REVOLVING GANTRY WITH 100 FEET JIB OF UNUSUAL DESIGN.

By Mr. A. W. Cowlishaw.

The gantry under discussion was built for the special purpose of gasholder erection, and was so designed that it should revolve about the centre point of the holder and travel round at the other end on a rail fixed near the plane of the lifts. A complementary condition imposed was that holders of diameters varying from 100 ft. to 250 ft. could be erected with as little rearrangement of the gantry as possible.

Considering these conditions, it was decided to utilise the timber crown framing in the tank as the base for the gantry—a 60-lb. rail being suitably carried along the periphery of the framing to act as the circumferential guide and support.

The original intention (but which was departed from later) was that the greater part of the guide framing or standards would be erected when the bell or floating portion was inflated to the required height, otherwise the original 45 ft. jib would have been unable to erect the framing. This explains the necessity for the timber crib located at the point of rotation. Its purpose is solely to distribute load due to the weight of the gantry on the inflated crown, so as to prevent any possible local distortion of the plates. The construction of the crib is simple, being composed of an angle ring at the base with Oregon rafters suitably braced and extending to a casting, supporting the pin round which the structure revolves, in the centre. No anchorage to the crown plates was considered necessary.

The condition that holders of varying diameter were to be provided for necessitated the horizontal and vertical arms of the gantry being fabricated in sections of suitable lengths. The two extreme sections—viz., the one attached to the pin and the one carrying the machinery at the rail end—are common to the completed structure for any case. The former was provided with ten connecting points to the pin giving an additional adjustment of 4 ft. 6 in. The horizontal girders are double braced Warren type—5 ft. in depth and 6 ft. centre lines in plan—all bracing members being light angles. In the stress diagrams all diagonals were taken as ties, and this condition was responsible for the counters in each bay—anlges being preferred to flats owing to the severe handling and stacking of the sections when erecting or dismantling. The splice points in all girders were necessarily
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similar in every respect, easily interchangeable and connected up with fitted bolts. The end carriages were provided with a pair of bogies 13 ft. centres, which took care of varying rail curvatures.

The machinery, which was located at the rail end, was attached to one frame—this facilitating erection and dismantling. One motor was employed for hoisting and luffing. The circumferential travel motion was effected by means of an electric winch, which was available, and which pulled on rope passing through the horizontal arm and attached to some convenient point on the concrete tank.

As previously inferred, the gantry ultimately had to be provided with a 100 ft. jib to erect the 140 ft. high framing. The questions of cost of materials, time of fabrication, ease of erection and later reclamation of material for other purposes were carefully considered. The unusual type shown in Figure 1 was fabricated. In outline the central shaft is composed of two 12 in. channels extending from head to base—laterally braced together with light angle struts and flat ties, and also provided with an outrigging composed of angle strut members and 1 in. diameter tie rods. Broadly, the central shaft took care of all the compression due to load; the ties and outrigging prevented undue deflection.

The following is a condensed outline of the method adopted for computation purposes:

A definite deflection is assumed at the centre, and the forces which would produce that deflection on the shaft acting as a beam are determined. To these forces are added the thrusts imposed on the short outrigging struts by the extension in the tie rods due to deflection of the beam. Then the sum of the moments of the forces at any point about the adjacent end of the column must be greater than the moment due to the axial load with its eccentricity. In calculating the tension in the ties due allowance is made for the shortening of the column under its axial load and under the extra compression due to the outrigging ties. That is to say, that no deflection which might produce in the shaft or in the ties stresses near the elastic limit can occur under the maximum load carried by the shaft. It is thus proved that the resisting forces are greater than the distorting forces under a distortion which is greater than the load can produce; while, at the same time, the maximum stresses are well within safe limits.

The outrigging members were suitably cross-braced at panel points. In detail, the use of the electric arc was found
to be most economical in every way—standard fittings in cast iron being supplanted by very simply constructed structural parts. Each tie rod was provided with a turnbuckle enabling initial lining up of shaft to be accurately carried out. A feature of the lateral bracing referred to was that the diagonal flats are arranged at the same angle of inclination, the effect being pleasing to the eye and easily determined mathematically.

As the luffing of the jib could not be effected from the machinery house, a crab winch was placed on the end section and operated as required. The narrow box of the jib also suggested the use of side guys as extra precaution against wind action or dragging load along ground prior to hoisting.

The gantry considerably reduced the cost of erection of the Fitzroy gasholder, and also enabled the work to be done in a comparatively short space of time.

The President said they were indebted to Mr. Cowlishaw for his very clear description of the gantry crane, and he thought members would agree that the design of the jib was unusual and worthy of being described at the Institute’s meeting. He moved a hearty vote of thanks to Mr. Cowlishaw.

The vote was carried by acclamation.

DISCUSSION.

Mr. A. L. Hargreave, speaking to Mr. Grice’s paper, asked how the formulae were determined for fixing the value of the various cars. Nothing had been mentioned concerning the relation of revolutions and horse power of the engines, which was a big factor. The omission favoured the high speed engine.

Mr. A. McCowan asked what Mr. Grice considered to be the limit of piston speed. The short stroke engine with a high revolution might have the same piston speed as the engine with a longer stroke.

Mr. A. E. Bell asked whether any comparison had been made between the high and low efficiency types of the lower priced cars, or was there any formula to bring those types together.

The President said in a great many discussions no mention had been made of the relation between the diameter of the cylinder and the stroke of the piston. One would think
there should be some relative connection between them. It seemed to him more or less a question of fancy on the part of the designers. But an outstanding fact was that the two most successful engines of the present day were of almost identical proportion as to diameter of cylinder and stroke of piston.

MR. A. E. HUGHES said a point in calculating the efficiency of motor-cars that had not been touched upon was the varying compression ratios. He would like to know if Mr. Grice could give any information on that point, and whether the Royal Automobile Club of Victoria had considered the effect that a high compression engine against one designed with a low compression would have on the ultimate performance of the cars. One car which performed very well in England made a very poor showing at the trials here. Was it due to the human element, or was it an inherent factor in the high efficiency engine under the Australian climate?

MR. J. H. GRICE said in a test such as the reliability trials it was almost impossible to take into account the factor of the revolutions. For instance, various cars would climb one portion of a hill on one gear and the remainder on another, and unless it was known which portion of the hill was climbed on a particular gear by each car, it was impossible to take the question of engine revolutions into consideration. From the point of view of the motorist the engine of small capacity that could do the most work should get the credit. The larger engine, with a slower rate of revolution, would do the same work with more comfort, but it appeared to be appreciated that the smaller engine, under present conditions, would do the work very satisfactorily. He could not give a figure with regard to piston speed, which appeared to be increasing from year to year. What was considered to be the limit two years ago had been much exceeded within the past few months. At present they were running up to about 6,000 revolutions a minute in racing cars; whilst two or three years ago 3,500 to 4,000 was considered to be the maximum. Replying to Mr. Bell, he thought it would be almost impossible to evolve a formula that would place the low efficiency cars on a level with the others. Two points stood out in regard to the car mentioned by Mr. Hughes. It was only taken out of the case two days before it started on the trial; and it was driven by a man who was not au fait with that particular car. It was geared considerably higher than the ordinary car, and
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it would take a man some time to become accustomed to the high gear. That particular car performed badly at the first trial, fairly well at the second, and in the third it secured fastest time by about 12 seconds. Compression was not a matter that could be taken into consideration in a formula. There had to be a lot of give and take in obtaining results. It was impossible to get them scientifically accurate.

MR. HUGHES said it was evident the human element was a most important factor.

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