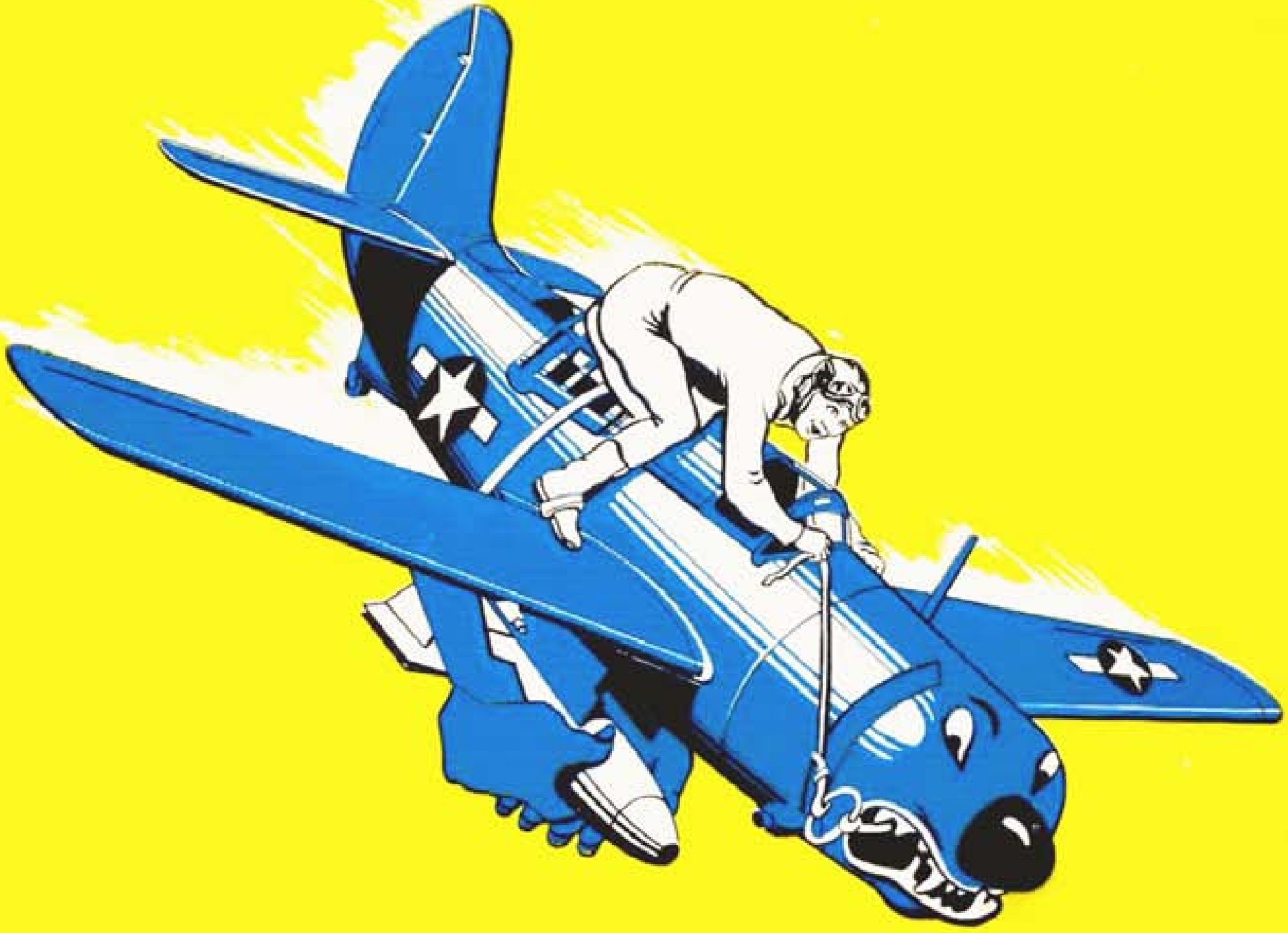
PILOT and BEAST



"WHAT EVERY YOUNG PILOT SHOULD KNOW ABOUT THE HELLDIVER"

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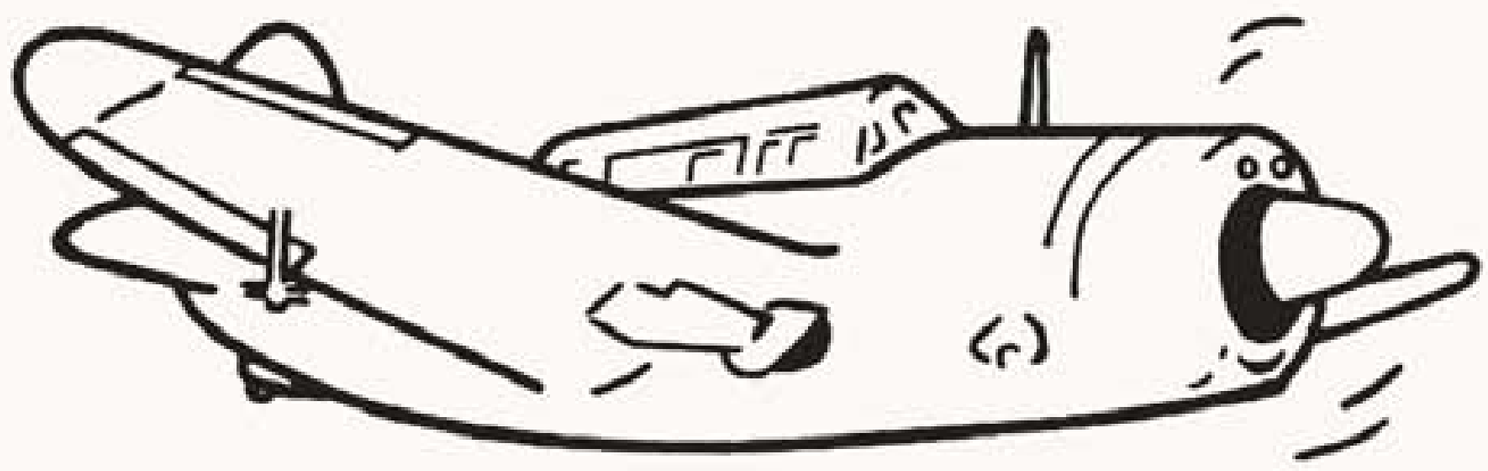
FOREWORD

This brief of operational information has been prepared for the instruction of Personnel being introduced to the Curtiss SB2C airplanes. The information contained herein is accurate although stated in a light vein.

PILOT and BEAST

WHAT EVERY YOUNG PILOT SHOULD KNOW ABOUT THE HELLDIVER



PREPARED BY
SERVICE DEPARTMENT
CURTISS-WRIGHT CORPORATION
AIRPLANE DIVISION—COLUMBUS PLANT
COLUMBUS 16, OHIO

CHAPTER I

Introductory

This book (if such it may be called) is being written to present to you the facts as we have found them. They will be given without apology and as much as in us lieth, without bias.

We can't give you the dope on everything in this short book, but we do hope to get you started in the right direction. May we begin by asking that you soon develop and cherish a healthy respect for this "Beast" as it is sometimes called, You are no longer a Dodo, that we know, but the ship you are about to fly is perhaps the biggest and most powerful of your career. If you treat it right you may live to fly even bigger ones someday. Need we say more?

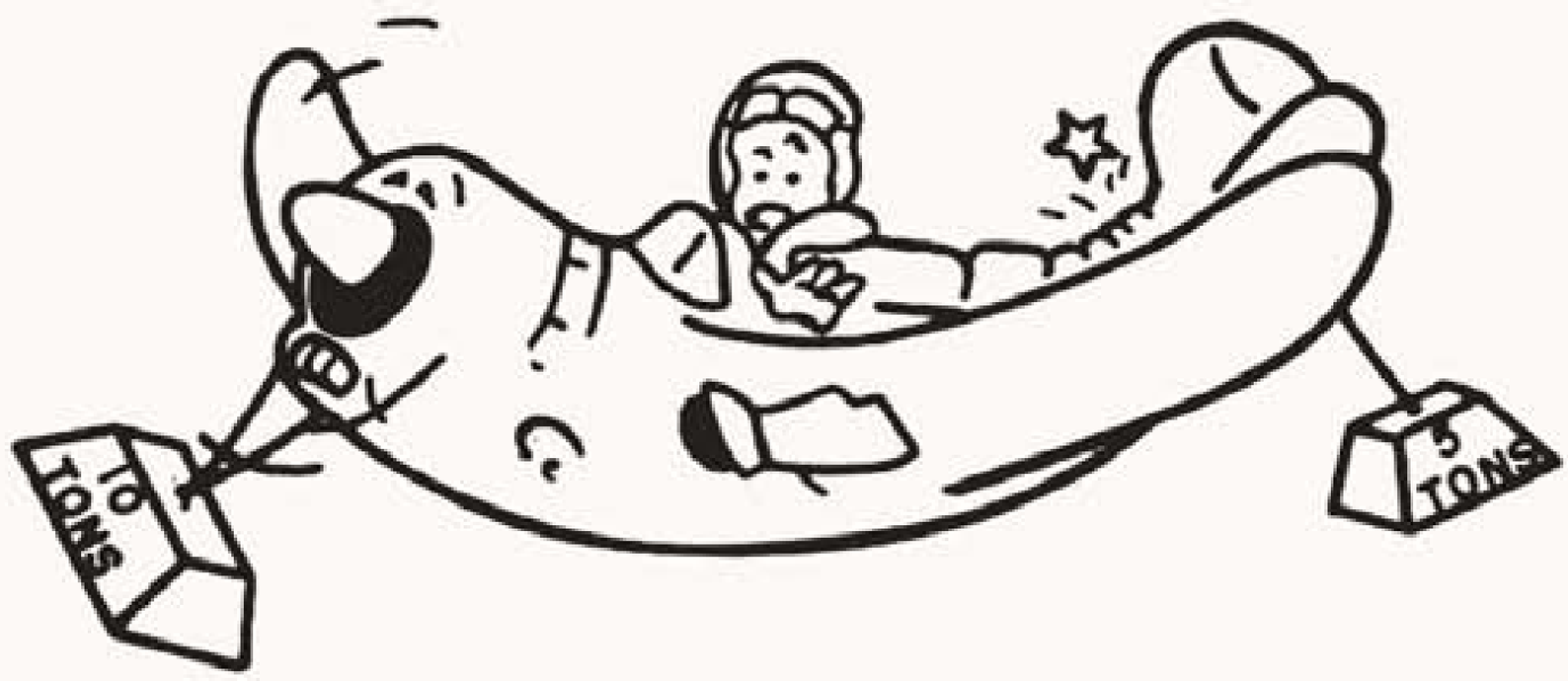
Don't let it fly you! It can you know, or rather you'll find out, if you do not take the trouble to master its every characteristic. Its engine, propeller, hydraulics, electrical system, controls, etc. are the important parts that together make up the complete airplane. Master these and you will find unending dividends, you will compensate for its temperament, you will understand the troubles you have, the mechanics will do a better job for you because they will know that you are not going to undo all their work by making small blunders, and last but far from least you will be able to understand emergencies so completely that all normal emergencies will cease to exist. It's going to be your "baby" from here on out so be good to it.

Already in the Pilot's Handbook you have read that the SB2C is a single engine, two place, low wing dive bomber which carries a fair amount of armament. You have also read that it has a span of 49' 8 5/8", but do you realize that it weighs upwards from 13,000 pounds! (6½ tons!) or did you stop to figure the wing loading (wing area - 422 sq. ft.) was 28 lbs. sq. ft. or better? So what? Well this merely means your glide angle will be about 45° without power. This is therefore a good airplane to leave on the ground if the engine is giving you any trouble. It is more comfortable to be a live fool than a dead hero.

Six and one half tons pulled by three or four blades and

1700 to 1900 horses. That is a lot of airplane to control. Half again as much weight as the old reliable SBD and nearly twice the horse power. Remember when you flew your first Cub at 65 h.p. and then made that big jump into your primary trainer at 235 h.p.? That was real power wasn't it? Here again you are making a jump into real power, only this time nobody's kidding anybody about it. You'll want that power one of these days to evade a bunch of Jap Zeros, but don't think there is one after you the first time you fly it!

That brings up one last word in this introductory statement. Remember that "Pilots who flat-hat don't draw longevity" especially in an SB2C. The manufacturer has tried to build the airplane as strong as the limitations of weight and performance allow, but don't forget there are certain restrictions placed on flight maneuvers: DON'T IGNORE THEM. Suppose for example that for reasons known only to yourself you decided to pull out of a dive at 10 "g's." Have you stopped to consider the effect on the structure of the airplane? The engine weighs better than 2,000 pounds and is roughly ten feet ahead of the center of gravity. At 10 "g's" it is resisting your pull-out with a force of better than ten tons! The tail being about twenty aft of the center of gravity is exerting a force of more than five tons to counteract the engine load! You are the guy in the middle. What do you do now? There is a reason for that 6.5 "g" restriction, isn't



there? Better check your latest T.O. We're getting better at building them and the top "g" may be raised.

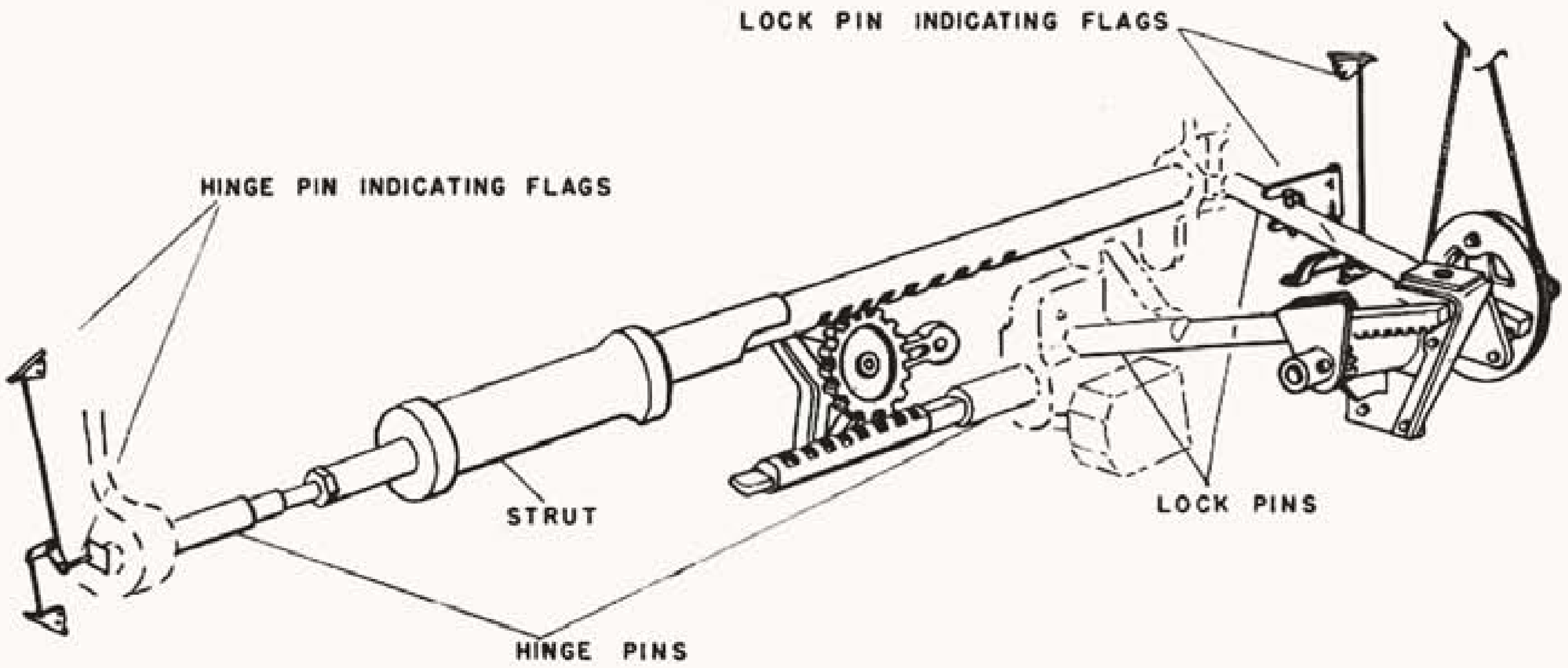
Have you noticed that little weight on the bottom of the control stick? There was once a window in front of the stick through which you could have seen it. Now if you have a desire to look you'll have to crawl under and look up through the bomb bay. It was put there just to help prevent you from pulling too many g's. Think a minute, understand how it

works? It only weighs about 15 lbs. but as the "g" loading goes up so does its effective weight. Or if you pull 8 or 9 g's it has an effective weight of 120 to 135 pounds. That makes the stick too heavy to hold and you don't exceed the restricted limit. Of course that is more of a hope than a fact for we know that you can strongarm it or even trim-out most of its effect, but you can't say we haven't tried to help you! Don't forget your early basic training. Remember that to "Black-out" a "g" load has to be pulled over a relative long period of time - but the effect on the airplane is dependent on the maximum "g" pulled regardless of the length of time, long or short!

Introductory Addendum

Horrible word, isn't it? Addendum we mean. Well, we just thought we'd put it here instead of at the back of the book. Our reasons are somewhat similar to our reason for eating the pie crust first; we get the worse over and live in anticipation of the happy ending. Actually, this might be called the second chapter but then we might never have had the opportunity to use that word! Our purpose for the moment is just to acquaint you with the general exterior of the entire airplane, we may go into more detail later.

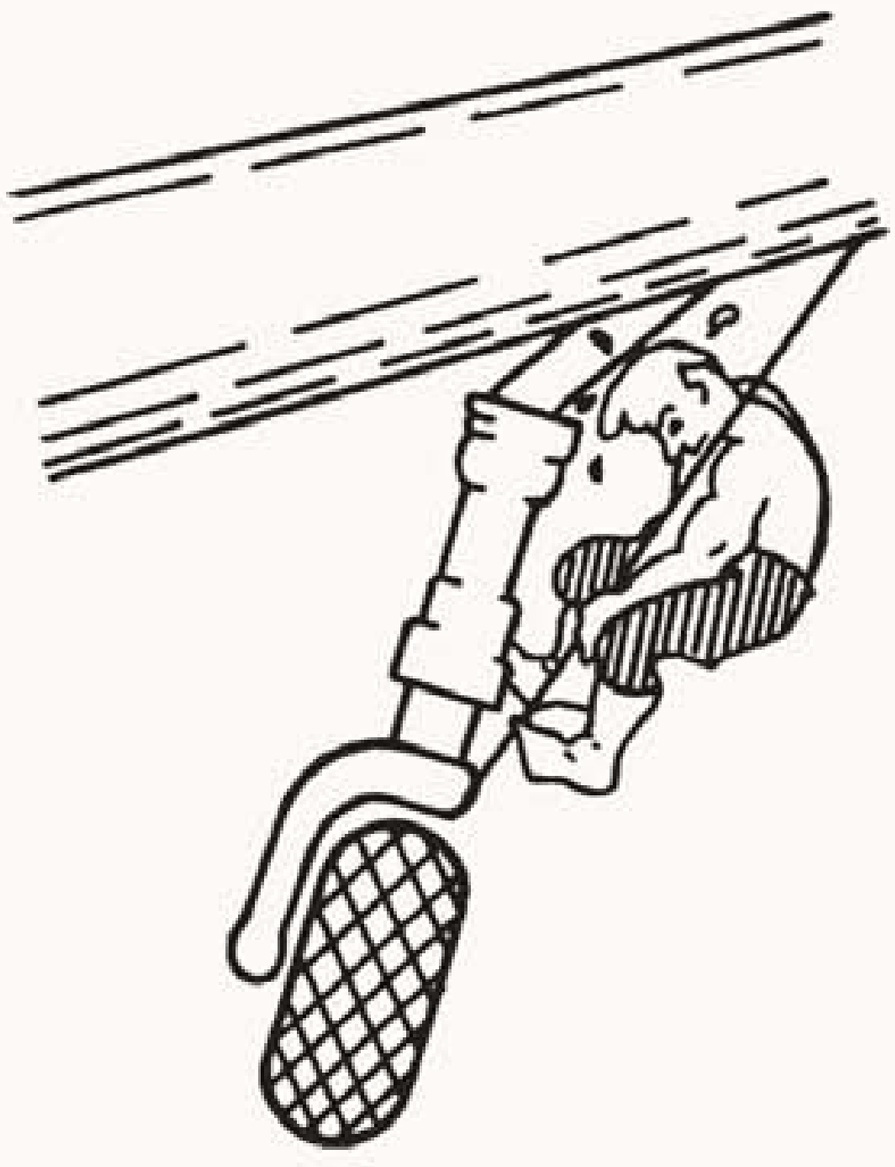
Pick out an SB2C "on the line" which has the wings folded and examine the wing locking device at the fold line. (It may add to your peace of mind later.) Notice the single hy-



draulic piston which serves to seat and retract both the front and rear hinge pins. This is the piston that does the work when you turn the control handle in the cockpit. Notice we

said turn! If you examine the mechanism more closely you will see the hinge pins must pass completely through the beam forgings before the passage is cleared for the "locking pins". The included sketch may also help to complete this description. As the rear hinge pin goes home in the rear beam forging, notice it actuates the two rear indicating flags drawing them in flush with the wing surface. The two indicating flags in the front, however, are actuated by the front locking pin as indicated. As you push the control handle toward the instrument panel the flags will retract into the wing. If the control handle seats with a smooth action and the flags go down as the handle is moved forward, you may rest assured that the wings are definitely extended and locked securely in place. Notice we mentioned there were four indicating flags on each side. The two on the upper surface are for you to see. The two on the lower surface are so the 'mech.' can check at the same time. Don't push the cockpit control handle in until you see the two rear flags go down (one each wing) for if it goes down on one side only, remember the handle connects to both sides and the other side will block your efforts. There is some law in physics about two objects in the same space at the same time.

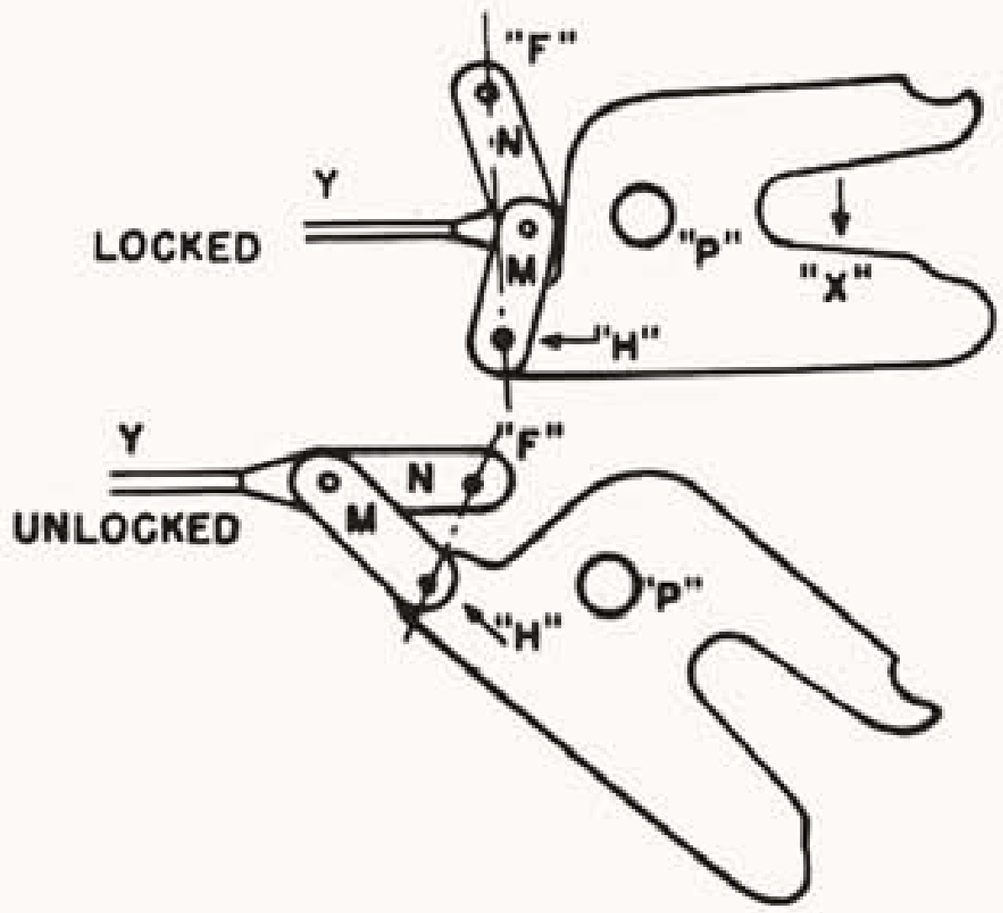
Suppose we move around now to the wheel pocket. Notice the clearance at the bottom of the oleo. We know that such checks as we are about to suggest are not part of your job but the clearance mentioned has a certain significance which does concern you.

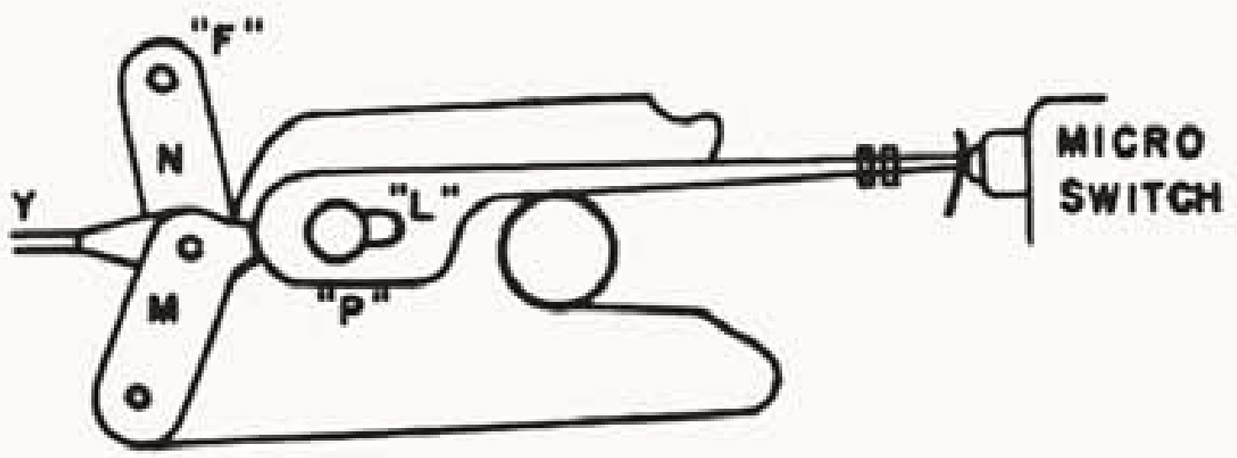


You can understand that the strut must be collapsed to exactly the same point each time the wheels are retracted. If therefore the strut is inflated over the recommended limit stamped on the oleo, there will be a greater volume of air in the strut to be confined in the same amount of space. The result -- ? To be explicit the air volume being greater the pressure will be higher at any given point of compression. It will therefore be increasingly more difficult to retract the gear as the amount of air volume increases. The point will

soon be reached when the gear cannot be retracted, but remember it is a fault of servicing the landing gear oleo and not a fault in the hydro system. As a further precaution you might check to see if the slanting wooden block is in place at the inboard end of the wheel well. Its purpose is to prevent the wheel from jamming up into the fuselage in case the collapsing cable should break. But you don't have to make these checks so just forget we mentioned them.

If you have any worries over whether your wheels will lock in the up position you might look at the locking device in the wheel well and see if it is in propor operating order. But you don't know what proper order is, do you? Then perhaps the included sketches will help. "F" and "P" are fixed points in the two sketches to the left below. The unlocking force is applied through connecting rod "Y". Everything be-

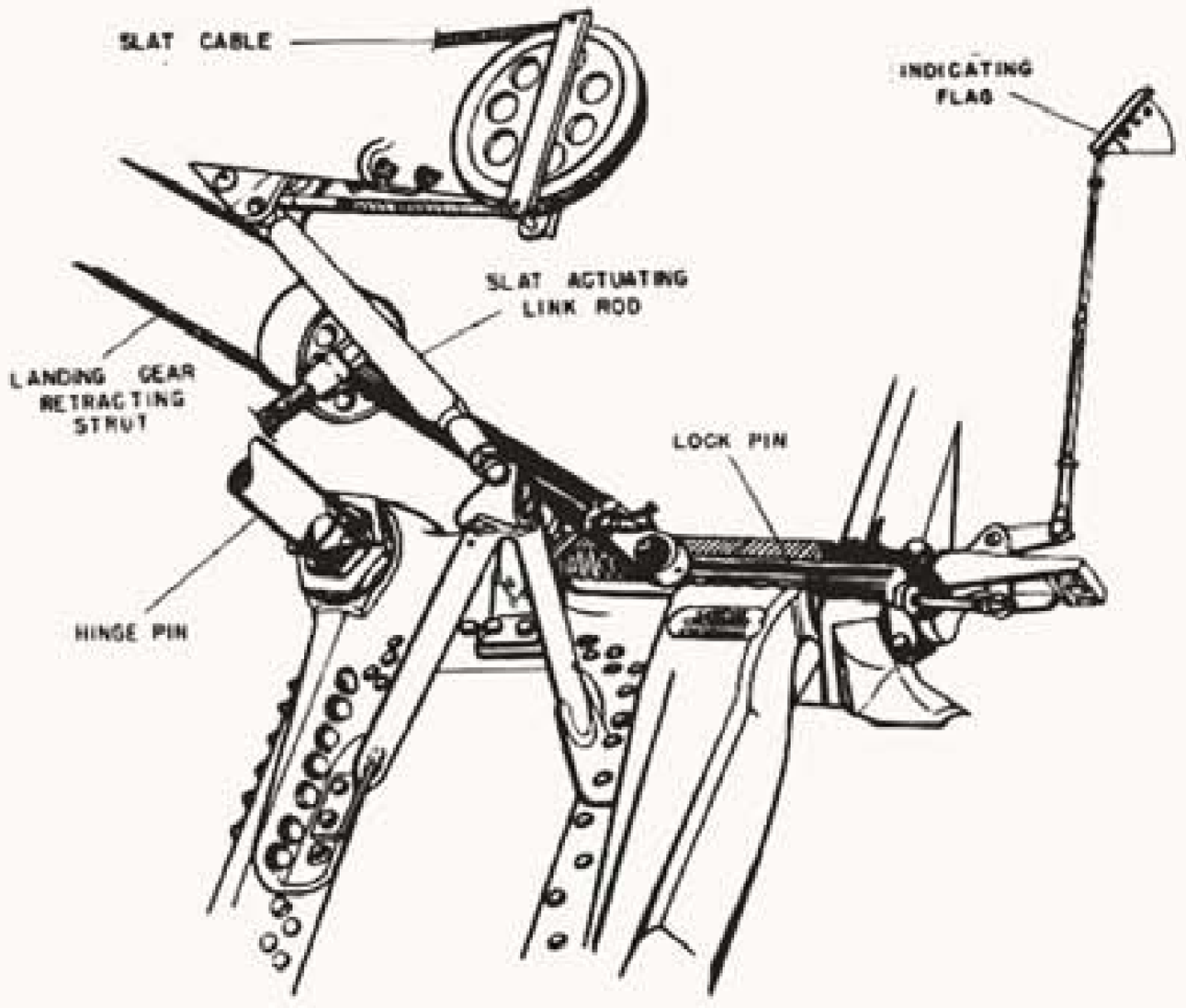




ing adjusted properly the best check in flight to find if the wheels have actually locked "up", is to raise the toggle switch mounted on the upper left hand corner of the instrument panel. If the wheels are properly locked up, the light will come on, if not it won't. To make the check as positive as possible you should open the #3 hydro valve, and make a dip pull-out. As you can see, the links "M" and "N" are the actual locking parts but they must pass over the dead center line (between "F" and "H"), before they can actually prevent the hook from snapping down. Any force applied to the hook at point "X" will only serve to lock the links tighter to the back side of the hook if they have passed the dead center point. The rod "L" is forced over into the micro switch by the links when they pass the dead center point. Simple, isn't it? (Note: a micro switch is the same as any other switch except that it works with hair trigger accuracy.)

One more word about the landing gear and we can forget

that it even exists until we need it for the next landing. It might be nice to know not only that your wheels are locked up, but also that they are locked down, and since SUPERMAN is still the only person we know with X-Ray vision we must trust the visual indications on the upper surface of the wing. These indications are the slat and the down-lock-indicating-flag. The slat (so called because it is a separate part of the wing and moves forward to form the slot) is connected directly to the landing gear and moves in and out as the gear moves up and down. Look at the drawing at the right to get a more complete picture of this entire setup. As can be seen, the down lock pin must move securely into the wing beam forging before it engages the bell crank that operates the flag in the upper surface of the wing. So if you see the flags just start to raise you can be assured the wheels are firmly locked down. Since the slats are directly connected to the landing gear, you can get a general idea of the relative position of the gear by watching them move out and back. But remember that the slat may appear to be full in or full out, and still not be an accurate indication of the wheels being locked either up or down.



Before we leave this discussion of the indicating flag it may be well to mention that occasionally some one in walking along the upper surface of the wing (while the airplane is on the ground) may step on this flag. This act has been known to impede the action of said flag. This may pass unnoticed during take-off, but pilots have been known to develop a distinct liking for the unaerodynamic interruption the said flag makes in the otherwise relatively smooth contour of the upper surface of the airfoil. However, since accidents happen even in the best regulated families, and someone may step on the flag of your particular airplane, don't be too excited if the flag does fail to come up. Check your hydraulic pressure gage on the instrument panel, if you have 1000 p.s.i. registered and the wheels are evidently down as indicated by the slats being out, the probabilities are that the wheels are locked.

Actually we have only looked at two places on the airplane thus far, the wing fold and the wheel pocket, although at the same time we have made at least some reference to items in the cockpit. Now getting back into the wheel pocket (comfortable, isn't it?) may we suggest that you step out and we will continue our journey in a leisurely fashion around the airplane. Don't forget to avoid the propeller, those blades have been known to terminate Dilberts life suddenly, as much as three or four hours after the engine has been shut off. There is little difference in the left and right sides of the airplane but remember it is all going aloft with you so it won't hurt to just stand a while and absorb the impression of the full six and one half tons of aircraft you are going to fly. With a full loading of fuel, bombs, radio gear, etc. that weight jumps to close to eight tons!

Stop for a moment at the rear of the right hand stub wing, (the wings are still folded of course) and look at the exposed part of the flap mechanism. We cannot explain the entire mechanism of the flaps in these few pages but by looking at the amount of mechanism you may be more willing to follow the few bits of advice concerning its care which we are about to give. You must remember in the first place that there are two distinct functions in the flap operation. First, there is the mechanical side of the system which controls which flaps (diving or landing) you are going to use. Second, there is the hydraulic side which only opens and closes the flaps with hydraulic pressure. Unless the flaps are closed tightly the first or mechanical operation cannot be made. Therefore, the first and most important item in the care of the flaps: do not attempt to make selection (for landing or diving flaps) until the flaps are closed and there is at least 800 lbs. pressure on the system. This will permit the mechanical locks to slide freely. The second item to be remembered is never to select diving or landing flaps with the wings folded! When the wings fold the mechanical linkage between the stub wing and outer section separates, then although you may make the selection of the center panel (stub wing), the outer panel will not be affected. The effect will be realized only when the wings are again extended! Note: The mechanic has a loophole and can circumvent this second item but that is an enlisted man's secret and you are an officer!

Now step back around the tail (empennage if you prefer), jump up on the walkway of the left wing and with the mention of one more item we will close this chapter. With the front cabin closed you can see just aft of it in the fixed

cabin an access door for the fuselage gas tank filler cap. No we are not going to tell you to be sure and fill up before taking off, but we are going to suggest that you check to see that this door is securely fastened. On the later airplanes the hinge of this door is along the forward edge and its security is not so important. But on the earlier models where it hinged along the lower edge, if it were left open the front cabin could not be rolled back. This might be embarrassing if you saw a blonde and wanted to put your hand out to wave.

CHAPTER II

Starting Things

We originally intended to entitle this chapter "The Cockpit" and give you a remote check-out, but having once seated ourselves therein, there appeared so many ways of itemizing the contents, we decided it would be best to entrust you with the responsibility of getting "checked-out" through personal contact. On this basis we will consider ourselves free to wander at will about the cockpit or the balance of the airplane if we so desire. So, if you want to come along, hang on!

At one time or another in your adolescence you undoubtedly found it impossible to extricate yourself from a precarious predicament and were forced to call for "Mamma" or "Daddy" as the case might have been. Then after it was all over and the tears were wiped away, you began to realize that if you had only taken the time to study the thing through in the first place the situation would not have occurred. In short a little pre-caution, you learned, can save you from many a "mess". So in this chaper we hope to save you from at least a few of the "messes" you might otherwise encounter in starting the SB2C.

If the cabin (front canopy) is closed as you first approach the airplane, walk around and climb up on the starboard walkway. The cabin release is found just below the aft edge of the windshield on this side (it is operated by depressing the button and sliding the cabin aft). (On the first 978 airplanes the cabin had to be cranked open but the crank is inserted in the same place.) If this has saved you a minute, then you might meet Hirohito a minute sooner!

Now sit down (in the seat, not on the wing!) and close the cabin, or at least roll it forward far enough to see what is overhead when it is closed. At the front end of the cabin, directly over your head you will see a small cable with a ball on one end and a lever on the other. If you pull this ball

and cable you release the cabin from its trucks and wind pressures from flight will lift the entire structure from the ship (but quick). If this same cable is pulled on the ground, nothing will seem to happen. But don't be surprised when the cabin suddenly is not there after take-off!

To the left and at the base of the cabin you will notice a small red lever. This is the control for an additional emergency exit door. Its purpose is to permit you to get out should you have turned over with the cabin closed.

Well, now you are in and we hope you know how to get out, so suppose we look around a little and see what else confronts us. If we are lucky we might even start it.

At your left, mounted just below the upper longeron, is the throttle quadrant. Four units are mounted on this quadrant; the throttle, the mixture control, supercharger control and the propeller governor control. Those glass plates in front of you cover the instruments you must use to govern your flights. Look them over and find out which one is where! The fuel pressure, oil pressure and oil temperature gauges are all in a single instrument at the top of the panel almost hidden by the gunsight. Those other two oil pressure gauges at the bottom of the panel are for the hydraulic and auto-pilot systems and shouldn't bother you as yet. The tachometer (rpm indicator) is at the upper right and the clock at the upper left of the panel. In case it is of any interest, the fuel level indicator gauges are slightly to the left of center near the middle of the panel. The cylinder head temperature is read from the gauge in the lower right corner of

the panel. This brings us around to the cowl flaps control, which is the crank at the lower right of the panel. It operates both cowl and oil cooler flaps.

To bounce backward for a moment (you like bounce drills, don't you?), you should remember never to exceed a cylinder head temperature of 268° C under any circumstances (248° C on the SB2C-1 and 1C). This can be done by opening the cowl flaps - but you know that.

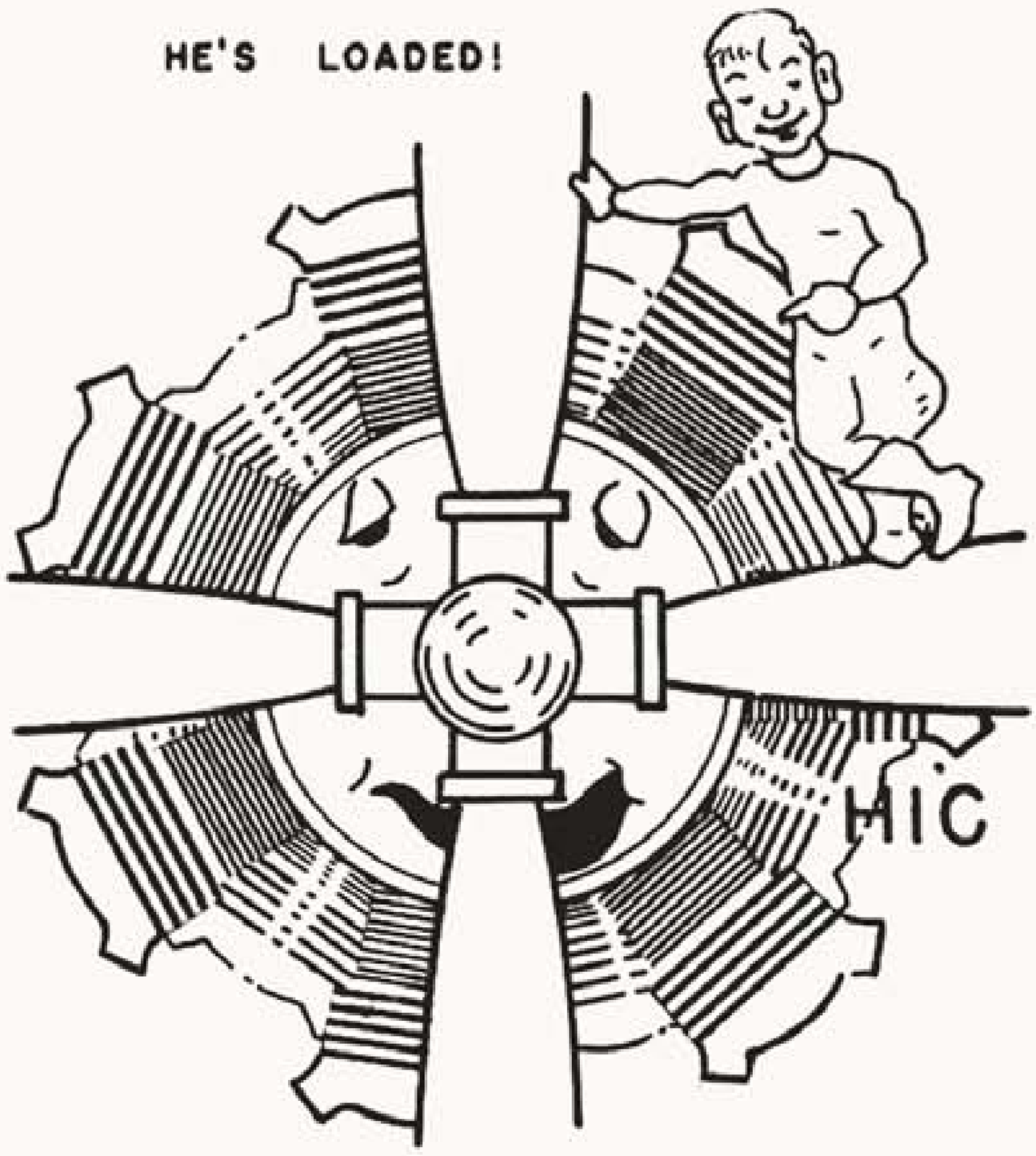
Still moving to the right we come next to the main switch box. Actually it is located down low beside the pilots seat from which most of the electrical circuits are controlled. We could name off the switches to you, but you can read the inscriptions on the box as easily as the hieroglyphics on this page, so we will only attempt to cover the high spots. In the upper rear corner of this main switch box, is a screw cap which covers a "receptacle". This "receptacle" is provided to serve as an outlet for any extra appliances such as an electric-heated flying suit or an electric shaver (24 volt of course!). Next forward are the battery and generator switches, and forward of these are the recognition light switches. In the extreme forward upper corner is the keying button for the recognition lights. By the way, it may be of interest to you to know that the recognition lights and the detonator (the blower outer of the IFF radio) are independent of the battery switch and will operate at any time so long as there is a battery in the airplane.

Moving down along the forward edge of the switch box you will find the auxiliary fuel pump switch, the primer switch (spring loaded to return to neutral), and the starter switch (which operates from "Start", or energize, to "Mesh"

and is also spring loaded to return to neutral), arranged from top to bottom in the order named.

Only one other item remains which you should understand if you really have a desire to "start things" in this airplane, and that is the function of the "B" switches. "B" is short for circuit breaker. You know, if you break your arm you can't move your fingers. Well, if you break an electric circuit the lights won't light. Simple, isn't it? These switches are of two types, toggle and push button but both perform the same function. The first thing to check then if an electric unit does not work is the "B" switch or the circuit breaker. Under all normal operation conditions on the ground as well as in the air these "B" switches should always be <u>on</u>. They do not of themselves control the function of the units.

The pilot's handbook outlines the starting procedure much more completely than we will attempt to do here. All we have to offer are a few suggestions. First, do not use the throttle as a pump. It is not one and cannot be so used. Set it as per the aforementioned instructions and <u>let it alone</u>! Moving the throttle only serves to increase or decrease the air passage of the carburetor. It has no direct connection with the fuel lines. The primer switch however, does have a direct connection to the fuel lines and it should be remembered that as long as the primer lines are opened by the switch being held on and the fuel pump (auxiliary or otherwise) is on, raw gasoline is being poured into the supercharger housing. If the primer is held on too long the engine



will become loaded and actually will die of suffocation. Of course, an engine must receive fuel to operate, so strike a happy medium in the operation of the primer. (On the first 978 airplanes, the primer is the only possible method of getting fuel into the cylinders, or rather the intake manifold, before the engine is running. There is another possibility on the SB2C-3, but we won't mention it here or you would know as much as we do). You must remember that all -3 and -4 airplanes use a Stromberg Carburetor and must always be started in "idle-cut-off". Of course in each attempt at starting the mixture will be moved forward to full-rich, but don't forget to return it to idle-cut-off before each fresh attempt. Keep one thing in mind in connection with the use of the primer and your luck may be improved. Heat has a direct relation to the amount of time required to vaporize fuel. Solid gasoline will not burn. Therefore, the vaporization time is most important. In application this means that on a cold day the primer should be used long enough in advance of the actual "meshing" to permit the raw fuel to vaporize and diffuse to the intake ports of the several cylinders. The warmer the day, the shorter the period of time required.

This brings us to the third or fourth item, which is the mixture control. The cautions in the pilot's handbook and in the technical orders say always to start every engine in the idle-cut-off position. This is such a good habit to develop that we can only add our word of approval to it. But don't be confused and think that putting the mixture control in full-rich is going to cause a back-fire. Far from it. If you remember what we said about fuel being required for the engine to run, you will know that back-fire is caused by insufficient priming or by moving the mixture control back during starting, and not the other way around. To sum the whole business up in a non-technical statement we might put it thus: A rich

mixture ignites more quickly than a lean mixture. Not only does it ignite more quickly but it produces more heat and power. Too lean a mixture ignites slowly and due to the inertia of a slow start, valve overlap permits the burning mixture to escape into the induction system, and the phenomenon known as backfire occurs. Q.E.D. Are you still with me? One other item which we will only mention in passing is that you cannot idle the engine at excessively low R.P.M. without fouling the plugs. To be more exact never let the engine speed fall below 800 R.P.M. for more than three (3) minutes at a time. It is better to keep the "idle" speed up to 1200 R.P.M. than to let it fall below 800-900 for any length of time.

Well, so it started on the fifteenth try did it? We were not so fortunate. It took us sixteen trials and we burned out two starters in the process. Oh, we haven't mentioned that feature yet have we Well, the starter is electric, that is, it is operated by an electric motor. At "starting" speed it should be rotating at a rate of 22,000 R.P.M. It requires only about 15 seconds of running for the starter to acquire this speed, and twenty seconds is sufficient extra time to be sure the proper speed is attained. Any excessive operation will only contribute toward its wearing out. The high rotational speed in this case does not have a cooling effect. The moral is, if the engine does not take hold on the second or third trial, wait about five minutes for it to cool off before making another try. Just think how tired you would be if you had to run that fast for the same length of time!

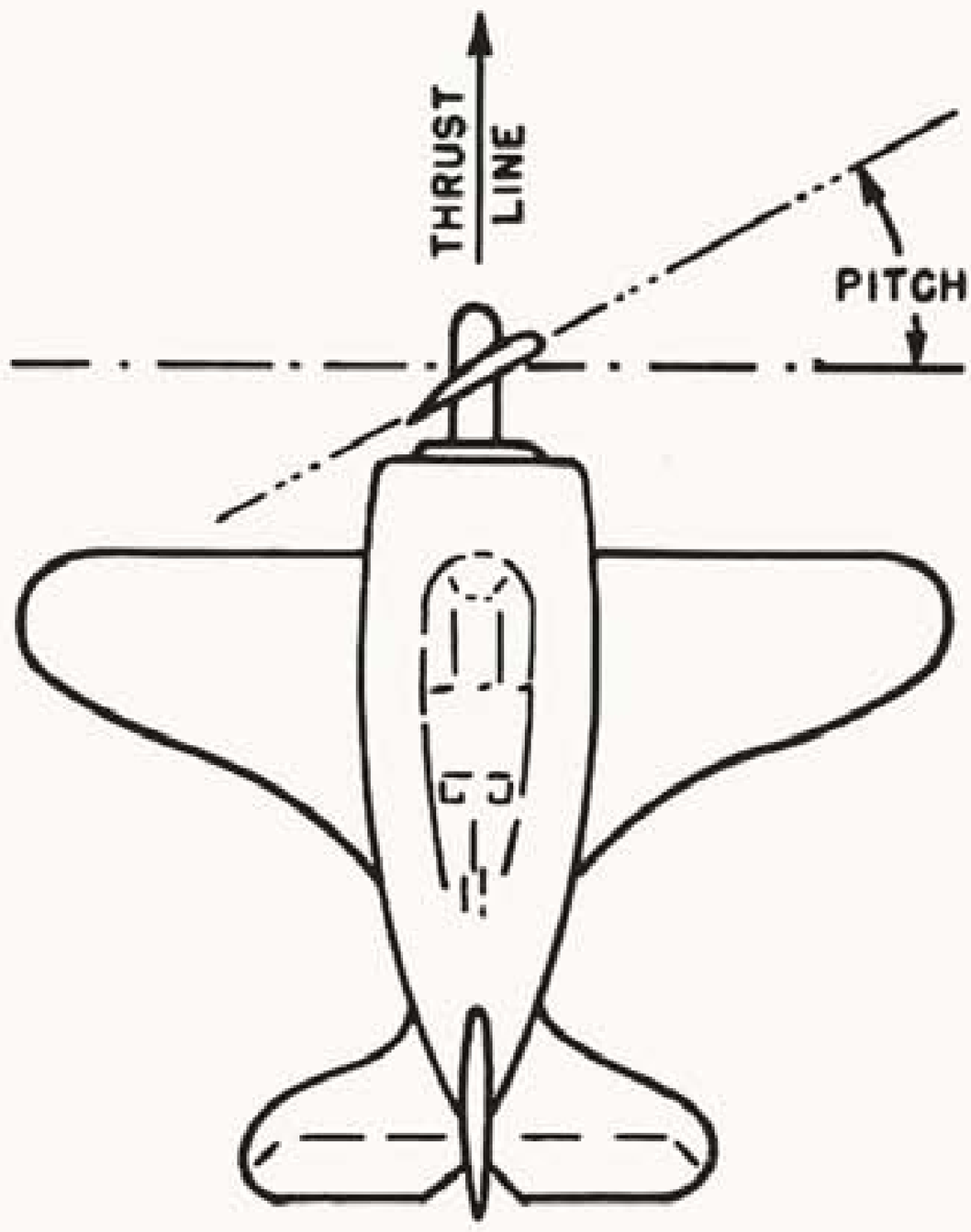
CHAPTER III

The Air Screw

In some ways we feel the term "air screw" is actually a better name than that we commonly use, but then by any other name (?).

Getting down to the fundamentals, the airplane under discussion is equipped with a Curtiss Electric, three or four bladed, controllable pitch, constant speed propeller. Both propellers are controlled in the same manner and are practically the same in construction; we will, therefore, for the sake of simplicity, talk about the four bladed unit only. And to be quite elemental, we believe we can explain the entire operation in which you as the pilot will be interested, simply by explaining the subject paragraph herewith completed.

"Electric", means the propeller is operated by an electric motor. No, it is not rotated by an electric motor, it is rotated by the engine (Wright R-2600), but the pitch of the blades is changed by an electric motor contained in the power unit housed in the spinner. The pitch of the blades is the angle the blades make with a line drawn perpendicular to the line of flight. The greater the propeller pitch, the faster you fly! (That is, within limits, because the blades take a bigger "bite" of air on each revolution.) Another related item you may "file and forget", is; the bigger the "bite" taken the harder the engine must work.



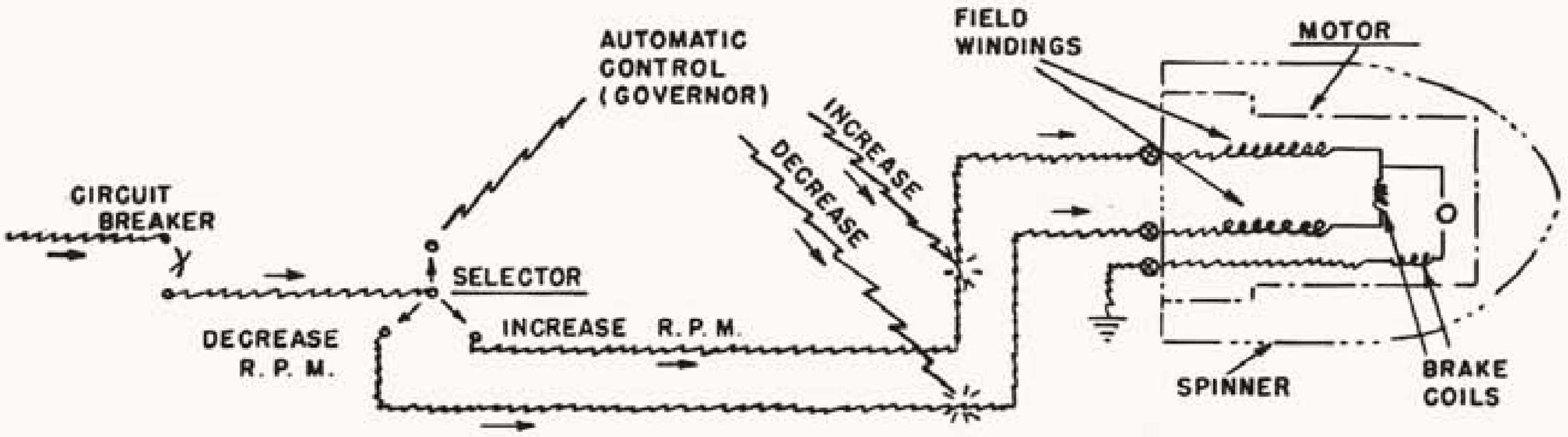
To get back to our electric motor, it is so installed that it will change the pitch of the blades in flight as well as on the ground. Since tremendous pressures are exerted on the blades in flight, a gear ratio of about 7,000 to 1 is

made between the motor and the blades. This should help to assure you that the blades will not change pitch suddenly and leave you holding the bag. And just to contradict another illusion you may have, may we say the propeller will not go into "high pitch" if or when the electric current fails. The blades are locked by two powerful spring operated brakes and can only be released by a flow of current through an electric magnet also located in the power unit. As a further comfort to you, all tendencies of the blades are to move toward low pitch. That is just a physical law over which we have no control.

"Controllable pitch", means we do have control over that tendency but we must bring in that 7,000 to 1 gear ratio to do anything about it. We speak of our control as being both "manual" and "automatic", but it must be remembered that either is electric!

Perhaps you never could read an electric diagram, but we are going to include one here and use it to explain these electric operations. We hope it works. The flow of the current is from left to right in this diagram. Just follow the lines through to the ground () sign and that is it. The first item is the circuit breaker. This (as the previously mentioned "B" switches) acts only as a fuse in the circuit and has nothing to do with the actual operation. Next in line is the "selector switch". This is the point at which the manual and automatic control comes in. If the switch is moved "up", the automatic control is thrown in. The automatic side of the story will be mentioned briefly later, let's get a picture of the general operation of the system first.

One electric motor with two field windings operates the pitch changing of the blades. If the current is directed

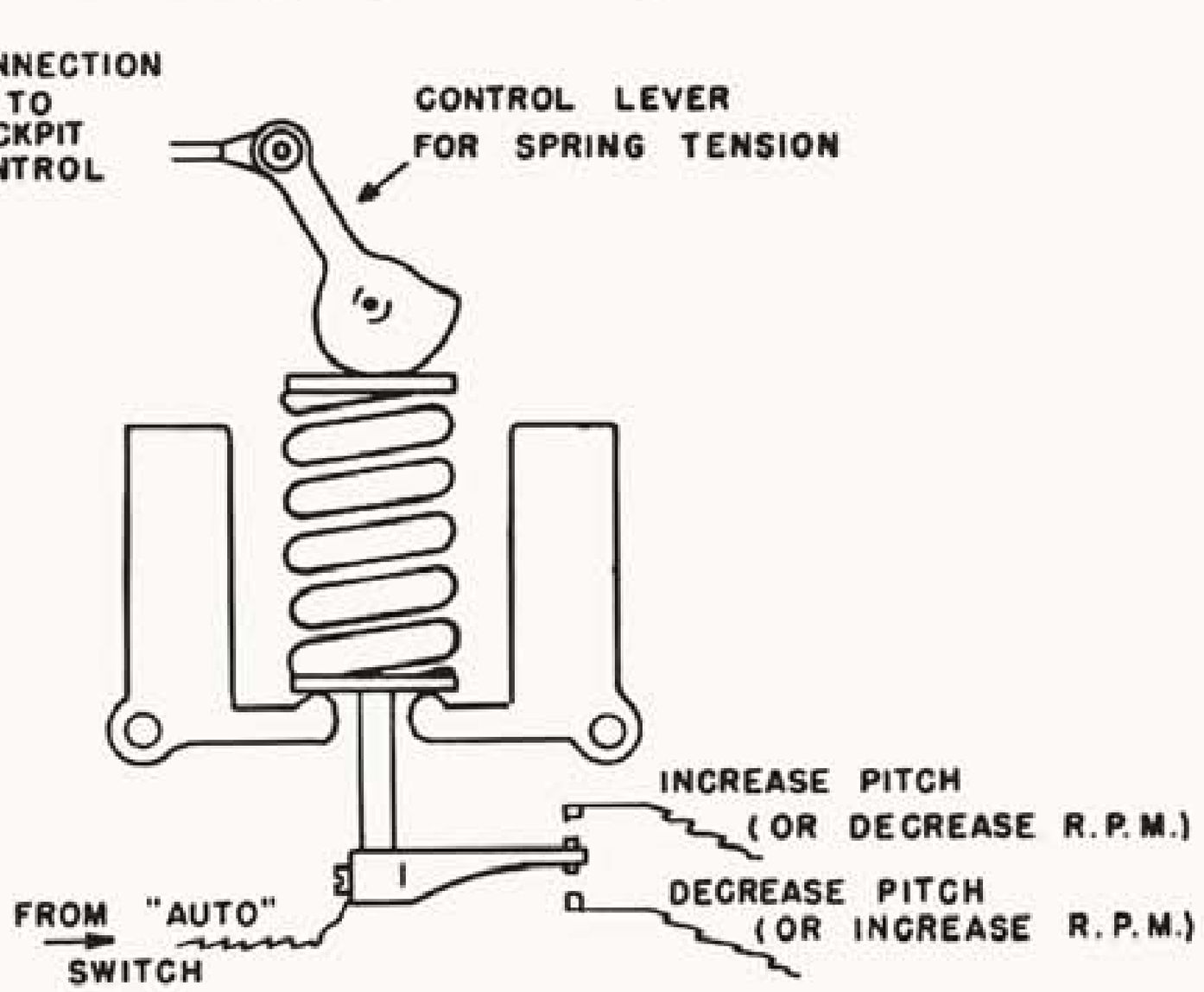


through one winding the motor will revolve one way and if it is directed through the other winding the motor will be reversed. For "manual" control, the selector switch is moved to one of the two lower positions and makes the contact which

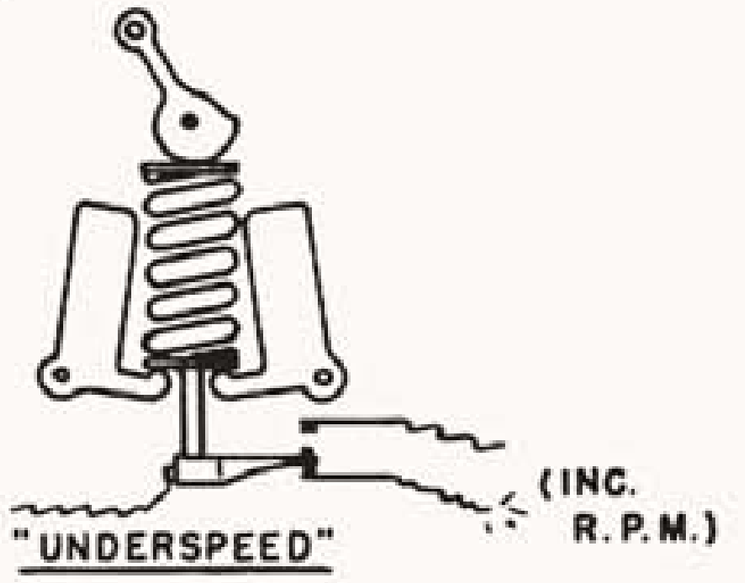
causes the blades to rotate toward "low" or "high" pitch. The selector switch is spring loaded and automatically returns to "neutral" from either of the manual positions. With the switch in the "neutral" position all current to the "power unit" is "cut-off" and the blades are then held in whatever position they may be in at the moment by the two spring operated brakes.

On the automatic side, a gear arrangement is made with the engine itself, to keep the engine at a constant speed. Can we go a step farther now without becoming confused? Let's try. - The governor geared to the engine is similar to any other fly-weight governor. Figuratively speaking we can say that as the fly-weights are moved out by centrifugal force they lift a contact which engages the lead to the "increase pitch" winding of the motor, the pitch of the blades increases and the engine slows down under the greater load. (Remember that item we told you to "file and forget"?) The fly-weights then move back in under the pressure exerted by the controlling spring, the same contact is lowered and touches the lead to the "decrease pitch" winding of the motor, the pitch of the blades decreases and the motor, working against a lighter load speeds up. This could go on indefinitely but the manufacturer thought it might be possible that you might desire at some time to stay "on speed" for a while, and so a blank space was left in the middle to permit some variation without having the propeller blades change all the time.

This last illustration is supposed to be the final word in clearing up the explanation so far given. The "control



"ON SPEED" CONDITION



"UNDERSPEED"

"OVERSPEED"

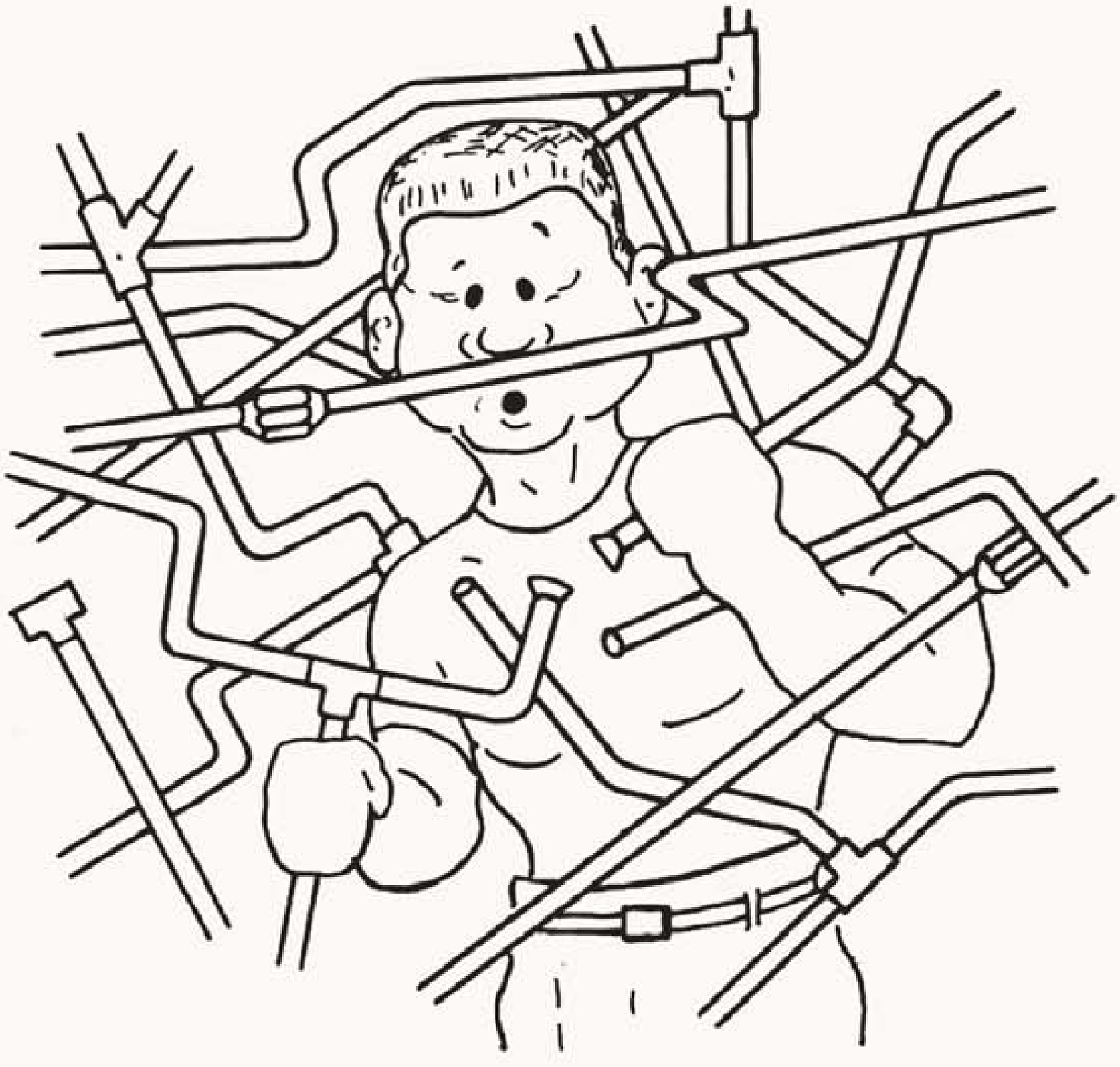
lever for spring tension" is the thing you move when you operate the lever on the thottle quadrant in the cockpit. If you have understood everything we have said so far you can readily understand that changing the tension on this spring will change the highest speed or lowest speed, at which the engine will be "on speed".

If you have not understood; - well - we tried!

CHAPTER IV

HydrOILics & Stuff

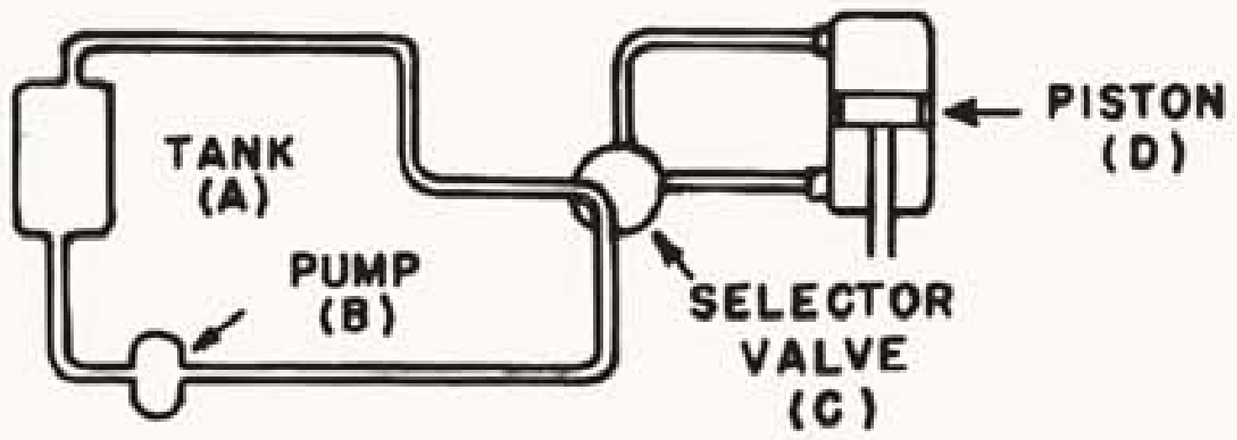
Are you ever bothered with pipe dreams? Do you know your shut-off valves? Does your oil pressure fluctuate like a passing wave? Then perhaps you are having hydroilic troubles. A good look into the bomb bay is not suggested as



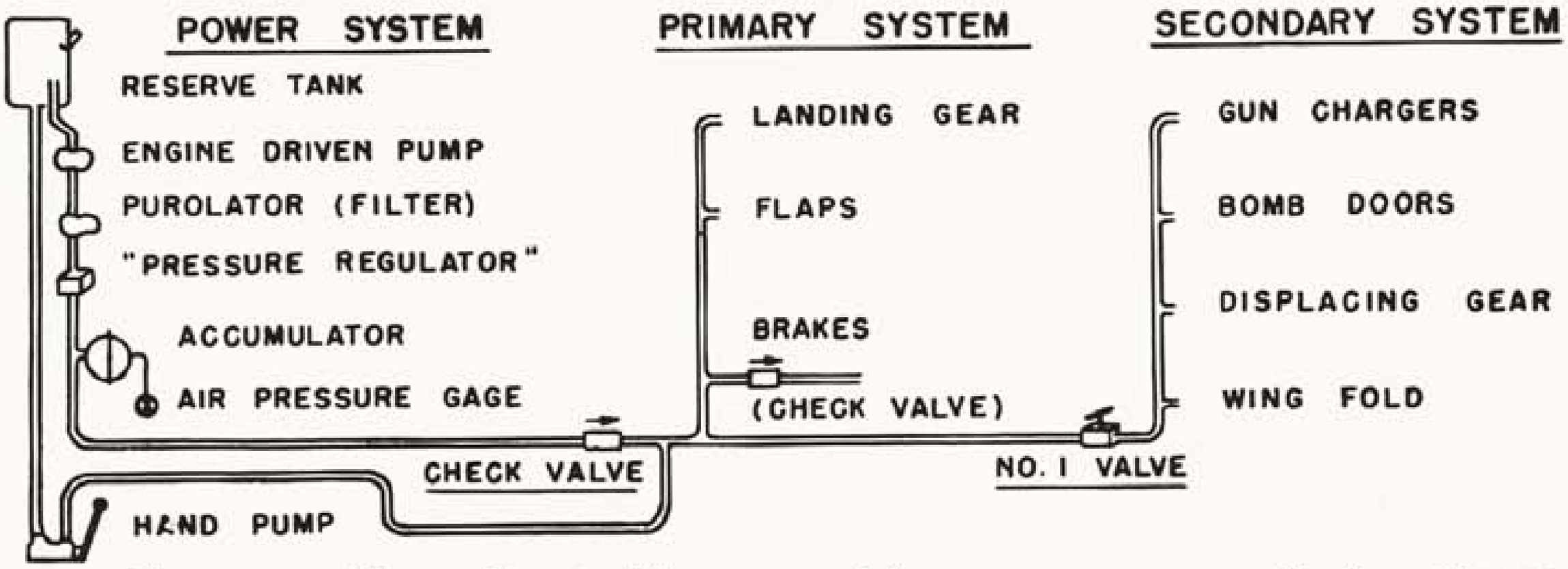
a cure for these symptoms. Nor do we intend herein to argue either pro or con on the advantages or disadvantages of the system. All we can hope to do is to help clear up the subject for you just as we have already done, (Joke) for the propeller and other items in the airplane. In short, we trust to leave you with a feeling of complete serenity and confidence in the hydraulics of the SB2C airplane.

You must believe us when we tell you that in truth the hydraulic system of the SB2C is a simple system. The little

diagram on the next page actually shows all the essential units of the system. In its simplest form as indicated, the only units needed are: a fluid supply tank (A), a pump (B), a selector valve (C), and an operating strut or piston (D). Each additional appliance in the system is only a refinement of this basic system. Do not let any one confuse you about the system by telling you anything else. Of course, we admit it has a great many more parts than are shown in the sketch below, but again remember these additions are only refinements of the basic system.



Take a blank sheet of paper and fill it out as per the information given just below. All of the main units of the system are listed here.

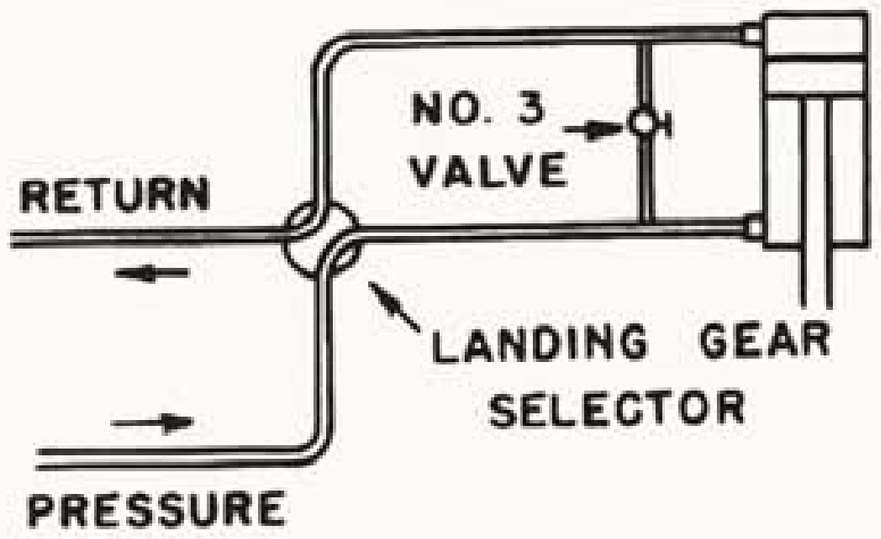


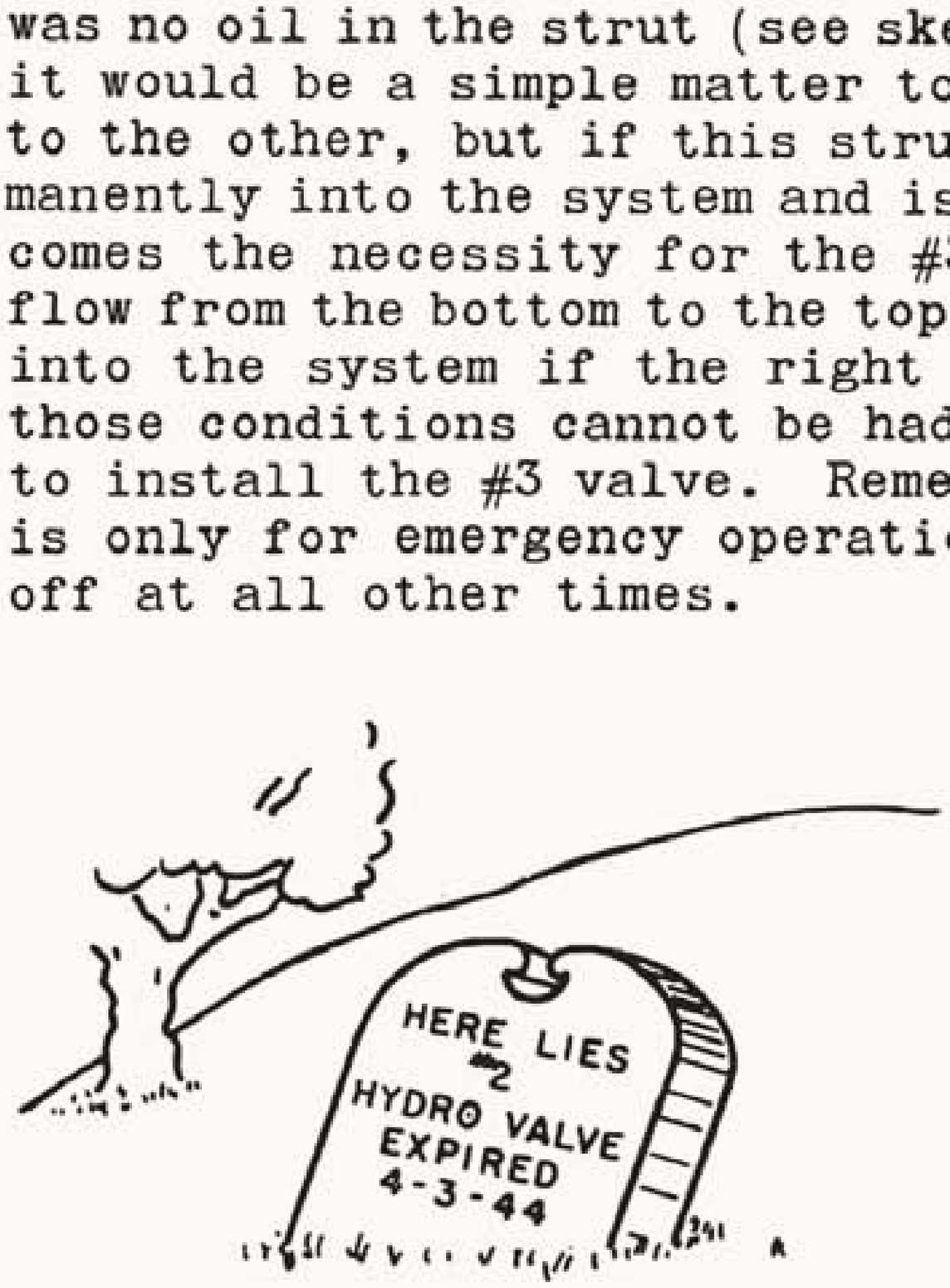
Now, notice that these units are arranged in three groups called; the power system, the primary system and the secondary system. Actually, it is all one system, you are just given a certain amount of control over the entire system through these separate groupings. In general the flow of oil is from left to right in the diagram (in the airplane it is from front to rear). If you shut off the valve marked #1 the oil flow to the units of the secondary system only will be stopped. (Fold your paper on the line running through the #1 valve and you'll see what we mean.)

As long as the engine driven pump and other units of the power system are functioning properly, there will always be a flow of oil into the "primary system" and if you leave the #1 valve open that same flow will continue into the "secondary system". If you are not using any of the units, the "flow" becomes a "pressure" of about 1000 p.s.i. and this pressure

will be registered on the gauge on the instrument panel. As we've said, the power system will always supply a "flow" or "pressure" to the rest of the system until something goes wrong. Then the entire system fails! Well, almost, but not quite. We still can fall back on the hand pump (of course, you shouldn't fall on it too hard!). As you can see, there is a direct line from the supply tank to the hand pump and the hand pump is connected directly to the primary system. - Now the reason for the check valve between the power and primary systems becomes evident. Oil can flow through this valve in one direction only so if the power system fails and your trust is placed in the hand pump, your efforts will not be wasted on a defunct power system. (Webster helped me on that one, too.)

There is another thing we want to mention now and that is the necessity for some type of relief (not W.P.A.) for the hydraulic oil in case it is desirable to operate some of the units manually. Again we take out our trusty paints and construct for you a lovely picture. Starting at the beginning, if there was no oil in the strut (see sketch)
it would be a simple matter to shift the piston from one end to the other, but if this strut is (as it is) connected permanently into the system and is full of oil then -- well, then comes the necessity for the #3 valve. It allows the oil to flow from the bottom to the top of the strut. It could go back into the system if the right conditions existed, but since those conditions cannot be had by wishing, it is much easier to install the #3 valve. Remember, however, that this valve is only for emergency operations and should be tightly shut off at all other times.





What happened to the #2 valve? Well, ask some old-timer. It was kicked around until it just expired under one of the drawing boards of this engineering department.

- Oh, sad day! To be more explicit it has been, in effect, removed from the system. The actual valve is still in on most airplanes in service but it is safety

wired off from the balance of the system, in such manner as to always permit the flow from the engine driven pump to pressurize the complete system.

With the system at least somewhat in mind now, may we suggest the following as an EMERGENCY HYDRO CHECK-OFF procedure. Remembering that normally the #1 valve should be "on" or "open", the #3 valve closed, and that the system pressure (indicated on the instrument panel gauge) should be about 900 to 1000 pounds per square inch. As long as these conditions prevail let the system alone, (if the pressure is up and still the hydraulic units don't work, we'll make the same guarantee they make for parachutes that don't open!)

Check-off List

A. If the indicating needle on the pressure gage (on the instrument panel) is oscillating more than usual, or if it fails to register, a leak or complete failure of the system is indicated. If a failure is evident your first concern should be with the fuel supply.

   1. If gas is very low, refer to booklet entitled "Dunking Sense".

   2. If fuel supply is adequate, proceed as in sections B or C following.

B. A complete loss of pressure may be the result of an engine pump failure or a depletion of the oil supply available to the engine pump. There are still five quarts of oil in the tank which are available to the hand pump. (Recall the system schematic.) If this occurs.

   1. Close the No. 1 valve - at once!

   2. If pressure cannot be obtained with a few strokes of the hand pump, place the flap actuator handle in "neutral" and try again.

   3. If pressure still cannot be obtained:-

WAIT: - until point of landing is approached! From now on, whatever you do is done! You can't make a second attempt. Again check your fuel. You should have at least fifteen min-

ute supply as an adequate margin of safety before continuing with the outlined procedure.

NOW: -

4. Carefully move the landing gear handle down to an approximate mid-position, which is essentially a neutral position.

5. Again operate the hand pump in an attempt to build up pressure. If pressure is obtained - - - maintain the status quo. In short, don't touch nothin'.

a. The pressure obtained can be used to pump the flaps down to the desired angle.

b. With flaps down return the actuator to "neutral".

c. Operate the hand pump to build up a reserve for later operation of the brakes. Try to obtain at least 1,000 p.s.i. (But don't waste this reserve by trying the brakes in the air!)

d. The landing gear can be extended by gravity.

6. If pressure cannot be obtained with the landing gear handle in the mid-position: - - -

The balance of the operations depend largely on that old reliable force known as gravity. Don't forget that by this time you should be circling the point of landing. So - - -

7. Open the No. 3 valve.

8. Put the landing gear handle full down. (The wheels probably went down when you first tried to find the mid-position of the quadrant, but with the No. 3 valve open they will now lock, if they have not already. Remember the indicating flag just starting up will indicate the locking pin is securely in the forging.)

9. If it is possible to obtain pressure with the landing gear handle in the down position and the No. 3 valve again closed, the landing gear locking pins may be forced into the forgings under pressure.

Note: If there is a pressure of 100 p.s.i indicated on the brake air pressure gage you may be sure of some braking power for landing.

Perhaps before discussing remedies for excessive oscillation, it might be well to mention an item about the emergency operation of the landing gear. A tremendous amount of hand pumping may be saved in lowering the gear if the No. 3 valve is opened before the selector handle is placed in the down position. This permits the oil in the cylinder to flow from one side of the retracting strut to the other as gravity pulls the gear to the down position. Allow about two minutes for gear to completely bottom then close the No. 3 valve and pump the locking pins in. If you attempt to pump the gear down all the way, you will find the pump so small and the retracting cylinder so large the task becomes almost endless. In opening the No. 3 valve you let the gear do most of its own pumping.

May we also recommend opening the flaps before lowering the landing gear whenever you must depend on hand pump operation alone? (At other times you may suit your choice.) This suggestion is made on the supposition that you may have a broken landing gear "down" line. You may use your own judgment on this recommendation, however, for successful carrier landings are often made without flaps.

C. If needle is oscillating more than usual:

1. Push the gun charger handles in and snap them out sharply. This should stop any by-passing of oil through the valve.
2. If oscillation does not stop. Close the No. 1 valve. This closes off the secondary system and will stop the leak if it is in this part of the system.
3. Any dirt in the brake valve which may be causing a by-pass of fluid, may be dislodged by smartly depressing the brake pedals several times.
4. If oscillation still continues place the flap actuator handle in "neutral". If oscillation stops the leak was in the flap "closed" line. You won't need that line to open the flaps for landing anyway.

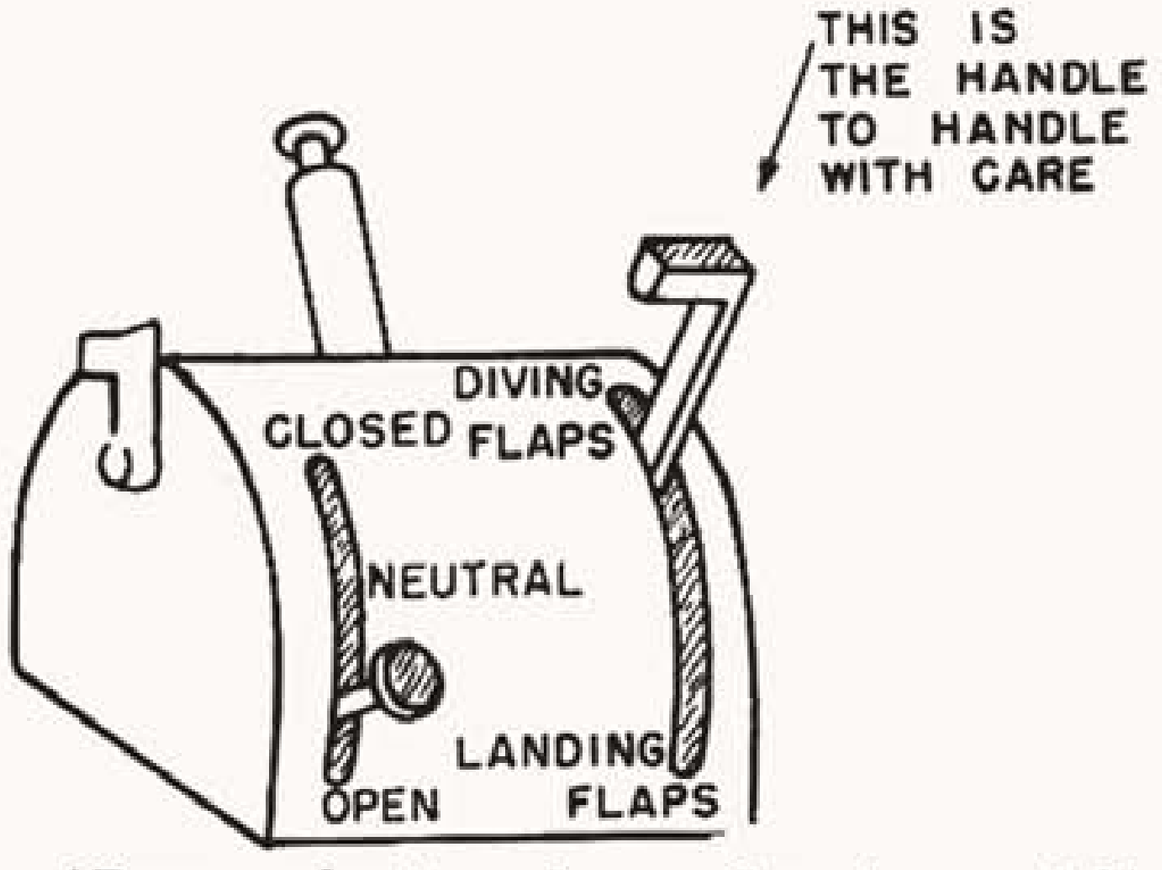
Remember that although seven units are hydraulically controlled all the units you will ever need in flight (almost) can be had with or without hydraulic pressure. To be specific: the wing fold will probably not be desired at 10,000 feet; the bomb doors are "spring loaded" (or under constant spring pressure) and can be opened by opening the #3 valve

and moving the selector handle to the "open" position; the weight of the bombs will swing the displacing gear "out", with or without hydraulic pressure (it will automatically retract when you land! Bomb doors should be open); if you have charged the guns immediately after take-off, and placed the control on the "Safe" position, even these may be used by simply moving the control to the "Armed" position. Of course, if the guns jam - well we've heard of fellows who fought battles with the propeller blades! The flaps cannot be opened, but what do you think the arresting hook is for? The brakes probably will work. The landing gear has been mentioned.

By the way, what would you do in case of a fire any place but in the engine compartment or fuel tanks? Of course you might try flying under water but even the sharks don't like soggy cigarettes. So if it appears to be a hydraulic fire:

1. Close the No. 1 valve. - But quick!
2. If fire still burns, place flap actuator in "neutral".
3. If fire continues to burn: - Move landing gear handle to the mid-position, even at the risk of extending the gear. If the landing gear "up" line is broken the oil forced out by the strut will continue to feed the fire until the gear reaches the full down position, then the fire will go out.
4. If the fire has not gone out by this time, the hydraulic system is probably not at fault. May we refer you to the booklets "Parachute Sense", or "Dunking Sense"?

One last word, the flaps may be operated by hand pump pressure if you got pressure under step B-4. There is, however, one caution which cannot be over-emphasized. Always try to obtain 800 p.s.i. pressure in the system before making selection of landing and diving flaps. Here is the picture again, (You know, the picture worth a thousand words) that shows which control we mean. Move the inb'd handle as often or whenever you desire, but do not touch the outb'd handle unless the flaps are closed, the system pressure should be at least 800 p.s.i. (Boy, what a long last word!)



So solly - stand by for late bulletin - honorable engineer inform us flaps designed to close when no pressure exist in lines - wish to convey recommendation to place control in neutral position when diving or landing. Honorable flaps closing at these times most embarrassing - in neutral position oil in flap lines blocked off from rest of system. So can lose system and still have flaps. Honorable author trust sometime information help defeat Hirohito.

Again - late bulletin as we go to press. Remember the manipulation which was necessary on the previous Beasts in closing the flaps by degrees on carrier take-off? You used to have to shift the handle from neutral to close - to neutral - to close - to neutral - - until you finally obtained the flap setting desired? We trust those days are over.

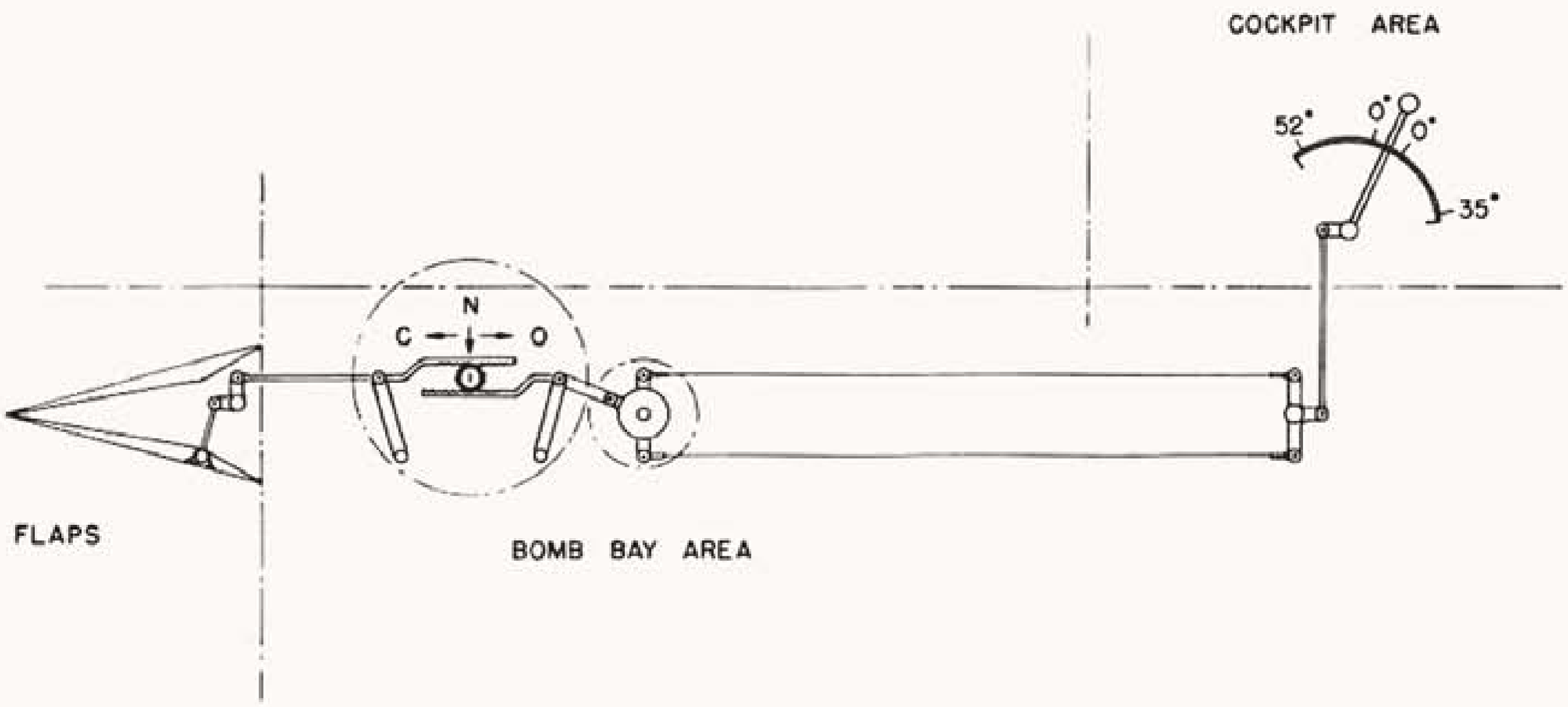
On the -5 airplane, the flap actuator and selector handles have been consolidated into a single control handle and moved to the left console in the front cockpit. The one control now does the complete job. It is now possible to pre-select any desired degree of flap movement merely by moving this control to the desired setting and leaving it there. You can in short ease the flaps open, and ease the flaps closed, just as it pleases you.

The new type mechanism requires only one consideration. You must wait until the phase in progress is complete before moving to the next. Or in moving the control handle from the full up or full aft position to the full down or full forward position you will find you must hesitate twice, first - when the handle reaches the landing flap "0" position (to wait for the flaps to close), next - when reaching the diving flap "0" position (to wait until the diving flaps have been selected). Then the control may be moved into the diving flaps range.

The arrangement which causes this is much like the gear shift on early automobiles. It was not until the Synchro-Mesh Transmissions were developed, that shifting could be done without hesitation. The hesitation period is not long, it is only to assure that one operation is complete before another begins. We do not intend that you worry too much about this flap set-up, but we will include a small sketch to give you an idea of how the system works. This is not an exact picture, it only represents the general installation and operation.

Notice first that the sketch is divided into three areas

- the cockpit area, bomb bay and the flaps. In the cockpit is the control handle and the quadrant. The upper segment of the quadrant is the landing flap range, the lower segment of the quadrant is the diving flap range. It will be noted that



there are two zero positions on the quadrant - one is zero landing, the other is zero diving. It is beyond these two zero positions that the selection for landing or diving flaps is made. Beyond the zero positions, the handle will cause the flaps to open or close, depending on its direction of movement.

The sketch shows the handle between the two zero positions. The bellcranks, connecting rods and cables are shown to be in the neutral position for all units.

Let us review flap operation a moment. Two distinct operations are necessary in using the flaps. One is the open and close operation - the other is the selection of landing and diving.

The selector unit in the bomb bay area is cable operated, as shown in the sketch. The small phantom circle encompasses the selector for landing and diving flaps. The large phantom circle encompasses the valve for opening and closing the flaps.

Look for a moment at the small circle. Assume that a selector valve (operated on a rotation principle) is connected to the center circle. Now follow the linkage - as the cockpit control is moved toward 52° (landing), the unit in the

small circle rotates clockwise selecting landing flaps. Moving the control toward 35° (dive) rotates the unit in the small circle counter-clockwise selecting dive flaps. The valve connected to this unit has considerable over travel so that once landing or diving flaps are selected, rotation may be continued without altering the selection.

Connected to the rotational drum of this forward unit is a small projecting arm, with a linkage back to the large circle area. As shown, this linkage to the second circle will be gradually pulled toward the right. As the linkage moves to the right, it will cause the small idler gear in the center, to also move to the right toward position "O". Now if the idler gear is connected to a valve and "O" represents the position of the valve which opens the flaps, then the valve will be selected to open the flaps.

Absorb this a moment before continuing to read.

In looking farther into the diagram another thing becomes apparent. As the flaps open, the linkage on the left will be pulled and the idler gear will be moved back toward "C". But it will never reach the "C" (or close) position because it arrives at "N" first. "N" is neutral which shuts off the flow of oil and stops the opening of the flaps. It can also be seen that the farther the control in the cockpit is moved toward 52° (or 35°) - the farther the idler gear will be moved away from the neutral position, therefore, the wider the flaps must open before the gear is again returned to neutral, shutting off the flow and stopping the flaps from further opening. Reversing the action of levers in the cockpit, will reverse the action in the bomb bay.

In simple terms the movement of the cockpit control determines which flaps (landing or diving) shall be selected and the degree of movement desired. The movement of the flaps themselves return the idler gear to its center position and stop further opening of the flaps.

A word about the rocket installation, since rocket pigtails have a tendency to dent exposed portions of flaps. Two items have been incorporated on the -5 airplane to attempt and prevent such a thing occurring inadvertently. One is an automatic switch - which breaks the circuit and prevents the rockets being fired if the outer panel flaps are open more than 4". The other is a hydraulic valve which closes off the return flow of oil from the outer panel flap struts, and so prevents

the flap opening. This valve is operated by the switch located beside the flap control handle on the left console. When it is desired to use the inboard flaps only the switch must be in the "rocket flap" position - if all flaps are desired, the switch must be in the "dive flap" position. Provision is made to assure full landing flaps at all times, regardless of the position of the rocket switch.

One other item should be mentioned about the -5 hydraulics. A sequence valve is incorporated which automatically prevents the bomb bay doors closing on oversized objects which may be attached to the bomb racks. This works very well except for the torpedo, it is a little long and hangs out in front. It is necessary therefore, that the doors be closed under hand pump pressure when the torpedo is installed. Care should be taken that the doors merely come up to the torpedo and do not press against it. The shut off (or sequence) valve mechanism is at the middle of each door and the front end of the doors would be crushed against the side of the torpedo, before the sequence valve would be actuated. After bringing the doors to a snugly closed position, place the selector handle in neutral and do not touch. Remember your vanity, crumpled bomb doors are not very becoming to a respectable airplane.

As a final note don't forget to open the bomb doors before dropping the torpedo. The only reason for closing them at all is to provide clearance for the catapult bridle. So, may we suggest you open the bomb doors as soon after take-off as you have a free moment then you can forget them until after your run on the target.

CHAPTER V

Finis

A word concerning crash landings. We hope you never have any, but if you do, remember that in most cases the pilots who have taken the time to understand (through study) the airplane they are flying, are the ones who live to fly again some other day. In this particular airplane perhaps the most important thing to remember is to first get rid of the auxiliary fuel tanks. The two on the wings are easy, just drop them the same as bombs. The "belly" tank is just as easy, but don't forget to open the bomb doors. If it so happens that after dropping the tank you have no hydraulic pressure to close the doors or can't pump them up with the hand pump, and to top it off you can't get the wheels down, well at this point it becomes a "fielder's choice". But don't take this too much to heart, we have never heard of such a case. We have heard some controversy among pilots as to whether the bomb doors should be open or closed for a deck landing. Some feel that the doors form a sort of skid and help prevent damage to the airplane structure. But others contend that the doors might catch on something and throw the ship end over end. Suffice it to say here that both methods have been successfully used and to date no fatalities have occurred solely because the doors were either opened or closed.

We have not yet mentioned anything about ditching (Ditching-Dunking-What's the difference the airplane goes into the water just the same) the airplane. What we say here will in no sense take the place of the ditching information you have already studied, it will only call to mind a few items directly related to the SB2C.

First be sure your wheels are "up". This is one of the reasons we told you on page 22 to check gas supply before fooling with hydraulic handles. If you had lost hydraulic pressure then dropped your wheels you could not get them back up. Remember hanging appendages are not conductive to unperturbed ditching. This brings up the bomb doors.

Again the recommendation is to <u>keep the doors closed</u>. If you are carrying a bomb load at the time, it is of course

advisable to dispose of it before ditching the airplane or it may dispose of you upon ditching. If you have lost hydraulic pressure you can close the doors with the hand pump unless you have a leak in the lines, in which case you will leave the doors open. (By the way, if you can get no pressure in the hydro system the bomb doors may be opened by opening the #3 valve and moving the bomb door selector lever to the open position.)

The life raft is carried in a container secured in the upper left side of the fixed cabin. It is easily accessible from within the rear cabin, but the rear canopy must be open to get at it from the outside. To open the rear canopy, depress the button on the right side of the fuselage just below the leading edge of the canopy itself, and slide canopy forward.

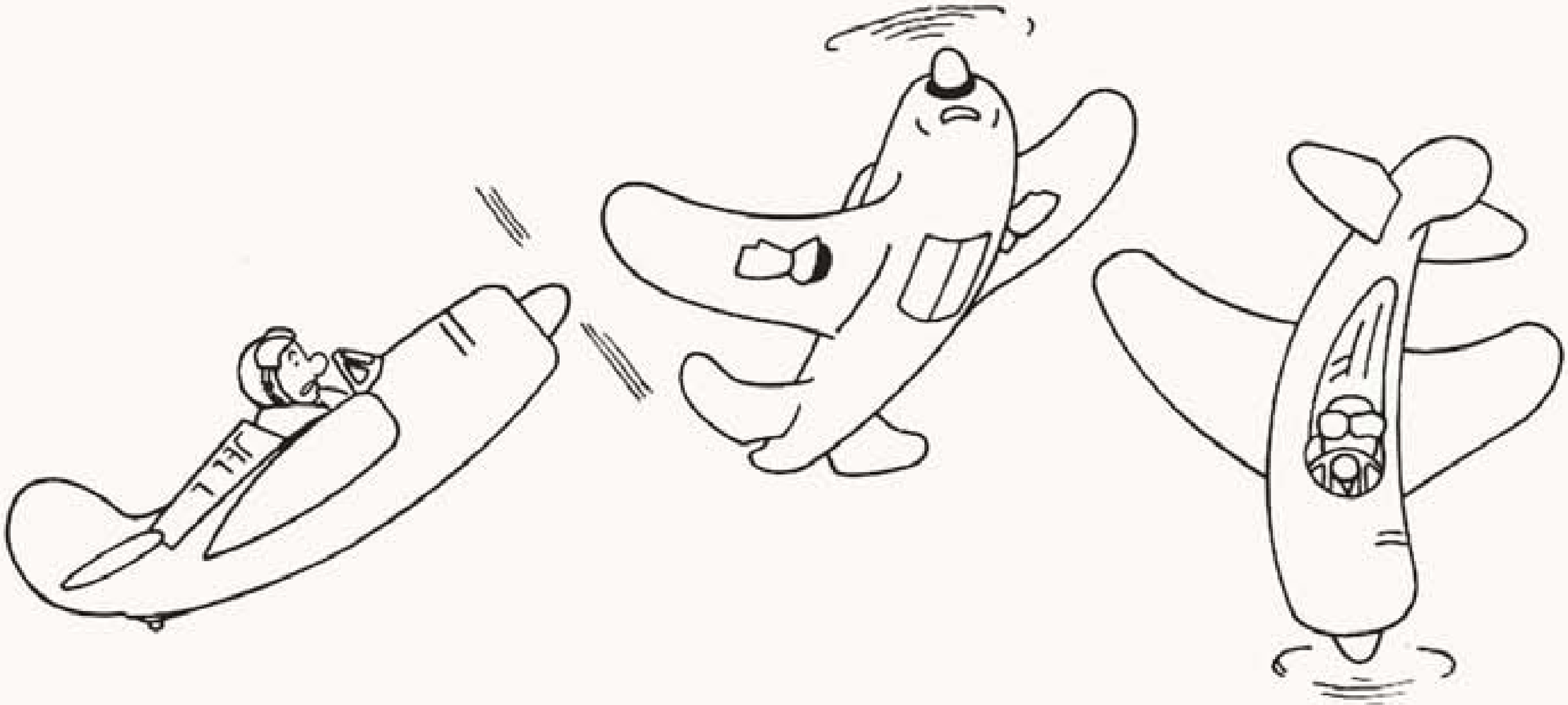
For the actual flight approach in ditching, remember to keep your tail low. Let it drag first and pull you in, in short try to make a normal carrier approach. Keep power on as long as possible but don't forget to cut the engine as soon as the tail begins to drag.

Yet that you may not be misguided in your normal flying from 40 to 40,000 feet, remember your basic training. "The greater the angle of attack, the higher the stalling speed." In short - to keep your head up, keep your nose down. There has been an ever-increasing tendency among pilots (most of whom are no longer with us) to pull the nose up when the engine starts to sputter or die-out. This is just the time when it becomes necessary to force the nose down, and we might at this point go to great length in telling why such things occur but - how can you expect to pick up speed going up hill? Maybe you are flying only 50 feet above the water but hold that nose down, after all why give Hirohito one for free? So in your ditching procedure keep the nose down in approaching the surface of the water. Then after you reach an altitude of approximately six inches you may pull the nose up as high as you wish so long as you don't gain altitude.

As an application of this newly acquired outlook we feel that in carrier take-off's you should never try to hang the airplane "on the prop".

SATISFACTORY ANGLE

SATISFACTORY ANGLE



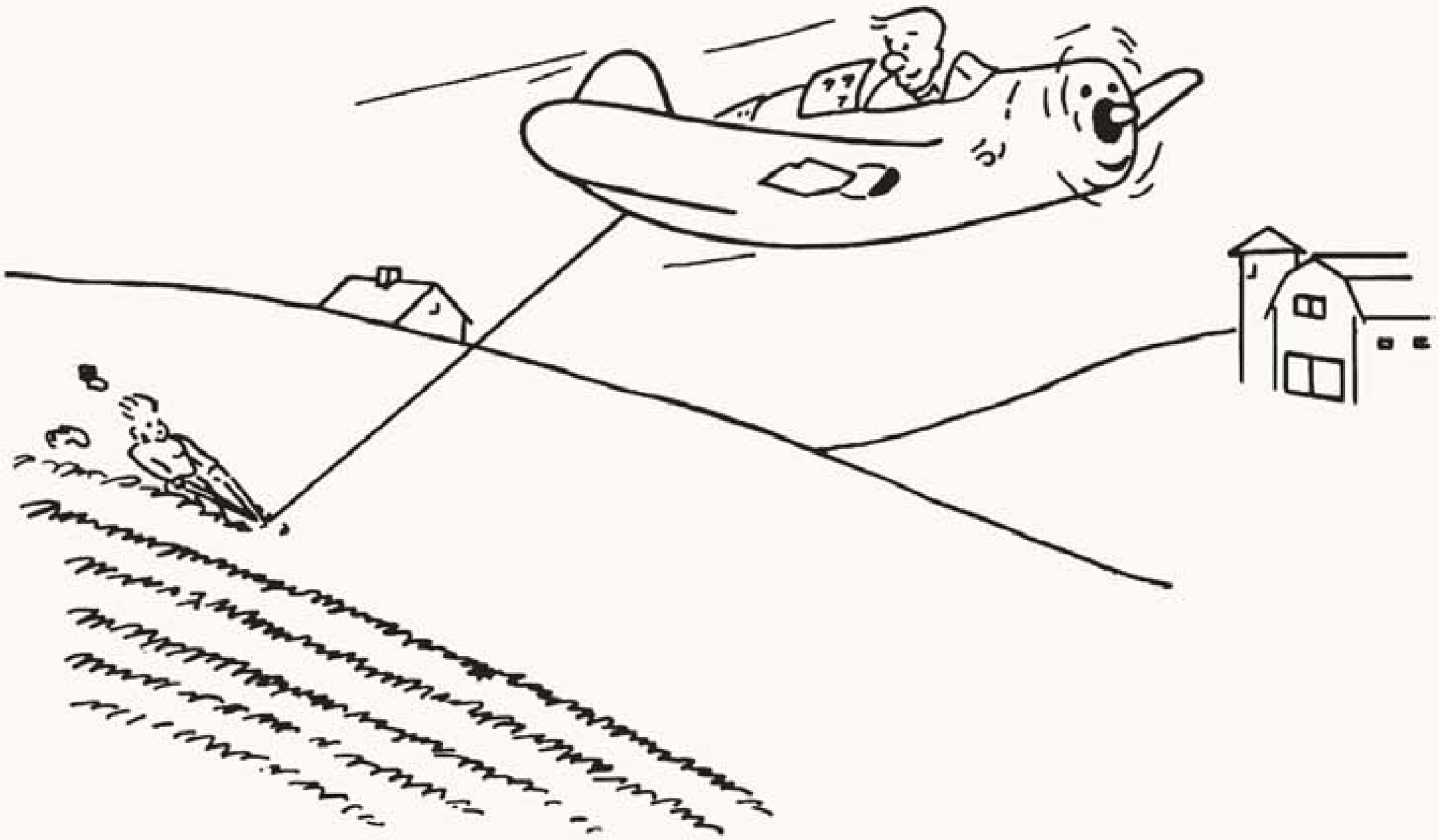
UNSATISFACTORY ANGLE

VERY UNSATISFACTORY ANGLE

And so with the thought that, if you keep your wits about you and understand the general workings of the airplane, you will always have a "fighting chance" and as a result a "chance to fight", we leave you to your own devices. Please don't feel that after reading this short treatise, you understand everything about the SB2C airplane. You have only received your introduction to it. Continue your study of the ship on every flight, and then pass the information you have gained on to the next fellow. This is the only way we can all learn. No one man can ever know the complete story, but we can all know more than we do. (There is only one who should be left out of this, that is Hirohito.) If you find difficulty in understanding any of the items of operation, we suggest you contact the nearest Curtiss representative. Who knows, even he may be able to help you. He spent some time with the airplane and in a training school before he left the plant and he might have picked up a little information that way.

And now, here's to good flying and happy landings. The airplane is yours, and you must learn by doing. We hope you

do very well indeed, and at the end of the war, find yourself on a peaceful farm still carrying the torch for the SB2C. Perhaps you can do your spring plowing with the "Beast".



SB2C-5 SUPPLEMENTARY

The Pilot and The Beast

Since first we went to press, progress has been made! The Columbus plant has given birth to a bigger and better Beast, the -5. We were able to hold up the proof copies long enough to include information on the new flap arrangement, but a number of items had to be passed by for lack of time. If you will bear with us now for a few more minutes we will try to bring you right up to date. So far as we know, we have made no mistakes in the printed text, but we do find it necessary to add to the material extant.

Weight

On page 2 we mentioned the airplane weighed upward from 13,000 lbs. The -5 at its minimum combat weight exceeds 15,500 lbs! The structure has been reinforced to accommodate the additional strain, but we still advise consultation of the latest T.O. in ascertaining the maximum permissible gravity acceleration.

Wingfold Control

As a further measure to prevent the wings from accidentally folding at 10,000 ft. (a practice still frowned on in the better circles), two separate controls must be operated on the -5 instead of the single unit mentioned on page 4. Both control handles are mounted to the left of the instrument panel above the console. In operation, the red upturned handle, must be drawn to its full aft position to unlock the white (or hydraulic selector) handle. Incidentally, pulling the red handle back also operates the lock pins. The white handle controls the hydraulic action of the wings, and may be moved from its normal (or "neutral") position down to fold the wings or up to extend them. When the wings are fully extended and locked,

as indicated by the position of the flags, check to see that the white handle is in "neutral" and the red handle is full in.

Landing Gear Down Lock

The landing gear indicating flag which was often damaged inadvertently by being stepped upon, has now been reworked into a spring loaded plunger. Go ahead, walk on it whenever you like.

Cabin

The forward cabin has been redesigned to give you greater visibility inasmuch as it is now composed of a single sheet of plexiglas on each side, the jettisoning device remains where it was. For increased safety a positive lock has been added to hold the cabin open no matter how rough an arrested landing you make.

Cockpit Arrangement

If the space alloted to this brief were greater, it might be well to undertake an entire new cockpit check-out, but the major changes can be mentioned in a few words. The hydraulic have all been moved to the left side of the cockpit, except for the gun chargers, the brake valves and the displacing gear which have remained in their old locations. The wing fold control is in the forward left corner of the cockpit. A control quadrant has been incorporated in the left console, and the landing gear, wing flaps and bomb doors are operated from this quadrant. The cowl flaps and the oil cooler flaps are now operated hydraulically and their control handles are also mounted on the quadrant. The old #1 and #3 valves have been replaced by the "A" and "B" valves which are located on the deck beside the left console. The "A" valve is now the shut-off valve for the secondary system. The "B" valve is the system dump valve.

The arresting gear control is now on the right console. Most of the electrical switches

are mounted on the right console altho the ignition switch is on the left console. The armament switches are mounted on a panel below the instrument panel.

Startor

On page 17 we told you how tired the starter would get if energized excessively. Now a direct cranking startor is installed as this kind does not build up a high rotational speed. It should be noted however, that the propeller blades will start to rotate as soon as the starter switch is engaged, so don't think the starter is stuck when this happens.

Fuel Capacity

For those of you who enjoy being "up in the air", two extra 45 gallon tanks have been incorporated in the wings. Don't expect to stay up too long however, for the fuselage tank has been decreased in capacity by 55 gallons. The net gain then is only 35 gallons, but deploying the fuel in this fashion moves the C.G. ahead in respect to fuel loading.

Gun Sight

The gun sight is no longer stowed on the deck. In the -5 it is permanently mounted above the instrument panel. In the first -5's the sight may be rotated clockwise for stowage. In later models it will be mounted in a fixed position under the bullet resistant glass. The sight target will shine directly upon the glass.

So far as we know this covers most of the major differences between the -5 and earlier models from a pilots standpoint, but we lay no claim to perfection. The check-off list which starts on page 23 is still correct, but for the -5 you should mentally substitute "A" and "B" for #1 and #3, for reasons previously stated.