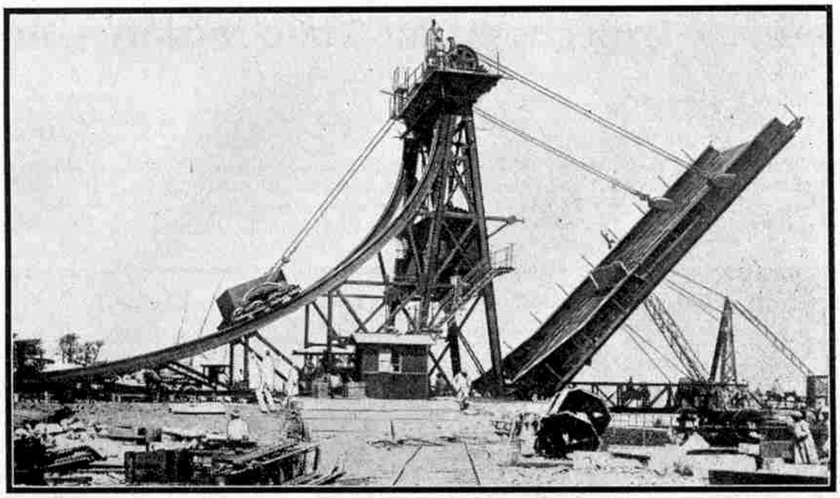
in the pull on these is allowed for by decreasing the slope of the rails on which the counterweight runs.

When the span is fully raised the counterweight is in its lowest position, that is, on the part of the track where it is almost horizontal. Most of the weight of the counterbalance is then carried by the rails, and only the small amount required to balance the span in its open position is taken by the wire ropes. At the other end of the curved track the slope is almost vertical. When the counterweight is travelling up or down this portion, and the lift-span is almost closed, or has just begun to rise, very little of the weight is taken by the track, leaving the greater portion to be carried by the wire ropes, thus providing the greater pull necessary to balance the span in this position.

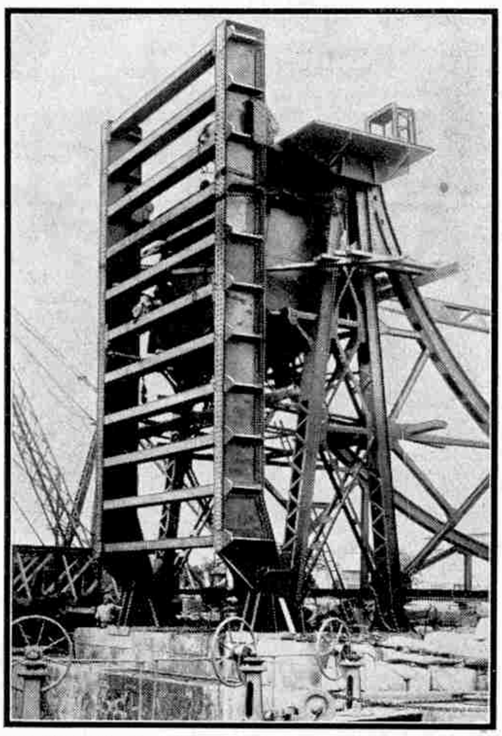


Operating the span of the Assiut Barrage lift bridge just before it was completed by finishing the masonry around the abutment and putting the handrailing in place.

The span never quite reaches the vertical position, as it is necessary to be certain that the bridge will always close from the fully raised position.

It will be realised that no portion of the weight of either the counterweight or the span is taken by the operating machinery, which has to deal only with resistance caused by friction and wind. This system of counterbalancing the span, therefore, effects a considerable saving in the amount of power required to operate the bridge.

In order to avoid difficulties in operation and maintenance the electrical machinery by which the span is raised and lowered is as simple as possible. The main driving unit is an electric motor, and the motor drive is transmitted through hydraulic variable speed gear. This gear not only allows the motor to be started practically free from load, but also allows the rate of movement of the bridge to be varied from the slowest creep to full speed. A further advantage of the use of this type of drive is that the hydraulic gear slips when the bridge is brought to a stop at the end of its travel, and so there is no possibility of damaging the motor.



The Ibrahimia lift bridge during erection. The main girders and cross girders have been erected, and the former have been lashed to the tower steelwork by wire ropes.

The electric motor is of 25 h.p., and this power gives ample margin for dealing with additional loads due to wind pressure on the span. The motor and the part of the variable speed gear that is coupled to it are placed in a machinery cabin mounted on the lower part of the tower, about 20 ft. above the roadway. This primary section of the variable speed gear transmits power by pumping oil to the secondary part. This is situated on a platform at the top of the tower, and through mechanical gearing and shafting it drives the two wire rope barrels for the operating ropes, which are situated between each pair of large wheels carrying the balancing ropes attached to the counterweight and the span.

The bridge can be raised or lowered in about 1½ min. The movements are controlled from a small cabin by the side of the bridge at ground level. From this position the operator has a full view of the lock, and within easy reach is the motor control switch and a hand wheel by which the hydraulic variable speed gear is controlled. The instruments and gauges for the electrical and hydraulic gear are also mounted in this cabin, and just outside it is a stairway that leads to the machinery cabin on the tower. There also is a vertical ladder from this machinery cabin to the top platform.

There would be no difficulty in raising and lowering the bridge even if the electric supply failed, for auxiliary machinery mounted in the cabin on the tower would then be brought into use. It consists of a hand winch assisted by a small petrol engine of about 3 h.p. The winch is operated by four men, and the petrol engine is geared to it through a gear-box and chain drive. A hydraulic coupling of a type now used in many motor cars is fitted in order to ensure that the engine will slip if it is overloaded, and therefore will not contribute more than its share of power to the winch. A shaft from the hand winch is taken to the top platform and is there geared to the final drive from the main machinery. In normal conditions two men at the winch handles, assisted by the petrol engine, can raise or lower the bridge in about 6 min.

There was included in the remodelling work at Assiut Barrage certain work on the head regulator of the Ibrahimia Canal, which leaves the Nile about a quarter of a mile upstream from the Barrage. This work included the provision of the new bridge shown in the lower illustration on this page. The bridge is of the same type as that across the lock of the Barrage, but its opening span is only 36 ft. between bearings.

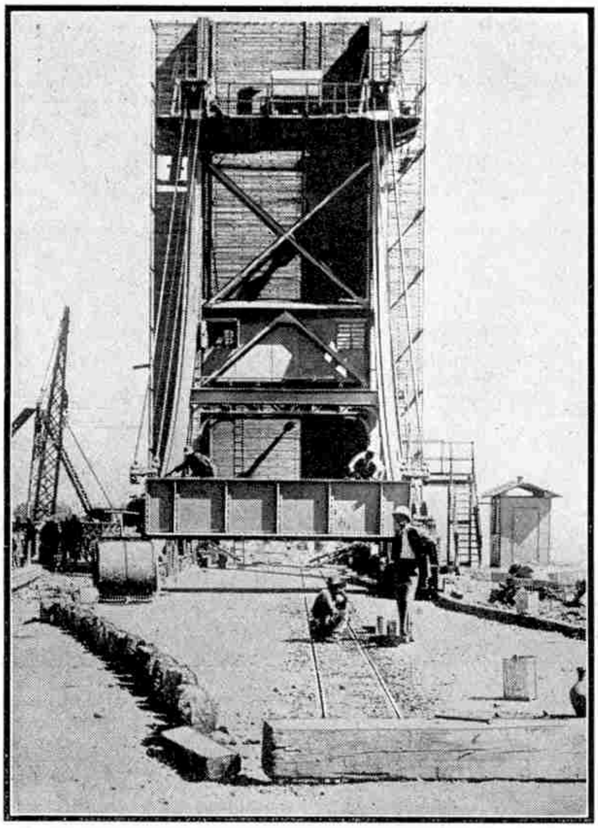
The illustration shows erection work at an interesting stage. It will be seen that the main girders have been erected vertically on their hinge pins and the cross girders carrying the roadway are in position. The counterweight is not yet assembled on its track. The spans of both bridges were erected in this manner.

New Lift Bridges in Egypt

Reconstruction Work on a Nile Barrage

DURING the last three years extensive alterations and reconstruction work have been carried out at the great Assiut Barrage, which stretches across the Nile about 236 miles from Cairo. The purpose of the Barrage is to hold up the water released from the great Dam at Aswan, more than 300 miles farther upstream, so that it can be directed into irrigation canals that are cut through the surrounding country. It was built about 37 years ago and has a length of 2,750 ft. Its piers rest on a masonry apron laid on the bed of the river. Originally it had 111 double gates, but one of the arches has been filled in during remodelling, and when the new work is completed there will be 110 double sluice gates, each 16 ft. 4 ins. in width. The combined height of each pair of gates is 23 ft., and they are arranged so that the water stored upstream of the structure can be discharged either under the lower gate, or between the upper and lower gates.

The Barrage is crossed by a roadway, carried on arches supported by the piers, and in the original structure a swing bridge carried the highway across the lock by means of which vessels passed through the Barrage on their way up or down the Nile. In the course of the reconstruction work that has recently been undertaken, the old bridge has been replaced by the hinged lift bridge shown on our cover, which is a view along the completed roadway, over the lowered bridge, and in the first two of the illustrations to this article.



The new lift bridge across the lock of the Assiut Barrage after completion, with the span fully raised. We are indebted to Messrs. Coode, Wilson, Mitchell and Vaughan-Lee, consulting engineers, for the information in this article and our illustrations.

The new bridge is wide enough for two lines of traffic, with footpaths for pedestrians, and is of sufficient strength to allow the passage of vehicles up to 20 tons in weight. It consists of a steel tower on which is hinged the opening span, which is balanced by a heavy counterweight that travels down a curved track when the lifting span is raised and moves upward along its track as the span is lowered. Electrical machinery is employed to raise and lower the bridge.

The opening span is about 60 ft. in length from the hinge to its outer end, and the lock it crosses is 52 ft. 6 in. wide. There are two main plate girders, connected by a series of stout cross girders supporting a roadway 17 ft. 6 in. wide. The footpaths for pedestrians are outside the main girders, and supported from them by cantilever brackets, and both the roadway and the footpaths are decked with timber.

At the inner end of each of the main girders are iron castings, bolted to the plates, which support the steel shafts forming the hinge pins of the lifting span. The shafts are 6 in. in diameter, and are supported by two massive brackets made from steel plates and sections, one on each side of each girder. At the outer ends of the main girders are steel brackets to which are attached the wire ropes that connect the lifting span to the counterweight.

The tower rests on steel plates bedded down on to the masonry of the lock walls about 2 ft. below road level, and the space above the plates is filled in solid with concrete. The base plates nearest the lock support also the brackets that carry the hinges of the lifting span, to which reference has already been made.

One of the most interesting features of the bridge is the elaborate arrangement provided for counterbalancing the weight of the span. The actual counterweight consists of a box built up of steel plates and sections, and divided into compartments by steel girders. It is loaded with cast iron blocks and pig iron, each layer of blocks being filled in solid with concrete, and four small pockets were left in the box in case it was found necessary to add more weight when the balance was tested after erection in Egypt. The total weight of the box and ballast is about 65 tons.

The box is swung on hinges between the centres of two cast steel arms, one of which can be seen in front of the box in the upper illustration on the next page, and each end of the cast steel arms is carried by a two-wheel bogie running on the track curving down from the top of the tower to the ground. The counterweight and the span are coupled to one another by means of four wire ropes, each 2 in. across, which pass over large pulleys 4 ft. 6 in. in diameter at the top of the tower.

The track is curved in the manner shown in the illustrations to allow the counterweight and the opening span to balance each other exactly in all positions. The familiar action of opening a hinged trap door illustrates the principle on which the arrangement is based, for less and less effort is required as the door is lifted, until finally when the door is vertical the whole of its weight is taken by the hinges. Similarly with the bridge. As the lifting span rises, more and more of the weight is taken by the hinges and less and less by the wire ropes, and the decrease