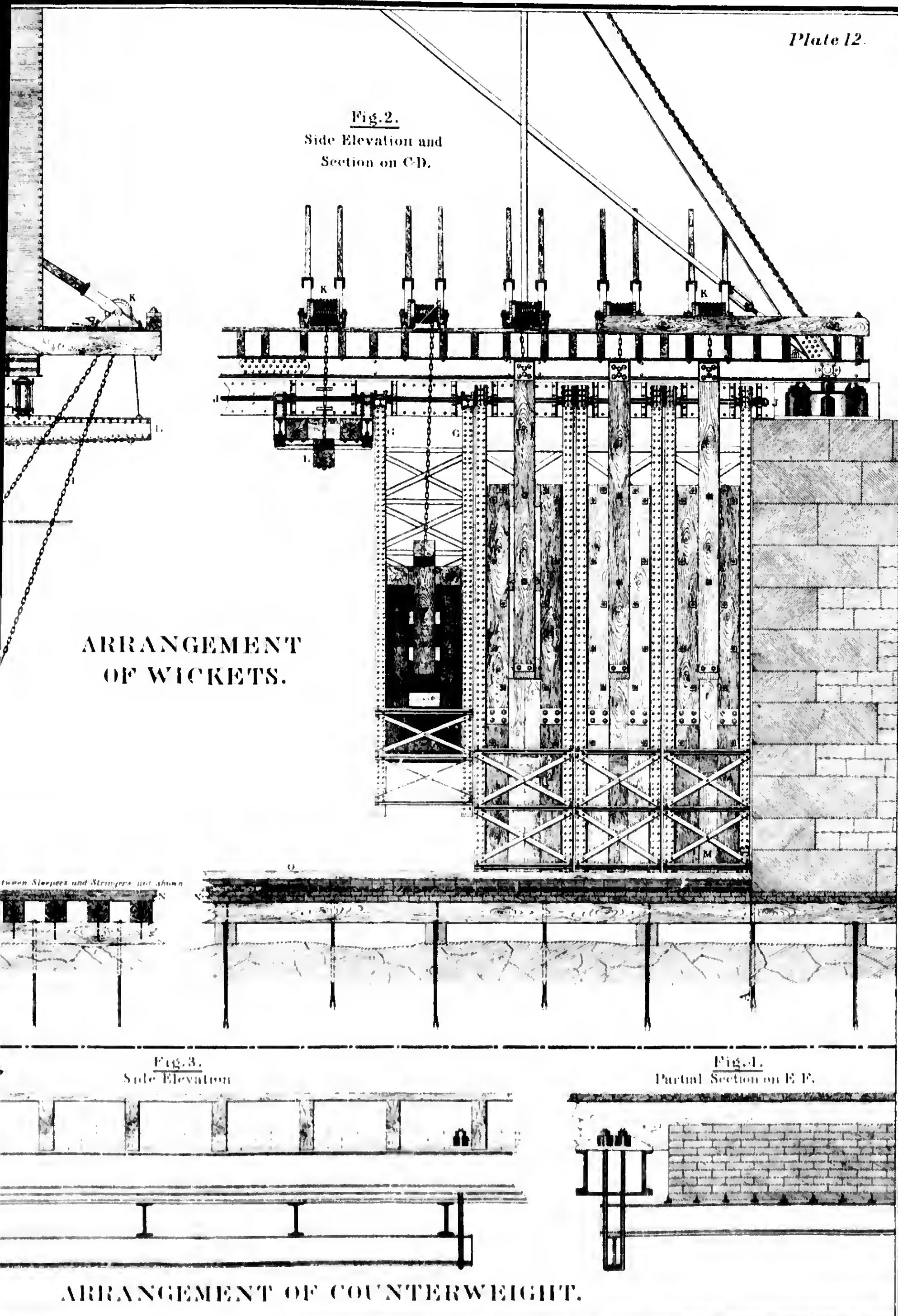


Plate 12.
Fig. 2.
Side Elevation and
Section on C-D.
ARRANGEMENT
OF WICKETS.
Fig. 3.
Side Elevation
Fig. 4.
Partial Section on E F.
ARRANGEMENT OF COUNTERWEIGHT.

ST. MARY'S FALLS CANAL.

Fig. 1.

PIER REVETMENT

General Scale.

Details

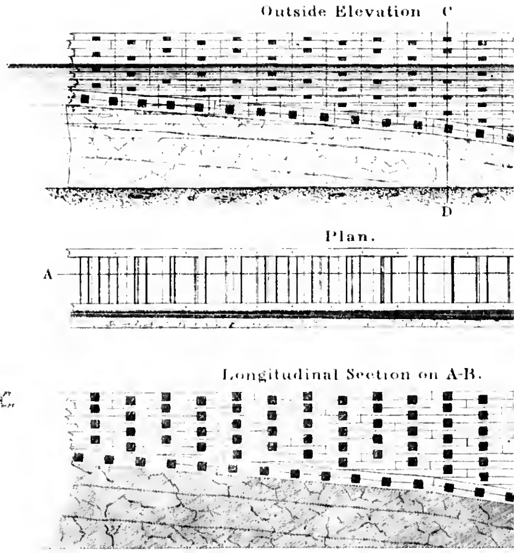


Fig. 2.

CRIB
in
SOUTH WEST PIER.

General Scale

Details.

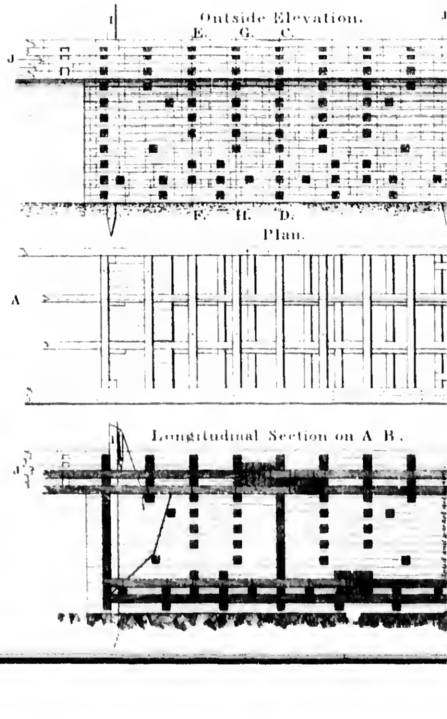
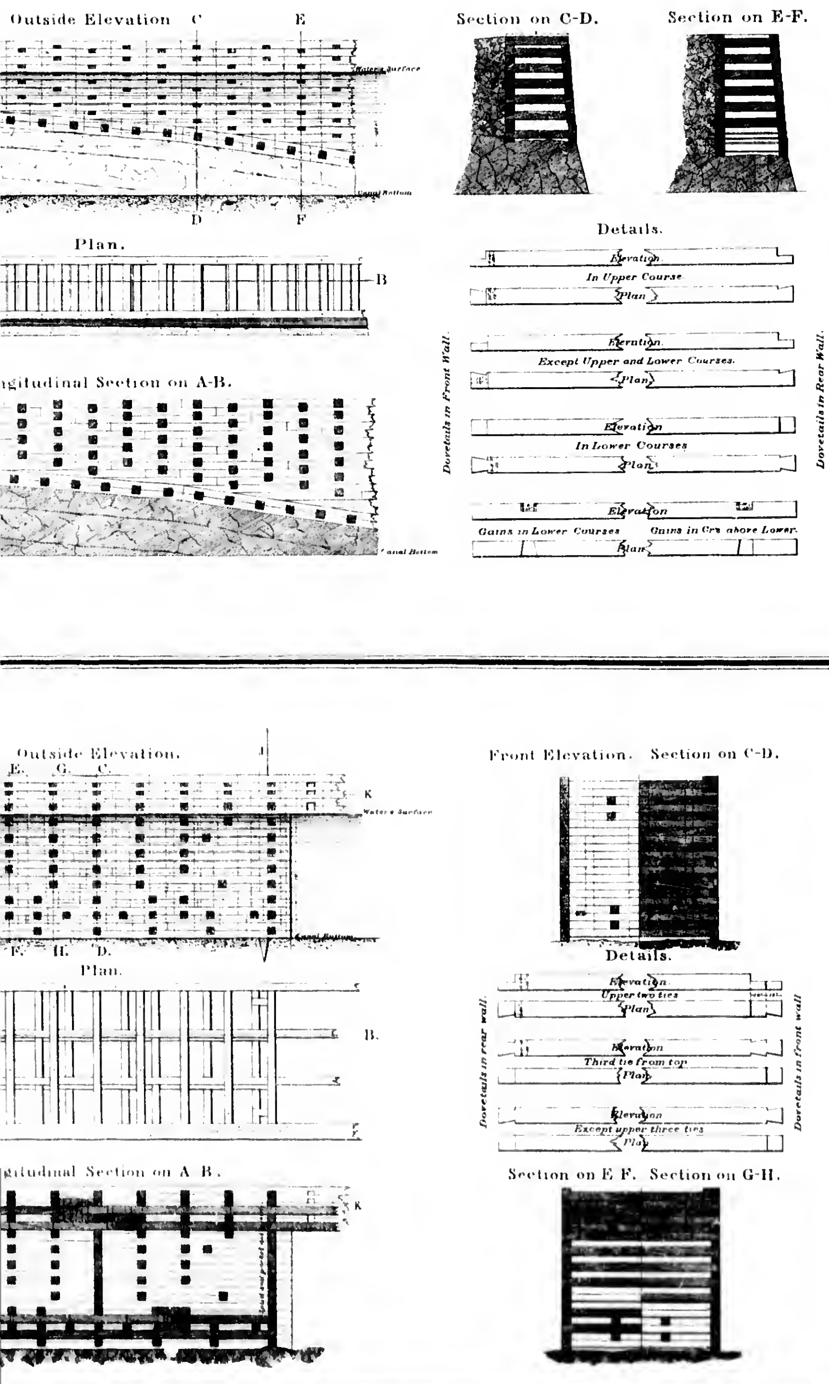


Plate 13.



Outside Elevation C E
Water Surface
Canal Bottom
D F
Section on C-D.
Section on E-F.
Plan.
B
Details.
Elevation
In Upper Course
Plan
Elevation
Except Upper and Lower Courses.
Plan
Elevation
In Lower Courses
Plan
Elevation
Gains in Lower Courses
Gains in Crs. above Lower.
Plan
Dovetails in Front Wall.
Dovetails in Rear Wall.
Longitudinal Section on A-B.
Canal Bottom
Outside Elevation.
E. G. C.
K
Water Surface
Canal Bottom
F. H. D.
Plan.
B.
Longitudinal Section on A B.
K
Front Elevation. Section on C-D.
Details.
Elevation
Upper two ties
Plan
Elevation
Third tie from top
Plan
Elevation
Except upper three ties
Plan
Dovetails in rear wall.
Dovetails in front wall.
Section on E F. Section on G-H.