51-16

Arm, Actuating
M-9722155
1 piece used
400/year now
1000/year anticipated

	Lot Size	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost		22.67	7.00	16.45	$46.12
Suggested Cost	100	.51	4.03	incl	$ 4.54
	500	.51	0.83	incl	1.34

Tools--$370.00

COMMENTS:

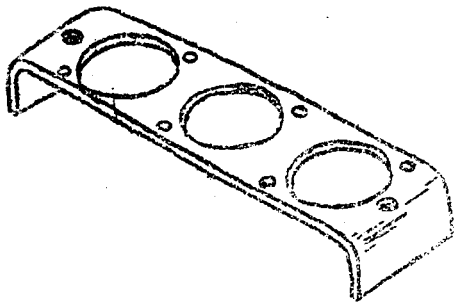
1) This arm controls the gear sector.

2) The Control Division has multi-slide wire machines capable of making this part at the prices shown above. Close tolerance wire would be used to eliminate the screw machine operation. It may be necessary to remove burrs from the ends of the wire.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH:M

Bracket-Transformer
M-9720791
1 piece used
400/year now
1000/year anticipated



	Lot Size	Mat'l/C	Adjusted Labor/ C	IME/C 235%	Shop Cost/C
Present Cost	---	11.50	3.90	9.30	$24.70
Suggested Cost	100	21.50			$21.50
	500	12.90			$12.90

Tools--$62.00

COMMENTS:

This bracket supports the transformers which convert the line voltage to a low enough value to prevent arcing in the potentiometers at high altitude.

The bracket can be bought, complete, from a reliable supplier at the prices shown.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Spacer-Latch Pin
M-9722154
1 piece used
400/year now
1000/year anticipated

	Lot Size	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	--	0.52	12.10	28.40	41.02
Suggested Cost					0

COMMENTS:

1) This spacer keeps the latch away from the frame.

2) It is suggested that this part be eliminated by making the boss on the casting .060" higher.

3) Punched washers can be purchased to the print for $1.45/C in lots of 1000.

4) Our own punch press department can make the part for $4.00/C.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Spacer-Latch Pin
M-9722154
1 piece used
400/year now
1000/year anticipated

	Lot Size	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	--	0.52	12.10	28.40	41.02
Suggested Cost					0

COMMENTS:

1) This spacer keeps the latch away from the frame.

2) It is suggested that this part be eliminated by making the boss on the casting .060" higher.

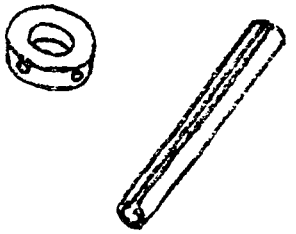
3) Punched washers can be purchased to the print for $1.45/C in lots of 1000.

4) Our own puhch press department can make the part for $4.00/C.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Washer-Thrust
K-9708719
2 piece used
800/year now
2000/year anticipated



	Lot Size	Shop cost/C
Present Cost		$143.92
Suggested Cost		-0-

COMMENTS:

These washers engage the latch to prevent turning of the pitch trim potentiometer while the altitude switch is engaged.

First Alternative: eliminate

A suggested change of the shaft (discussed on the shaft page) would incorporate, at no additional expense, the function of these washers into the shaft itself.

Second Alternative: substitute

One roll pin could be used in place of these two washers in conjunction with a minor change in the present design of the latch (as discussed on the latch page.)

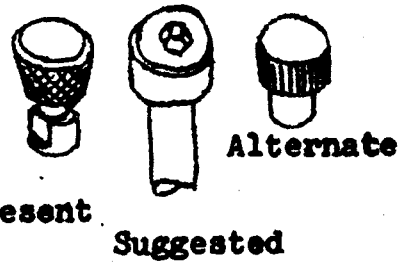
Third Alternative: method of production

The washers may be purchased complete for $71.00/C.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Knob, Push Button Switch
M-9720781
2 pieces used
800/year now
2000/year anticipated



	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	101.23	23.70	55.80	180.73
Suggested Cost				-0-

COMMENTS:

1) These knobs are pushed to engage the autopilot or the altitude control.

2) It is suggested that the knob and shaft be consolidated into a standard Allen-head shoulder screw.

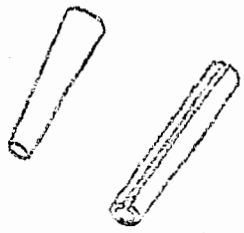
3) On the present shaft, a standard black plastic knob (threaded brass insert) could be used. A slight change in the end of the push button switch shaft would be necessary to accommodate this knob.

Lot Size	Shop Cost/C
200	9.90
1000	7.40

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Taper Pins



	Lot Size	Pcs/Unit	Costs Present	Costs Proposed
N501 P805 #6/0 5/64 pin x 5/16	500	2	.99	.772
	2500			.372
N500 P805 #6/0 5/64 pin x 5/16	500	3	2.92	.772
	2500			.372
N501 P906 #5/0 3/32 pin x 3/8	500	2	2.94	.768
	2500			.418
AN385-50-3 #5/0 3/32 pin x 3/8	500	2	1.06	.768
	2500			.418
AN385-50-4 #5/0 3/32 pin x 1/2	200	2	.98	1.307
	1000			.432
AN385-50-5 #5/0 3/32 pin x 5/8	200	2	.97	1.331
	1000			.456
N501 P1108 #4/0 1/8 pin x 1/2	200	1	2.61	1.094
	1000			.494
AN385-40-4 #4/0 1/8 pin x 1/2	200	1	1.21	1.094
	1000			.494

COMMENTS:

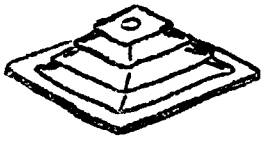
1) These pins are used throughout the assembly.

2) We believe that for most of the above applications, roll pins should be seriously considered.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Boot
1 piece to be used
400/year now
1000/year anticipated



Suggested Cost	Shop Cost/C
Mold $350.00	$100.00

COMMENTS:

1) This boot would be used in place of the costly machined surfaces of the barrel and yoke which now attempt to seal the opening in the panel.

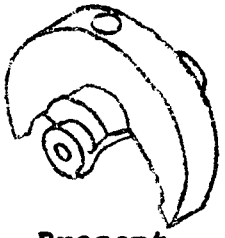
2) A silicone rubber boot can be made for the above price by the Chemical Department.

3) A vendor has stated that he believes neoprene will do the job and that he can supply parts for well under $1.00 each. He has been sent a print and will quote.

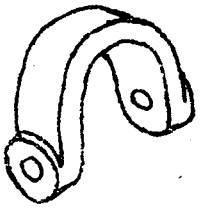
MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Yoke
P-9783323
1 piece used
400/year now
1000/year anticipated



Present



Proposed

	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	45.08	330.40	776.60	1152.08
Suggested Cost	40.00	47.80	112.30	200.10

COMMENTS:

1) This yoke helps transmit the pitch signals to the pitch selsyn and covers part of the opening in the panel.

2) It is suggested that a new yoke be designed as shown. A boot costing $1.00 as described elsewhere would cover the opening.

It is proposed that the casting be designed to give sufficient clearance without machining except where accurate surfaces are needed. The following planning for the new casting machining operations is proposed.

a)	Ro File	.017
b)	Sand blast	--
c)	Drill, rm., & burr 2 holes to .250 etc.	.020
d)	Bore .296/.292" & .3125/.3123" dia. holes	.050
e)	Ro drill, ream, & bore (2) .0943/.0938 and (1) .1567/.1562" D. holes	.155
f)	Remove burrs	.03
		.272 x 1.76

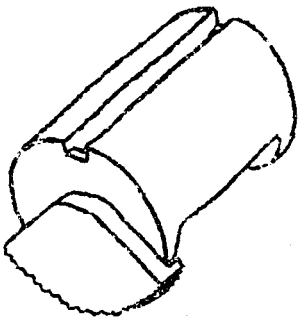
3) An investment casting vendor quotes $275/C for the yokes per drawing. Any dimensions which must be held closer than ±.003" will have to be machined ($785.00--mold price).

4) On machining the present part, an estimated $100/C could be saved if the internal surfaces were cast to give the desired clearances. The drilling cost for item (10) of the planning would be about $15.

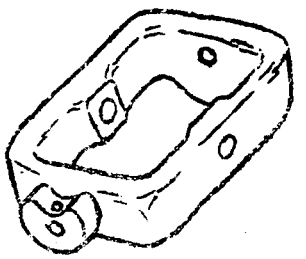
MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Barrel
T-9741827
1 piece used
400/year now
1000/year anticipated



Present



Proposed

	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	75.31	584.00	1374.00	$2033.31
Suggested Cost	65.00	193.00	454.00	$ 712.00

COMMENTS:

1) The barrel is used to help cover the opening in the top panel while allowing the roll motion of the stick.

2) It is suggested that a box casting shown above be used with a rubber boot to cover the opening. This boot is shown on another sheet. The suggested planning of the machining in this casting is as follows:

a)	Rough File	.009
b)	Sand Blast	--
c)	Rough & finish turn right end	.200
d)	Rough and finish turn left end	.200
e)	Profile I/S pads to dim.	.07
f)	Dip right end to dim.	.150
g)	File burrs	.100
h)	Ro-drill &bore "E" & "F" cpt.	.320
i)	Drill & burr cpt. less dowel hole	.027
j)	Tap cpt.	.004
k)	Burr bursh & fin.	.016
		1.096 x 1.76

3) By using the investment casting method, the barrels would cost $4.25 each. Any dimensions which must be held closer than ±.003", and the gear teeth, would have to be machined. (mold price - $1075.00)

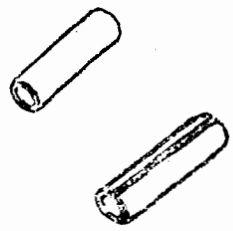
4) On the present planning, it is felt that operations (3-5) and (4-5) will become lower when a time study is made. The filing (8) could be on piece work at about $.15. This could perhaps be lowered to $.10 if the filing of the 47° I/S angle can be eliminated. It is felt that the cost of turning the teeth should be about $.10 to bring it in line with other planning on this job. The painting also seems high. About $.10 seems better.

The suggested casting shown is designed for use of a tape drive on one end for the roll selsyn. The present cam drive would be used for the turn compensation selsyn. It can be adopted to gear drive by adding the gear segment.

MATERIALS & PURCHASING DEPT
VALUE ANALYSIS UNIT
August 1951

AGH/M

Spacers



	Quan. Req'd	Lot Size	Shop Cost/C
Present Cost			
201A233-P1 approx.5/16 x 1/4	2	--	$13.98
-P2 approx.11/32 x 1/4	1	--	20.27
-P3 approx.17/32 x 1/4	1	--	21.71
201A280-P1 5/8 x 1/4	2	--	15.00
Suggested Cost			
201A233-P1	2	200	1.91
		1000	1.36
-P2	1	100	2.46
		500	1.58
-P3	1	100	2.58
		500	1.70
201A280-P1	2	200	1.91
		1000	1.36

COMMENTS:

1) These spacers are used to support the terminal boards and the transformer bracket.

2) The suggested costs (above) indicate that the substitution of roll pins might be a feasible alternative. Each roll pin would be driven into the frame to the desired depth. Then the terminal board or bracket would be forced over the extending end. This would also eliminate the screws now used for holding these parts on.

3) Another alternative would be zinc plated brass spacers which are available in standard sizes as follows:

3/8" long	1.16/C
1/2" long	1.16/C
3/4" long	1.32/C

4) Standard fenolin spacers are available as follows (in quantities of 500 to 1000.) These are lighter than the zinc plated brass spacers.

3/8" long	2.40/C
1/2" long	2.70/C
3/4" long	3.30/C

5) Aluminum tubing with a 125 instead of a 63 finish on the ends can be purchased to meet the specifications. These would cost about 5.00/C.

6) A different approach would be to form the bracket itself to incorporate the functions of the spacers. This would entail a small tool charge.

MATERIALS AND PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Nut-Bearing
M-9722151
1 piece used
400/year now
1000/year anticipated

	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	71.76	8.80	20.60	101.16
Proposed Cost				57.00

COMMENTS:

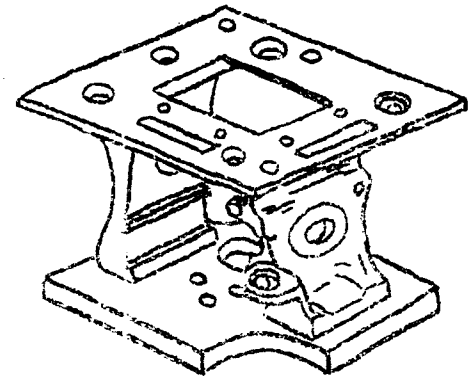
1) This piece holds a bearing in place on the pitch selsyn axis.

2) A reliable vendor can supply these nuts, to print, at the suggested cost.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Supports & Plates
(Machining)
T-9741828
1 assembly used
400/year now
1000/year anticipated



	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	--	238.00	2204.00	$3142.00
Suggested Cost	--	609.00	1431.00	$2040.00

COMMENTS:

1) This is the main frame of the whole control. Here these parts are assembled and their machining is completed.

2) Based upon a partial examination of the operations on this assembly, it is felt that a 50% saving can be realized on all day work operations by putting them on piece work.

3) Possibly a slight further reduction could be realized by straddle milling the step instead of profiling. There does not seem to be any improvement of the auto-pilot by removing the anodize from the area in contact with the cover.

4) Functional necessity does not seem to warrant all of the .0005 in./in. and .001 in./in. tolerances on the supports and plates.

5) A slight increase in cost of this machining may result if the bearing housings are incorporated into the castings T-9741833 and T-9741840 as suggested on those parts. However, this would be more than offset by the elimination of the separate bearing housings.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AGH/M

Support-Bearing
(Roll Selsyn)
T-9741833
1 piece used
400/year now
1000/year anticipated

Present

Proposed

	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost				
Bearing	182.45	133.30	313.20	628.95
Housing	20.93	128.00	302.00	450.00
				1078.95
Suggested Cost	190.00	100.00	235.00	525.00

COMMENTS:

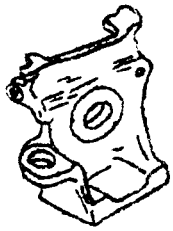
1) This support forms one side of the frame and holds the roll selsyn.

2) It is suggested that the bearing housing and the present support be combined into one casting as shown in the sketch. The cost of machining the supports and plates assembly may be increased slightly but increases will be far more than offset by the savings involved.

MATERIALS & PURCHASING DEPT
VALUE ANALYSIS UNIT
August 1951

AH/M

Support-Bearing
(Turn compensation selsyn)
T-9741840
1 piece used
400/year now
1000/year anticipated



Present

Proposed

	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost				
Support	193.33	156.00	368.00	717.33
Housing	20.93	128.00	302.00	450.93
				1168.26
Suggested Cost	200.00	96.00	226.00	522.00

COMMENTS:

1) This support forms one side of the frame and holds the turn compensation selsyn housing and the altitude control switch.

2) It is suggested that the bearing housing and the present support be combined into one casting as shown on the sketch.

3) Savings in machining of the present or proposed part appear to be possible as follows:

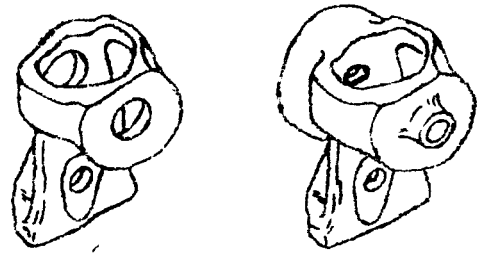
   a) Combining operations (3) and (5) with the proper fixture should allow a savings of $.18 planned cost.

   b) Operation (6) seems high ($.60). $.30 seems better.

MATERIALS & PURCHASING DEPT
VALUE ANALYSIS UNIT
August 1951

AH/M

Support-Bearing
P-9783303
1 piece used
400/year now
1000/year anticipated



Present Proposed

	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost				
Support	129.26	224.00	526.00	879.26
Housing	20.93	128.00	302.00	450.93
Housing	15.36	82.90	194.80	293.06
			TOTAL	$1623.25
Suggested Cost8	135.00	227.00	534.00	896.00

COMMENTS:

1) This support holds the pitch selsyn and detent switch.

2) It is suggested that the present casting and the two bearing supports which assemble to it be cast as one piece as shown in the sketch.

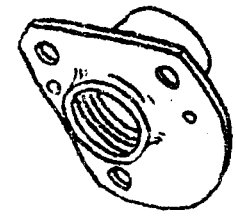
3) It is felt that operation (3) and (5) on the planning could be combined if the proper fixture is used to give a savings of $.06 on the planned cost. It is believed that $.35 would be a good figure for the planned cost of operation (8) on the new design.

4) On the present casting about $.06 planned cost savings could probably be realized by combining operations (3) and (5) with the proper fixture.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Housing-Bearing
(Adjustable)
M-9722153
1 piece used
400/year now
1000/year anticipated



	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	15.36	82.90	194.80	293.06
Suggested Cost				-0-

COMMENTS:

1) This housing holds the bearing for one end of the pitch selsyn shaft extension.

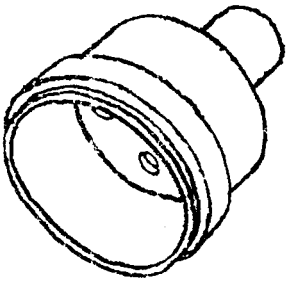
2) If this housing is needed for adjustment, then, it could be done completely in a screw machine at about $35.00/C total cost.

3) However, it is believed that this part could be eliminated by incorporating its function into the pitch selsyn bearing support casting as shown on another page.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Housing-Bearing (Selsyn)
M-9722152
3 pieces used
1200/year now
3000/year anticipated



	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	20.93	128.00	302.00	450.93
Suggested Cost				-0-

COMMENTS:

1) This housing holds the selsyn and its bearings.

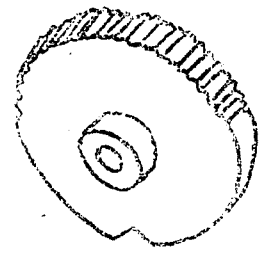
2) The cost of these bearing housings could be reduced considerably by having screw machines both rough and finish turn the part. This could be done for a cost of approximately $35.00/C.

3) However, it is suggested that this part be eliminated by incorporating it into the support castings as shown on those sheets.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Gear Segment & Cam
(Pitch Switch)
P-9783304
1 piece used
400/year now
1000/year anticipated



	Lot Size	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost		17.00	123.00	289.00	$429.00
Suggested Cost	100	210.00			210.00
	500	185.00			185.00

COMMENTS:

1) This piece actuates the selsyn and detent switch for pitch.

2) The part can be purchased at the above cost.

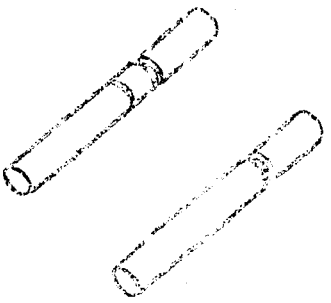
3) On the present part it is felt that the finishing operations 2 and 3 should be done in screw machine. Operation 4 is high in comparison to other gear and cam. Perhaps .075 is better. It appears that operation (1) could be done on piece work for $.03.

Mat'l/C	Adjusted Labor/C	IME/C	Shop Cost/C
30.00	61.00	143.00	234.00

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH:M

Pin-Pivot R. H.
K-9708722
1 piece used
400/year now
1000/year anticipated



	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	6.05	47.00	110.70	163.75
Suggested Cost	0.93	13.00	Incl.	13.93

COMMENTS:

1) This shaft supports the right end of the barrel.

2) It is suggested that the shaft be made all one diameter from centerless ground stock. Then it is only necessary to notch and cut off. This plan was worked out with the help of the Screw Machine Department.

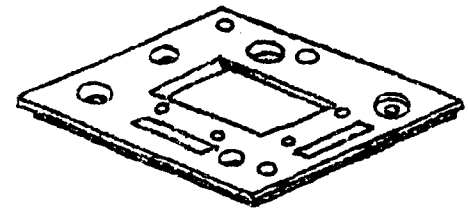
3) The pivot pin used at present may also be purchased at a cost of:

Lot Size	Cost/C
100	$65.00
500	40.00

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH:M

Plate Upper
T-9741831
1 piece used
400/year now
1000/year anticipated



	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	43.98	334.00	786.00	1163.98
Suggested Cost	48.00	195.00	458.00	701.00

COMMENTS:

1) This plate is the top member of the controller. It mounts to the ship and the controller parts hang from it.

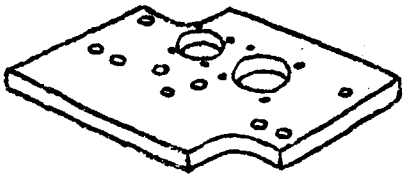
2) It is suggested that special tolerance rolled sheet be used instead of machining thicker plate to the desired thickness. Special sheet with ± .004" tolerance can be purchased for a tolerance extra on the standard price of only $.06/lb.

3) An additional saving of about $180/C would be realized if the step can be eliminated from around the edge. Doing this would raise the controller 1/8" and would require adding pins or other stops under the plate to prevent the cover's caving in on the internal mechanism.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Plate Lower
T-9741841
1 piece used
400/year now
1000/year anticipated



	Mat'l/C	Adjusted Labor C	IME/C 235%	Shop Cost/C
Present Cost	72.19	113.00	265.00	450.19
Suggested Cost	57.00	55.00	129.00	241.00

COMMENTS:

1) This plate forms the bottom of the controller.

2) It seems that special tolerance stock could be used to eliminate the surface profiling operations. This is available at $.06/lb. extra.

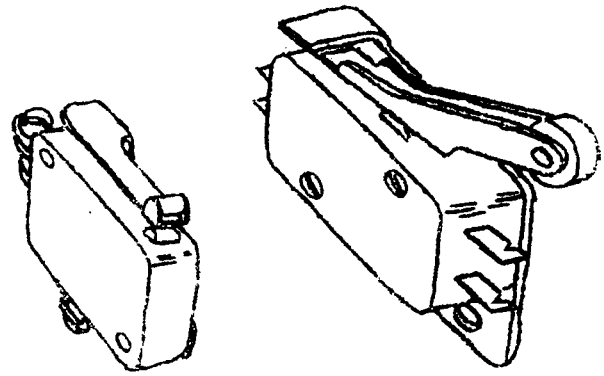
   Also it seems that the plate could be made only 3/16" thick. At this thickness ±.004" can be purchased. At 1/4", ±.007" is the best obtainable.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH:m

Micro Switch & Actuator

V3-1 Switch & JV-5 Actuator
2 each used
800/year now
2000/year anticipated



Present Proposed

	Shop Cost/C	
Cost of Parts Replaced	Roll	Pitch
Switch	$ 63.74	$ 63.74
Actuator	28.37	28.37
Mounting Plate	21.00	16.90
	$113.11	$109.01
Suggested Cost CR1070-D105	$ 93.00	$ 93.00

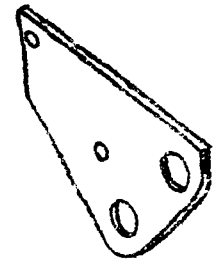
1) These switches change the control of the plane from the gyros to the selsyns when the control stick is moved off dead center.

2) The suggested switch is complete, with the actuator and mounting plate. In addition to the material savings shown above, the cost of assembling these separate parts would be added to the proposed savings.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AGH:AEM

Plate-Switch Mounting (Pitch)
M-9722102
1 piece used
400/year now
1000/year anticipated



	Lot Size	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	--	5.90	3.30	7.70	16.90
Suggested Cost	100	10.30			10.30
	500	6.20			6.20

Tools--$38.00

COMMENTS:

1) This plate holds the pitch detent switch and allows adjustment of the switch.

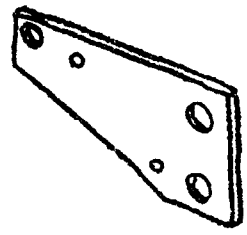
2) The plate can be procured, complete, for the suggested cost.

3) This part will not be needed if a #CR1070-D105 switchette can be substituted for the microswitch as elsewhere suggested.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Plate-Switch Mounting-Roll
M-9720798
1 piece used
400/year now
1000/year anticipated



	Lot Size	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	-	10.00	3.37	7.70	$ 21.00
Suggested Cost	100	10.90			$ 10.90
	500	6.00			$ 6.00

Tools--$40.00

COMMENTS:

1) This plate supports the roll detent switch and allows switch adjustment at assembly.

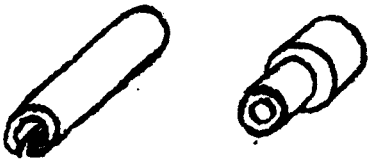
2) The roll switch mounting plate may be purchased for the above cost.

3) This part will not be needed if a #CR1070-D105 switchette can be substituted for the microswitch as elsewhere suggested.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Pin, Stop
K-9708727
3 pieces used
1200/year now
3000/year anticipated



Proposed Present

	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost				85.80
Suggested Cost				.355

COMMENTS:

1) These pins used to limit motion of the pitch trim potentiometer.

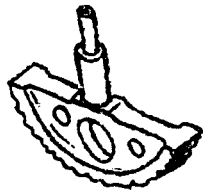
2) It is suggested that roll pins be substituted. If they are used, then the holes do not have to be counter-bored or reamed. This would be additional saving, not shown above.

3) These pins are purchasable at $48.00/C

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Gear Sector Blank
P-9783313
1 piece used
400/year now
1000/year anticipated



	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	23.05	318.00	747.00	$1088.05
Suggested Cost	60.00	162.00	381.00	603.00

COMMENTS:

1) This sector drives the pitch selsyn.

2) It appears that a cost reduction can be achieved in this part as follows:

   a) Combine operations (1)and(2) in screw machine. If necessary, eliminate reducing the thickness back from the rim. This could be done for about $.60 each.

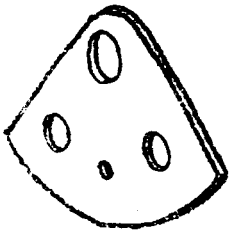
   b) Do not try to maintain .0005 on the .4375" diameter hole in operation (11). Drilling should not cost more than $.07.

   c) About $.05 should be sufficient for the tapping operation.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Cam
M-9720783
1 piece used
400/year now
1000/year anticipated



	Lot Size	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	--	19.00	9.90	23.30	52.20
Suggested Cost	100	10.40	4.40	10.30	25.10
	500	6.20	4.40	10.30	20.90

Tools--$39.00

COMMENTS:

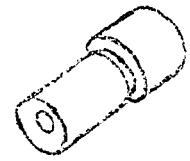
1) The cam supplies the proper motion for turn compensation.

2) The cam can be purchased for the price in the material column with the radius blanked to ±.005". Then there would be no turning operation and the grinding operation would be no greater than that done now. The holes would have to be reamed.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Retainer, Ball
M-9720780
2 pieces used
800/year now
2000/year anticipated



	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	5.99	56.50	132.75	$195.24
Proposed Cost	72.00			72.00

COMMENTS:

1) These retainers hold the ball in the center of the barrel.

2) The ball retainer may be purchased for the above cost.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH:M

Swivel
K-9701541
1 piece used
400/year now
1000/year anticipated

	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	.044	179.00	421.00	600.44
Suggested Cost	76.00			76.00

COMMENTS:

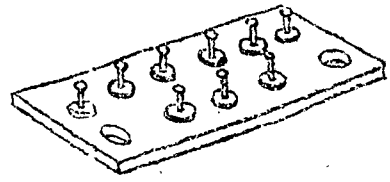
1) This swivel guides the pitch gear sector so that motion is transmitted to the pitch selsyn.

2) The swivel can be purchased at the above cost.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH:M

Terminal Boards
165B881
166B614
1 each used
400/year now
1000/year anticipated



	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Cost to Make				
165B881	27.24	63.00	148.30	$238.54
166B614	27.24	63.00	148.30	$238.54
Cost to Purchase				
165B614				$33.00
165B881				quotation unavailable

COMMENTS:

1) These terminals hold the wires from the selsyns etc. for easy access.

2) The 166B614 terminal boards may be purchased complete for the above figure. While we do not have the exact quotation on #165B881, it is to be expected that the ratio of reduction will be about the same.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Washer
K-9708734
9 pieces used
3600/year now
9000/year anticipated

		Shop Cost/C
Present Cost	9/32 o.d. x .147-.157" i.d. x .031" thick	$4.16
Suggested Cost		.074

COMMENTS:

1) These washers are used under the heads of the screws which hold the selsyn housings in place.

2) A standard cadmium-plated steel washer is available at the above price.

   Suggested Washer--5/16" o.d. x .156" i.d. x .032" thick

3) Monel or 18-8 stainless steel washers, almost to specification, are available at .65/C.

   Suggested Washer--3/8" o.d. x .147" i.d. x .031" thick

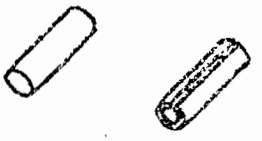
4) Washers to specifications may be purchased from a different source at:

Lots	Cost
1000	$1.32/C
5000	1.09/C
9000	1.06/C

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Dowel Pins



	Quantity Per Unit	Cost/C
Present Cost		
1/8 x 3/8	10	$1.63
1/8 x 1/4	7	1.63
Suggested Cost		
1/8 pin x 3/8 roll pin		.476

COMMENTS:

These pins are used throughout the assembly to maintain part alignment.

Standard roll pins are available at the above price.

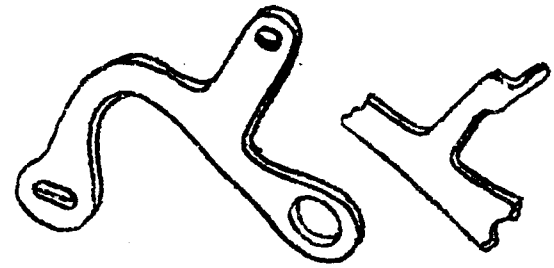
1/4" roll pins are not standard in 1/8" length. However, it appears that 3/8" pins may be usable.

Use of a roll pin eliminates the necessity for reaming the pin holes producing an added substantial saving not above listed.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Arm, Cam Follower
M-9720787
1 piece used
400/year now
1000/year anticipated



Present Proposed

	Lot Size	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Cost of Parts Replaced					
Follower Arm	--	16.00	20.70	48.40	85.10
Actuating pin	--	146.64			146.64
			Total		$231.74
Suggested Cost	100	27.30	2.40	5.70	35.40
	500	16.60	2.40	5.70	24.70

Tools--$41.00

COMMENTS:

1) This arm directs the motion of the turn compensation selsyn by following the cam.

2) It is suggested that a bent-up arm, shown in the partial sketch, be formed on the follower arm to replace the follower pin. There would be no assembly operation of the pin to the arm, giving additional savings not shown above.

3) The suggested part may be purchased for the price in the material column. The only machining operations needed to be done would be reaming and counter-sinking. It may be necessary to touch up the slot although it can be held to ±.001" in punching.

4) The present part may be purchased for the price in the material column below with all holes punched. Only reaming and counter-sinking and possibly touching up the slot, need to be done here.

Lot Size	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
100	16.50	2.40	5.70	24.60
500	9.70	2.40	5.70	17.80

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Pivot, Cam Follower Arm
M-9720789
1 piece used
400/year now
1000/year anticipated

	Lot Size	Shop Cost/C
Present Cost	--	$80.50
Proposed Cost	100	60.00
	500	45.00

COMMENTS:

1) This pivot holds the turn compensation cam follower arm.

2) The pivot may be purchased at the above cost.

3) If the small shoulder could be eliminated, a standard shoulder screw could be purchased at a cost of $16.00/C.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Bushing, Cam Follower Arm
M-9720793
1 piece used
400/year now
1000/year anticipated

	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost	1.93	55.90	131.10	$188.93
Proposed Cost	62.00			62.00

COMMENTS:

1) This bushing prevents wobble of the cam follower arm.

2) Purchase cost is $62.00/C.

3) For the simple function of providing a pivot for the arm, this part in conjunction with the special shoulder screw is judged to still cost two to three times what it should.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Pin, Actuating
M-9720792
2 pieces used
800/year now
2000/year anticipated

	Lot Size	Shop Cost/C
Present Cost	—	$146.64
Suggested Cost	200	60.00
	1000	28.00

COMMENTS:

1) One of these follows the compensation cam while the other is on the actuator of the compensation selsyn.

2) This pin may be purchased at the above cost.

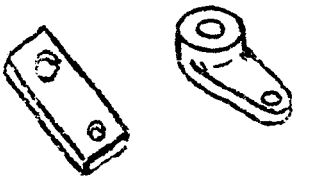
3) A cost reduction of 40% can be realized by increasing the tolerances to ± .001. This would make the pin a one operation part (shop cost $87.90).

4) It was suggested that one of these pins be incorporated into the compensation arm on that part's sheet.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Actuator
M-9720790
1 piece used
400/year now
1000/year anticipated



Proposed Present

	Lot Size	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost		2.17	47.10	110.30	159.57
Suggested Cost	100	8.70			8.70
	500	4.50			4.50

Tools--$24.00

COMMENTS:

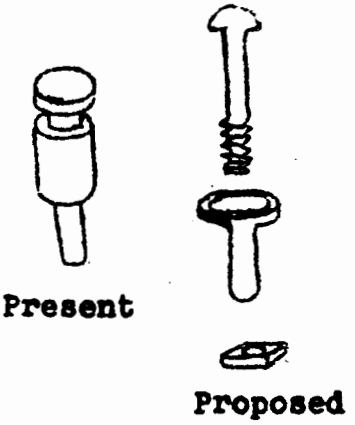
1) This part imparts the motion to the turn compensation selsyn.

2) The proposed part may be purchased at the suggested cost. It could be pinned to the selsyn shaft just as the spring actuating arms are secured to their shafts.

MATERIALS & PURCHASING DEPARTMENT
VALUE ANALYSIS UNIT
August 1951

AH:M

Pin, Spring Anchor
M-9720799
1 piece used
400/year now
1000/year anticipated



	Shop Cost/C
Present Cost	$51.10
Suggested Cost	2.00

COMMENTS:

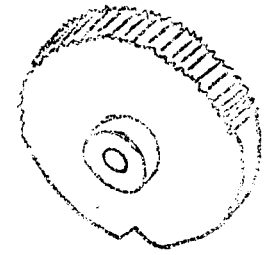
1) This pin anchors the spring which holds the turn compensation mechanism against the cam.

2) It is suggested that a standard spacer or flat flange eyelet and a standard screw with a speed nut be substituted. The eyelet or spacer would be drawn up tight against the housing by the screw. It does not appear that the axial movement of the spring will cause functional failure.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Gear Segment and Cam
(Roll Switch)
P-9783306
1 piece used
400/year now
1000/year anticipated



	Lot Size	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost		59.32	89.00	209.00	$357.32
Suggested Cost	100	185.00			185.00
	500	155.00			155.00

Tools--$270.00

COMMENTS:

1. This part operates the roll selsyns and detent switch.

2. The gear may be purchased at the above cost.

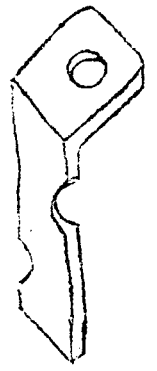
3. On the present part, the price from screw machine seems high. It ought to be finished there at about $ .30 to be in line with other parts. Also, the de-burring could be done on piece work at $ .03 planned cost.

Mat'l/C	Adjusted Labor/C	IME/C	Shop Cost/C
30.00	46.00	107.00	183.00

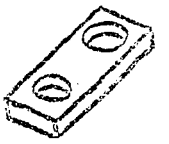
MATERIALS &PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH:M

Arm, Actuating (Spring)
K-9708724
2 pieces used
800/year now
2000/year anticipated



Proposed



Present

	Lot Size	Mat'l/C	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Present Cost		1.78	14.10	33.20	$49,08
Proposed Cost	100	19.40			19.40
	500	12.00			12.00

COMMENTS:

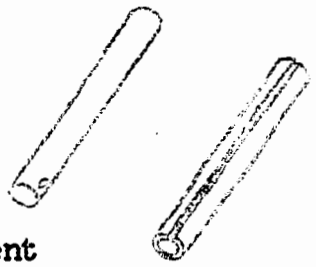
1) These arms operate the springs that return the stick to neutral.

2) The suggested part may be purchased complete for the above cost. In addition to the indicated savings, the dowel pin (cost--$38.84/C),which fits into one end of the present actuating arm, the cost of assemblying it and the taper pin used at assembly will be eliminated.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August11951

AH:M

Pin, Actuating (Spring)
K-9708721
2 pieces used
800/year now
2000/year anticipated



Present

Proposed

	Shop Cost/C
Present Cost	38.84
Suggested Cost	-0-

COMMENTS:

1) This pin acts against a spring to return the control stick to the neutral position.

2) By changing the design of the spring actuating arm, the function of this part can be incorporated into the arm. This proposed design change of the arm would be less expensive than the present arm.

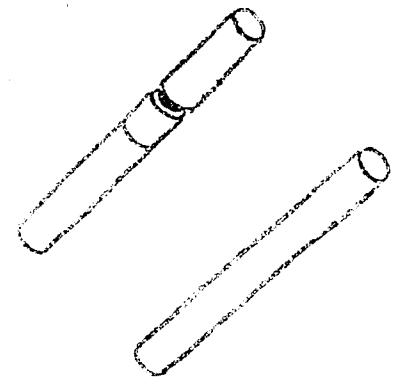
3) Another alternate would be to substitute a roll pin for this pin. The roll pin would take the place of the actuating pins and also the taper pins now used to hold the actuating pins in place. In addition, drilling and reaming the holes for the taper pins would not be required.

Lot Size	Shop Cost/C
200	1.56
1000	0.856

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH:M

Shaft-Return Spring (Pitch)
M-9722166
1 piece used
400/year now
1000/year anticipated



	Mat'l/C	Adjusted Labor	IME/C 235%	Shop Cost/C
Present Cost	2.52	47.10	110.60	$160.22
Suggested Cost	1.48	10.18	incl.	$11.66

COMMENTS:

This shaft forms one half of the selsyn shaft for the pitch selsyn and its return spring.

It is felt that this shaft might be made all one diameter. The notch holds a snap ring to keep the spring away from the bearing housing.

With the suggested changed actuating spring arm, elsewhere shown, we believe the spring will be permanently positioned without the washer and snap ring. Made from centerless ground stock, the plain rod then costs $11.66/C as shown.

MATERIALS AND PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

Washer-Panel
K-9751820
4 pieces used
1600/year now
4000/year anticipated

	Shop Cost/C
Present Cost	$2.58
Suggested Cost	0.065

COMMENTS:

These washers prevent cracking the plexiglass panel when tightening the screws that attach it.

A standard, neoprene washer is available at the above cost. It is nearly the specified dimensions.

	Suggested Washer	Specified Washer
I. D.	.167"/.157"	.166"/.156"
O.D.	.390"/.375"	3/8"
Thick	.050"/.040"	1/16"

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

ASSEMBLIES

Present Costs		Quan. Per Unit	Adjusted Labor/C	IME/C 235%	Shop Cost/C
Controller Assembly	W9706037	1	$7640.00	17960.00	$25600.00
Support-Selsyn & Gear	T9741829	1	641.00	1509.00	2150.00
Selsyn & Shaft Assy-Roll	P9783308	2	251.00	592.50	843.50
Barrel & Lever Assembly	T9741834	1	314.00	736.00	1050.00
Potentiometer & Dial Assy.	M9722167	1	200.00	470.00	670.00
Selsyn & Shaft Assy-Pitch	P9783307	1	199.50	469.50	669.00
Plate & Fastener	P-9783305	1	190.00	446.50	636.50
Gear Sector & Ball Assy.	P9783310	1	123.50	290.50	414.00
Gear & Shroud Assy.	P9783309	1	57.00	134.20	191.20
Bushing & Follower Arm Assy.	P9783311	1	47.50	111.50	159.00
Potentiometer Bracket & Pin	M9720796	1	47.50	111.50	159.00
Actuator & Pin Assy.	M9720797	1	38.00	89.20	127.20
Pin & Support-Bearing Assy.	M9720788	1	28.50	67.10	95.60
Dial & Pin	M9720795	1	15.30	35.70	51.00
				TOTAL	$33659.50

These assemblies consitute

1) These assemblies constitute most of the assembly operations which go into building up the controller.

2) As a result of general observations made on these assembly operations, it is felt that a 60% saving would be realized by putting all of them on piece work.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

LIST OF PEOPLE WHO HELPED ON VALUE ANALYSIS SURVEY OF G-3 AUTOPILOT

Name	Position	Department	Works
LA Carlson	Engineering	A&OS	Schdy
GW Frank	"	"	"
FP McGowan	Purchasing	"	"
CE Dodge	"	"	"
MP Relihan	"	"	"
DF Timberlake	"	"	"
HW Shafran	Planning	"	"
GW Levoy	Manufacturing	"	"
RF Call	Cost	"	"
WH Price	Production	"	"
IW Johnson	Welding	Works Laboratory	"
SP Raffay	"	" "	"
P Moench	Powdered Metallurgy	" "	"
RD Ahles	Investment Casting	" "	"
H Durfee	Tooling	Control	"
J Hiitter	Manufacturing	"	"
FJ Gannon	Cost	Punch Press	"
HJ Uebele	Planning	" "	"
NG Wickstrom	"	Screw Machine	"
WJ Dempsey	Production	Aircraft Instruments	West Lynn
RF Buckley	Engineering	" "	" "
JG Lancaster	Cost	" "	" "
TE Donovan	"	Control	Morrison
J Slavin	Engineering	"	"
G Irby		Chemical Dept.	Pittsf.
LD Miles	Value Analysis	Purchasing	Schdy
EC Hovey	Physics Div.	KAPL	"
DL Eagan	Value Analysis	Purchasing	"
DB Peterson	Engineering	Loco. & Car Equpt.	Erie
CM Watt		Canadian GE	Toronto
FA Reedq	Creative Engineering Program		Schdy
RD Chisholm	" "	"	Schdy
AG Hoyt, Jr.	Test Engineer	Test	"

and

Various members of Central Purchasing

ITEMS ON WHICH THE SURVEY IS NOT COMPLETED

1) Converting control stick motion to selsyn signal.

   a) More value into ball of present system

   b) Cam drives

   c) Tape drives

   d) Gimble system

2) Selsyns

3) Push Button Switch

4) Cover

The above parts have been studied, and some alternatives giving better value have been prepared. At this time, however, it is felt that additional investigations are warranted because satisfactory value has not yet been factored into these expensive parts.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M

PARTS NOT INCLUDED IN THIS SURVEY

1) Standard screws, nuts, washers, shims, lockwashers, rivets
2) Retaining rings
3) Dowel pins
4) Wiring parts
5) Springs
6) Pitch trim assy - aircraft change anticipated
7) Dzus fasteners
8) Potentiometers
9) Switch RH and S., Inc. #31008
10) Light and bulb assembly
11) AN Connectors
12) Ball bearings
13) Transformer

COMMENTS:

Because of the multiplicity of parts and the limitations imposed by time and available personnel, the scope of this survey could not include all of the parts that make up the G-3 Autopilot.

MATERIALS & PURCHASING DEPT.
VALUE ANALYSIS UNIT
August 1951

AH/M