Chapter 5 Cockpit fittings and furnishings – a plethora of fine detail

The rudder bar and pedals
Replicating aircraft instruments
Switches and switch plates
The oxygen regulator and diluter
Canopy release installation
The pilot's main control pedestal
Engine control quadrant assembly
Map case and flare chute
Control column and torque tube
Pilot's seat and armour plate

For convenience in the chapter that follows, I have treated the fitting out of the cockpit as a logical progression, beginning at the front with the rudder bar and pedal assembly, instrument panel and central switch box, and then advancing clockwise through the plethora of fixtures and fittings that cram the sidewalls – first starboard and then port – and ending with the centrally located control column, pilot's seat and armour plate.

The reality was rather different, since I tended to dodge and dive around as fancy, expedience, inspiration and means took me. Moreover, while working in the cockpit I was also engaged on several other fronts. For example, much of the exterior skinning of the fuselage with litho-plate – which I leave for Chapter 8 – took place concurrently with work on the interior of the cockpit; moreover, when I installed the control column, the mainplanes were already partly skinned. The reason for this chronological juggling will, I hope, be obvious, for were I to treat events in their actual order, the resulting muddle would be likely to leave the reader running for the exit.

The forward cockpit area

Secreted below and behind the instrument panel and the forward switch box, the Mustang's **rudder bar assembly** is a logical starting point in the long and laborious fitting out process. Little of it is visible in the full-sized aircraft, let alone in a model, which meant that I could focus on the pedals themselves, while greatly simplifying the concealed rudder bar and its associated impedimenta.

The full-sized rudder fork assemblies are castings, so I began by studying the drawings with a view to breaking down their three-dimensional shape into more simple, achievable components – a reductionist approach that lies at the heart of scratch building. Since they would be painted, I was able to fabricate my versions entirely of brass parts, held together using soft solders of graded melting points. As photo 1 makes clear, the parts are either lathe-turned or – as in the case of the fork arms and their paired paddle-like appendages – cut from the sheet. It is worth noting that I machined the holes in the cylindrical fork arm bosses slightly undersize and opened them up with a reamer after assembly, thereby assuring good alignment for the rudder pedal bearings.

Photo 2 shows the fork assemblies – by now all in primer coat – secured to their much simplified rudder bar by a pair of retaining screws just visible at their outboard ends. The two extremities of the bar engage in blocks held captive between adjacent fuselage frames. This reflects full-size practice, although in the model it necessitated the rudder bar being cut in two, with a split sleeve and bolt arrangement to facilitate installation (photos 4 and 5).

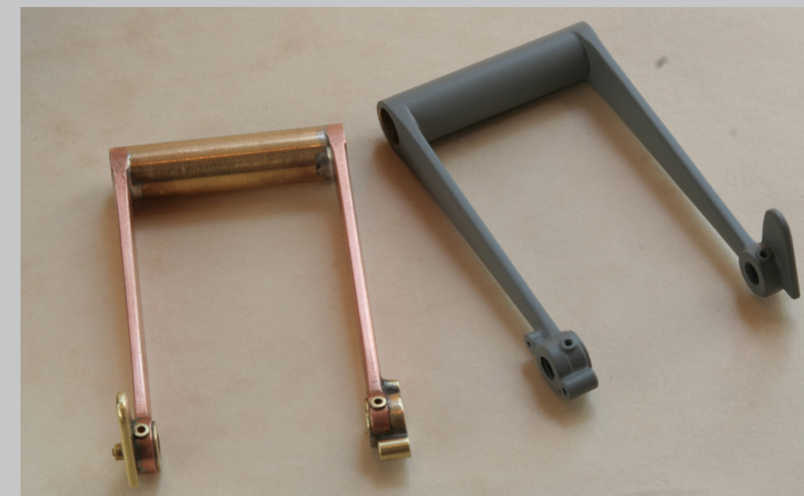
The pedals themselves (aluminium castings in the real thing) are also fabricated in my model from a combination of soft soldered brass parts. Photo 3 shows how I imparted a slight curvature in the sheet brass so that it would fair neatly with the tube. The prominent external 'rims' were cut in the flat from a heavier gauge of brass, well annealed and bent to the required U-shape. The tricky part came last, when I tried to pinch each set of three components together in a bench vice in order to solder them in a single operation. It took several attempts, to say the least!

This took care of the major elements of the pedal assemblies, except for an important detail, which threw me into the unknown! A very prominent feature of the castings is the embossed NAA logo and the instruction 'DEPRESS PEDAL TO RELEASE PARKING BRAKE'. Heavy flying boots quickly wear away the paint, so that the embossing jumps out like a sore thumb in all but factory fresh aircraft. This would be hard to ignore in a 1:5 scale model, yet how to achieve it? Would it be possible, I wondered, to acid etch some 11-thou thick litho-plate and to laminate this to the front faces of both pedals?

I decided to experiment with a 40 per cent solution of ferric chloride and some old Letraset dry transfers. The technique is simple enough: I painted one side of a test piece with Humbrol enamel and applied some dry transfers to the other, the idea being that the corrosive solution should eat away at the unpainted metal surface, but not where it is masked by the Letraset and paint. The first results were encouraging, and after several attempts with varied etch times I got some nice crisp, albeit shallow, impressions.

The next stage was to create some art work, and this involved scanning the NAA logo, tracing it in a graphics package on my Apple Mac and adding the three lines of type from a suitably matching font. I then scaled the work to size and sent it to a graphics studio to have sufficient dry transfer rubdowns made for several attempts. In the event, I successfully etched five or six usable pieces, the best of which I cut to fit exactly inside the pedal rims, allowing sufficient material to curve downwards around the tubular brass basal part of the pedal. When satisfied with the form and fit, and with the piece held securely in place, I simply ran some thin cyanoacrylate glue into and around the edges, which fixed the aluminium laminate rock solid to the brass in seconds. After an exploratory primer coat, I filled any remaining cracks or fissures in the seam by running in a fillet of more viscous CA glue, and the job was ready for its cockpit green topcoat (photo 5). Finally, I used some steel wool to take the paint off just where needed, and out popped the NAA logo and lettering... real embossed aluminium, and not that difficult to contrive!

The remaining detail of my rudder pedal assembly consists of the two vertical 'brake operating rods'. These are quickly made from aluminium tube with flattened and drilled ends, which are bolted to a pair of brass horns at the rear of the rudder bar and fork assembly. Note also the two prominent horizontal spring loaded adjustment rods, to which the rudder cables will ultimately be shackled. The dummy springs are hand wound from alloy wire, but they look the part well enough.



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Photos 1 and 2: *The rudder fork 'castings' are made entirely of brass. Note the four tiny lubricating nipples.*

3

Photo 3: *The pedals with their acid etched litho-plate 'veneer'.*

4

Photo 4: *The near completed assembly in primer, showing the contrived split sleeve arrangement, without which it would be impossible to fit the assembly into its retaining blocks located on either side of the fuselage. Not shown are the two internal brass 'axles' over which the pedals pivot within their respective forks.*

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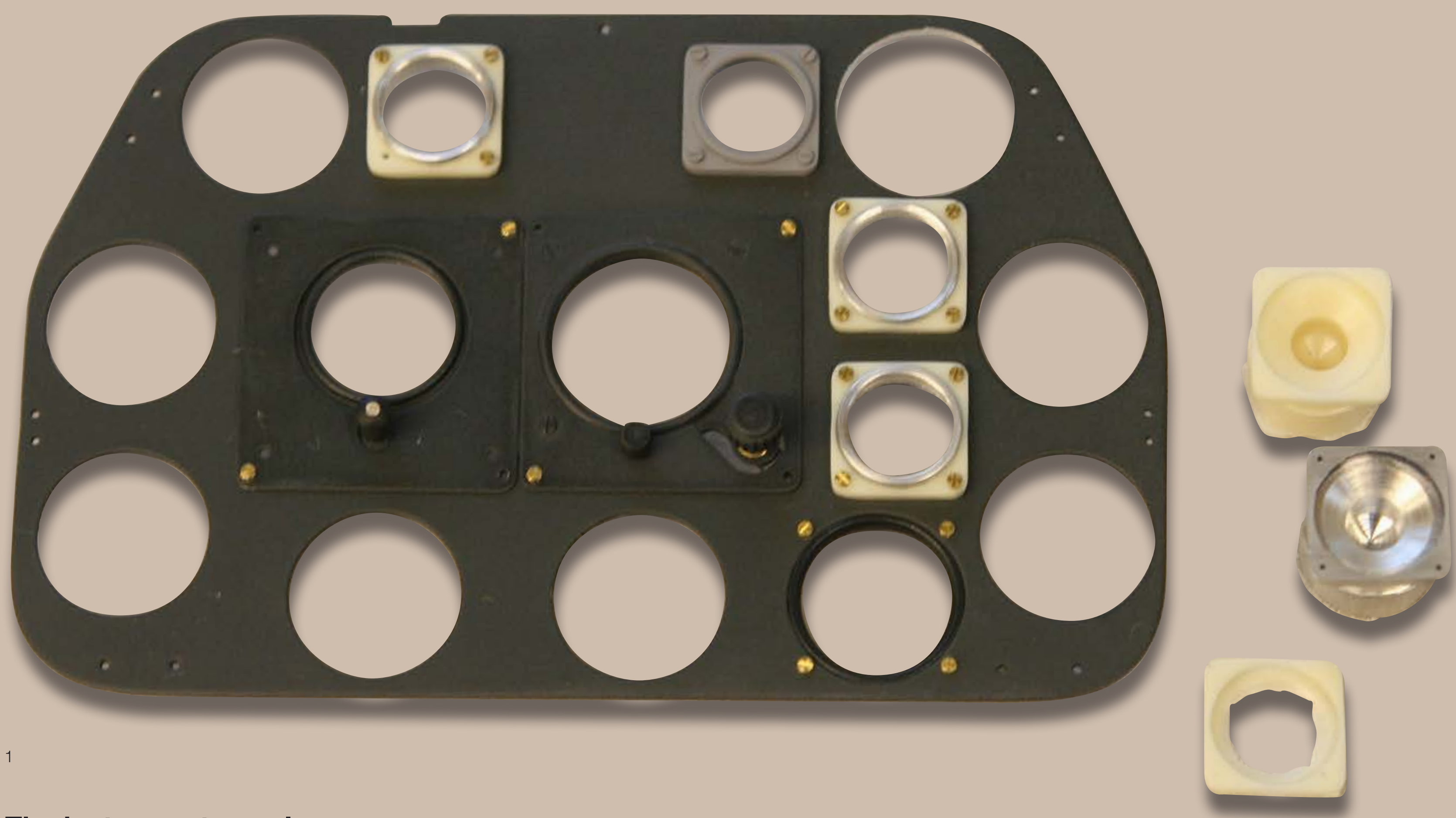
Photo 5: *The completed assembly, together with prominent adjustable sliding rods (in bare metal) to which the rudder cables are to be shackled.*



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The instrument panel

The instrument panel merits highlighting in any aircraft model: it is what people crane their necks to see; and it could make a model in its own right – the flickering, vibrating sensory soul of an aeroplane. I described the relevant sheet metal work in Chapter 4; the greater effort came when equipping the panel with its full complement of dials, switches, buttons and other paraphernalia.

The way I do it, building a set of 1:5 scale aircraft instruments from scratch is typically a three-stage process. First, the visible 'bezels' have to be made, which generally involves lathe turning; secondly, 'artwork' representing the calibrated instrument faces and (separate) needles, etc. must be produced and made into dry transfer 'rubdowns'. This stage involves the services of a specialist graphics studio equipped to convert the home-grown digital 'artwork' into dry transfers); thirdly, the various component parts, including the instrument 'glass' (and a separate clear disc onto which to mount the needle), have to be assembled together and the completed instrument fitted into the panel and carefully sealed.

Circular bezels, while they can differ in design, are relatively simple to machine accurately on a small lathe using brass or aluminium alloy; however, in the P-51D, like many US-built aircraft, cockpit instruments are routinely installed flange side outwards, adding to the challenge of modelling them, particularly since the polygonal flanges vary significantly from instrument to instrument. I decided that my best option would be to resin-cast the flanges separately from their metal bezels, so the first step was to make a full set of tiny aluminium patterns from which to take silicone rubber moulds. To make castings like this I use fast curing model maker's two-part resin supplied by a UK company called Sylmasta. I keep a varied stock of brass and aluminium tube from which to turn instrument bezels, selecting in each case the tube with the most appropriate diameter and wall thickness. I could equally well use solid bar, but this is wasteful in time and material. When making bezels I keep a close eye on my references, since the shape of the rings can vary, not only in diameter but also in cross section.

I outline how I make standard 'needle-and-dial' instruments in my book 'Spitfire in my Workshop', so I'll restrict my account here to the odd ones out. The Mustang's attitude indicator, turn and bank indicator and directional gyro are all distinctly three-dimensional, and therefore call for special treatment. As can be gleaned from the photos 2 and 3 shown opposite, the attitude indicator consists of a simple back plate and a circular front plate, incorporating a long downward projecting tongue, the two being held apart from each other by a hidden spacer. Both are cut from litho-plate. After spray painting, the 30-degree calibrations and the little triangular pointer are applied individually using standard white Letraset. The horizon and reference bars are cut from white styrene micro-strip fastened discreetly with superglue. The tiny assembly is then inserted together with a cover 'glass' (made of thin PETG) into its turned aluminium bezel and secured and sealed at the back with viscous epoxy glue very judicially applied.

The directional gyro in my model consists of a slotted faceplate and part of a tiny turned aluminium disc of around 2.5-mm thickness. Its linear compass scale (visible in photo 5 on page 113) is computer generated in a graphics package, printed in black on white photo paper, then cut and glued around the periphery of the disc, which in turn is glued perpendicularly to the back of the face plate with the aid of two tiny hidden styrene supports located above and below the back of the slot. It is clear from my pictures that varying shades of dark grey are used for painting these instruments and the panel itself, never black. Careful study of photographs of the original pays dividends in this regard.

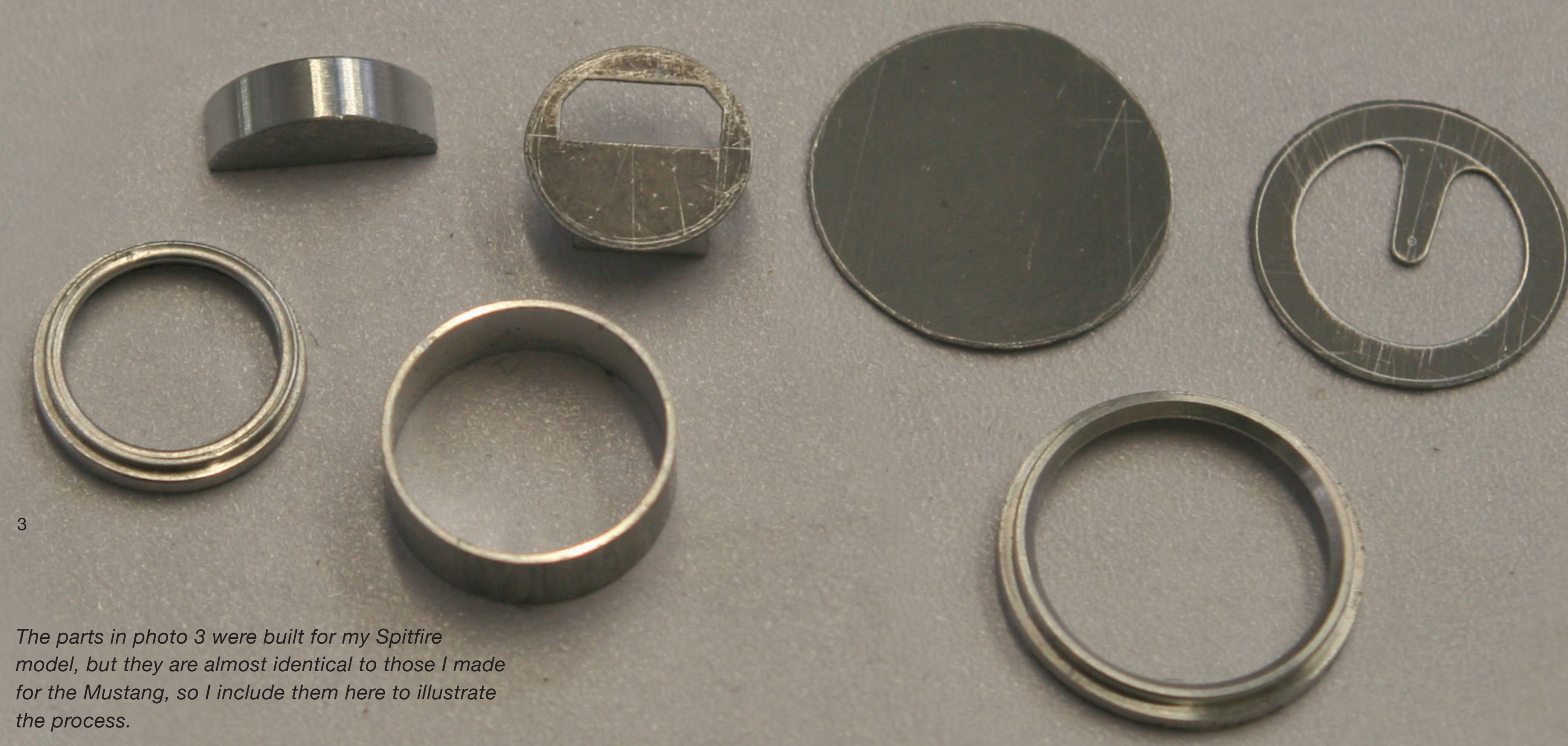
The main parts of the turn and bank indicator (photos 2 and 5) include its slotted face-plate and a piece of translucent plastic tube. The 'ball' inside the tube is scavenged from an angler's lead shot box, and Letraset is used for two white wraparound bands. The 'bat' is brass shim scavenged from from an old etched fret (my 'spares box' is full of them) and painted and glued in place on top of a tiny concealed spacer.

2

Photo 1: *Square flanges are relatively easy to make. One of my lathe-turned aluminium patterns is shown far right, together with two of the resulting castings, one of which has been separated from the waste body of the casting. Four similar castings are shown installed temporarily in the panel, each one of them fitted with separately lathe-turned circular bezels.*

Photo 2: *The blind flying panel is outlined in white. Fitted within it are the part-completed directional gyro (centre top) and the turn and bank indicator (in grey primer). The completed attitude indicator is located top*

Photo 3: *Component parts of the directional gyro (left) and the attitude indicator (right), including the circular bezels. They are made from lathe-turned brass and aluminium and hand cut litho plate.*



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The parts in photo 3 were built for my Spitfire model, but they are almost identical to those I made for the Mustang, so I include them here to illustrate the process.

The instrument panel continued

All aircraft instruments, including the conventional 'needle and dial' variety, which I turn to briefly next, are protected behind glass, for which I substitute tiny hand cut discs of thin PETG sheet. The 'glass' goes into the back of the recessed bezel first, followed by a second clear disc carrying the off-white rubdowns that represent the needle or needles (white is too harsh), and finally a third disc, this time of white styrene adorned with the grey-black rubdown representations of the instrument faces. The entire layer-cake assembly, including the bezel, is secured and capped off at the rear of the panel with a sealing layer of rapid hardening epoxy glue, or similar. The whole point of applying the 'needles' onto their own bespoke thickness of PETG, is that this creates the impression that they stand slightly proud of the underlying instrument faces, a subtle touch of realism that is well worth the extra effort.

All three of the more bulky instruments described above are treated slightly differently. Since they project some distance from the back of the panel, I encircled each one within a stub of closely fitting thin walled brass tube, adding a cover-plate and then the cover-all epoxy sealant. This precaution both protects the delicate parts and prevents ingress of fine dust that can severely compromise the effect, and which is impossible to remove.

Some aircraft instruments – including three of the Mustang's six primary flight instruments – are designed to be set or adjusted by the pilot prior to and during flight. In general the various little knobs with which they are equipped are simple to make on a small lathe and to install with a tiny shaft or pin. However, some have distinctive 'knurled' or ridged sides, which are not so simple to replicate in miniature. I have a collection of small jewellers' screwdrivers, all with finger-grip ridges. Suffice it to say, some are now shorter than they used to be! Therein lies a minor tenet of scratch building: if it's not practicable to make a part, seek a proxy.

Assembling and installing the instruments took several weeks of work, but that was only part of the story. The panel and its integral central console contain numerous switches, each one of which had to be made and fitted individually, which is where I turn to next. But first, a brief focus on the switches themselves.

Aircraft switches

Aircraft switches generally come in two kinds – the bright metal up-down 'toggle' type and the rotary sort, typically made from a hard black plastic. Let's take the toggle switches first, beginning with the ball-ended variety (like a tiny toffee apple), which are the most straightforward. To make a 1:5 scale 'copy' I simply dip the dome head of a 3/64-in. diameter, or thereabouts, aluminium rivet into Crystal Clear (a viscous liquid commonly used to create the effect of glazed windows in small scale models), or, alternatively, rapid-hardening casting resin. In adhering to the rivet head both of these viscous fluids assume a nice spherical shape, which can be enlarged by successive dipping and hardening cycles. To finish the job, the ball end is dipped in Humbrol aluminium paint. I tend to do about twice as many as I need, then select those that are the most uniform in size and shape.

Making the alternative taper-type switches is more challenging, since they have to be individually lathe-turned. Doubtless there is a better way, but I begin by chucking in my small bench-top lathe some 3/32-in. OD aluminium tube reinforced by a 'core' of brass or steel wire. The wire is there to impart stiffness while the fine taper is turned along the scale length of the switch, a process that demands working tight up to the chuck, a very sharp tool and feather-light feed. I cut the taper by working inwards towards the chuck, which is safer and which makes parting off easier. Freed from the lathe, the tiny switch is slid onto the shank of a 3/64-in. diameter aluminium rivet, and secured with a single drop of thin CA glue before being returned to the chuck so the outer end can be slightly rounded with a jeweller's file, followed by grade-000 steel wool. Once a rhythm is established, I estimate that I can produce half a dozen or so usable tapered switches in an hour, accounting for failed attempts, of which there are plenty!

Ball-ended or tapered, both kinds of toggle switch require a boss, which I represent by using short lengths of telescoping aluminium tube of 3/64 and 3/32-in. internal diameter. The ends of both tubes are squared up in the lathe and then assembled together so the smaller just projects from the larger. The combined piece is glued together, cut to a length of 1/4-in. or thereabouts and inserted from behind into holes in the pre-painted switch plate, where they are secured at the rear by a dab or two of CA glue (photo 7). With the bosses in place, the switches themselves can be inserted and glued at a later stage, each one trued with an improvised depth gauge. This is particularly important where the switches are aligned together in pairs or rows.

Now for the ubiquitous rotating-type switch. Here, the obvious choice was resin, and this mandated a styrene pattern, comprising a slotted lathe-turned conical boss with a carved, wedge-shaped crosspiece set into it. The only embellishment is the tiny bas-relief cap that adorns the crest of the switch, which I represented by a tiny sliver of 5-thou styrene. With the completed and primed pattern suspended in a suitable small container, it was a routine operation to pour a small silicone rubber mould (photo 6). The casting operation needs little commentary, except that it is expedient to make more than are needed.

As is often the case, the making of these tiny switches proved easier than anticipated; in fact, the biggest challenge came when applying the fine white marker lines along their rounded crests: I found it impossible to apply these as dry rubdowns, and even waterslide transfers proved exasperating to tease into position, to the point when my hands began to tremble with the frustration of it all. Somehow I got there in the end!

Photo 4: *The lower part of the instrument panel during fitting out. It awaits the identity label that surrounds the two small red and green warning lights.*

Photo 5: *The Mustang's instrument panel at an advanced stage of build showing the installed turn and bank indicator with its prominent white 'bat'.*

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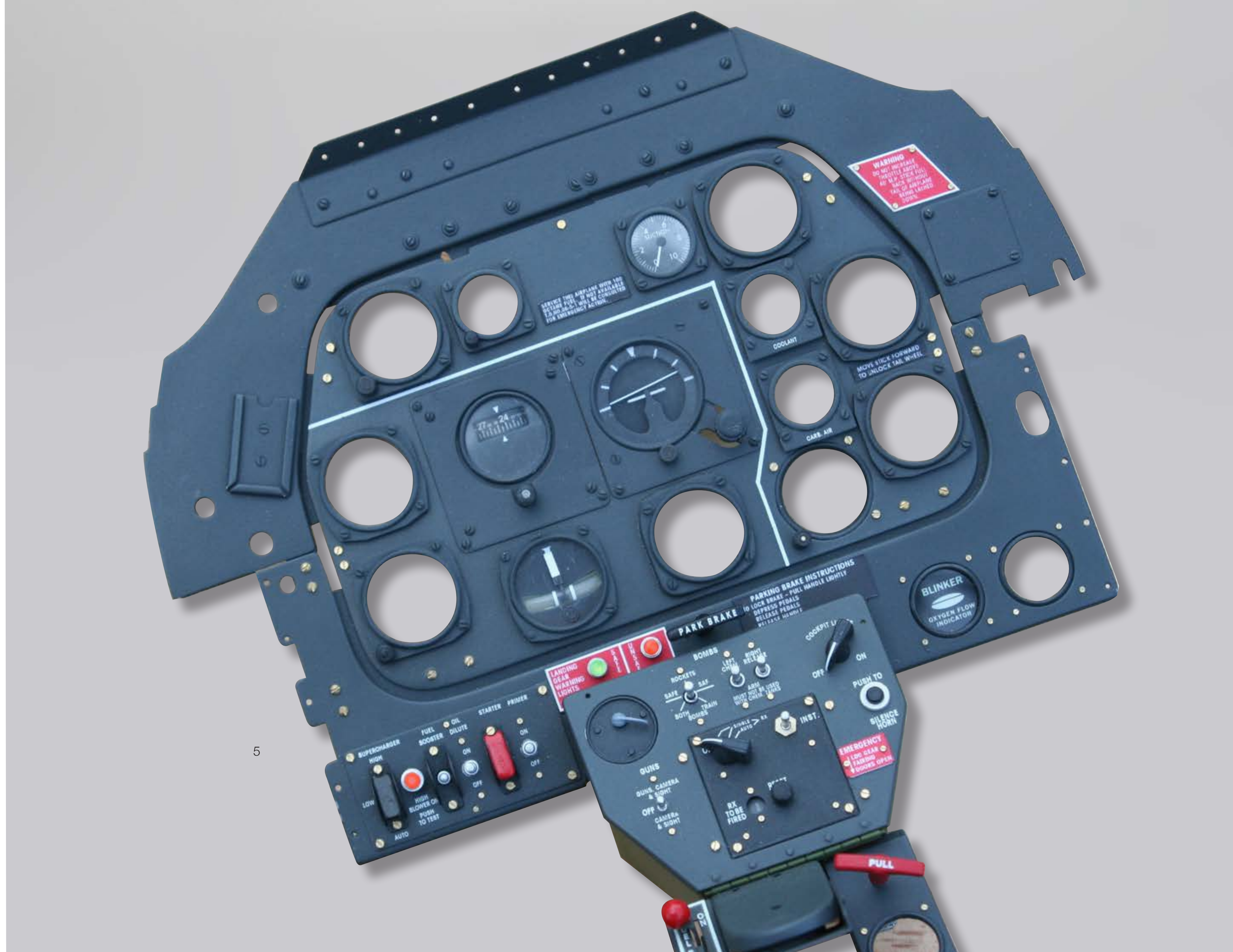

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Having dealt with the numerous scale switches that litter the Mustang's cockpit, I can return to the concluding stages in the fitting out of the instrument panel. Scrutiny of photo 5 shows that two of the toggle switches at the lower left of the instrument panel are protected by safety guards. I made the small channel-section supports from scraps of litho plate, while the flip-up covers – one red and the other black – are represented by solid plastic parts, a credible result easily achieved.

A final feature deserving of mention is the pair of green and red **warning lights** located on the lower part of the panel. The component parts hardly need comment: a turned plastic core within a turned and stepped aluminium ring. It is the nature of the plastic that is relevant. Most hobby suppliers now stock what is termed UV reactive acrylic rod, and it comes in various diameters and colours, including green and red. Its effect, when used in this way, is subtle and convincing (photos 4 and 5).

When surveying the completed instrument panel, it is easy to overlook the number of slotted screw heads of different types and sizes represented there – countersunk, cheesehead and roundhead – some painted and some not. In my model all are real mechanical fixings, mainly 16 and 14BA, and sourced at considerable expense. Some of them perform the function that they represent, although most do not.

I described on page 104 how I made the **central console**, otherwise termed the **pilot's switch box.** This too had to be carefully detailed, starting with the hinge that is visible along the entire lower edge of the cover plate. Made from short lengths of aluminium tube threaded onto brass wire it is glued in place from the back, and embellished with five dummy rivets. The rest of the flanged polygonal plate was then variously furnished, as shown in photos 5 and 8, with a cluster of armament control switches, the emergency landing gear alarm and a switch for cockpit lighting.

The NAA design team made good use of the underside of the centre console to site the fuel shut-off control, the fuel tank selector switch and the parking brake handle and hydraulic pressure gauge. I have mentioned before how my catalogue of NAA drawings enabled me to make numerous parts of the model almost exactly as miniature versions of the original, and such was the case here: including the three individual sheet metal mounting plates, each of a differing type, faithfully replicated in folded litho-plate. Where I modified the wedge-shaped bracket and plate for the fuel selector switch it was only so that I could attach it securely to the underside of the console with two small wood screws. In its turn, and much as in the original, it supports the two rectangular brackets that are located on either side of it (photo 8). As to the smaller detail, the push-pull handle for the park brake was made from a styrene boss and T-piece, while the grey coloured butterfly-type fuel selector switch is filed from a scrap of sheet brass soldered into a turned brass boss. The red coloured knob of the fuel shut-off handle is a bead from a plundered necklace (photo 5).

Worthy of mention is the **fuel selector data plate**. In the originals that I have seen this is a brass casting incorporating the cramped design in bas-relief. Doubting my skills with an acid bath, I substituted an aluminium plate adorned by a single black dry transfer rubdown, which can be seen clearly at the bottom of the photograph on page 25. Albeit a compromise, I view the result with pride, particularly given the struggle I had to re-construct the design in Adobe Illustrator – not the easiest software for a novice to master.

From the few features that I have described thus far, it is very obvious that the Mustang's cockpit is littered with labels and data plates. I have no idea how many I produced on my lap top computer – several hundred by any estimate.

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Photo 6: *My interpretation of the rotary aircraft switches, which abound in a Mustang cockpit. The pattern is seen bottom right along with the silicone rubber mould and four of the finished items. Their discardable cone-shaped base is actually the chuck of the pin vice that I used to grip the pattern while pouring the rubber.*

Photo 7: *This close up from the left hand side of the cockpit exemplifies the three types of switches described in the text: tapered toggle; ball-ended toggle and rotary.*

Photo 8: *The pilot's switch box cover plate (left) and the folded aluminium bracket incorporating the fuel tank selector switch mounting plate together with its associated fuel shut-off control plate.*

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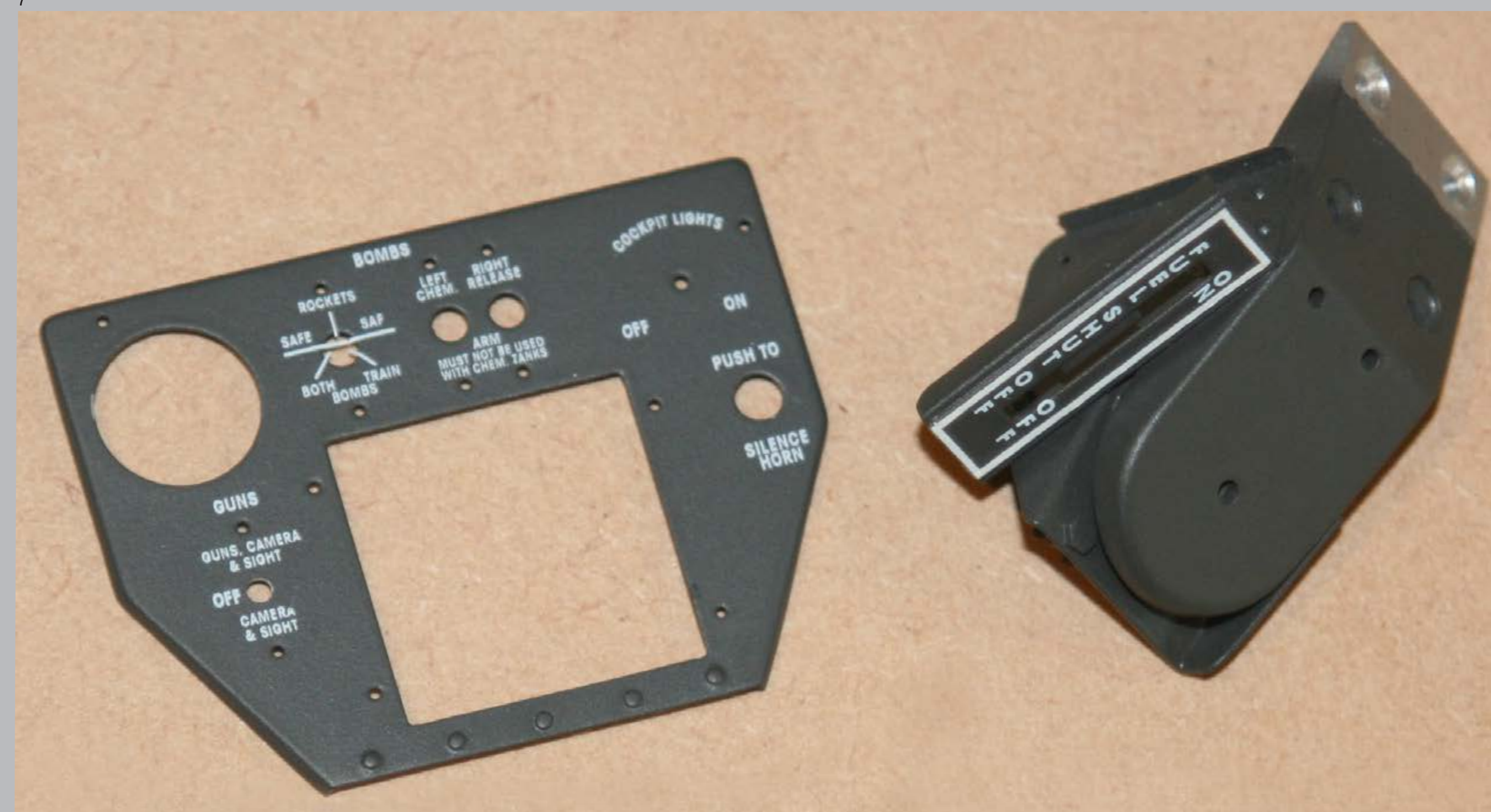

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The starboard side wall

Photo 1 shows the starboard side of the cockpit at a point when the major structural features had been made and installed. The interior of the model is ready for fitting out, and on the starboard side that mostly concerns **'switch panels'**. Making them involves three stages: first, the sheet metalwork to form the panel itself; secondly, the detailed components, predominantly, but not exclusively, switches and, finally, the painting and all-important labelling stages, which necessitate the production of customised dry transfers. Forethought must also be given to the means by which each completed panel will be attached securely and permanently in its allotted space.

I'll begin with what is blandly designated in the Mustang Maintenance Manual as the **right hand switch panel.** This is the most demanding of the set to model, and the reasons are plain from photos 2 and 3: There are no fewer than nine toggle switches aligned between four wedge-shaped guard bars (which also serve as label plates), a rotary switch, the ammeter, and the prominent vertically orientated circuit breaker reset box. The square switch plate itself was straightforward to represent convincingly by using 2.5-mm styrene sheet rounded off along all four sides. I marked and drilled nine holes for the switch positions and cut the opening for the ammeter.

The out-jutting switch guards are triangular in section, and they were tricky to make, not least because there is severely limited space within which to create three 60-degree parallel folds. Forming the apex fold was easy enough, but after that I was forced to cheat by cutting the two descending limbs to the correct depth and then grafting in the basal side using styrene strip and superglue.

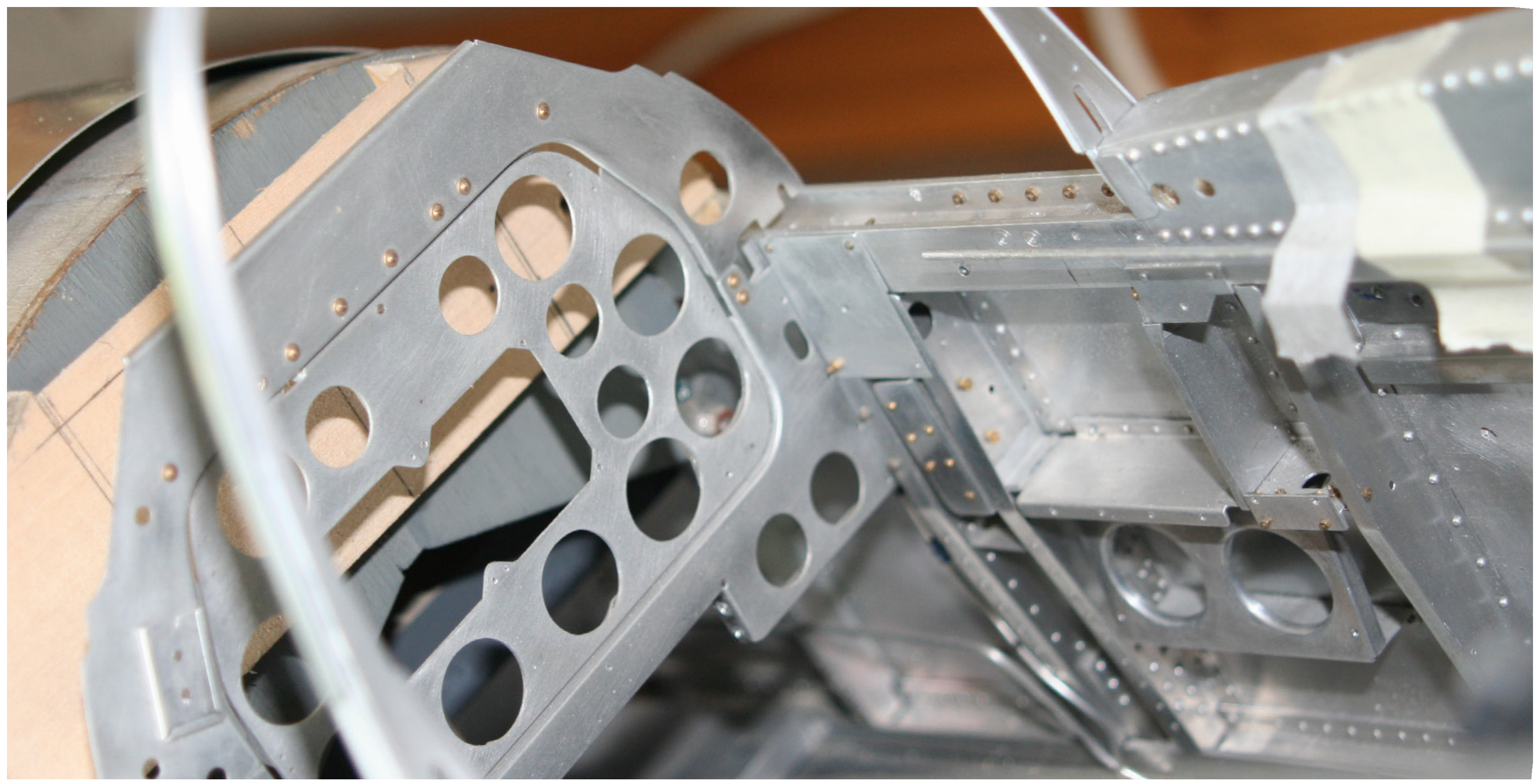
I described how I make toggle switches in my previous section about the instrument panel. Their miniature retaining rings or bosses are shown to good effect in photo 3. In the model these are represented by two concentric aluminium tubes inserted into the holes in the pre-painted panel, where they are secured with CA glue at the rear. This is followed by the switch itself, the extended shank of which is also glued at the rear. As described previously, a small ad hoc depth gauge is helpful during both of these steps, and any slight lateral irregularity within the strictly regimented line of switches can be adjusted using the fingertips.

The Mustang's ammeter required some very careful lathe work and machine grade alloy bar. In effect, I had to turn and part-off a shallow and very delicate Z-section ring incorporating a relatively broad basal flange and a narrow lip all round the top. The internal tongue-shaped projection is made separately from a piece of litho-plate judiciously grafted into the surrounding ring with thin CA glue. Clearly, such an approach leaves the part highly vulnerable to damage. I justify it only on the basis that it is reinforced on installation of the ammeter dial and glass, and that the part is located deep within the model's interior, remote from any likelihood of it ever being tampered with.

The **circuit breaker reset box** was straightforward to shape out of solid styrene, with a 'hinge' comprising of abutted aluminium 'micro-tube' and a tiny strip of litho-plate drilled for seven snap head rivets. The rotary dimmer switch, derived from my cache of resin castings, required only a neat circular base plate to complete the surface detail. In the full-sized aircraft the entire switch panel hinges outwards and downwards, and I acknowledged this by including a dummy hinge along the underside and a pair of tiny slotted fasteners (modified dome-head rivets) at the top left and right corners of the panel.

Immediately aft of the switch panel is the smaller **radio control plate** (photo 4). From a modelling standpoint, this is a much simplified version of the above. The obvious novel element being the large, fluted signal light potentiometer knob. I made it in the lathe from aluminium bar, filing the eight circumferential flutes by hand.

The radio control plate is illustrative of a general principle: all the completed switch panels have to be fixed to the airframe. As mentioned earlier, this can involve *ad hoc* arrangements contrived on the basis that they will never be seen: a simple glued-on wood or plastic retaining pad, for example. However, several of the numerous cockpit brackets and mounting plates specified by the Mustang's designers are clearly visible, and since I enjoyed instant digital access to the near complete archive of production and assembly drawings, I could locate these parts quickly and easily. More often than not, it turned out to be as easy to replicate the arrangement on the full sized aircraft as to fudge it with a contrivance of my own. A second observation, quickly apparent through scrutiny of references, is that while the shape and location of the various switch panels are generally consistent, their precise layout and functions can vary depending on the aircraft. If the model maker is working strictly to a comprehensive set of detailed and exhaustive photographs of an individual cockpit, this is of no concern; if not, then a little due diligence is needed to avoid potentially embarrassing misinterpretations.



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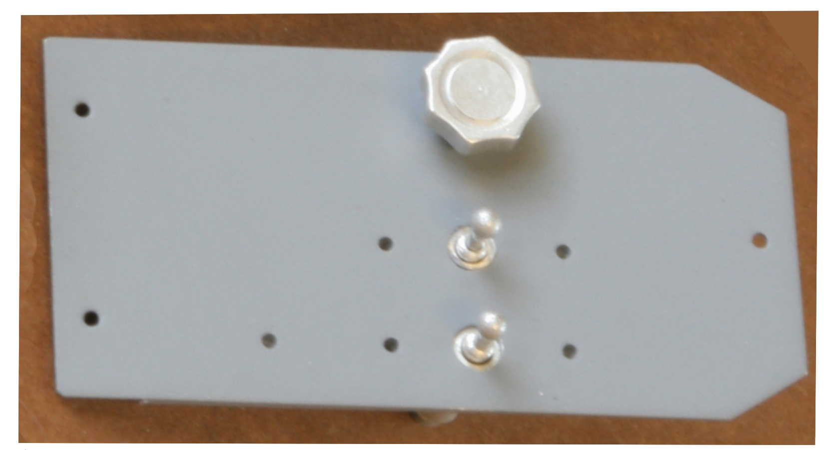

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Photo 1: *The starboard side of the cockpit photographed at the point when most of the structural features are made and installed. The interior is now ready for the fitting out stage.*

Photos 2 and 3: *The right hand switch panel during construction and completed. Note the parallel switch guards made from folded litho-plate and the delicate turned body of the ammeter. The polygonal component represents the circuit breaker reset box.*

Photo 4: *With the notable exception of the large, fluted knob, the radio control pate offered few challenges to make or fit.*

The next stage takes us further aft along the starboard cockpit wall to the **destroyer switch plate**, location of the fateful 'self-destruct buttons' (photo 5) and their associated IFF system (Identification Friend or Foe). These occupy the left hand side of the panel, while the remainder is given over to navigational, coolant and communications functions, including the paired sockets for the headphone jacks, which I mimicked by using stock hexagon brass and aluminium tube. Again, there is not much that is novel here, except the vertical array of push buttons that take only a minute or two each to lathe-turn from black plastic and then to polish. The challenge – if it amounts to that – was to create the recess for the destruct buttons. I outline elsewhere how I make skin blisters from well annealed litho-plate. This, in effect, is no more than a small flanged skin blister in reverse. It is glued to the rear of the panel with CA, reinforced around the flange with five-minute epoxy or plastic metal. The two push-buttons are inserted into their respective holes after painting and captured at the rear with more thick epoxy glue.

Immediately below the destroyer switches, and spanning the entire space between two fuselage frames, is the mundanely named **miscellaneous radio equipment mounting plate.** This provides another simple exercise in folding litho-plate, this time into the shallow box-like configuration shown at the top of photo 6. The interior of the piece is reinforced by a snug balsa fill, which provides strength, rigidity and a solid substrate into which to implant the sparse detail: two push-button circuit breakers and a rather splendid alarm bell, which I turned and polished in my lathe. Its underlying circular mounting plate, with projecting lugs for the screw fixings, is made from a styrene sheet cut out and glued on.

Photo 5: *The ominously named 'destroyer switch plate'.*

Photos 6 and 7: *The radio equipment mounting plate pictured before and after painting and detailing. Its main feature is a conspicuous alarm bell. The two bare metal support panels are also part of the miscellany of equipment crammed onto the starboard cockpit side wall.*

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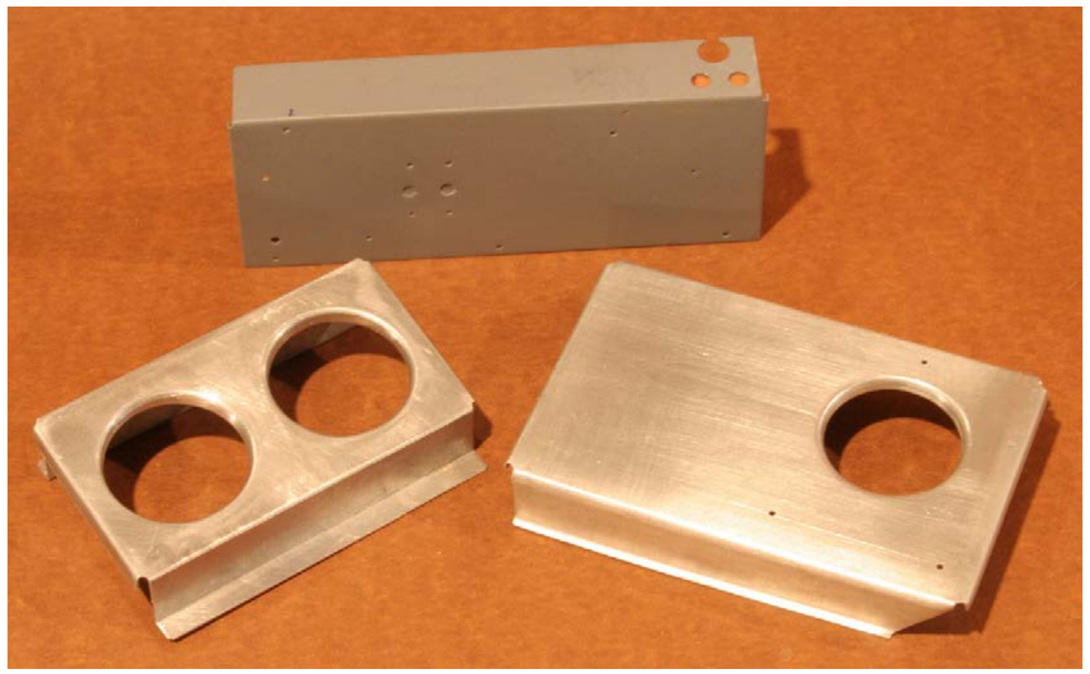

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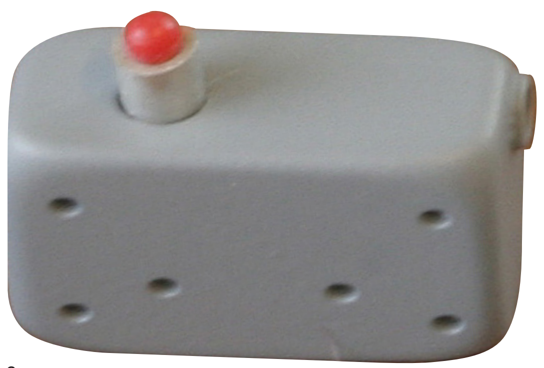
As shown in photo 8, the four switch panels described above occupy most of the space on the starboard cockpit wall, but not all of it: The **radio control box** can be seen immediately aft of the radio control plate, and at a canted angle, presumably to make it easier for the pilot to operate. Behind it lies a wedge-shaped mounting plate, which is not visible in the photograph. I made the rectangular box from model board, machine-milled for accuracy, and faced on all visible sides with litho-plate, or thicker material in the case of the front plate. This imitates the folded metal construction of the original nicely. The raised cover along the outboard side is made from styrene with the five aligned holes carefully drilled. The five red push buttons need no explanation, and the toggle lever at the end is filed from sheet aluminium with a black plastic tube to replicate the handle. Small dummy screw fastenings, emplaced where indicated on the references, and the data plates on the front side, complete the little model. It is fastened to its backplate by two styrene pegs and CA glue.

Photo 8: *The radio control box – and most of the other equipment described in this section – is seen in this picture taken before the installation of the pilot's seat. Just visible on the right hand side of the destroyer switch plate is a 'canvas' pouch. The canvas effect is achieved by using lead foil painted, weathered and crimped to represent stitching.*



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Another item on the list is the **recognition light keying switch assembly.** Mounted on the face of the longeron just above the right switch panel, this little dice-like box enables the pilot to set his recognition lights to continuous or flashing mode. I milled the shape from a scrap of model board, filing the heavily rounded corners that characterise the original (photo 9). Two holes are needed, one in the top for the red button within its aluminium sleeve, and one in the rear face for a cable conduit that runs aft to disappear behind the pilot's seat. Reminiscent of the radio control box, it is secured at the final assembly stage by CA glue and a sturdy plastic peg that engages in a hole drilled in the longeron (photo 10).

Out of the entire inventory for the starboard cockpit wall, the **oxygen regulator and diluter** proved the most challenging to model: Bolted to a sturdy rectangular plate immediately aft of the instrument panel, it is a particularly prominent feature inside the cockpit, so I was obliged to get it right. As shown in photo 10, an elbow-type connector near the top passes through a hole in the instrument panel, while on the opposite side there is an out-feed tube for the pilot's oxygen hose. A third connector also pierces the instrument panel, but being completely hidden from view, I omitted it.

The concentrically down-stepped cylindrical body of the instrument was turned on the lathe from brass bar, and set aside while I fashioned the triangular backplate, including its three raised and drilled mounting lugs, from individual pieces of soft soldered sheet brass. Holes were drilled laterally into the body of the regulator for the input and output feeds, including the 90 degree elbow connector which is painted metallic blue in photo 10, and for the clearly visible hexagonal plug. The regulator body is fronted by a distinct aluminium disc containing a butterfly-type control knob, the latter being fashioned from a scrap of 0.5-mm sheet brass soft soldered into a turned and slotted brass boss. There is a separate circular data plate to denote the various control settings, and this required custom rubdowns created in the usual way on my computer. Photographs of the real thing show a subtle variation in the shades of 'black' between, for example, the data plate and the main body of the regulator, and I was careful to acknowledge this when it came to spray painting.

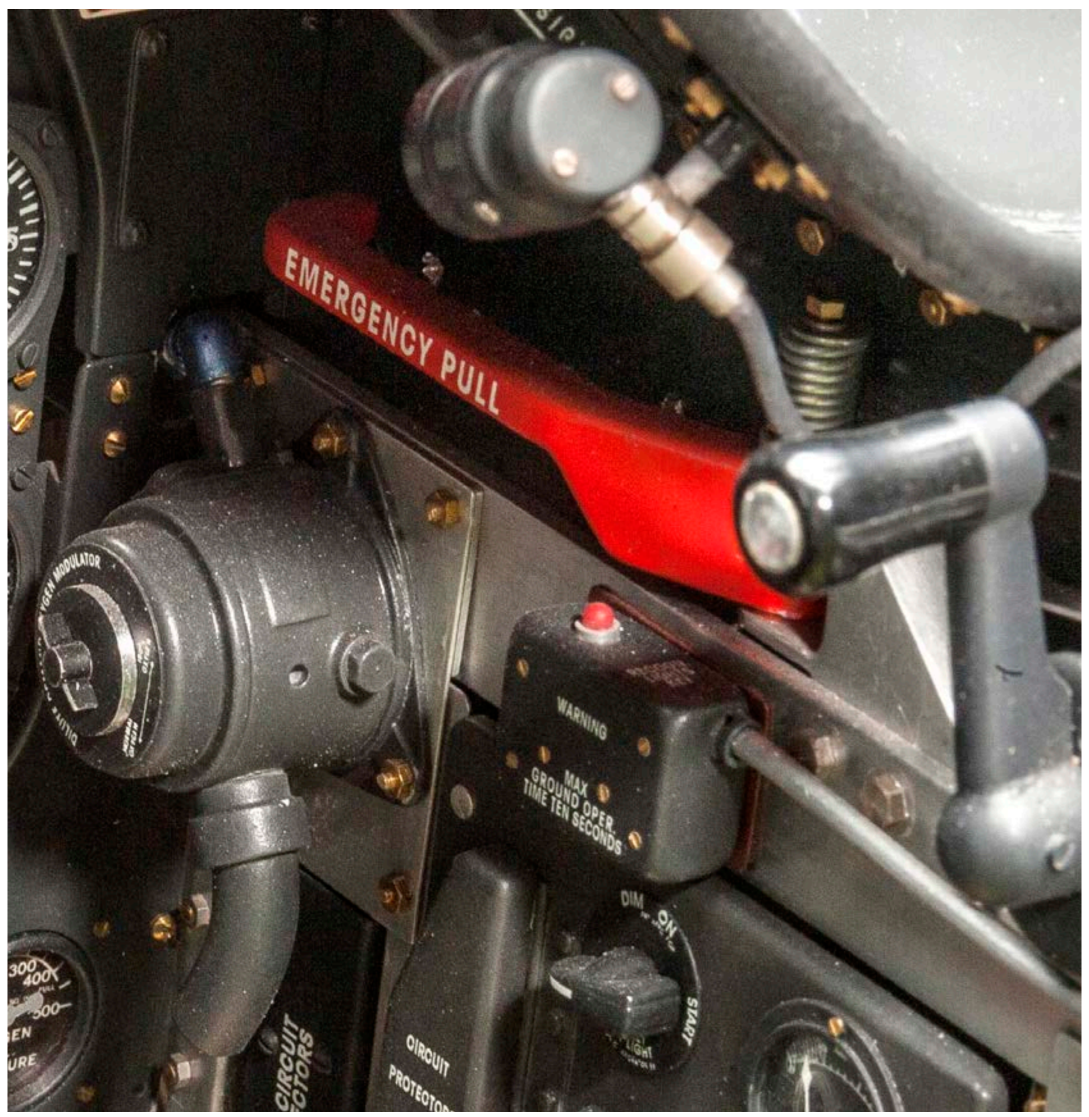

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Photo 9: The recognition light keying assembly. The six small holes are for embedded screws that will be added at a final stage.

Photo 10: The cylindrical oxygen regulator is a prominent feature on the starboard side of the cockpit. Note the different shades of black-grey used when painting the piece to enhance its realism. Immediately adjacent is the recognition light keying switch, which is described in the text. Also shown is the canopy emergency release handle (coloured red) and, in the foreground, the canopy actuating handle. The cockpit swivel light with its bare metal cable connector is located at the top of the picture.

Photo 11: Component parts of the canopy actuating handle help reveal the way it was built.

Photo 12: The completed actuating handle and canopy emergency release handle. The red-painted lever was made from two-part casting resin for convenience… an example of the efficacy of "mixed media" in model making.

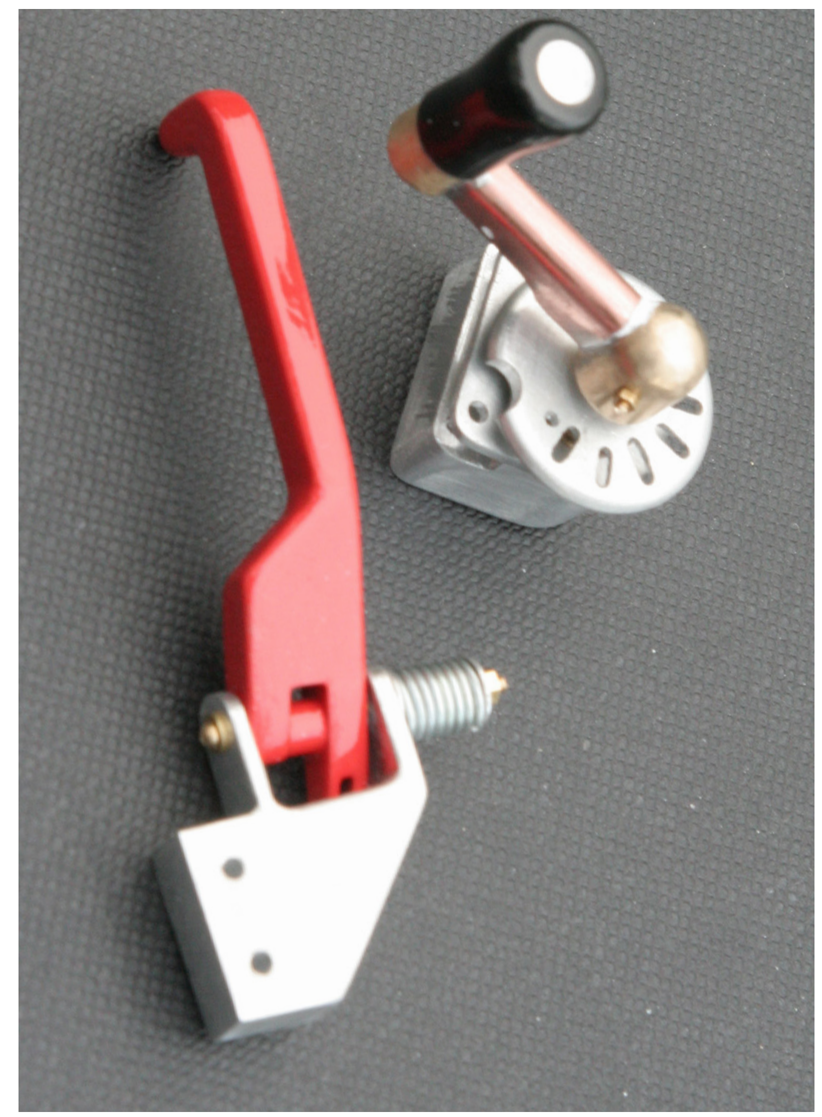
While this one small component occupied a couple of days of careful work, the observant will note the lack of an oxygen hose. I'm tempted to claim justification on the grounds that it is possible to find full-size Mustang cockpits similarly bereft; but in truth it has more to do with my total lack of inspiration and success when it came to finding anything among my bric-a-brac remotely resembling the real thing.

While the story of the Mustang's sliding canopy belongs elsewhere in this book, I include in this section the **canopy actuating and emergency release handles,** simply because of their locations on top of the starboard upper longeron, and because I built and installed them contemporaneously with the various other items described above.

I made the **emergency release handle** out of a scrap of hardened two-part resin, for the simple reason that its double-cranked shape would need a lot of careful cutting and filing, and resin is very easy to cut and file (with the precaution of a suitable face mask). The secret is to approach the job logically. First, file or mill the resin blank to a depth equivalent to that of the lever at its deepest part; next mark the plan view on the top surface of the resin and cut and file to shape using the vice jaws as an aid to cutting; then mark where material must be cut away in side elevation and, finally, mill the two required slots at the pivot end, drill the vertical hole through the clevis for the retaining pin and round off all edges neatly. The handle, painted red in photo 12, is mounted in a triangular-shaped support assembly, which I cut out of solid aluminium alloy. My small milling machine is a boon when it comes to this type of work, and it took me, as I recall, no longer than an hour to make the part. With the addition of a long round-headed brass bolt, nut and washer from stock, and the little hand-made spring, the job was done.

The canopy actuating handle (photos 11 and 12) presented more of a challenge, particularly the handle arm, which had to be turned, cut and filed from three pieces of brass, which were then soft soldered together and fitted with a turned aluminium shaft. The simple quasi-triangular bracket assembly that bolts onto the longeron was again milled, drilled and filed from alloy stock (note it has a separate face-plate), and the plastic knob is exactly that, a plastic knob turned in the lathe (and, as such, it required no painting). The circular stop plate called for some cheating: the distinct lip around its circumference is formed in the original as a tooled sheet metal pressing. I decided this would be impractical, so I rounded off the edges of the metal part and let its thickness represent the lip. Once the part is fitted the ploy is well concealed for it is not possible to see the reverse side. The downside was that the six small circumferential drilled holes required very patient extending with a needle file to achieve the required slotted shape.

11



12

The port sidewall

The port side of the Mustang's cockpit is dominated by the bulky multi-functional **control pedestal assembly**. Unencumbered by weight constraints, I made it from solid model board, routing out cavities at the rounded end to accommodate the boost and ram air controls and the flap selector control respectively. The outward facing flank of the piece is laminated with styrene sheet, with a second layer cut and superimposed over it to represent the impressed design at the base of the pedestal (photo 1). The rounded 'bas-relief' effect is easily imparted after the styrene has bonded hard by gently abrading the cut edges of the plastic with fine-grade steel wool. The filling effect of the grey primer does the rest.

Switching to litho-plate, I made and installed the fluted panel along the base of the pedestal and the long slotted skin plate over the top and rear. Fastened with tiny self-tapped screws, this remained removable throughout the build. The small, sloping 'plinth' that supports the aileron trim control is carved from solid casting resin, glued onto a rectangle of litho-plate, and attached to the main body of the piece with a tiny screw at each corner. Photo 2 shows progress at this stage, including installation of the vertical brass shafts for the aileron and rudder trim control wheels and their horizontally orientated counterparts for the elevator trim wheel and the undercarriage selector lever.

The next job was to make the two access plates shown in photos 3 and 4. These are also made from litho-plate. However, the larger of the two necessitated a dual operation by which one 'blister' is superimposed upon the other, which called for two formers rather than one. This was a first for me, and it took several attempts to get right – an example of perseverance winning out where experience is lacking. Photo 4 shows the sub-assembly at a fairly advanced stage.

I do not propose to go into detail of how all the individual parts of the pedestal assembly are made, since much will be evident from my photographs. However, it is worth singling out the big articulated **chassis selector lever,** which posed a challenge, even with scaled drawings and numerous good reference photographs. Yet again, it came down to resolving a rather awkward shape into its simplest parts, most of which could be conveniently hand cut, lathe turned or milled. Thus, by using a combination of soft soldered brass, and with additional resin and styrene detail grafted on courtesy of the ever ubiquitous and universal CA glue, I was able to conjure up a reasonably accurate rendering of the original component (photo 7). The same applies to the **delicate bomb release control.** The stalky angular shape is cut from two paired-up pieces of 0.5-mm aluminium sheet and detailed with spacers, a turned plastic hand grip, brass cable shackles and 'real' stainless steel braided wire (photo 5). A very fiddly job!

Finally, the **trim tab controls** (photo 6): the aluminium body of the big elevator trimmer wheel with its raised boss and rim, was simple enough to turn and part-off in the lathe. More challenging was its ridged finger grip, for which I used half-round styrene micro-strip glued on at precisely marked intervals around the circumference. I cut each of the tiny plastic pieces slightly longer than needed and cleaned them back flush with the workpiece once the glue had dried. As testimony to the power of cyanoacrylate, not one came adrift, even when assailed by the steel wool that I used to round off the sharp cut ends. Final details included filing the little groove that denotes the neutral position and the prominent hole adjacent to the boss.

The rudder and aileron trimmer controls were made in a similar way, but via an intermediary 'pattern', from which I cast the two identical wheels in resin. As before, I lathe-turned the body of the wheel, capturing its slightly sloping sides, convex upper surface and basal rim. The ribbed effect was achieved as previously described. The hole in the top of each wheel, which contains a fixing screw, was spot drilled on the pattern and opened up in each of the subsequent castings. As always with this sort of work, automotive spray primer comes in handy at the finishing stage because of its smoothing and gap filling properties. Close scrutiny will show that each of the three trim controls has a tiny triangular pointer, which is part of a separate disc cut out of brass shim. The associated arcuate data plates – which denote degrees of trim either side of neutral – are also made from metal shim, and they demanded particularly accurate cutting out in order to 'register' with their respective dry transfer rubdowns. All of this is shown in photo 14.

Early in the construction of the pedestal, I screwed two 8BA steel studs into its hidden outward-facing side. They project by about 3/16-in. and engage into corresponding holes in the cockpit wall, where they are secured from the outside by two shallow nuts recessed into the soft balsa layer. This provides a secure mechanical anchorage for the bulky pedestal, which is totally hidden once the outer skin has been applied.

The completed pedestal assembly is shown in photo 7. However, before it could be permanently installed, I had to make the control cable guard assembly, which encloses the floor space between the rear of the pedestal and the radio shelf bulkhead. Clearly shown on page 127, this is cut and folded from litho-plate, a fairly straightforward task given its simple, box-like shape. It is secured by rivets pushed through a flange on its upper side, much like the technique used when fixing the fuselage frames.

***Photo 1:** The control pedestal is made of model board faced with styrene sheet.*

***Photo 2:** The first litho-plate panels are added, along with provision for elevator, aileron and rudder trim tab controls. The rectilinear slots in the detachable upper panel are for the carb ram air and the flap selector control levers.*

***Photo 3:** The two moulded detachable inspection covers are ready for fitting. Note the stub of brass tube emplaced with epoxy glue. This provides anchorage for one of two tubular aluminium control shafts that run aft from the pedestal. It is totally hidden when the rearward panel is installed.*

***Photo 4:** Both inspection covers are secured in place with tiny 16 BA round head screws, self-tapped into the underlying model board. Note the boost and ram air control levers have been temporarily installed, along with their delicate slotted guide plate cut from brass shim. The flap selector lever is detailed with a tiny plastic bead painted yellow.*

***Photo 5:** Close up of the bomb release control which is mounted onto the forward end of the pedestal.*

***Photo 6:** The completed but yet to be painted elevator trim tab control, with a sample of the half-round styrene strip used to detail it. The pattern for the rudder and aileron trimmer wheels is shown in the screw clamp.*

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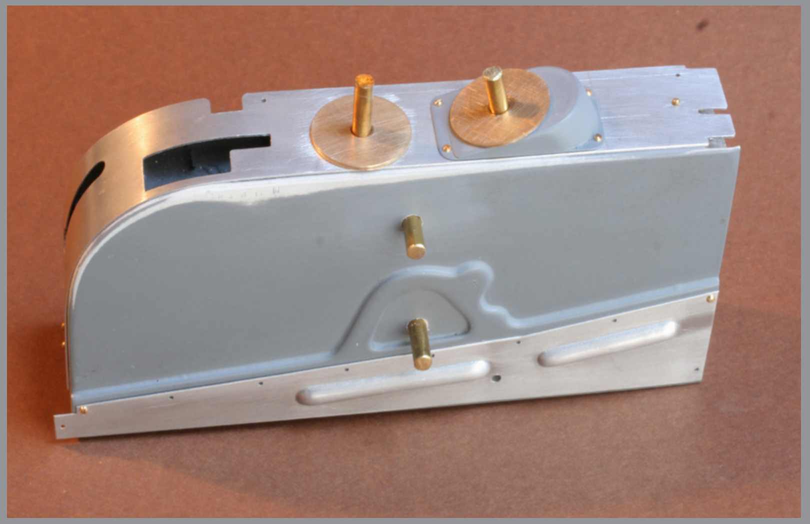
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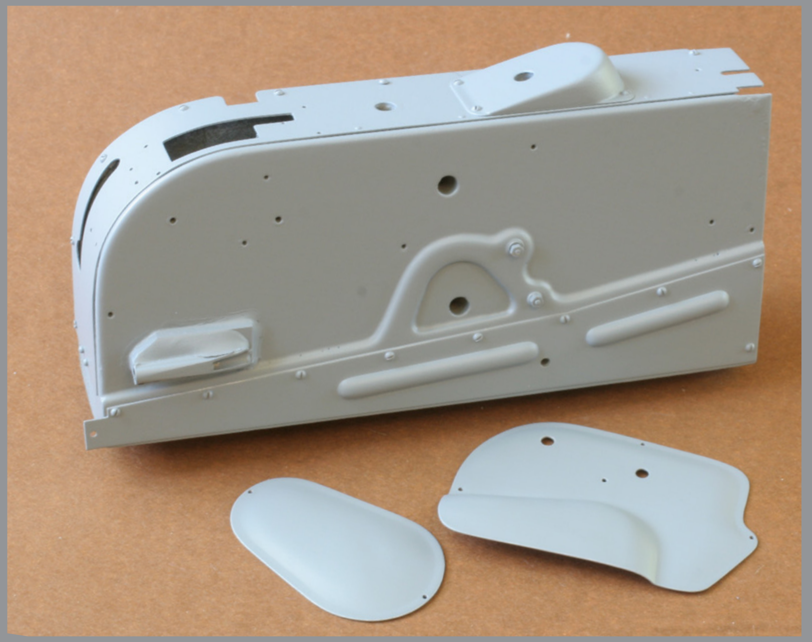
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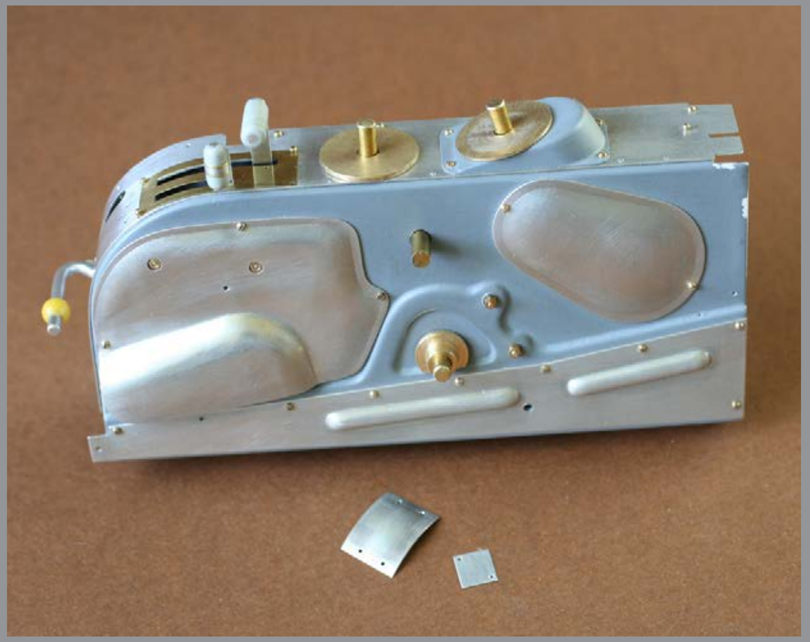
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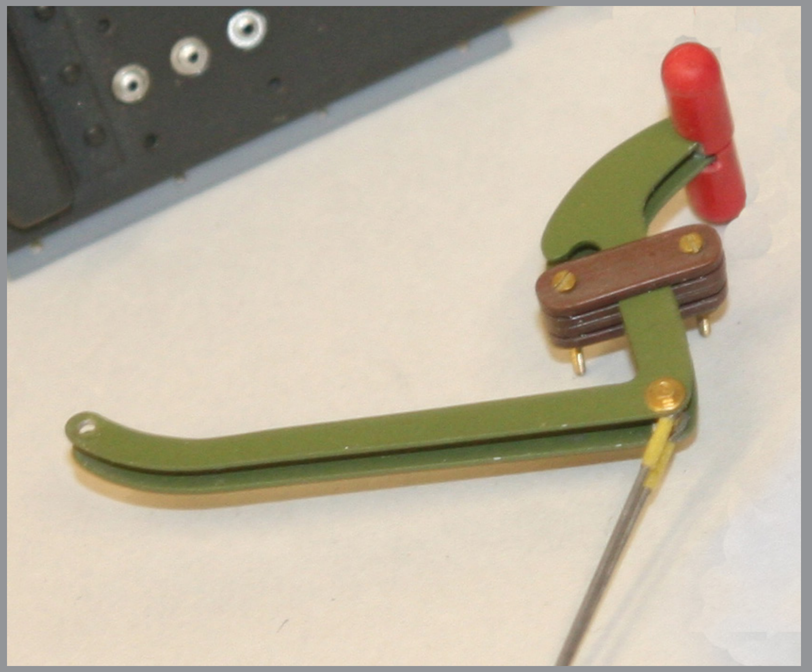
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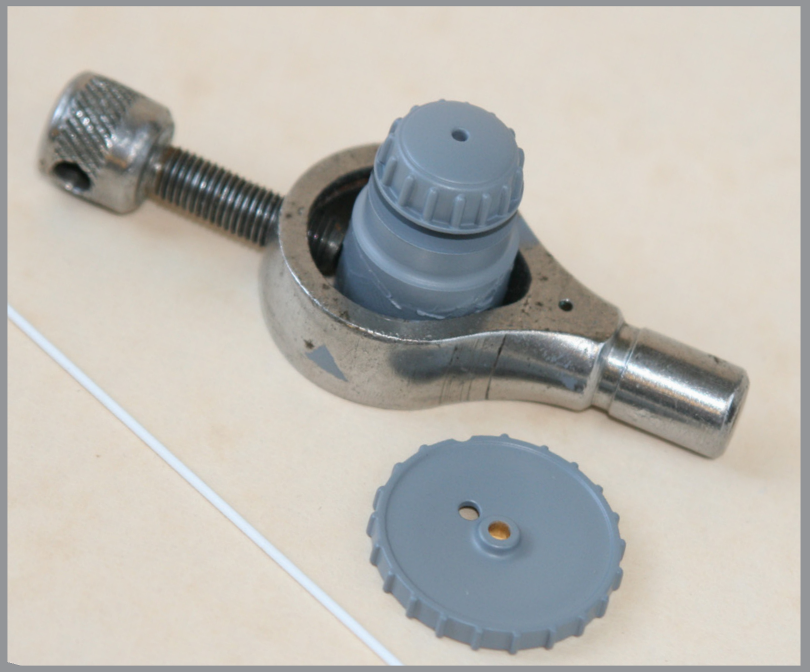
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Engine control quadrant

The Mustang's engine control quadrant exemplifies a tenet of scratch building that I return to repeatedly in my writing: that which appears complex is often no more than an assemblage of relatively simple parts, all of which are within the capabilities of most model makers to cut, file and fold to shape. Even where machine tools are required, the work involved in making a small replica of the control quadrant is of the simplest kind. However, all of this is only practicable given reliable and comprehensive component and assembly drawings from which to tease out the arrangement and precise form of the individual parts, how they assemble together and the degree to which they can be simplified without undue compromise to those features of the finished assembly that are visible.

In this particular case, a further consideration involved how to most effectively attach the assembly to the port side upper longeron, and to this end some creativity was called for. The vertical aluminium plate immediately below the longeron and its embedded spindle are contrivances of my own (photo 8). They are invisible in the finished model, but provide strength and a convenient foundation over which the assembly can be built.

To an approximation there are 50 to 60 separate pieces visible in photo 9, and they aggregate into a collection of sub-assemblies, as can be seen. All three control levers share a common spindle, but key to understanding and thereby replicating the assembly in miniature is that the uppermost two levers, for the engine and throttle controls respectively, are retained within a pair of arcuate guides bolted directly to the longeron (photo 8). Hence they must be assembled first and independently of the main body of the quadrant, which includes the propeller pitch control (painted red in my photographs). I made all three levers from sheet brass, drilled at their pivot points. The big fluted throttle handle (which incorporates the K14 gunsight range control) was the most demanding of the three to build; by comparison, the two remaining levers were straightforward to make and fit with their simple spherical control knobs, both raided from my 'bead box'.

The central component of the assembly is the badge-shaped face plate, which is predominantly litho-plate folded and flanged, with a superimposed laminate of thicker sheet aluminium containing a central circular recess for the friction lever assembly. The big throttle handle is made up of set of concentric parts, consisting of an internal aluminium spindle, a core of white styrene (incorporating the microphone switch push button) and a fluted outer hand grip. The latter proved less challenging than it first appeared. Starting with a measured length of thin-walled brass tube, I built up the flute pattern over it by applying 10-thou styrene Micro-strip, both circumferentially and longitudinally, using very sparing applications of CA glue.

Blanketed beneath sufficient spray coats of automotive primer, the sharpness disappears and a very credible fluted effect is achieved.

The more challenging friction adjustment assembly at the centre of the quadrant is built from no less than six tiny individual aluminium parts, together with a small 'knurled' disc plundered from an ancient draftsman's compass. By making all the various parts a tight push fit reinforced by the penetrating qualities of the thinnest of CA glues, I am confident that they will not fall apart! Photo 10 shows the nearly completed but still unpainted assembly in position on the longeron.

Sometimes, scale model makers derive great satisfaction from the smallest of happenstances: the two push-pull control rods, which are clearly shown in my photos, are made from aluminium tube flattened at their coupled ends. As can be seen, they pass through oval holes in the instrument panel in perfect horizontal alignment with the longeron. This is exactly how it should be, yet since both major assemblies were built independently of each other, at a distance of some considerable time, and referenced only from independently scaled down production drawings, I indulged myself with a pat on the back! In hindsight chastisement might be more in order, for I had failed completely during the building of both these major sub assemblies to check how one related to the other in terms of position.

7

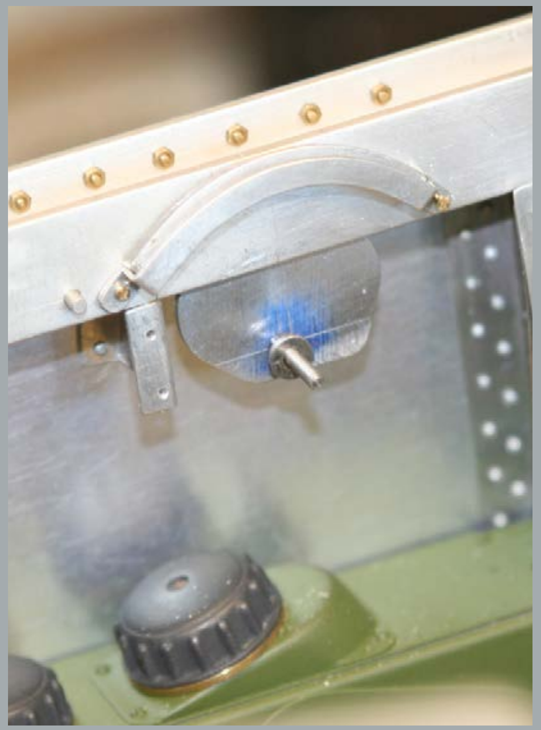
Photo 7: *The very nearly completed pedestal assembly ready for installation into the port side of the Mustang's cockpit. Note the prominent articulated undercarriage selector control lever, which is described in the text.*

Photo 8: *The two delicate arcuate guides bolted to the longeron are integral parts of the engine control quadrant and faithful to the full-sized aircraft. By contrast, the spindle mounted on the aluminium plate is a contrivance of my own which greatly simplifies the construction and installation of the quadrant without compromise to its appearance.*

Photo 9: *My 1:5 scale version of the Mustang's engine control quadrant comprises of well over 50 individual parts. Most, but not all are shown here.*

Photo 10: *The quadrant during test fitting. Final details were added after the painting stage. The big fluted hand grip is seen to good effect here, with its integral vertically orientated cable grip.*

9



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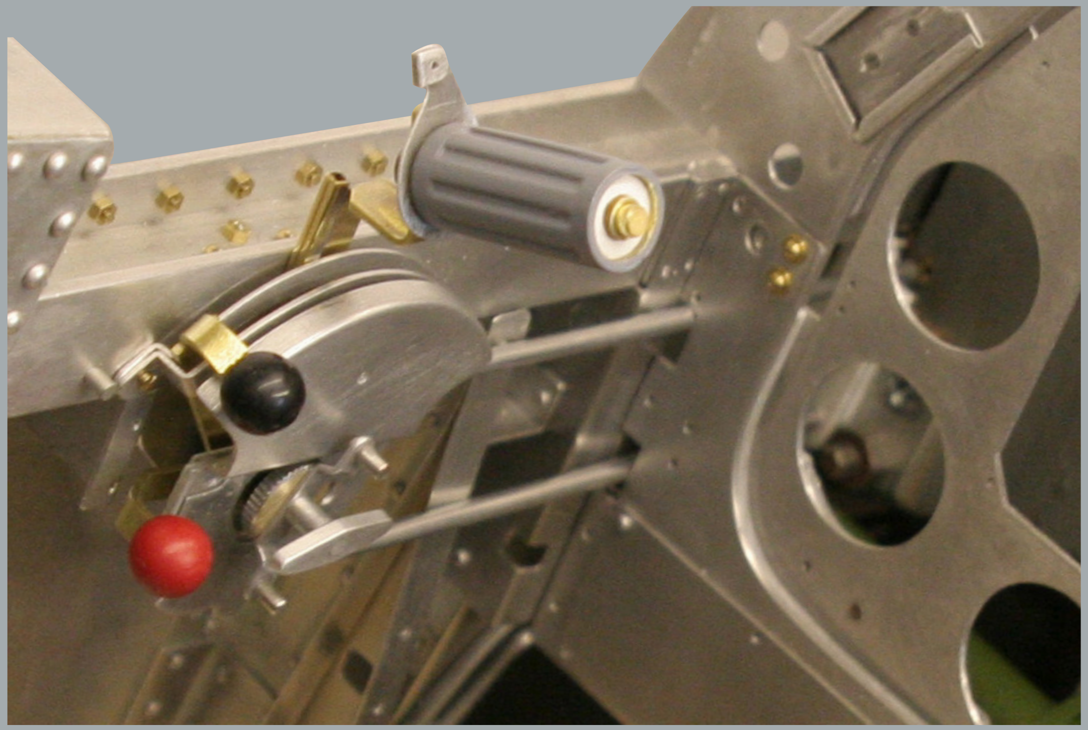

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Located immediately aft of the control quadrant is the **left hand switch panel**, which serves the radiator and oil coolant systems, along with the landing light and left-hand cockpit light. I made my version from litho-plate, cut, drilled at the corners and folded, much as described in my section on the starboard cockpit wall. As photo 12 shows, three of the four contained switches feature their own mounting plates, which I also cut from scraps of litho-plate. In my experience medium-thickness CA glue provides an excellent metal-to-metal bond, and to be doubly sure I not only clean the mating surfaces but also score them thoroughly using the tip of a scalpel blade. For such lightweight cosmetic work the stresses involved are negligible, and unless CA glues prove to degenerate over time, I am relatively confident in their use. The white styrene backing, just visible in my photo, provides the 'substance' at the rear of the panel by which to retain the four switch bosses and various tiny screws. All three switch types described previously are represented on this one panel.

The remaining items required for the port side wall comprise a **flare chute,** the pilot's retractable arm rest and the map and document case. Photo 13 shows the completed flare chute just prior to installation into the model. It is built around a piece of thin walled aluminium tube glued into a rectangular mounting plate, the latter being orientated such that the assembly adopts the correct rearward and upward rake relative the fuselage side. The three variously shaped flanges that make up the head of the assembly had to be cut and filed by hand and drilled at the corners for the four spring retaining pins and their lengthy 14BA round head screws. The dummy recoil springs are hand-wound using soft aluminium wire, which is a lot easier than winding the real thing! The detachable cover cap was turned in the lathe, and the safety chain plundered form my wife's trinket box! Assembly is simple enough: the tube is inserted through a hole in the fuselage side, locked in place with superglue, then carefully sanded flush on the outside after the glue had set. The mounting plate was further detailed on the inside with the addition of 12 small hexagon nut and stud sets.

The only issue when making the simple sheet metal **pilot's arm rest** was to mimic the centralised portion of the triple hinge set: I used litho-plate pinched over a length of piano wire and notched with a razor saw. As in the full-sized aeroplane, the centre hinge is secured by four countersunk screws; in my model screws 2 and 3 are cut and filed flush with the reverse side of the workpiece, while 1 and 4 are left long, so as to engage via a concealed spacer into push fit holes in the bottom of the longeron; about an hour's work in all (photo 14).

Finally, the **map and document case**, which is located near the floor between frames 133 and 146. The full-sized version appears to be made from a combination of sheet metal and a composite material; I used litho-plate and sheet styrene, the latter very slightly abraded horizontally and vertically to impart a subtle surface texture. My drawings indicate that in forming the pockets, the materials were riveted together down the length of the internal flanges, and this is how I made mine. The safety strap is cut from a scrap of leather (from a dolls' house supplier) and ornamented with a turned brass stud (photo 15).

12

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14

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Photo 12: *The left switch panel prior to painting and fitting out.*

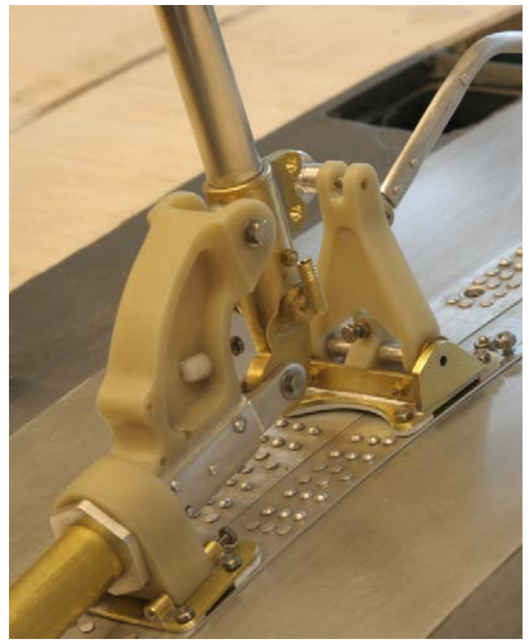
Photo 13: *The model's completed flare chute.*

Photo 14: *The flare chute installed and, just above it, the simple fold-down arm rest.*

Photo 15: *The map and document case with its leather strap.*

The central cockpit area

1



2

All of the activity described so far in this chapter has focused on fitting out the space inside the fuselage, where the work benefited from relatively unrestricted access to the cockpit from above and below. By contrast, the **control stick and aileron torque tube assembly** is installed directly onto the wing centre section, which necessitated that the immediate local area be clad with its litho-plate skin and detailed with multiple rows of large and closely spaced dome-headed rivets. As can be seen in photo 5, only the extreme front end of the torque tube and its adjacent bearing are actually visible in the finished model, the greater part of its length being concealed beneath the cockpit floor. Nonetheless, I included the shaft back to its rear support bracket, because this provided a convenient point of attachment. Where nuts, bolts and washers are used in the assembly (and there are quite a few), I scaled to the nearest commercially available equivalent.

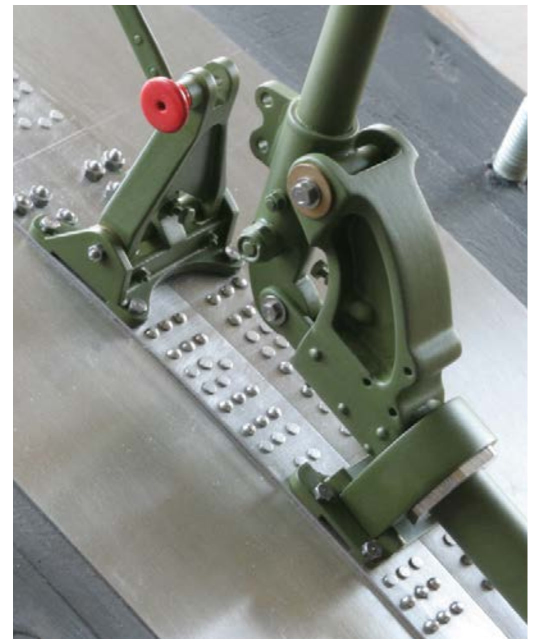
At first glance, the array looks daunting to model, but it is made up of a relatively straightforward set of parts. Several of these are produced as castings in the full-sized aircraft, and – as shown in my photographs – I copied them by using pre-cured resin, hand cut and machined out of the solid. I habitually keep the residue from two-part casting jobs for just this purpose, and if I do not have sufficient leftovers I pour a blank specially. Resin turns beautifully in a small lathe, and my mini-milling machine takes to it too. Perhaps the biggest advantage is that it is quick and easy to cut and file accurately by hand (while wearing a mask!), and it gives a perfectly smooth finish in small components that would be hard to achieve otherwise. So, by resorting to this most machinable of materials I was able to mill, drill and hand file credible copies of the main parts quickly and easily, using the production drawings as my guide. These are shown unpainted in photos 1 and 2, and (for the technically minded) they comprise of the arch-backed 'control column fitting', the V-shaped 'control lock arm' and the rather more straightforward 'torque tube bearing'. Not the least of the challenges in replicating these parts are their several deeply recessed and slotted features, and it was here that my milling machine and selection of small milling cutters came into their own.

Most of the metal parts were straightforward enough to produce from stock brass and aluminium tube, brass plate and aluminium hexagon, as can be construed from the photos. In order to capture its elegant taper, I chose to turn the control column in the lathe from solid aluminium bar. The two most demanding of the sub assemblies were the control stick socket, which is made from four brass parts soft soldered together (photo 1) and the above-mentioned forward facing torque tube fitting, which combines resin and aluminium components using the agency of superglue.

As can be seen from my photographs, the elevator control stick connecting tube is attached to the bottom of the control stick socket by a clevis. In the real aircraft it passes freely through the entire length of the larger diameter torque tube. Mine extends to just about half way down, where it terminates in a little ad hoc plastic 'piston' (photo 1). This simple contrivance in the model acts both to keep the elevator tube concentrically located, and it generates some credible degree of friction on the stick, thereby enabling it to be moved with a silky smooth forward, backward and lateral action. There was no obvious need for this refinement at the time, except that I judged it worth such a simple expedient to gain a realistic effect. However, at a much later stage, the ability to move the stick out of the way made the impossible possible when it came to fitting many a small component or to tightening some tiny and otherwise inaccessible nuts or screws.

Subsidiary to the control column assembly is the static aileron control locking mechanism, with its hump-backed aluminium retaining tube. This is also bolted to the top of the wing, immediately forward of the stick. The idea in the actual aircraft is that the stick is pushed forward until one of the pair of forward facing lugs at its base engages within the clevis in the hinged control lock, where it is secured by a removable pin (painted red) – a minor but a very satisfying detail to include in the model (photo 3).

The last component to be made was the handgrip, complete with trigger and switch button, and, again, I chose resin for this. I drilled and rough cut a resin blank, pushed it onto the top of the column and started carving, filing and sanding. There is no great technique involved, just patience, care and a good two-view drawing. When the piece looked like a handgrip from the front, side and above, I knew the job was done! One minor detail warrants explanation: the tiny slot for the trigger was cut into the resin with a dental bur mounted in the milling machine (photo 4).



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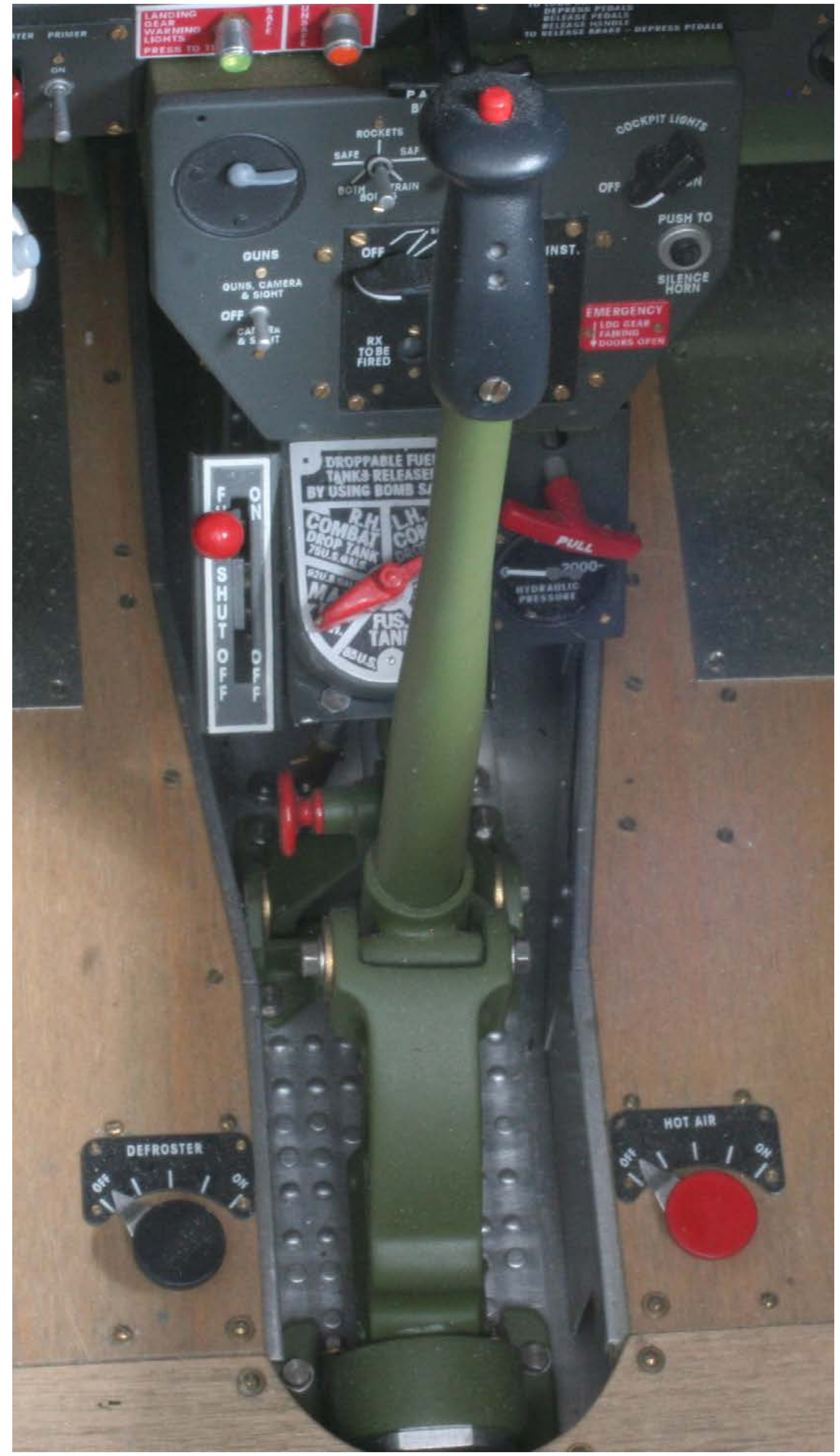
Photos 1 and 2: *The major components of the control column assembly and its associated aileron control locking mechanism were fabricated from an unlikely combination brass, aluminium and solid resin parts. Note the small, white plastic 'piston' attached to the elevator control stick connecting tube, the purpose of which is explained in the text.*

Photos 3: *After spray painting in the mandatory cockpit green no trace of the mix of the materials used remains. The picture shows to good advantage the top wing skinning and the reinforced plates with their heavy rivet detail. In retrospect, I wonder why I bothered, for very little is visible in the completed cockpit.*

Photo 4: *The completed resin hand grip with its tiny 'trigger' slot cut with the help of a dental bur.*

Photo 5: *The completed and installed control column assembly.*



5

The pilot's seat and armour plate

During the exceptionally cold and wet April of 2012, I resolved to tackle the pilot's seat, a job I had toyed with and repeatedly put off over several years, simply for the lack of a clear idea of how or with what to make it. My biggest problem, despite its stark simplicity, was the sheet metal seat pan. Ideally, I would have used brass, as I did for my Spitfire seat, but I seriously doubted my 'panel beating' abilities. Aluminium might be easier, but how to solder it? I even contemplated using styrene sheet and vac-forming the thing! In the end I devised a technique that was new to me.

But first, the tubular seat frame: as my pictures show, this consists of an inverted 'U' cross braced at the bottom, and – perpendicular to it – a quasi-square frame of a slightly smaller tubular diameter. For convenience, I used solid brass rod rather than tube throughout. Brass of this diameter bends quite easily if heated cherry red and quenched; and after several hit-and-miss attempts, I managed to capture the required geometry, including the problematic 'embayment' at the front of the seat. For the preliminary soldering operations I used a high melting point soft solder. This facilitates subsequent stages of the work when solders of successively lower melting points are used. Photo 1 of the assembly on its simple jig serves to summarise this stage.

Because the Warren McArthur seat was sub-contracted by North American Aviation, I have no GA drawings. However, it is fully detailed in an excellent 'exploded' sketch in the P51-D Parts Catalogue. This was my salvation, for even without dimensions I was able to assess and 'scale-off' the items I needed to make, and I own up to omitting all those parts that are hidden with the seat installed. This left the belt lock handle (port side) and lift lock handle (starboard side) assemblies and the two triangulating seat pan side supports (photos 2-4). In the full-sized version, the side supports are formed from folded sheet metal; envisaging problems, I compromised by milling a linear channel into a pair of 3/32-in. sheet brass strips. It looks fine when painted, but I could reasonably have saved myself the trouble since, with the seat installed, this milled feature is all but totally hidden.

With the fine detail done and dry fitted, it was time to tackle the tricky bit. After much thought, I discarded the brass option for the seat pan and seat back in favour of litho-plate, placing my faith in superglue to do the work of solder! I began by making three-dimensional basswood patterns of both, exactly as if I were intending to vac-form them (which remained a fall-back plan). With the patterns primed and treated with mould release agent, I arranged them, shaped-side upwards, in suitable containers which I part-filled with two-part resin, thereby creating a pair of robust female moulds (photos 5 and 6). But would I be able to force softened litho-plate down into them? Well, yes, and very easily, as my photos attest. Admittedly, the process left a slight wrinkle here and there, but this adds to rather than detracts from the effect. I simply tacked the finished and trimmed litho-plate parts in exact position relative to the brass, then ran more CA glue liberally into the hidden V-shape created between the two, hardening it with accelerator as I progressed. With the raw edges of the aluminium tamped over and around the supporting frame with a tiny hammer, and 'weld seams' simulated with more viscous Superglue, I managed to achieve a creditable result relatively easily. Next I cut the two peripheral vertical slots in the aluminium for the stanchion clips, which can be seen two thirds of the way up the seat back (photo 8). Finally, to reinforce the soft and easily damaged aluminium, I smeared the hidden sides of the seat and back pans with a generous layer of five-minute epoxy glue.

Originally, I had intended to mount the seat on its two spring loaded tubular supports, more or less as in the original, yet it became apparent as the job proceeded that this would require some very precise engineering, potentially 'a bridge too far'. Hence I devised the crude but simple flat brass beam at the base of the seat frame that is just about visible in photos 2 and 3. Using this I was able to bolt the seat directly but discretely to the armour plate, adding dummy stanchion clips (the prominent features bolted either side of the seat frame) at the conclusion of the job.


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Photo 1: *A simple jig around which to bend the annealed brass frame for the pilot's seat.*

Photos 2 and 3: *The almost completed seat frame, showing the milled stays for the seat pan and the lift lock handle.*

Photo 3: *The crude hidden brass beam at the back of the seat is a device of my own to assist construction and installation of the seat and its armour plate.*

Photo 4: *Part of the belt lock handle on the port side of the seat frame,*

Photo 5: *The carved wood pattern for the seat pan.*

Photo 6: *Both patterns and the resulting female moulds used to form the sheet metal components of the pilot's seat.*

Photos 7 and 8: *The near completed seat before and after spray painting.*

Armour plate

I made the pilot's rear armour from mild steel. It consists of three separate parts: the body armour, head armour and a bridging plate by which the two are riveted together. I used steel simply because I had some to hand; it could as well have been aluminium alloy or brass, or even styrene sheet at a pinch. It helped that my stock was 1/16-in. thick, which, multiplied by five, scales exactly to the real thing, although the head armour is slightly thicker. Having cut out and drilled the sheet metal parts, the first requirement was to impart the pronounced forward orientated set along the top of the body armour – a task requiring a sturdy bench vice, hardwood block and a hefty hammer. I made the brass roller for the pilot's harness and its two small steel brackets, then riveted all six parts together, adding the two channel-section brackets for the seat support tubes (photo 1). Bolted to the rear of the head armour is the antenna relay support plate, and for this I reverted to litho-plate, which made the cutting and delicate counter folding relatively easy (photo 2).

I happen to live within two miles of a dolls' house specialist supplier, probably the only one in half a day's drive, and the perfect place to seek fine leather for the miniaturist. Not only did I find my leather, but also a sample closely matching the aqueous green that I had referenced – good fortune indeed. There are two parts to the covered head rest assembly: a back plate and the cushion itself. The former was easy to clad in the supple leather using contact adhesive applied to the reverse side. I made the oval cushion body from basswood, 'upholstering' it with felt under the leather. The sides are trimmed with a narrow strip of leather, delicately folded under along the edges and secured with carefully applied contact adhesive.

In the full-sized aircraft, the seat can be adjusted in height by means of a pair of vertical support tubes (photo 3), the pilot's weight being compensated for by two sturdy springs. As mentioned above, the upper ends of the tubes are through-bolted to brackets fixed to the front of the armour (as shown), while their lower ends lodge into sockets integral with the underlying fuselage structure. The seat slides on the tubes by means of four bushes contained within U-shaped clips, the latter being bolted directly through the tubular seat frame, two at the top and two at the bottom. This is broadly how I built my version (photo 4), using scale chrome-plated tubes plundered from an old portable transistor radio aerial. As can be discerned, I turned the bushes in brass and made the clips out of litho-plate. However, given that the lower clips are completely hidden when the seat is installed, I saved myself some work by leaving them out. Thus, while the topmost clips perform their function, the seat is bolted at its base directly to the armour by means of spacers and the bogus brass beam described above. The completed and painted assembly, comprising seat and armour plate is shown in photo 6.

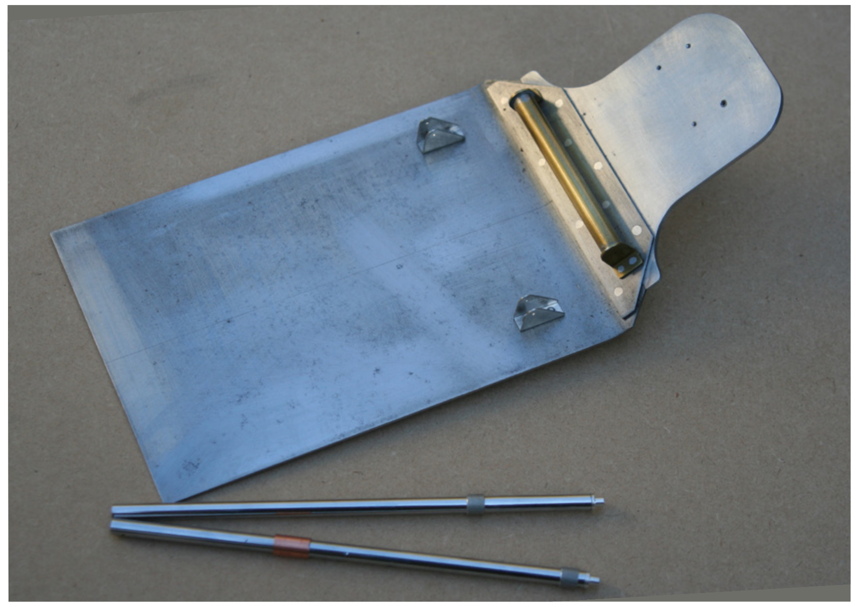

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Photo 1: *The completed armour plate assembly together with the two support tubes on which the pilot's seat is carried.*

Photo 2: *The rear of the head and body armour, showing the antennae relay support plate fitted with four bolts. The flanges on either side serve to retain the leather covered head rest assembly. Visible lower down is one of the channel-section brackets used to secure the armour to the top of the paired port and starboard seat support beams.*

Photo 3: *The seat support beams installed, together with their complement of brass and aluminium bushes and the prominent springs. The latter were commercially sourced. Note the two turned aluminium spigots inset into the ends of the tubes: they fit into sockets in the fuselage underbelly. The three holes near the bottom of the armour locate the 'false beam' built into the base of the seat frame.*

Photo 4: *Where visible, the means by which the seat is bolted to its supports in the model adheres very closely to full-size practice.*

Photo 5: *The unpainted armour plate. The head armour is slightly thicker, which is as it should be.*

Photo 6: *The seat and armour plate ready for installation. Practically everything visible in the real thing is represented in this 1:5 scale version, albeit that there is a lot of hidden detail left out!*

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