

the bottom longerons are of lighter construction than those in the forward portion of the fuselage.

The undercarriage legs fold outwards; this has the advantage that the loads are concentrated close together, and the high stresses generated when undercarriage legs are attached to the wing spar some distance outboard are avoided. The disadvantage is that the wheel track is relatively narrow. The armament, in this case two cannon and four machine guns, is of necessity carried outboard of the wheel wells in the wings.

The Spitfire is a good example of the single-spar wing with strong leading-edge covering forming a torsion-resisting "tube." The small auxiliary spar has relatively little work to do.

Girder Construction

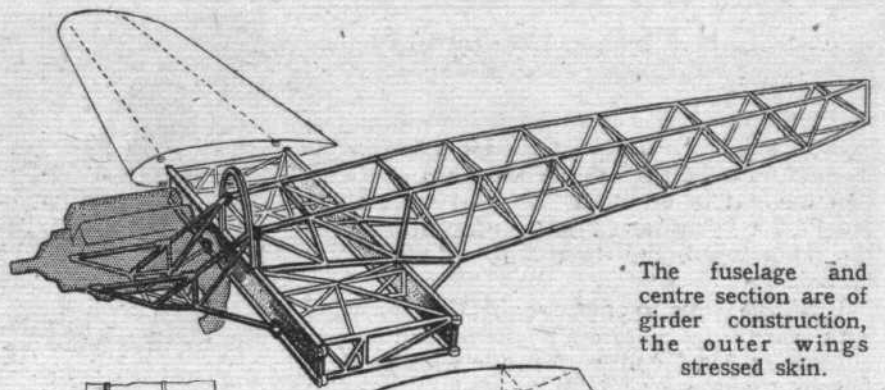
The Hawker Hurricane may now be said to be the only fighter example still in extensive operational use of girder-type construction. Reference as made above to the greater facility with which equipment can be installed in a fuselage of this type, owing to the fact that workers can reach the equipment through the openings between the ties and struts.

In the case of the Hurricane there was, however, another reason for retaining the girder type. The Hawker firm had for many years specialised on this form of fuselage construction, and in the "old biplane days" rolled and drawn steel strip construction had been used for the wing spars. The manufacturing processes thus did not present any unknown problems, and Mr. Camm, bearing this in mind, and foreseeing the possibility of delays in getting into production if a change to shell construction had to be made, decided to adhere to the type of structure with which he and all the staff and workmen were familiar.

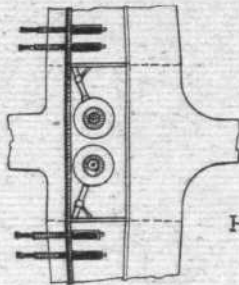
The result was the first Hurricane in which, it may be remembered, the wings were also of girder construction and fabric covered. The later Marks of Hurricane have stressed-skin outer wings but have retained the girder fuselage and wing centre section, as shown in the sketch. That the type of structure originally designed was amply strong for its work will be realised when it is recalled that originally the Hurricane weighed some 6,000 lb. loaded, and that recent versions have tipped the scales at 50 per cent. more than that. This was not done without increasing the gauges of material used in the structure, of course, but it was done without making major structural alterations.

Both in the Spitfire and in the Hurricane there are centre-section spars. In the former the spar is contained within the fuselage and the wings "buttoned on" close by the fuselage sides. In the Hurricane, on the other hand, the centre section is of fairly large span, and the joint of outer stressed-skin wing to girder centre section occurs a considerable distance outboard.

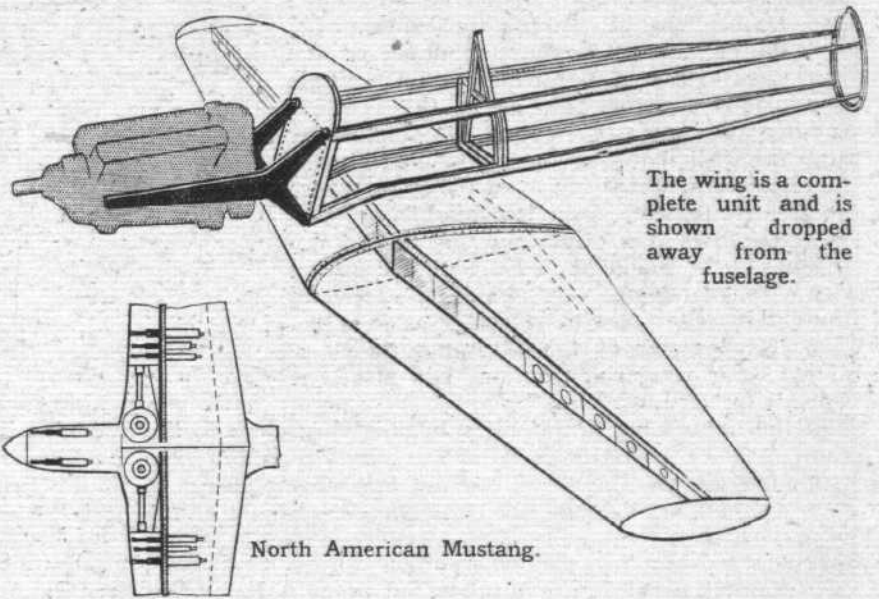
For sheer simplicity of design "motif" it would be difficult to improve on the type of construction employed in the North American Mustang, which combines a single-spar wing with a very simple stressed-skin fuselage. The two are complete units in themselves and attached to one another by four bolts only. It should, perhaps, be explained that the sketch of the Mustang, as well as the other sketches, tend to give a slightly false impression in that intermediate fuselage formers are omitted and only the main formers shown. The four long-



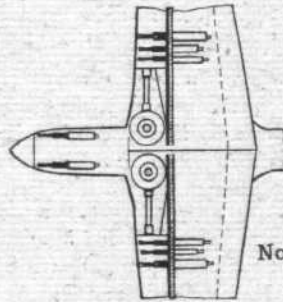
The fuselage and centre section are of girder construction, the outer wings stressed skin.



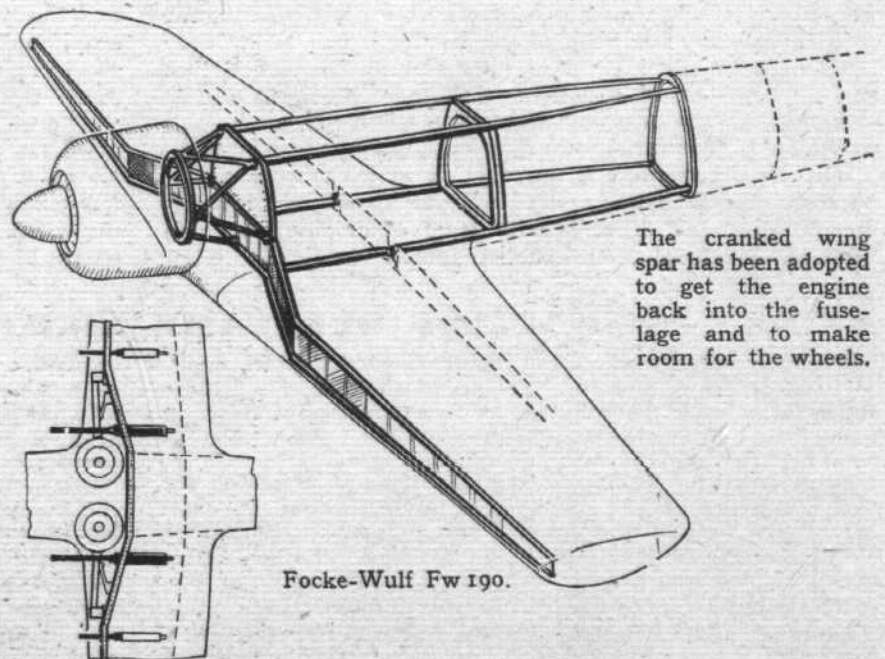
Hawker Hurricane.



The wing is a complete unit and is shown dropped away from the fuselage.



North American Mustang.



The cranked wing spar has been adopted to get the engine back into the fuselage and to make room for the wheels.

Focke-Wulf Fw 190.

erons run through to the tail, but are tapered off towards their rear ends. At the front they carry the engine bulkhead, to which is attached at four points the fork ends of the very simple engine bearers. These are of box section