framing. The bucket arm was rotated to the boom at a fixed radius. In place of the usual bucket a large circular cutting drum was employed. The circumference of the drum was fitted with teeth, which were designed to excavate the material and deposit it into a trough built into the radial arm. The "trough arm" was fitted with a scraper, which carried the material along the trough to a chute, down which the material was discharged on to an annular ring, designed as a circular conveyor, which was supported about two-thirds of the way up a conical tower on the bottom framing. The framing was fitted with four large traction wheels, which were separately driven and steered so that the machine could be easily travelled and steered in any direction.

The digging action was as follows:—The arm, equivalent to the bucket arm of a power shovel, was lowered to a more or less vertical position with the cutting drum resting upon the ground and the bottom of the digging face. As the cutting drum slowly rotated the arm and drum were gradually raised at a speed coincident with the rate at which the teeth on the cutting drum could excavate the material, which, as previously mentioned, was conveyed along the arm in a steady stream down the chute onto the circular conveyor, which was slowly rotated by means of a circular rack until the material reached a plough at a point opposite to the boom, where it was discharged into a circular feeding pan attached to the conveyor.

The conveyor consisted in principle of a circular wheel, 70ft. in diameter, almost like a huge cycle wheel, with steel wires as the spokes. The material was slowly fed from the feeding pan on to the flat rim of the rotating wheel until it reached an adjustable plough at a point almost opposite the feeding pan. Here it was ploughed off on to the ground, from which the ironstone had been removed on the previous cut.

Unfortunately the cutting drum and the conveyor on the arm of the cutting drum arm failed to function in practice, as it was intended to do, and an ordinary shovel bucket and arm were substituted for them. This method, however, proved too slow in practice and the excavator was scrapped, its place being taken by a Wilson steam crane navvy. The combination of steam crane navvy and circular conveyor was used for several years but eventually the wheel conveyor was also discarded.

(To be continued)

The Avro "Lancaster" Heavy Bomber

LAST week we accepted the invitation of the Ministry of Aircraft Production to see in production and in the air the latest addition to the Bomber Command aircraft, the "Lancaster" heavy bomber, designed and built by A. V. Roe and Co., Ltd. Recently, Mr. Winston Churchill, the Prime Minister, spoke of the unprecedented ordeal which German cities and towns will have to withstand by bombing in the coming months, and it will be in the enforcement and maintenance of this ordeal that the "Lancaster" will play an ever-increasing role. In this new bomber the United Nations have a vehicle of aerial destruction unparalleled in the history of the world, and to be produced in such numbers that it will rapidly take its place in the forefront of the weapons which, together, will bring victory to the Allied cause.

Already, but a few months after its commissioning, this bomber has left its mark on the German landscape and its people. It has helped powerfully by night to batter Cologne and Essen, with bombs of the heaviest calibre. By day it has carried out the epic raid led by Squadron Leader J. D. Nettleton, V.C., on Augsburg, and the raids on Danzig and Flensburg. Its future achievements depend upon the decisions of Bomber Command.

DEVELOPMENT

Behind the design and construction of the "Lancaster" there lies some thirty-two years of aircraft manufacturing experience and development, for the Avro Company has been one of Britain's foremost aircraft constructors for the last 15 years, from 1914-18. In every way this new bomber is a worthy successor of its famous ancestors, the Avro " 941 K," the "Tutor," the "Anson," and the "Manchester," the last of which was fully described and illustrated in our issue of June 5th last. It was on the basis of the "Manchester" that the whole of the technical staff of A. V. Roe and Co., under the leadership of its managing director, Mr. R. H. Dobson, C.B.E., F.R.Ae.S., set to work to produce the "Lancaster." In record time the drawing-office, led by the company's chief designer, Mr. R. Chadwick, P.R.Ae.S., produced the necessary drawings, while Mr. C. E. Fielding, another of the company's directors, whose special interest is the plan- nophysical and practical, of the work, ably backed by Mr. S. D. Davies, B.Sc., A.R.Ae.S., and his team of fellow-workers in the experimental department of the works, broke all records in the manufacture of the prototype aircraft. The prototype "Lancaster" was designed and built in record time, and may be justly looked upon as a triumph in aeronautical engineering.

Effective use of the "Lancaster" and the report of the Ministry of Aircraft Production testing staff it was soon obvious that the Allied cause had now what has since been aptly styled by many pilots a "war winner."
and fighter aircraft. Other engines, notably the Bristol "Hercules," are also being fitted to the "Lancaster." An outstanding feature which was demonstrated on the occasion of our visit is its ease of control, and this, coupled with its high speed, is of great defensive value. Heavy offensive armament is also carried in four Parnall power-operated gun turrets working on the Fraser and Nash hydraulic system.

**Principal Dimensions**

- **Span**: 102ft.
- **Length overall**: 69ft. 4in.
- **Height**: 20ft.
- **Gross wing area**: 1207 square feet
- **Depth of fuselage**: 8ft. 2in.
- **Width of fuselage**: 5ft. 6in.
- **Max. undercarriage wheel diameter**: 5ft. 6in.
- **Length of bomb compartment**: 166ft.
- **Weight of aircraft fully loaded**: Approx. 30 tons
- **Maximum speed**: Approx. 200 m.p.h.
- **Max. range**: Approx. 3000 miles
- **Max. bomb load**: Approx. 8 tons
- **Type of engine**: Rolls-Royce "Merlin XX" 130
- **Number of engines**: Four
- **Number of guns**: Ten Browning, 0.303in.

The keynotes of the "Lancaster" design are ease of production, easy transport, and easy maintenance and repair. The design, the makers claim, lends itself to rapid and relatively cheap production, as the entire machine is built up of numbers of components which are manufactured largely as separate and self-contained units, and are easy to transport and to assemble. Full 100 per cent. interchangeability has been aimed at and achieved, and this, coupled with ease of construction, has contributed largely to the ease of maintenance and repair.

The fuselage is built up of transverse formers and in the factories of other large aircraft. In design it may be described as a mid-wing four-engined all-metal cantilever monoplane, with a retractable undercarriage. In general, it is powered by four Rolls-Royce "Merlin XX" liquid-cooled engines, which have given such a good account of themselves in other bombers point, and it is so designed that it can be opened for access on either side of the centre section of the fuselage. The bomb doors are plated, and there is also an armour plate behind his head. Certain other vulnerable parts of the aircraft structure and also parts of the gun turrets are armoured plated, Whilst the fighting controller's position is sealed off, and a bullet-proof glass is fitted in order to provide added protection.

Within the centre section of the fuselage the oxygen bottles are stowed in a crate, the pilot's cockpit, fitted with a comfortable rest bed with an adjustable back rest. Aft of the rear spar a mid-upper turret and a mid under turret are fitted, the crew in the cockpit being so designed that the crew can not be released until the bomb doors are open. In cases of emergency or in case of a possible failure in the hydraulic system, the bomb doors and also the retractable undercarriage can be operated by means of an emergency compressed air system. There is intercommunication between all the members of the crew, and there are readily accessible stowages for parachutes provided at all the crew stations, along with easily reached oxygen points.

In our next article we hope to deal with the production of the bomber in the workshops and the assembly bays.

(To be continued)

**Lancaster** Heavy Bomber

**THE ENGINEER**

**Aug. 14, 1942**

The "Lancaster" heavy bomber is now in production in many factories of the Avro group, and in the factories of other large British aircraft manufacturing firms. It is also being built in one of Canada's largest aircraft factories. Thus many thousands of men and women are toiling by day and by night to produce more and more "Lancaster" bombers at an ever-increasing rate.

**General, Design and Construction**

As will be appreciated from the accompanying engraving, showing one of a series of "Lancasters" on the ground, with another circling round in the air, the new bomber has particularly graceful lines and a pleasing appearance, perhaps rarely seen in large military aircraft. In design it may be seen as a mid-wing four-engined all-metal cantilever monoplane, with a retractable undercarriage. In general, it is powered by four Rolls-Royce "Merlin XX" liquid-cooled engines, which have given such a good account of themselves in other bombers.