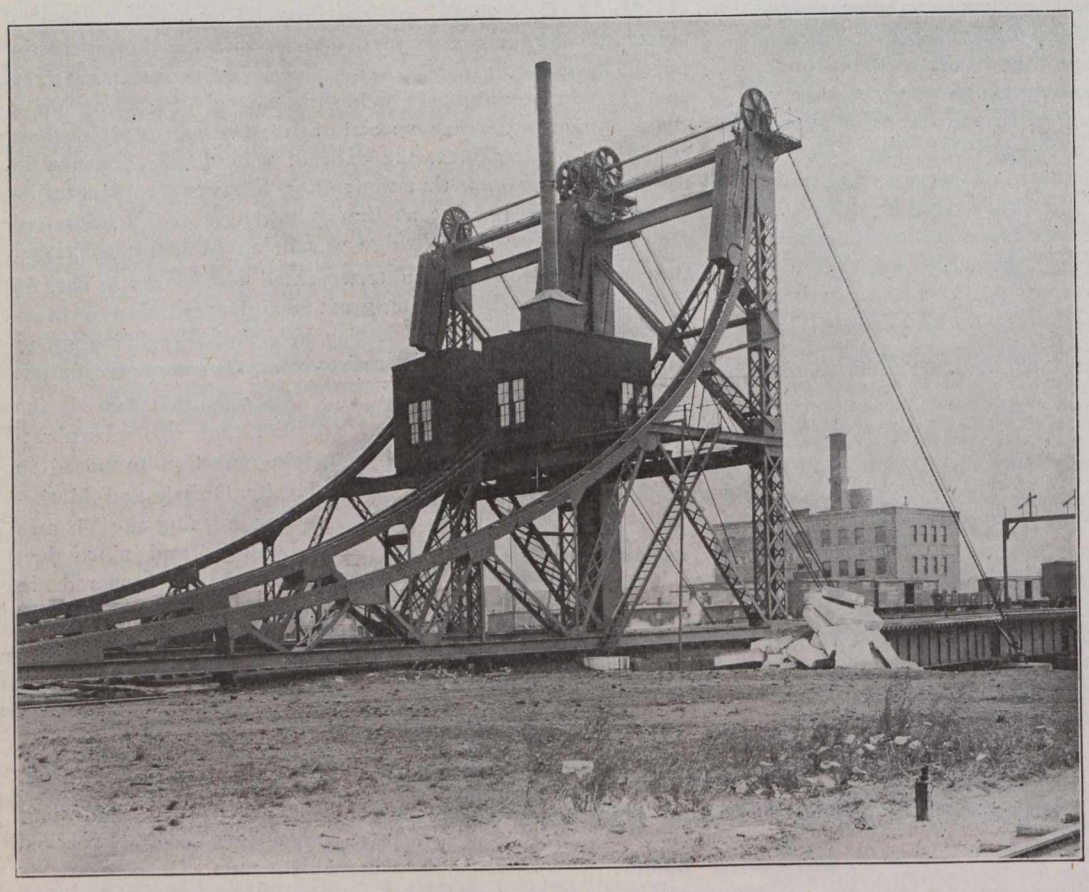
leaves with trusses 77 feet long and 9 feet deep, drawn up by ropes attached to shore towers 77 feet high. Each counterweight consists of ten castings 6½ feet diameter and six others 5½ feet diameter, mounted on a 6-inch shaft 8 feet long. The weights running on double rails are attached to the leaves by four 1½-inch crucible steel cables worked by steam power. At each side of the centre opening is an approach span. The dead weight of each leaf is 60 tons, and the total counterweight at each side is 70 tons. It has a central road 22 feet wide and a 6-foot walk outside each of the trusses. The superstructure cost $38,700, on which there was probably a considerable contractor's loss. It is opened forty to fifty times per day and can be operated by steam power in one minute by means of 6-inch screws 18 feet long, lying horizontally, and attached at one end to the trusses at the upper shore panel point. The screws have three threads ¾ inch square and 4½-inch pitch.

The bridge over the west fork of the south branch of the Chicago River for the Chicago Terminal Transfer Railroad has a clear span of 61 feet, with girders 70 feet long, and was completed in 1899 from plans by George S. Morison. Two ropes and one chain are attached to each of the counterweights, the chains having a rigid hold on the sheaves, while the ropes carry all or most of the load. Provision was made at first for two spans meeting on a centre pier, but the towers and lifting machinery were put in for one span only. The light centre pier gives rigid bearing to the girders and offers less obstruction in the channel than would the centre pier of a swing bridge. Since it was first built the bridge has been raised 4 to 5 feet with new masonry. It has four tracks with sixteen girders 70 feet long and eight girders 27 feet long. The part that is moved is underbalanced in its lower position and overbalanced in its upper position, thus requiring power to start it from either extremity. After its completion, the designer stated that if building another one he would have it underbalanced throughout, and would raise and lower it with a winding engine. The bridge is in two parts, each of which can be operated separately. The sheaves at the tower are six feet in diameter and each counterweight weighs 27 tons.

The Harway Avenue lift over Coney Island Creek, at Brooklyn, was completed in 1898 at a cost of $25,000. The clear span is 50 feet and it is worked by a five-horse-power electric motor, but has also hand power gearings. It is 31 feet wide between railings, and has three main girders 10 feet apart on centres. Each counterweight weighs 45,000 pounds and is supported by 1¾-inch ropes passing over sheaves at the top of towers which are 35 feet high.

A temporary bridge of this type was placed over the Passaic River a few years ago and was built complete in forty days. The clear opening is 40 feet, the hoisting towers being framed of timber, but the girders are of steel. Adjoining it is 280 feet of pile trestle, the total cost of the whole construction being $12,000.

A patent was recorded on March 4, 1899, in favor of Mr. Montgomery Waddell for a bascule bridge with trusses counterbalanced by weights attached to the upper panel points and rolling on curved tracks similar to the design invented by Belidor, but differing therefrom by having open web truss supports instead of simple beams.



A Belidor Bridge at Chicago.

One of the most recent of this type is that completed in 1908 at Tiverton, over Sakonet River. The original design was made by Mr. Augustus Smith, and was revised and approved by Mr. J. R. Worcester. The road is 32 feet wide with a 5-foot cantilever walk on each side, the central way being proportioned for 40-ton electric cars. The opening span is of the Délille system, with two leaves and a clear water width of 100 feet, and at each side of it is a 70-foot girder which supports the counterweight. There are also masonry approaches 581 and 439 feet long, with concrete arches and earth filling between the spandrel walls. The counterweights are rigidly attached by struts to the moving leaves and instead of separate circular rollers, as on the previous design, the counterweight in this case extends clear across the roadway, being mounted at each end on four-wheeled trucks. Motors are connected directly to the track wheels and ropes are not needed. The moving span is without tail pits and all parts are open for inspection. The steel superstructure weighs 430 tons and the total cost of the whole bridge was $250,000.

Tower Bascules With Vertical Moving Counterweights.—Three different methods of counterbalancing draw-bridge leaves were evolved in France during the first part of the eighteenth century by Messrs. Derché and Poncelet.

The Derché System.—In the Derché system, invented by Captain Derché about 1810, chains from the front end of the moving leaf passed over fixed pulleys on shore, and the