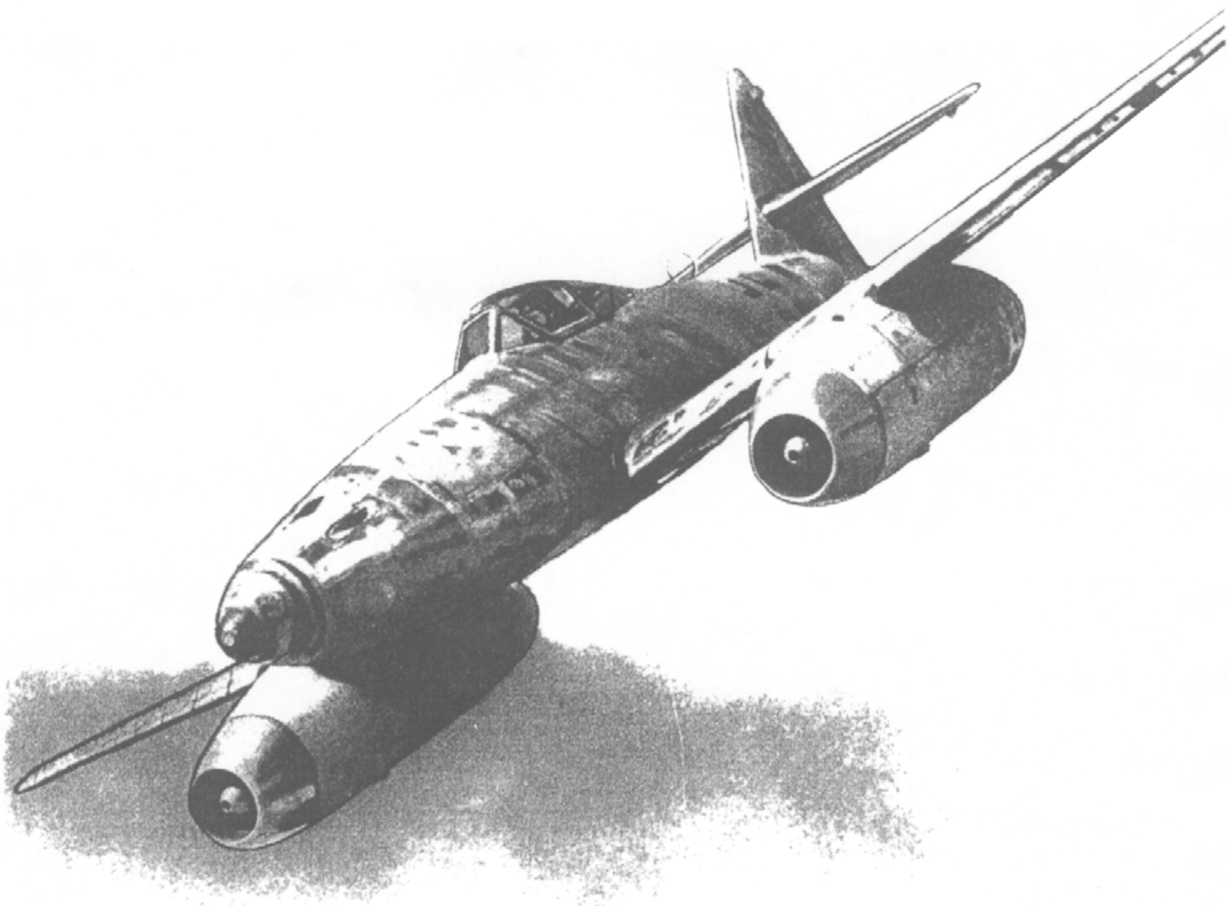
DESIGN ANALYSIS OF

Messerschmitt Me-262 Jet Fighter



PART 1 — THE AIRFRAME

By JOHN FOSTER, JR., *Managing Editor, "Aviation"*

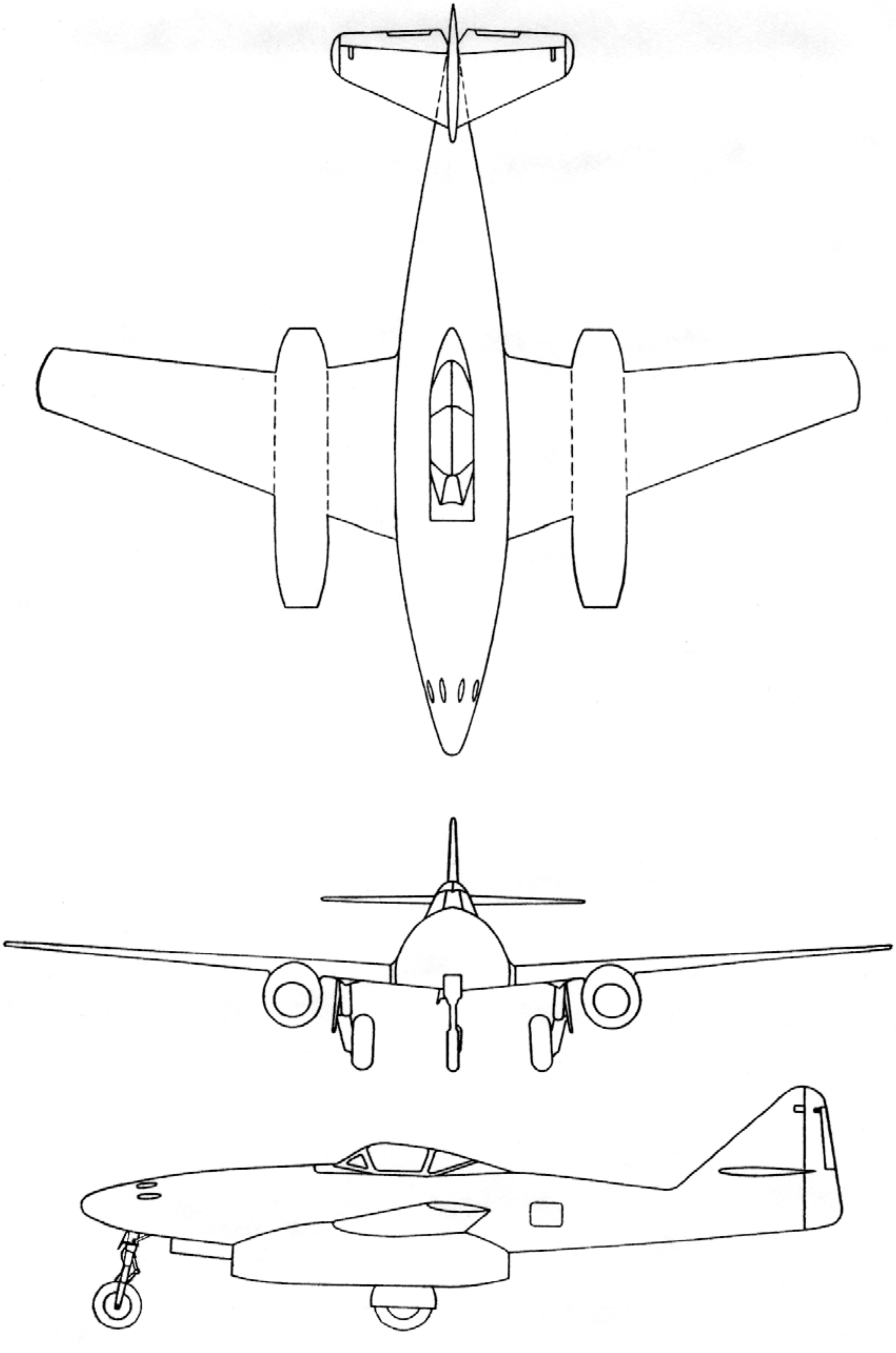
This first detailed engineering study of Germany's top jet propelled fighter — the 15th in our series — reveals many unorthodox design and construction features and shows the importance of the production engineer in its development.

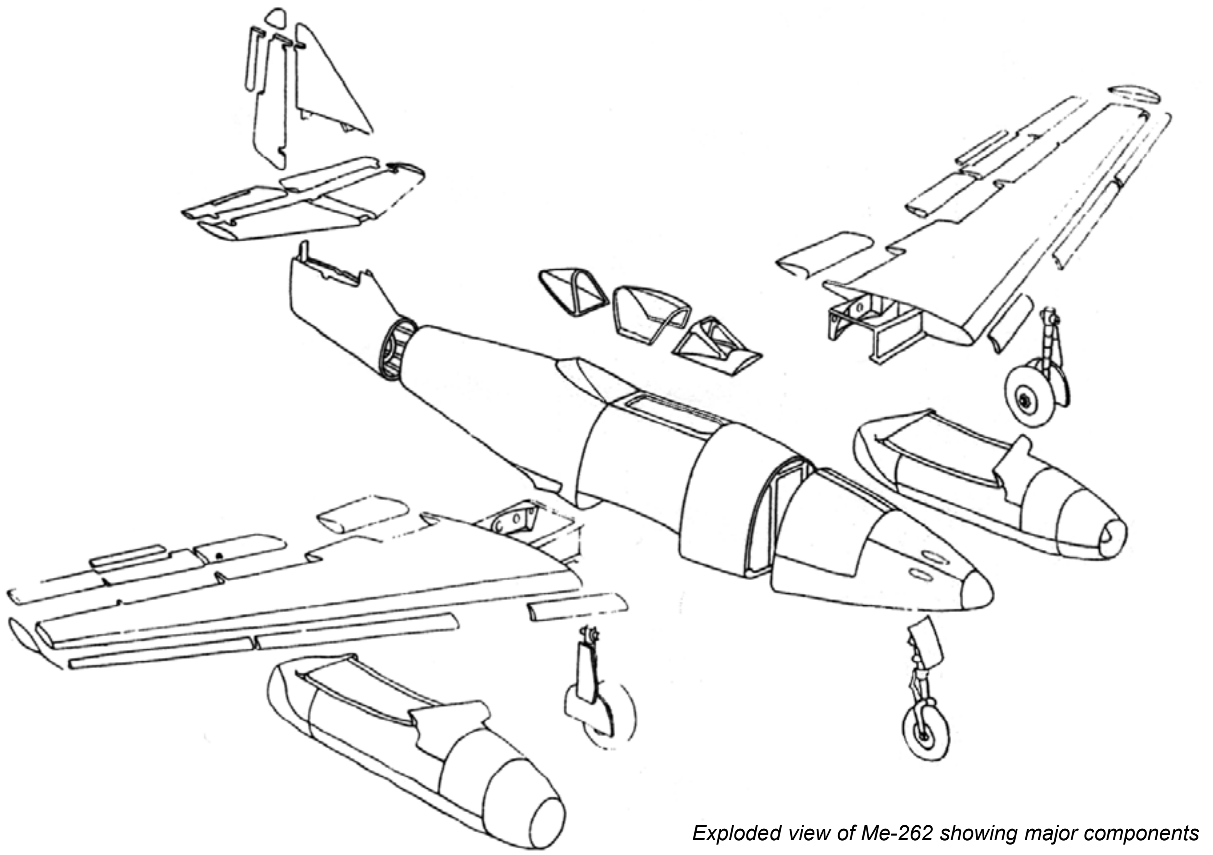
GERMANY'S MOST SUCCESSFUL jet propelled plane, the Me-262, is an unusual combination of radical and orthodox design, materials combinations, and workmanship, some of the latter being surprisingly sloppy. It shows, too, that the production engineer had as important a place in its development as anyone connected with the project.

A low-wing monoplane of 40 ft. 11½ in. span, 34 ft. 9-in. length, and 11 ft. 4-in. over-all height, it was used as a fighter, fighter-bomber, and ground attack craft, and was apparently also designed for photo reconnaissance use.

The very tip of the fuselage looks exactly like a propeller spinner – and may well be just that – with a hole cut in front so that a gun camera mounted inside, reached by a small, quickly removable access plate set in the left side. A solid web bulkhead backs this section up, serving as a jacking point. Then follows a 14½-in. section enclosing a flush-riveted channel-shaped former, the whole being screwed to the next section which contains the nose wheel and the four 30-mm. MK-108 cannon grouped high in the nose section.

Since the length of these guns is but 3 ft. 6 in., a very compact installation has been achieved with no external projections. A large spherical support around the barrel





Exploded view of Me-262 showing major components

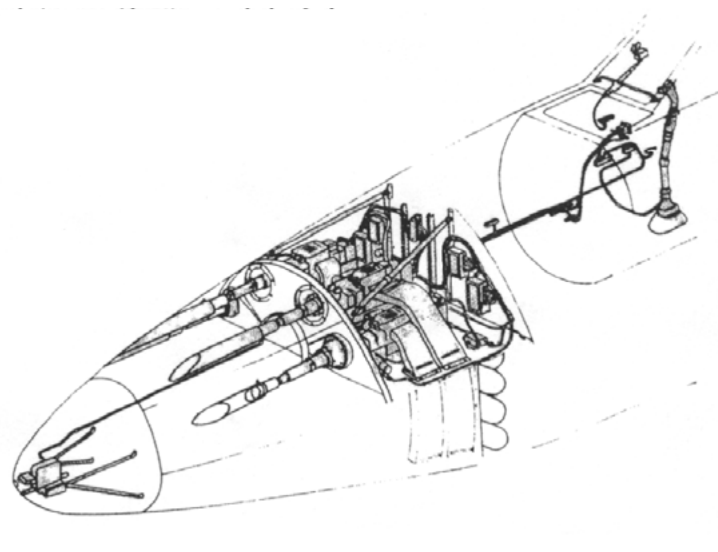
near the aft end facilitates adjustments during sighting in operations.

The guns are usually set to converge at 450 meters. The MK-108 fires 575 – 600 rounds per min. with a muzzle velocity of 1,570 fps., and weighs bu 134 lb. Compressed air for charging is carried in eight bottles set inside the fuselage on the left ahead of the cockpit.

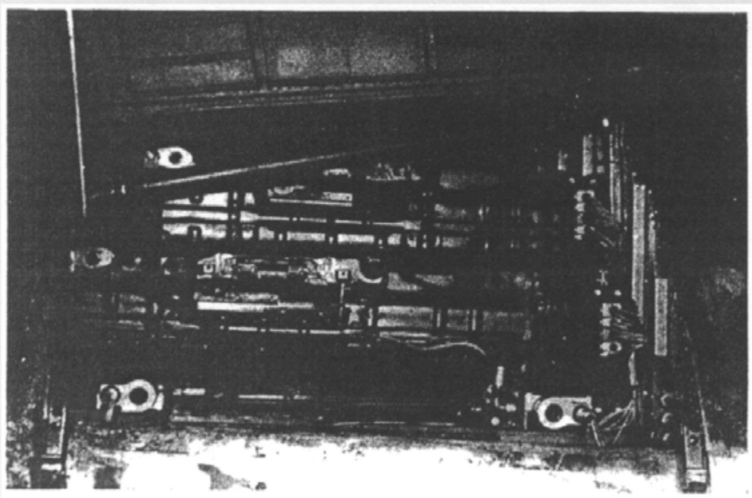
The two top guns carry 100 rounds each, the bottom pair 80 each, and all are fired simultaneously by a switch on the contact stick.

Although the 262 was designed as an interceptor, Hitler ordered it made into a bomber. The result was installation of two jettisonable bomb racks, each carrying one 550-lb. bomb. Additional armament on later models consisted of 24 R4M 5-cm. rockets, 12 under each wing, and it is reported that the Germans planned to install up to 48 under each wing.

Skin of the 6 ft. 5½-in. long section aft of the spinner is .080 sheet steel. Since the cannon are mounted high, the use of steel in that section is understandable because of the blast effect, but even the belly skin is of the same material. It is possible the employment of steel was dictated by transportation difficulties rather than design considerations or lack of aluminum, for reports emanating from Germany indicate that the



Phantom view showing installation of gun camera in nose, four 30-mm. MK-108 cannon, with ejector shutes below, and electrical connections for firing.



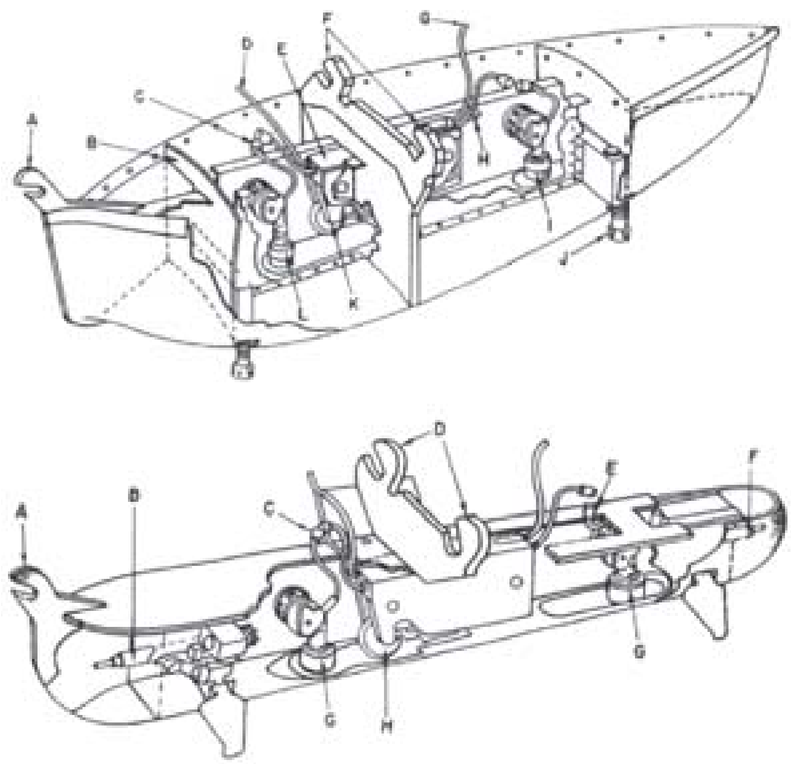
Closeup of left gun compartment, showing access panel in raised position. Note turnbuckle tie rod at top; it makes one of four points at which complete nose section is attached to bulkhead at right.

Nazis were not pressed at any time for this material. However, since the nose section carried both the heavy armament and the nose wheel, the added strength of the steel may have been a deciding factor.

The cannon are most accessible, for two 35¼ in. long access doors, piano hinged 1½ in. off the top centerline, can be quickly opened simply by loosening two flush toggle latches like those used on cowling of the FW-190 (see page 131 Oct. 1944 *AVIATION*) exposing all the gun mechanism as well as the ammunition drums.

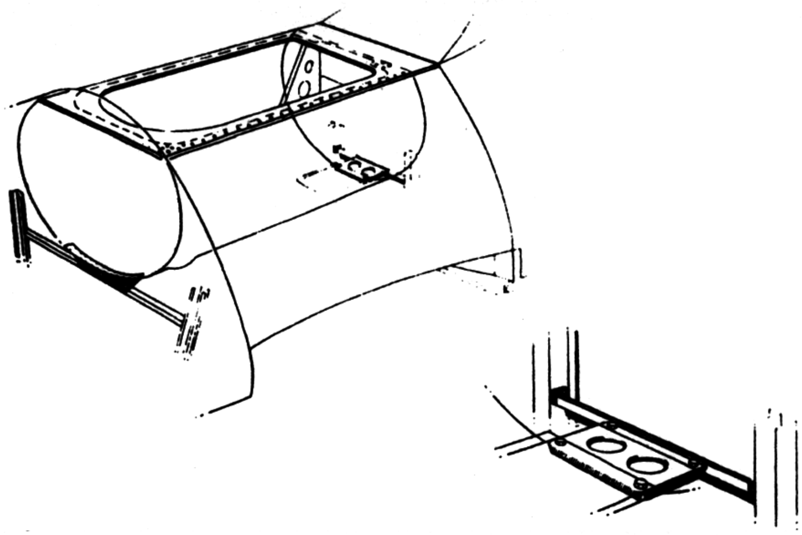
This whole nose section attaches to the mid-fuselage in a simple but effective manner. At each lower corner is a 1-in.)approx.) high-tension steel bolt fastening it to the solid web bulkhead of the mid-section. At the top, some 6 in. from the centerline, are two 1-1/2-in. steel tubes, also bolted to forged fittings on the mid-section bulkhead and extending forward to the bulkhead at the front end of the gun access doors. Both these tubes are built as turnbuckles so that alignment adjustments can be easily made.

View from below fuselage connection, showing how through-bolt — one on each side — joins nose to mid-fuselage section. After connection is complete, access holes are covered with doped fabric. At top is one of quick fasteners by which cowling over gun compartment is held in place.



Hitler ordered Me-262 used as bomber, even though it had been designed as interceptor, so two types of bomb racks were developed. Type A is at top, showing: Forward suspension point (A); forward bulkhead (B); three-point connection to fuzing arm (C); power lead to fuzing arm (D); bomb releas slip (E); aft suspension points (F); power lead to release circuit (G); mechanical jettison rod (H); charging head (I); adjustable crutch (J); suspension hook (K); and charging head (L). Type B (bottom) shows fprward suspension point (A); crutch ratchet (B); power lead to fuzing arm (C); aft suspension points (D); lead to fuzing arm (E); crutch ratchet (F); charging heads (G); and suspension hook (H).

Phantom view showing cylindrical-section cockpit in fuselage. This "liner" section is designed for pressurization, but craft and reports studied reveal Nazis did not actually pressurize Me-262 in operation.

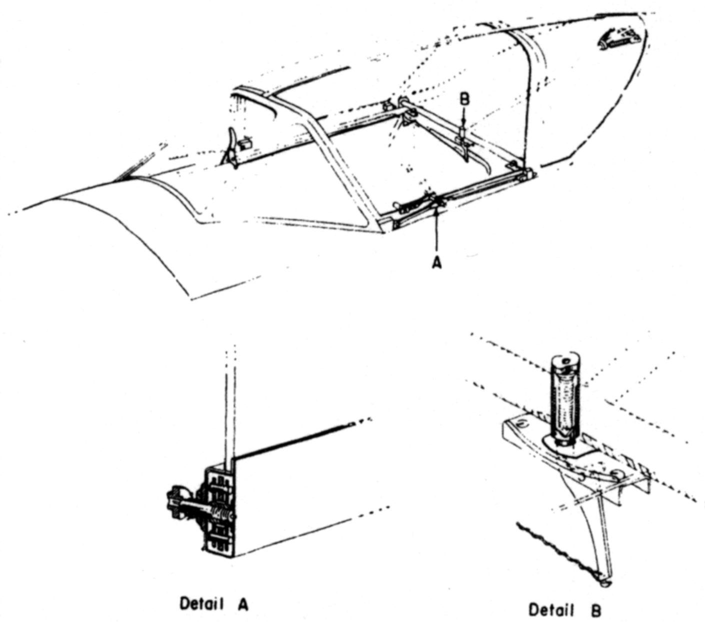


Thus it would be possible for a trained crew to change a damaged nose section in the field in short order, or it would be a simple matter to install a nose equipped with different armament or photo recon units.

At the end of the nose section, the Me-262's fuselage cross section is practically an equilateral triangle, only slightly rounded out.

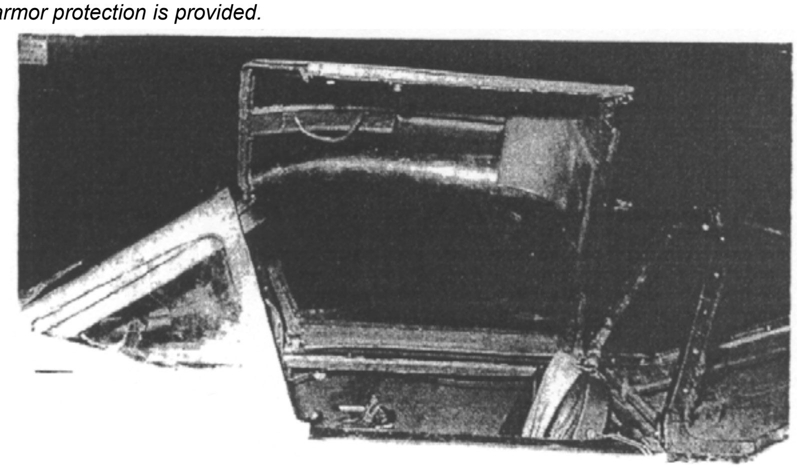
First bulkhead in the mid-fuselage section is solid web aluminum alloy with six vertical and two horizontal hat shaped stiffeners.

At a point 16¾ in. back is a channel shaped former, flush riveted to the skin, and 16 in. farther aft is another solid web bulkhead, with vertical and horizontal hat shaped stiffeners. Practically all the space between the two solid bulkheads is taken up by the fore fuel cell (which will be discussed in detail in the section devoted to the fuel system). The bottom panel of this section consists of a waffle grid, double stressed skin, 34¾in. long and 55 in. wide. The panel is attached to the fuselage by flush screws and captured nuts, the same system employed on the FW-190 panel beneath the fuel cells. Interchangeability of these panels evidently was not much of consideration in Me-262 production, for the screws were set approximately 1¾ in. apart but with variations of as much as ¼ in. and considerable misalignment.

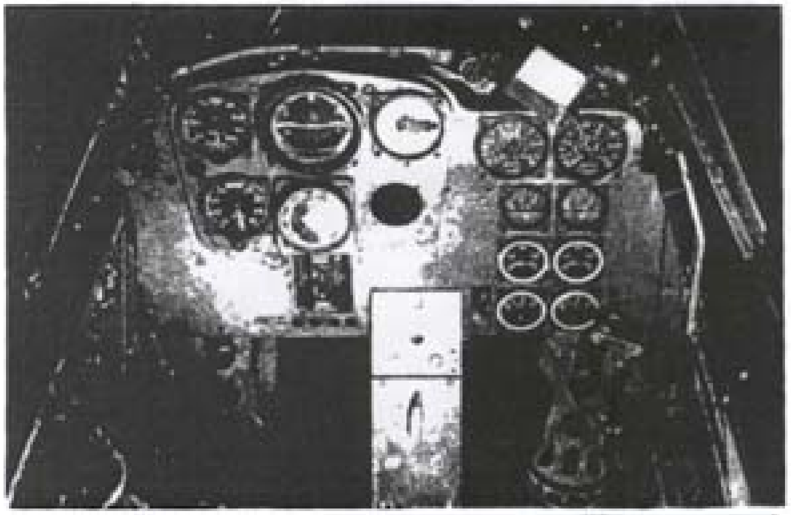


Detail sketch of cockpit canopy, showing jettison lever on pilot's right and locking lever at his left. Front windshield panel is 3½-in. thick bullet-proof glass. No side or bottom armor protection is provided.

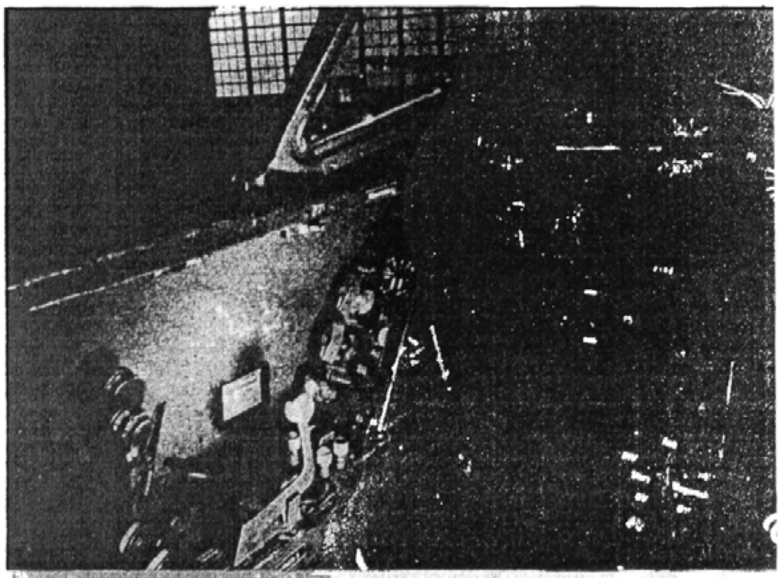
Every Nazi pilot apparently was his own Führer, for the Germans call the next section the *Führerraum*, or pilot space. And they must have been little Führers, for the rudder pedals are quite close to the seat and there is no fore-and-aft adjustment



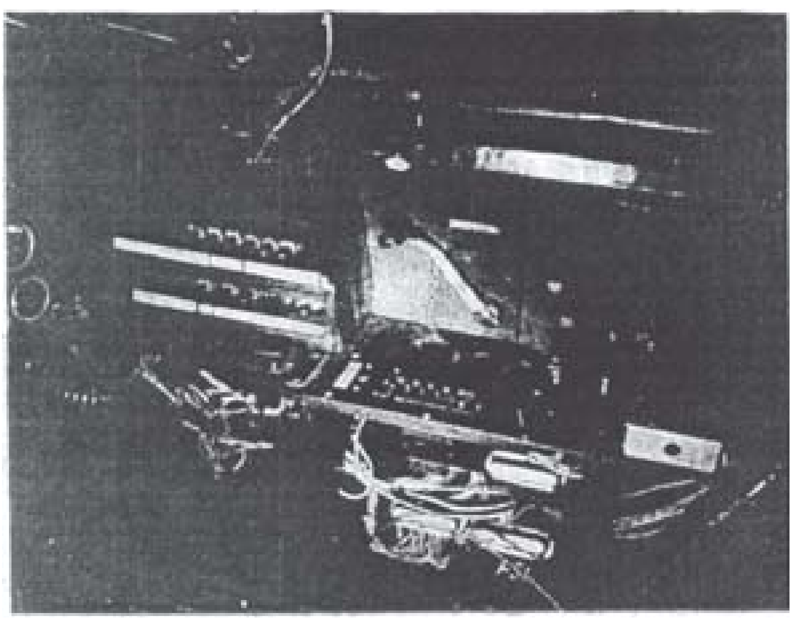
Me-262 canopy open, showing jettison lever and cable at pilot's right. note curved sil- houette armor plate which fits over pilot's head. Evidently, this was modification of original design, for basic plans show n such installation. At windshield base at left can be seen cockpit ventilating scoop. Apparently, this was also a last-minute modification, one which showed workmanship far below German standards.



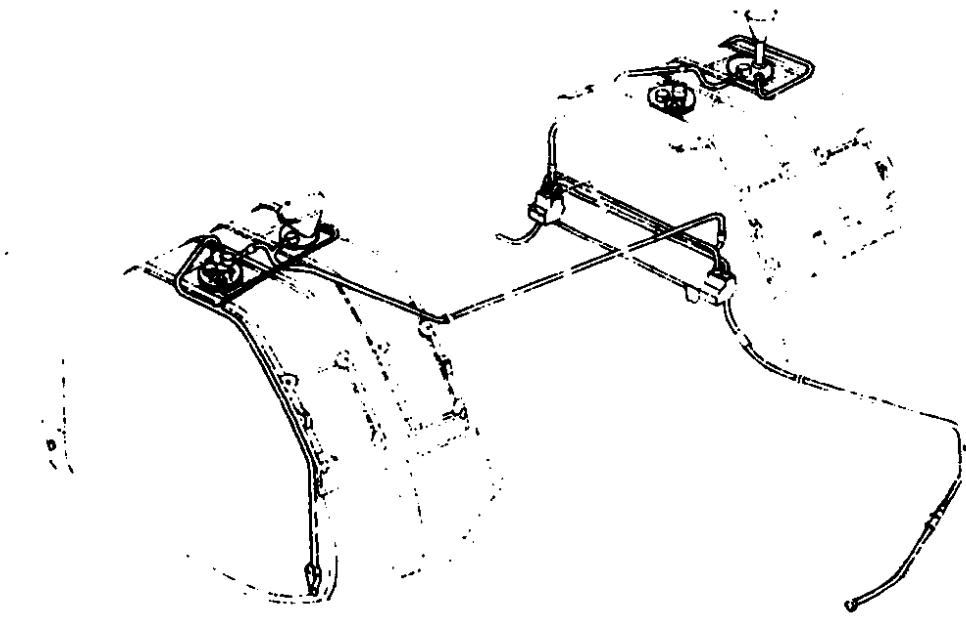
Main instrument panel with flight instruments,at left, engine instruments at right and bomb switches on panel at lower center. Note how gunsight at top has been swung to right out of way for landing and takeoff. Engine instruments, from top to bottom are: Tachometers, gas temperature gages, lube oil pressure gages, and fuel supply inidicator. Original design called for installation of gas pressure gages, also fuel injection pressure gages alongside oil pressure gages.



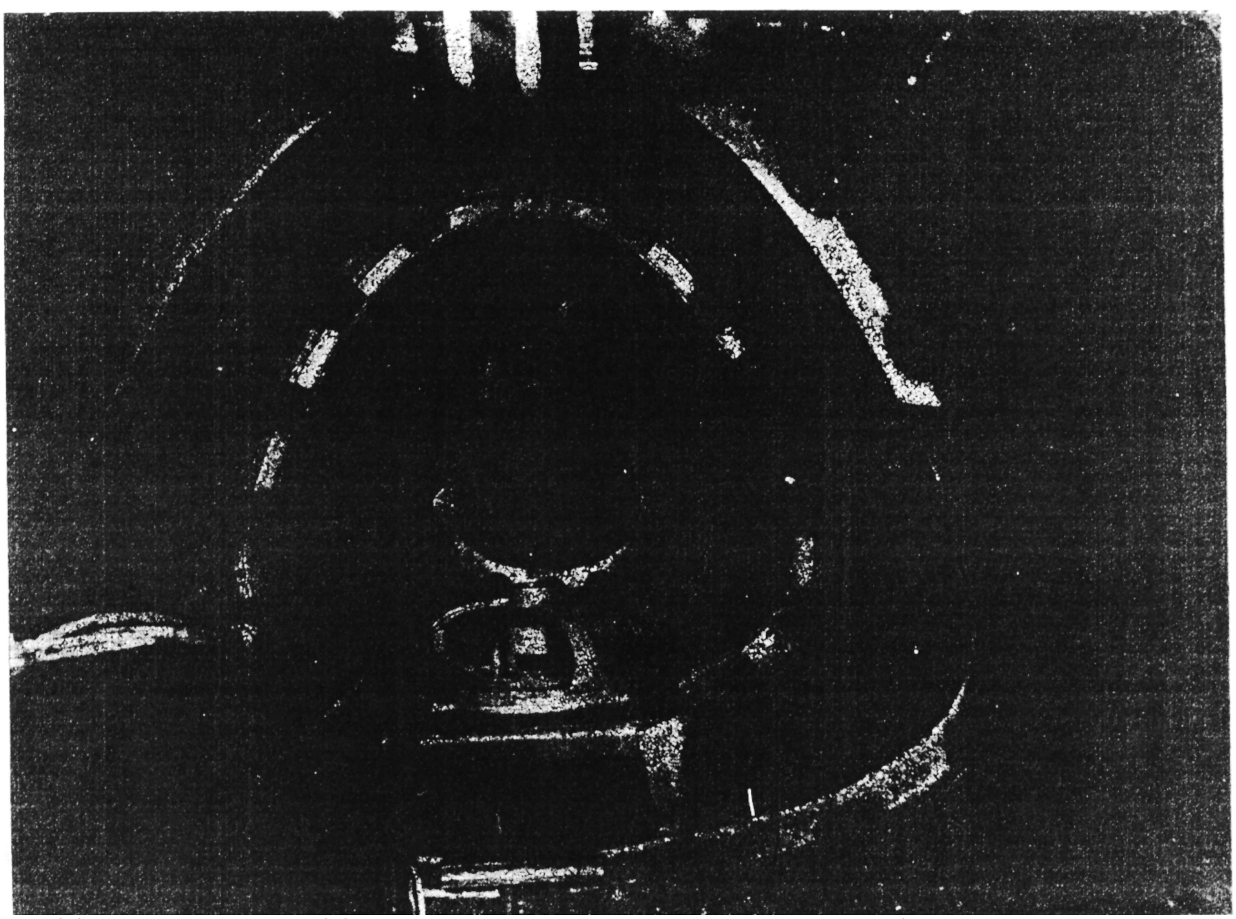
Left side of cockpit showing, on diagonal panel: Oxygen flow indicator, emergency landing gear and flap operating switches and oxygen valve. On horizontal panel, from front to rear, are: Landing gear and flap position indicators, landing gear and flap operatging buttons, stabilizer pitch indicator and operating switch, throttle quadrant, and (not in photo) fuel selector valves, rudder trim tab crank, and jet assisted takeoff unit jettison release. At base of front panel can be seen pull handle for nose wheel brake, and at right, beneath left windshield panel, is lever to open or close cockpit ventilating scoop.



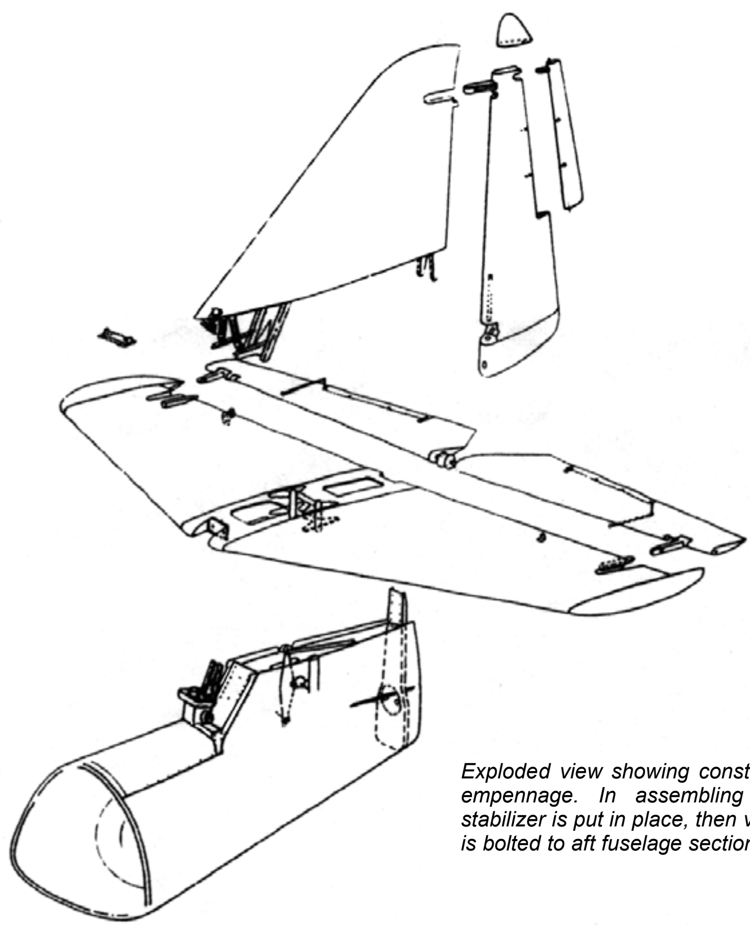
Right side of cockpit showind, at wisdshield base, canopy jettison lever below which are, from left to right: Pilot heater, Very signal, radio frequendy selector and on/off switches, and tachometer low-speed selector switches. Curved handle in fuselage side is bomb release. Pulling it clear back beyond bomb release stop jettisons bomb racks.



Phantom view showing two main 238-gal. fuel tanks just fore and aft of cockpit. Each tank is fitted with two booster pumps, and selector valves permit pumping from either tank to either engine, or from aft to fore tank. A 53-gal. reserve tank can be installed below cockpit, and Nazis had plans for an additional tank to go behind aft unit, with approximately half its capacity.



Inside aft fuselage, with radio in laeft foreground, are seen master compass in center, oxygen bottles at top, and elevator, rudder, and rudder trim tab torque tubes at right. Shown are typical stringers which completely replace longerons. Formers in this section are integral part of wkin sheets, which are joggeled to thickness of metal for lap hoint, then bent inwrd to make "J" or channel section..



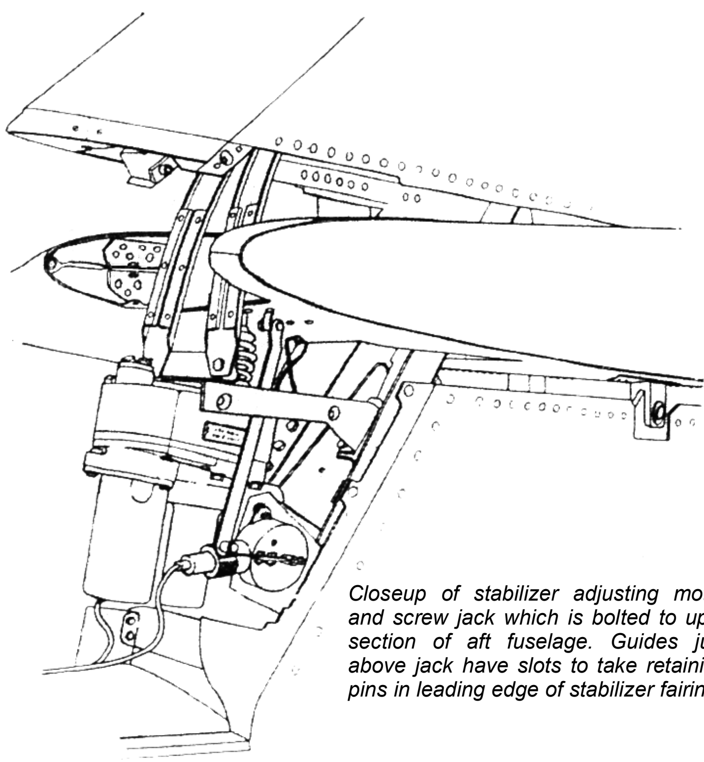
Exploded view showing construction of empennage. In assembling Me-262, stabilizer is put in place, then vertical fin is bolted to aft fuselage section.

either on the pedals or the seat. An average sized American sitting in the cockpit finds his knees sticking well up in the air right in front of some of the instruments.

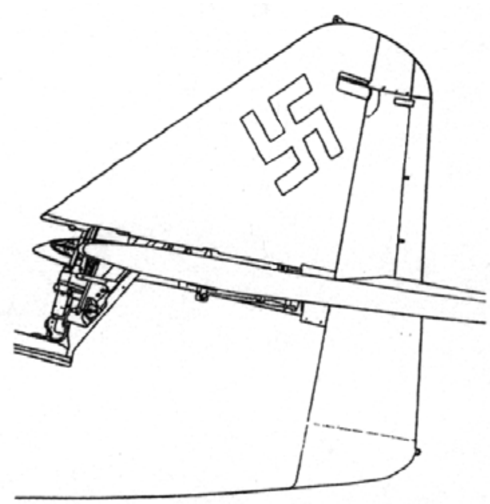
Only one channel-shaped former extends form the cockpit rail to the bottom of the fuselage at the cockpit which is, in effect, a horizontally-disposed cylindrical section with part of the wall sliced off. This "cockpit liner" section was designed for pressurization, but the craft examined had no means of developing pressure and there are no reports of any of the 262's actually operating in combat with pressurization.

Further evidence that cockpit pressure was an unused design feature is found in the windshield, a conventional three-piece flat-plate unit in which the front piece is 3½-in. bullet proof glass, set in a steel frame, but merely screwed in without the usual synthetic rubber mounting found in other German craft. The seal – which certainly does not appear to be designed for pressure – appears to be plastic designed only to prevent normal air leakage.

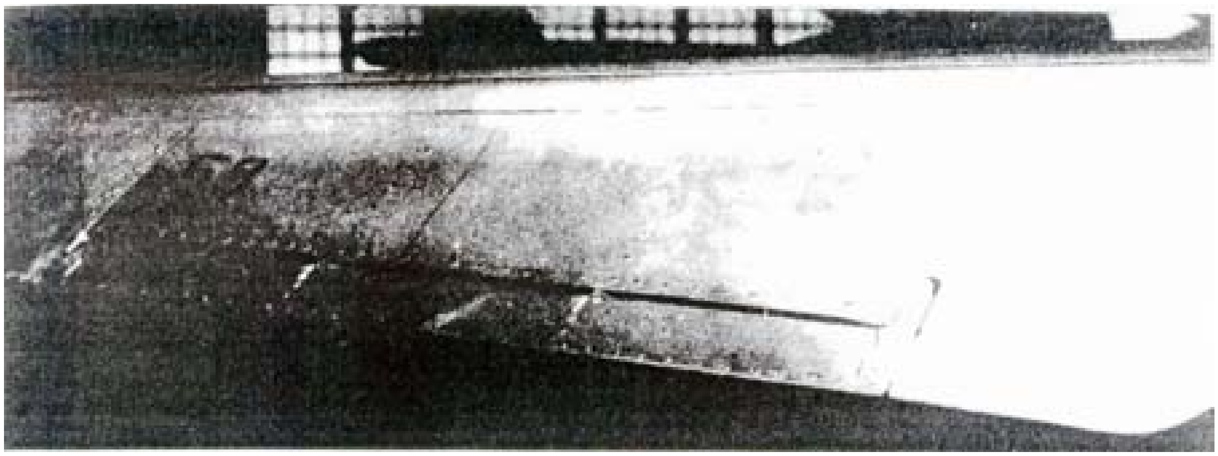
The cockpit canopy consists of two rounded plastic glass sections mounted in a frame with flat fore-and-aft pieces and tubular base. It pivots on th right side for entrance and exit, and it can be locked closed only from the inside by a lever



Closeup of stabilizer adjusting motor and screw jack which is bolted to uper section of aft fuselage. Guides just above jack have slots to take retaining pins in leading edge of stabilizer fairing.



Overall view of empennage, showing installation of stabilizer and its adjusting mechanism. A single-piece drawn aluminum fairing, held by 41 screws, encloses this unit.



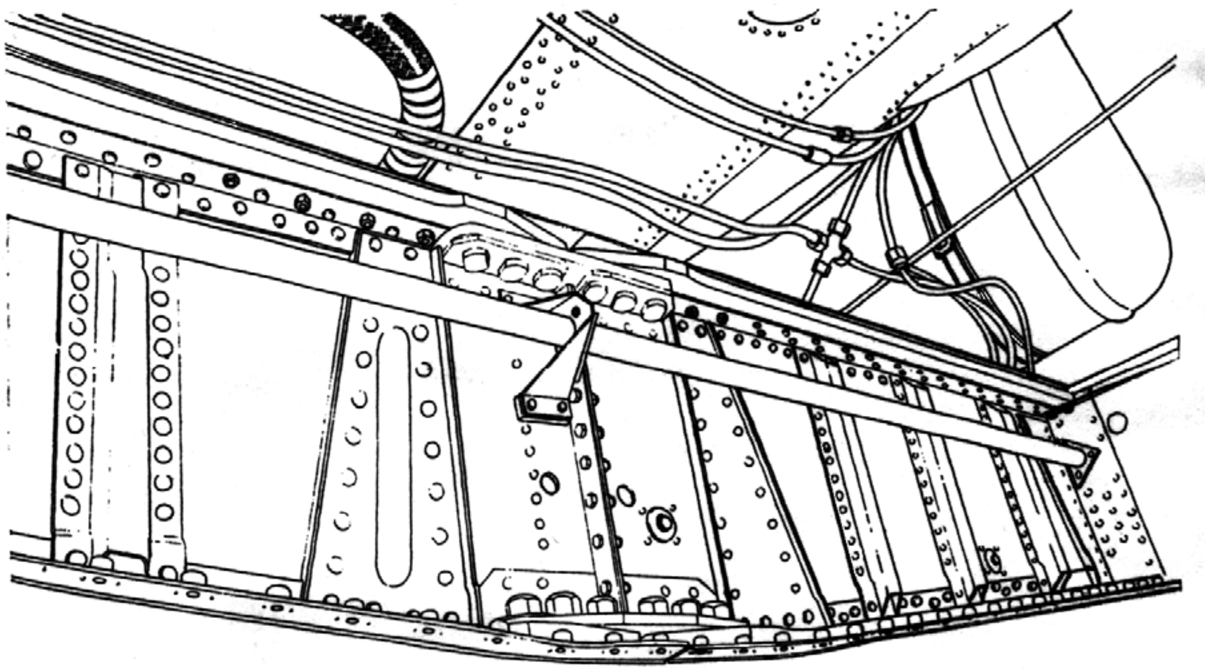
Detailed photo of mass-balanced elevator trim tab, evidently originally designed as servo unit but in actual practice riveted in place by gusset plates (shown at either end). Note that trailing edge of tab is neatly flush riveted, but elevator itself has ordinary rivets.

which drives pins into holes set in the base of the windshield frame and the turtleback section. A 16-mm.-thick head and shoulder silhouette armor section, which extends up and over the back of the pilot's head, is bolted to the canopy frame just ahead of the turtleback section.

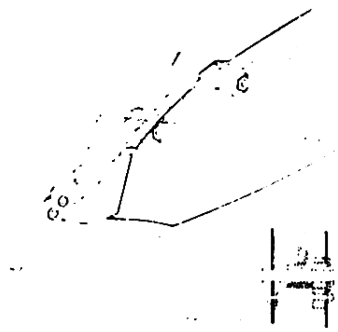
Either the Germans changed their own minds about instrumentation or had them changed by Allied bombing, because original designs called for more instruments than are actually installed – at least that's the case on some late planes. The main instrument panel is divided in two sections, with flight instruments on the left, engine instruments on the right.

Flight instruments include: Artificial horizon, combined with bank and turn indicator, airspeed indicator (some of which have been red-lined at 658 mph.), altimeter, rate of climb indicator, repeater compass, and blind approach indicator.

Engine instruments include: Two tachometers of two-speed variety to give readings from 0 – 3,000 rpm. and form 2,000 – 15,000 rpm. (generally red-lined at 8,900 rpm.); two gas pressure gages indicating up to 1 kg./cm.²; two gas temperature gages indicating up to 1,000 deg. C. (with marks on the gages at 680 deg.); two oil pressure gages; and fuel gages for front and rear tanks. Called for in design plans, but not installed in craft studied, were two fuel injection pump pressure gages, marked at 65 kg./cm.².



Front face of main spar joint at centerline, showing flanges on aluminum webs bolted together, and steel splice plates on top and bottom of both steel booms. This particular plane had been flown without bolts through splice plates being safety wired. Reserve fuel tank can be installed just in front of spar, being held in position through skin panel screwed to captured nuts (seen on lower boom).



Phantom sketch showing method of attaching full length slot to guide which travels over gall bearing rollers bolted to nose rib. Slots open automaticlaly at 186 mph. in gliding angle and at 279 mph. in climb.

Just below the center of the main panel is the bomb switch panel, marked for dive or level bombing and for instantaneous or delayed action fusing.

Above the main panel is the gunsight, in most cases the old-fashioned REV1 16B reflector type, which can be swung to the right out of the way for takeoff and landing.

On a slanting panel just to the left of the main board are valves for emergency operation of flaps and landing gear; oxygen flow indicator; oxygen pressure gages (not on all planes); and oxygen valve.

On a horizontal panel just below this unit are: Position indicators for flap and landing gear, and buttons, immediately aft for operating both these systems; stabilizer pitch indicator; stabilizer adjusting switch; fuel selector valves; rudder trim tab crank; and release cable to jettison rocket units for assisted takeoff.

A corresponding panel on the pilot's right contains pitot heater switch; Very signal switches; radio frequency selector and on/off switches; starter switches for starting motors; and switches to select low speed indicator on the tachometers.

The electric junction box is installed below these panels outside the fuselage cockpit liner, and it is easily accessible from the ground because it is located just above the wheel well.

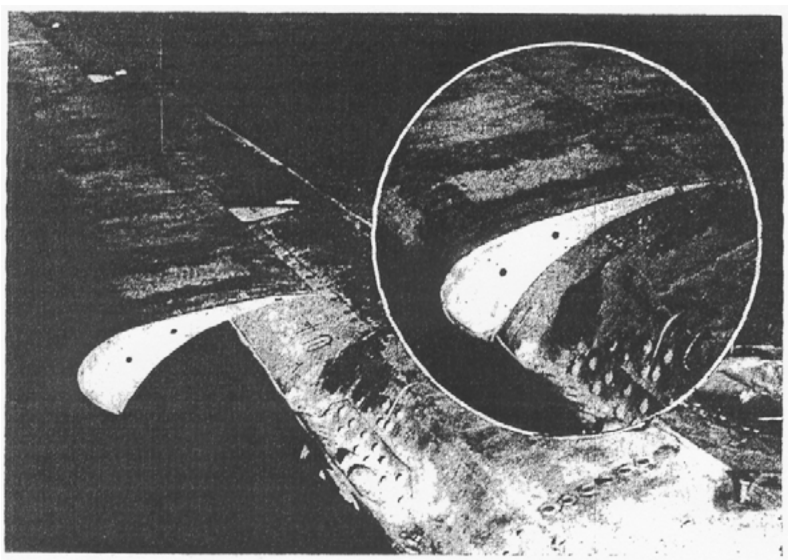
At the base of the main panel on the left is pull handle for the nose wheel brake, a unit evidently installed to facilitate stopping on the small turfed fields which the Germans were forced to use during the later stages of the war.

Just under the windshield base frame, also on the left, is a pull lever to operate a small square air scoop set in the fuselage side. This apparently was a late factory modification – and the workmanship would certainly never have passed German inspection in the early days.

The pilot's seat is adjustable only up and down on a parallelogram frame, and it is locked in position by a lever under the front of the seat which engages a pin in ratchet teeth. Unlike earlier German craft, the Me-262 has no bungee cord to facilitate moving the seat. The upholstered back of the seat is held in place by two clip springs to facilitate removal for access to the battery, which sits just behind the seat frame.

The seat itself does not incorporate armor plating; this is, instead, attached to channel-shaped vertical and horizontal stiffeners riveted to the solid aluminum alloy bulkhead which begins the aft fuselage section and forms the front panel of the rear fuel cell space. The bottom skin panel for this section measures 35½ x 60 in. and is similar in construction to that under the front cells. In the middle of this fuel cell, some 17¼ in. back, is a former which is built-up double channel section up the sides to the second-from-centerline stringer, from which it is single channel. This former, like most others, has cutouts for the stringers.

In this connection it is interesting to note that the Me-262 has no



Detail showing inboard end of steel-skinned outer slot in open position. Note that leading edge of wing is of angular shape, with rolled steel sheet riveted to it behind slot to give proper airfoil. Inset shows slot in closed position.

Closeup showing wingtip and outboard end of slot in open position. Wingtip is attached by bolt, which can be seen in access hole just behind formation light at spar line. A horizontal pin inside leading edge and vertical plate fitting into yoke of auxiliary spar complete three-way tip attachment with use of but one bolt. Note roughness of weld joining upper and lower skin sections of tip.

longerons, employing only hat-section stringers – one along the top centerline aft of the cockpit; five along the sides (with one ending at former 14); and five along the bottom (the two outermost ending at former 15).

The bulkhead forming the ft end of the rear fuel cell is a solid web but is sheet steel of approximately .080 gage.

An unusual construction feature is found throughout much of the aft fuselage section, where the formers are made of the aluminum skin sheets themselves. In fabrication, the skin sheets are formed to the fuselage contour, then the aft ½ in. is joggled to the thickness of the metal itself – about .050 – then bent inward to form a channel or J-section. The next skin is lap jointed and flush riveted in place.

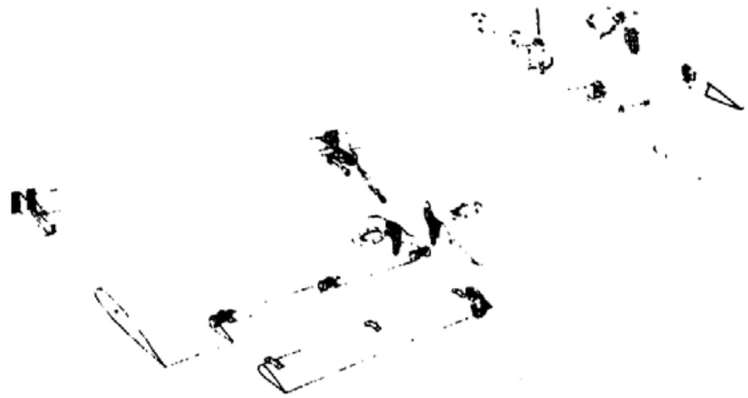
Whether this method of construction should be blamed or merely the type of labor available is not precisely known, but many of the joints were not at all clean, requiring the use of considerable filler to smooth them out. Careful study, however, seems to indicate it was probably more the quality of labor than the design, for many of the rivets were somewhat out of line and had required considerable filler themselves to give anything like a smooth finish.

Immediately aft of the cockpit the fuselage shape starts its change to a very narrow elliptical section only 2 ft. wide at a point just ahead of the stabilizer.

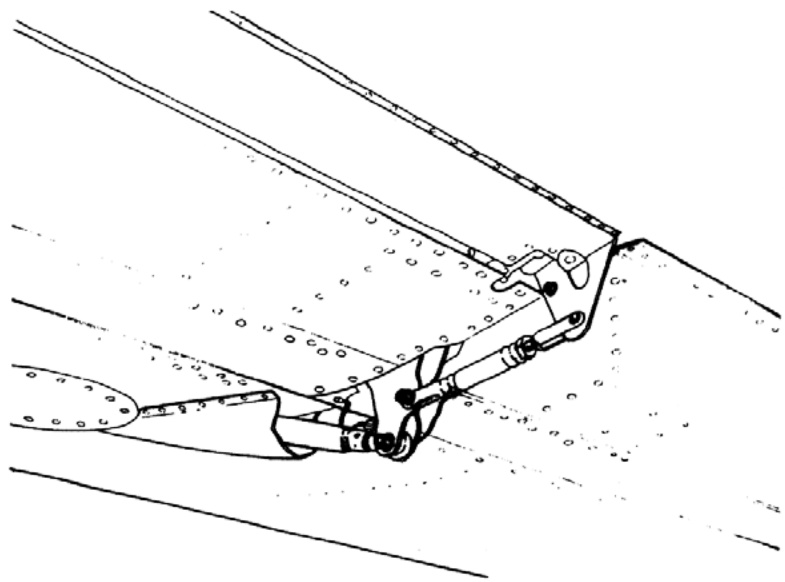
Construction of the tail cone is, in some respects, quite like that on the FW-190. It bolts to the aft fuselage section with the joint larded (at least on some planes) with liberal quantities of filler and covered by a doped fabric strip in a vain attempt to get a smooth surface.

The former aft of the joint is a built-up ring riveted to a steel I-beam section which slants aft 47 deg. from the vertical and extends up some 2 ft. above the fuselage top to form the lower part of the front fin spar.

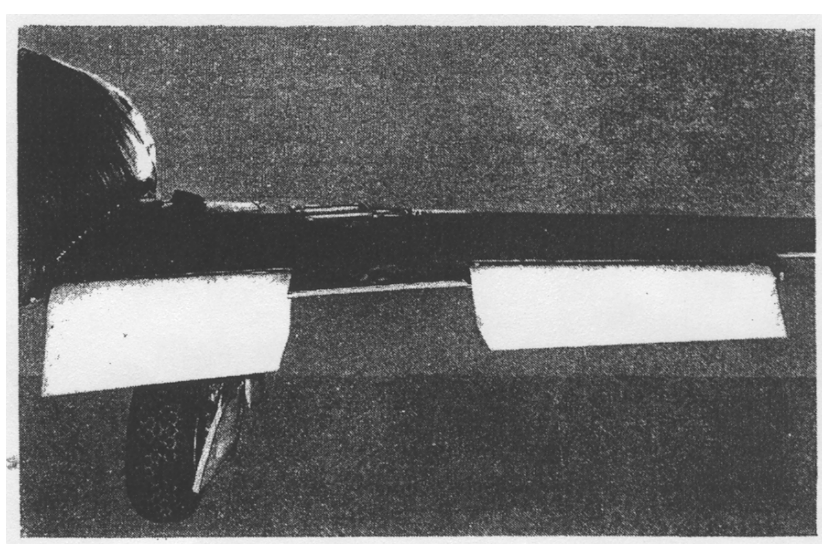
The end of the tail cone, 4 ft. 8¼



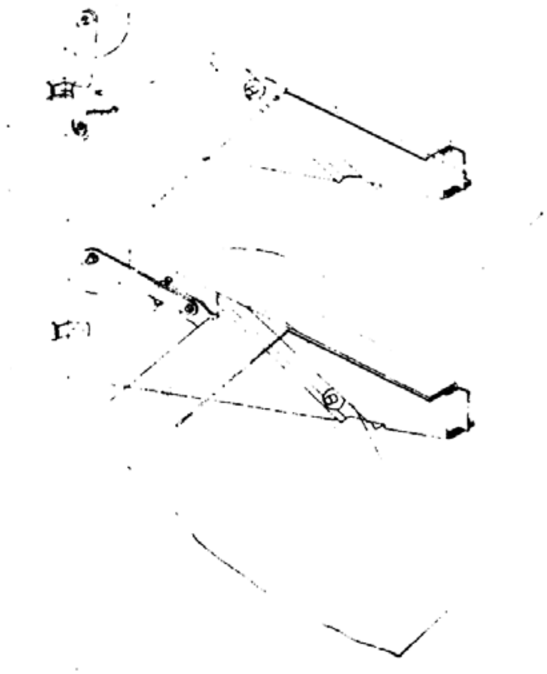
Exploded view of wingtip, two-section aileron and aileron trim tab.

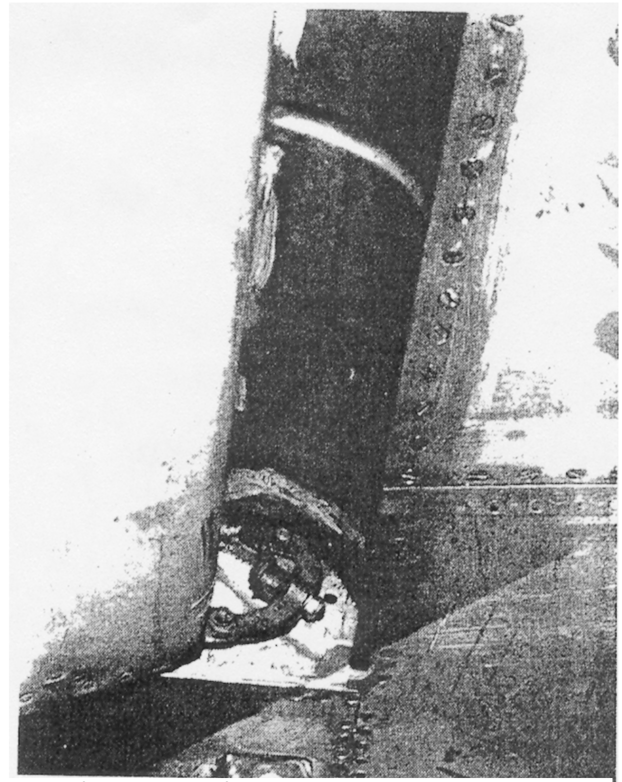


Aileron trim tab apparently was originally designed as servo unit, but in practice it turned out to be merely ground adjustable through turnbuckle tie rod shown connecting it with aileron control bracket. Note that trailing edge of tab has flush rivets while that of aileron itself uses conventional rivets to hold skin panels to flat strip.



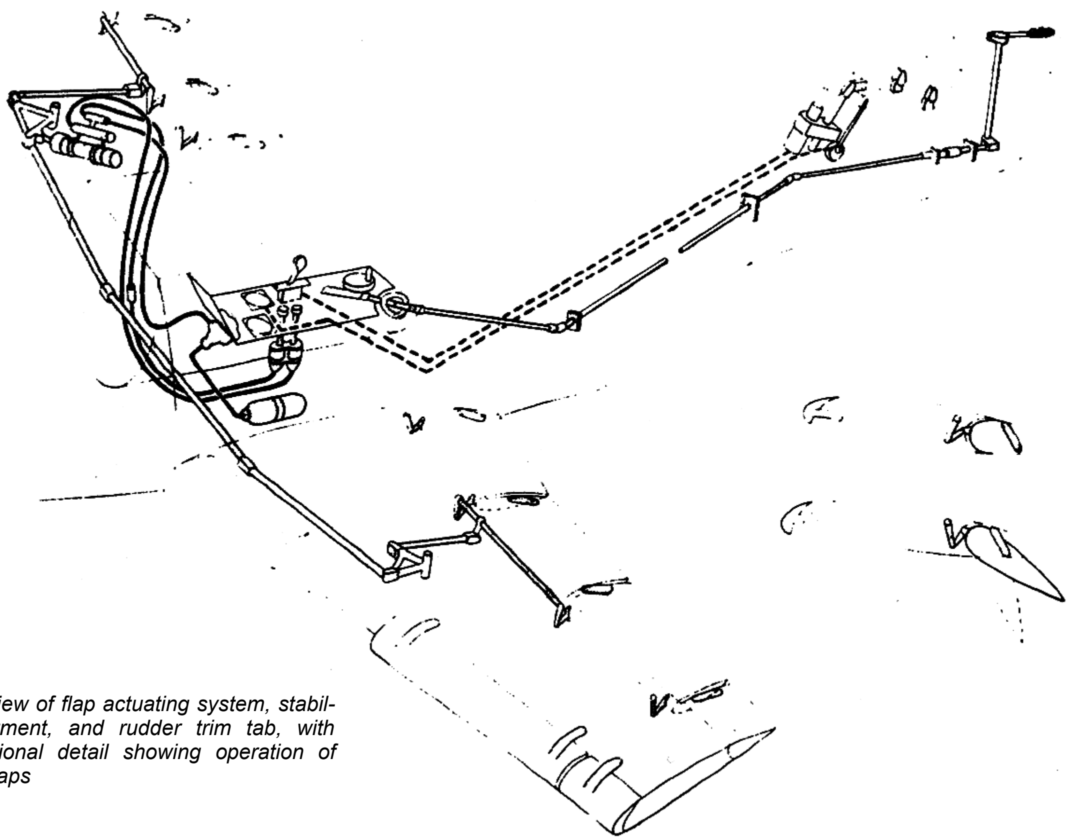
Right hand flaps in fully extended position – down 50 deg. Upper wing surface extends back over slots so that in extended position they are shrouded about 1½ in.





Phantom sketch showing how flaps are moved back and down. Hydraulically operated toggle at left forces flap back, but 7-in. track (which is channel shaped) moves it down. Set screw in toggle arm can be adjusted for upstop.

Closeup of right inboard flap in extended position showing toggle with its adjusteing set screw. Note how one adjacent lower wing surface is attached by flat screws, probably to facilitate production as well as maintenance.



Phantom view of flap actuating system, stabilizer adjustment, and rudder trim tab, with cross sectional detail showing operation of slots and flaps in. aft of the former just mentioned, is a stamped flanged aluminum channel section member which also serves as the bottom of the rear fin spar and rudder post.

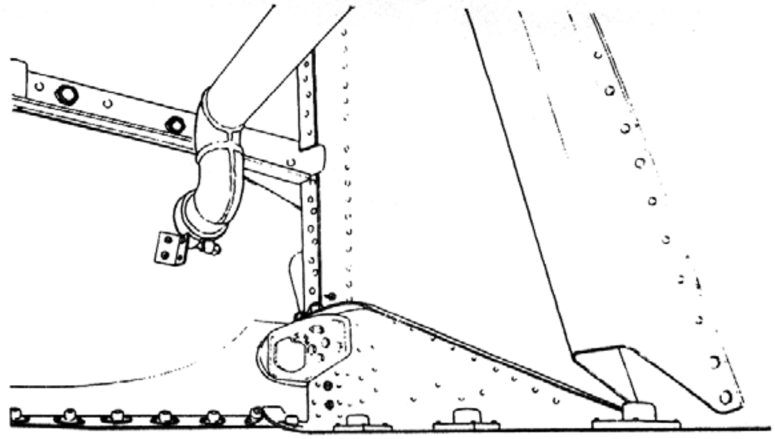
Connecting the tops of these two spars is a horizontal stamped flanged channel member upon which the stabilizer is mounted. In production, the stabilizer must be installed before the fin and rudder are put in place.

Then the fin, the spars of which have steel plates riveted to their lower ends, is attached to the tail cone by seven bolts along each side of the front spar and four on each side of the rear spar. In construction, the fin is built up in two halves, divided on the vertical plane of the fuselage axis. The halves are then bolted together along the spar line through access holes in the skin. These holes – of approximately 1 in. dia. – are then covered with small doped-fabric patches. The joint along the leading edge is covered by plywood fairing which is screwed on. Rounded tip of the fin is built in two halves, welded together and attached to the main body by flush screws. A single-sheet, deep-drawn aluminum fairing is fastened by 41 flush screws to the base of the fin and top of the fuselage.

Chord of the rudder is narrow, being but 20½ in. at the widest point, but there is plenty of depth, for the rudder has an overall height of 6 ft. 11 in., extending from the top of the fin to the bottom of the tail cone. A small tip is screwed to the top just above the large mass balance, and the main section of the unit follows conventional construction practice.

The spar is D-section, with the curved part fitting closely inside the fin trailing edge. Conventional stamped flanged aluminum ribs with lightening holes extend back to the trailing edge, where the skin surfaces are crimped together and riveted with 3/8-in. ordinary round-head rivets.

Fore part of the bottom portion of the rudder, beneath the lower hinge, is comprised of two formed sheets flush riveted to the spar and lowest rib. The aft portion containing the formation light is made up of two small formed sheets attached by flat screws.

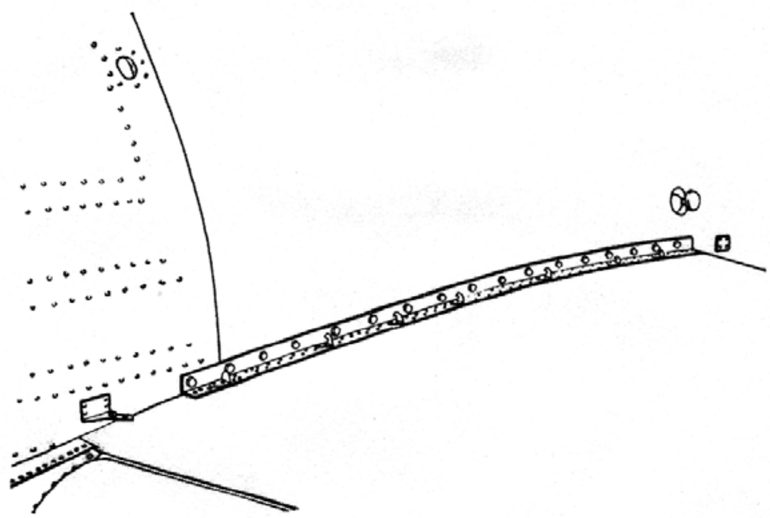


Wing-to-fuselage attachment inside left nose rib, showing bolt through fitting which is attached to bulkhead forming aft end of front main fuel cell.

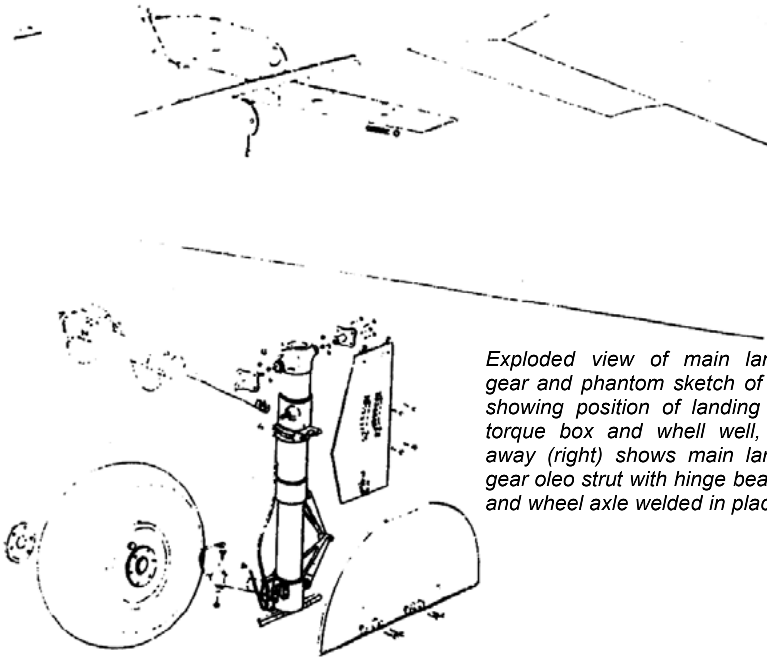
Although the rudder is quite deep, it has but two hinges, both typical self-aligning ball bearing units. The top bearing is set just beneath the mass balance, the lower at the bottom rib, where push-pull controls also attach.

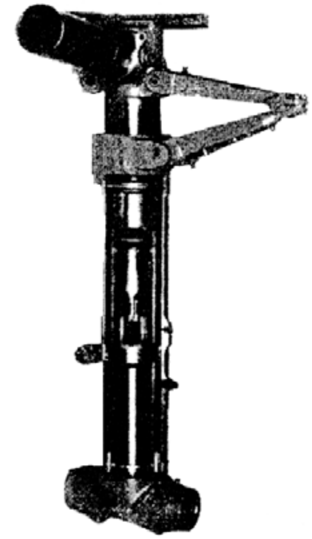
Oddly enough, the combination servo and trim tab has four hinges and, comparing its construction with other parts of the plane, it sowed every evidence of having come from a different shop. It too, has a mass balance, set right under the top self-aligning ball bearing hinge. The two middle hinges are small metal blocks with vertical pins holding them to the tab and yokes attaching to the rudder false spar, giving a universal joint effect. The lower hinge is a vertical pin extending up from a rudder rib. Trailing edge of the tab is formed by crimping together the skins, around which a strip is folded and flush riveted. It is 36¾-in. deep, with 4-7/16 in. chord at the top and 6 in. at the bottom.

As is the case with several other German planes, the 262's all metal stabilizer is adjustable, the incidence being changed by a small electric motor operating a screw jack mounted inside the fin fairing on the front face of the frame to which the vertical fin is bolted. This unit is

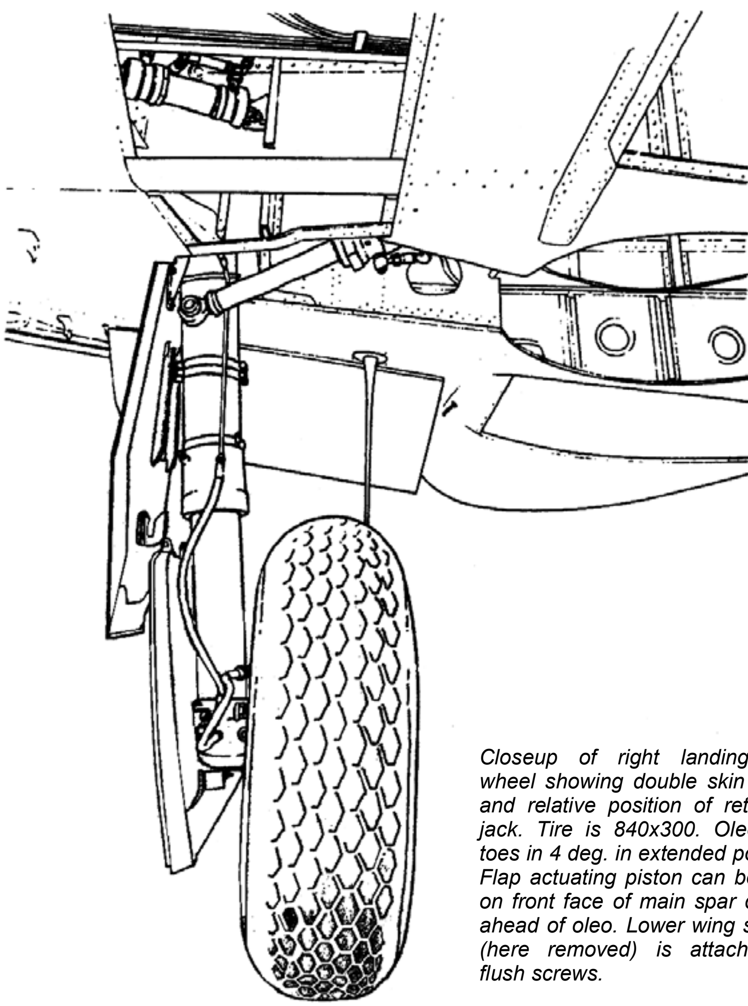


Principal wing-to-fuselage attachment is by 17 bolts through flanged member riveted to top wing surface. On first Me-262 brought to America for tests, many of these holes were elongated and some were as much as 1/16 in. out of line, so extra steel strip was added, holes being reamed to take ⅞-in. bolts. Angle bracket at left is anchor for fillet cable which goes under slips seen riveted to horizontal part of flange.





Exploded view of main landing gear and phantom sketch of wing showing position of landing gear torque box and whell well, Cut-away (right) shows main landing gear oleo strut with hinge bearings and wheel axle welded in place.



Closeup of right landing gear wheel showing double skin fairing and relative position of retracting jack. Tire is 840x300. Oleo strut toes in 4 deg. in extended position. Flap actuating piston can be seen on front face of main spar directly ahead of oleo. Lower wing surface (here removed) is attached by flush screws.

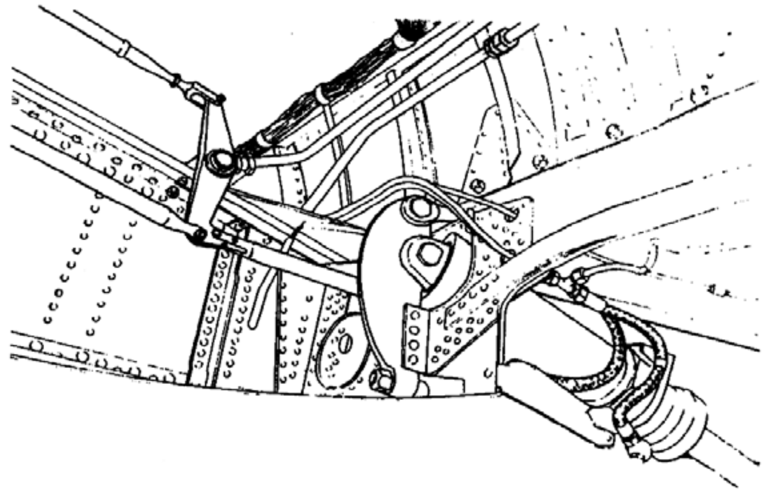
mass-balanced trim tabs set near the inboard end. These tabs were apparently designed as interchangeable servo units, for a small arm at the outboard end extends up from the right one and down from the left, and captured enemy documents show an anchoring arm designed into the stabilizer trailing edge. However, the operational experience or Allied bombing made completion of this plan impossible, for the tab arms were not connected to the stabilizer and, in fact, the tabs had been riveted into immobility by small gusset plates at each end. Nevertheless, each tab had four hinges, with ball bearing units at each end and pins through yokes for the two in the middle. As is the case with the rudder trim tab, the trailing edges of the tabs are nicely flush riveted.

One-piece pressed-aluminum stabilizer fillets are held in place by a leading edge pin which moves up and down between greased strips riveted to metal brackets just above the adjusting jack, and by screws – one top and bottom – 10 in. aft of the stabilizer spar.

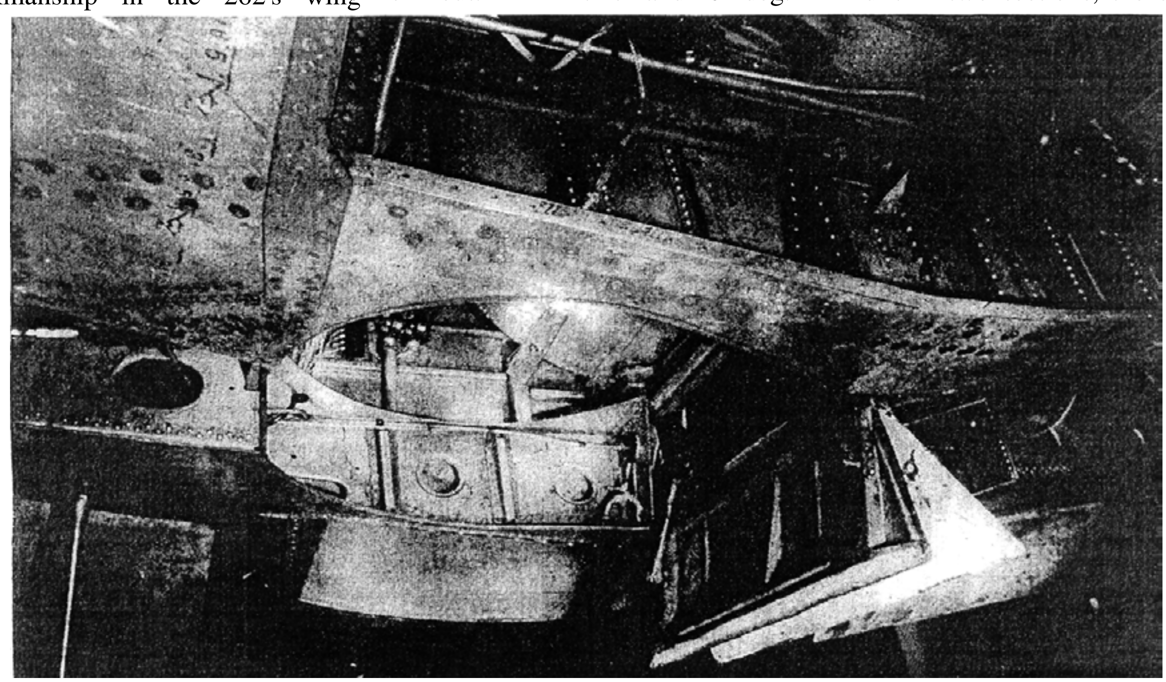
There are many interesting variations in both design and workmanship in the 262's wing which, though approximately like our laminar flow foils, has a plan form which is angular, to say the least. The leading edge has a 20-deg. sweepback; the spar sweeps back 12 deg., starting at the fuselage side; the trailing edge sweeps forward 8½ deg. to the outboard side of the power plant; then sweeps back 5 deg. from there on out. All this and 6 deg. dihedral, too.

The wing is built around a composite I-beam main spar having steel booms and built up dural web, tapering in depth from 14½ in. at the centerline to 3 in. at the tip attachment fitting. Spar boom caps are ¾ in. thick at the centerline, the upper being 4¼ in. wide, the lower 4¾.

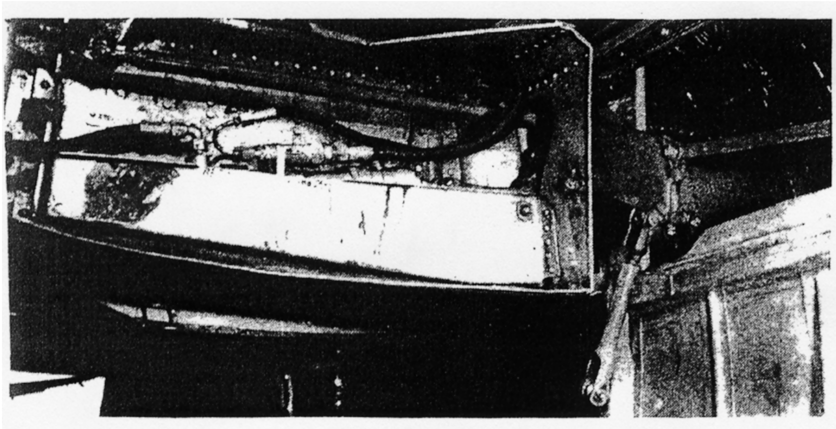
Built in two sections, the spar is

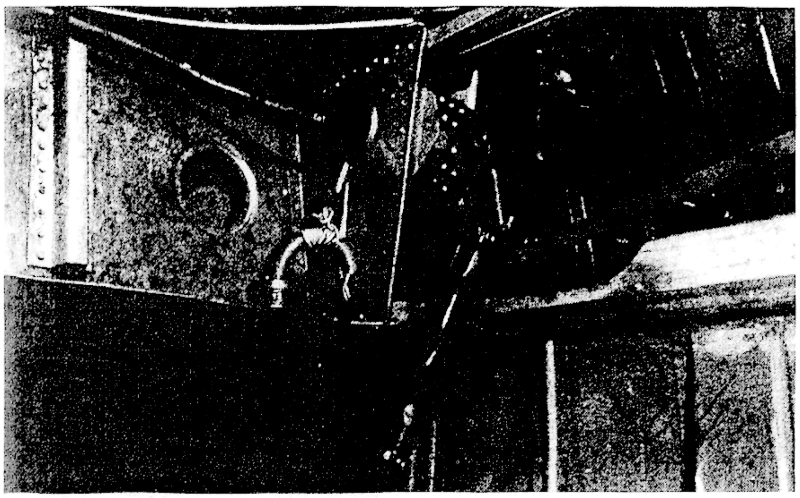


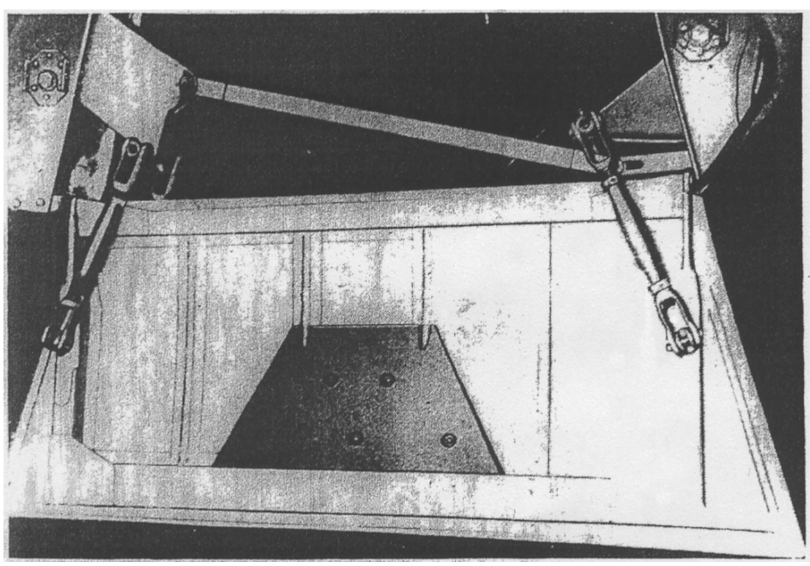
Looking up and forward into right wheel well at fitting for landing gear retracting cylinder, which is attached to root rib. At upper left, attached to main spar top boom., is aileron bell crank showing difference in size in push-pull rod from control stick (top) and those extending to ailerons (bottom). Above retracting cylinder fitting can be seen self-locking nuts attaching fuselage skin to flange on upper wing surface.



Looking up and aft into main gear well. Seen are centerline fairing doors, which serve as landing gear uplock, and construction of auxiliary spar will be noted. Just above this spar can be seen bottom part of cylindrically shaped cockpit liner, a unit designed for pressurization but unused in this way. Opening in front of main spar takes 53-gal. reserve fuel tank.







Top photo, made from left main wheel well, shows fairing door operating cylinder fitting on aft face of main spar at left center, with universal joint connection to box-type bell crank which is, in turn, universally-connected to fairing doors, corner of which is shown at lower right. Flat tie rod on upper corner of bell creank is connected to crank, which distributes power to aft end of doord, details of which are shown in center photo. Connecting linkage here is bolted to box-type structure attached to front face of auxiliary spar. Lower photo is of German pespective sketch, showing how unit was designed.

open automatically at 186 mph. in gliding angle and at 279 mph. in a climb.

The 5¼-in. wingtip, with its integral formation set in a transparent plastic covering, is built in two halves, flush riveted to an inboard rib and spar. The two halves, flush riveted to an inboard rib and spar. The two halves are welded together around the outer edge and, on at least one craft, a thoroughly sloppy weld it was. Its method of attachment, however, is neat and can be accomplished fairly fast with simple tools.

A horizontal pin near the leading edge slips into a holed angle plate on the wingtip rib, then the tip is pushed toward the planes so that an angle bracket slips int a forged fitting riveted to the end of the spar, whereupon a through bolt with self locking nut is pushed down from the top through small access holes. At the time the tip is pushed toward the wing, a vertical plate slips into a yoke attached to the end of the auxiliary spar with the result that a three-way fastening is obtained with only one bolt being necessary.

All metal ailerons are of conventional design, having a channel-section aluminum spar, rolled sheet aluminum leading edge, and stamped flanged ribs. At the trailing edge the two skins surfaces are crimped and riveted to a flat 3/3-in. strip. Here, as on the rudder and stabilizer, the rivets are not flush.

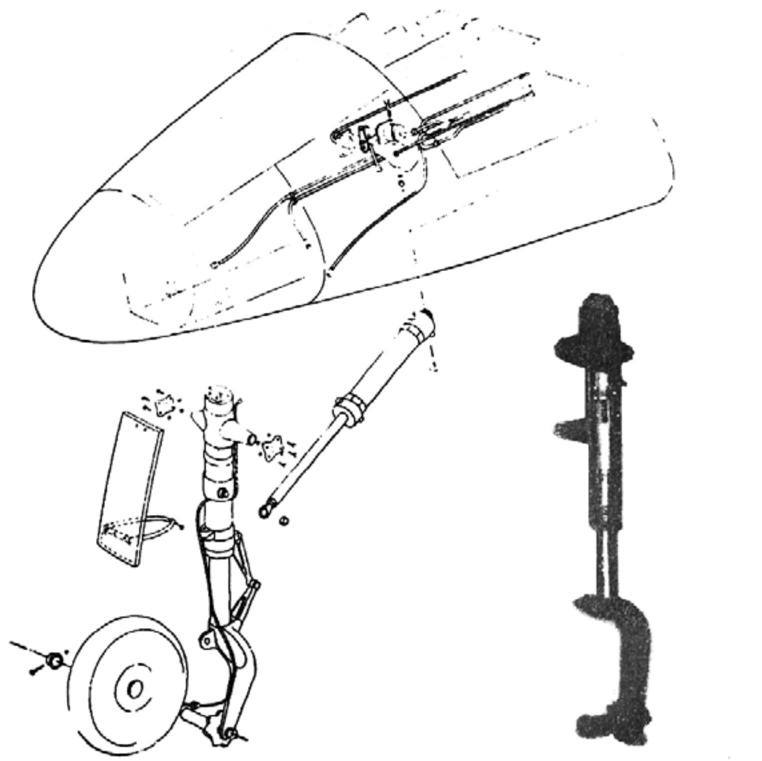
The ailerons are built in two sections. Each have a 42-in. span, and the two sections are connected via the control bracket, which is split so that one half is riveted to the outboard rib of the inner section, the other to the inboard end of the outer section. A self-aligning ball baring hinge also serves as a connecting point for the two sections, and similar bearings re bolted to ribs aft of the auxiliary spar at each end.

Evidently the 38-5/8 x 3 in. trim tabs were originally proposed as servo tabs, but in practice they ended up only as ground-adjustable units, for the control arm, riveted to the outboard end of the inner aileron section, is attached by a turnbuckle rod to the aileron-operating bracket rather than being attached to the wing to give the servo action.

Unlike the elevator hinge points provided in the rudder and elevator trim tabs, those on aileron tabs are simply straps bolted to the aileron and hooked around pins in the tab. Like those on the other tabs, however, the trailing edges are neatly flush-riveted.

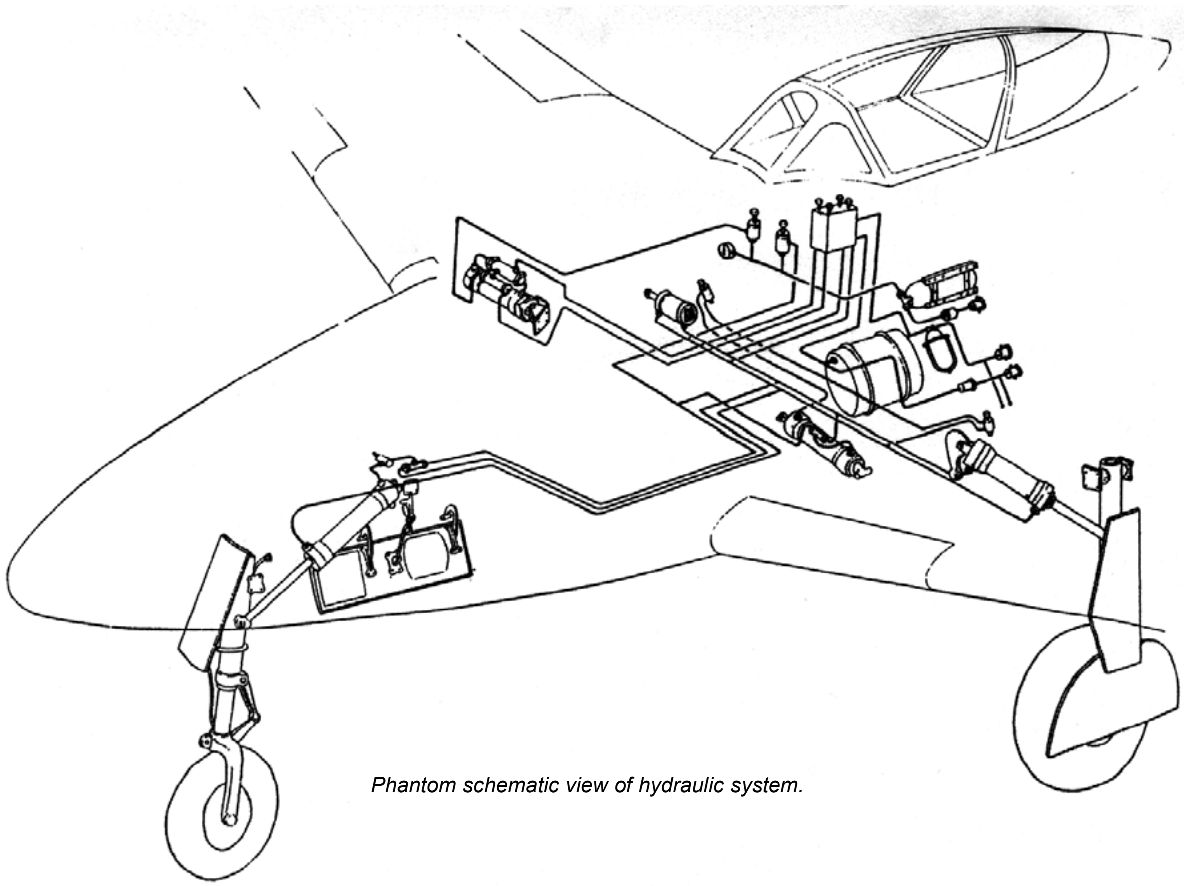
Flaps are built in two sections: The inboard (which has a 21¾-in. chord) extending 38½ in. from the wing root to the power plant, and the outer section extending 48¾ in. from the power plant. With rolled aluminum leading edges, stamped channel-section spar, and conventional ribs, they are built in two halves, bolted together except at the trailing edge where the skin surfaces are crimped and riveted (with brazier head rivets) to a ½-in. aluminum strip.

Ball bearing rollers at both ends of each section run in 7-in. steel guides which re bolted to the auxiliary spar so that, in operation, the flaps move back and down, for the guides slant down 35½ deg. from the top to the bottom wing surface. This action is imparted by hydraulically operated toggles which force the flap bodily aft approximately 5½ in. – and down because of the guide – except for

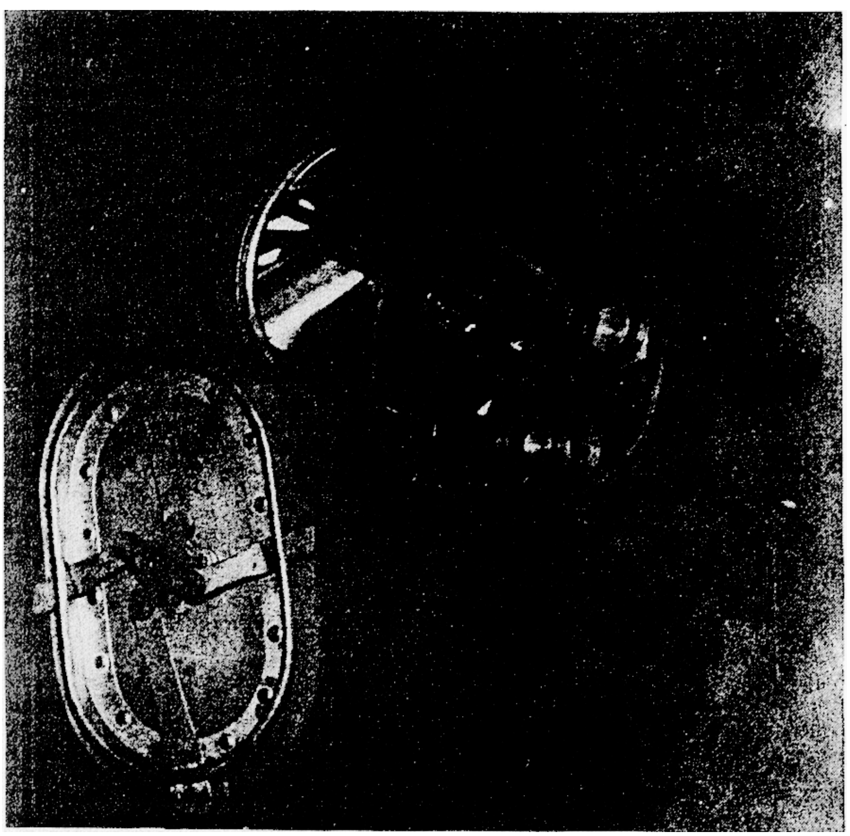


Phantom view showing installation of nose landing wheel, which is depicted in exploded view. Inset is cutaway of nose wheel strut. Not that original plans called for conventional torque scissors, however, late model 262's had built-in shimmy dampers.

Looking aft and up into nose wheel well at retracting cylinder attachment. As nose wheel retracts, it strikes tubular linkage to pull and lock fairing door closed.



Phantom schematic view of hydraulic system.



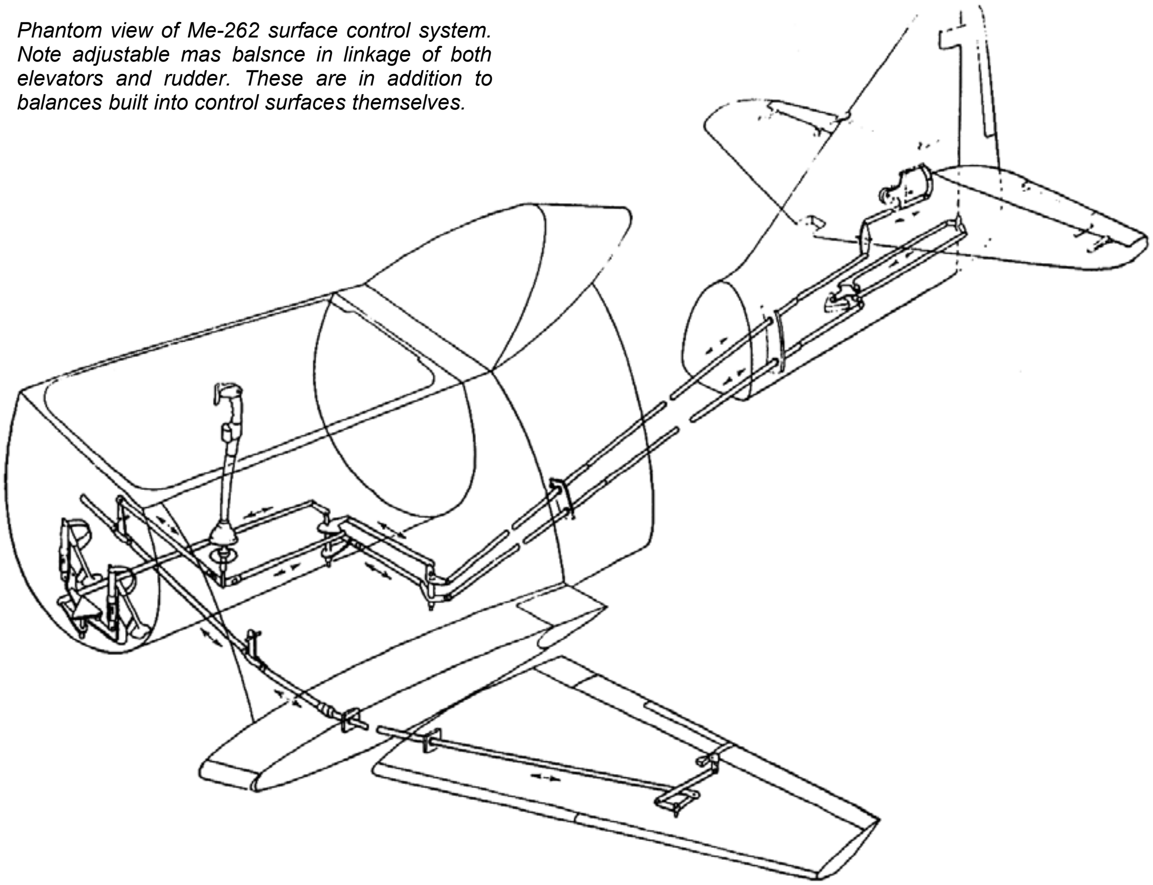
wing surface extends out over the flap so that even when extended to the full 50 deg., the flap leading edge is shrouded for 1½ in.

The flap actuating cylinder is set at a 45-deg. angle to the front face of the main spar directly ahead of the oleo hinge point and is attached to one corner of a triangle whose apex is its hinge point on the spar. Where the piston attaches there is also attached a push-pull rod which extends across the plane to the left to a bell crank set just over the left power plant, with a push-pull rod going straight back to the aft face of the auxiliary spar. Here it is connected to an arm extending down from a torque tube connected to the toggles which force the flaps back and down.

Right side flaps are actuated by a tube going straight back from the

Quickly removable cover for hydraulic reservoir filler, a unit very similar to many used on Focke-Wulf 190. Four of five of these units on Me-262 are interchangeable, but the fit in some cases was so bad that doped fabric strips had to be added as is evident here.

Phantom view of Me-262 surface control system. Note adjustable mas balsnce in linkage of both elevators and rudder. These are in addition to balances built into control surfaces themselves.



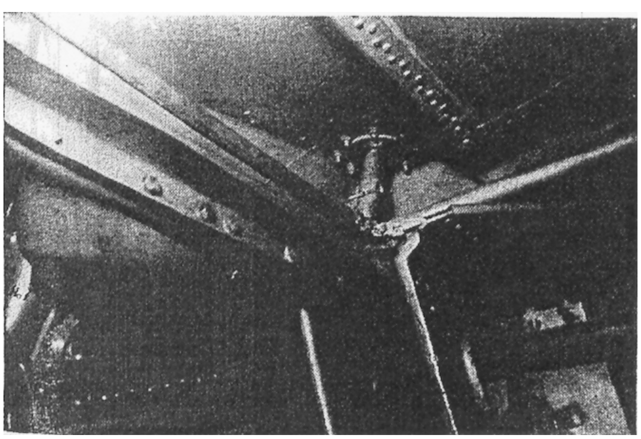
base of the triangular member connected to the actuating piston.

Pilot error in forgetting to lower the landing gear is avoided through the system being so arranged that the flaps cannot be extended until the landing gear has been put down.

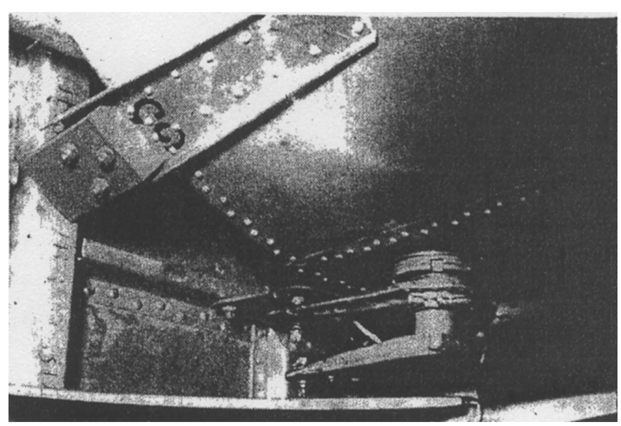
The left outboard flap on the craft examined has markings at 0, 10, 20, 30, 40, and 50 deg., with the 20-deg. mark in red for takeoff.

Three of the lower wing skin panels, extending over three ribs each, are held in place by flush screws placed approximately 1½ in. apart. While the primary purpose may have been to facilitate access, the small number of units requiring maintenance give rise to the belief that it may have been employed to facilitate production by eliminating blind riveting.

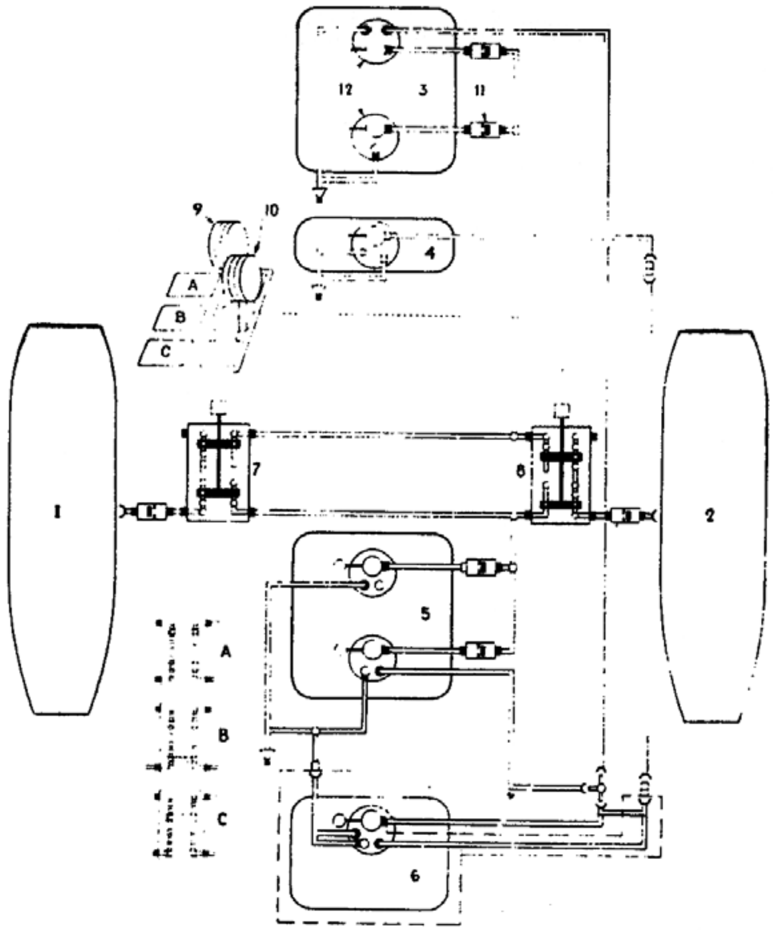
Quite an unorthodox method is used to attach the wing to the fuselage. Near the base of the root nose rib, 9 in. aft of the leading edge, a 1-in. bolt goes through a two-sided forged bathtub fitting which is bolted to the aft face of bulkhead backing up the front fuel



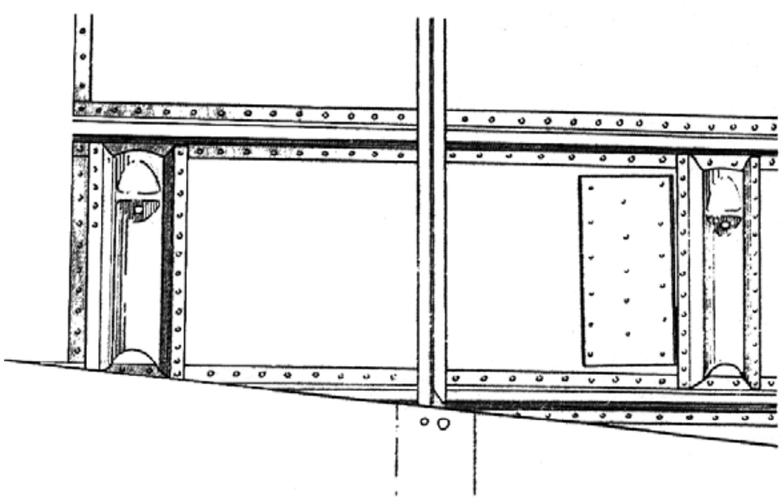
Bottom of control stick, seen extgending through ball and socket joint in bottom of cockpit liner, with aileron torque tubes extending to right and elevator tube extending aft.



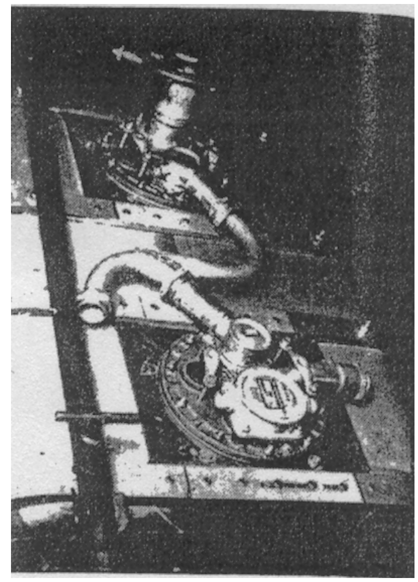
Elevator bell crank and trim tab (unused because trim tabs were riveted to elevators) over auxiliary spar attached to bottom of cylindrical cockpit liner.



Schematic diagram of Me-262 fuel system showing: (1) and (2), left and right engines; (3) fore fuel tank; (4) auxiliary fuel tank; (5) aft fuel tank; (6) extra auxiliary tank; (7) and (8), valves for left and right power plants; (9) and (10) left and right engine safety petcocks; (11) reverse vavle; (12) fuel pumps. Craft studied lacked extra auxiliary tank (6), and reports from abroad indicate Germans were unable to get this modification into more than few planes before their defeat.



Inside rear fuel cell showing pressed fitings between stringers to which fuel cell is bolted for suspension. Front bulkhead in this section is aluminum alloy supporting rear armor plating, and aft web is sheet steel. Plywood buffer sheet at bottom is screwed in place.



Top of one of two 238-gal. main cells showing installation of two booster pumps, plywood covering, and supporting straps.

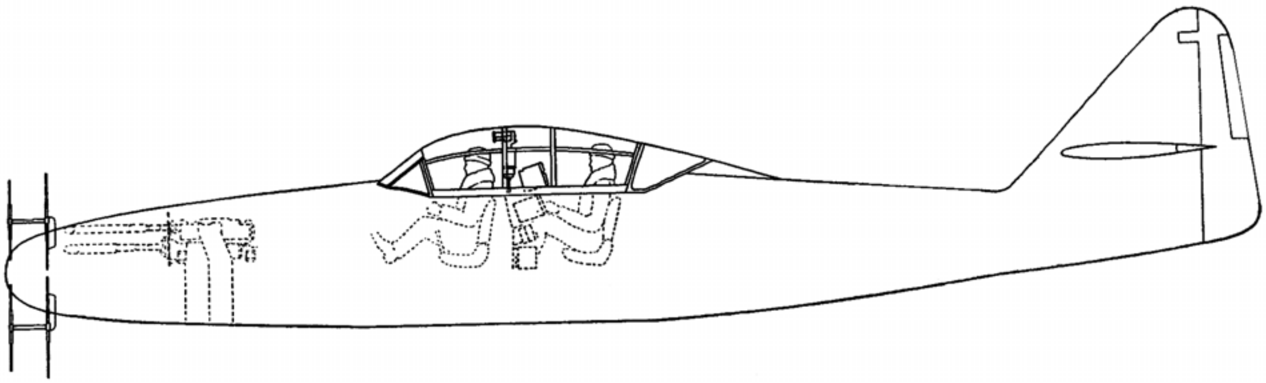
cell. A similar sized bolt is used on the root rib aft of the auxiliary spar. Then, riveted to the top wing skin at the fuselage line is a 1-3/16 x 1-3/16-in. steel angle member through which 17 bolts and self-locking nuts attach it directly to the fuselage skin.

On the first Me-262 brought to this country for study, many of the holes in the fuselage skin had been elongated and some were as much as 1/16 in. out of line. When the craft was being prepared for flight tests, the holes were reamed to take 7/8 in. bolts and an additional steel strip was used to back up the vertical half of the angle member.

The wing fillet, just over 73 in. long, is held in place by a cable anchored to an angle bracket at the trailing edge and going under seven hooks riveted to the attaching angel-member, with a turnbuckle at the front keeping it snug. The fillet around the leading edge is a drawn light aluminum alloy section attached by eight flush screws.

Oleo struts for the main wheels of the hydraulically retractable tricycle landing gear are hinged in a built-up steel box structure on the end of spanwise spars extending 30 in. from the root rib midway between the main and auxiliary spars.

The 26-in.-long forged oleo strut is 5½ in. in dia. and has conventional torque scissors on the aft side designed for a 20-in. piston travel. In preparing the craft for



Phantom view showing final modification — the Me-262-B2 — a two-man radar-equipped night fighter. Addition of extra seat meant moving fuel tanks, radio and other equipment farther aft in rear fuselage section.

flight tests it was found that the main wheels had considerable lateral play, but when the normal 1.200 lb. pressure was built up, the wobble disappeared.

The retracting jack is bolt-hinged to a steel fitting bolted to the root rib at the end of the front spar of the landing gear torque box, while the piston is attached to the front of the oleo strut by a ball and socket joint.

Fairing for the main gear is built in two section, both of which are double-skinned grid-type structures with the top section hinged to the torque box end and the lower bolted to a bracket welded to the oleo piston just above the axle.

In operation the main wheels swing up and into the bottom of the fuselage, with the right strut operating an actuating valve at the end of its arc. This valve in turn closes fairing doors which are hinged at the fuselage centerline and which serve as the landing gear up lock.

To accomplish this, a hydraulic cylinder is attached parallel to the aft face of the main spar just to the left of the fuselage centerline. Its piston is connected to a welded steel box type bell crank which, in turn, is attached by a universal joint to another box bell crank set between two stamped flanged vertical plates set along the centerline. At the lower corner of this bell crank are universal joint tie rods connected to the leading edge of the built-up fairing doors, and at the upper rear corner is a flat steel tie rod connected to a triangular shaped built-up bell crank attached to similar tie rods on the trailing edge of the fairing doors.

Thus, when the oleo strut hits the actuating valve, the piston moves to the right, forcing the tie rod-connected bell cranks to snap the doors closed under the wheels, with the 90-deg. change in direction between the units serving as the locking mechanism after the hydraulic pressure on the piston is relieved.

The nose wheel retracts aft and up into a well below the armament compartment, the wheel, near the end of the retracting arc, striking a transverse tube which pulls the double skin fairing door closed. Spring loaded pins moving into the piston serve as up and down locks.

German drawings studied in connection with this article show provision for the conventional torque scissors, but on the later model craft examined, the nose wheel contained a built in shimmy damper. The nose gear retracts and extends after the main wheels have been locked either up or down.

Both the landing gear and flap operating systems have connections with a compressed air bottle which can be cut in for emergency operation of the two systems.

Surface controls present several odd and interesting features. The control stick, for example, is mounted in a ball and socket joint set in the bottom of the cockpit liner, extending down 4 in. and ending in a welded angle bracket. Attached by a ball bearing joint to one face of this bracket is a 3/4-in. tube extending to the right above the main spar. Just inside the fuselage, and bolted to the top boom of the spar, is a bell crank from which 1-in. push-pull tubes extend, with one universal joint in each at the fuselage side (to compensate for spar sweepback) out to bell cranks set just ahead of the aileron control arms..

Attached to the aft face of the angle bracket on the stick is a 5/8-in. elevator operating tube going aft to a self aligning ball bearing crank set just over and ahead of the auxiliary spar, from which a 1-in. tube extends to the left side of the fuselage and another bell crank to connect to a similar sized push-pull tube going aft. A third bell crank is set in the empennage near the stabilizer leading edge. Extending straight aft from this crank is another push-pull rod connected to the elevator horn and, just ahead of the horn, a large mass balance which can be ground adjust on the fulcrum.

This balance is in addition to those already noted as being set in the elevators themselves, and may be a late modification. Reports from abroad have indicated that at speeds over 500 mph. the ailerons and elevators of the 262 become extremely hard to move and that an extendable control stick designed to give increased leverage had been developed. However, no such stick, or provisions for its installation could be found on the craft studied, and it is held possible the mass balance just discussed has been utilized in its stead.

Rudder pedals are very similar to those on the FW-190, incorporating the main wheel brake pedals as integral units. A torque tube extends aft from the right pedal inside the cockpit liner, then through a seal to a bell crank where another tube extends to the left side of the fuselage to a second crank which is connected with the push-pull tube extending to the empennage, where a third crank, with adjustable mass weight, is connected to double tubes connected to the enclosed rudder horn.

The fuel system consists of two 238-gal. main tanks plus a 53-gal. reserve and, at least in design plans, and auxiliary tank of about 170 gal. capacity. Both self-sealing main tanks have plywood coverings and are suspended by two straps on the ends of which are bolts that go up through pressed fittings riveted to the inside of the fuselage skin about two-thirds of the way up the side. Nuts are put on the bolts through access holes in the fuselage skin, with the holes covered by doped fabric patches.

Each of the main fuel cells has two booster pumps and the reserve tank has one, the system being so arranged that fuel can be pumped from any tank to either engine, or fuel from the rear tank can be pumped to the front.

The reserve tank (at least some of these have not been self sealing) goes just in front of the main spar. It is trapped to a single-skin panel, 19-3/4 in. deep by 66¼ in. wide, that is reinforced by six hat shaped stiffeners and is attached to the fuselage by flat screws placed approximately 1¾ in. apart.

Evidence of the Nazi's attempts to get more range out of the Me-262 is shown by plans for installation of the 170-gal. auxiliary tank aft of the rear main cell. It is not known how extensively, if at all, this plan was carried out, for the craft studied was the latest model produced and it had no such installation. Instead, the radio was installed in the space and, a little farther aft, the master compass and oxygen bottle. Access to these units is via a 17½ x 15¼-in. door held in place by four quick fasteners.

Radio installation consists of the usual German equipment – FuG 16Z or FuG 16ZY (VHF R/T, D/F and retransmission facilities for ground control stations) and in some cases IFF had been installed.

Whether Hitler was finally convinced that the Me-262 was not the world's hottest bomber or whether the Luftwaffe went ahead in the face of his orders is not known, but one final modification of the craft -- the Me-262 B2 – was in the works when the Germans capitulated.

This was to make the plane a two-man, radar-equipped night fighter. Principal changes necessary were made in the cockpit, where the pilot's seat appears to have been pushed forward slightly to help make room for addition of the radar operator's screens and seat immediately behind. This, of course, meant changing the design of the canopy to give the necessary length, and relocation of the aft fuel tank, normal radio equipment, oxygen bottles and master compass, all of which were pushed further aft in the fuselage.

Study of the plans for this change does not indicate that much, if anything, had been done to compensate for the added weight aft of CG and, since the craft had to be trimmed nose heavy for take-off as originally designed, it is believed that even more trim had to be applied for the night fighter version. Too, since the 262 was not the most maneuverable to begin with, it is believed that the radar-loaded version was not as good a combat craft as the original day fighter version.

The concluding part of this study will cover the Junkers Jumo 004 gas-turbine jet-propulsion power plants, used in the Me-262 but designed for use in other craft as well.

ACKNOWLEDGEMENT

For unusual cooperation, *AVIATION* is deeply grateful to Col. J.M. Hayward, Chief,Technical Data Laboratory, ATSC, and to Capt. Irving P. Brown, Chief, Capts. W.H. Carter and H.R. White and Lts. J.E. Arnoult, F.D. Van Wart, and Bernard Ellis of the Foreign Equipment Branch.

Special thanks are due Sgt. Robert Foster, Hangar Chief; Staff Sgt. Harry Kilpatrick, Crew Chief; Tech. Sgt. Warren Stoddard; and Sgts. George Ledbetter and Wilfred Vigor.

Span ....40 ft. 11½ in.
Length...34 ft. 9 in.
Height (fin above ground)............21 ft. 4 in.
Wing area (approx).....................270 sq. ft.
Chord (root)...................................8 ft. 4 in.
Chord (tip)..................................2 ft. 9¾ in.
Aspect ratio..7.5
Wing loading ....44.5 lb.
Wt. empty ....8,514 lb.
Useful load ....7,106 lb.
Gross wt. ....15,620 lb.
High speed (red line) ....658 mph.
Range ....50-90 min.
Max. thickness, 35% of chord.
Max permissible CG., 30% MAC

Edit ors note:

This article was originally published in the October and November, 1945 issues, Volume 44, numbers 10 and 11, of *Aviation* magazine, published by McGraw-Hill Publishing Company of New York, NY, USA.

This reconstruction is derived from microfilm. The source is University Microfilms International, Publication No. 364 (*Aviation Week and Space Technology*), Reel No. 21 (January 1945 – December 1945). The source was a tightly bound volume, so that there is some distortion of the images, especially near the binding. It has not been practical to remove or compensate for all the distortions, so none of the illustrations in this reconstruction should be considered reliable sources as to fine details of shape, proportion or spatial relationship. The distortions are, in general, small, and should not detract from a general appreciation of arrangement and relationship.

The editor has attempted to represent the original layout of the article, but there are some exceptions. Limitations in the compositing tools cause a difference in the text flow relative to the illustrations, compared to the original, so that some changes have been made, to compensate partially for that effect, and the tabular data have been removed from the flow of text and brought together on a single page after the text, partly to make them more accessible, and partly to sidestep problems with page layout. In addition, the original Part II article contained a foldout. Images from that sheet have been added at the end of the article. The images have considerable overlap, so that no information is lost, even though it is not practical to reproduce the original illustrations.

This article was one in a series of design analyses published in *Aviation* during the war years, between May 1943 and November 1945. The subjects were the Bell P-39 *Airacobra*, Curtis C-46 *Commando*, Fleetwing BT-12, Douglas A-20 *Havoc*, Bristol *Beaufighter* (British), deHavilland *Mosquito* (British), North American P-51 *Mustang*, Lockheed P-38 *Lightning*, Focke-Wulf FW-190 (captured German), Boeing B-17 *Flying Fortress*, North American B-25 *Mitchell* (specifically, the B-25H and B-25J models), Mitsubishi "Zeke 32" *Hamp* (captured Japanese), Consolidated Vultee B-24 *Liberator*, Fairchild C-82 *Packet*, and Messerschmitt Me-262 (captured German), with one article dealing specifically with the Me-262's Jumo 004 jet engine. Some of the analyses were authored by senior members of the design teams at the original manufacturers, while others were written by staff editors of *Aviation* magazine.