AERO MODELLER

ANNUAL 1956 - 7

AEROMODELLER ANNUAL 1956-57

A review of the year's aeromodelling throughout the world in theory and practice; together with useful data, contest results and authoritative articles, produced by staff and contributors of the *AEROMODELLER*

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AEROMODELLER ANNUAL 1956-57

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CONTENTS

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Introduction

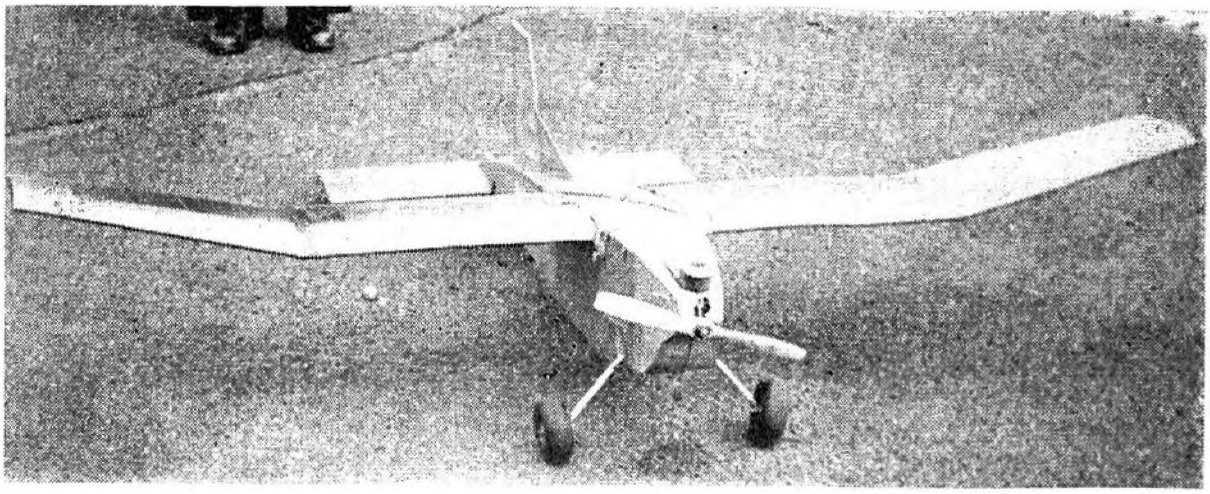
Wonders of the New Age

RESULTS OF THE international events that have taken place already this year encourage us to hope that 1956 will go down in the annals as distinctly memorable. Our own World Power Championships, where once again we were able to act as hosts at Cranfield, provided us with first and second places, following a three-man fly-off when British team-men Ron Draper and Dave Posner were joined by that famous flying patissier Silvio Lanfranchi, proxy for U.S. entrant L. H. Conover. Last year's winner Mike Gaster was unlucky to come as low as 12th, but his effort proved enough to secure the team award for Great Britain in addition to individual places. Earlier in the year, a freelance team from the Southern Cross M.A.C. had proved victorious in the Dutch International Flying Wing Contest—a category that had previously been considered essentially a continental walk-over : Ted Hemsley had got almost within striking distance of the leaders in the King of the Belgians Radio Control Cup : and finally "Gadget" Gibbs had come within an ace of winning the speed event in Belgian Criterium of Europe event. An ever-lengthening contest calendar makes it impossible to report results of the Wakefield and International Glider events in this volume, since they will be fought out when these pages are still in the hands of the printers.

At home the model aircraft trade has shown a continuing trend towards quality products in the higher price ranges, with more and more emphasis on an increasing degree of prefabrication. This has indeed spread to the low-priced beginners' kits with growing use of diestamping processes. Most significant development, however, is the beginning of what can only be called an "American invasion" by the formation of British registered companies to market some of the highly-detailed plastic kits that have so captured the model market in the United States. Using what seem to be identical dies to those in use in America the first samples are already appearing in the shops. Some word of caution is, we feel, desirable at this stage, to remind would-be users of these kits that their modelling future is in their own hands. They can take the lazy outlook of regarding these beautifully detailed products as complete after an evening's assembly work, or they can take the better view of looking upon them as merely the highly finished groundwork with the drudgery done for them, on which they can build up an even more beautiful finished model. With this outlook some good can come of plastics—without it there is the danger of craftsmen losing their skills to become mere stickers-together.

A near-aeromodelling activity that we have featured in this year's ANNUAL is the growth of interest in ultra light aircraft first mentioned last year. Now that the Popular Flying Association have demonstrated the Turbulent in many parts of the country, groups are springing up willing and able—if they are aeromodellers!—to build their own machines.

For our cover painting this year, we introduce a new young artist from Scotland in the shape of R. D. Carrick. We hope his work appeals to readers as it does to us. Meanwhile, we make our annual bow, confident in the variety of fare on offer, and hope that you will enjoy reading it as much as we have compiling it.

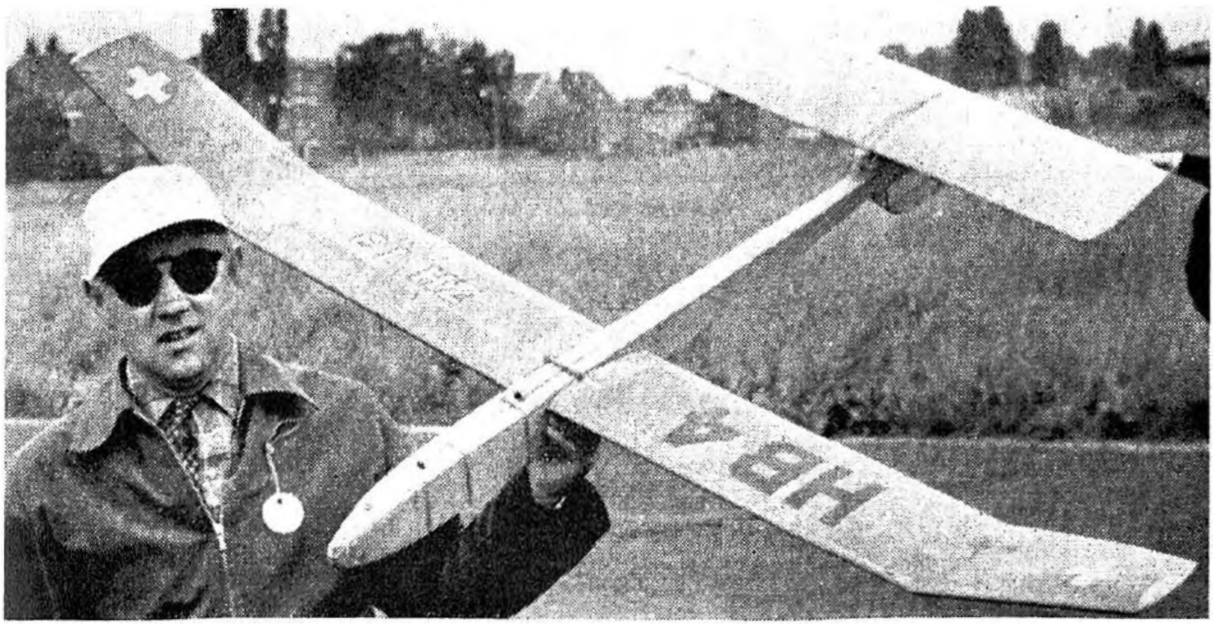


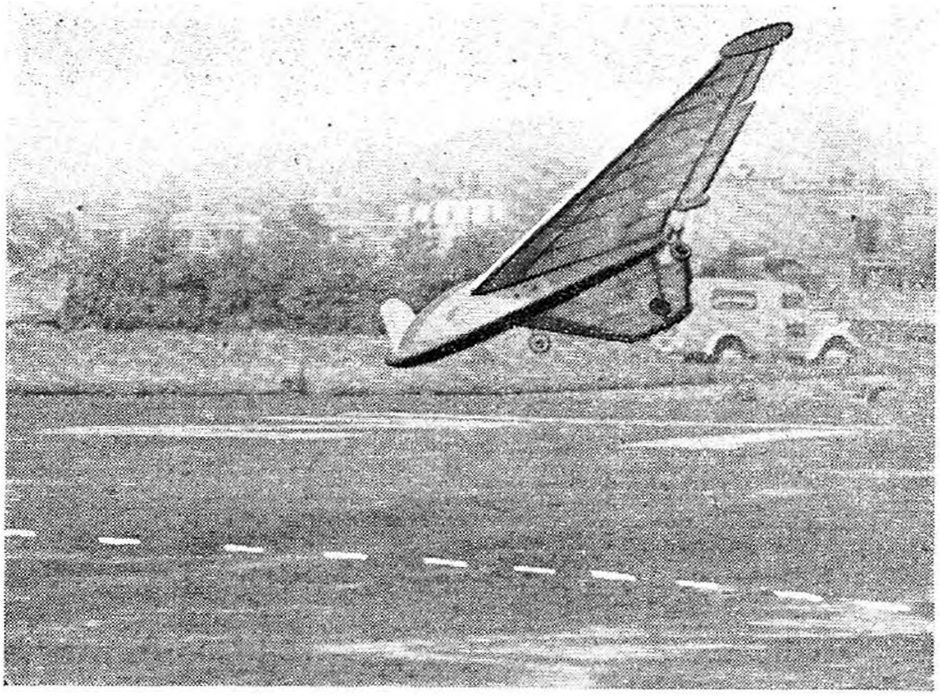
Completely re-designed model which won King of the Belgians Cup for the Equipe Gobeaux. Micron 60 engine is retained, still without engine control, u/c is fully sprung, and full length of elevator span utilised for control movement.

FOURTH INTERNATIONAL RADIO CONTROL CONTEST
DEURNE AERODROME, ANTWERP, BELGIUM
KING OF THE BELGIANS CUP (MULTI CONTROLS)

Place	Name	Country	Points (Max. 2590) 1st Round	Points (Max. 2590) 2nd Round
1 ...	Gobeaux, J. P. ...	Belgium	1703	—
2 ...	Stegmaier, K.... ...	Germany	1098	—
3 ...	Hemsley, O. E. ...	Great Britain	778	344
4 ...	De Hertogh	Belgium	575	509
5 ...	Lichius, H.	Germany	532	—
6 ...	Higham	Great Britain	—	—

Klauser's winning glider, held by compatriot Schmid who completed winning one, two, three Swiss trio. Note how small model is compared with huge gliders formerly so general for r/c use. Underslung fin is also popular Swiss feature.





Winner's spot-on landing! Telephoto shot by Roger Clark shows Bickel's single-channel delta—based on A.P.S. *Vultan* coming in to land in marked circle. This model, beautifully flown, undoubtedly stole the limelight at the contest with its near maximum points (587 out of possible 630).
(*Photo:* Roger Clark)

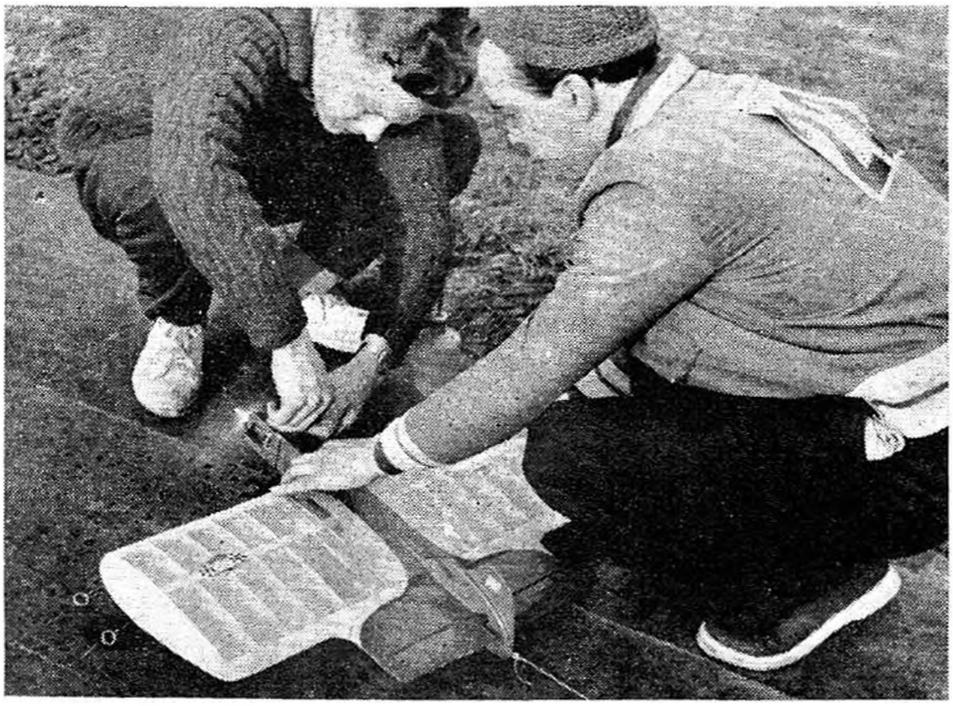
MINISTRY OF COMMUNICATIONS PRIZE (SINGLE CHANNEL)

Place	Name	Country	1st Round	2nd Round
1 ...	Bickel	Switzerland	587	301
2 ...	Setz	Switzerland	85	429
3 ...	Brunenkant	Germany	234	381
4 ...	Fisher	Great Britain	288	337
5 ...	Dzeich...	Germany	326	—
*6 ...	Brinkman	Holland	177	316
7 ...	De Dobbeleer ...	Belgium	301	188
8 ...	Berglund, E.	Sweden	151	286
9 ...	Enzeroth	Switzerland	—	253
10 ...	Laiy	Belgium	225	146
11 ...	Kreulen	Holland	—	190
12 ...	Parkinson	Great Britain	70	179
13 ...	Janse	Holland	149	147
14 ...	Berglund, G.	Sweden	—	139
15 ...	Longdot	Belgium	106	—
16 ...	Bossard	France	100	—
17 ...	Christianse	Holland	80	—
18 ...	Schoorel	Holland	—	—

* *Special Merit Award presented by the Aerodrome.*

MINISTRY OF HEALTH PRIZE (GLIDERS)

Place	Name	Country	1st Round	2nd Round
1 ...	Klauser	Switzerland	220	369
2 ...	Huber	Switzerland	281	172
3 ...	Schmid	Switzerland	229	142
4 ...	Mabille	Belgium	185	138
5 ...	Muschner	Germany	183	80
6 ...	Meyer	Germany	120	182
7 ...	Boys, H.	Great Britain	104	141
8 ...	Poulain	France	—	138
9 ...	Airey	Great Britain	—	—



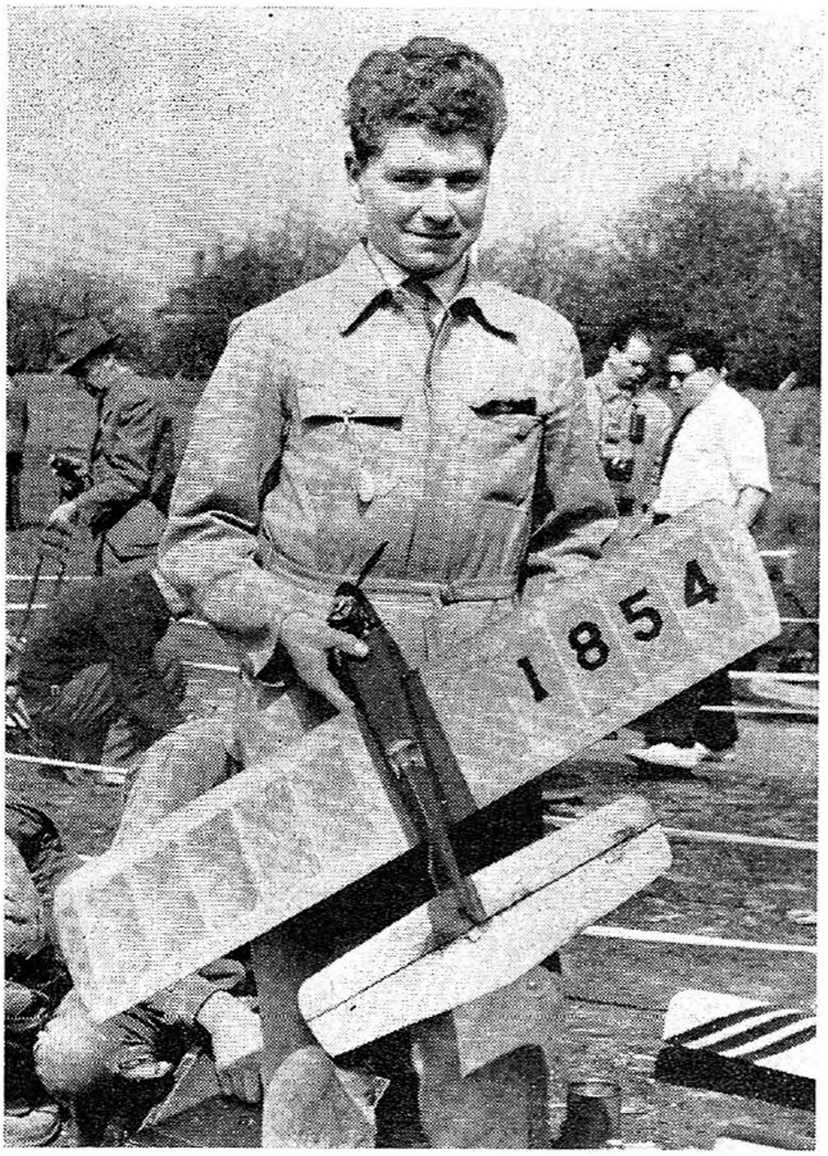
Mike Templeman of Sidcup Club attends to the E.D. Racer in his light all-wing combat design, while World Record holder "Gadget" Gibbs assists.

VIIth CRITERIUM OF EUROPE, BRUSSELS 30th APRIL 1st MAY

SPEED 2.5 c.c.

Placing	*Name*	*Country*	*Engine*	*Speed*
				m.p.h.
1	Battlo	Spain	Super Tigre ...	125.5
2	Gibbs	England ...	Carter Nipper ...	124.52
3	Jarry-Desloges ...	France	Jarry Special ...	107
4	Huppertz	Germany... ...	Webra Mach 1 ...	105
5	Gorziza	Germany... ...	Webra Glo. ...	102
6	Hic	France	Webra Glo. ...	101.5
7	Chavallaz	Switzerland ...	Super Tigre ...	99.5

The Dutch enthusiasts build team race models that are both realistic and capable of high performance. *At left:* Van de Dyk and his 27-ounce Glass Fibre model, fourth in the Brussels final. *Below:* Smelt's winning racer had a modified E.D. 2.46 diesel with reed valve. Flew at 82 m.p.h. for 35-40 laps.



European Stunt Ace is Lecomte of Belgium, flying compatriot Henry Stouffs' famous "Blue Pants" design, available through *Aeromodeller* Plans Service. Lecomte is particularly clever in continuity of flight pattern with perfect manoeuvres.

GRAND PRIX DE CRITERIUM D'EUROPE

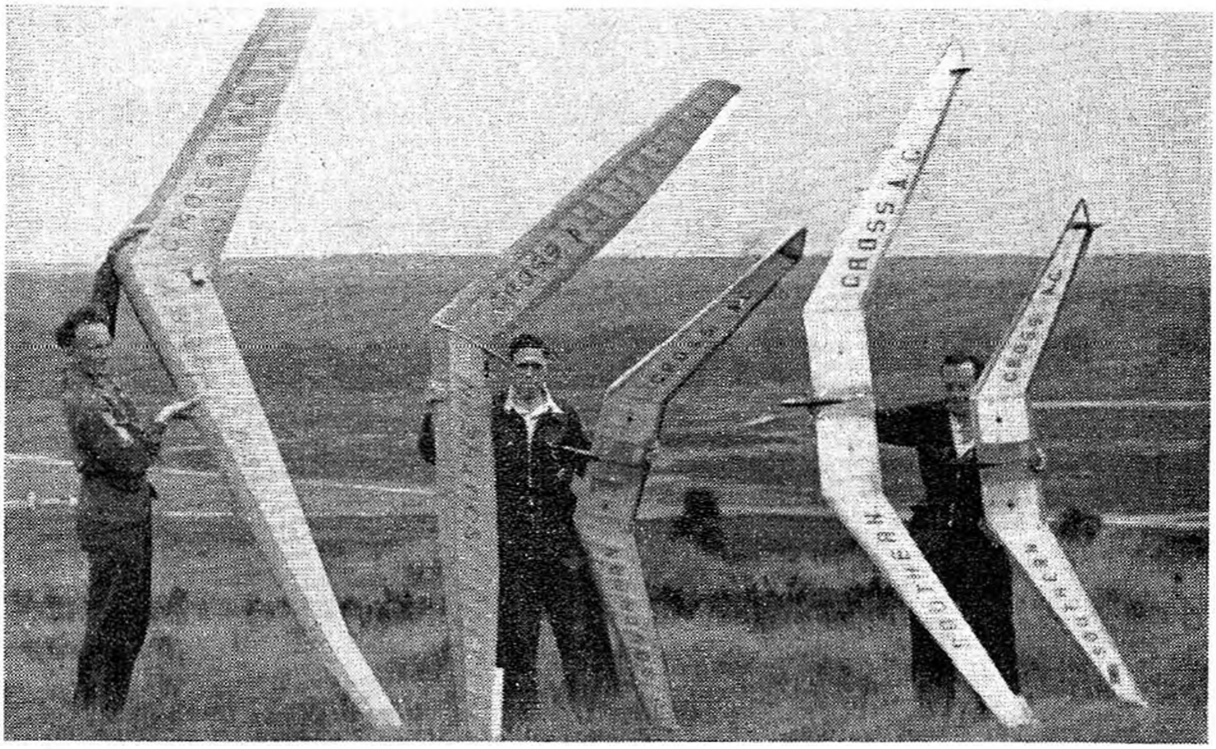
1	Spain	5
2	Germany ...	9
3	Belgium ...	9
4	France ...	11
5	Austria... ...	11

Also: Great Britain, Switzerland, Holland.

AEROBATICS

Placing	*Name*	*Country*	*Engine*	*Points*
1	Lecomte	Belgium ...	E.D. 2.46—Blue Pants ...	913
2	Rieger	Germany ...	E.D. 2.46—O.D. ...	874
3	Mathey, A. ...	Switzerland ...	E.D. 2.46—O.D. ...	865
4	Patriarche ...	Belgium ...		833
5	de la Plaza ...	Spain		791
6	Garcia	Spain		781
7	Humbertjean ...	France ...		781
8	Battlo	Spain		742
9	Rekk	Belgium ...		723
10	Chavaillaz ...	Switzerland ...		718
11	Happetian ...	France ...		714
12	Godsiabois ...	Belgium ...		714
13	Laniot	France ...		680
14	Busch	Spain		646
15	Grevink	Holland ...		646
16	Rautek	Austria ...		635
17	Mathey, J. ...	Switzerland ...		630
18	Deville	Belgium ...		619
19	Roggi	Austria ...		588
20	Schweizer ...	Austria ...		432

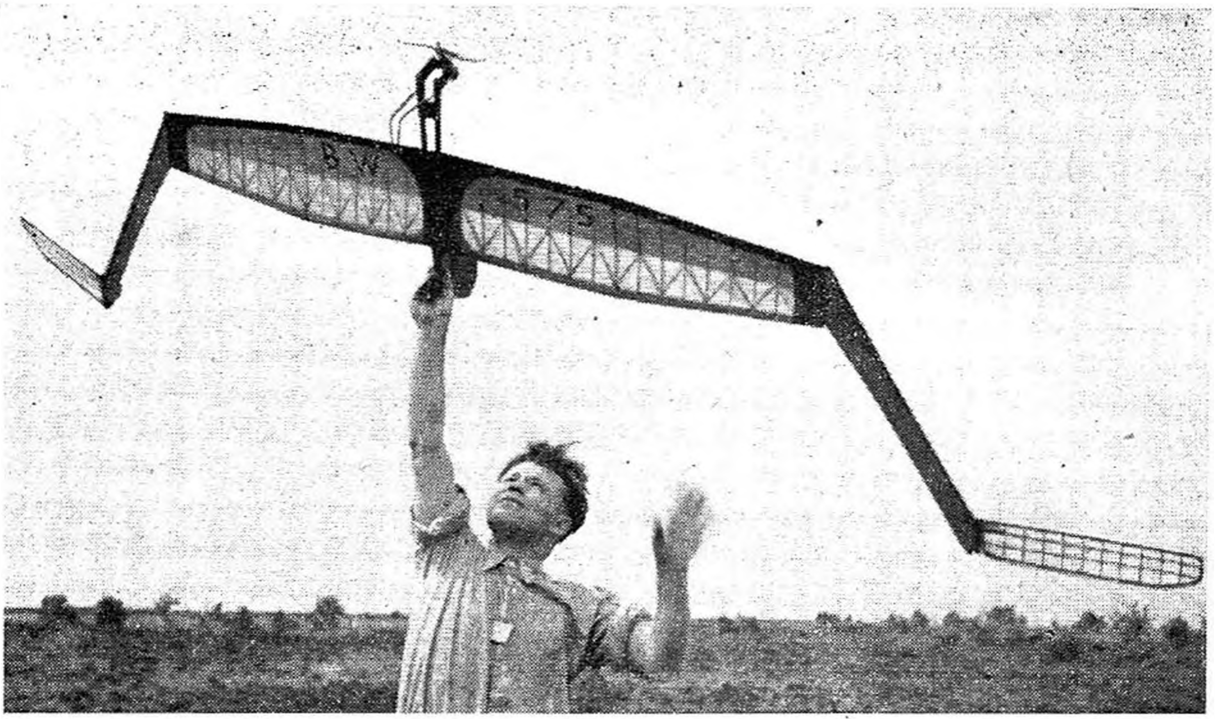
Placing	*Name*	*Country*	*Engine*	*Speed/Time*
		COMBAT		
1	Garcia	Spain	Byra 2.5	—
		JET		
1	Fernandez ...	Spain	Dynajet	131
		TEAM RACE FINAL (10 km)		
1	Smelt	Holland ...	E.D. 246 (Clack Valve)...	5.45
2	Howard	England ...	Oliver Tiger	5.47
3	Edmonds ...	England ...	Oliver Tiger	5.50
4	Van de Dyk ...	Holland ...	Oliver Tiger	6.4



Successful British "freelance" team from the Southern Cross A.C., who so thoroughly trounced continental opposition at Terlet, winning both individual event and team award. On right is Ray Delves who flew proxy for F. C. Smith, notching first place on his behalf. Other team members are Graham Gates and Keith Donald, 4th and 5th respectively.

FIFTH INTERNATIONAL FLYING WING CONTEST
Held at Terlet, in Holland on 9/10th. June, 1956

No.	Name	Country	1	2	3	4	5	Total
1	Smith, F. C. ...	Great Britain ...	0:57	1:19	0:54	3:00	3:00	9:10
2	Graf, W. ...	Switzerland ...	1:14	0:47	1:03	3:00	3:00	9:04
3	Weber, G. ...	Germany ...	2:50	2:13	0:44	0:59	2:00	8:46
4	Gates, G. ...	Great Britain ...	1:21	1:36	1:31	1:11	3:00	8:39
5	Donald, K. ...	Great Britain ...	2:07	1:35	1:40	1:26	1:42	8:30



Almost in the "wotzit" class is this curious power model entered by Zwilling, which aroused some controversy on the vexed question of "what is a tailless model". At risk of starting it off again, we would venture to say it comes within a reasonable definition.

No.	Name	Country	1	2	3	4	5	Total
6	Gerken, H. ...	Germany ...	1:14	3:00	1:21	1:30	1:23	8:28
7	Olsson, L. ...	Sweden ...	—	2:08	1:27	2:24	1:19	7:18
8	Kron, H. ...	Germany ...	1:27	1:41	2:19	1:12	0:34	7:13
9	Wilkins, P. ...	Great Britain ...	1:48	1:19	1:36	1:23	1:07	7:13
10	Schonborn, W.	Saar	1:22	1:38	1:13	1:31	1:10	6:54
11	Osborne, J. ...	Holland ...	1:38	1:16	1:27	1:27	1:01	6:49
12	Graf, E. ...	Switzerland ...	0:52	0:45	1:16	1:25	2:24	6:42
13	Fiks, G. ...	Holland ...	0:29	1:25	1:31	1:31	1:41	6:37
14	Andersson, K.	Sweden ...	0:25	1:27	2:00	1:17	1:45	6:24
15	Schroder, P. ...	Germany ...	1:21	1:12	0:23	1:05	1:56	5:57
16	ten Hagen, G.	Holland ...	0:44	1:08	0:47	1:29	1:48	5:56
17	Cornellison, G.	Holland ...	2:46	0:31	1:12	0:45	0:25	5:39
18	Waldhauser, H.	Saar	—	—	1:58	2:44	0:24	5:06
19	Struik, E. ...	Holland ...	0:56	1:04	0:49	0:52	1:21	5:02
20	Way, R. ...	Great Britain ...	0:32	1:10	1:01	0:59	0:57	4:39
21	Harig, W. ...	Saar	1:04	0:23	0:36	1:47	0:45	4:35
22	Mansson, U.	Sweden ...	0:27	0:54	1:21	0:43	0:50	4:15

TEAM RESULTS

	points		points
Great Britain	1,579	Sweden	1,077
Germany	1,467	Saar	995
Holland	1,162	Switzerland	946

Maestro of the pure vertical climb, Dave Posner releases his Oliver Tiger-powered Dream Weaver in characteristic attitude. Model maintains this climb angle with wash-in rotating the wings about the fuselage axis. Colour black and orange silk.

He bows to conquer! Coventry's Ron Draper, the 1956 World Power Champion ducks his head at every vertical launch. This is to get out of the way of the screaming OS MAX-I. 15 engine and to ensure that all three VTO points were well and truly in contact with *terra firma*. Model is all-red, known as Crescendo, and climbs in a steep wide spiral. Timer operates both the cut-out and an automatic rudder for the glide.

WORLD POWER CHAMPIONSHIPS 1956
FOR F.N.A.F.O.M. CUP
Held at Cranfield, Beds., England

No.	Name	Country	1	2	3	4	5	Total
1	Draper, R.	Great Britain	3:00	3:00	3:00	3:00	3:00	15:00 +5:20
1	Posner, D.	Great Britain	3:00	3:00	3:00	3:00	3:00	15:00 +4:52
1	Conover, L. H. ... (*Lanfranchi*)	U.S.A. ...	3:00	3:00	3:00	3:00	3:00	15:00 +4:15
4	Fresl, E.	Yugoslavia ...	3:00	3:00	3:00	2:57	3:00	14:57
5	Bergamaschi, C. ...	Italy... ...	3:00	2:55	3:00	3:00	3:00	14:55
6	Thompson, J. ...	Ireland ...	2:53	3:00	3:00	3:00	3:00	14:53
7	Fiks, G.	Holland ...	3:00	2:36	3:00	3:00	3:00	14:36
8	Schenker, R. ...	Switzerland	3:00	3:00	2:32	2:56	3:00	14:28
9	Rudolph, Frau M....	Germany ...	3:00	3:00	2:34	2:41	3:00	14:15
10	Morelli, A.	Ireland ...	2:11	2:51	2:58	3:00	3:00	14:00
11	Asano, T. ... ... (*P. Manville*)	Japan ...	2:21	3:00	2:26	3:00	3:00	13:47
12	Gaster, M.	Great Britain	3:00	1:18	3:00	3:00	3:00	13:18
13	Huffman, W. F. ... (*G. Coughlin*)	U.S.A. ...	2:43	2:54	2:02	2:30	2:51	13:00
14	Masek, J.	Czechoslovakia	3:00	3:00	3:00	1:34	2:22	12:56
15	Eisen, J. ... ... (*F. McNulty*)	Canada ...	3:00	3:00	2:46	2:16	1:50	12:52

Silvio Lanfranchi, aeromodelling's most cosmopolitan character, and a great flier who has now gained 1st, 2nd and 3rd placings in World Power Championships, two of these occasions with proxy models. Here he has Laurie Conover's Lucky Lindy (after Lindbergh), a small tail, shallow pylon model which Silvio flew magnificently to 3rd in '56.

Top opposite shows the smallest model in the Championships, a little Zeek with Atwood Wasp .8 c.c. glowplug engine, flown by Italian Roberto Zappata as a reserve. It performed well but lacked the altitude for long duration.

No.	Name	Country	1	2	3	4	5	Total
16	Pfenninger, M. ...	Switzerland	1:50	3:00	2:05	3:00	2:56	12:51
17	Sladek, R. ... ... (*V. Jays*)	U.S.A. ...	3:00	2:24	1:26	3:00	3:00	12:50
18	Bausch, L.	Holland ...	2:22	1:53	2:45	3:00	2:49	12:49
19	Piesk, L.	Germany ...	3:00	1:55	2:27	3:00	2:23	12:45
20	S'Jongers, J. ...	Belgium ...	3:00	2:05	2:04	3:00	2:33	12:42
21	Osterholm, S. ...	Finland ...	3:00	3:00	1:53	2:01	2:32	12:26
22	Hormann, G. ...	Austria ...	0:29	2:56	3:00	3:00	3:00	12:25
23	Cerny, R.	Czechoslovakia	2:42	0:42	3:00	3:00	3:00	12:24
24	Friis, H. O. ...	Sweden ...	0:21	2:57	3:00	3:00	3:00	12:18
25	Ranta, S. ... ... (*J. Bickerstaffe*)	Canada ...	3:00	3:00	0:00	3:00	3:00	12:00
26	Domberger, H. ...	Austria ...	3:00	2:20	1:46	2:25	2:24	11:55
27	Teunissen, A. ...	Holland ...	2:20	3:00	1:45	2:30	2:15	11:50
28	Hajek, V.	Czechoslovakia	2:48	3:00	3:00	0:00	3:00	11:48
29	Upson, G. ...	Great Britain	1:50	2:43	1:55	3:00	1:56	11:24
30	Houtrelle, H. ...	Belgium ...	1:51	1:48	2:03	3:00	2:13	10:55
31	Hutjes, W.	Holland ...	1:43	2:11	2:33	2:13	2:08	10:48
32	Manninen, P. ... (*Jaaskenlainen*)	Finland ...	3:00	1:58	1:34	1:26	2:39	10:37
33	Raulio, H.	Finland ...	1:35	2:05	2:28	1:12	3:00	10:20
34	Ruzek, L. ...	Czechoslovakia	1:59	2:16	1:58	2:17	1:49	10:19
35	Woods, D. ...	Ireland ...	1:50	1:38	0:56	3:00	2:53	10:17
36	Zigic, D.	Jugoslavia ...	0:00	3:00	2:13	2:50	2:02	10:05
37	Leppert, H. ...	Germany ...	3:00	1:08	2:24	2:25	0:48	9:45
38	Hoyer, E.	Austria ...	2:43	1:43	2:38	1:50	0:00	8:54
39	Baker, R. S. B. ...	Australia ...	1:25	1:17	2:17	1:27	2:14	8:40
40	Zapata, R.	Italy... ...	3:00	0:00	1:45	1:44	2:08	8:37
41	Lippens, G. ...	Belgium ...	1:35	1:34	1:28	1:44	2:03	8:24
42	Hagel, R.	Sweden ...	2:20	3:00	0:00	0:00	2:37	7:57

43	Jeanne, L.	Belgium ...	0 :00	3 :00	1 :32	1 :42	1 :28	7 :42
44	Grunbaum, P. ...	Austria ...	1 :38	1 :51	1 :27	1 :14	1 :17	7 :27
45	Monti, F.	Italy... ...	1 :21	1 :34	1 :08	1 :39	1 :27	7 :09
46	Gunic, B.	Jugoslavia ...	1 :27	0 :00	2 :38	3 :00	0 :00	7 :05
47	Kmoch, V. ...	Jugoslavia ...	0 :33	3 :00	0 :00	1 :22	1 :43	6 :38
48	Lorimer, H. ... (*G. French*)	Canada ...	0 :18	1 :20	1 :33	1 :43	1 :22	6 :17
49	Hamma, W. ...	Germany ...	3 :00	3 :00	0 :00	—	—	6 :00
50	Etherington, W. ... (*J. Done*)	Canada ...	1 :12	1 :11	1 :11	1 :32	0 :00	5 :06
51	Bacchi, R.	Italy... ...	3 :00	0 :24	0 :00	—	—	3 :24
52	Maibach, F. ...	Switzerland	3 :00	0 :00	0 :00	0 :00	0 :00	3 :00
53	Hartill, W.... ... (*N. Green*)	U.S.A. ...	2 :23	0 :21	0 :00	0 :00	0 :00	2 :44
54	Browne, D.... ...	Ireland ...	0 :30	—	—	—	—	0 :30

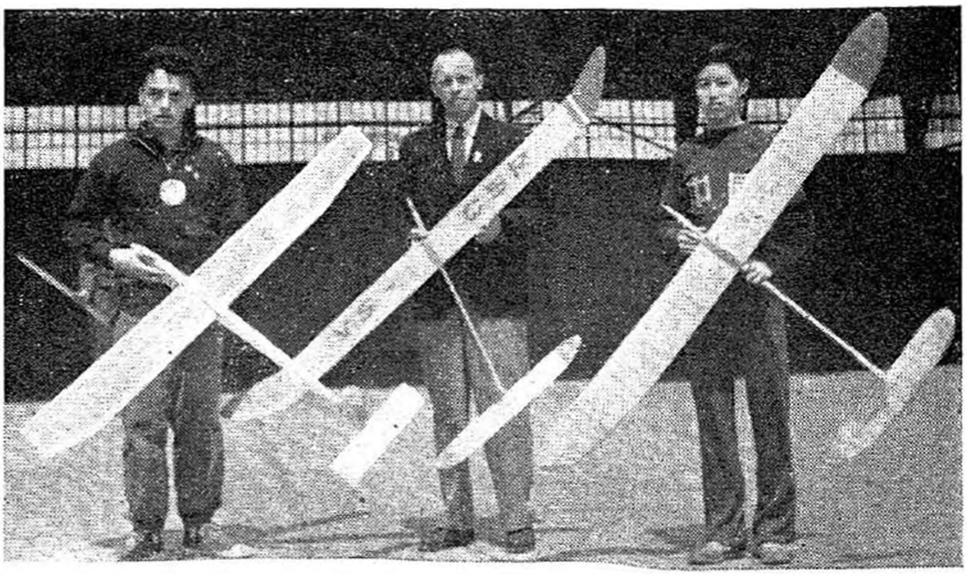
Bird, R. E. (Australia), Schiltknecht, P. (Switzerland), Pimenoff, S. (Finland) recorded no flight times.

TEAM RESULTS FOR FRANJO KLUZ CUP

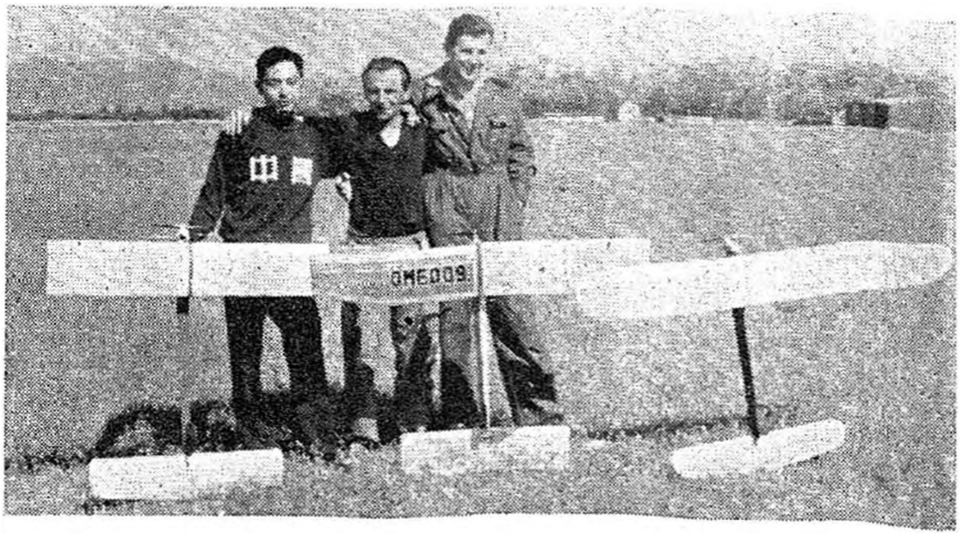
1	Great Britain ...	2598
2	U.S.A. ...	2450
3	Holland ...	2355
4	Ireland ...	2350
5	Czechoslovakia	2228
6	Germany ...	2205
7	Finland ...	2003
8	Austria ...	1994
9	Jugoslavia ...	1927
10	Belgium ...	1921
11	Canada ...	1869
12	Italy	1841
13	Switzerland ...	1819
14	Sweden ...	1215
15	Japan ...	870
16	Australia ...	520

Frau Maria Rudolph, only woman competitor in the Power Championships, once more provided a shock for the staid males. Placing 9th, her immaculate models, full of ingenious ideas like table tennis bat facing for the wing seat, etc., were a constant source of admiration from fellow entrants.

1956 SOVIET INTERNATIONALS FOR "PEOPLES' DEMOCRACIES"
Held at Dunakeszi, Budapest, Hungary



A/2 Victors, Peter Roser of Hungary (2nd), Vladimir Spulak, the winner, from Czechoslovakia, and third place man, Siu Min-Czian of the Chinese Peoples' Republic. Times were 849, 776 and 740 seconds.



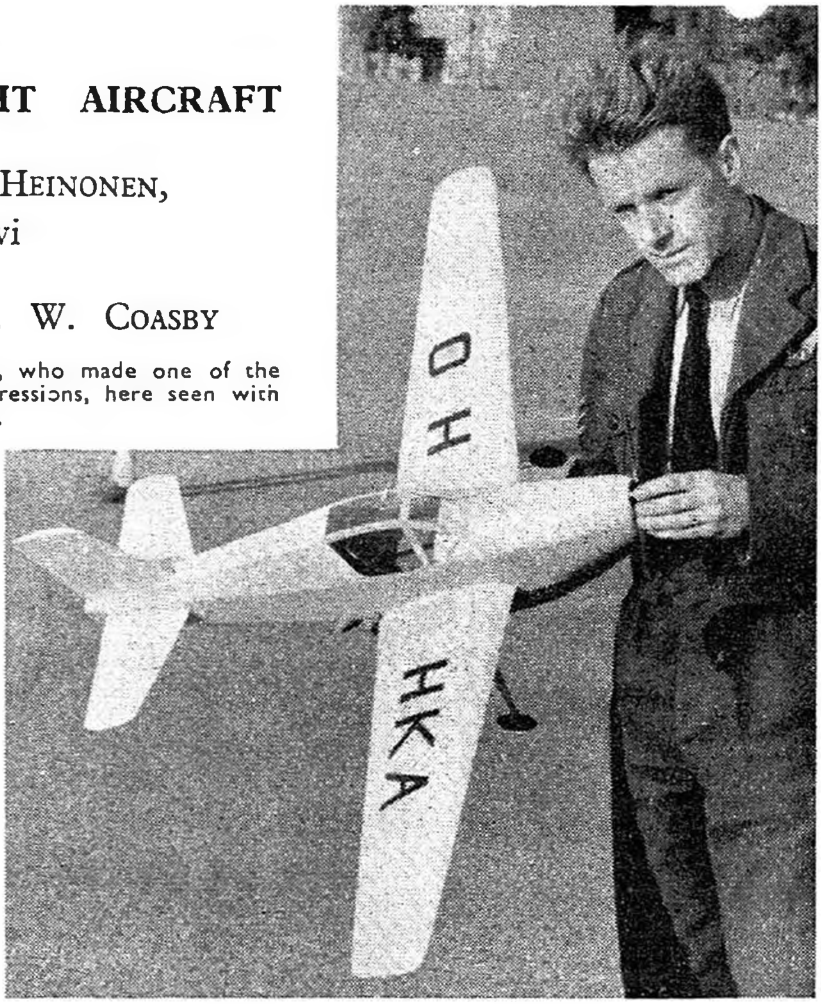
Top three in power, Liu Ming-Tao (3rd) from China, L. Ordogh (2nd) of Hungary and Radoslav Cerny (1st) of Czechoslovakia. Note how all three models are alike in proportions if not in outline.

Three Wakefield experts, Georges Benedek of airfoil fame who came 3rd for Hungary with his short motored twin skein model. Winner Radoslav Cisek has a more conventional design in centre (Czechoslovakia), and in second place, Vladimir Matvejev of Russia with his astounding model made from grasses, and using a very thin arched wing section.

HK-1 FINNISH LIGHT AIRCRAFT

Manufactured by HEINONEN,
Jami-jarvi

Model designed by J. W. COASBY



Bob Collington of R.A.F. Hemswell, who made one of the prototype models and gives his impressions, here seen with his version.

THE HK-1 is an attractive low-wing single seater light aeroplane made at Jami-jarvi, Finland, which many readers will remember as the scene of the 1950 Wakefield Contest. The design is based on use of the Czech Walter Mikron 4-cylinder engine and comes almost into the light class such as the Turbulent.

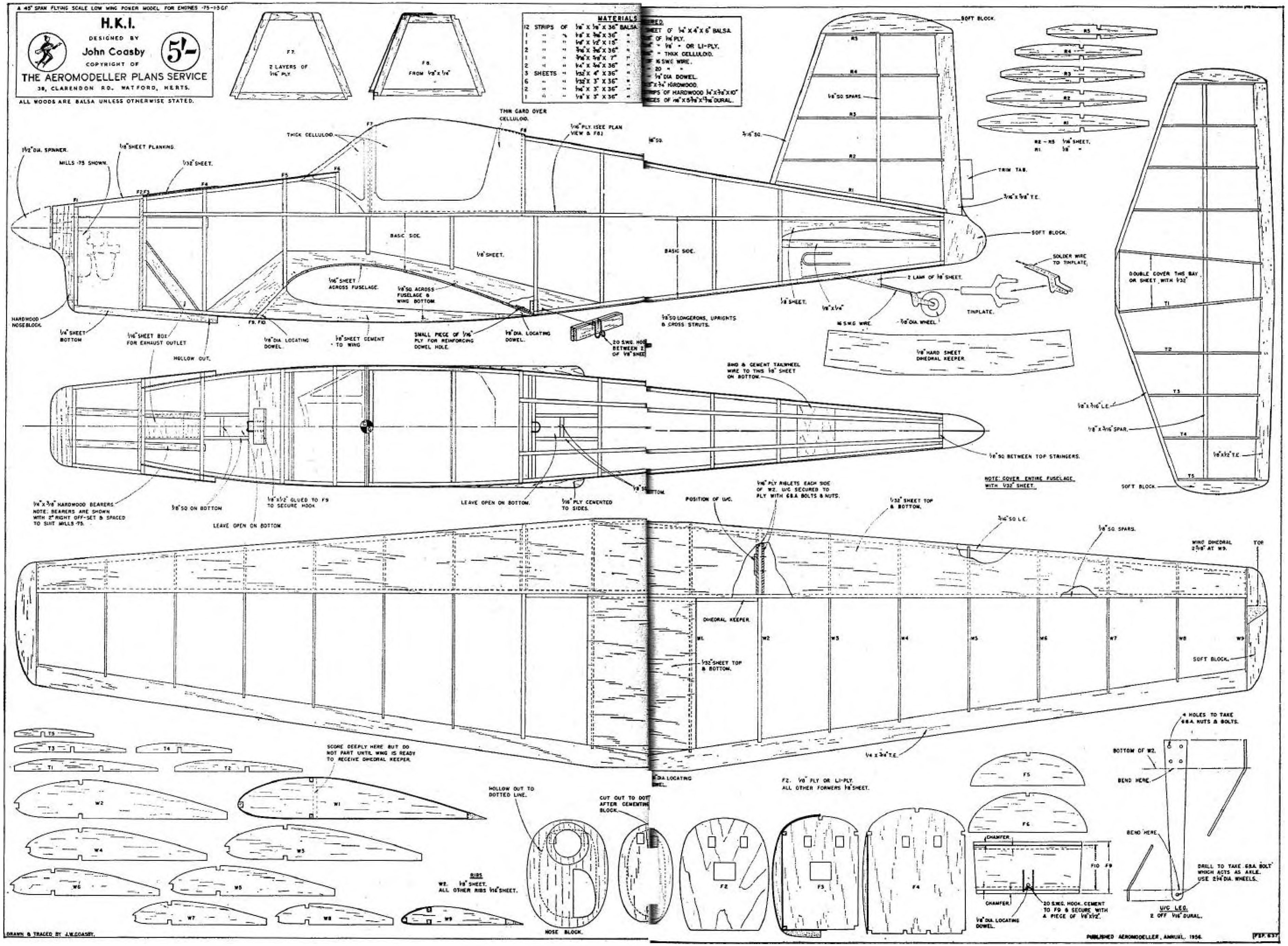
Its appeal as a model was apparent to scale expert Ron Moulton when outlines appeared in a Finnish aero magazine, and recommended by him to John Coasby, at that time at a loose end for a really "out of the rut" free flight scale project. Features that influenced this choice included fully cantilever wings without struts, some amount of dihedral, large tail area, ideal undercarriage position for a model—all of these angles in addition to generally attractive lines.

On the drawing board it soon became apparent that true scale features could be retained throughout, so that scale wing *thickness* has been embodied in addition to keeping outline correct. No un-scale variations have been introduced at any point, and a sturdy reliable flier is the final result. Useful feature is unobtrusive main fixing that knocks off when needed, but is amply stout enough for all normal occasions.

As a test bed arrangement a number of plan prints were distributed and models built by club members. Model illustrated was built and tested by Bob Collington of R.A.F. Hemswell, whose trimming notes and comments here follow. It should be noted a number of his suggestions have been embodied in the plan as offered.

"Medium balsa was used throughout and plans followed exactly. It was necessary to add $\frac{1}{8}$ in. uplift to elevator, but this was explained by extra weight of Mills used against specified Dart of prototype model.

"I used pendulum rudder for first test flights, but this was quite unnecessary, and now she's flying quite contentedly with about 3 degrees left


A 45" SPAN FLYING SCALE LOW WING POWER MODEL FOR ENGINES ·75–1·5 c.c.
H.K.I.
DESIGNED BY
John Coasby
COPYRIGHT OF
THE AEROMODELLER PLANS SERVICE
38, CLARENDON RD., WATFORD, HERTS.
5/-
ALL WOODS ARE BALSA UNLESS OTHERWISE STATED.
F7. 2 LAYERS OF 1/16" PLY.
MATERIALS
THIN CARD OVER CELLULOID.
THICK CELLULOID.
1½" DIA. SPINNER.
1/8" SHEET PLANKING.
MILLS ·75 SHOWN.
1/32" SHEET.
BASIC SIDE.
1/8" SHEET.
HARDWOOD NOSEBLOCK.
1/4" SHEET BOTTOM.
1/16" SHEET BOX FOR EXHAUST OUTLET
HOLLOW OUT.
1/8" DIA. LOCATING DOWEL.
SMALL PIECE OF 1/16" PLY FOR REINFORCING DOWEL HOLE.
1/8" SQ. LONGERONS, UPRIGHTS & CROSS STRUTS.
SOFT BLOCK.
TRIM TAB.
SOLDER WIRE TO TINPLATE.
TINPLATE.
16 S.W.G. WIRE.
1/8" HARD SHEET DIHEDRAL KEEPER.
BIND & CEMENT TAILWHEEL WIRE TO THIS 1/8" SHEET ON BOTTOM.
DOUBLE COVER THIS BAY OR SHEET WITH 1/32".
1/8" SQ. BETWEEN TOP STRINGERS.
NOTE: COVER ENTIRE FUSELAGE WITH 1/32" SHEET.
NOTE: BEARERS ARE SHOWN WITH 2° RIGHT OFF-SET & SPACED TO SUIT MILLS ·75.
1/8" SQ. ON BOTTOM.
LEAVE OPEN ON BOTTOM.
POSITION OF U/C.
1/32" SHEET TOP & BOTTOM.
1/8" SQ. SPARS.
DIHEDRAL KEEPER.
SOFT BLOCK.
4 HOLES TO TAKE 6 B.A. NUTS & BOLTS.
BOTTOM OF W2.
BEND HERE.
DRILL TO TAKE 6 B.A. BOLT WHICH ACTS AS AXLE. USE 2¼" DIA. WHEELS.
U/C LEG. 2 OFF 1/16" DURAL.
SCORE DEEPLY HERE BUT DO NOT PART UNTIL WING IS READY TO RECEIVE DIHEDRAL KEEPER.
RIBS
W2. 1/8" SHEET. ALL OTHER RIBS 1/16" SHEET.
HOLLOW OUT TO DOTTED LINE.
NOSE BLOCK.
CUT OUT TO DOTTED LINE AFTER CEMENTING BLOCK.
F2. 1/8" PLY OR LI-PLY. ALL OTHER FORMERS 1/8" SHEET.
CHAMFER.
20 S.W.G. HOOK. CEMENT TO F9 & SECURE WITH A PIECE OF 1/8" x 1/2".
DRAWN & TRACED BY J.W. COASBY.
PUBLISHED AEROMODELLER ANNUAL, 1956.

rudder, no side-thrust or down-thrust on engine, though I'd be inclined to recommend just a couple of degrees right thrust (this has been incorporated on plan), it might cure the necessity for rudder. My first impression with such a short moment arm was that the tailplane area would be inadequate and even went as far as to build an extra tail with 1 in. added at each tip, but the plan tail is completely adequate, the c. of g. works out with the Mills at $\frac{1}{4}$ in. aft of main spar; this shouldn't vary much as the weight of the cockpit details I included are all on or near the c. of g.

"Now for flying. On test glide I had to play about considerably with the elevator to get the glide just right. I might add I knocked one of the wheels out of joint when my wing break-off didn't. However, with wind about 5 to 7 knots towards sundown, I find it performs much happier with a running release than from a launch. When trimmed out the glide was fast—but not too fast, and the touchdown was very realistic.

"On power—well here I hit a snag. I have a new engine, not quite run-in yet and max. revs are not yet forthcoming and with all the engine would give on a 7×4 prop. it just managed to stagger off after a very long run, do a couple of circuits, and down on to the runway again. This landing was really something to see.

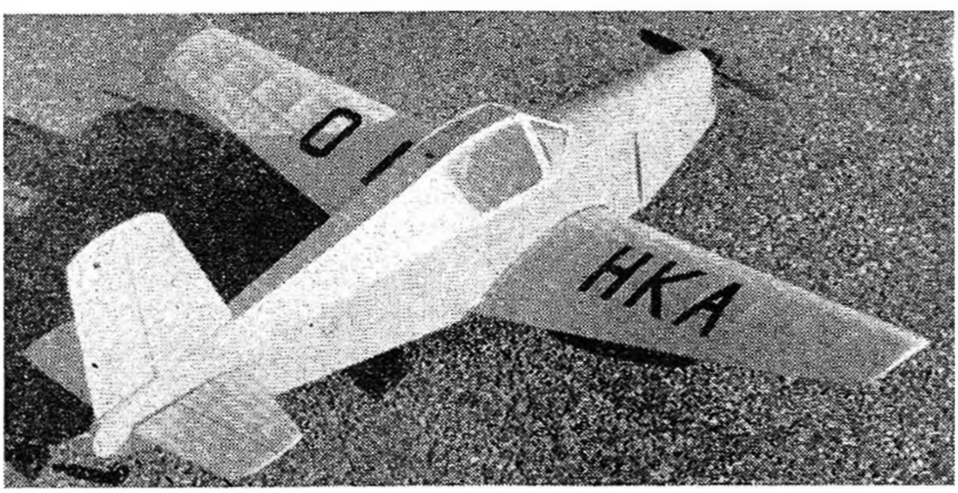
"From hand launch on power it flies very well, though, of course, I really don't feel a scale model is a scale model unless she gets airborne from the deck. From hand launch she flies (with the rudder aforementioned) in wide circuits with max. climb about 100 feet; this will be improved on with an engine giving of her best. I think an 8×4 prop. might be the answer with ·75 Mills.

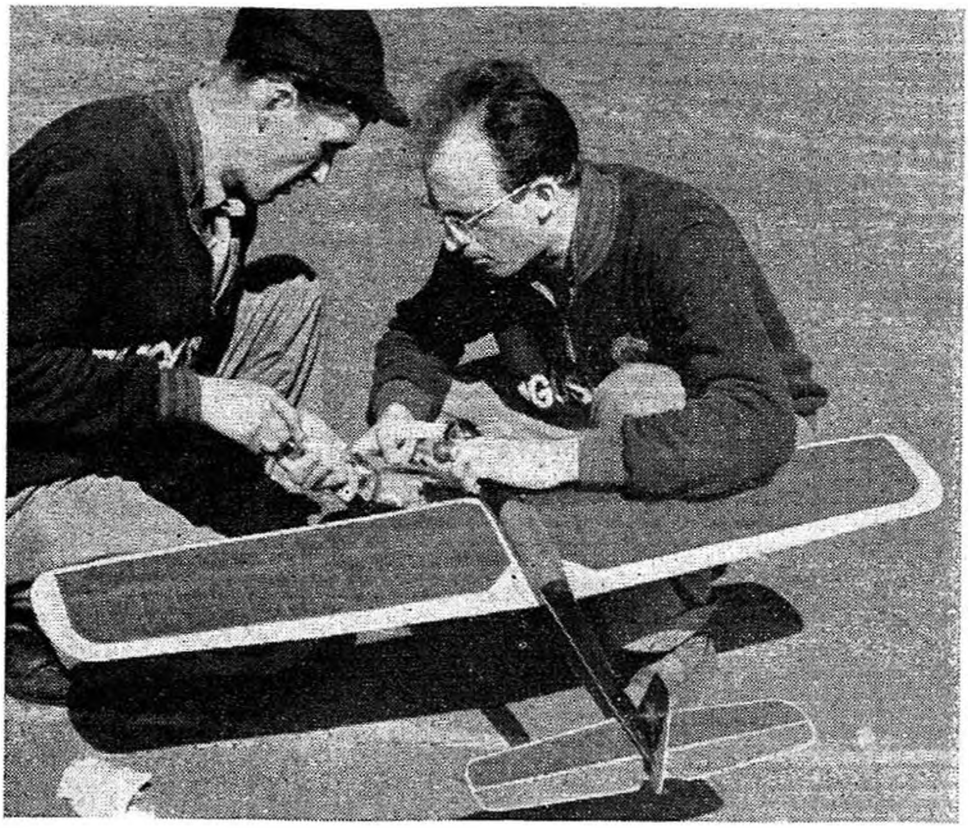
"In a nutshell, I would say simple to build, simple to fly—no vices—engines ·75 to 1 c.c., a Dart providing weight is kept to an absolute minimum should suffice."

Brief Building Hints

Fuselage basic side is built by tracing side view on to $\frac{1}{32}$ in. sheet 4 in. wide and then cementing longerons and uprights on to the sheet.

When both sides have been made they are inverted over plan view with front end protruding over building board and cross struts installed, together with F3 and F4, F9 and F10. Rear top decking is constructed by putting top two stringers into position, then cross struts. Side struts are offered up to decking, measured, cut to size and then cemented into position. Before sheeting the decking sides, chamfer top stringers to angles of sides. Wing construction is quite straightforward. Install u/c legs after bottom L.E. sheet is cemented on, but before top sheet is added. Fin is constructed flat on building board and smaller halves of ribs together with other spar installed after fin is removed from board.





"STELA" STUNT CONTROL LINER

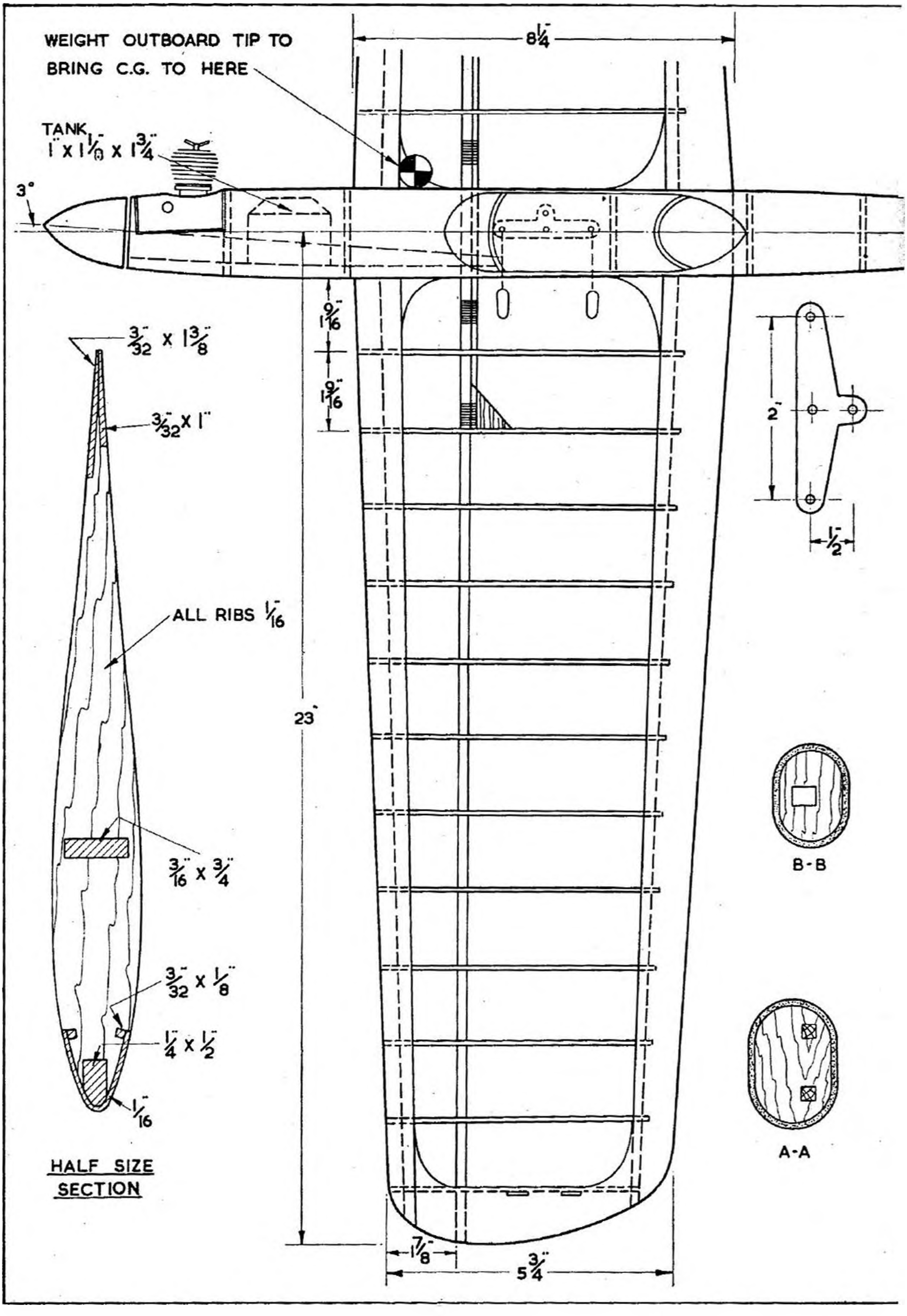
By T. PRUKNER, Jugoslavia

THIS INTERESTING controliner was developed during 1952-3-4, and produced at the 1955 World Speed Championships near Paris, when the aerobatic event was so curiously awarded to Frenchman Humbertjean. No detailed results of the event were ever published so we cannot say just how well Prukner did with it, but its attractive appearance was remarked and should appeal to readers as a somewhat different project.

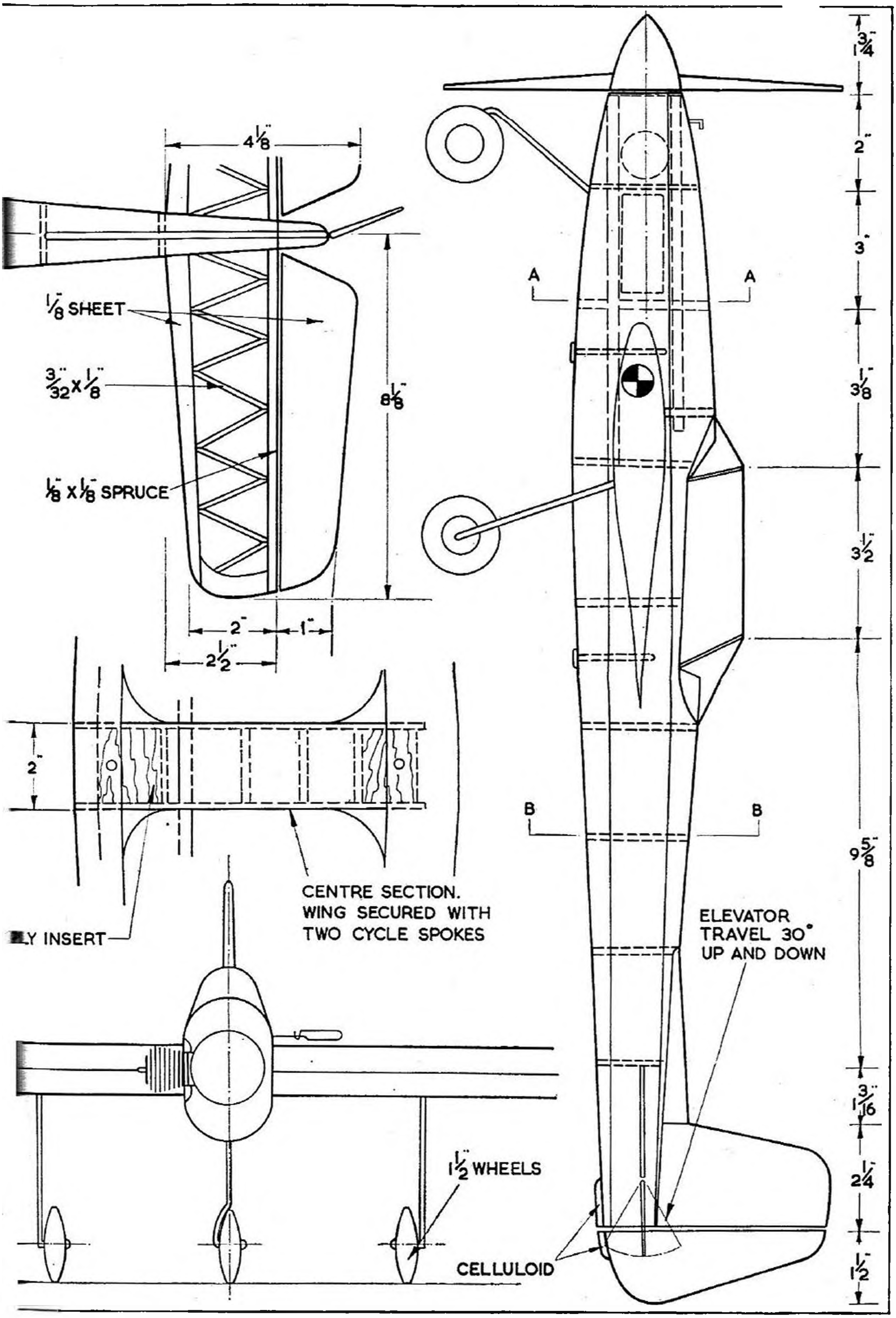
Superficially it resembles Alan Hewitt's well-known *Ambassador*, until it is realised that instead of the customary aspect ratio limit of about 4 : 1 *Stela* boasts a ratio as high as 6 : 1. Next item of interest is the tricycle undercarriage—in itself a quite unusual feature on a modern controliner. Like most Jugoslav models it was originally designed to fly anti-clockwise, but in our drawing it has been switched round to the more normal clockwise flight. C.G. is forward of the main spar and lies midway between this and leading edge. Total elevator movement is 30°-15° each up and down, and fin is permanently offset.

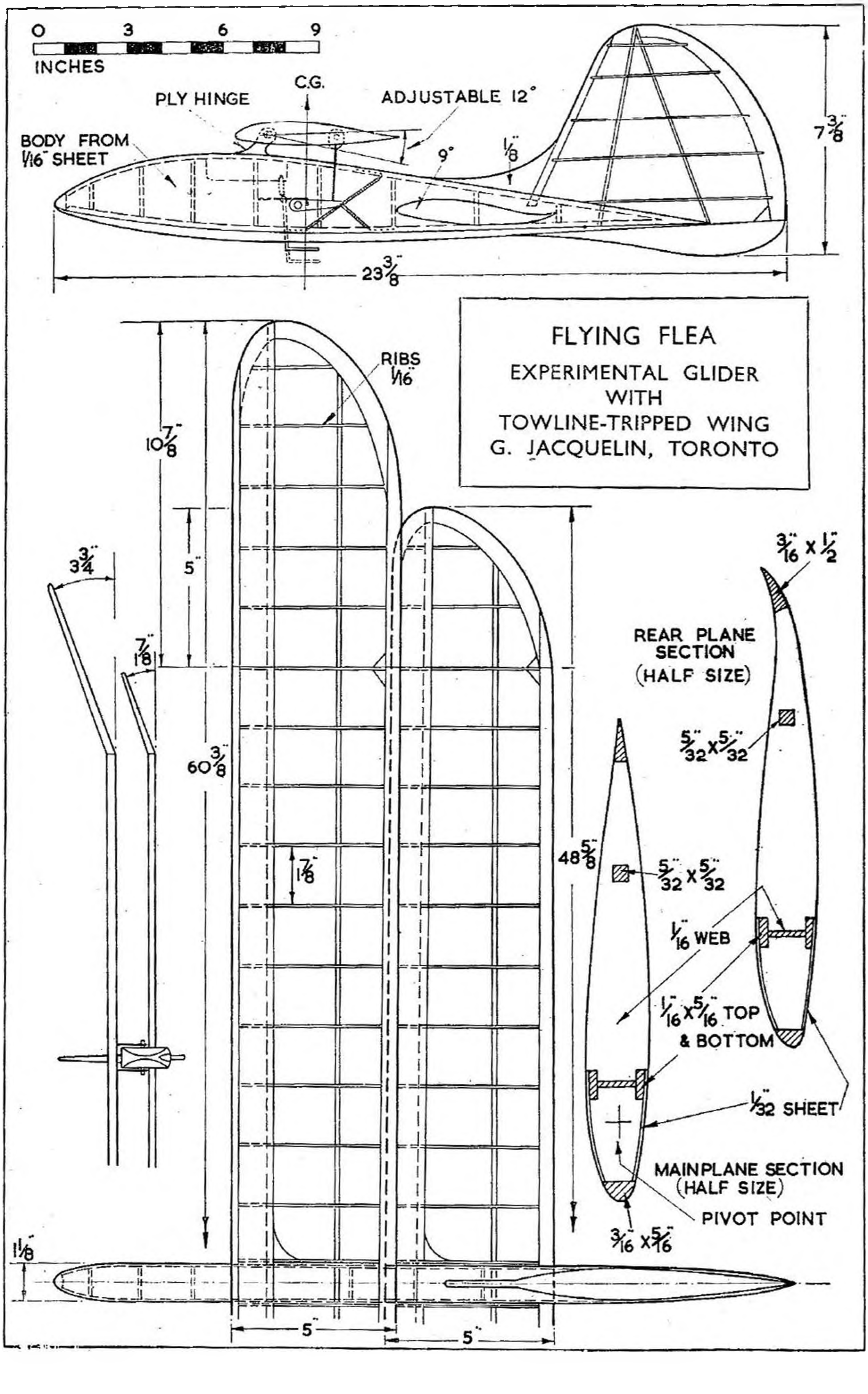
Motive power on the original was a sidewinder mounted native Jugoslav Aero 250. However, any good 2·5 c.c. engine will do the necessary. A special tank with a 40 c.c. capacity is fitted, but here again any "ready-made" will do. Feature we liked particularly was de-mountable nature of wing, which can be slid out complete with control wires. In use it is firmly located with long screws (bicycle spokes would do very well).

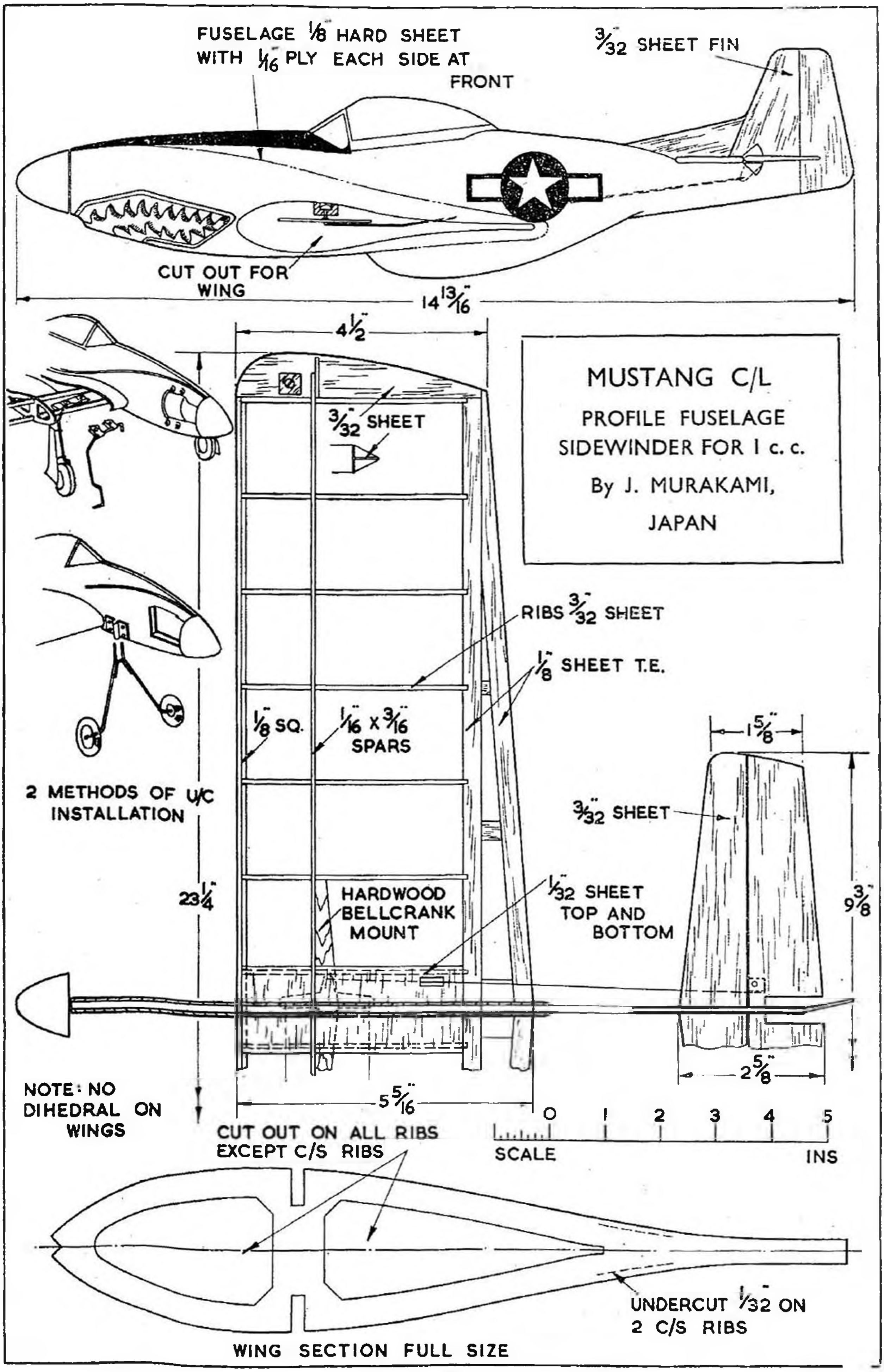
For competition or sport flying it should make a wide appeal to those in search of a good looking, portable stunter that is definitely out of the rut.

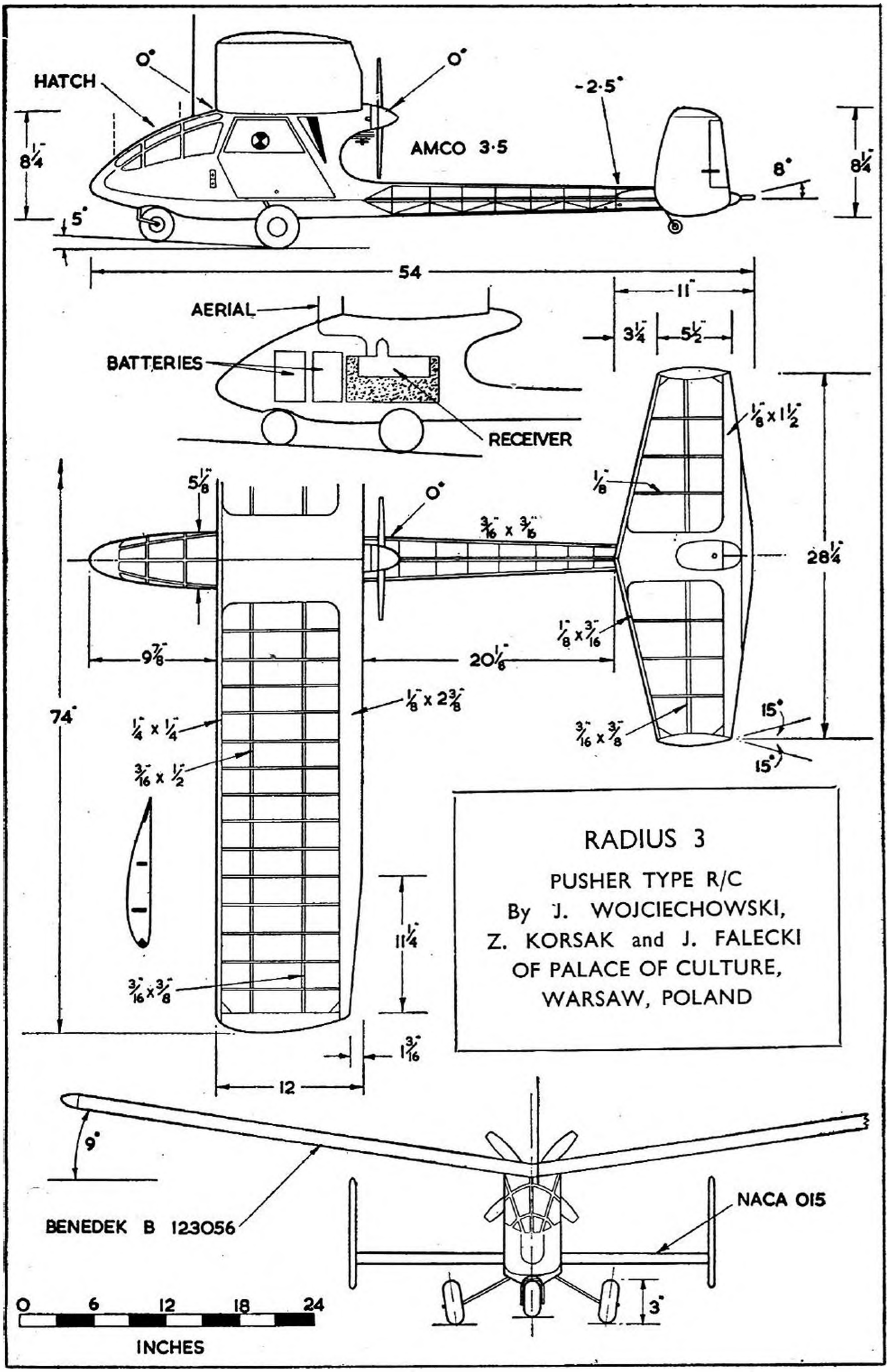


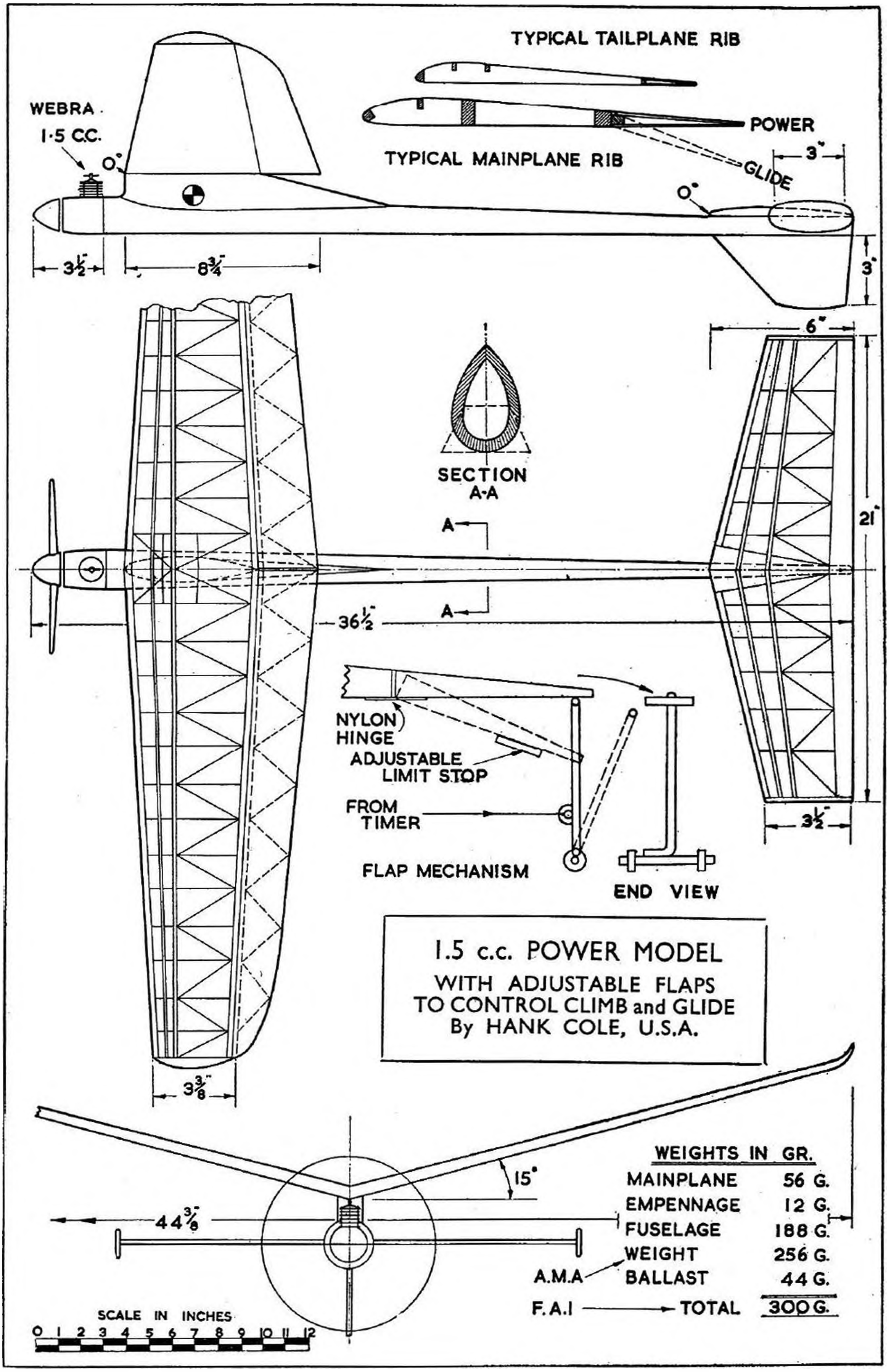
WEIGHT OUTBOARD TIP TO
BRING C.G. TO HERE
TANK 1" x 1 1/8 x 1 3/4"
3°
8 1/4"
9/16"
1 9/16"
2"
1/2"
3/32" x 1 3/8"
3/32 x 1"
ALL RIBS 1/16"
23"
B-B
3/16" x 3/4"
3/32" x 1/8"
1/4" x 1/2"
1/16"
A-A
HALF SIZE
SECTION
1 7/8"
5 3/4"


4 1/8"
1/8 SHEET
3/32" x 1/8"
8 1/8"
1/8" x 1/8" SPRUCE
2"
1"
2 1/2"
2"
LY INSERT
CENTRE SECTION.
WING SECURED WITH
TWO CYCLE SPOKES
1 1/2" WHEELS
A
A
B
B
ELEVATOR
TRAVEL 30°
UP AND DOWN
CELLULOID
1 3/4"
2"
3"
3 1/8"
3 1/2"
9 5/8"
1 3/16"
2 1/4"
1 1/2"

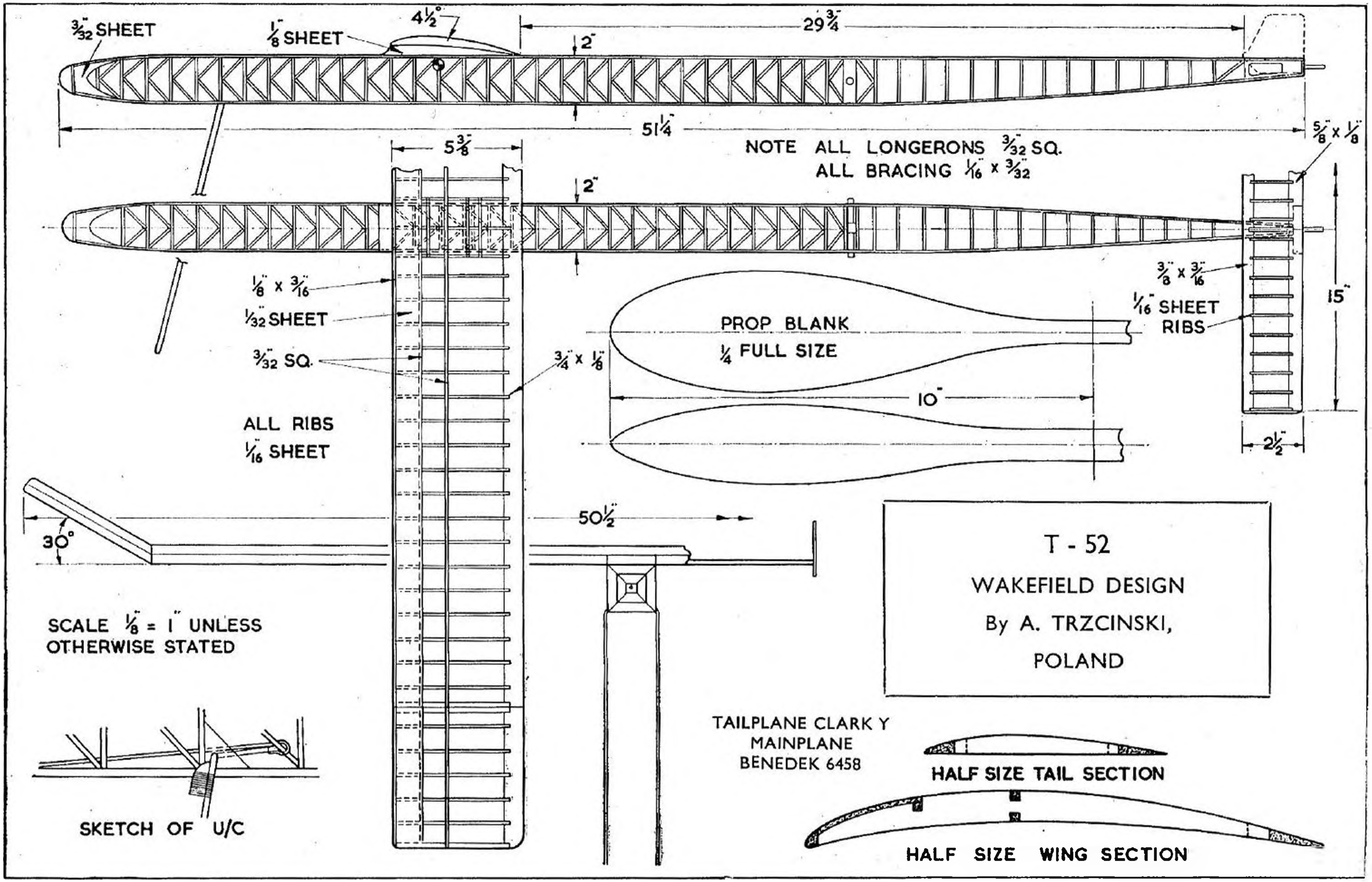

0 3 6 9
INCHES
C.G.
PLY HINGE
ADJUSTABLE 12°
BODY FROM 1/16" SHEET
9°
1/8"
7 3/8"
23 3/8"
FLYING FLEA
EXPERIMENTAL GLIDER
WITH
TOWLINE-TRIPPED WING
G. JACQUELIN, TORONTO
RIBS 1/16"
10 7/8"
5"
3 3/4"
1 7/8"
60 3/8"
1 7/8"
48 5/8"
3/16" x 1/2"
REAR PLANE SECTION (HALF SIZE)
5/32" x 5/32"
5/32" x 5/32"
1/16" WEB
1/16" x 5/16" TOP & BOTTOM
1/32" SHEET
MAINPLANE SECTION (HALF SIZE)
PIVOT POINT
3/16" x 5/16"
1 1/8"
5"
5"

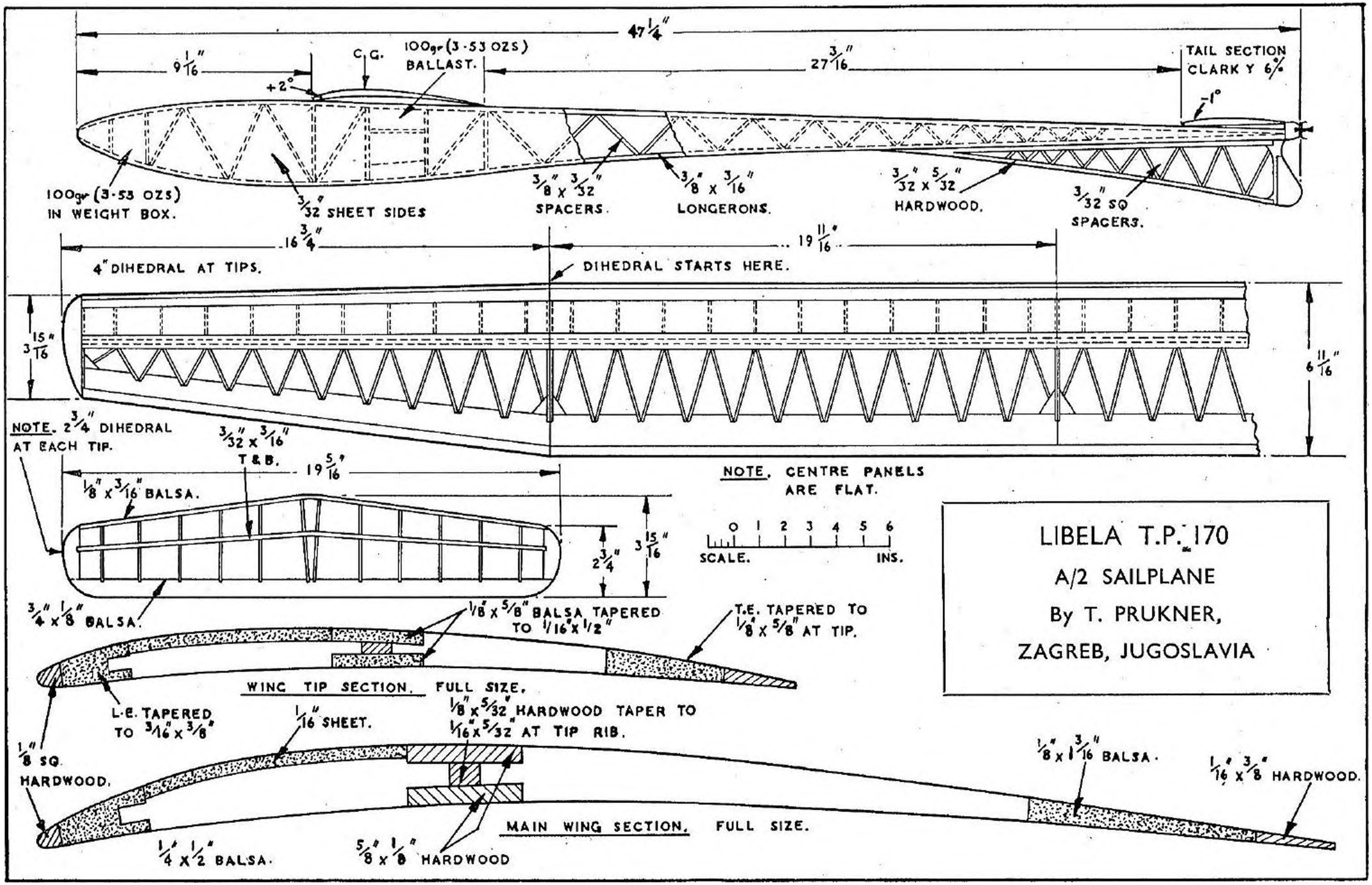

FUSELAGE 1/8" HARD SHEET WITH 1/16" PLY EACH SIDE AT FRONT
3/32" SHEET FIN
CUT OUT FOR WING
14 13/16"
4 1/2"
MUSTANG C/L
PROFILE FUSELAGE
SIDEWINDER FOR 1 c.c.
By J. MURAKAMI,
JAPAN
3/32" SHEET
RIBS 3/32" SHEET
1/8" SHEET T.E.
1/8" SQ.
1/16" x 3/16" SPARS
2 METHODS OF U/C INSTALLATION
1 5/8"
3/32" SHEET
HARDWOOD BELLCRANK MOUNT
1/32" SHEET TOP AND BOTTOM
23 1/4"
9 3/8"
2 5/8"
NOTE: NO DIHEDRAL ON WINGS
5 5/16"
0 1 2 3 4 5
SCALE
INS
CUT OUT ON ALL RIBS EXCEPT C/S RIBS
UNDERCUT 1/32" ON 2 C/S RIBS
WING SECTION FULL SIZE

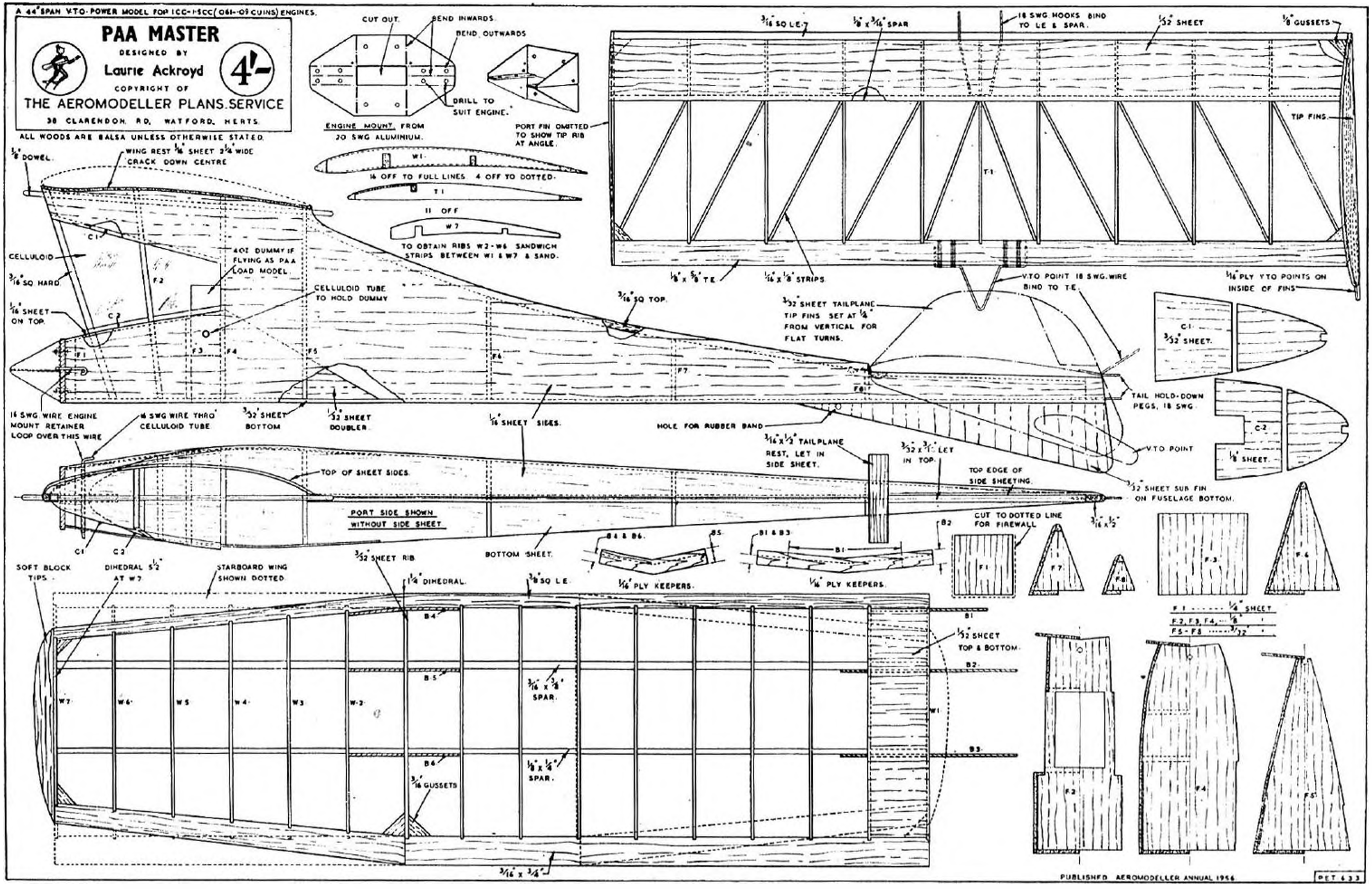

HATCH
0°
0°
-2·5°
AMCO 3·5
8¼"
8¼"
8°
5°
54
11"
3¼"
5½"
AERIAL
BATTERIES
RECEIVER
5/8"
0°
3/16" x 3/16"
1/8" x 1½"
1/8"
28¼"
1/8" x 3/16"
9⅞"
20⅛"
74"
1/8" x 2⅜"
1/4" x 1/4"
3/16" x 1/2"
3/16" x 3/8"
15°
15°
11¼"
3/16" x 3/8"
1 3/16"
12
RADIUS 3
PUSHER TYPE R/C
By J. WOJCIECHOWSKI,
Z. KORSAK and J. FALECKI
OF PALACE OF CULTURE,
WARSAW, POLAND
9°
BENEDEK B 123056
NACA 015
3"
0 6 12 18 24
INCHES

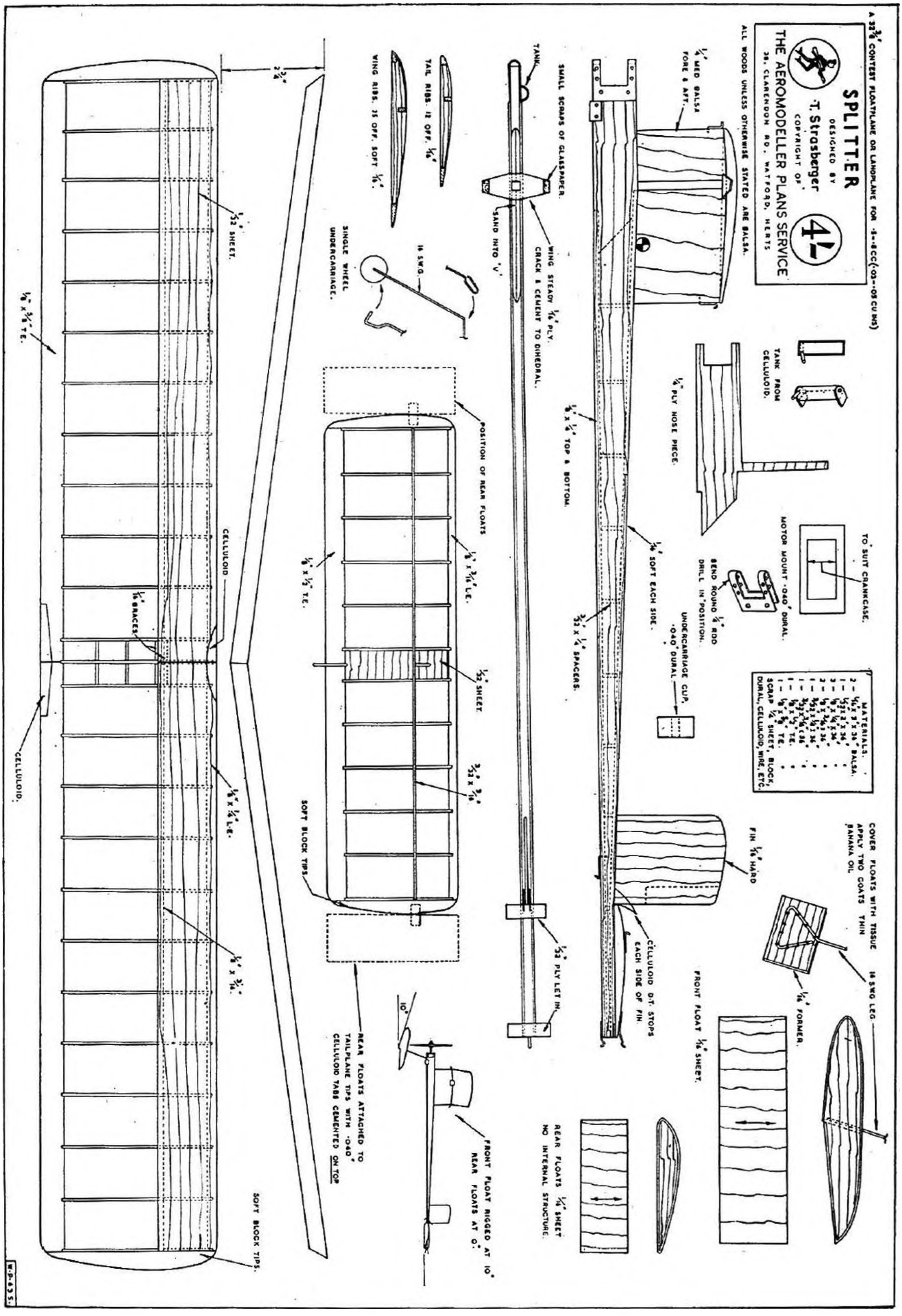


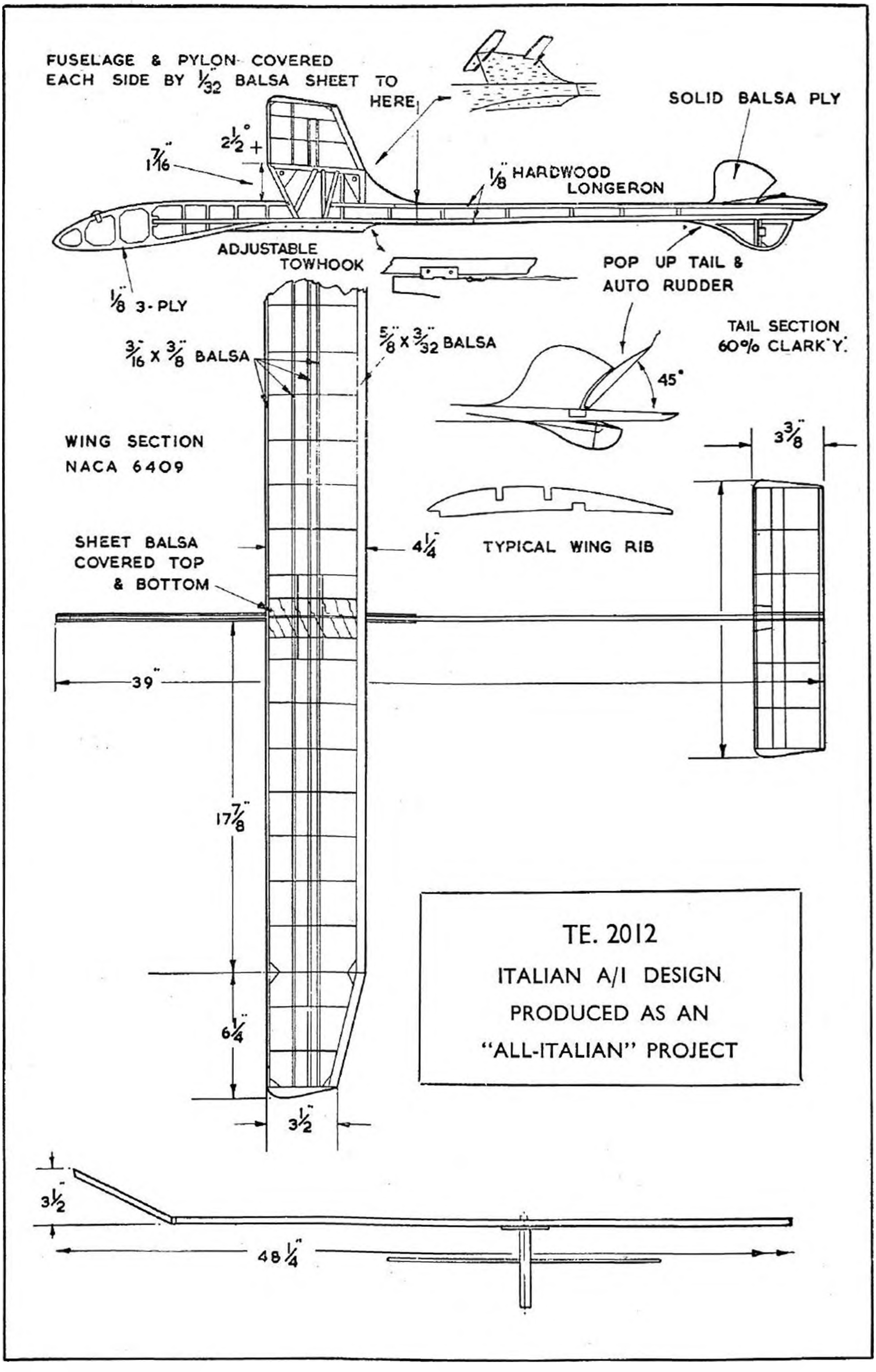
1.5 c.c. POWER MODEL
WITH ADJUSTABLE FLAPS
TO CONTROL CLIMB and GLIDE
By HANK COLE, U.S.A.


3/32" SHEET
1/8" SHEET
4½°
29¾"
2"
51¼"
5/8" x 1/8"
5⅜"
NOTE ALL LONGERONS 3/32 SQ.
ALL BRACING 1/16" x 3/32"
2"
1/8" x 3/16"
1/32 SHEET
3/32 SQ.
3/4" x 1/8"
ALL RIBS
1/16" SHEET
PROP BLANK
¼ FULL SIZE
10"
3/8" x 3/16"
1/16" SHEET
RIBS
15"
2½"
30°
50½"
SCALE 1/8" = 1" UNLESS
OTHERWISE STATED
T - 52
WAKEFIELD DESIGN
By A. TRZCINSKI,
POLAND
SKETCH OF U/C
TAILPLANE CLARK Y
MAINPLANE
BENEDEK 6458
HALF SIZE TAIL SECTION
HALF SIZE WING SECTION


47 1/4"
9 1/16"
C.G.
100gr (3·53 OZS) BALLAST.
+2°
27 3/16"
TAIL SECTION CLARK Y 6%
-1°
100gr (3·53 OZS) IN WEIGHT BOX.
3/32" SHEET SIDES
3/8" x 3/32" SPACERS.
3/8" x 3/16" LONGERONS.
3/32" x 5/32" HARDWOOD.
3/32" SQ SPACERS.
16 3/4"
19 11/16"
4" DIHEDRAL AT TIPS.
DIHEDRAL STARTS HERE.
3 15/16"
6 11/16"
NOTE. 2 3/4" DIHEDRAL AT EACH TIP.
3/32" x 3/16" T & B.
19 5/16"
1/8" x 3/16" BALSA.
NOTE. CENTRE PANELS ARE FLAT.
0 1 2 3 4 5 6
SCALE. INS.
2 3/4"
3 15/16"
3/4" x 1/8" BALSA.
1/8" x 5/8" BALSA TAPERED TO 1/16" x 1/2"
T.E. TAPERED TO 1/8" x 5/8" AT TIP.
LIBELA T.P. 170
A/2 SAILPLANE
By T. PRUKNER,
ZAGREB, JUGOSLAVIA
WING TIP SECTION. FULL SIZE.
L.E. TAPERED TO 3/16" x 3/8"
1/16" SHEET.
1/8" x 5/32" HARDWOOD TAPER TO 1/16" x 5/32" AT TIP RIB.
1/8" SQ. HARDWOOD.
1/8" x 1 3/16" BALSA.
1/16" x 3/8" HARDWOOD.
MAIN WING SECTION. FULL SIZE.
1/4" x 1/2" BALSA.
5/8" x 1/8" HARDWOOD


A 44" SPAN V.T.O. POWER MODEL FOR 1CC-1.5CC (.061-.09 CU.INS) ENGINES.
PAA MASTER
DESIGNED BY
Laurie Ackroyd
COPYRIGHT OF
THE AEROMODELLER PLANS SERVICE
38 CLARENDON RD. WATFORD, HERTS.
4/-
ALL WOODS ARE BALSA UNLESS OTHERWISE STATED.
CUT OUT
BEND INWARDS
BEND OUTWARDS
DRILL TO SUIT ENGINE.
ENGINE MOUNT FROM 20 SWG ALUMINIUM.
PORT FIN OMITTED TO SHOW TIP RIB AT ANGLE.
16 OFF TO FULL LINES 4 OFF TO DOTTED
11 OFF
TO OBTAIN RIBS W2-W6 SANDWICH STRIPS BETWEEN W1 & W7 & SAND.
1/8" DOWEL
WING REST 1/16" SHEET 2 1/4" WIDE CRACK DOWN CENTRE
CELLULOID
3/16" SQ HARD
1/16" SHEET ON TOP
4 OZ DUMMY IF FLYING AS PAA LOAD MODEL.
CELLULOID TUBE TO HOLD DUMMY
3/16" SQ TOP
16 SWG WIRE ENGINE MOUNT RETAINER LOOP OVER THIS WIRE
16 SWG WIRE THRO' CELLULOID TUBE
3/32" SHEET BOTTOM
1/32" SHEET DOUBLER
1/16" SHEET SIDES
HOLE FOR RUBBER BAND
3/16" x 1/2" TAILPLANE REST, LET IN SIDE SHEET.
3/32" x 1" LET IN TOP.
TOP EDGE OF SIDE SHEETING
3/32" SHEET SUB FIN ON FUSELAGE BOTTOM.
TAIL HOLD-DOWN PEGS, 18 SWG.
V.T.O POINT
TOP OF SHEET SIDES
PORT SIDE SHOWN WITHOUT SIDE SHEET
BOTTOM SHEET
3/16" SQ L.E.
1/8" x 3/16" SPAR
18 SWG HOOKS BIND TO LE & SPAR.
1/32" SHEET
1/8" GUSSETS
TIP FINS
1/8" x 5/8" T.E.
1/16" x 1/8" STRIPS
V.T.O POINT 18 SWG WIRE BIND TO T.E.
1/16" PLY V.T.O POINTS ON INSIDE OF FINS
3/32" SHEET TAILPLANE TIP FINS SET AT 1/4" FROM VERTICAL FOR FLAT TURNS.
3/32" SHEET.
1/8" SHEET.
CUT TO DOTTED LINE FOR FIREWALL
SOFT BLOCK TIPS
DIHEDRAL 5 1/2" AT W7
STARBOARD WING SHOWN DOTTED
3/32" SHEET RIB
1 1/4" DIHEDRAL
3/8" SQ L.E.
1/16" PLY KEEPERS.
1/32" SHEET TOP & BOTTOM
3/16" x 3/8" SPAR
1/8" x 1/4" SPAR.
3/16" GUSSETS
3/16" x 3/4"
F1 ...... 1/4" SHEET
F2, F3, F4 ...... 1/8"
F5 - F8 ...... 3/32"
PUBLISHED AEROMODELLER ANNUAL 1956
PET 633


A 32 3/4" CONTEST FLOATPLANE OR LANDPLANE FOR ·5–·8CC (·03–·05 CU INS)
SPLITTER
DESIGNED BY
T. Strasberger
COPYRIGHT OF
THE AEROMODELLER PLANS SERVICE
38, CLARENDON RD., WATFORD, HERTS
4/-
ALL WOODS UNLESS OTHERWISE STATED ARE BALSA.
1/4" MED BALSA FORE & AFT.
TANK FROM CELLULOID.
1/4" PLY NOSE PIECE.
TO SUIT CRANKCASE.
MOTOR MOUNT ·040" DURAL.
BEND ROUND 1/4" ROD DRILL IN POSITION.
UNDERCARRIAGE CLIP. ·040" DURAL.
MATERIALS.
2 – 1/16" x 3" x 36" BALSA.
1 – 1/32" x 2" x 36"
3 – 1/8" x 1/4" x 36"
2 – 1/8" x 3/16" x 36"
1 – 3/32" x 1/4" x 36"
1 – 3/32" x 3/16" x 36"
1 – 1/8" x 1/2" T.E.
1 – 1/8" x 5/8" T.E.
SCRAP 1/4" SHEET, BLOCK, DURAL, CELLULOID, WIRE, ETC.
COVER FLOATS WITH TISSUE APPLY TWO COATS THIN BANANA OIL
16 S.W.G. LEG.
1/16" FORMER.
FIN 1/16" HARD
FRONT FLOAT 1/16" SHEET.
1/16" SOFT EACH SIDE.
CELLULOID D.T. STOPS EACH SIDE OF FIN.
1/8" x 1/4" TOP & BOTTOM.
3/32" x 1/4" SPACERS.
REAR FLOATS 1/16" SHEET NO INTERNAL STRUCTURE.
SMALL SCRAPS OF GLASSPAPER.
WING STEADY 1/16" PLY. CRACK & CEMENT TO DIHEDRAL.
TANK
SAND INTO 'V'
1/32" PLY LET IN.
POSITION OF REAR FLOATS
1/8" x 3/16" L.E.
1/32" SHEET.
3/32" x 3/16"
FRONT FLOAT RIGGED AT 10° REAR FLOATS AT 0°.
10°
TAIL RIBS. 12 OFF. 1/16"
WING RIBS. 25 OFF. SOFT 1/16".
16 S.W.G.
SINGLE WHEEL UNDERCARRIAGE.
REAR FLOATS ATTACHED TO TAILPLANE TIPS WITH ·040" CELLULOID TABS CEMENTED ON TOP
1/8" x 1/2" T.E.
SOFT BLOCK TIPS.
2 3/4"
1/32" SHEET.
CELLULOID
1/8" x 1/4" L.E.
1/8" x 3/16".
SOFT BLOCK TIPS.
1/16" BRACES.
1/8" x 5/8" T.E.
CELLULOID.
W.P.635.

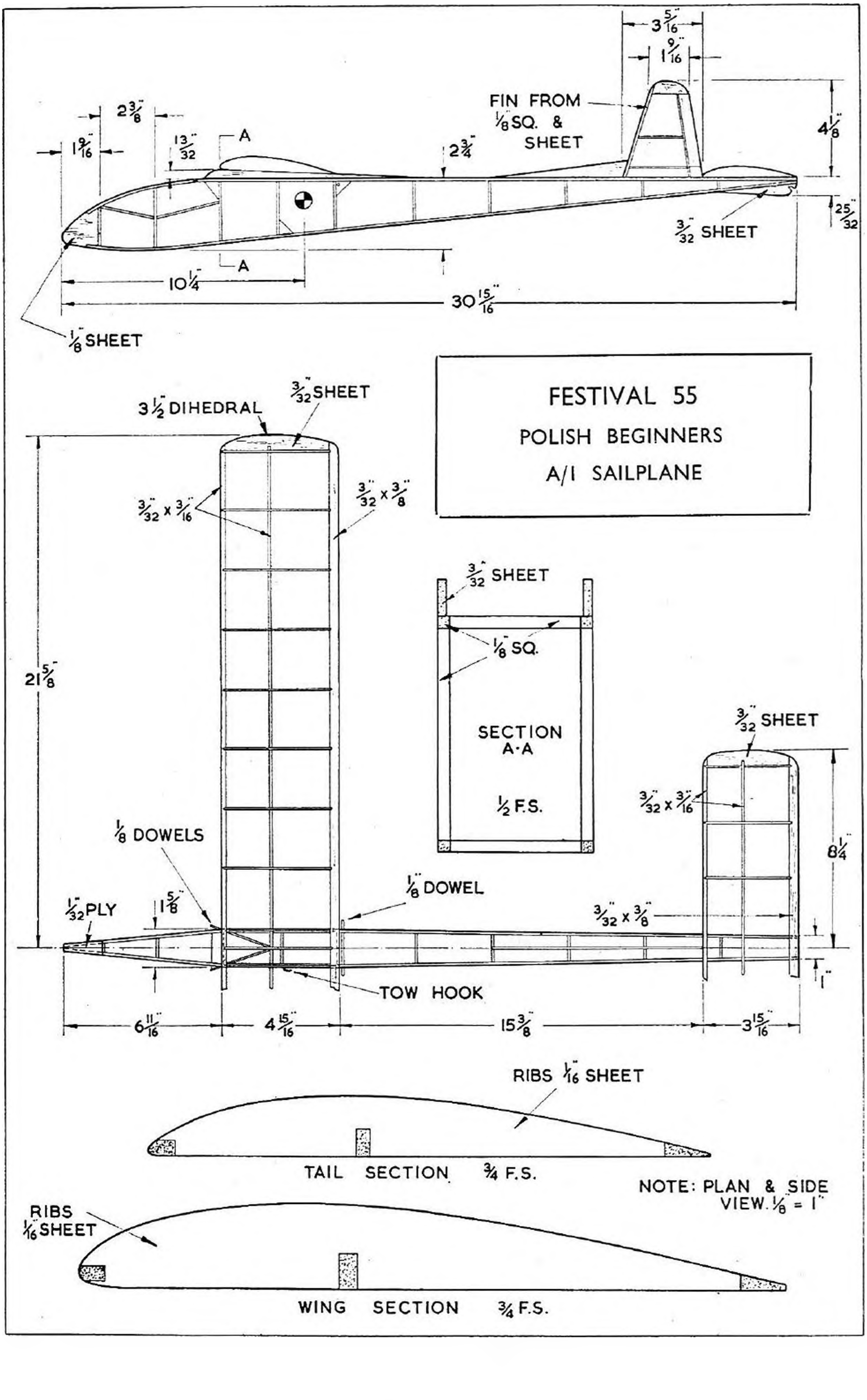


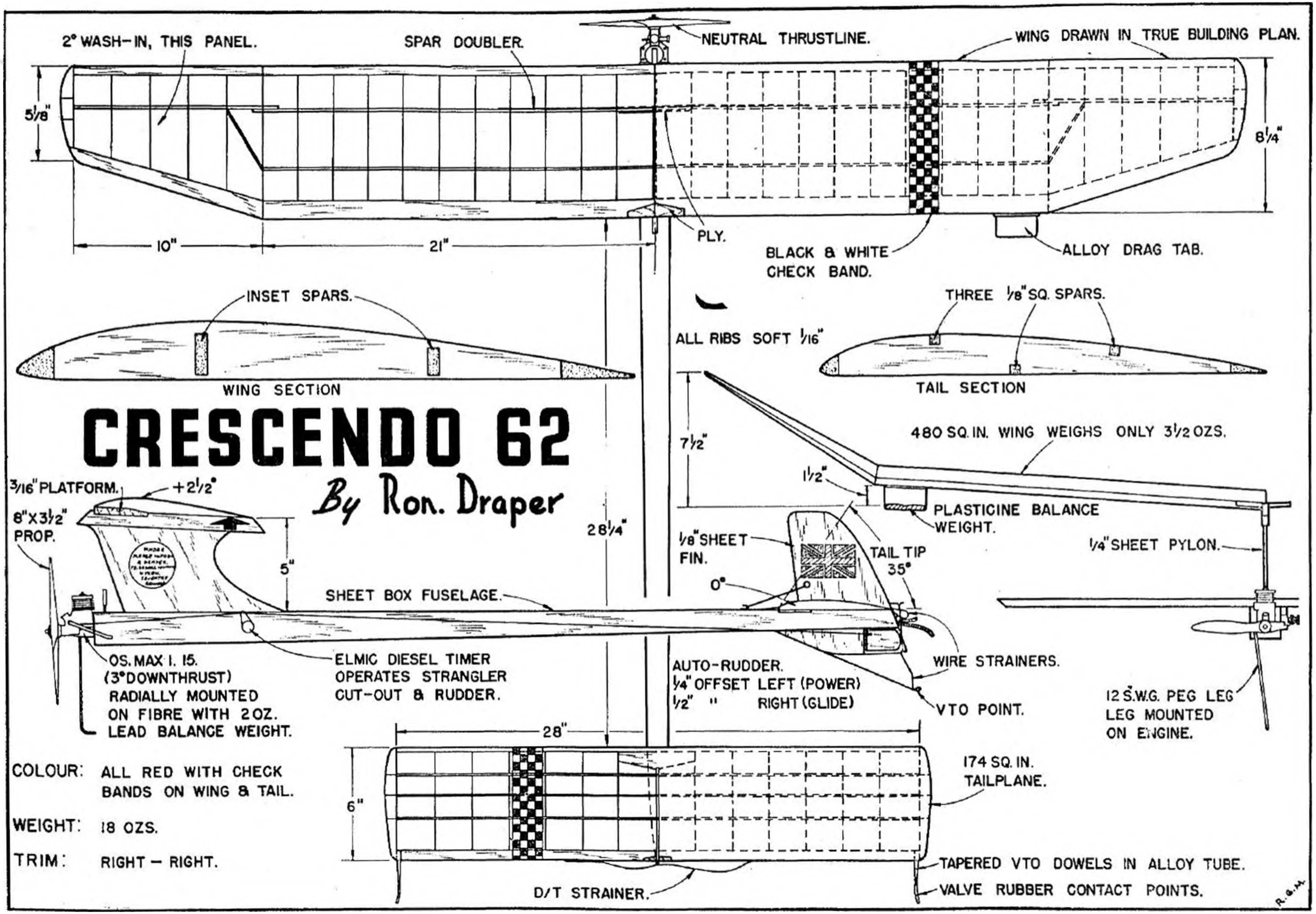
TE. 2012

ITALIAN A/I DESIGN

PRODUCED AS AN

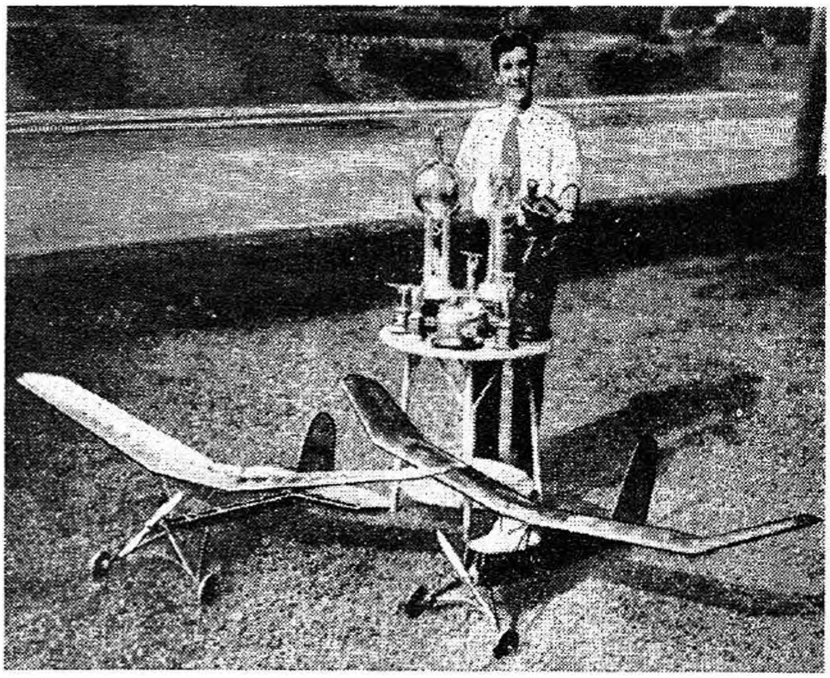
"ALL-ITALIAN" PROJECT


FESTIVAL 55
POLISH BEGINNERS
A/1 SAILPLANE
3 5/16"
1 9/16"
FIN FROM 1/8" SQ. & SHEET
4 1/8"
2 3/8"
1 9/16"
13/32"
A
2 3/4"
3/32" SHEET
25/32"
A
10 1/4"
30 15/16"
1/8" SHEET
3/32" SHEET
3 1/2" DIHEDRAL
3/32" x 3/16"
3/32" x 3/8"
21 5/8"
3/32" SHEET
1/8" SQ.
SECTION A-A
1/2 F.S.
3/32" SHEET
3/32" x 3/16"
8 1/4"
1/8 DOWELS
1/8" DOWEL
1/32" PLY
1 5/8"
3/32" x 3/8"
TOW HOOK
1"
6 11/16"
4 15/16"
15 3/8"
3 15/16"
RIBS 1/16" SHEET
TAIL SECTION 3/4 F.S.
NOTE: PLAN & SIDE VIEW. 1/8" = 1"
RIBS 1/16" SHEET
WING SECTION 3/4 F.S.



CRESCENDO 62
By Ron. Draper
2° WASH-IN, THIS PANEL.
SPAR DOUBLER.
NEUTRAL THRUSTLINE.
WING DRAWN IN TRUE BUILDING PLAN.
5 1/8"
8 1/4"
10"
21"
PLY.
BLACK & WHITE CHECK BAND.
ALLOY DRAG TAB.
INSET SPARS.
WING SECTION
ALL RIBS SOFT 1/16"
THREE 1/8" SQ. SPARS.
TAIL SECTION
7 1/2"
480 SQ. IN. WING WEIGHS ONLY 3 1/2 OZS.
1 1/2"
PLASTICINE BALANCE WEIGHT.
1/4" SHEET PYLON.
3/16" PLATFORM.
+2 1/2°
8" X 3 1/2" PROP.
5"
28 1/4"
1/8" SHEET FIN.
TAIL TIP 35°
0°
SHEET BOX FUSELAGE.
OS. MAX I. 15. (3° DOWNTHRUST) RADIALLY MOUNTED ON FIBRE WITH 2 OZ. LEAD BALANCE WEIGHT.
ELMIC DIESEL TIMER OPERATES STRANGLER CUT-OUT & RUDDER.
AUTO-RUDDER. 1/4" OFFSET LEFT (POWER) 1/2" " RIGHT (GLIDE)
WIRE STRAINERS.
VTO POINT.
12 S.W.G. PEG LEG LEG MOUNTED ON ENGINE.
28"
6"
174 SQ. IN. TAILPLANE.
COLOUR: ALL RED WITH CHECK BANDS ON WING & TAIL.
WEIGHT: 18 OZS.
TRIM: RIGHT - RIGHT.
TAPERED VTO DOWELS IN ALLOY TUBE.
VALVE RUBBER CONTACT POINTS.
D/T STRAINER.
R.G.M.

EVOLUTION OF THE POWER MODEL



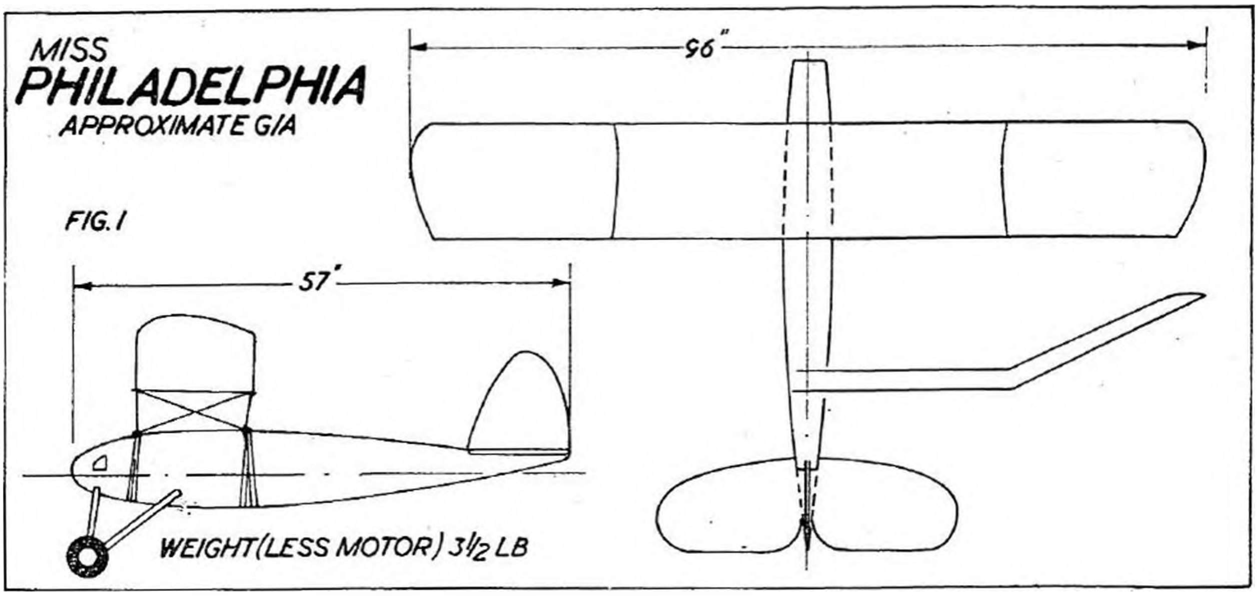
Maxwell Bassett of Philadelphia and his pioneering "Miss Philadelphia" models equipped with the earliest Brown petrol engines.

PRIOR TO 1932 a model aeroplane powered by an internal combustion engine was virtually unknown. Admittedly the occasional pioneer in this country, and America, did produce the odd machine which flew, fitted with a heavy, large and generally inefficient engine. As long ago as 1908 reports in the aeronautical journals of the time mention flights with model aeroplanes fitted with petrol engines and in 1914 D. Stanger set up a British record for the type with a duration of 41 seconds—a record which stood unchallenged for nearly twenty years. The model was a biplane powered by a four cylinder "double-vee" engine.

Strangely enough it was in this year, 1932, that interest in power models sprang to life simultaneously, and quite independently, both in England and the United States. In this country Col. (then Captain) Bowden built and flew his "Kanga" biplane, fitted with a hand-built engine made by E. Westbury, to set up a new record of 70 seconds duration. This was followed somewhat later by a high wing monoplane, which further boosted the record and was particularly noteworthy in that it was powered with an engine specially designed for aircraft propulsion (again by Westbury)—the 15 c.c. "Atom Minor"—and an engine which was subsequently used by a number of British modellers. The original "Atom Minor" eventually went on to power Bowden's 8 ft. span "Blue Dragon" which ultimately established the British duration record at 12 mins. 48 seconds and was probably the best known of the pre-war power model designs this side of the Atlantic in the 1930's.

Development of power models must, necessarily, wait on the development of suitable power plants and in this respect America went right ahead from the start. The Brown engine just mentioned, appeared as a hand-made prototype in 1932 and within a few years was in large scale production. Other manufacturers were attracted into the business, so that quickly the commercial side became competitive, keeping prices right down and within the means of most modellers. Also the technical standard of both design and production rapidly reached an extremely high standard.

By comparison, right up to the onset of World War II there was no British commercial engine produced of directly comparable quality, or price,



with upwards of a dozen or so contemporary American products. The later entry of America into the war also enabled them to continue development, with a still expanding market, to bring the spark ignition engine to near perfection. Activity in both countries then tapered right off and virtually closed down during the war period. But by that time the standard of American engine production was so high that it was to remain unchallenged for many years to come. Also because of the vast number of cheap, powerful and reliable engines which had been turned out in the late 1930's, a similar high level had been reached with regard to power model designs. Subsequent British and Continental model and engine design first directly copied and then tried to improve upon contemporary American practice, although the post-war engine question was somewhat complicated by the appearance of glow plug ignition and compression ignition, as alternatives to the hitherto standard spark-ignition petrol engine.

Thus, strictly speaking, all the pre-war honours in power modelling belong to the United States. Pre-war British design standards, both in models and engines have, if pursued, left us an unfortunate legacy of "model engineering" requirements—gawky designs which combine exaggerated functional features with uneconomic structures, by accepted present-day standards. This is not disparaging to the small group of pioneers, who saw the British power model through its early days. They were few in number and thus more restricted in the development which could be undertaken in the time. They had not the same access to first class materials as in America, nor the same opportunities for competitive flying to improve the breed. Right up to the outbreak of war, the rubber model was the mainstay of the aeromodelling movement. Gliders were beginning to be accepted as a fairly interesting ancillary to the main competitions, but the main place for power models on gala days, was usually the "concours" enclosure!

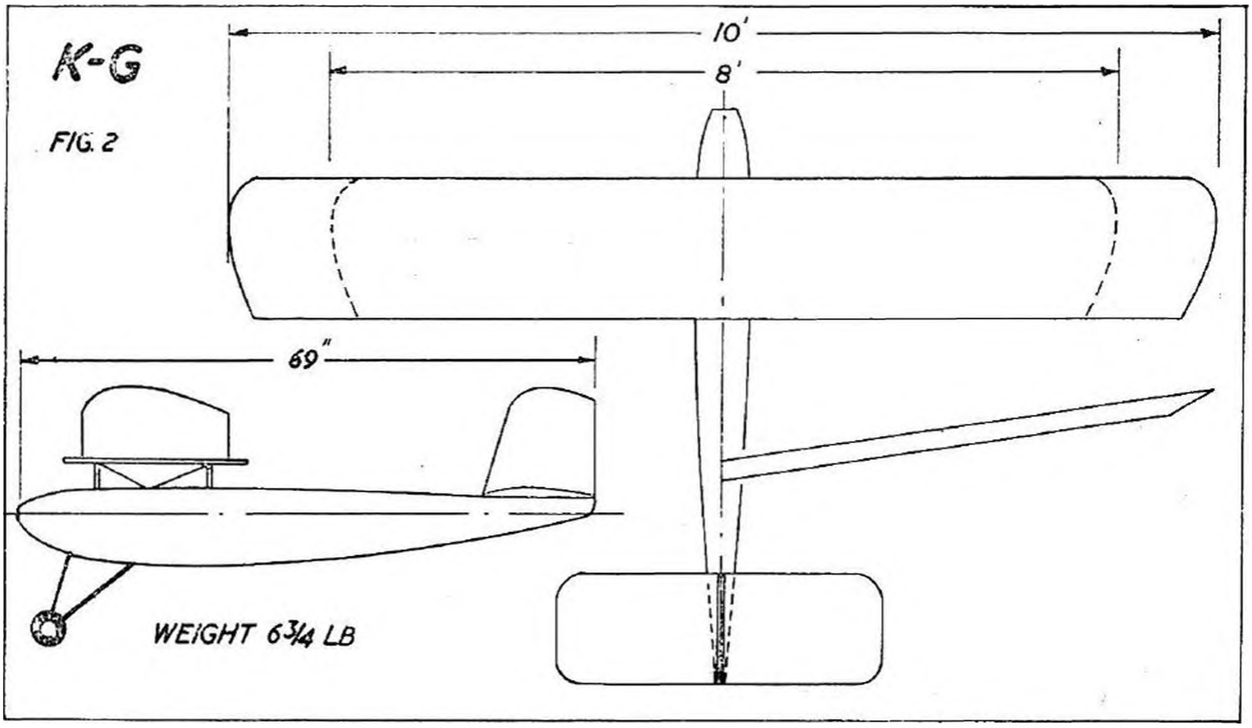
The first successful United States power model made a somewhat sensational appearance on the scene at the 1932 American Nationals. Built by Maxwell Bassett of Philadelphia and fitted with a 10 c.c. engine made by Bill Brown of the same city, it nearly stopped the meet as it made one flight after another—especially as the rules current at the time allowed it to be entered in the duration contests against rubber powered models! However, as far as our records show, he did not oust the rubber jobs from all the top prizes and so the significance of an unlimited power run was overlooked—for another year. At the 1933 Nationals, Bassett won the Mulvilhill, Stout and Moffat trophies (all for open duration), and also many other major open duration events during that year. By 1934 the power model (or "gas" model, as it was and still is called in America) was entered as a separate event for the first time—and for good measure, Bassett again won that with a flight of 21 min. 57 secs.!

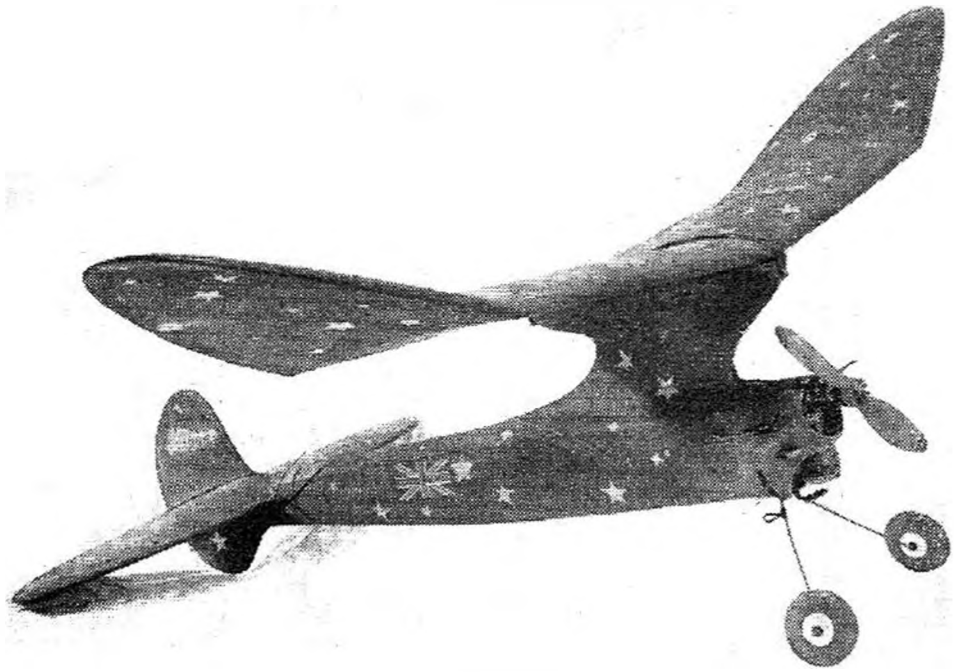
Above all, Bassett was a first-class model flyer. He had also developed an original design layout suitable for power flying and, initially at least, was the only modeller able to obtain the Brown engine—the only reliable lightweight power plant to appear at that date. With all this behind him, he succeeded in holding top place in the world of power flying right through until 1936.

The model he flew was large but light—eight ft. wing span with a total weight of about 3½ lb., less motor. The original 10 c.c. Brown engine weighed about 6½ ounces, bare of ignition equipment. The g/a drawing—Fig. 1—shows that the design incorporated such "modern" features as high-mounted wing and tip dihedral. Replace the wide track forward-mounted undercarriage with single cantilever legs and replace the wire wing mount with a pylon and it is not so very different in layout from a modern design.

Under power Bassett's model had a strong tendency to loop, which he offset by making the model turn, thus achieving the first "spiral climb" as a typical duration trim—although the actual rate of climb was only of the order of 250-300 ft. per minute. Other modellers trying a similar layout got into trouble and it was commonly held, by 1936, that a high-mounted wing and low thrust line was bound to produce spiral instability.

Probably Bassett's greatest rival for top honours in the very early days, was Joe Kovel who, in conjunction with Charles Grant, evolved the K-G design incorporating Grant's ideas of design layout to combat spiral instability based on proper placement of the centre of lateral area. Fig. 2. (The first K-G design, incidentally, was a high wing design and consistently spun in whenever it was trimmed for a turn; the successful K-G layout incorporated a parasol mounted wing, but placed the thrust line fairly high.)

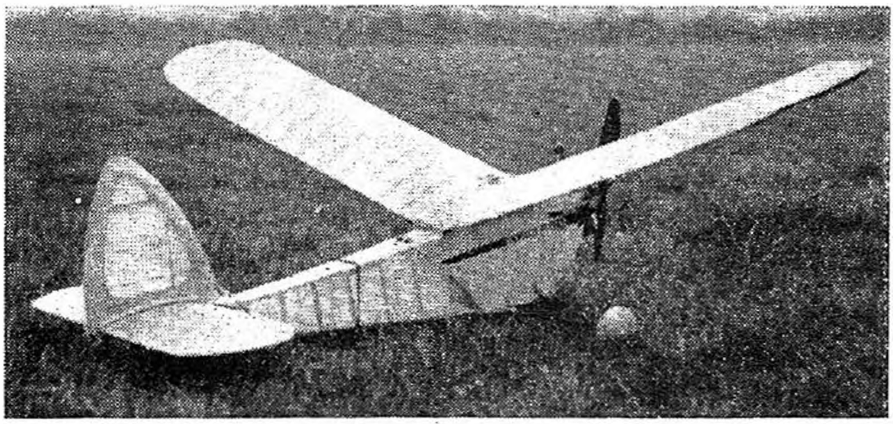




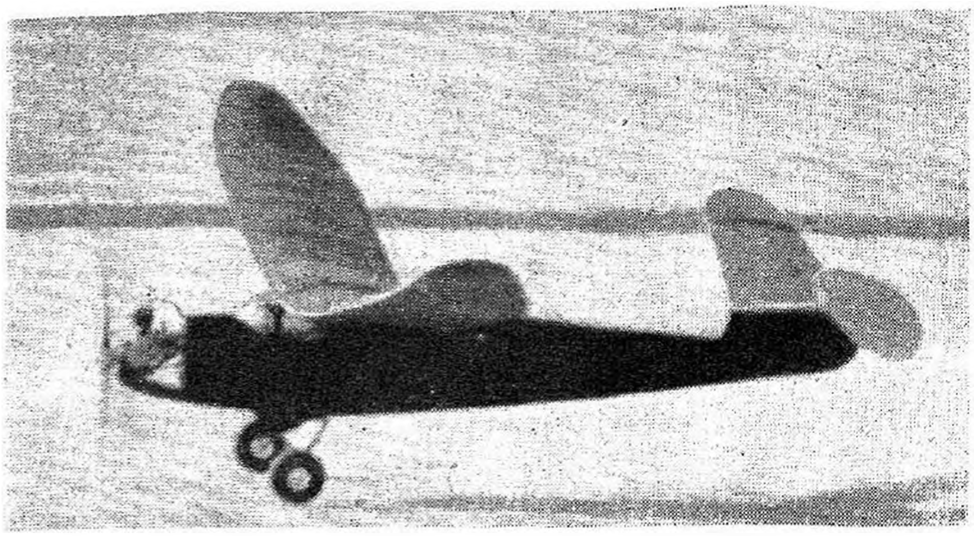
.he fabulous Goldberg "Zipper" forerunner of the modern small pylon model and here as originally designed with a 6 c.c. Baby Cyclone petrol engine.

Kovel lacked the modelling experience and practical "know-how" of Bassett, but placed second to him in the '34 Nationals with an 8-ft. span model, following up by establishing a world's record flight of 64 mins. 40 seconds early in 1935 at the Eastern States Contest with the 10-ft. span K-G. Both models used the Brown Junior engine, by then available as a commercial article selling at $21.50.

By this time other design trends had appeared. Modellers throughout this early period were beset with stability troubles and many and varied were the layouts tried to overcome this. Irwin Ohlsson (later of Ohlsson and Rice motor fame) achieved considerable contest success in State meets with a straight dihedralled cabin model, featuring a high thrust line and inverted engine (Kovel's first model also had an inverted engine, but this was changed to upright mounting as the plug oiled up). Bill Atwood (1935) retained the upright motor, mounted in the bottom of the fuselage (i.e., low thrust line) but lowered the wing right onto the fuselage. Leo Weiss produced the first of the true streamliners (the fuselage was hollowed out from solid block) and topped the 1935 Nationals with a 64 min. 28 secs. flight, but was about the only modeller during this period to achieve good results with a shoulder-wing layout. Ben Shereshaw tried a low wing pusher, and then streamliners. And there were other well-known names in the list, many still actively linked with the commercial side of aeromodelling in the States.



Steep dihedral, deep belly and large fin, typify Colonel Bowden's model designs, this one being the Porlock Puffin of 1939/40 vintage.



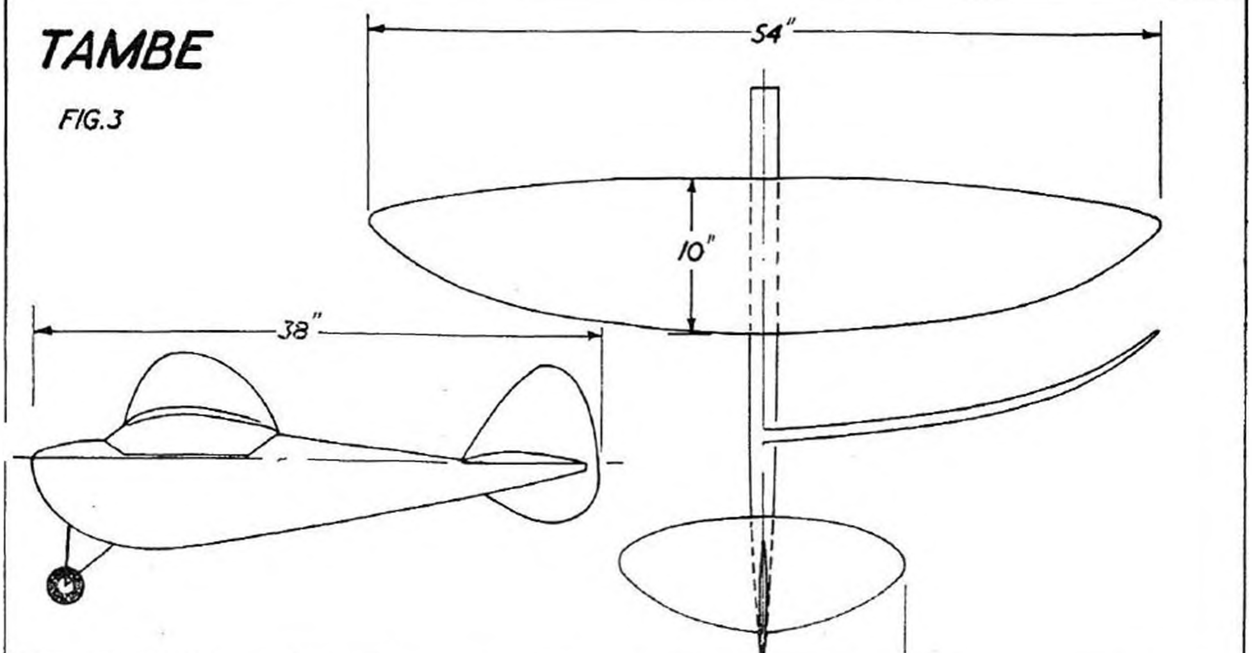
Introducing streamlining to the power model, yet still retaining a cabin on a performance model, was the famous Elbert J. Weathers' "Mystery Man". Unique features were "vee" tailplane, drop-off dolly undercarriage and eliptical dihedral for wings.

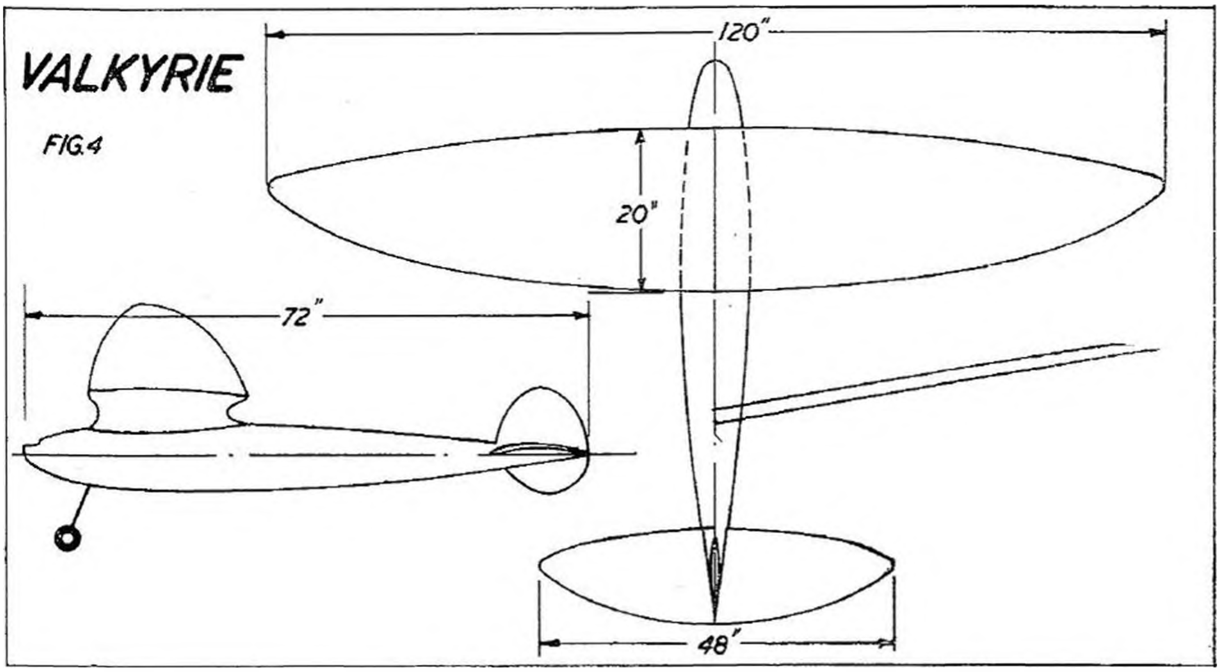
1936 saw a whole spate of new models at the American Nationals with a new variation introduced—that of model size. At the end of 1935 only two commercial engines were readily available—the Brown Junior and the Baby Cyclone. In the following year appeared such well-known types as the Forster, Gwin Aero, Bunch, Mighty Midget, Tlush Super Ace, G.H.Q., etc. Smallest model at the Nationals was Petrides' 300 sq. in. job and the largest Vernon Boehl's 14 ft. 8 in. span giant, which weighed a matter of some 3½ pounds only in flying trim. It was this year, too, that the extremes in possible design began to show up—Leon Shulman's "Wedgy" and "Tambe" Fig. 3, characterising the narrow, deep fuselage type with high thrust line (the functional, ugly design); and Martin Faynor's "Cavalier" a tapered wing streamliner which, even twenty years later, would be difficult to better in appearance.

Most people by this time had abandoned the extreme low thrust line sition of the original Bassett layout, although the same basic configuration was widely retained in cabin designs, but the thrust line reasonably high (although there were notable exceptions). And the cabin models were beginning to look much prettier. Weiss's original streamliner started a definite trend with elliptic wings of fairly high aspect ratio and monocoque or hollow log fuselages,

TAMBE

FIG. 3





both with shoulder-and parasol-mounted wings, although the former were particularly prone to spiral stability troubles. In the purely "functional" field, many original designs appeared based on the K-G layout. Except for the deep-bellied fuselage trend started by Shulman, aerofoil sections were quite thick, R.A.F. 32, N.A.C.A. 4412 and the Grant sections being particular favourites. Shulman, on the other hand, went over to an extremely thin section, virtually the McBride B-7 indoor section.

Although the problem of getting stability was still present, the main question now developing was to increase performance and the 1937 Nationals was particularly noteworthy for the first appearance of the true pylon layout—a power duration configuration which has remained far and away the most popular ever since. This was evolved by Carl Goldberg, leading American indoor flyer at the time. He applied, virtually, indoor design layout to free flight power, mounting the wing high above the fuselage and thrust line on a streamlined pylon, balancing out the looping tendency by moving the centre of gravity well aft.

Goldberg's first model to demonstrate these principles—the "Valkyrie", Fig. 4—was a most intricate piece of work, beautifully constructed and, although spanning 10 feet, was extremely light. The 6-ft. long fuselage, for example, was covered with $\frac{1}{16}$ in. sheet. It was lost o.o.s. on an early flight.

The pylon model represented a definite advance for "performance" flying, since it improved on the stability of the plain parasol wign and combined it with the advantage of streamlining in that low drag shapes could readily be used for the fuselage. It was also one of the few design layouts which proved capable of coping with the increased power, and thus increased speed, resulting from the later engines—increased flying speed, quickly showing up thelimitations of any layout with "marginal" stability.

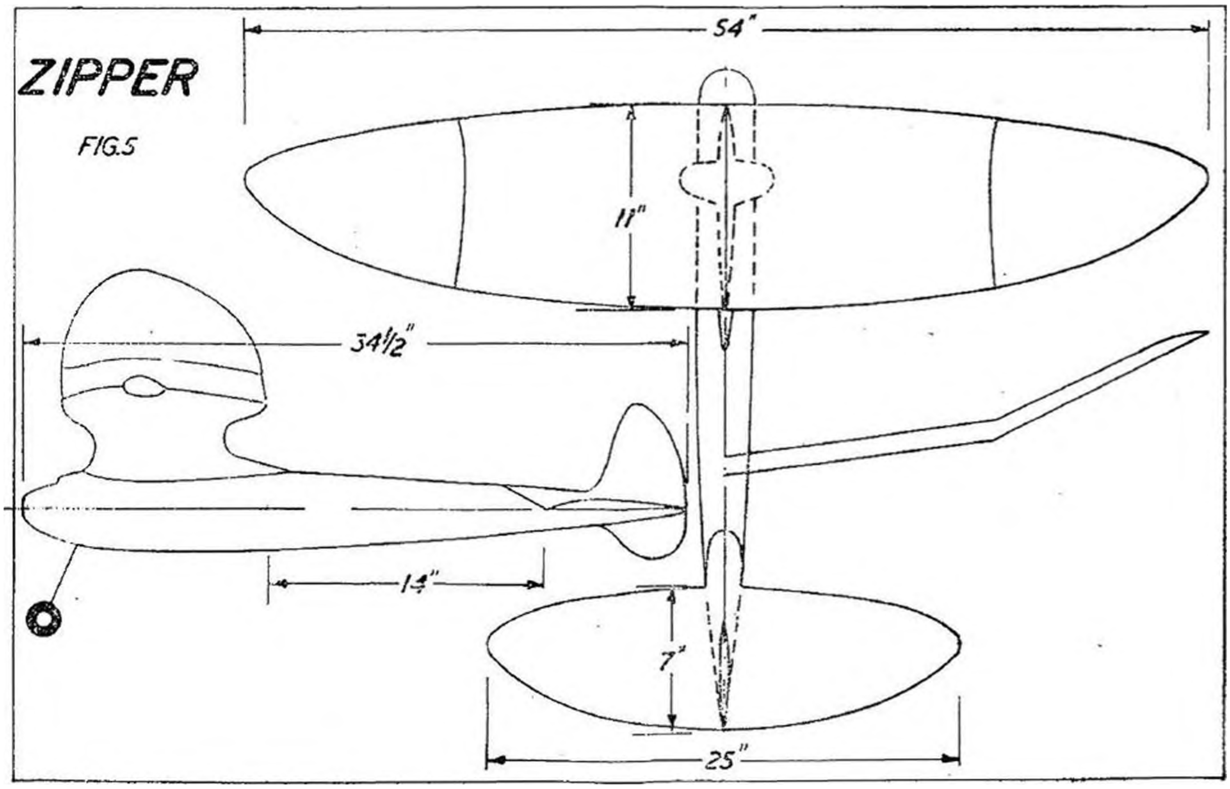
The inherent advantages of the pylon model were also unintentionally supported by the contest rules in deciding on a limited motor run as the most suitable method of limiting average performance to practical figures, plus a fixed minimum wing loading (largely aimed at restricting the glide) and, later, a minimum power loading rule (aimed at restricting the climb). Under these restrictive rules the pylon model was the one layout which enabled the best to be got out of model and motor—faster rates of climb on the one hand and the flattest glides for a given wing loading. Incidentally, the development of the restrictive rules themselves is quite interesting. Starting from no restrictions at all, first power flight was limited by a fuel allowance—$\frac{1}{4}$ ounce per lb. model weight, then $\frac{1}{8}$ ounce, then $\frac{1}{16}$ ounce, as performances progressed. When even the latter proved inadequate in limiting the number of fly-aways, a fixed motor run of 45 seconds was adopted, reduced to 30 seconds and finally, by 1940, 20 seconds. Wing loading and power loading rules came into being soon after the introduction of "limited motor run" rules.

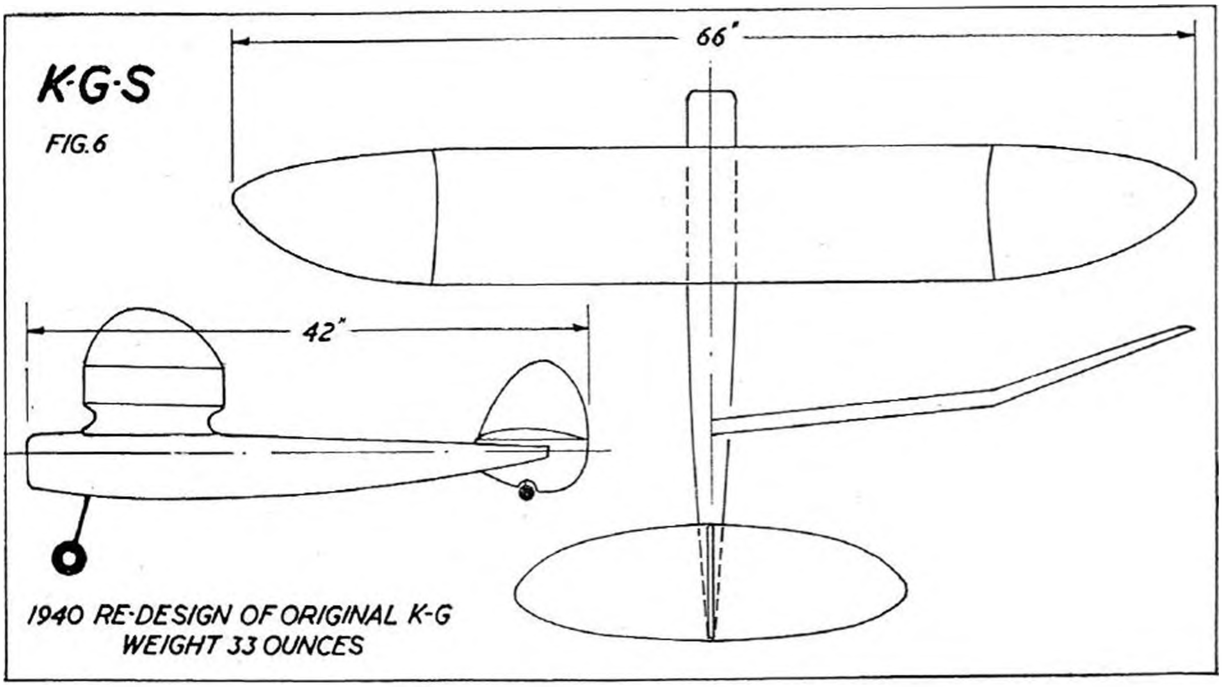
Actually it was not until 1939 that the pylon model finally became universally accepted as the most favourable layout for duration work, the model which really clinched the deal being Goldberg's commercial design, the "Zipper"—Fig. 5. From that time on the availability of pylon model kits put models with a terrific performance in the hands of thousands of modellers at a time when there were engines in plenty becoming available at quite moderate prices. Virtually at this stage, duration flying with power models became a sport which anyone could enter with a reasonable chance of success simply by adopting a commercial design, rather than a contest in which the individual design and the man behind it was what mattered most.

Critics of the pylon model layout who regard such designs as "monstrosities" overlook the fact that the original pylon designs from Goldberg—the "Valkyrie", "Zipper", "Sailplane"—were quite beautiful aeroplanes, with elliptic wing and tail surface planforms, scientific construction and nicely streamlined fuselages. It was at a latter period that exaggeration and functional simplification crept in—exaggerated pylon heights, squared outlines, extreme dihedral angles, etc.

ZIPPER

FIG.5





These factors arose partly from the natural quest for more and more performance (more powerful engines in smaller models) and partly from a desire to be different at all costs (either to make the ultimate design rather more original or simply to try a further line of development around a now proven basic theme). Some leading modellers, of course, just would not accept the pylon layout as the ultimate answer and a number of alternative designs were developed to a high degree—the low centre of lateral area layouts, for example, and shoulder wing models with exaggerated downthrust angles. But for a good basic and reasonably safe layout for high power flying, the pylon configuration, or its many variants, has remained supreme for nearly twenty years. The variants include designs in which the wing is mounted at equivalent pylon height, but the pylon structure as such incorporated in a fairly conventional deep fuselage, often sharply concave from the wing trailing edge position aft. Numerous cabin designs have been proportioned along these lines and have generally proved safer to handle with high powered engines than the conventional high-wing type of layout.

An excellent example of the general trend in design size over the period 1934 to 1940 is given by comparing the original K-G design (Fig. 2) with the K-G-S of 1940.—Fig. 6. The latter was produced by Henry Struck as a then contemporary duration contender based on the same layout as the original K-G and for *the same engine power*, although the actual engine *size* was now smaller, due to developments in engine efficiency. Most noticeable differences are the contrast in overall sizes and the necessity of substantially reducing the fin area on the later, faster-flying model to retain adequate spiral stability. Also the K-G-S employed a polyhedral wing which has generally been held as the best form for absorbing the high torque of more powerul motors. The other main difference is the general cleaning up of the more modern design.

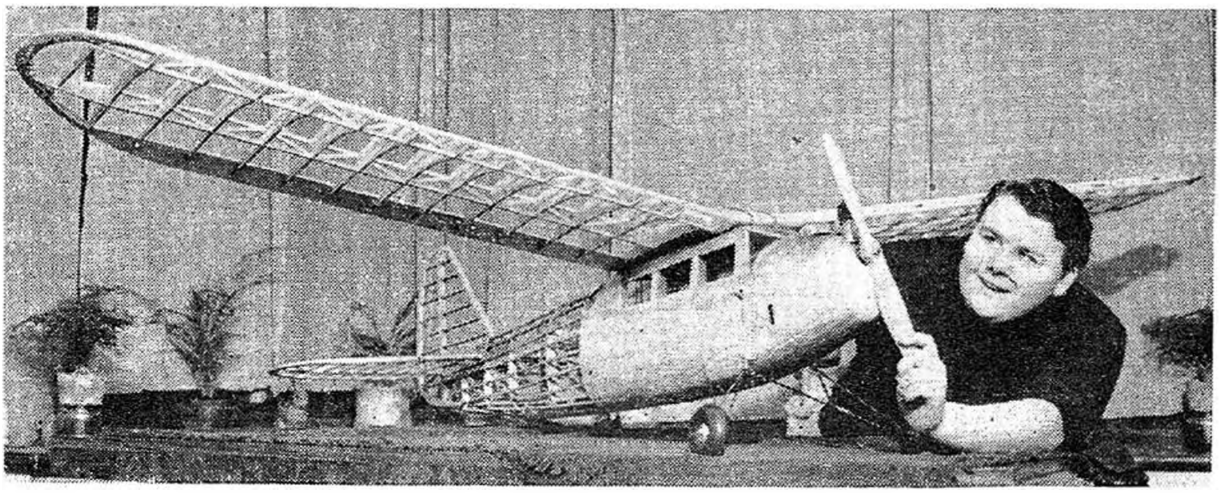
The first of the really small commercial engines made its appearance in 1940 with the .097 cu. in. (1.6 c.c.) Atom, weighing only $1\frac{3}{4}$ ounces, so that at last the small, lightweight power model became a practical proposition, even though it still had to carry batteries and an ignition coil. Engines, too, were now so numerous that free flight power was divided into classes according to engine size, Class A originally being for engines of up to .2 cu. in., Class B .201 to .3 cu. in., and Class C from .301 up to 1.25 cu. in. These classes have, of course, subsequently been much modified in range in keeping with the emergence of popular engine sizes.

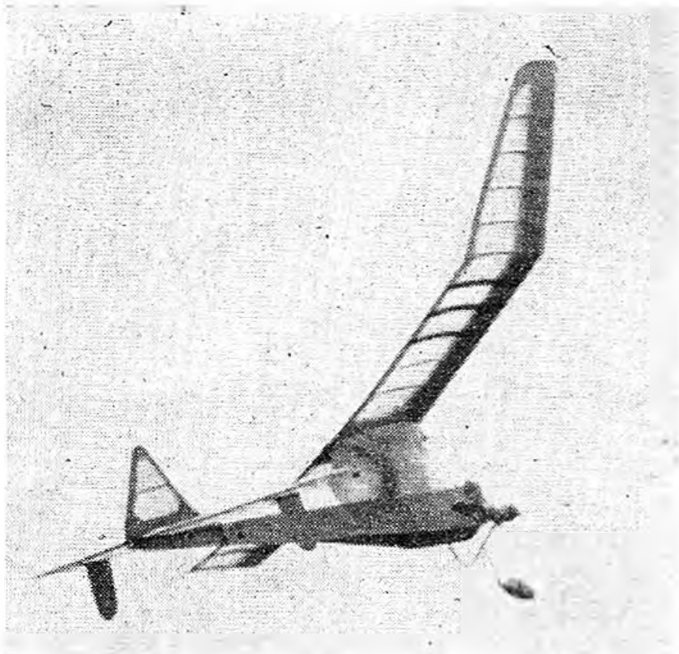
The war brought a stop to engine development, but not to model design. During the war period a number of outstanding individual designs were originated, culminating in a whole host of first-class designs appearing in kit form as soon as peacetime production could be restarted. With the first post-war years initiating an unprecedented boom in aeromodelling interest throughout America and Britain, and subsequently throughout Continental Europe and farther abroad, British modellers begged, borrowed or acquired somehow American engines, built American kits when they could acquire them, or worked from published plans and wholeheartedly got down to finding out just what the Americans had evolved in the way of high performance power models. The typically "English" type of model with its more moderate performance and semi-scale appearance was not neglected in the meantime, borrowing good features from duration design layout and developing into what is today the so-called "sports" type of model for Sunday flying.

Many of the first post-war power kits to appear in this country were, frankly, either direct copies of contemporary American designs, or modified around a successful American layout. In fact, adopting a basic pylon or "developed" pylon layout it was difficult to achieve originality since the Americans had already exploited most of the possible variations on the same theme. At one stage, for instance, Leon Shulman's "Banshee" design virtually monopolised top places in British contests and, however much individual designers tried to work in different shapes around the basic design, it still looked like a "Banshee"! And for quite a long time it was still the imported American engines which led the duration field.

In 1946, in fact, British power modelling was rather worse off than the American movement in 1939. It had more design "background" to draw on for data, but still lacked readily-available high-performance engines at moderate prices. But both in this country and America the days of the spark-ignition petrol engine were coming to a close, although few people would have dared to prophesy this at the time.

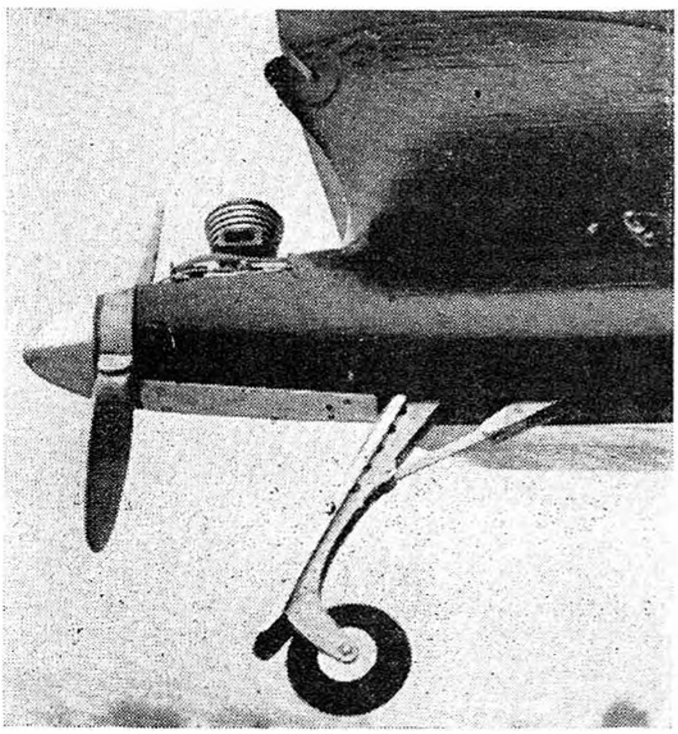
Graham Moffatt, famous film star featured in many Will Hay productions, was a keen aeromodeller and is here seen with the American Berkeley super Buccaneer, a pre-war kit which still has great appeal.





During the latter part of the war there had been rumours that model compression ignition engines were being made in Continental Europe, an area hitherto regarded as rather "backward" in regard to power flying. Power model flying in Britain was banned by law during the war years and there was probably little chance of it being carried on in any other part of Europe. But as soon as war finished it seems that modellers all over Europe with any pretensions to being able to handle a lathe started to turn out these compression-ignition engines, popularly termed diesels. Some of the best, and earliest,* came from Switzerland and samples eventually reached this country. It was soon obvious that here was more than just an idea—compression-ignition was a practical proposition and, although demanding a more robustly constructed engine, did away with the weight and complication of having to carry ignition equipment in the model. This was particularly significant, for the diesel would also work in very small sizes and so the baby power model could be produced without having to carry a prohibitive weight penalty.

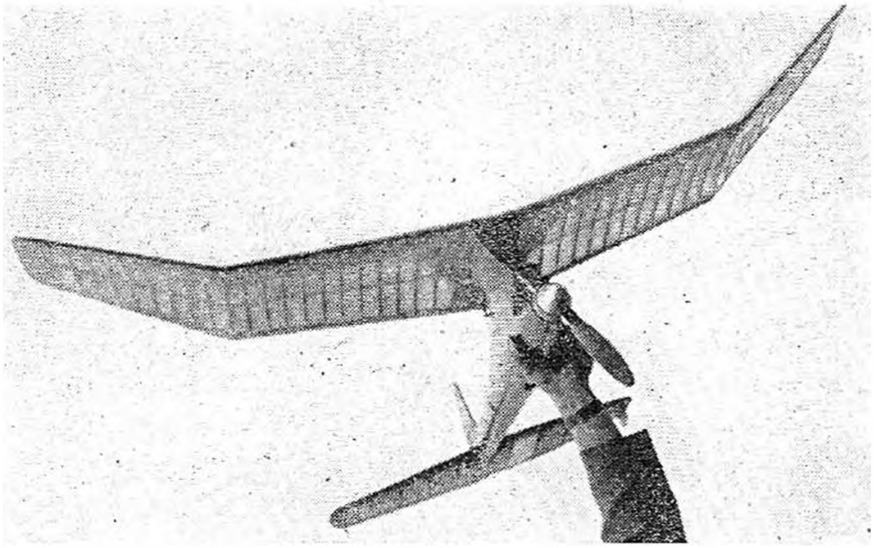
Although the diesel also found its way into the United States (brought back there by returning Servicemen) and a number were produced for their home market, what was to the Americans a more attractive alternative was now available—the glow plug replacing the spark plug and timer on otherwise conventional spark - ignition motors. The glow versions ran faster and because they needed no ancillary equipment other than a starting battery, represented a considerable saving in weight. American ideas on engine design and production being geared to lightweight construction for engines, glow ignition was therefore doubly a more attractive feature.



So now, for the first time, British and American power trends showed a divergence, although the same American influence on both model and engine

* *The Swiss "Dyno", generally regarded as the first of the commercial diesels, was actually made and advertised in* 1938.

Top, opposite, Leon Shulman's famous "Banshee" with steep tip dihedral and *left*, the Yugoslavian "Zigic" design based on Shulman's theories, but with folding propeller and retracting undercarriage.



The Yugoslavian Zigic design was known as the "W" and won the International Power event at Eaton Bray, largely through its refined design features, which gave it superior performance, although highly loaded.

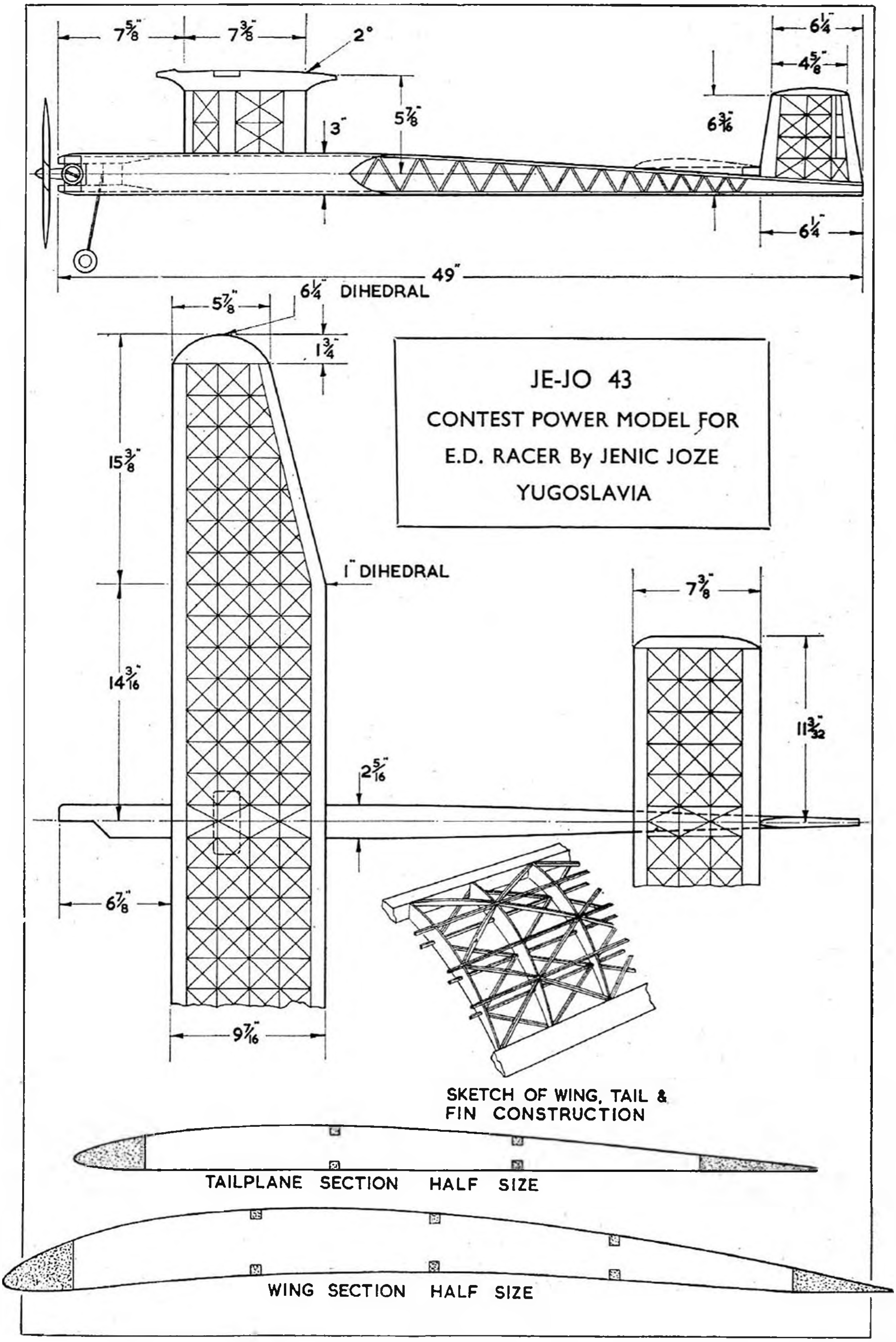
design has remained apparent right up to the present time, particularly through the post-war "boom" period of aeromodelling interest and trade activity (at one time in this country there were some fifty or more engine manufacturers and upwards of a hundred power model kits on the market). Better ideas on detail design and construction have become more or less standardised in each country and within the last few years not all the best ideas have come from across the Atlantic. The "extreme" type of design has largely disappeared from favour. The pylon layout still remains supreme for pure duration work, although it has become more simplified with a tendency towards "utility" effect and squarer lines. The cabin type model, provided it is not grossly overpowered, has become a pleasant, safe machine to fly without undue sacrifice of realistic appearance.

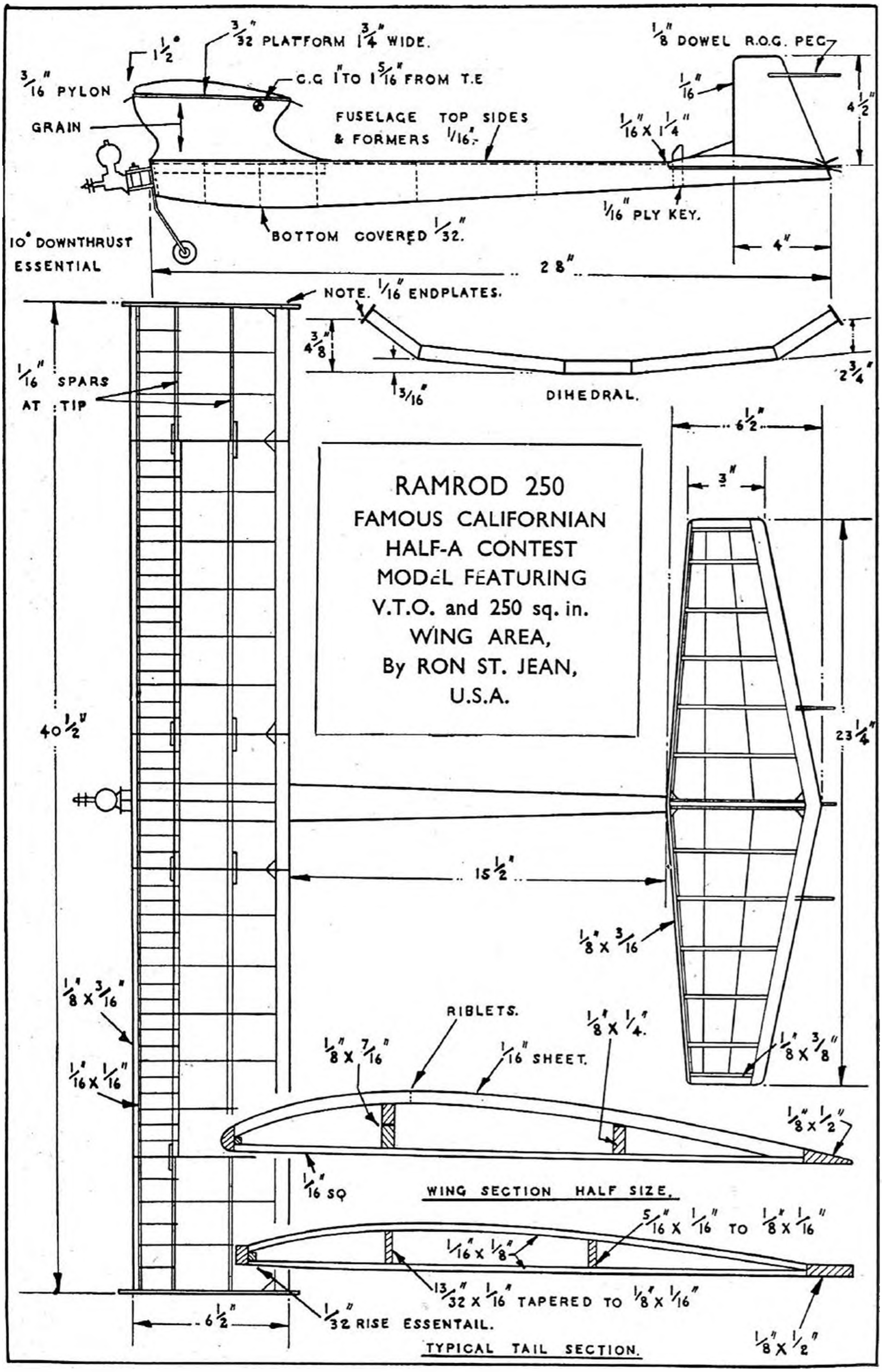
Performance has been largely attendant upon improvements in engine performance, which has now reached the stage where quite fantastic rates of climb can be achieved. Stability of duration designs is generally much higher than it has been and people have learnt how to *handle* their models better. Largely, too, the old spiral climb originally associated with the high-performance model has given way to "straight up" or wide sweeping turns under power.

FACT OR FANCY ?

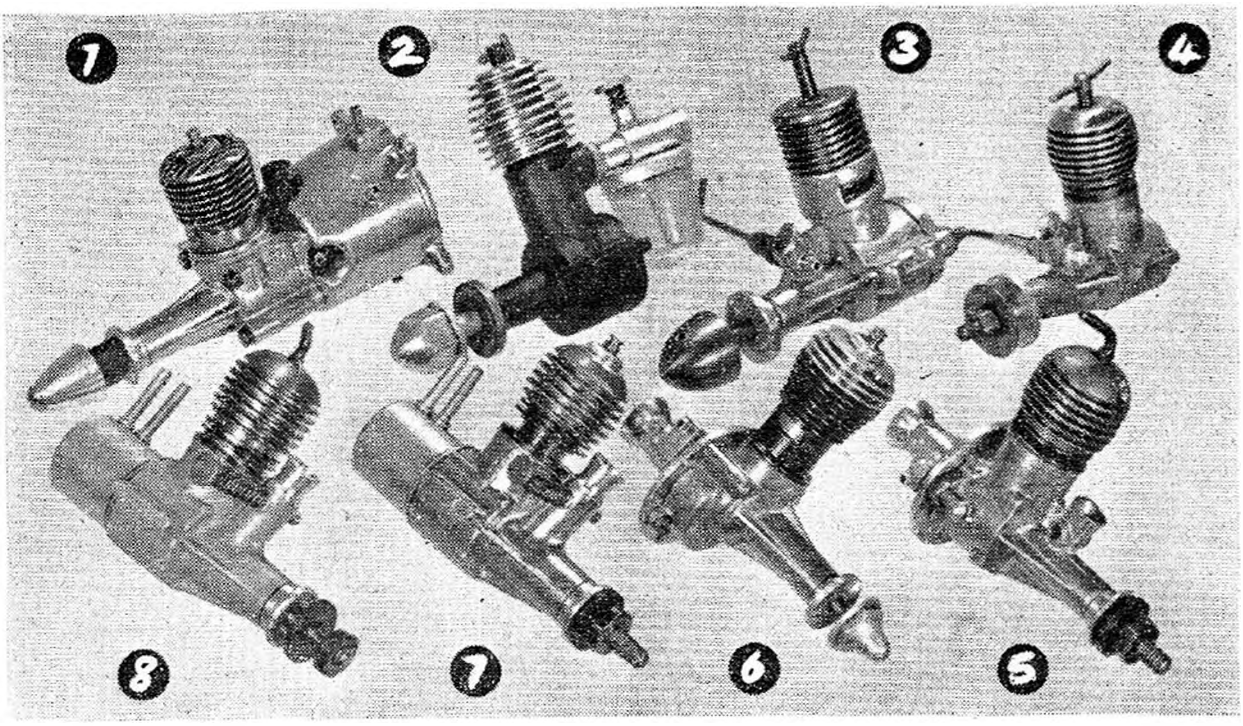
Tilting the tailplane for turn trim has a similar effect on all models. This is a fallacy. The effect of tilting the tailplane depends very much on the centre of gravity position of the model. With a *forward* c.g. position, the effect of tail tilt varies with speed, so in this respect it may not be any safer than offsetting the rudder for turn. With a c.g. well aft, tailplane tilt effect tends to become more constant and so less critical than the rudder for turn trim. It should give the same effect on power and glide with the c.g. at 100 per cent., or farther aft.

An anhedralled tailplane improves spiral stability. This is fact Negative dihedral on the tailplane should increase spiral stability on most conventional designs, but it will not normally be a *cure* for spiral instability caused by other design features.


JE-JO 43
CONTEST POWER MODEL FOR
E.D. RACER By JENIC JOZE
YUGOSLAVIA
7 5/8"
7 3/8"
2°
3"
5 7/8"
6 3/16"
6 1/4"
4 5/8"
6 1/4"
49"
5 7/8"
6 1/4" DIHEDRAL
1 3/4"
15 3/8"
1" DIHEDRAL
7 3/8"
14 3/16"
11 3/32"
2 5/16"
6 7/8"
9 7/16"
SKETCH OF WING, TAIL & FIN CONSTRUCTION
TAILPLANE SECTION HALF SIZE
WING SECTION HALF SIZE



RAMROD 250
FAMOUS CALIFORNIAN HALF-A CONTEST MODEL FEATURING V.T.O. and 250 sq. in. WING AREA,
By RON ST. JEAN, U.S.A.
3/32" PLATFORM 1 3/4" WIDE.
1 1/2°
3/16" PYLON
GRAIN
C.G 1" TO 1 5/16" FROM T.E
FUSELAGE TOP SIDES & FORMERS 1/16".
1/8" DOWEL R.O.G. PEG
1/16"
1/16" X 1/4"
4 1/2"
1/16" PLY KEY.
BOTTOM COVERED 1/32".
10° DOWNTHRUST ESSENTIAL
4"
28"
NOTE. 1/16" ENDPLATES.
4 3/8"
3/16"
DIHEDRAL.
2 3/4"
1/16" SPARS AT TIP
6 1/2"
3"
40 1/2"
23 1/4"
15 1/2"
1/8" X 3/16
1/8" X 3/16"
1/16" X 1/16"
RIBLETS.
1/8" X 7/16"
1/16" SHEET.
1/8" X 1/4".
1/8" X 3/8"
1/8" X 1/2"
1/16" SQ
WING SECTION HALF SIZE.
5/16" X 1/16" TO 1/8" X 1/16"
1/16" X 1/8"
13/32" X 1/16" TAPERED TO 1/8" X 1/16"
1/32" RISE ESSENTAIL.
6 1/2"
TYPICAL TAIL SECTION.
1/8" X 1/2"



POINT-EIGHT PERFORMANCE

A Critical Survey of Popular Engines in the .8 c.c. (.049 cu. ins.) Class Based Upon an Extensive Performance Test Employing Standard Propellers.

By RON MOULTON

ABOUT OCTOBER each year, when evenings begin to get short, and week-ends less suitable for model flying, I look about for a subject that can be studied through the winter months when time is available, and which offers an answer in the end-product that can be put to good use by all. The ANNUAL features on Autogiros, Flying Scale, Combat and Engine Timers have each in their way provided illuminating answers in past issues of this book; but none could compare for positive results with last winter's search for the answer to that now ancient query—which is better, diesel or glowplug?

I had been fed up to the back teeth with the constant claim from across the Atlantic that "America makes the finest half-A motors in the World" and became determined to find out for myself just how valid these statements were. Some 350 engine tests later (each prop in a family of ten was checked at least three times in each engine) I was forced to the conclusion that the Americans are quite right, not only for glowplug which heads the field, but also for diesel—a type which has yet to gain nationwide popularity in the vast U.S.A.

But, lest I offend the pioneering European manufacturers, I should point out that the whole question of performance hinges upon several vital factors. First, on the purpose for which the engine is being used. Second, on the manner in which it is used, and Third, on the actual condition of the engine.

Three engines which were in the original selection absolutely failed to make the grade in this test and do not feature in the results. They were all American, one new and two so worn out that although noisy, they were flat as the proverbial pancake when rev-readings were taken. So European diesel makers can take heart in the consolation that they produce a unit which continues to pour out power for seemingly endless hours with a reliability factor of 100 per cent.—which is more than can be said for the others.

We are dealing with two entirely different markets when mixing American and European. In the U.S.A., keen competition has forced development through inclusion of many "Half-A", or .049 cu. ins. capacity class model contests. PAAload, particularly the Clipper Cargo event, has produced a demand for the ultimate in power output for this size of engine, and the result has been that revolutionary design changes have been introduced to these miniature two-strokes—with beneficial results as the test figures indicate. On the sport side, as distinct from the competition engine, the European product has the long life and adaptability to commend it, as befits the requirement for the class, where .8 c.c. contests are non-existent and the majority fly solely for fun. Remember, it was in Europe that the .8 first became a working proposition, with the delightful French Maraget and Micron miniatures, closely followed by Mr. Healey's Amco .87, each of which went into series production, and we owe a lot to these earlier pioneers for giving us the lead to a size of engine that now heads the popularity poll.

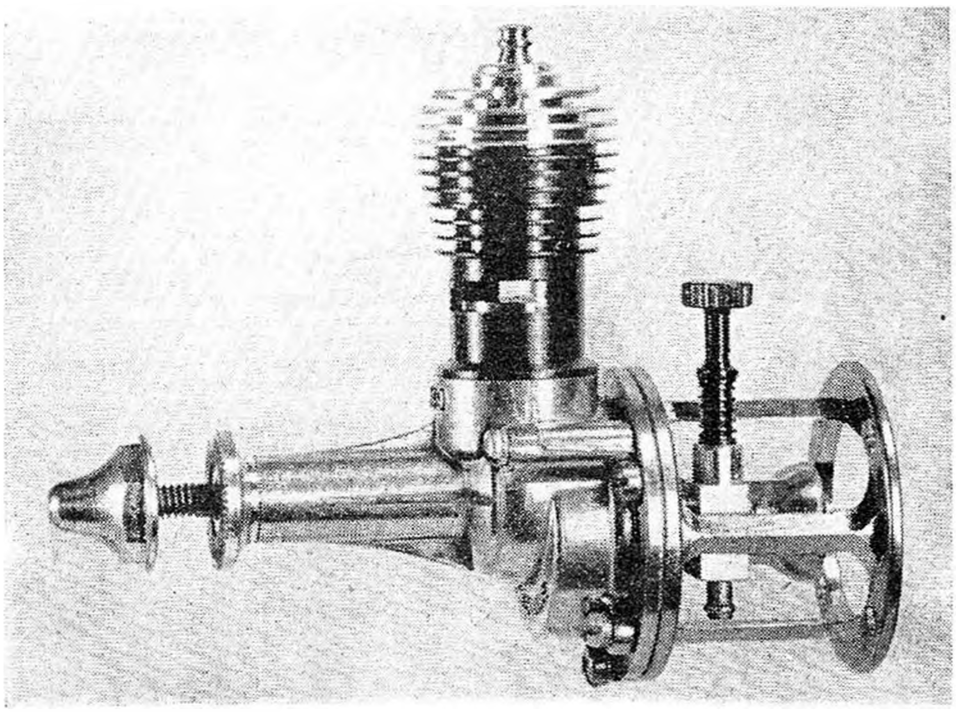
But these are generalisations. What of the facts and figures?

Firstly, there were many more engines at my disposal than are indicated on the table. Some .5 c.c. engines were eliminated as irrelevant, the Dart being retained as a "point-six", and others failed to impress as being incapable of reaching the power-band from 5,500 to 12,500 revolutions per minute. Those engines that do appear may be taken as being in prime condition, and each a favourite in the Moulton workshop. Secondly, each engine was given the chance to produce the best figure. Some tests in freezing conditions were later repeated in hot weather to find the best result, and a variety of fuel formulae tried in every case.

Thirdly, this was to be a test for static r.p.m. with an established set of propellers which would be representative of those employed on both sides of the Atlantic for free-flight. (6 x 4 size being also most common when .8 c.c. is used for control-line.)

I set out determined to be fair—though would admit to bias in favour of the Allbon Merlin—and was more than surprised at some of the ultimate results,

Parade of engines used in the test opposite: 1. Ohlsson Midjet; 2. Mills .75; 3. Allbon Merlin; 4. Allbon Dart; 5. McCox; 6. Cox Thermal Hopper; 7. McCoy Baby Mac .049 Glow; 8. McCoy .049D.



At right: The Cox Thermal Hopper is seen mounted on a special light alloy machined bracket for radial attachment to a front bulklead. Total engine weight is still considerably less than 2ozs.

as I am sure they will also shake some of the diesel protagonists. Since each engine had the same treatment, had to draw suction feed from the same tank level, record on the same rev-reader and was operated by the same person—then I trust that the readers will accept my findings as an honest attempt at comparison. If it so happens that you do not believe them, then I invite you to spend the eighty hours involved in testing to find the same results for yourself!

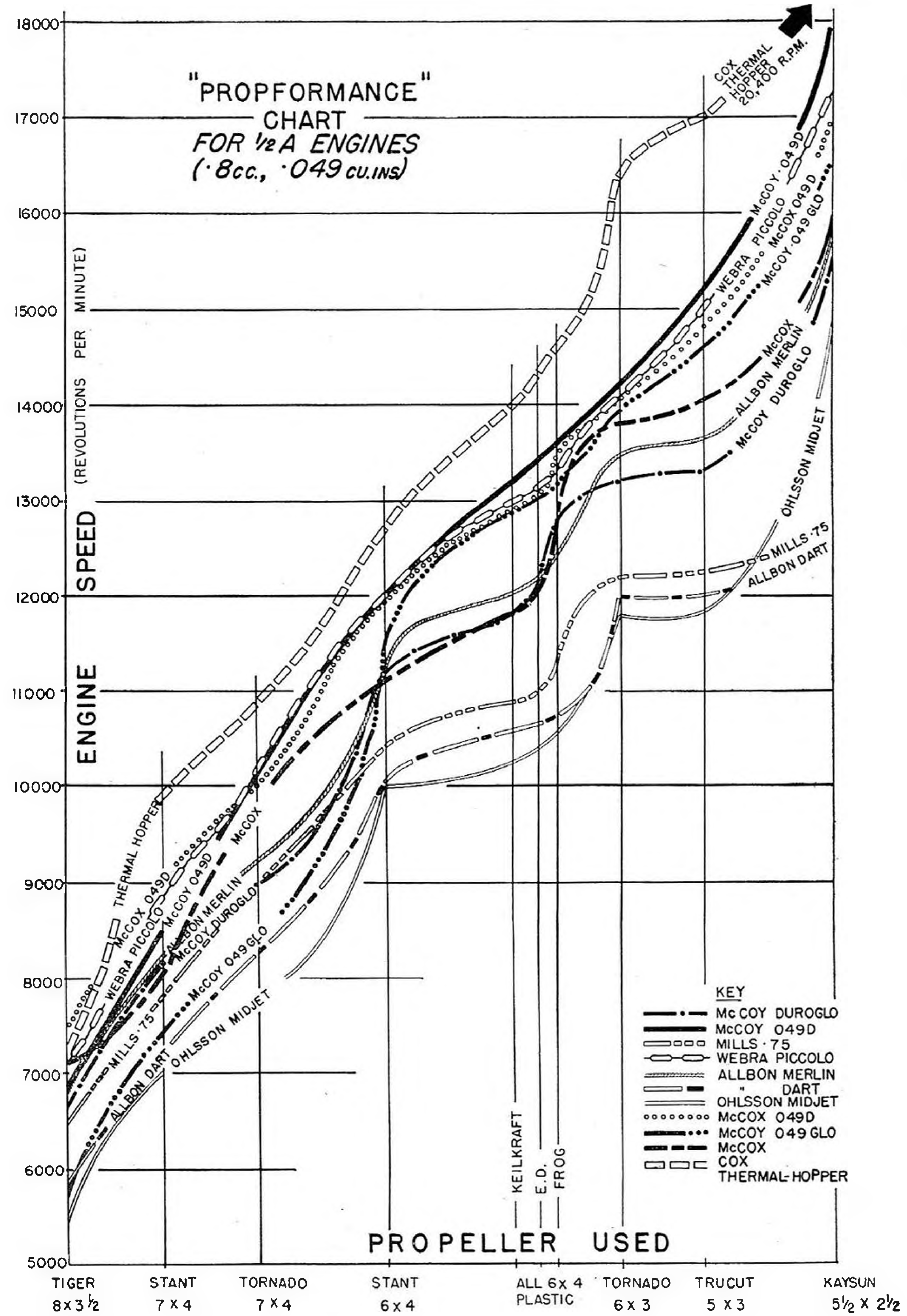
Point to note: Do not read the "Propformance" chart in terms of brake horse power. The practically smooth curve for one engine like the McCoy .049D becomes decidedly lumpy for the Ohllson Midjet over the same base scale. Comparative readings should be taken up each prop line, while the curves form an overall comparison to locate most useful prop size.

We begin with the diesels.

I included the ALLBON DART because it is larger than .5 c.c. and has always given the impression that it could beat some of the point-eights. It does so quite handsomely, and really begins to score with the 6×3 Tornado prop on which it will hold a steady 12,000 for minutes on end. Allbon diesel fuel gave best results, but one should be careful not to over-prime the Dart as it takes a while to clear the excess fuel from the cylinder and crankcase. A single choke rather than priming gave second or third flick starting every time. This engine has about three hours running and countless models behind it, yet the only sign of wear is in the threads in the cylinder for the compression screw. Verdict, perfect for sport or scale, using a 6×4 or 6×3 for most models.

The MILLS .75 is a veteran in design, and a darling in the eyes of all who have been wise enough to own one. This particular motor was to all intents and purposes ageless. The Mills simply goes on for ever, revs like mad for a side-port induction unit and is a perfect charm to start by simple finger choking at a wide variety of control settings. In fact, it is difficult, without a rev-reader, to check audibly which setting gives peak revs, the Mills is so flexible. Without doubt the prop it likes most is a 7×4, especially the Tornado which it holds at a very steady 9,000 r.p.m. A heavy blade 6×4 of the Stant type would seem better for small models, controliners, etc., and beyond the 11,000 mark the Mills is revving too fast for the capacity of its thimble-size tank. It can be used at high speed, but is out of class on less than a 6×3. Runs on anything, likes Roadway, Mercury 6, 8 or RD with equal thirst for each.

First of the McCoy diesels was the radially-mounted .049 with the confusing title of DUROGLO. It carries a traditionally square "Mac" crankcase, utilises the cylinder porting Europe took from Ray Arden and subsequently became universal for all high speed diesels, and introduced the novel fibre head insert to prevent comp. screw release, plus the plastic "O" ring sealer for the contra-piston fit. When first introduced, the Duroglo was over-stressed in its crankshaft, and there were many failures, including that of this particular engine. Later shafts were stronger, and this one has about two hours to its credit, without fear of breakage. The Duroglo has no "compression feel" thanks to the resilience of the plastic ring on the contra piston, and one cannot work the motor up to starting compression with the same instinctive action provided by a lapped contra piston. Result is that you never really know when it is going to start. One primes the exhaust, endeavours to keep the fuel line full (carb. suction is weak), and at some time in a few seconds' fast flicking it will burst into full song without any trace of a slow build-up as with any other over-rich engine. I did not like it on the 7-in. and 8-in. props; but it really began to get moving on


"PROPFORMANCE" CHART
FOR ½A ENGINES
(·8cc., ·049 CU. INS)
ENGINE SPEED (REVOLUTIONS PER MINUTE)
PROPELLER USED
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
TIGER 8 x 3½
STANT 7 x 4
TORNADO 7 x 4
STANT 6 x 4
ALL 6 x 4 PLASTIC
KEILKRAFT
E.D.
FROG
TORNADO 6 x 3
TRUCUT 5 x 3
KAYSUN 5½ x 2½
COX THERMAL HOPPER 20,400 R.P.M.
THERMAL HOPPER
McCOX 049D
McCOY 049D
WEBRA PICCOLO
ALLBON MERLIN
McCOY DUROGLO
McCOX
MILLS ·75
McCOY 049 GLO
ALLBON DART
OHLSSON MIDJET
KEY
McCOY DUROGLO
McCOY 049D
MILLS ·75
WEBRA PICCOLO
ALLBON MERLIN
" DART
OHLSSON MIDJET
McCOX 049D
McCOY 049 GLO
McCOX
COX THERMAL-HOPPER

the Frog Nylon 6×4 which represents its most useful prop size for most types of model except perhaps r/c, where it is an even match with the Mills for revs on the 7×4 though ten times as sensitive to needle setting. For any Duroglo owner I recommend the W. D. Broadley treatment of blending McCoy with Cox to form the McCox—with reed induction.

The new backplate on the McCOX makes all the difference to induction control. The needle valve is most flexible to control, the fuel line is kept full, and the engine appears to benefit from the self-adjusting intake timing which the reed system offers. On the performance score, the McCox is now a really useful engine on the 8×3½ or 7×4's, then it shows no advantage over the plain shaft induction Duroglo on the 6×4's but jumps ahead again on 3-in. pitch. Though a taskmaster for mounting, as it calls for two point radial fitting with a large hole through the bulkhead for the rear carb., the McCox is a most worthwhile combination product, calling for the minimum of workshop engineering.

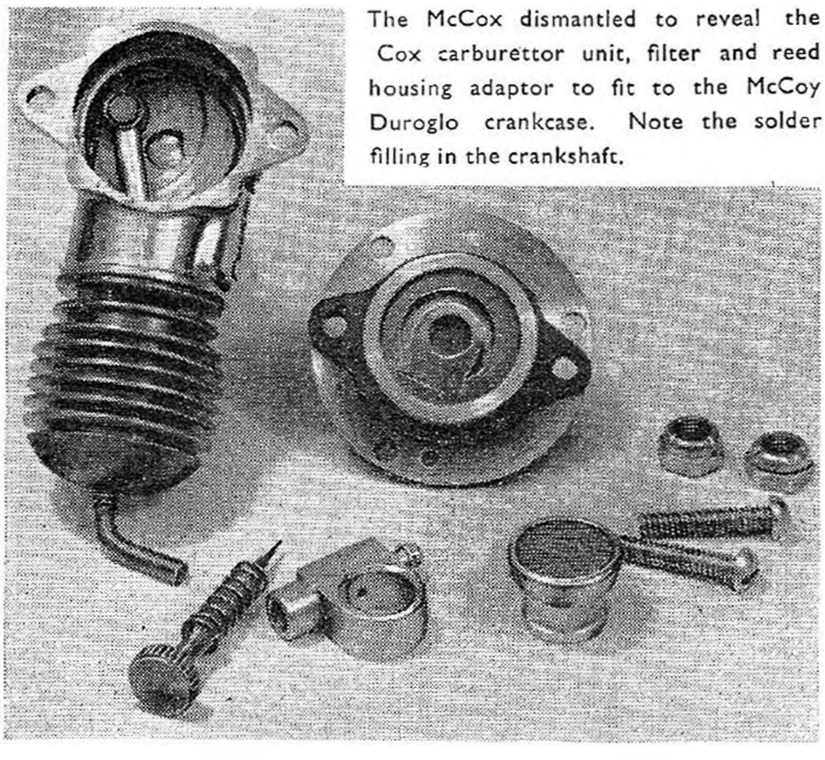
The example tested was the second one "made" by a keen American aeromodeller, William D. Broadley of Philadelphia, who first considered the four advantages of reed induction as fitted to the Cox Thermal Hopper, and rightly thought that the diesel McCoy would benefit by (1) the ability to run either way; (2) better fuel economy; (3) have better suction; and (4) possibly have more power. Since each of these points is borne out in the prop tests, I feel sure that the simple modification procedure will be of interest to all, particularly for American readers, and also in view of my own further experiment using the new McCoy .049D cylinder.

The parts needed for the McCox are as follows:

(1) Complete .049 McCoy diesel (Duroglo).

(2) A Cox Thermal Hopper engine induction assembly: reed housing, reeds, crankcase backplate, venturi intake with screen and needle valve with housing and spring.

All machining operations may be accomplished with a minimum of equipment: a drill press, No. 2 cut 5½ in. needle file, Swiss pattern flat, a grinder and two drills, No. 40 .098 in., No. 63 .0370 in. The procedure is as follows:



The McCox dismantled to reveal the Cox carburettor unit, filter and reed housing adaptor to fit to the McCoy Duroglo crankcase. Note the solder filling in the crankshaft.

Start with the Cox induction system as a complete unit.

(1) Remove venturi and needle valve housing.

(2) Position the crankcase backplate stem in the chuck of a drill press. Be sure the part is centred and held firmly but not deformed.

(3) While the drill press is rotating file the outside diameter of the reed housing until it is able to fit snugly into the crankcase of the McCoy engine. Care should be taken to minimise any out of round of the reed housing. This can be accomplished by long straight strokes of the file and keeping the work and file free from chips.

(4) Remove crankcase backplate from the drillpress. In the backplate you will find four threaded holes 90 degrees apart. Choose any two so that they are 180 degrees apart and drill these holes with a No. 40 .098 in. drill. These drilled holes will be spaced properly for mounting to the McCoy crankcase mounting lugs.

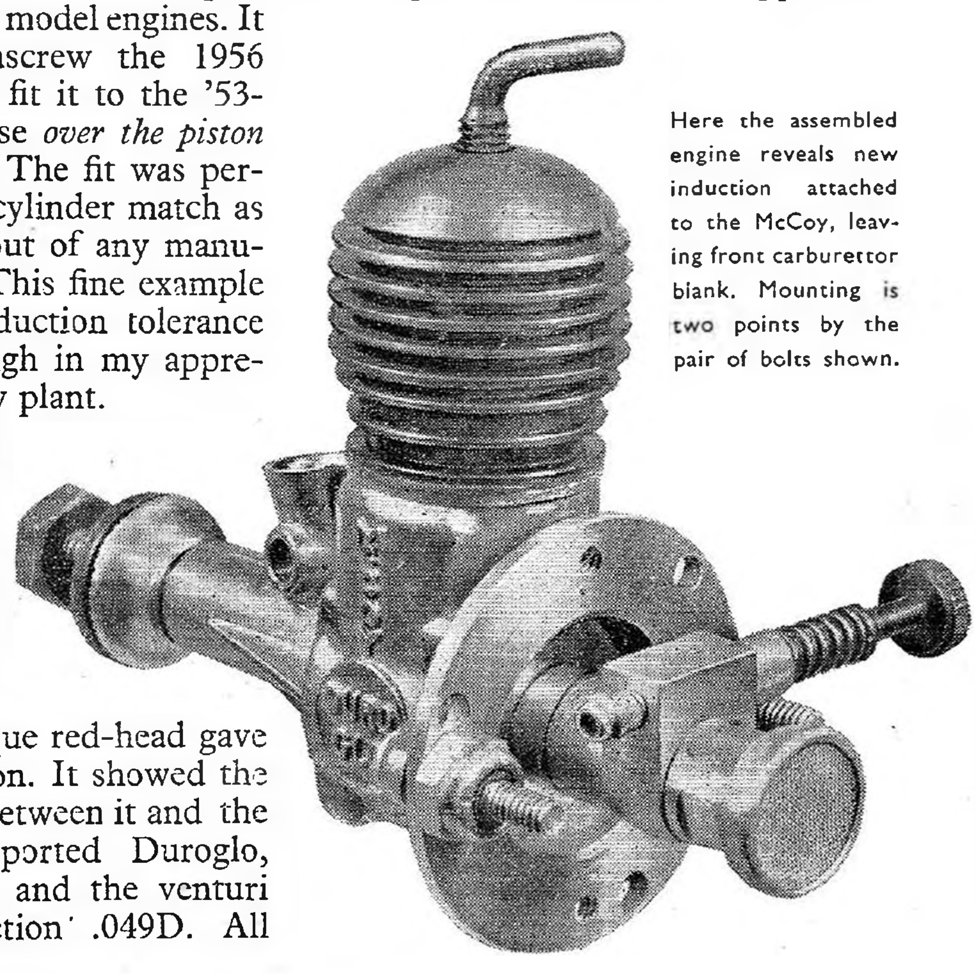
(5) With the Cox backplate in position the piston will, when at the bottom of its stroke, strike the reed housing. This interference is eliminated by grinding the piston skirt, taking off only the minimum of metal.

(6) The needle valve housing has a small fuel jet located on the inner side of the ring. Enlarge this hole by drilling with a No. 63 .0370 in. diameter drill.

(7) Seal the crankcase by removing the shaft from the engine and heating it with a soldering iron until solder will melt into the hole, filling it flush with the crankshaft web. It is better to fill this hole because it reduces crankshaft volume, permitting better pumping efficiency.

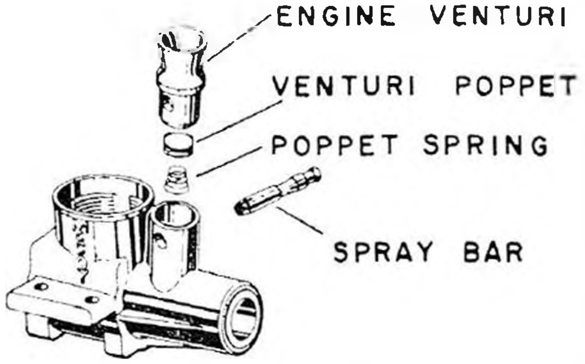
It is not necessary to remove the McCoy needle vale housing.

The difference in operation of the McCox inspired the thought that the later type cylinder, with greatly reduced transfer port area, as used on the new McCoy .049 Diesel, would also offer interesting figures if only it could be made to fit the Duroglo crankcase. I never expected to find what followed, and think that the ensuing hybrid motor represents the greatest tribute ever applied to any manufacturer of model engines. It was possible to unscrew the 1956 .049D cylinder, and fit it to the '53-'54 Duroglo crankcase *over the piston* of the older engine! The fit was perfect, and the piston/cylinder match as good as ever came out of any manufacturer's test bay! This fine example of constancy in production tolerance will forever stand high in my appreciation of the McCoy plant.



Here the assembled engine reveals new induction attached to the McCoy, leaving front carburettor blank. Mounting is two points by the pair of bolts shown.

I now had a Cox induction, Duroglo crankcase, .049D cylinder engine which was christened the McCOX .049D, and the performance obtained from the unique red-head gave a two-way comparison. It showed the difference in power between it and the earlier big-transfer-ported Duroglo, and also between it and the venturi poppet valve induction .049D. All



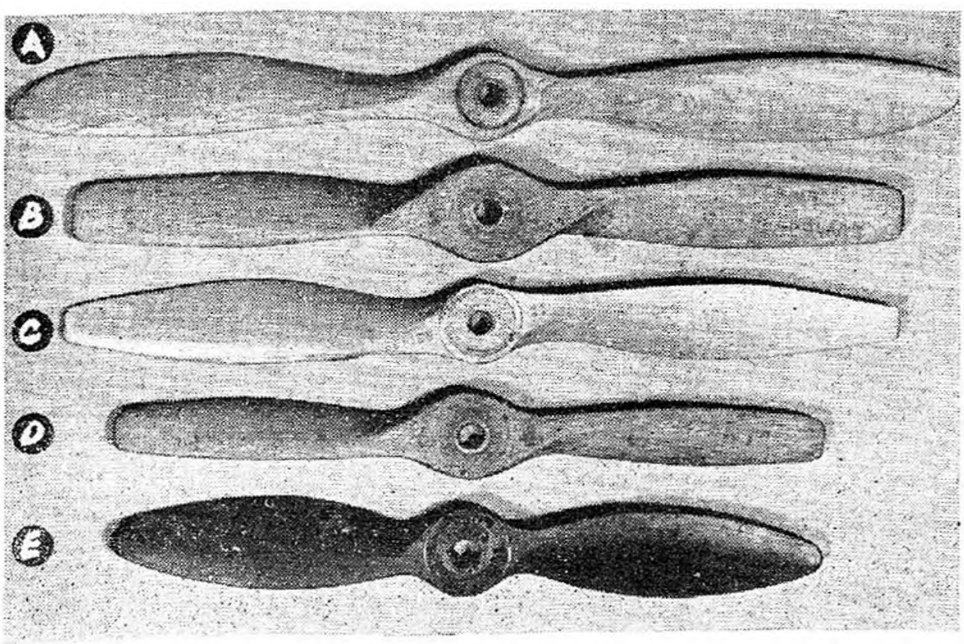
of which may sound confusing, so we shall deal with one at a time.

The hybrid McCox .049D was ahead of the previously described McCox, and the Duroglo before that, all the way along the scale. It started more easily, ran faster, zoomed away on the little plastic Kaysun $5\frac{1}{2}$ in. × $2\frac{1}{2}$ in. up to 17,000 r.p.m., and at this stage in the tests was right on top of the field.

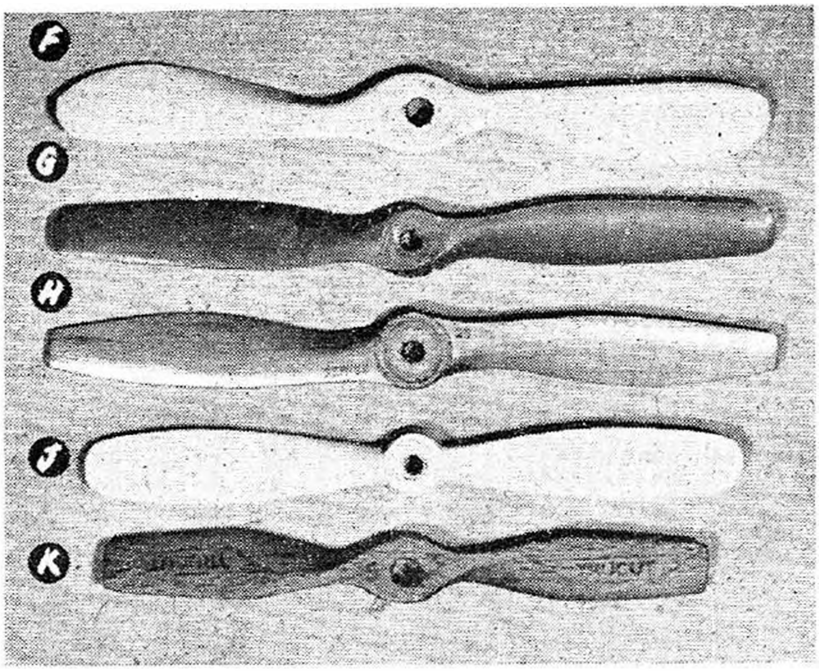
It proved once and for all to me that the transfer port is the criterion of miniature two-stroke design, and that the smaller area ports of the '56 cylinder were making all the difference to the overall performance. The second comparison involves a jump in this article, for I will leave the description of the McCoy .049D until last of the diesels; but the observed difference in performance that could be directly attributed to the respective rear-reed or front-poppet systems was in favour of the latter, of which more anon.

Thus I concluded the radially mounted McCoy and McCox tests, and to be frank, I did not like the two point fixing. If a prop happened to slip on the shaft through an oversize boss hole, then the vibration generated was enough to "kill" the test and reduce performance to low level. With beam mounts the same eccentricity of a misplaced prop had less than half the effect, and therein lies one more clue to the ultimate findings on the latest McCoy.

Still on the subject of the two point fixing with radial mount of the backplate, the WEBRA PICCOLO confirmed a growing suspicion that although simple for model construction and mounting, this form of engine attachment has a distinct disadvantage in vibration. The Piccolo was already known to head its class among those point-eights which had been checked on the b.h.p. analysis at AEROMODELLER. Performance of a high order was therefore no surprise; but the superiority only comes with the small props that are perfectly balanced. One of the more aggravating features of this engine is the way it apparently repels fuel along the feed tube when just about to start! Suction is very weak at



Actual propellers used for the tests. (A) Tiger 8 x $3\frac{1}{4}$ in. a prop. originally created for 2.5 c.c. free-flight glowplug engines, but also perfect for many motors of smaller capacity. (B) Stant 7 x 4 in. machined finished prop. has wide application for free-flight. (C) American Grish Bros. Tornado 7 x 4, a remarkably efficient prop. with an extremely fine finish. (D) Stant machine finished 6 x 4, a popular size for .5 c.c. capacity sport flying. (E) The wide bladed Keil Kraft flexible plastic 6 x 4 prop. which is virtually unbreakable.



(F) This is the E.D. white plastic non-flexible prop. of unusual outline, but most efficient thrust performance. (G) Frog 6 x 4 in Polystyrene plastic, also available in Nylon. (H) Tornado 6 x 3 by Grish Bros. of Indiana, U.S.A., has a fine finish and is a perfect power converter for most engines of less than .8 c.c. (J) American Kaysun plastic 5½ x 2½ prop. provided highest r.p.m. This is one of a popular American plastic range supplied in many cases with new engines. (K) The small Tru-cut 5 x 3, a machine finished prop. for .5 c.c. engines or suitable where the propeller diameter is limited, as on a scale model. Note: All plastic propellers in this photo fractured at the hub during the course of testing!

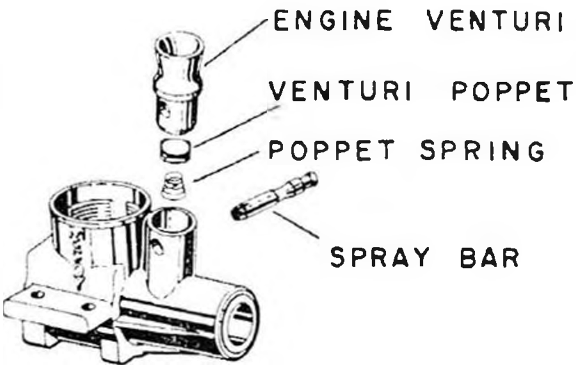
low revs, especially when the tank is 1½ in. below the front shaft carburettor position, and because of this, the Piccolo tests took about twice as long as that of any other engine. Every care was taken to ensure prop balance; but even then one must juggle the prop on the shaft at various "O'Clock" attitudes to help balance out the reciprocating parts of this short stroke unit.

On a Stant 6×4, the Piccolo was equal to the hybrid McCox .049D and crept just a little ahead on the 6×4's and Tornado 6×3 until we came to the little 5 in. sizes where the increase was a matter of 200 revs. For practical purposes, such a difference could be ignored, and the performance of the Piccolo and McCox .049D said to be remarkably identical.

All of the radial mount engines were finally checked on Mercury RD fuel which gave the cleanest exhaust and highest r.p.m. of several brands tried.

Attention now turns to beam mount, and the ALLBON MERLIN. This is the first of the British .049 diesels, though others hover above and below that capacity, and one must always remember that it is manufactured for a market where there is no competition for the class in the annual contest programme, and also that it is offered as an inexpensive unit for a wide variety of uses (including marine work). It is probably the simplest assembly ever devised, with only the cylinder jacket to hold all together, and there is no doubt that it has become the British schoolboys' delight. At first it had a weakness in the gudgeon pin which was easily revealed at the first sign of over-compression when handled rather roughly. This was put right by Allbon (Davies Charlton Ltd.) and the example tested could be considered an average engine with a total of three hours running time behind it, and never a cause for complaint.

For an engine that makes no claim to superior performance and can hardly be said to bear the external appearance of a high speed racer, the Merlin hides its light under a bushel. Thoroughly at home on the bigger props, and by no means lagging behind the top-line on a 6×3 which I suggest is its best size for contest free-flight, the Merlin leads the rest in one particular respect. It will *always* give this "middle-line" performance, no matter how many times it is taken apart to see what the insides look like, nor whether the cylinder is put back in a new position. High performance engines are more sensitive on this



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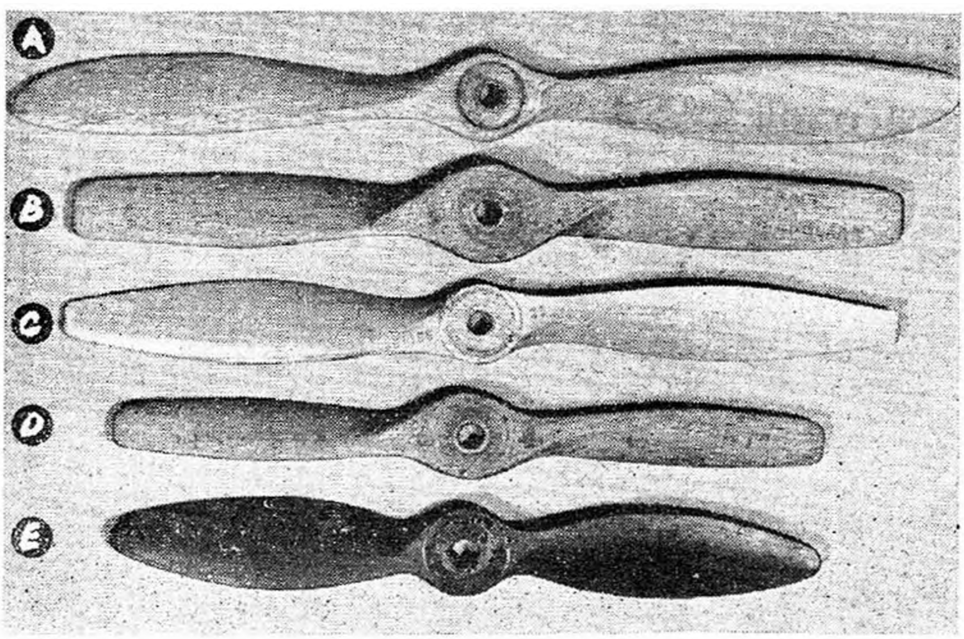

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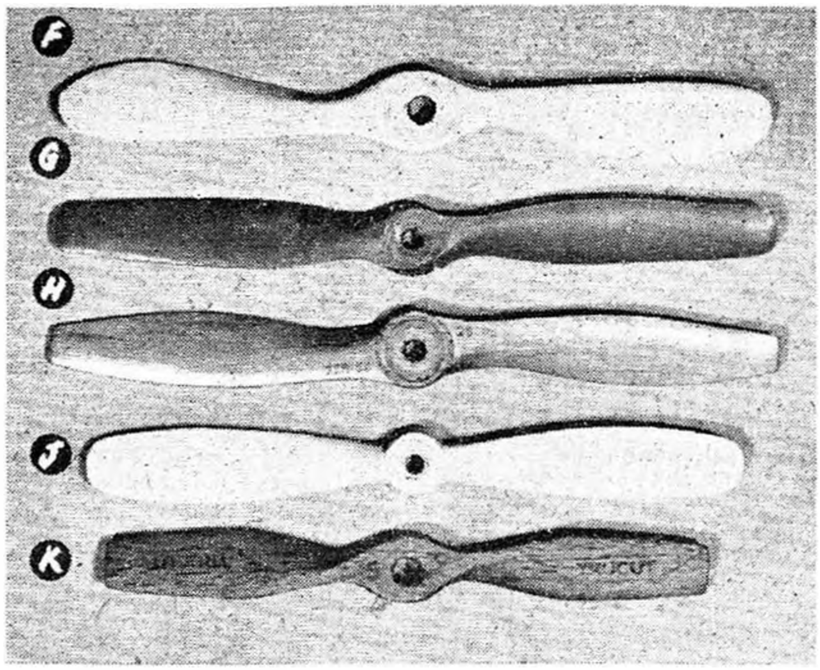

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All of the radial mount engines were finally checked on Mercury RD fuel which gave the cleanest exhaust and highest r.p.m. of several brands tried.

Attention now turns to beam mount, and the ALLBON MERLIN. This is the first of the British .049 diesels, though others hover above and below that capacity, and one must always remember that it is manufactured for a market where there is no competition for the class in the annual contest programme, and also that it is offered as an inexpensive unit for a wide variety of uses (including marine work). It is probably the simplest assembly ever devised, with only the cylinder jacket to hold all together, and there is no doubt that it has become the British schoolboys' delight. At first it had a weakness in the gudgeon pin which was easily revealed at the first sign of over-compression when handled rather roughly. This was put right by Allbon (Davies Charlton Ltd.) and the example tested could be considered an average engine with a total of three hours running time behind it, and never a cause for complaint.

For an engine that makes no claim to superior performance and can hardly be said to bear the external appearance of a high speed racer, the Merlin hides its light under a bushel. Thoroughly at home on the bigger props, and by no means lagging behind the top-line on a 6×3 which I suggest is its best size for contest free-flight, the Merlin leads the rest in one particular respect. It will *always* give this "middle-line" performance, no matter how many times it is taken apart to see what the insides look like, nor whether the cylinder is put back in a new position. High performance engines are more sensitive on this score, and, moreover, are dependent on the skill of the operator in using the the right technique and fuel to extract any superiority. The Merlin performs in anyone's hands, and runs well on a variety of mixtures though I adhered to the manufacturer's own Allbon fuel for the test. One of the interesting features of the "Propformance" Chart is the way the Stant 6×4 and Tornado 6×3 create bumps in the curves among the engines that do not reach 13,000 on the plastic 6×4 sizes, and the Merlin can be said to fare best among this group.

The Merlin can be radially mounted; but is far happier when solidly established on a pair of firm beams.

One other diesel completes the test, other than glowplug, and as already mentioned, this is the latest McCOY .049D. It has so many new features that it could be said to be an entirely new design after the Duroglo, yet one cannot forget that each engine has the same bore to an accuracy of .0001 in. or even less. Most important, it has beam mounts—one single factor that might give it the edge over the McCox hybrid with the same barrel. It also has superb carburettor control which may, or may not, be better than the automatic reed system of the Cox. Suction is perfect right from the start, and it will lift fuel into the carb without choking providing the flick is vigorous. Reason for this is the venturi poppet valve below the spray bar in the carb; which effectively stops "blow-back" from the shaft valve overlap, and at the same time gives an intake port adjustment that automatically aligns itself with the speed of the engine.

In the cylinder head, a spring tensioner retains the compression screw position, and McCoy remain faithful to the "O-ring" sealer for the contra-piston. Incidentally, the latter has a lip to prevent the two pistons coming into contact, so presumably McCoy's have no bother with bent con-rods or fractured gudgeon (wrist) pins from the ham-handed!

On test, the .049D was a wizard, that is apart from the feel-less character of the compression adjustment; though one must remark that the porting appears to have made the new motor more predictable. Once set, the compression adjustment need not be touched for any restart, possibly due to "O-ring" resilience taking up the load of an over-rich state, via the minute clearance betwixt the contra piston and cylinder.

While handling was as good as one could wish (Mills or Allbon style) the .049D started off on the wrong foot by being inferior to the McCox on large props—indicating the adaptability of the reed induction on the latter—yet from the 7×4 downwards in prop sizes it cleared the field. On the Frog 6×4, which it really loves, the red-head from Culver City was offering its most useful margin of superiority, but one must note how close the figures are, and bear in mind that "it ain't what you've got, but the way that you use it!"

At the risk of repetition, let me point out once more that the greatest single lead to the improved performance of the .049D over the Duroglo is most definitely in the use of smaller transfer ports.

Thus we leave diesels, with a scramble for the lead between the German Webra and the U.S. McCoy, with the latter certainly ahead most of the way, and less demanding in attention to mounting and balance.

Glowplug

It might be considered unfair that I should judge performance of .049 cu. in. engines on the figures obtained from only three examples of the many American glowplug ignition types. I started with six.

The three tested are representative of contest purpose engines in current production. For best performance, a fuel containing 40 per cent. nitro-methane was used, and in addition, checks were made with Mercury No. 7 which also contains nitro. Figures were lower on the latter mixture, but not to any great degree, and in each case only the highest figures obtained have been quoted. Original plugs were used in each engine without recourse to rewiring, etc.

Firstly, the McCoy BABY MAC .049 Glo, the companion to the D for diesel, with entirely different cylinder and other changes. I had read a report by a renowned authority, now resident in the U.S.A., that the diesel was "up" on the glowplug, so the results were not exactly a surprise. On the big $8\times3\frac{1}{2}$, the little engine had a struggle to keep going smoothly, but it came into its own sphere on the 6×4's with a set of figures that place it ahead of some diesels. The most impressive feature of this Baby Mac is the extreme ease of starting and the complete lack of vibration unless grossly maltreated with a prop $\frac{1}{8}$in. out of line at the boss hole. The Tornado 6×3 is its favourite, and it is only 250 static r.p.m.s behind best diesel performance at this stage.

Large pitches were tried experimentally to see how such a performance glow engine would take the load; but 4 in. appears to be the practical maximum.

Next came the revolutionary Ohlsson MIDJET, with reed induction, novel tank mount (or beam), taper exhausts and quite the most intriguing transfer/exhaust overlap applied to a mass produced engine. The Midjet was given every chance to give of its best, in fact two examples were alternated in the test mount to ascertain which was ready for the final set of figures. After 80 minutes running in, one of them appeared better than the other, so the tests commenced. On the $8\times3\frac{1}{2}$ the running speed was only just over what must have been minimum tick-over; but as soon as the 6×3 was fitted, the Midjet broke out into full song with very loud note and soared higher still with the Kaysun $5\frac{1}{2}\times2\frac{1}{2}$ plastic. If I were to use this engine in contest work, I would be tempted to fit this small prop for one gains the impression that the Midjet is only really "ready to go" at the 15,000 mark, and its smooth running about this speed on small props is impressive, if at times hard on the eardrums.

Lastly, El Supremo. The engine I dared to doubt, and which has led the Clipper Cargo PAAload event in the U.S.A. for several years with such feats as lifting 40 ounces of ballast off the ground in large span models. The Cox introduced so many radical features to the model engine business that it could be called a daring experiment. Nevertheless, it was one that has become the main item of a factory programme employing 120 people who turn out 2,000 engines *daily*! Yes—I have that figure in black and white, and photographs to substantiate same!

The engine tested was the second in my possession, the earlier one of '53 vintage being sadly in need of new valves and thoroughly worn out, having flown in the California desert where dust had done its worst, and in a British winter where mis-handling also had its effect. A brand new replacement was obtained by good fortune, and unpacked from its hermetically sealed plastic moulded box to arrive so meticulously clean that no one could doubt the claim that the THERMAL HOPPER *does not have* a factory run. I would like to comment that the handling leaflet and packaging of this engine set a standard only equalled by the performance of this remarkable product.

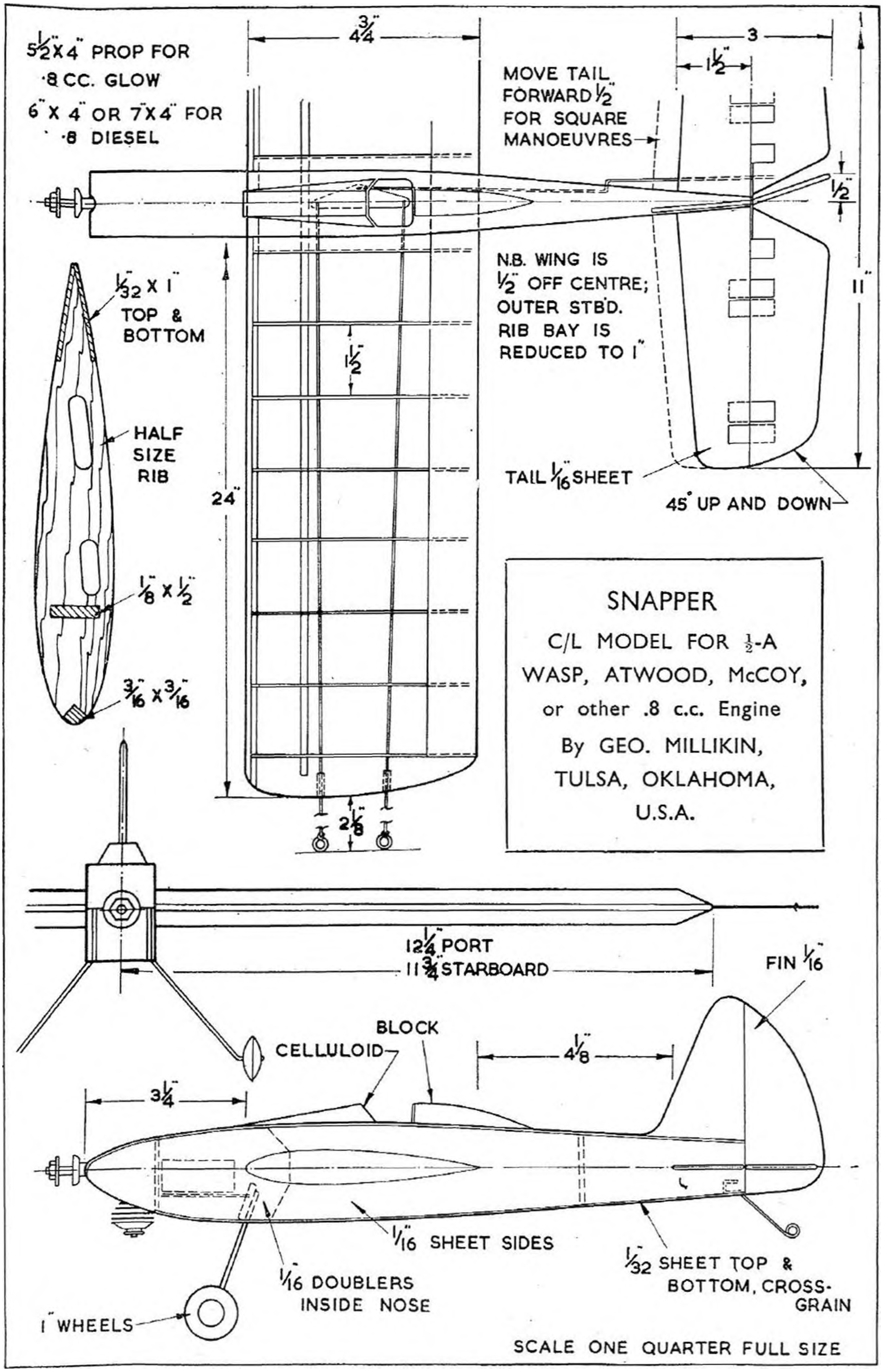
By a secret "Temp-Trol" process, L. M. Cox of Santa Ana assemble the Thermal Hopper with the confidence exemplified by their instruction that "The only break-in required is very rich (slow) running the first 60 *seconds after starting the first time*". The italics are mine.

When I state that the engine started on the very first flick, and was recording more than 20,000 r.p.m. in its first few minutes of running, one begins to appreciate how the Cox Thermal Hopper has attained such a reputation. The figures and the curve speak for themselves. My first surprise came with the 7×4 figure; but I pressed on without double checking until I got a reverse direction run on the Stant 6×4. This read 12,800 r.p.m. The Thermal Hopper was stopped and restarted anti-clockwise. Same figure! I took the prop off, put it on the shaft back to front and started again, anti-clockwise. Same figure again! Surely there should be some difference with the prop running normal or backwards—I checked with other sizes; but only with the finely sectioned blades could one find a few hundred r.p.m. change. Once more, the 6×3 Tornado seems to be the most useful prop; but one cannot ignore the fine 7×4 figure for cargo lifting. Carburettor control is non-sensitive, suction good though speed is relative to the fuel level, and starting simple as one could wish. The only disadvantage of the engine is its mounting and rear carburettor position; but L. M. Cox have recognised this problem and can supply a lightweight mount adaptor which is shaped from solid aluminium. Unfortunately a high frequency vibration shattered this mount at some speed near to 21,000 r.p.m., and examination revealed a crack in the small plastic prop hub. Which happened first is a matter for conjecture; and the satisfying point is that the all-embracing instruction leaflet specifically warns modellers not to fit a plastic prop unless it is labelled as suitable for the Thermal Hopper. The one I had fitted is not apparently among those advised!

The dieselites will most probably scorn the Cox figures as exceptional, or regard the author as incapable of reading r.p.m. They are welcome to their opinion. For my part, the long hours finding the information I wanted have been far from wasted, and I hope that the comparative curves will serve to stimulate manufacturers to extract even greater output from the small .8 c.c. class of engine.

PROPELLER/R.P.M. TEST FIGURES

ENGINE	Tiger 8x3½	Stant 7x4	Tornado 7x4	Stant 6x4	Keil Kraft 6x4	E.D. 6x4	Frog 6x4	Tornado 6x3	Trucut 5x3	Kaysun 5½x2½
DIESEL										
ALLBON DART ...	5,900	7,200	8,250	10,100	10,600	10,750	10,750	12,000	12,000	12,600
MILLS .75 ...	6,500	7,800	9,000	10,450	10,900	11,000	11,300	12,200	12,200	12,800
McCOY DUROGLO ...	6,600	8,100	9,000	11,200	11,750	12,000	12,800	13,200	13,300	15,500
ALLBON MERLIN ...	6,800	8,200	9,200	11,400	12,000	12,200	12,500	13,500	13,600	15,800
McCOX ...	7,100	8,000	9,800	11,100	11,800	12,000	13,000	13,800	14,000	15,800
McCOX .049 D ...	7,500	9,000	10,000	12,000	12,900	13,000	13,100	14,100	14,800	17,000
WEBRA PICCOLO ...	7,100	8,800	10,050	12,000	13,000	13,100	13,250	14,100	15,000	17,200
McCOY .049 D ...	6,800	9,000	10,100	12,000	13,200	13,400	13,600	14,250	15,200	18,000
GLOWPLUG										
OHLLSON MIDJET ...	5,500	7,000	7,800	10,000	10,250	10,400	10,700	11,800	11,800	14,800
McCOY .049 GLO ...	5,800	7,400	8,400	11,400	12,800	13,000	13,200	14,000	14,000	16,800
COX THERMAL HOPPER ...	7,200	9,900	10,900	12,800	14,000	14,400	14,600	16,400	17,000	20,400

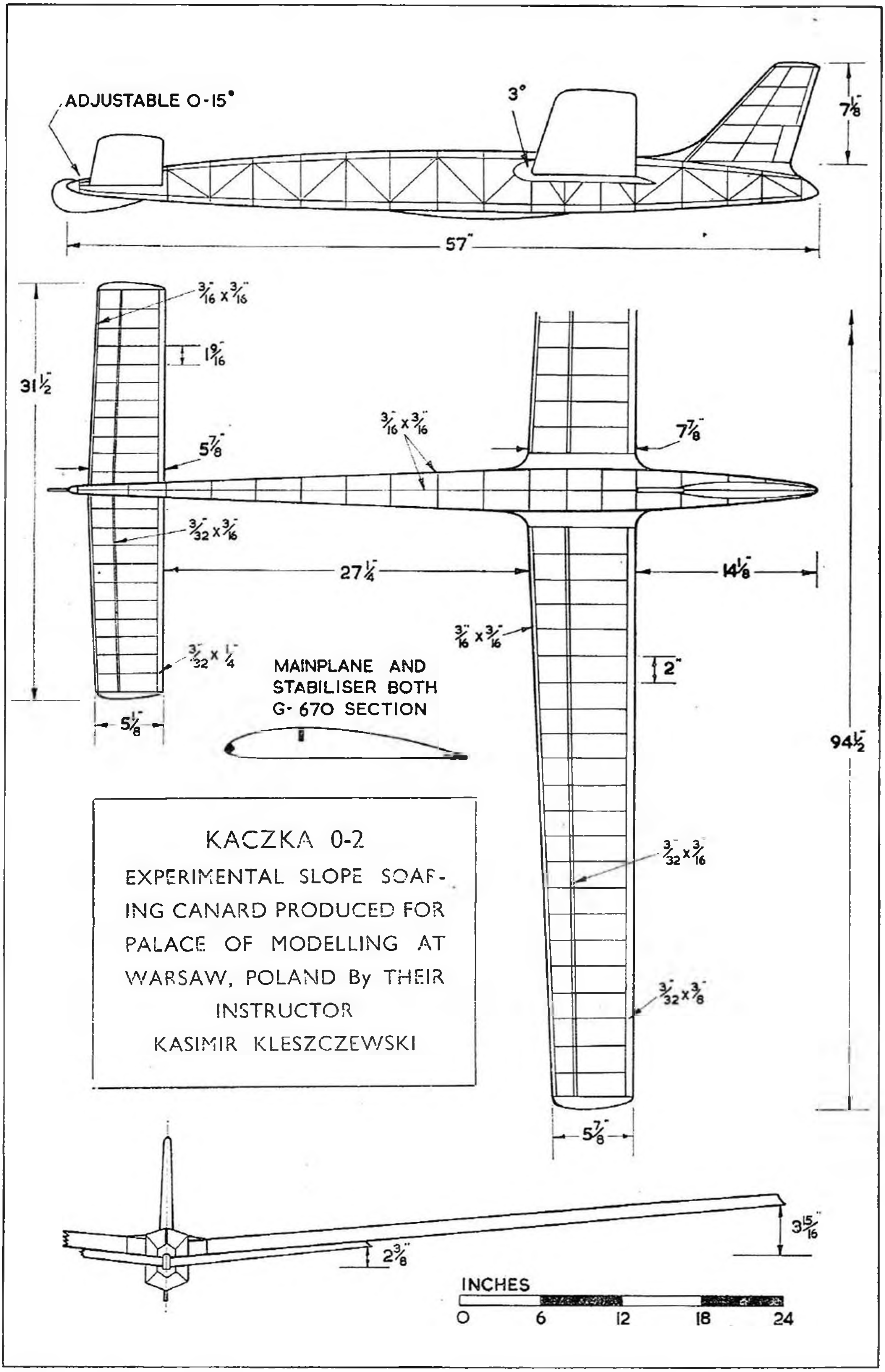


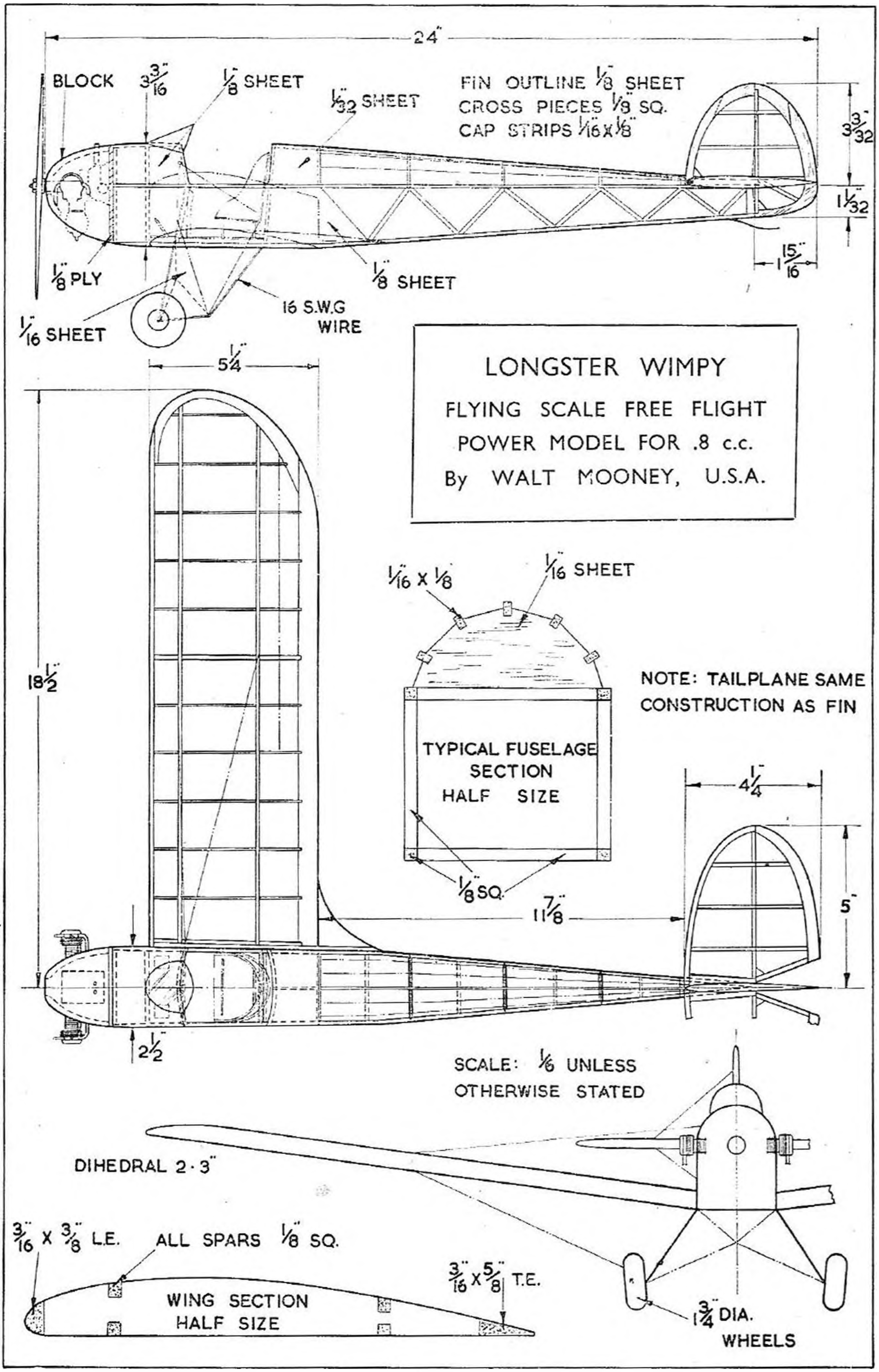
SNAPPER

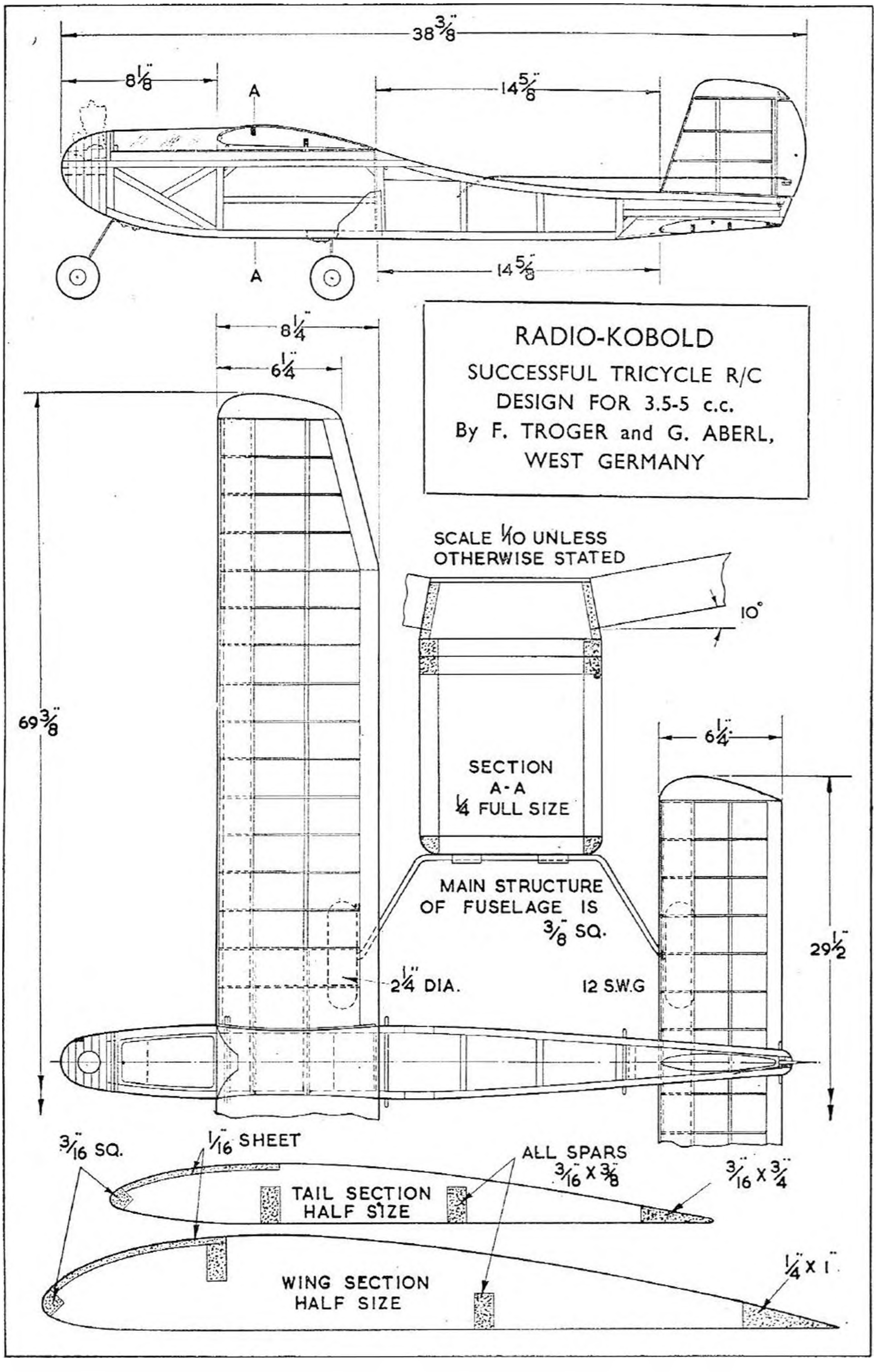
C/L MODEL FOR ½-A WASP, ATWOOD, McCOY, or other .8 c.c. Engine

By GEO. MILLIKIN, TULSA, OKLAHOMA, U.S.A.

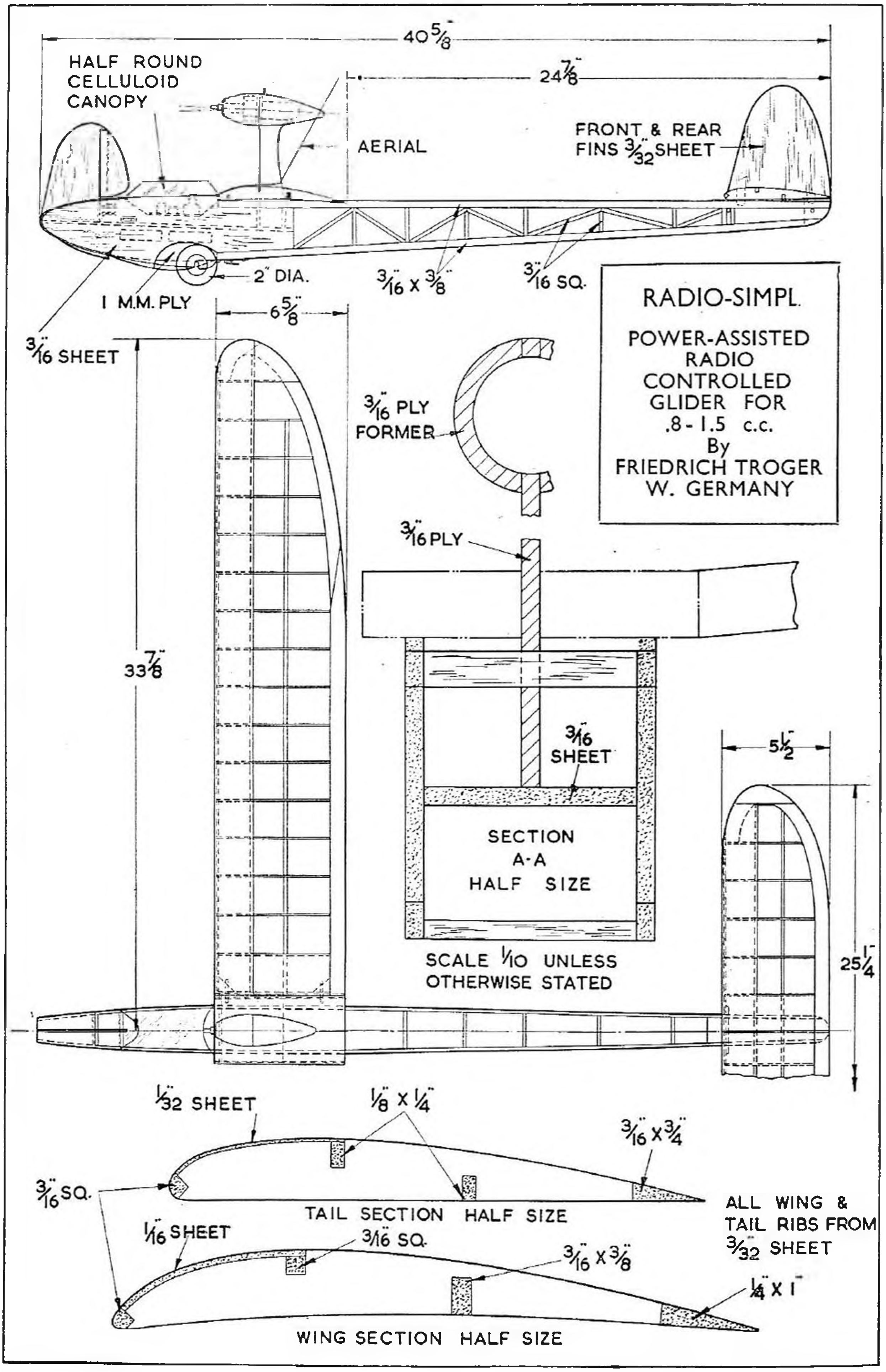
SCALE ONE QUARTER FULL SIZE


ADJUSTABLE 0-15°
3°
7 1/8"
57"
3/16 x 3/16
1 9/16
31 1/2
5 7/8"
3/16 x 3/16
7 7/8"
3/32 x 3/16
27 1/4"
14 1/8
3/16 x 3/16"
3/32 x 1/4
MAINPLANE AND
STABILISER BOTH
G-670 SECTION
2"
5 1/8"
94 1/2"
KACZKA 0-2
EXPERIMENTAL SLOPE SOAR-
ING CANARD PRODUCED FOR
PALACE OF MODELLING AT
WARSAW, POLAND By THEIR
INSTRUCTOR
KASIMIR KLESZCZEWSKI
3/32 x 3/16
3/32 x 3/8
5 7/8"
3 15/16"
2 3/8"
INCHES
0 6 12 18 24


LONGSTER WIMPY
FLYING SCALE FREE FLIGHT POWER MODEL FOR .8 c.c.
By WALT MOONEY, U.S.A.
24"
BLOCK
3 3/16"
1/8" SHEET
1/32" SHEET
FIN OUTLINE 1/8" SHEET
CROSS PIECES 1/8" SQ.
CAP STRIPS 1/16"x1/8"
3 3/32"
1 1/32"
1 15/16"
1/8" PLY
1/8" SHEET
1/16" SHEET
16 S.W.G WIRE
5 1/4"
18 1/2"
1/16" x 1/8
1/16" SHEET
TYPICAL FUSELAGE SECTION HALF SIZE
1/8" SQ.
NOTE: TAILPLANE SAME CONSTRUCTION AS FIN
4 1/4"
5"
11 7/8"
2 1/2"
SCALE: 1/6 UNLESS OTHERWISE STATED
DIHEDRAL 2·3"
3/16" x 3/8" L.E.
ALL SPARS 1/8" SQ.
WING SECTION HALF SIZE
3/16" x 5/8" T.E.
1 3/4" DIA. WHEELS



38 3/8"
8 1/8"
14 5/8"
A
A
14 5/8"
8 1/4"
6 1/4"
RADIO-KOBOLD
SUCCESSFUL TRICYCLE R/C
DESIGN FOR 3.5-5 c.c.
By F. TROGER and G. ABERL,
WEST GERMANY
SCALE 1/10 UNLESS
OTHERWISE STATED
10°
69 3/8"
6 1/4"
SECTION
A - A
1/4 FULL SIZE
MAIN STRUCTURE
OF FUSELAGE IS
3/8" SQ.
29 1/2"
2 1/4" DIA.
12 S.W.G
3/16 SQ.
1/16" SHEET
ALL SPARS
3/16" x 3/8"
3/16" x 3/4"
TAIL SECTION
HALF SIZE
1/4" x 1"
WING SECTION
HALF SIZE


40 5/8"
24 7/8"
HALF ROUND CELLULOID CANOPY
AERIAL
FRONT & REAR FINS 3/32" SHEET
2" DIA.
I M.M. PLY
3/16 X 3/8"
3/16 SQ.
RADIO-SIMPL.
POWER-ASSISTED RADIO CONTROLLED GLIDER FOR .8 - 1.5 c.c.
By FRIEDRICH TROGER W. GERMANY
6 5/8"
3/16 SHEET
3/16" PLY FORMER
3/16 PLY
33 7/8"
3/16" SHEET
SECTION A-A HALF SIZE
5 1/2"
25 1/4"
SCALE 1/10 UNLESS OTHERWISE STATED
1/32 SHEET
1/8 X 1/4"
3/16" X 3/4"
3/16 SQ.
TAIL SECTION HALF SIZE
ALL WING & TAIL RIBS FROM 3/32" SHEET
1/16" SHEET
3/16 SQ.
3/16" X 3/8"
1/4" X 1"
WING SECTION HALF SIZE

"BUZZARD WINGS" OR NEGATIVE WINGFORM

By Ing. KURT NICKEL, *translated by* HANS PFEIL

ARROW-PLANFORM for a wing may incorporate either a forward (negative) or backward (positive) sweep. To determine the precise angle (displacement of wing datum line against fuselage centre-line rectangle) of sweep, especially in case of taper wings, the quarter chord stations of all rib stations are taken as reference line (*see* Fig. 1). The angle of sweep (P) is positive, if the wing tips are displaced rearwards, negative in the case of forward positioned tips (buzzard wings).

The usual positive sweep (sweepback) is found on many old-time aircraft, and vintage flying models, too. For instance, on the Bucker training planes "Jungmann" Bu 131 and "Jungmeister" Bu 133, also on the early "Falcon" intermediate glider, and Kirschke's 1938 glider model "Strolch". Most modern flying models have but a straight, high aspect ratio wing; the same applies to most modern sport and transport aircraft. Pronounced sweepback is commonly associated with tailless models, rather more on modern than on early designs. (*Cf.* the Austrian "Schlauchkurbler" design which set off a number of other variations, and provided countless contest winners.) Marked sweepback is also a common design feature of high speed (sonic) fighters. There are some very good reasons for such a development, both in model and full size designs.

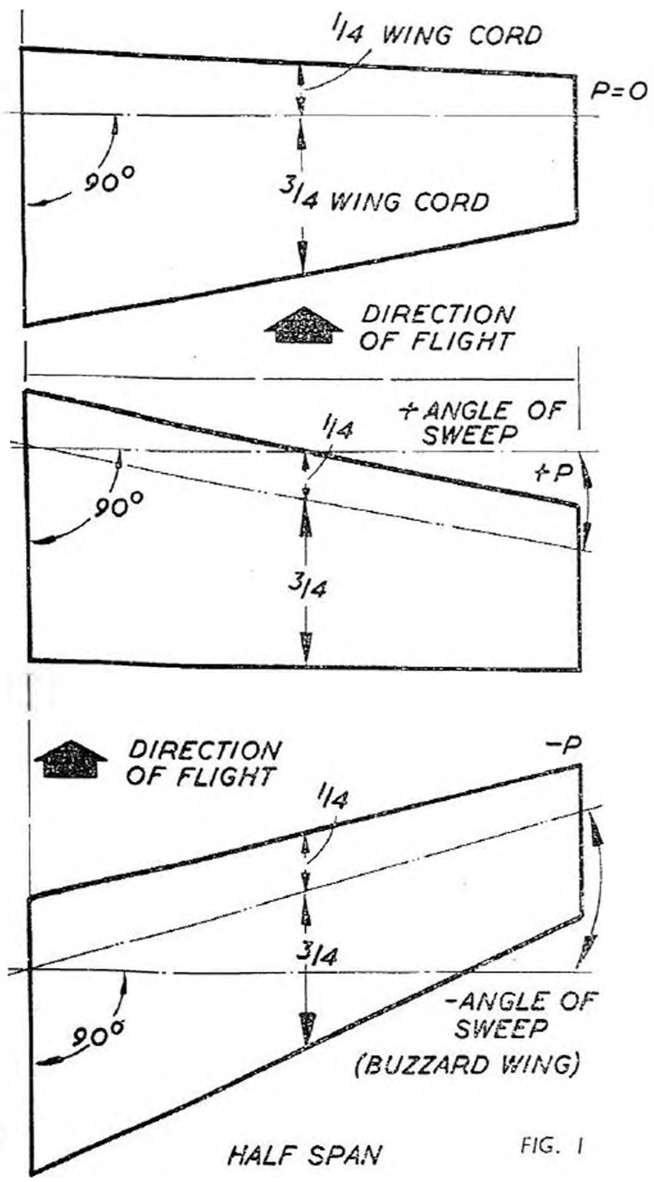


FIG. 1

1. Best known advantage of the swept back wing is its inherent fine longitudinal stability, even more evident in combination with a twisted (washed-out) wing. The t.e. need just be bent up. One can regard this as a replacement for the stabiliser (tailplane) on a model, the wing-tips more or less taking over tailplane functions. If the sweep-back angle is sufficiently large (25 to 30 degrees) and the washout well dimensioned (approximately 6 to 8 degrees), one can omit the tailplane, and the auto stable all-wing or tailless model is obtained.
2. Positive sweep-back induces higher lateral and directional stability. *See* Fig. 2. If a model is off course to the left, there is a skidding moment to the left. Owing to the sweep-back angle, the left wing is at dead right angle to air stream, while right

wing is not. Left wing shows increased lift and increased drag, right wing less of both, owing to air stream being at a still larger angle of attack to line of flight. Result from increased lift is an up movement of the left wing, which returns plane to its normal flight path and lateral position. Such an automatic stability has its advantages, but also disadvantages.

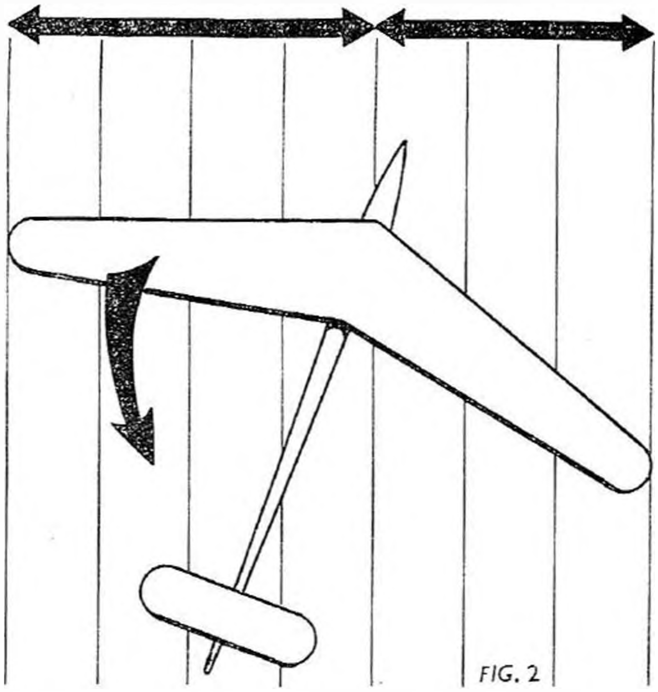


FIG. 2

3. When a wing incorporates positive sweep (sweepback) there is a loss in overall lift generated. This applies already for a wing with no washout, and is more marked for a wing embodying washout such as is used on most tailless flying models.

Reason for this drop in overall lift is, that on a swept wing, boundary layer starts wandering in the sense of sweeping along the wing. This induces a greater number of boundary layer particles at wingtips, which in turn produce a very early wing stall. With a model, such an early stalling tendency is even more evident, owing to the boundary layer being more sensitive and critical and less "adherent" to wing, in view of reduced air speed. However, to obtain the lowest sinking speed, one should have the maximum overall lift possible.

We may mention that even high-speed aircraft suffer through this loss of efficiency, in so far as the landing characteristics get more and more critical. To obtain an advantageously low landing speed, the overall lift of a wing should be as high as possible. However, the early tip stall owing to the boundary layer compression at tips may occur not only early, but more readily on one wing than on the other. This will cause plane to skid or to yaw during landing, which may render the complete landing approach a highly tricky affair. In full size design practice, the boundary layer fence was developed as an antidote.

So much for the normal sweepback (positive sweeping) of wings. How do we stand for negative sweep, the "buzzard wing"? Basically, everything is reversed here, compared with the swept-back wing. Where the sweptback wing had undesirable characteristics, they are desirable for the swept forward wing, and two such points are of particular interest to modellers.

1. Swept forward wings have a higher overall lift. As free-flight models are required to have a maximum flight duration, which can be best guaranteed through a lowest possible sinking speed, any increase in overall lift is highly welcome. Test flights and wind tunnel checks on performance of swept forward wings are rare, we could only trace a very early WWI (MVA) Gottingen test report, which is rather favourable. The reasons for the assertion—a swept forward wing is more favourable—are theoretical considerations, which can be put as follows: A swept forward wing must show a higher overall lift, because for sweepback, lift is less. As stated, characteristics

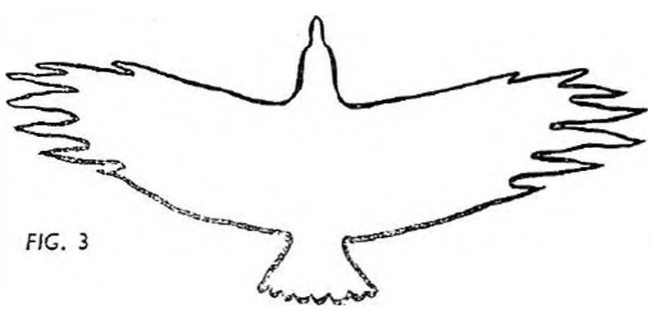


FIG. 3

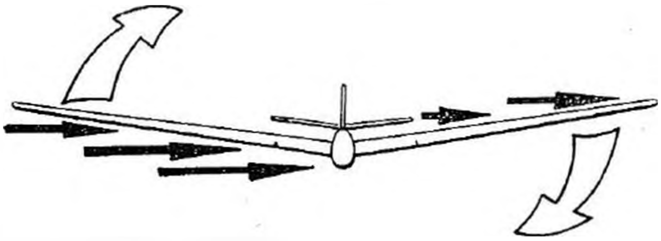


Fig. 4. Autostabilising effect of normal dihedral

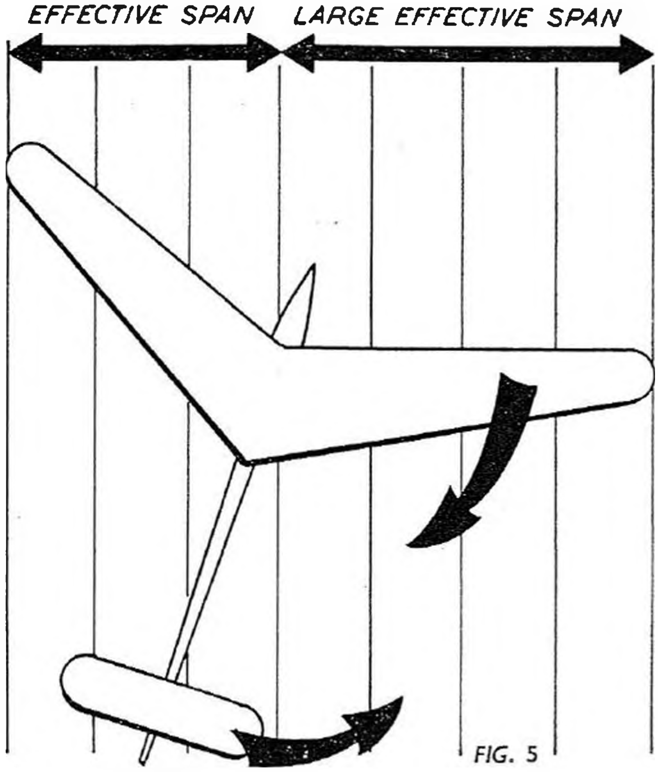


FIG. 5

are reversed. An instructive example is mother nature's wing planform for soaring birds. Soaring birds such as buzzards hold wings motionless, with an average sweep-forward of wing tips from 10-20 degrees against datum line—*see* Fig. 3. For landing, when highest possible lift is required, birds put their wing tips even more forward, which is nothing but a very high degree of forward sweeping. As nature always chooses the most simple and yet most effective "design method", this measure for increasing lift should just be ideal. If a better effect could have been obtained through increasing wing-camber for instance, nature would no doubt have chosen that modification.

2. Swept forward wings possess a lesser degree of directional stability than straight wings and, therefore, have a more ideal turning and flight circling characteristic. We shall now explain a little further how this reduced directional stability is of advantage. As the plane has not such a marked tendency to hold course, "skidding" or side-slipping with final crack-up—as a result of over-stability very common with gliders—no longer appears. Normally, directional stability is equal (in modellers' minds) with weathercock stability, the model holding its nose against the wind, due to an oversize fin. Owing to such a distribution of lateral area, C.L.A. far back, the model will keep on swinging its nose back into the direction of wind. If model is thrown into a bank owing to a squall, dihedral will tend to stabilise model in its previous normal flight horizontal. Stabilisation will only come via a side-slip, during which the fin is attacked by a lateral stream of air (see Fig. 4). Result is a turn in the same sense as the lateral displacement from normal flight path (side-slip). Owing to turn the outer wing travels through the air faster, has more lift than the inner wing, and thus counteracts stabilisation of model.

Eventual result in the worst case will be a spiral dive; in less severe cases, a prolonged side-slip will produce a marked loss of height. See Fig. 5. When a buzzard wing model comes into a lateral airstream, owing to skidding motion in side-slip, the fin effect is appropriately counter-balanced by different half-span projections in buzzard wing, causing different overall lift for either wing pinion. Such a counteracting force is aerodynamically speaking more appropriate than a forward fin; especially for power models with a relatively short nose moment arm, and a good deal of drag can be ruled out (or pylon area lessened) and forward fin be done away with. Result will be a worthwhile improvement of power flight stability. As regards radio-controlled models, buzzard wings offer more "turnability" with less rudder area necessary to induce turn. This makes for very little rudder travel, and less control forces necessary. Additional benefit from the foregoing, is a very small loss of height in circling flight.

Before we go more deeply into the use and advantages of buzzard wings for models, a few remarks and a review of buzzard wing application to full size

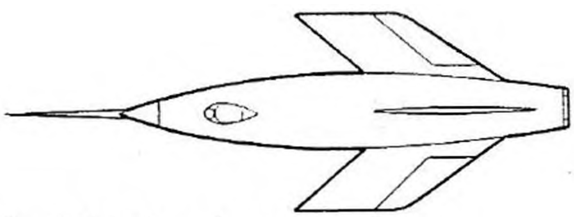


Fig. 7. American ultra-sonic experimental aircraft Convair XB 53.
Fig. 6. Junkers Ju 287 in plan view, showing pronounced sweep forward of wings.

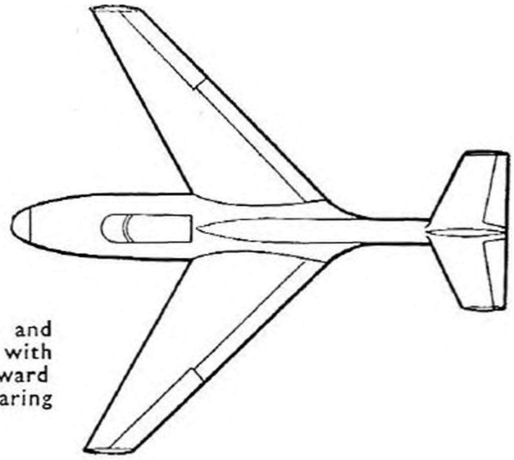
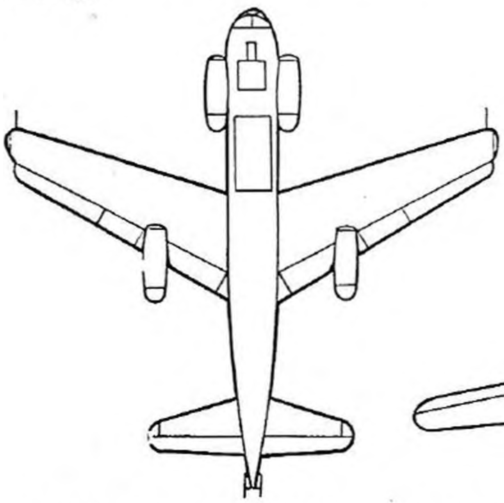


Fig. 9. Blohm and Voss project with swept forward wings like a soaring gull.



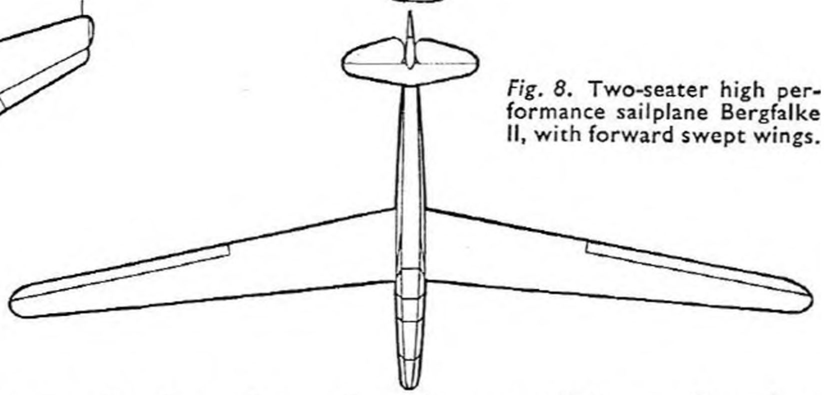


Fig. 8. Two-seater high performance sailplane Bergfalke II, with forward swept wings.

aircraft may be of interest. In the first place, there is one of the earliest jet-bombers of WW II, the Ju 287 which was in its development stages when Germany collapsed, but has been further improved and put into production by Russia. (*See* Fig. 6.) Another machine of interest is the CONVAIR project XB-53 (*see* Fig. 7), which incorporates a marked sweep forward, on short span, stubby wings, to attain ultra-sonic speeds. Reason for employing buzzard wings on this particular craft are advantages offered in helping to break sonic barrier. The deep chord wing allows very rigid construction to be employed, which is a "must" on such a layout. With soaring gliders (full size), the buzzard wing is quite the vogue. Almost every modern two-seater design favours a small degree of forward sweep. A type which is very well spoken of by German gliding enthusiasts, and which is being home-built in quite a few clubs, is Mue 13E, also known under its proper name "Bergfalke II" (Mountain falcon). (Fig. 8). This sailplane uses a sweep angle of 5.5 degrees (forward). We asked designers why and reasons given are: Design considerations such as better visibility for second pilot or student pilot, as second man must be positioned right atop centre of gravity. Thanks to negative wing sweep, the space-consuming wing attachment and root assembly can be put further back, aft of C.G. In this way, a lightweight construction is possible, compared with heavy and intricate wing-attachment necessary otherwise. Improvement in pilot's visibi ity is most praiseworthy. Another German project was the Blohm and Voss BVP 209, a fighter with span of 26½ ft. and length of 29 ft., which in plan form resembled a soaring gull, and employed a pronounced sweep forward. This has, however, so far not proceeded beyond the drawing board stage. Most modern and most advanced German two-seat soarer, the HKS-1, has about —4.5 degrees negative sweep (*see* Fig. 11). Again many design advantages are mentioned for this layout; among them, this plane is very safe in "peeling off for dive", and need not incorporate wing-washout, which otherwise is a must on hi-performance gliders.

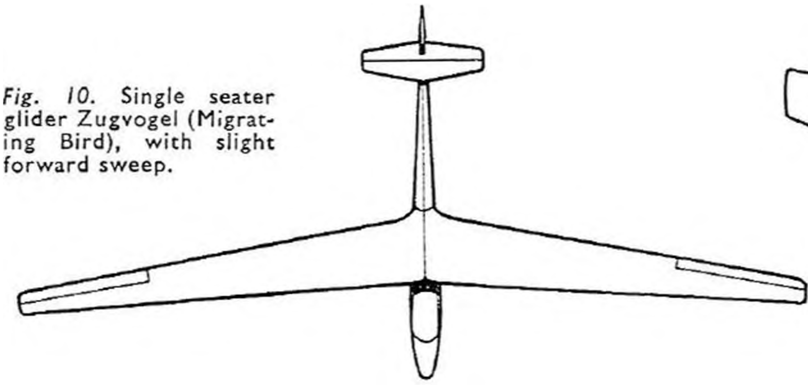


Fig. 10. Single seater glider Zugvogel (Migrating Bird), with slight forward sweep.

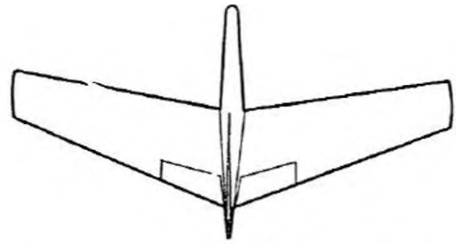


Fig. 12. Tailless model glider developed by Wennerstrom in U.S.A. which featured pronounced buzzard wing layout.

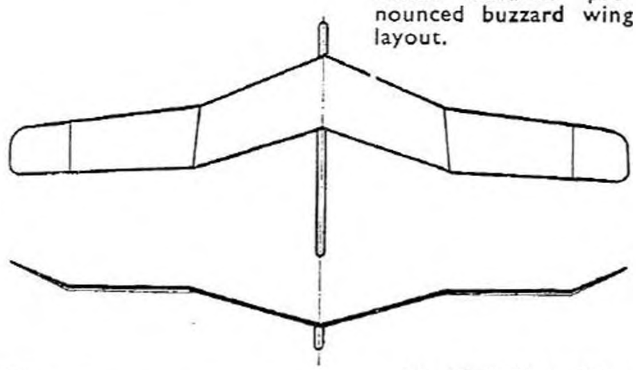


Fig. 11. Two-seater high performance sailplane HKS-1.

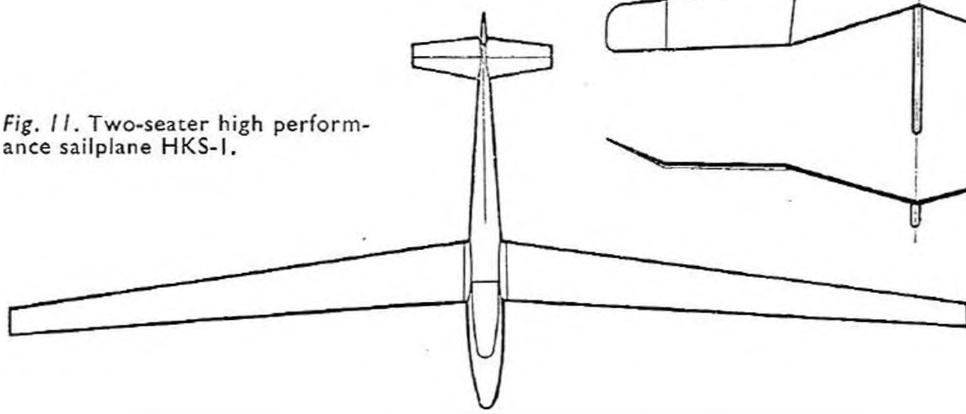


Fig. 13. Tailless glider model developed by Werner Thies, after suggestions from Dr. Alexander Lippisch.

Now for the aeromodelling sphere. Here again, many tests and trials have been made over the years to find out the secret of buzzard wings. In the main, they are dealing only with tailless and "all-wing" gliding models. It's an open secret, that all the hard work put in here has not been entirely successful, and the performance obtained from a normal model could not be bettered. Among designers who tried buzzard wings was Bruce K. Wennerstrom (Fig. 12), who reported an aspect ratio of 1 : 6 to 1 : 9 as most advantageous, and a taper ratio (root to tip chord) of 2 : 1. His best sweeping angle was minus 15 degrees. Dihedral quoted was 7.5% of span. Wing section used for tests being symmetrical and of 12% thickness. Under-cambered or aerofoils with a swept-up trailing edge were not of any advantage and flight performance with such was poor. The wing wash-*in* was three degrees, the greater angle of incidence being at the wing tips. Wennerstrom is reported to have built gliders—rubber and power models of that configuration, which he claims were all stable fliers, crashproof, and quite fast. (*Note by H. Pfeil:* Wennerstrom was not the original thinker, but T. E. Hindell of Battersea, a correspondent of his, and a number of Hindell's findings and suggestions were incorporated in this MAN feature. He built a number of tailless gliders, and the once famous "Cloud Scythe" by S. Strojek.)

Increased flight speed with Wennerstrom's buzzard wing models can be traced back to use of a symmetrical wing aerofoil. This cannot bring any material improvement for contest models, however, as there, a very low sinking velocity is a must for best possible competition performance.

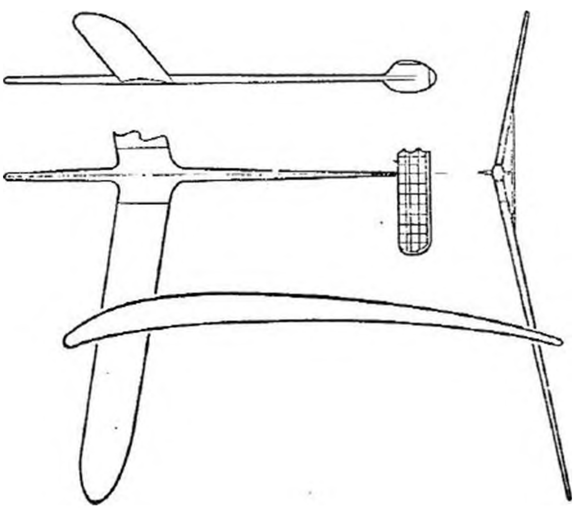
In Germany, about 3-4 years back, Werner Thies, noted glider exponent in Schleswig-Holstein, and one of Germany's best all-round contest flyers (winner, A-1 last year's Nationals), embarked on a series of tests and research on buzzard wings. Original idea to make these tests came from Professor Alexander Lippisch, noted for his Delta wing tailless aircraft. He tested among others a solid balsa chuck glider with buzzard wings of about 28 in. span. This model incorporated a buzzard type centre part, with straight outer panels added. In 1954, the A-2 team trials for World Championships, 1955, were held at Kaltenkirchen (Germany), where Ruediger Franke of Cologne entered a normal A-2, that was 10 degrees buzzard-winged, and this particular model showed absolutely spotless directional stability. Surprising was the high sensitivity to thermals, which brought immediate response from model, going every time into upward spirals (*see* Fig. 14). Franke placed 5th in the team trials, and if he had not been ruled out of the World Championship comp. that way, it would have been interesting to see him flying his buzzard glider against the world's best. Another German aeromodeller, Helmut Loeser, of Kiel, produced several models with buzzard wings, for power free-flight. He made the 1955 team, but his performance was disappointing. For this "Banshee"-like power skyrocket, the buzzard wing brought quite a stable climb, but the glide was not so convincing (Fig. 15).

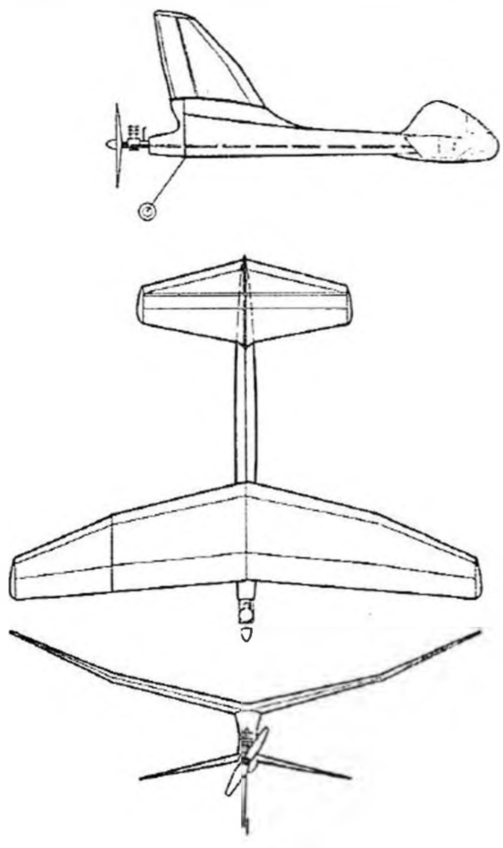
Let us summarise model designers' findings and suggestions, and see how much use can be made of the buzzard wing layout.

There is in the first place the tailless or all-wing model. In this layout, the wing tips take over the function of the tailplane on a normal model. The foremost wing tips are so to speak, the main wing of the normal model, the centre-section (swept back against the tips) makes the tailplane substitute. As the main or most forward wing must have the greatest angle of incidence, we must rig the outer wing panels at a positive incidence of 5 degrees. The angle of sweep should be 20 to 30 degrees positive. Only with such an angle of "arrow-form" one can be sure of sufficient longitudinal stability. A high-performance model airfoil has its best L/D ratio at about 6 degrees positive incidence. Under such circumstances, the main wing will have only 1 degree positive incidence, which means quite an appreciable loss of performance. The

Fig. 14. An A/2 Contest Sailplane designed and flown by Ruediger Franke of Cologne, using 10° forward sweep. This model placed 5th in trials and therefore did not compete in the World event.

Fig. 15. Another contest model, this time by Helmut Loeser of Kiel, which did reach National team level, but failed to put up any sensational flights in the main competition.





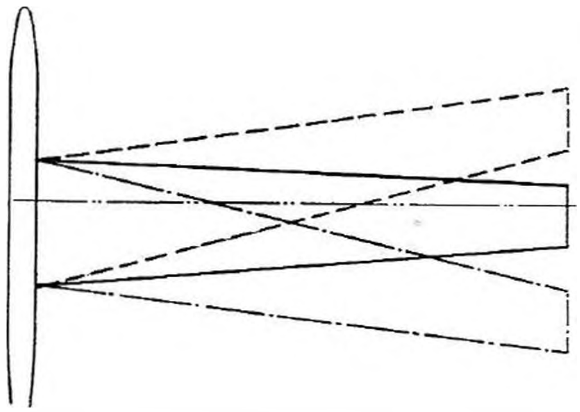
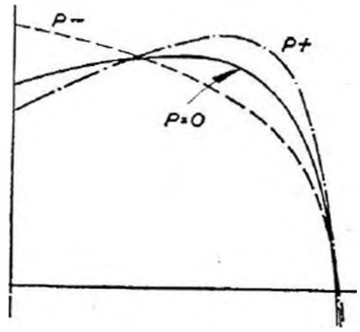


Fig. 16. Comparative lift coefficients of swept forward, back, and centrally placed wings.



mean average incidence for the whole wing will be about 3.5 degrees (provided the wash-out is kept to moderate limits). On a conventionally designed model, there is about 84% of the main flying surface rigged at about 5.5 degrees incidence, a small remainder of 16% (which is the tail area), is rigged at about 3 degrees, so that an overall incidence of 5 degrees is the eventual result, pretty close to the most advantageous L/D. This goes to show that a tailless model will normally fly below its best possible performance, as the difference in sinking velocity between the mean average incidence angles of 3.5 degrees and 5 degrees is quite substantial. If the angle of attack is increased through a gust or other cause, disturbing flight, the wing-tips always stall *first*. As already mentioned, the disturbance of boundary layer very rarely occurs precisely at the same moment in both wing panels, so the model is prone to side-slip and skid, eventually going into a spiral-dive. Thus lateral stability is quite topsy-turvy, and the peel-off for dive is out of the control of the flyer. A buzzard winged tailless thus has a jerky skidding tendency, which makes for awkward towing. Some boundary layer stabilising means, such as slots at the tips, can remedy this. Such an arrangement will restore good lifting properties. But if "the cost" of this restoration is considered, drag has sky-rocketed. Chances of improving flight performance for the tailless, through use of buzzard wings, are thus rather remote. This is mainly so because of low flight stability. If this deficiency could be eliminated, through a design measure of some kind, the buzzard winged tailless might one day surpass performance of the normally swept tailless, since a higher overall lift is generated; the wash-out angle may be less.

Full use of swept wing advantages, however, can only be made on a normal model. If buzzard wings are envisaged, keep the following in mind:

1. Effects of either form of sweep on directional stability.
2. Sweepback and sweepforward are increasing longitudinal stability, in so far as the angular difference between wing and tail-plane incidences is smaller. In other words, that the difference in overall lift produced at various angles of attack of wing, is somewhat levelled out. This results in a lesser sensitivity to angle of attack changes which in turn means that one can use a small size stabiliser, or alternatively, one may use a short tail moment arm.
3. Sweeping wings means also changing lift distribution over wing, spanwise.

FIG. 17

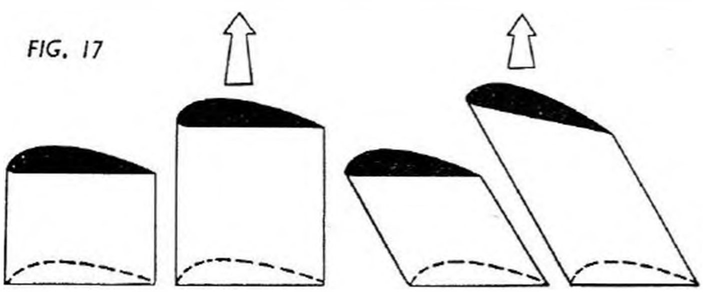


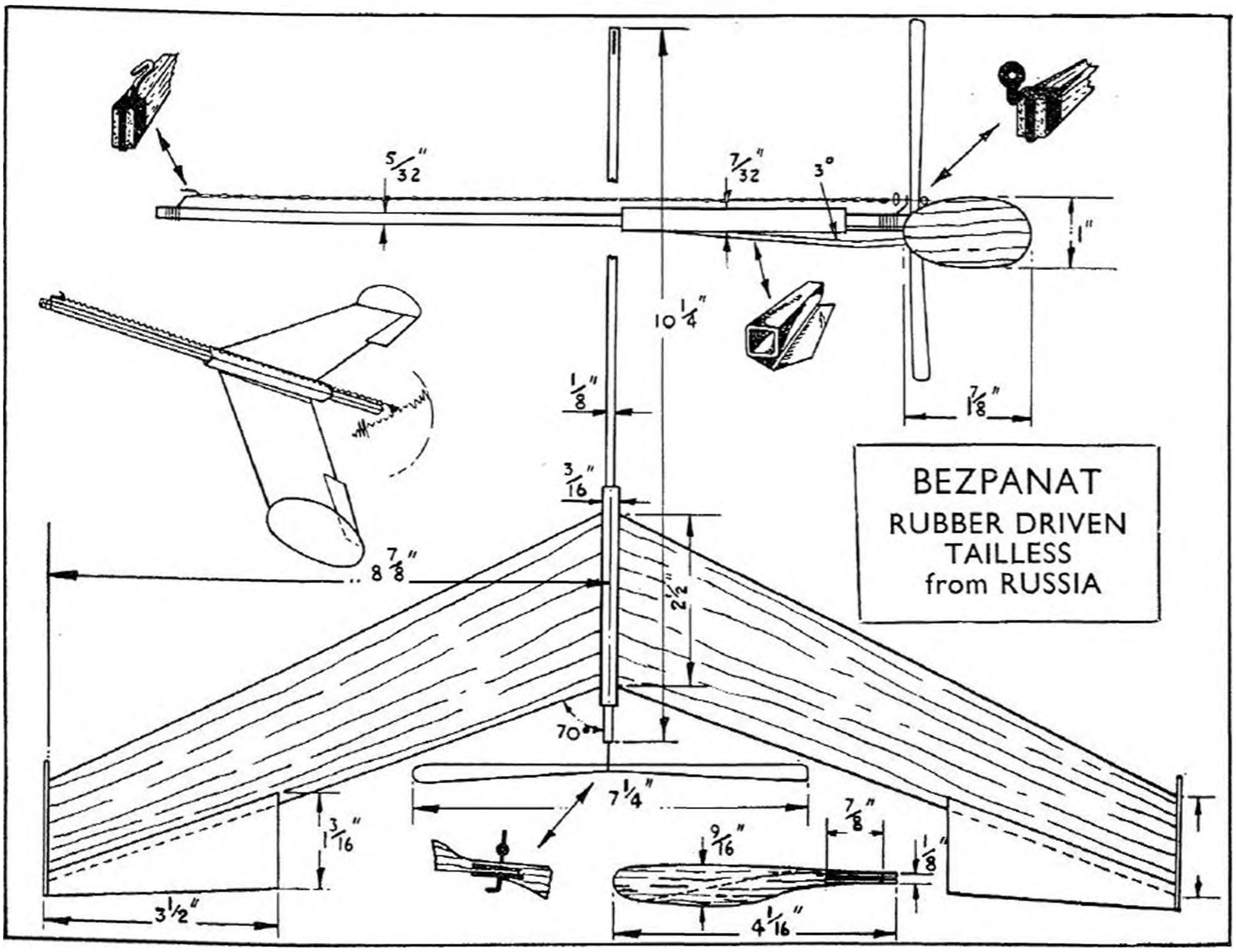
Fig. 17. Diagrammatic comparison of torsional stresses on normal and swept forward wings.

When sweeping angle is positive (sweepback) the wing tips generate more lift, due to boundary layer density increase. This means a higher stress (statically) on wing structure (C_l factor is stepped up) and the stall will occur earlier. To counteract this, wing must be washed out, which means, again a *lesser* overall lift generated from the total wing.

With negative swept (buzzard wings), however, the wing tips are relieved of static stress, as lift generation is higher at the centre section of wing (see Fig. 16 for lift diagram for semi-span). This produces the same effect as wash-out does on a normal type (straight) wing. Effects of buzzard wing layout on spiral dive (peel-off) and lateral stability (yawing) is quite favourable. Wing-wash-out can be eliminated through use of buzzard wing, and if lateral stability were sufficient, one could imagine, giving wash-in to both wing tips. This would bring about an optimum of overall lift generated.

4. A very unfavourable characteristic of the buzzard wing, which comes out under towing, is the wing deformation under stress. A straight wing will hold its incidence and general rigging under tow and stress overloads, while on a buzzard wing, an additional *torsional* stress is fully in evidence, which makes for an increase-change of incidence angles at the wing tips. (Provided the wing structure is normal, i.e., main spar at ⅓ of wing chord from l.e., and all other spar and rib dimensioning straightforward.) Owing to increased angles of incidence at both tips, list is yet further stepped up, which in turn increases stress loads, as a vicious circle, and eventually, such a wing "breaks its own neck" through the heavy torsion exercised on the wing spars at root. If the eventual result is not so very severe, at least the wing tips will stall, and plane may not only skid, but peel off into spiral dive. This can be fatal under towing.

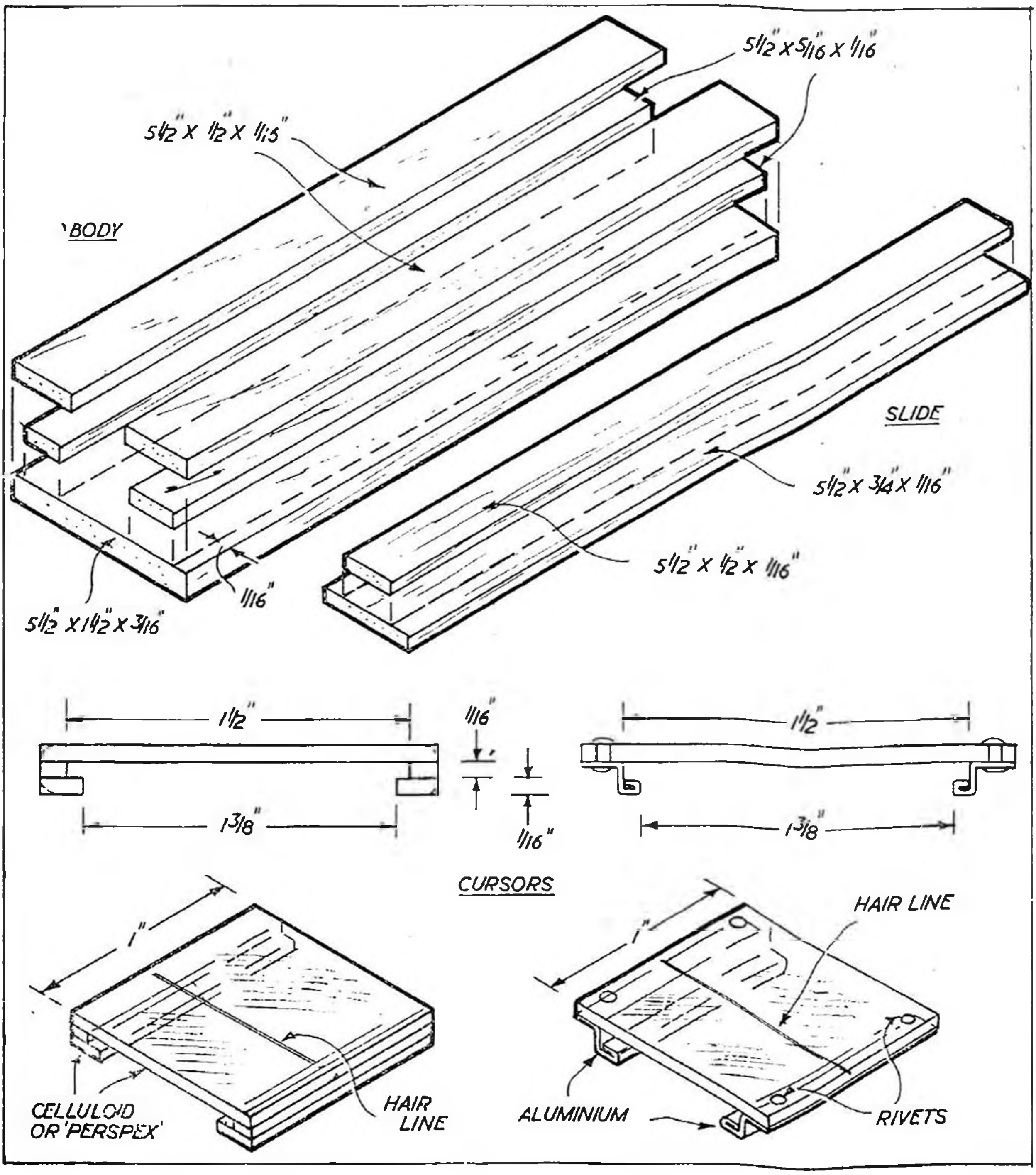
In view of advantages offered by buzzard wings for normal flying models, we hope that its popularity will increase in due course. Their disadvantages have also been set out fairly in the expectation that this will encourage experiments to overcome them and produce all-round successful results.

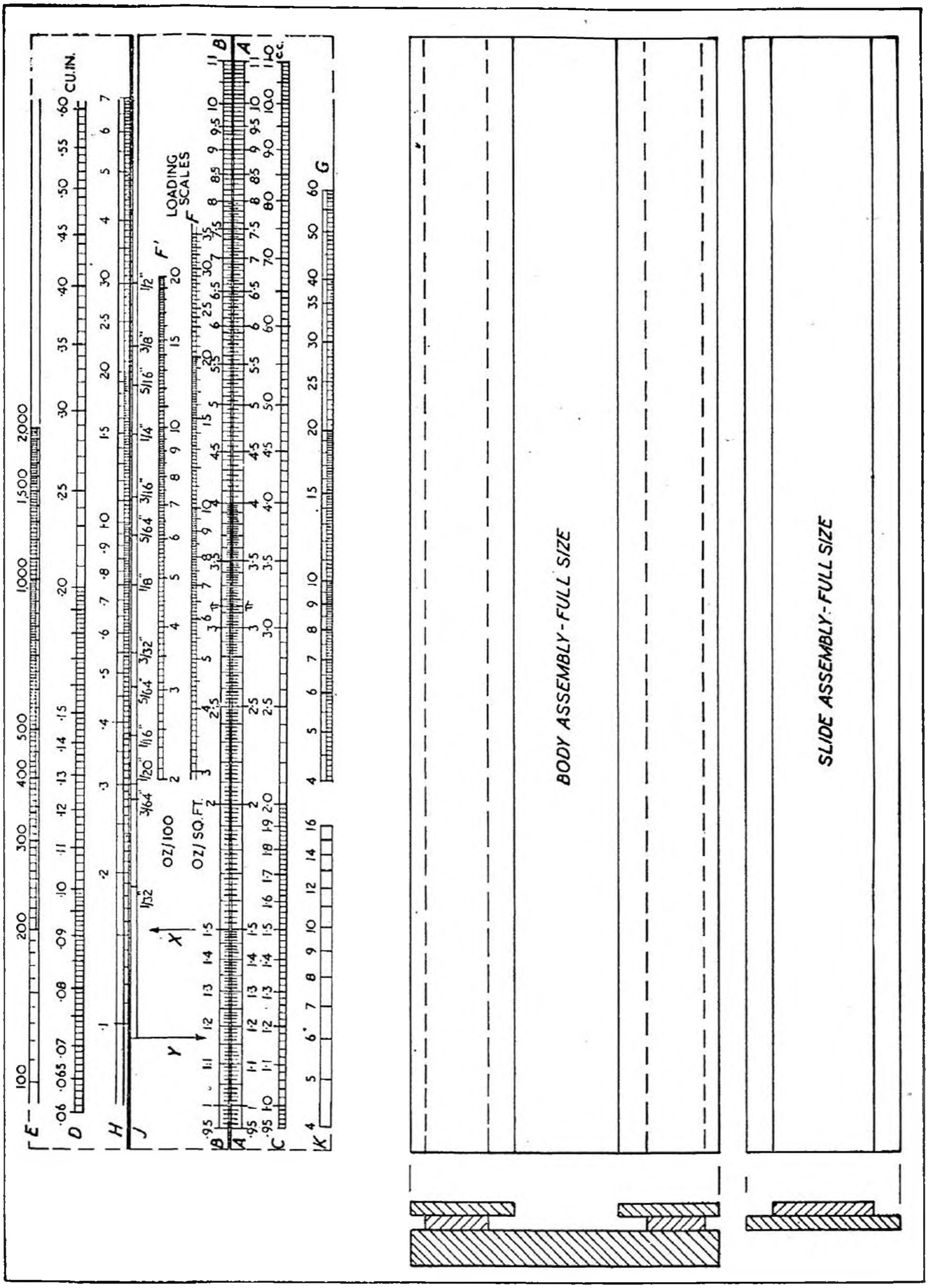


A SLIDE RULE ESPECIALLY DESIGNED FOR AEROMODELLERS

HOWEVER MUCH modellers may dislike it, there are some calculations which just have to be made in planning a new design, or checking over a model against a contest specification. The quick answer to all such work is a slide rule.

Now a slide rule is not an expensive instrument to be handled only by the mathematical experts. It is about the easiest possible tool for making calculations, is very simple to learn to use and as regards cost—well the "AEROMODELLER" slide rule is one to make yourself at a total cost of just a few pence! The "AEROMODELLER" rule, too, is a special one, designed specially for aeromodellers. In other words it incorporates useful direct-reading scales which you will not find on any other slide rule, giving immediate solutions to aero-





SPECIAL NOTE! **Do not attempt to trace off scales or to cut your copy of this Annual. Instead send stamped addressed envelope large enough to take drawing without folding together with postal order value 6d., direct to the publishers and we will send you a scale printed on best quality art paper ready to stick down on your slide rule.**

modelling problems. Whilst the drawn scales may not achieve the same accuracy as machine engraved scales as used on the expensive slide rules, the standard of accuracy is more than high enough for model work—probably more accurate than you can measure or build to.

The two most important features of this build-it-yourself rule are the scales and accurate cutting and assembly of the wooden parts. The scales and full size patterns for the body and slide parts are reproduced full size in the drawing. It will be virtually impossible to trace the scales accurately onto a sheet of plain paper since these are too intricate, so if you do not want to cut out the page from your Annual, send for a special print of this plan printed on art paper.

For the body and slide parts we recommend obeche or any similar straight grained hard wood. You can use hard balsa, if you prefer, and this will give just as good service if the rule is not knocked about. Start by cutting the five body pieces and the two slide pieces dead accurate to the dimensions given. When cut, lay over the full size patterns to check.

The body parts are carefully cemented together to build up the section shown, making sure that the narrower pieces are spaced $\frac{1}{16}$in. from the edges of the base and run dead parallel to these edges. The overlapping top pieces should have a gap of exactly $\frac{1}{2}$-inch between them, parallel throughout the length of the rule. Let this assembly set thoroughly before proceeding.

Before cementing the two slide pieces together, check that the larger part will slide smoothly through the channel in the centre of the body. Relieve by lightly sandpapering until this is so. With this part slid in place in the body, try the top part of the slide in a similar manner and rework as necessary for a snooth, sliding fit without wobble. Then remove the two pieces and cement together, aligning the edges parallel.

When set, slip the slide in place, lined up with the ends of the body. It will help if the edges are slightly waxed by rubbing with a candle. Now cut out the paper scales as one complete rectangle and check that these fit exactly over the assembled rule. Then paste down in place over the rule, using photo paste, a P.V.A. adhesive, rubber gum or tissue paste in preference to cement. Make sure that all of the paper is stuck down smoothly and uniformly.

When dry, cut very carefully along the "cut" lines between slide and base scale edges, using a sharp razor blade. This must be done without damaging the scales or the rule. Then you should be able to manipulate the slide freely with its attached scale now separated from the body scales.

The final stage in completing the rule consists of making the cursor. The main part is a piece of $\frac{1}{16}$in. clear celluloid (or you can use slightly thicker "Perspex") cut dead accurate to the required rectangular shape. Two alternative designs are shown in the constructional sketches, one employing cemented up construction and the other riveted on aluminium sheet guides.

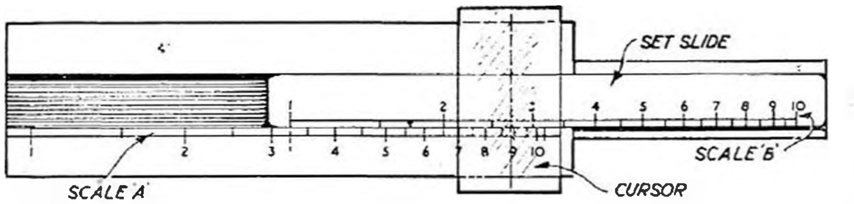
Before assembling the cursor, score on the hair line on the bottom surface of the celluloid in the mid position and dead square with the "running" edges. If the cursor hairline is out of truth the rule will not read accurately for many calculations.

Whichever method of making the cursor you employ, assemble for a fairly tight fit in the channels on either side of the base and then relieve, as necessary, to give a nice smooth sliding fit, but make sure that the cursor cannot rock diagonally.

The scales can be protected by coating with clear lacquer or paper varnish, although a rather better method is to cover them with transparent cellulose tape, trimming off neatly at all the edges. Instead of ordinary cellulose tape, get *acetate* tape, or one of the waterproof variety which is more proof against handling and ageing than common (cellulose hydrate) tape.

Use of the various scales of the rule is then as follows, the eleven scales on the rule being identified by letters. Readers familiar with the slide rule can omit reading the first two sections.

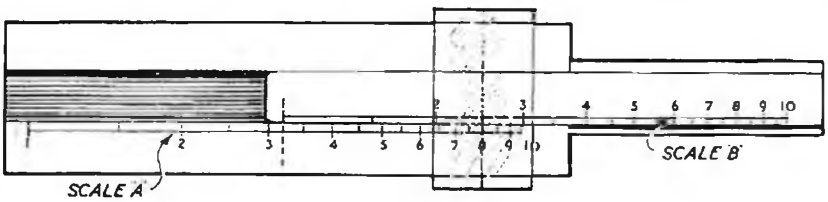
Multiplication—use scales A and B.



The principle of setting the rule is shown in the diagram. Suppose you have a wing chord ($3\frac{1}{4}$ inches) to multiply by a span (27 inches) to find the area of a rectangular wing. (The values chosen are purely arbitrary and it will be seen represent a rather awkward calculation for working out the long way. The slide rule will give a solution in a matter of a second or so.)

Find the first figure (3.25) on scale A and set the 1 of scale B against it. Now move along scale B until you come to the second figure (27)—actually you read this as 2.7 and automatically multiply the answer by 10—and read off the answer opposite this number on Scale A. Answer 88 sq. in. (approx.).

As a positive guide, the cursor can be slid along scale B to the second figure.



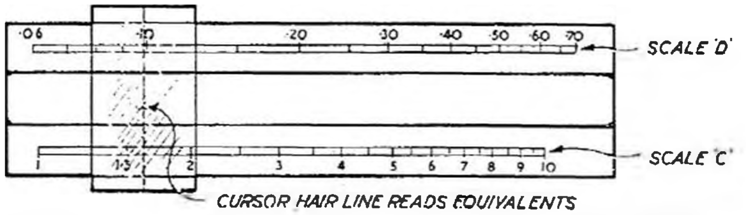
The cursor will have to be used if the multiplication involves more than two numbers—e.g., the area of an elliptic wing where the formula is π x semi-span x root chord/2. The "pi" position (3.14) is marked on both A and B scales so start by setting the 1 of scale B against π on scale A. Suppose the semi-span, is $21\frac{1}{2}$ inches and the root chord 7 inches. The complete sum is done in steps, first multiplying by 21.5—i.e., moving the cursor along the B scale to 21.5. For the next step, moving the 1 of scale B against the cursor setting brings the next figure (7/2 = 3.5) off the base scale, so the 10 of B must be set against the cursor line (which is equivalent to multiplying by 10). Read off against 3.5 on the B scale (or set this position with the cursor) for the answer = 236 sq. in.

A little practice will soon get you used to the method of multiplying. Use simple numbers for a start, like 2 x 3 x 4, etc., so that you can immediately check your answers. Once you have mastered the technique you will wonder why you have never used a slide rule before—it makes sums so simple!

Division—use scales A and B.

The principle involved is simply to set the *divisor* on the B scale against the number to be divided on the A scale and read off the answer on the A scale opposite either the 1 or 10 on the B scale—just as easy as that! It the example shown, 8 is being divided by $2\frac{1}{4}$, to give 3.2 as the answer.

Repeated divisions then carry on in a similar manner, or alternate multiplication and division can be done in a mixed sum by combining the two



basic methods just described. Squares and cubes of numbers are obtained by multiplication. Square roots can be extracted by setting the cursor against the figure on the A scale and adjusting the slide until the same value is read on the A scale against 1 or 10 on the B scale and on the B scale at the cursor hairline.

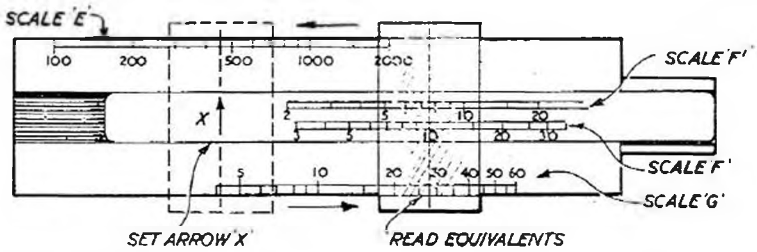
Special scales on the "Aeromodeller" *slide rule.*

Scales C and D give instant conversion of cubic centimetres into cubic inches, or vice versa. Simply set the cursor line against the known or given value on either C or D and read off its equivalent on the other scale.

In the example illustrated the c.c. equivalent of an American .099 cu. in. motor is required. The cursor line is set over .099 on the D scale and the answer read on the C scale—1.62 c.c. Similarly for converting c.c.s into cu. ins., this time starting with the C scale and reading off the answer on the D scale.

E, F and G scales.

These give solutions to problems involving wing area or total area, wing loading or total loading and model weight, one of the quantities being unknown. Two F scales are given, one graduated in ounces per 100 sq. in. loading and the other in ounces per sq. ft.



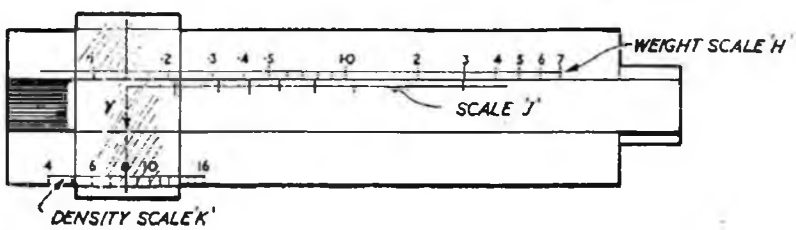
To use, set arrow X against the appropriate area, using the cursor to align the slide. Move the cursor along to the required loading on scale F and read off the appropriate weight on scale G. Alternatively, for a given weight, set the cursor against this weight and read off the loading on F. These scales can also be used for finding the wing area appropriate to a given weight and loading by aligning the F and G scales with the cursor and then moving the cursor along to arrow X and reading off area on scale E.

Scales H, J and K.

These scales give the actual weights of standard 36 x 3 inch balsa sheet appropriate to different grades or densities of balsa. The density range covered is from 4 to 16 lb. per cubic foot. 4-6 lb. ba sa is ultra-light; 6-8 lb. stock light; 8-10 lb. stock medium; 10-12 lb. stock medium-hard ("Hard" is the common term, as opposed to "heavy"); 12-14 lb. stock, hard; and 14-16 lb. stock extra-hard.

Balsa is normally specified according to these grades, so it is useful to be able to check what a particular thickness of sheet should weigh for a given grade. To do this, set arrow Y against the appropriate balsa density on scale K, using the cursor to align, and read off directly the weight of a standard sheet of that grade on scale H against the sheet thickness, on scale J.

Alternatively, to find the grade or density of a sheet, weigh it and set the slide so that the thickness on scale J is against the weight found on scale H. Align the cursor with arrow Y and read off the corresponding density on scale K.



LONGITUDINAL STABILITY

By D. Hirdes

Your Nordic A 2 is straight overhead and 164 ft. high. Apart from such things as timekeepers' eyesight or O.O.S. due to drift, your flight time will be governed by two things: (1) The minimum sinking speed of the model; and (2) whether the model can hold this minimum sinking speed for the greater part of the glide.

The Minimum Sinking Speed

For every model there is only one forward speed at which it will have the minimum rate of sink *see* Fig. 1. If the model flies at speed A, it will sink slowest. At speeds B and C, respectively slower and faster than A, it will sink faster.

Finding speed A for your particular model can be done as follows. Choose the calmest conditions you can find, a 50 ft. towline and no turn on the model, then at constant C.G. position make several flights for each of four tailplane settings. Take the mean value of the times obtained for each setting and plot as in Fig. 2. Draw a smooth curve through the points and read off which tailplane setting gives the best average time. Then firmly cement this packing in.

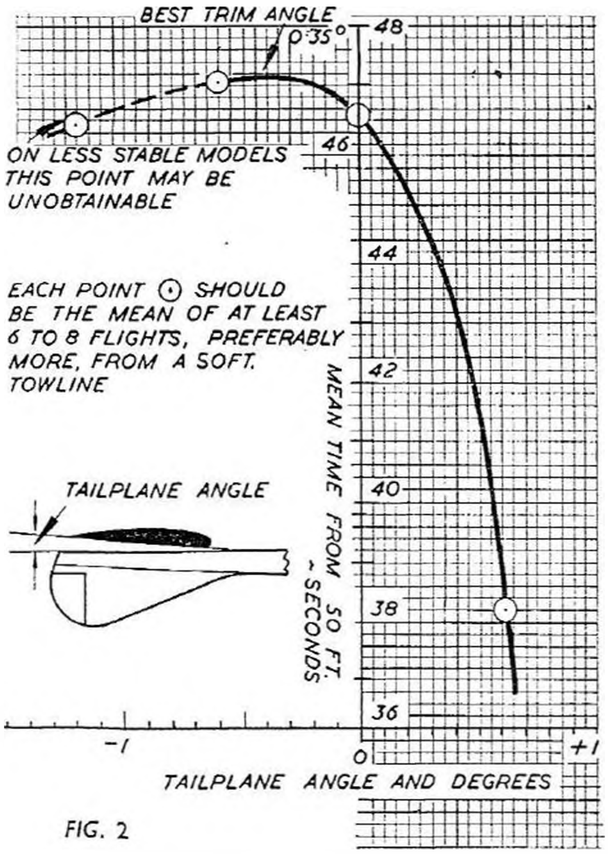


FIG. 2

Having thus found the trim for minimum sinking speed, we now have to ensure that the model will fly at this speed for as long as possible in the accepted contest weather. (High winds in general.) This brings us to the stability of which there are two kinds.

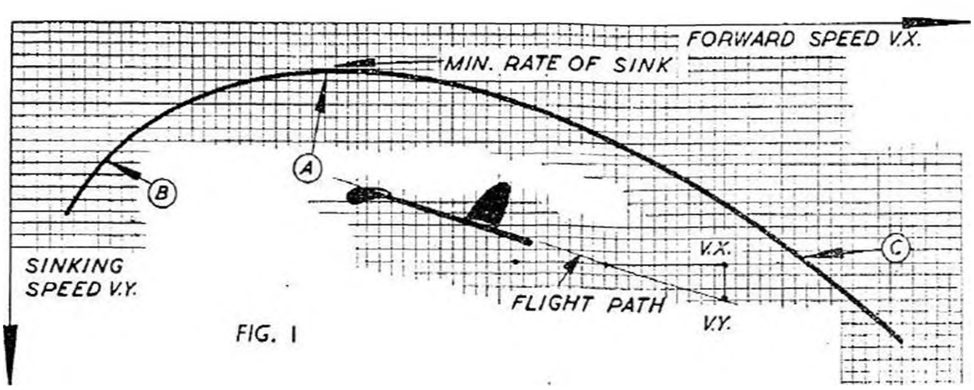


FIG. 1

Static Longitudinal Stability

You could call this the WILL IT or WON'T IT kind of stability, and it is the kind of stability we MUST have. If your model gets disturbed from its smooth flight path the tailplane must furnish a correcting force to bring it back on track again. This is in general ensured if we have sufficient tailplane area and moment arm. Or better use the now well-known Tail Volume Coefficient as given by:—

$$V_T = \frac{S_T \times l}{S_W \times c}$$

where S_T = Tailplane area, sq. in.
l = Tailplane moment area
(from 50% wingchord to 25% tailplane chord), in.
S_W = Wing area, sq. in.
c = Wing mean chord
$\frac{\text{(Wing area) in.}}{\text{Span}}$

Modern A2's have shown that values between 0.70 and 0.85 will give adequate stability and that higher values can actually lead to stability troubles as we will see later.

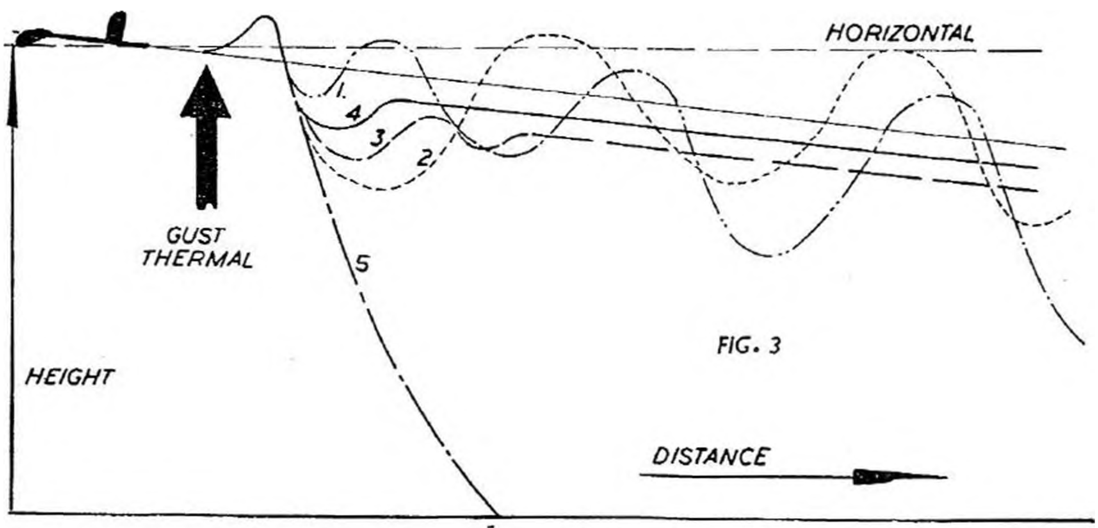
Lindner's 1954 World Championship winner had a value of 0.74 and won in appalling conditions of high wind and rain.

Dynamic Longitudinal Stability

Let's call this the HOW WILL IT kind of stability. Note that we take it that we have the WILL IT kind. Take a look at Fig. 3. Here you see the various motions a model can make after having been disturbed by a gust or thermal. I'm sure you will all recognise them.

Curve 1 shows the dynamically unstable model. We've seen it all at some time or other.

Curve 2 shows a model with neutral dynamic stability. The loops are all the same size and neither increase nor decrease.



1. DYNAMICALLY UNSTABLE MODEL.. MOVE CG AFT AND RETRIM.
2. NEUTRALLY STABLE MODEL. MOVE CG FORWARD AND RETRIM.
3. DYNAMICALLY STABLE MODEL.
4. DYNAMICALLY STABLE MODEL. APERIODIC CASE. TO BE AIMED AT.
5. APERIODIC CASE MOVE GC FORWARD AND RETRIM

IN GENERAL PUTTING TURN ON A MODEL WHICH IS DYNAMICALLY STABLE IN STRAIGHT FLIGHT WILL IMPROVE THE STABILITY EVEN MORE

Curve 3 shows the dynamically stable model. The loops get smaller and finally damp out after the model has lost some height.

Curves 4 and 5 show the so-called aperiodic stability. There is only one loop, but in 5 this is so large that it looks more like a dive and the ground gets in the way.

The curve as in 4 can be realised the writer had a Quickie, which would do exactly such a motion after being viciously stalled off the line. The advantage over 3 is that there is less height lost. A moment's thought will make it clear that during the time our model is waltzing up and down in the sky the forward speed is constantly varying, *see* Fig. 4.

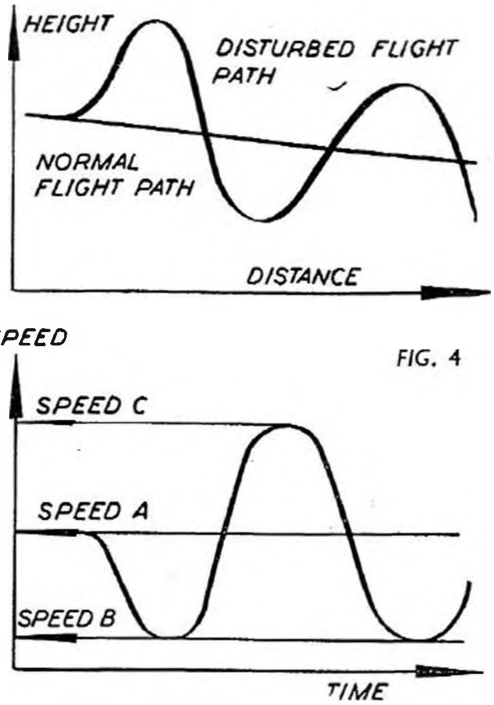


FIG. 4

On the way up it will fly slower, point B of Fig. 1, on the way down it will pass through the correct speed, point A of Fig. 1, and then go on to or beyond the speed of point C in Fig. 1.

All the time the model is flying faster or slower than speed A it has a higher sinking speed and our aim therefore should be to have the model return to speed A as soon as possible.

On existing models this can be done by finding from tests the correct C.G. position. On new designs it will also pay to keep the moment of inertia down. In simple terms this means make the tail of the model as light as possible.

The C.G. Position

Disturbances acting on the model can be divided as follows:

1. An horizontal gust, due to a sudden increase in windspeed.
2. A vertical gust, due to the model entering a thermal.
3. A combination of 1 and 2.

This latter is the kind more normally encountered on contest days. *See* Fig. 5.

Whatever form the disturbance takes, the effect on the model will be a change in lift on wing and tail. The horizontal gust causes this by the increase in windspeed, while the vertical gust increases the angle of attack.

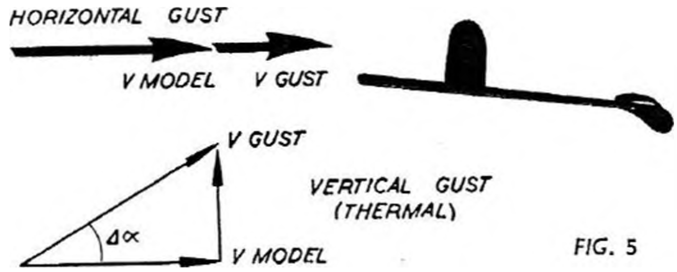


FIG. 5

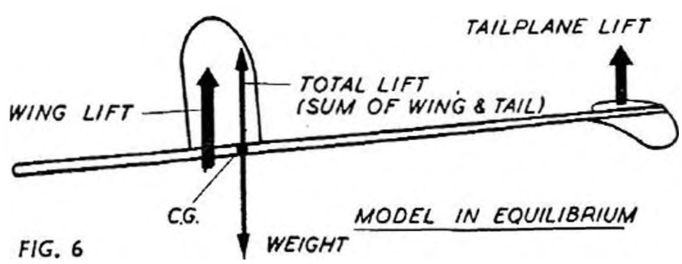


FIG. 6

Before the disturbance the model was in equilibrium and the total lift (sum of lift on wing and tail) acted in the C.G. *See* Fig. 6.

The increase in lift caused by the disturbance will not act in the C.G., but at a point called the Neutral Point (N.P.) *see* Fig. 7. This name

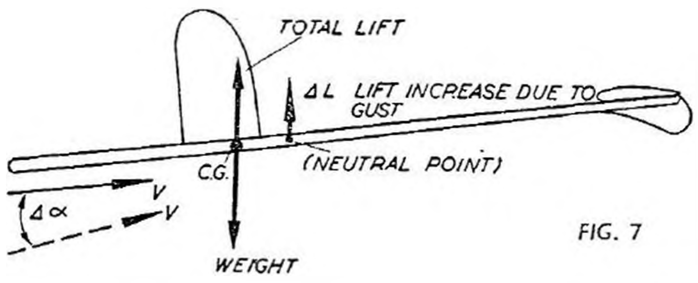


FIG. 7

comes from the fact that if you move the C.G. so far aft that it coincides with this point, the model becomes neutrally stable. No matter what you do to the tailplane setting, you just will not get the model to fly. It will dive, it will stall, but never glide properly as there is a total absence of any correcting force. This shows that it is not the longitudinal dihedral angle (difference between wing and tailplane setting), that determines whether a model will be stable or not.

The stability is governed by the Static Margin, that is the distance between the C.G. and the Neutral Point, a sort of C.G. moment arm. *See* Fig. 8.

The C.G. must be in front of the N.P. to obtain stable flight as only then will the lift increase caused by the gust furnish a turning moment to offset the stall.

Apart from the above, the amount of Static Margin you use also determines HOW your model will return to the correct spe d after a disturbance. To find the best C.G. position we do not have to know where the N.P. is. As a matter of fact the N.P. is not a fixed point on models due to scale effects, but wanders around over a small range.

The correct C.G. position is found as follows. In calm conditions, with no turn on the model, tow it up on a 50 ft. line and stall it off. If the stalls build up, motion 1 or 2 of Fig. 3, move the C.G. *aft* and retrim with the tailplane to get the model back to speed A. Do not move the C.G. more than 2 to 3% of the chord. After some tests it will be found that motion 3 or 4 can be obtained, although on some models it may be that you cannot achieve motion 4 and have to be satisfied with 3.

Now fly the model in more turbulent conditions to check whether at any time you get motion 5. If you do the C.G. is a bit too far aft.

Final task now is to put turn on and of course, compensate for this by more negative on the tailplane. The ideal is for the model to make one dip during the turn, after being stalled off the line, and then be back on its smooth flight path again.

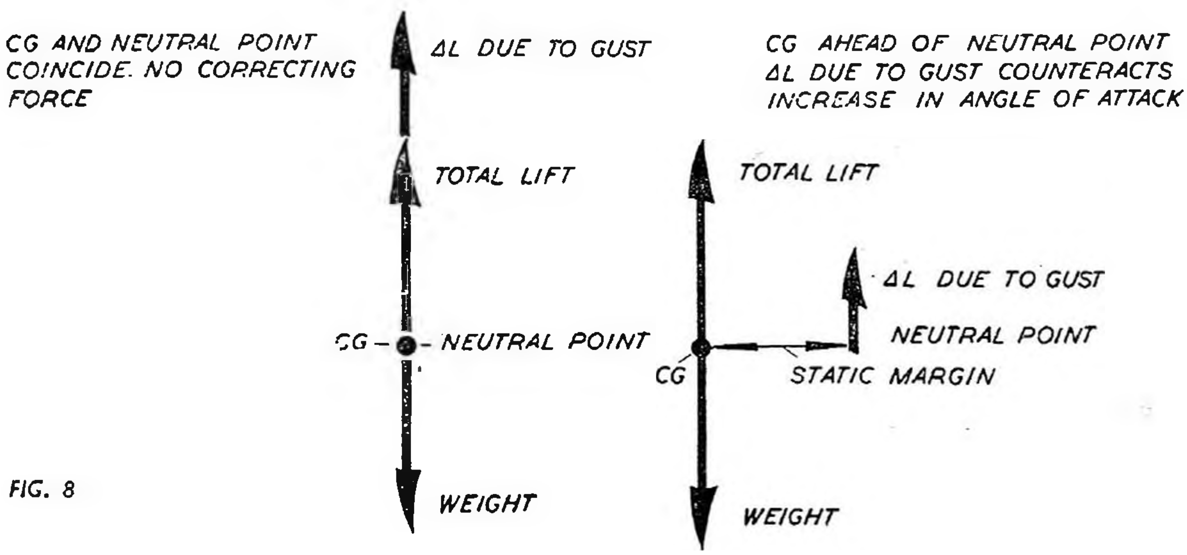


FIG. 8

The Moment of Inertia

On new designs the dynamic stability can be improved very substantially by keeping the moment of inertia as low as possible. It will pay handsomely to be quite fanatical about this.

Make the aft end of the fuselage as light as possible. Save all you can on tailplane and rudder fittings. Make the tailplane as light as possible, but make it warp free, as any warping will lead to endless trouble due to its effect on Neutral Point position.

In general, the moment of inertia is inversely proportional to the tailplane area and is less if we have a large tail on a short moment arm than when we have a small tail on a long moment arm, providing both arrangements give the same value for the Tail Volume Coefficient. This is also the reason why tail volume coefficients of more than about 0.85 can be detrimental to the stability, as due to the need for longer moment arms and/or larger tailplanes the moment of inertia is increased.

The effect of increasing the moment of inertia can easily be demonstrated to yourself by putting weight in the tail and nose of the model so that the C.G. remains as before.

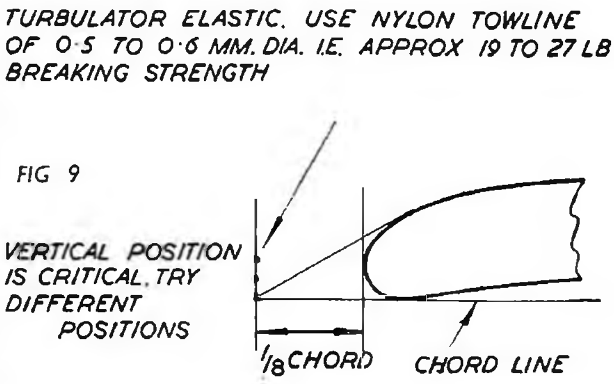


FIG 9

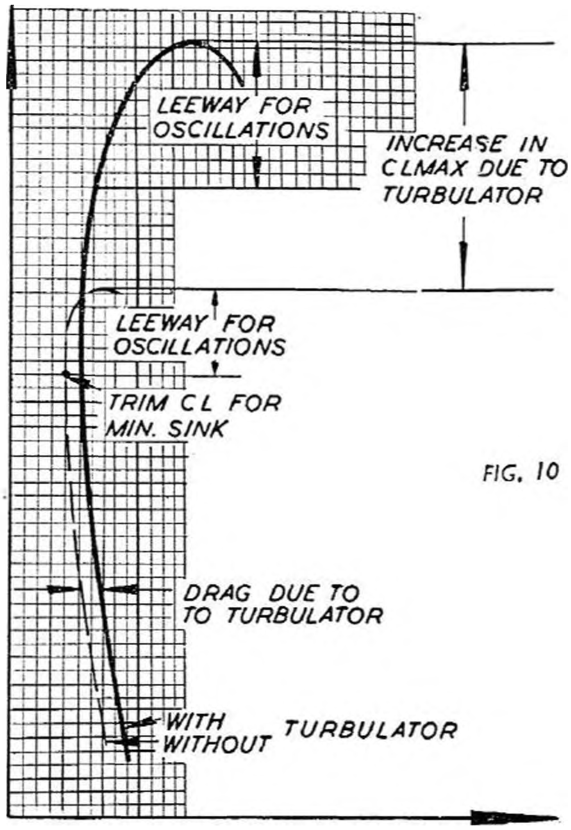


FIG. 10

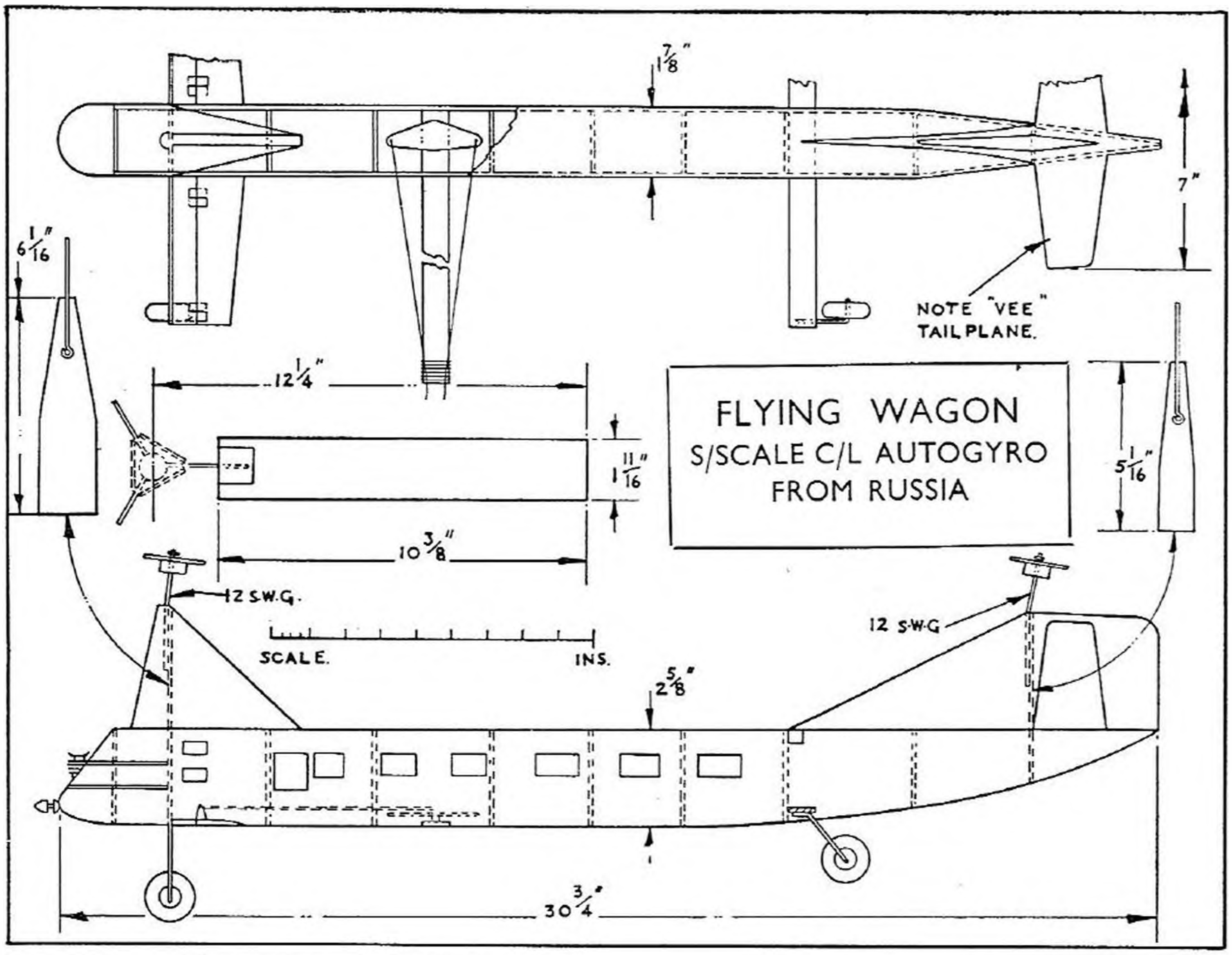
Effect of Turbulators

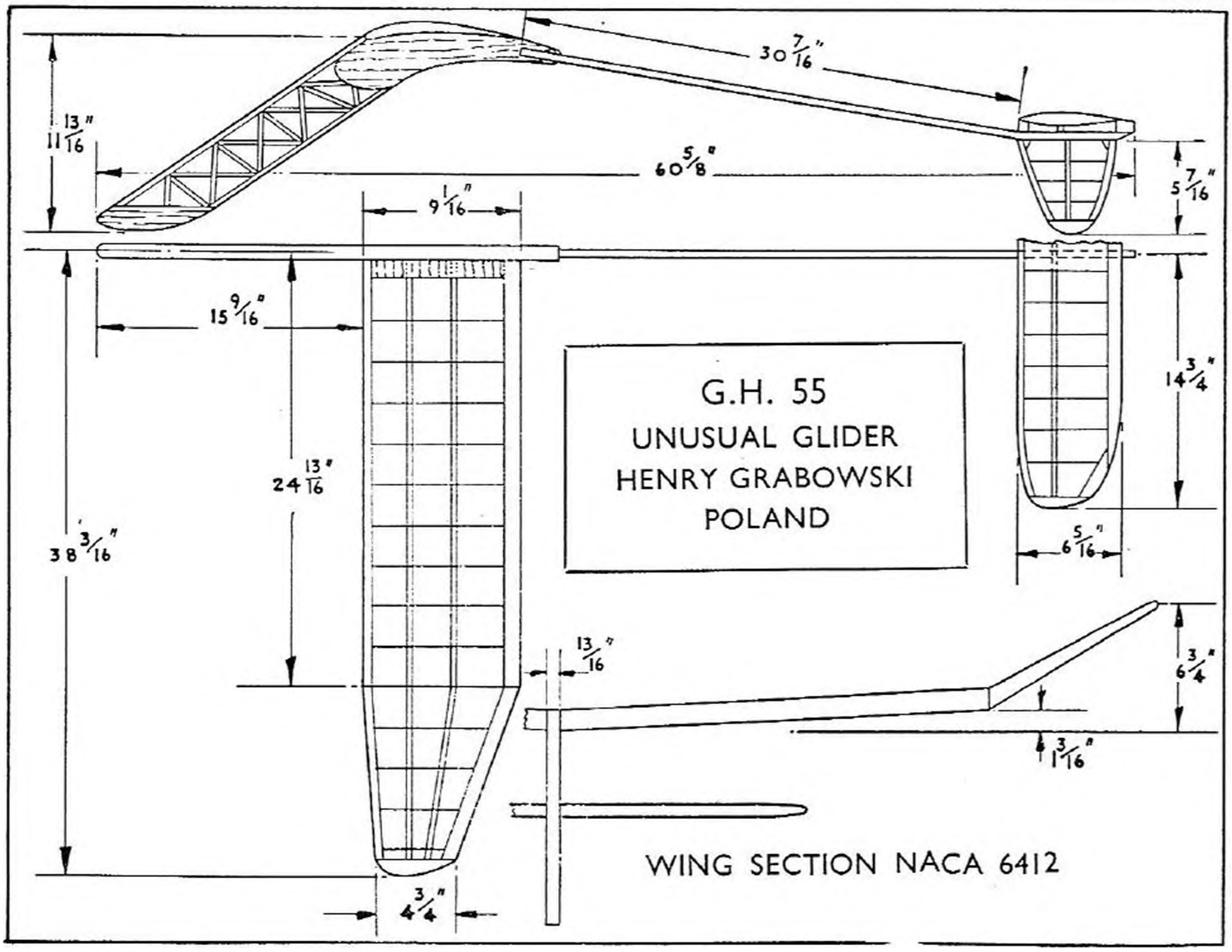
Turbulators have been tried by many modellers and in many forms. So far the best results are obtained by the turbulator elastic as used by Max Hacklinger.

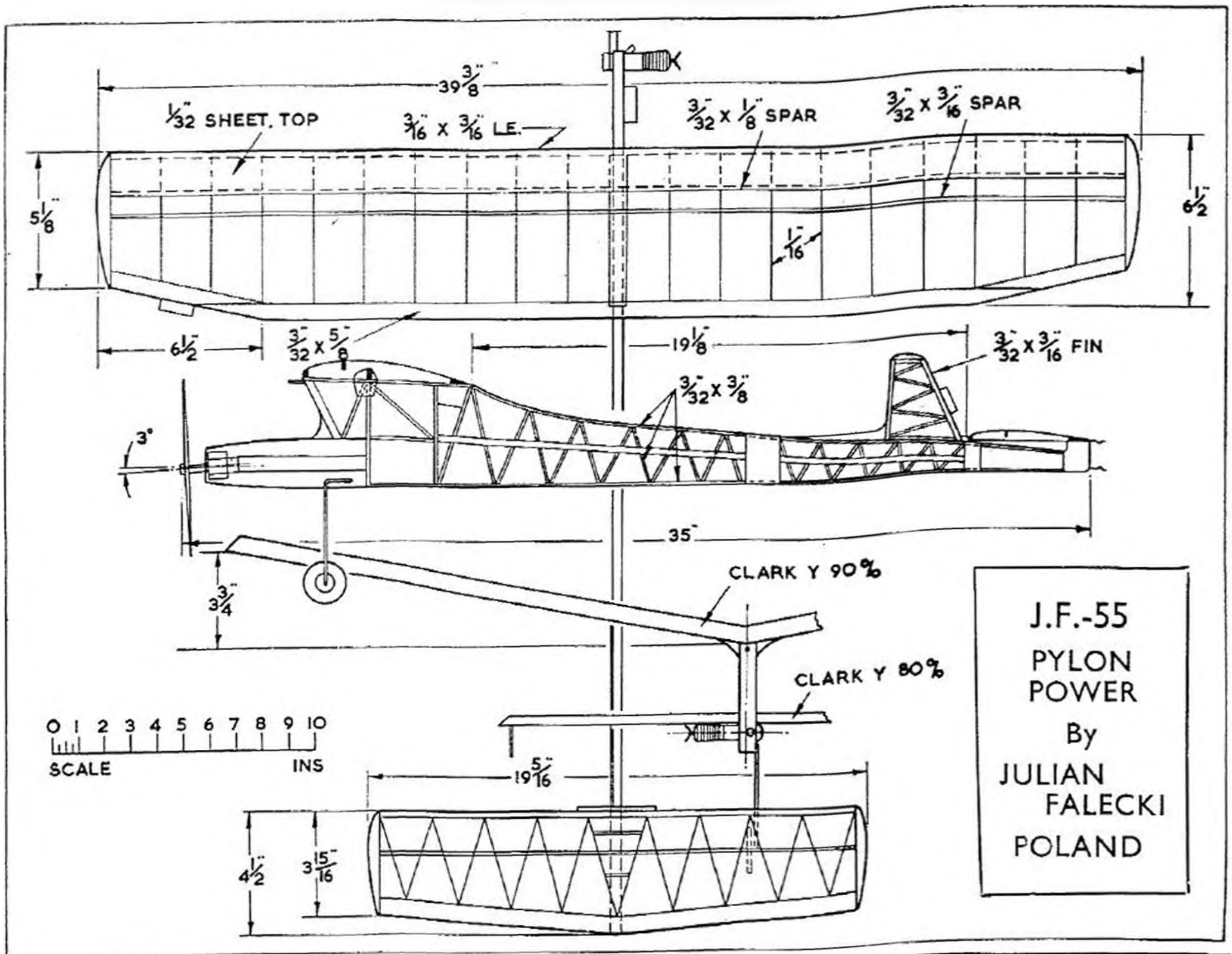
Nylon towline of 0.5 to 0.6 mm. diameter fixed about $\frac{1}{8}$ chord ahead of the aerofoil, seems to give the best effects. The diameter is fairly critical as is the position in the vertical plane *see* Fig. 9. Here again tests should be made at various heights before rejecting the idea.

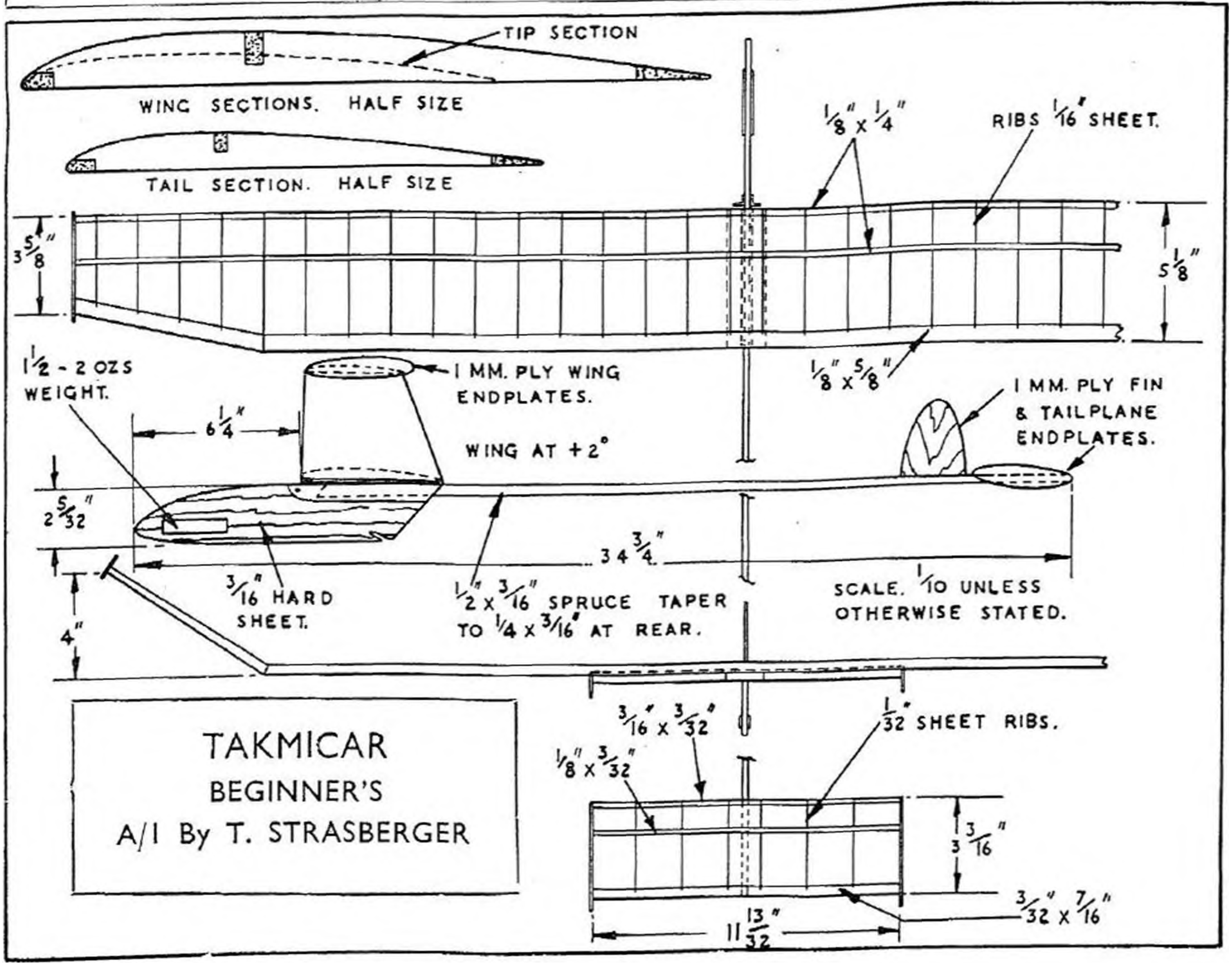
The effect of the turbulator is that it raises the C_L max. of the wing and reduces the scale effects. The increase in C_L max. will give a larger difference between the C_L the model flies at in steady flight and the stall, *see* Fig. 10, thus leaving more leeway for oscillations before the model stalls, while the reduction in scale effects also helps towards a smoother flight path.

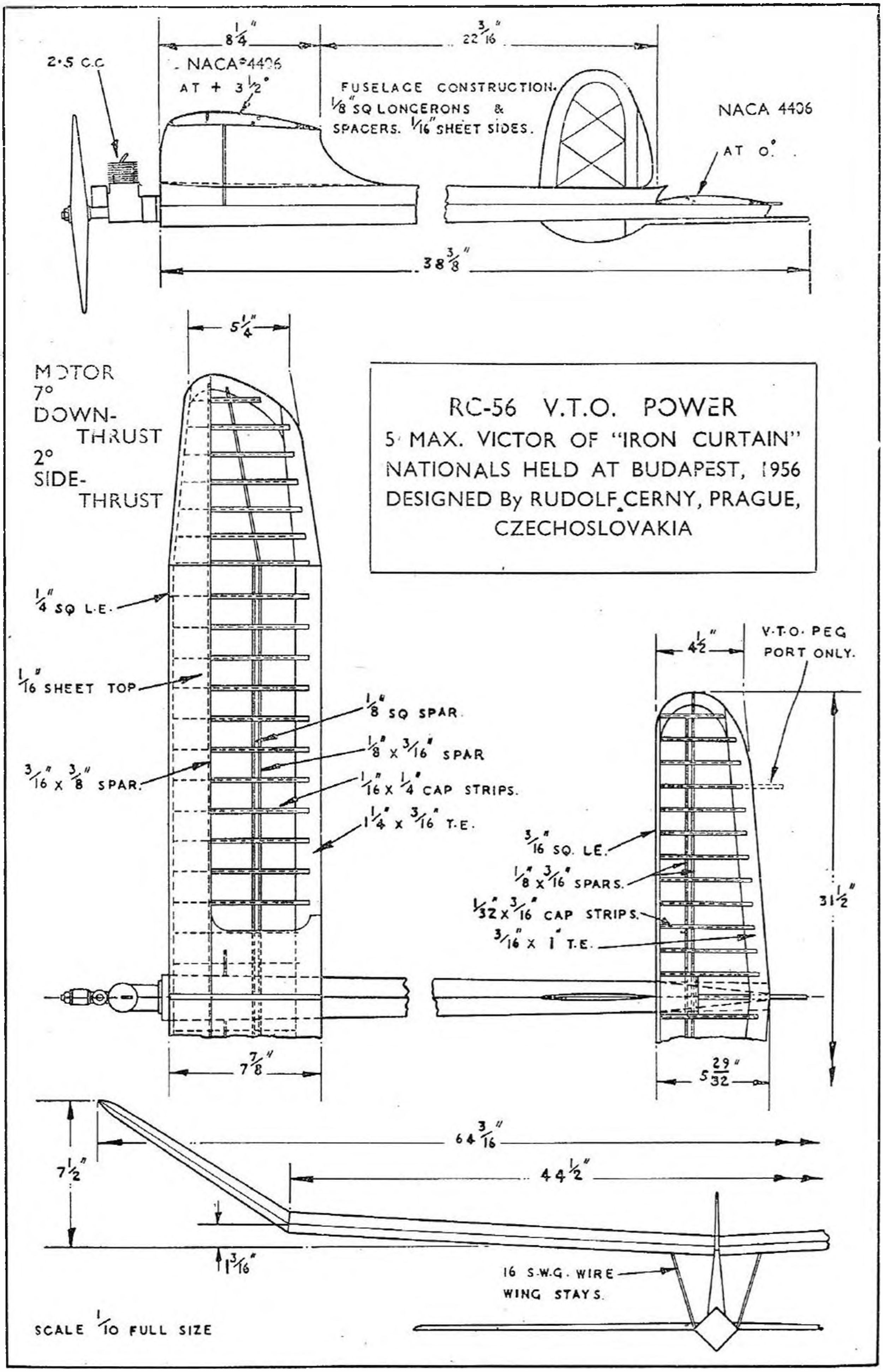
Although we have focused our attention primarily on A2's in this article, it holds, of course, equally well for Wakefields and Power jobs, who spend the major part of their flight time gliding.


1 7/8"
7"
6 1/16"
NOTE "VEE" TAILPLANE.
12 1/4"
1 11/16"
10 3/8"
FLYING WAGON
S/SCALE C/L AUTOGYRO
FROM RUSSIA
5 1/16"
12 S.W.G.
12 S.W.G.
SCALE.
INS.
2 5/8"
30 3/4"


30 7/16"
11 13/16"
60 5/8"
5 7/16"
9 1/16"
15 9/16"
14 3/4"
G.H. 55
UNUSUAL GLIDER
HENRY GRABOWSKI
POLAND
24 13/16"
38 3/16"
6 5/16"
13/16"
6 3/4"
1 3/16"
WING SECTION NACA 6412
4 3/4"


39 3/8"
1/32 SHEET. TOP
3/16" x 3/16" L.E.
3/32" x 1/8" SPAR
3/32" x 3/16" SPAR
5 1/8"
6 1/2"
1/16"
6 1/2"
3/32" x 5/8"
19 1/8"
3/32" x 3/16" FIN
3/32" x 3/8"
3°
35"
3 3/4"
CLARK Y 90%
CLARK Y 80%
0 1 2 3 4 5 6 7 8 9 10
SCALE
INS
19 5/16"
4 1/2"
3 15/16"
J.F.-55
PYLON
POWER
By
JULIAN
FALECKI
POLAND


TIP SECTION
WING SECTIONS. HALF SIZE
TAIL SECTION. HALF SIZE
1/8" x 1/4"
RIBS 1/16" SHEET.
3 5/8"
5 1/8"
1/8" x 5/8"
1 1/2 - 2 OZS WEIGHT.
1 MM. PLY WING ENDPLATES.
6 1/4"
WING AT +2°
1 MM. PLY FIN & TAILPLANE ENDPLATES.
2 5/32"
34 3/4"
3/16" HARD SHEET.
1/2" x 3/16" SPRUCE TAPER TO 1/4 x 3/16" AT REAR.
SCALE. 1/10 UNLESS OTHERWISE STATED.
4"
TAKMICAR
BEGINNER'S
A/1 By T. STRASBERGER
3/16" x 3/32"
1/8" x 3/32"
1/32" SHEET RIBS.
3 3/16"
3/32" x 7/16"
11 13/32"



RC-56 V.T.O. POWER
5 MAX. VICTOR OF "IRON CURTAIN" NATIONALS HELD AT BUDAPEST, 1956
DESIGNED By RUDOLF CERNY, PRAGUE, CZECHOSLOVAKIA
2·5 C.C
NACA 4406 AT + 3½°
FUSELAGE CONSTRUCTION. 1/8" SQ LONGERONS & SPACERS. 1/16" SHEET SIDES.
NACA 4406 AT 0°
8¼"
22 3/16"
38 3/8"
5¼"
MOTOR 7° DOWN-THRUST 2° SIDE-THRUST
1/4" SQ L.E.
1/16" SHEET TOP
1/8" SQ SPAR
1/8" x 3/16" SPAR
3/16" x 3/8" SPAR
1/16" x 1/4" CAP STRIPS
1¼" x 3/16" T.E.
7 7/8"
4½"
V.T.O. PEG PORT ONLY.
3/16" SQ. L.E.
1/8" x 3/16" SPARS.
1/32" x 3/16" CAP STRIPS.
3/16" x 1" T.E.
31½"
5 29/32"
64 3/16"
44½"
7½"
1 3/16"
16 S.W.G. WIRE WING STAYS.
SCALE 1/10 FULL SIZE

MOTOR SERVOS, ESCAPEMENTS & ACTUATORS

It is an unfortunate fact that despite its compactness, apparent simplicity and light weight, the electro-magnetic type of actuator escapement has a number of limitations. The average run of escapements of this type are far from foolproof, leading to unreliability—sticking, skipping, susceptibility to motor alignment, torque and tension, etc. In fact, it is probably true to say that an absolutely reliable and foolproof escapement of this type demands a watch-making standard of skill and precision in manufacture, coupled with really sound electro-mechanical design, with correspondingly high production costs.

Apart from the difference in weight—and even this need not be very real, since the smallest commercial model motors available weight only ¾ ounce—the electric motor is an attractive alternative since, in theory at least, it can be made self-switching. Current consumption need be no higher and will usually be less than that of an electro-magnetic escapement, whilst it should not be susceptible to the inherent faults of the latter. The motor-servo does, however, have its own inherent problems, namely: the necessity of self-starting every time, the fact that it must operate through a high reduction gearing, and the susceptibility of any switching contacts to intermittent or complete failure at any time. Generally, too, the more one tries to make the servo motor do, the greater the number of contacts required and the greater the complexity of the attendant circuitry. Also certain types of motor circuits can, and do, cause interference with the radio side or can promote rapid corrosion and wear of relay contacts.

The question of reliable self-starting is a matter of motor design and construction. Currently there are on the British market some half dozen different types of small electric motors modestly priced, any one of which could be adapted for motor-servo use. All are of the permanent magnet type with three-pole armatures, which is not an ideal arrangement for self-starting, but except for the odd specimens, all will self-start consistently under light load and run satisfactorily on 3 volts supply.

Individual motors can be checked quite simply. The method of taking a motor and tapping the battery leads on and off a number of times is not satisfactory for, unconnected to any mechanical system, the armature will tend to stop each time in one or other "favoured" positions. The best method is to assume that the motor may stop in *any* armature position due to the friction braking of the drive system to which it will be connected. Its self-starting characteristics can then be investigated by fitting a graduated disc to the shaft as in Fig. 1, marked off in, say, 20 degree intervals. Try for self-starting in each position in turn, braking the disc lightly with the finger to stop it at each position and *keeping* this light finger braking applied as a starting load.

Any motor which does not self-start readily at any one position could fail as a servo motor. In some cases it is possible to overcome this trouble, if found, by increasing brush pressure or, in the case of carbon brush motors, by first letting the motor run in for a fair period to bed the brushes down. Another source of trouble is lubricant applied to the shaft getting onto the

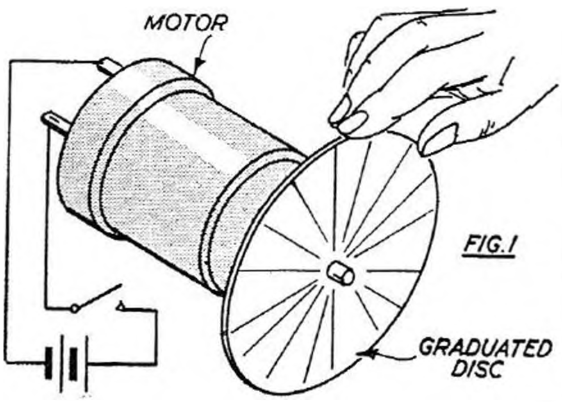


FIG. 1

commutator and producing a high resistance contact, which can be avoided by using a special *contact oil* for all lubrication. This is especially helpful in the case of motors with metal brushes, since a contact oil actually *reduces* contact resistance with metal-to-metal contacts. It is not so useful with carbon brush motors, as any fluid on the commutator can form a "paste" with carbon dust to fill the slots between the commutator segments and so short the segments. As far as practicable, therefore, carbon brush motors are best run as dry as possible, whereas metal brush motors generally benefit from light lubrication with contact oils or contact lubricants.

A reduction gear drive is a necessity, both to reduce the speed of the driven or operating spindle to a practical figure whilst allowing the motor to operate at a high r.p.m., and to increase the available torque. As the motor characteristic curves reproduced at the end of this article show, current consumption rises rapidly with decreasing motor speed, hence the higher the operating speed the better, as far as the batteries are concerned. Lower currents also mean longer brush life and greater brush reliability with metal brush motors.

With straight drives, torque figures are very low at high speeds. Mechanical losses through gearing will vary considerably according to individual units, but taking 70 per cent. efficiency as an average for good gearing (lower with worm gearing), available torque on the driven spindle equals "straight" torque appropriate to that motor speed *times* reduction gear ratio *times*. 7. Thus a direct pull of several ounces is possible, if required, from a motor with a "straight" stall torque of a fraction of an inch-ounce.

Normally the torque required to operate standard control surfaces is quite low. The torque of a typical ($\frac{3}{16}$ x 24) rubber motor used with escapement type actuators is plotted in Fig. 2 from an actual test. (Values for other rubber sections can be calculated on the basis that torque $\propto$ (cross section)$^{1.5}$. This provides adequate power to turn a rudder through a crank motion with only a single row of knots. In general, however, with motor servos, the linkage t›

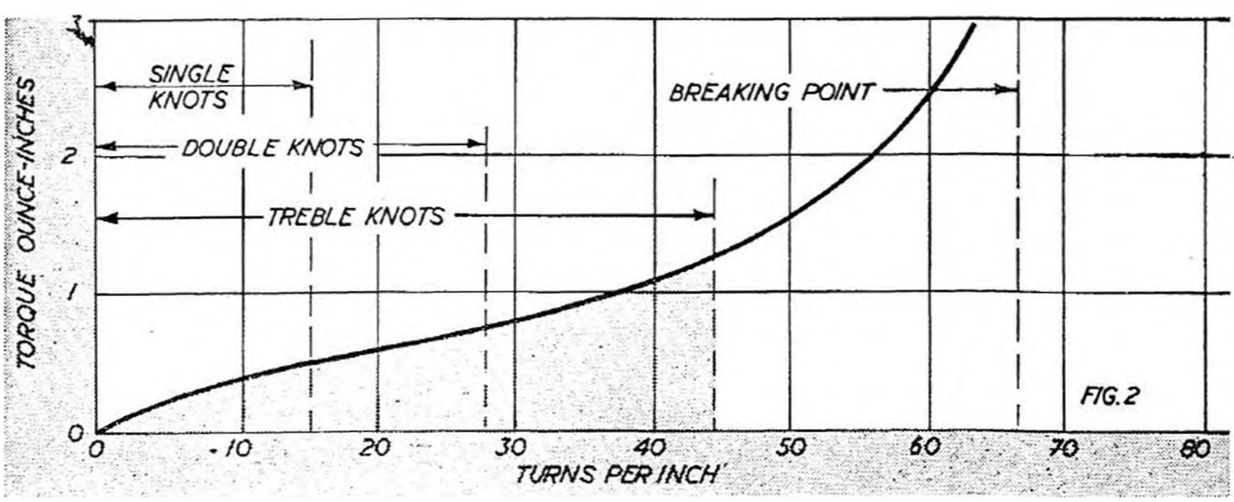
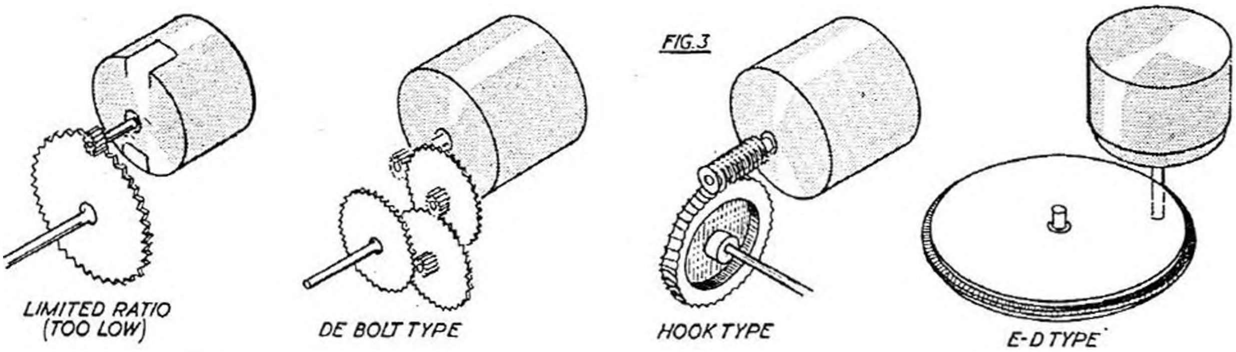


FIG. 2

FIG.3



the control surface requires far more torque to move than that required to operate the control surface itself on standard escapement type units. This is not a disadvantage for the hook-up is usually far more positive and there is still an extremely high safety factor of excess torque available (which there is not with a rubber drive). It will also be found in practice that the elimination of slackness coupled with more positive drive can mean that rudder area and/or movement may have to be appreciably reduced on changing over from escapement type to servo motor actuators for equal control response, otherwise the model would be over-controlled.

Four alternative methods of gearing are sketched in Fig. 3, all of which have been utilised in practice. The order of reduction required is roughly 40:1, with an approach to the higher figure preferred. Thus the single spur and pinion arrangement is not really satisfactory since it is limited to a relatively low ratio. Compound type gearing (e.g., as used on the American de Bolt "Multi-Servos") is good but requires precision gearing and accurate mounting to avoid "tight" and "slack" spots, etc. Worm reduction provides an effective solution where suitable miniature worm and pinion gears are available of "precision" standard, working at reduction ratios of up to 80 : 1 although gear losses will be higher, (i.e., overall efficiency practically less than 30%). It has the disadvantage of applying an axial load to the motor shaft and thus possibly affecting brush contact pressure on some motor designs. The fourth alternative—the apparently crude friction drive—works quite well in practice and is used in the E-D power driven actuator. With a friction wheel diameter of $2\frac{1}{16}$ in. and a shaft diameter of only $\frac{1}{16}$ in., the reduction is of the order of 33 : 1, neglecting slip. The main objection to this scheme is that it puts a heavy radial loading on the motor bearings which could, in some cases, cause excessive wear or even the bearing bushes to loosen up. Other systems could possibly be used satisfac-

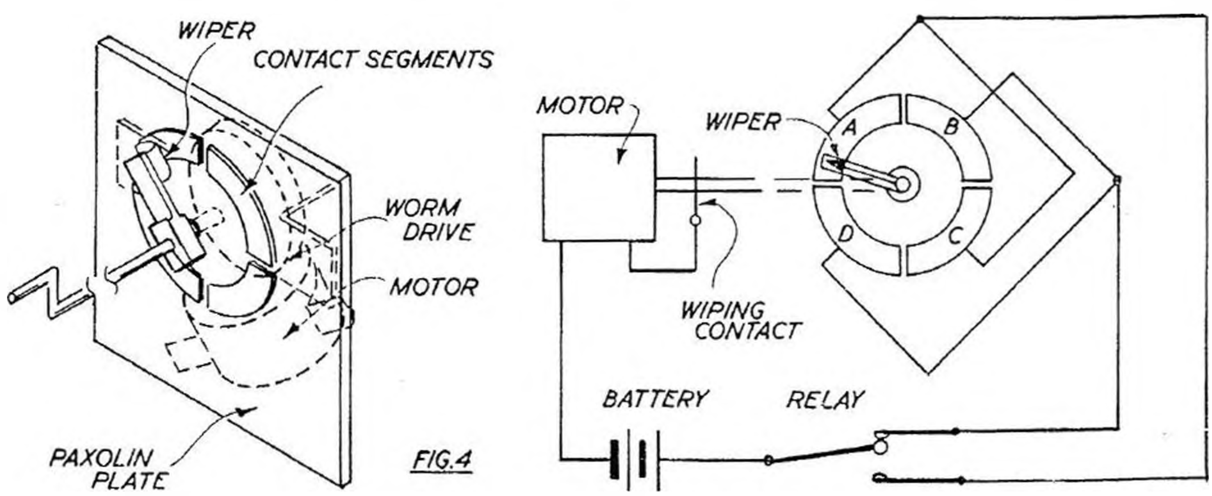
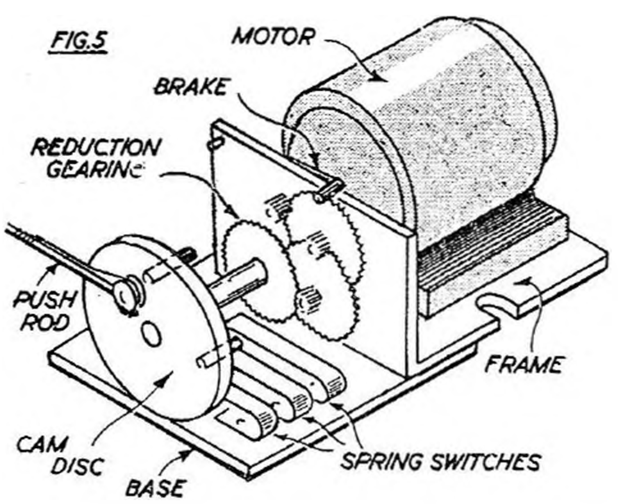


FIG.4



torily, even a simple pulley drive, although this is getting away from one of the basic advantages of motor servos of positive power drive. More intricate gearing schemes bring us back to the "watchmaking" class of precision work again.

The method of linking the final drive of the motor to the control required depends very largely on the method of motor switching or control used. A simple and direct solution for use with single-channel receivers is detailed in Fig. 4. This scheme was first used in this country (E. J. and A. Hook) some seven years ago and proved consistent and reliable with an "Electrotor" as the motor unit.

The drive shaft (through worm reduction gearing) carries a wiper arm traversing four segments A, B, C and D insulated from each other by a small gap. With the relay contact in the "signal off" position, and supposing initially that the wiper arm is contacting either segment A or C, the motor circuit is closed and so the motor drives round until the wiper comes to the end of the "live" segment. The motor will over-run slightly, carrying the wiper on to the start of the next adjacent segment, which is disconnected and so the motor stops.

When the relay changes over to the "signal on" position the adjacent segment is now "live", and so the motor will rotate through exactly one-quarter of a turn, over-running at the end as before by the same amount. A relay change to "signal off" will initiate a further quarter turn rotation. Thus the servo is self-neutralising (in that it will automatically rotate through a quarter turn on release of the relay from a control position).

The effect of a relay chattering is not as catastrophic as with a rubber-driven escapement since an occasional relay "skip" would have the effect of "inching" on part control movement, which would probably be automatically countered by the operator as soon as the model deviated from the expected path. An occasional rapid skip would *not* alter the control sequence, which is a great advantage from the pilot's point of view. If the skipping was bad enough to upset the sequence, *i.e.*, "inching" through more than a quarter of a turn when supposedly held in neutral, then the radio link itself is behaving too unreliably for any satisfactory control.

This system involves two wiping contacts which could become a source of trouble. However, since both are metal-to-metal contacts, lubrication with *contact oil* coupled with inspection and cleaning at regular intervals should be a satisfactory safeguard. No spark quench is strictly necessary across the motor although a .1 mfd. condenser might be connected as a precaution against excessive radio interference.

The de Bolt type servo motor (Fig. 5) operates on somewhat similar principles, but with cam-operated switches, cam action being provided by pins mounted on the cam disc attached to the final drive shaft. Leaf type contacts are employed and, with high shaft torque available, contact pressure can be quite high. Also, being clear of any shaft points requiring lubrication, contact performance should remain satisfactory.

Control response is again simple sequence with self-centring action, the cams being timed for quarter turn rotation per step. Response should be clear from the circuit diagram given in Fig. 6. Normally this type of actuator is utilised with push-rod linkage to the control surface, as drawn, thus requiring that the servo motor be mounted at right angles to the fuselage axis. It could, of course, equally well operate a cranked drive straight off the final drive shaft (and the system of Fig. 4 equally well adapted for push-rod control action by mounting at right angles to the line of action of the push-rod).

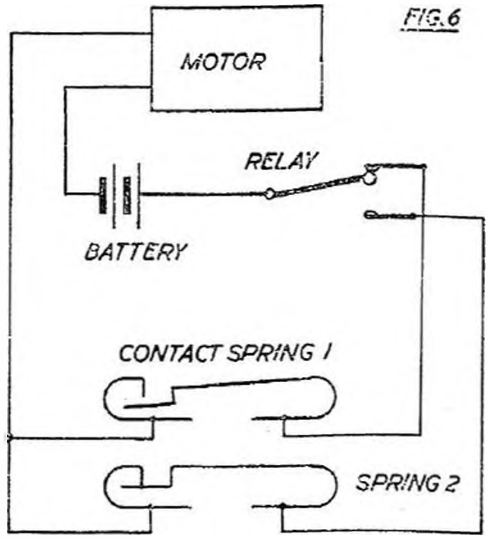


FIG. 6

A characteristic of both these types of servo units is that the exact quarter turn "stop" positions are dependent on the self-stopping of the motor and gear system. In other words, there is a small but definite over-run or "free-wheeling" of the system past the automatic "switch off" position. The higher the reduction gear ratio of the better to reduce the over-run. The Hook system has shown a practical consistency at least as good as that achieved with e capement type linkages, but in the de Bolt units a definite brake is used to assist in stopping and so minimise over-run. Provided the braking action is not excessive or mechanically fallible to the point where self-starting could be interfered with, brake stopping would appear a desirable feature. If the receiver relay incorporated double-pole change over contacts, electro-dynamic braking could be coupled to the motor circuit.

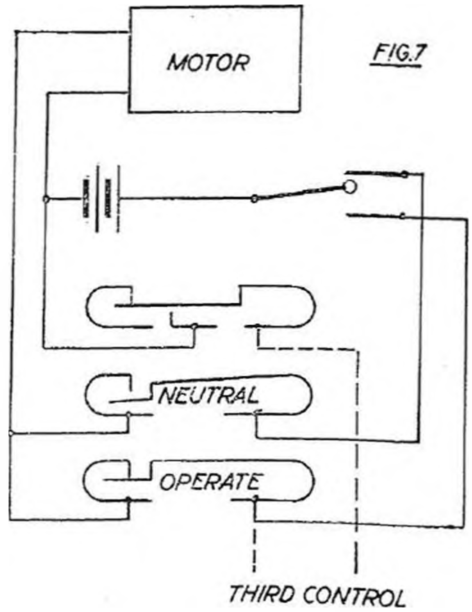


FIG. 7

Further versions of the de Bolt "Multi-Servos" have additional contact switches to provide multi-control systems through a single channel receiver (*i.e.*, with the receiver relay operated as a simple "on-off" switch) and can also be used in combination with each other. Similar principles, in fact, apply to all basic motor-servos of this type. A wide variety of alternative control operating schemes with sequence or "pulse selected" positions can be produced by suitable design of the switching arrangement. Circuit diagrams of two typical de Bolt servos

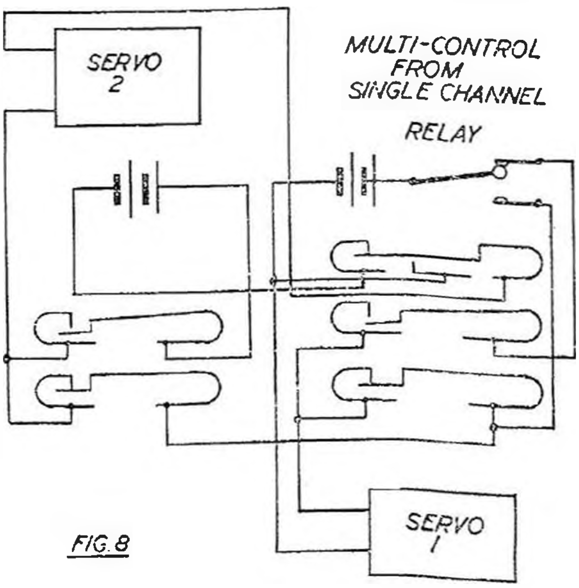


FIG. 8

are given in Fig. 7 and Fig. 8 as illustrative of this point.

Additionally, of course, it is also possible to produce a non-neutralising unit by arranging the switching (one control contact only required) to give 180 degrees rotation on each relay change over—*see* Fig. 9. This is a strictly "positional" control, particularly suitable for engine controls with multi-channel receivers since it holds any position to which it is set until the next change is signalled—either "tripping" to its next set position (a quick push on a control button), or traversing to its control position and stopping there under continuous signal (*e.g.*, control switch operated to a set position and left there), depending on the arrangement of the motor control switch.

It should be mentioned that all motor servo systems of this type act on the principle of switching themselves off in the required "control" or neutral positions and thus consume current only when actually moving the control surface or control mechanism from one position to another. Also any attempt to give alternative settings of any particular control must essentially involve stopping the control at definite "steps" or positions, whether this be arrived at through sequence signals or pulsing to correspond to the timing of the cam switches.

Attempts to use motor servos for truly proportional controls, *i.e.*, where the controls can be stopped in or trimmed to any particular position, tend to

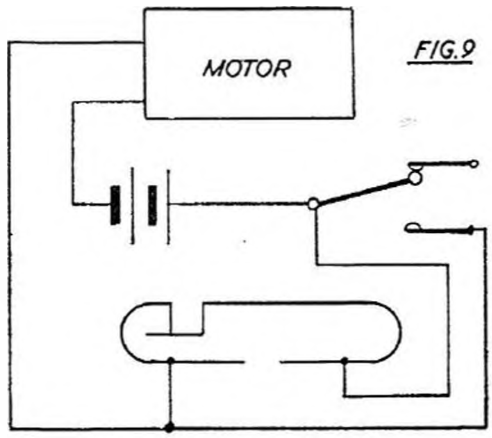


FIG. 9

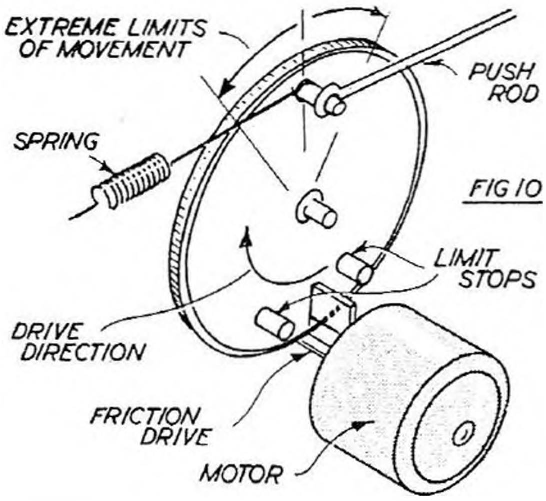


FIG 10

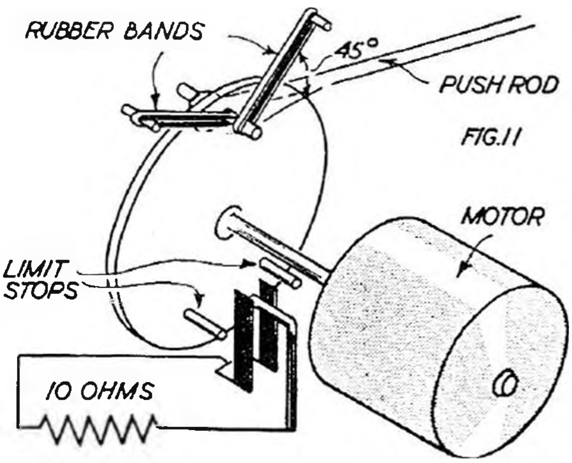
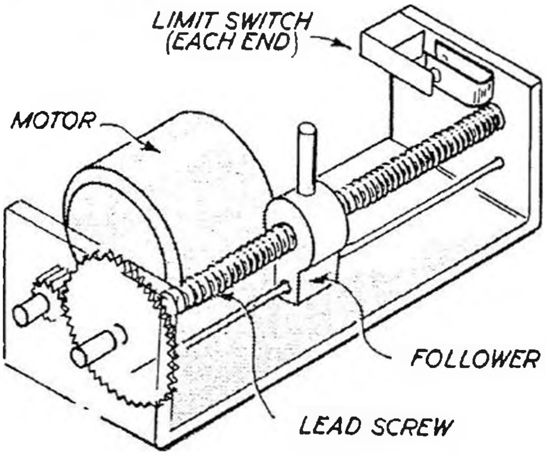


FIG. 11



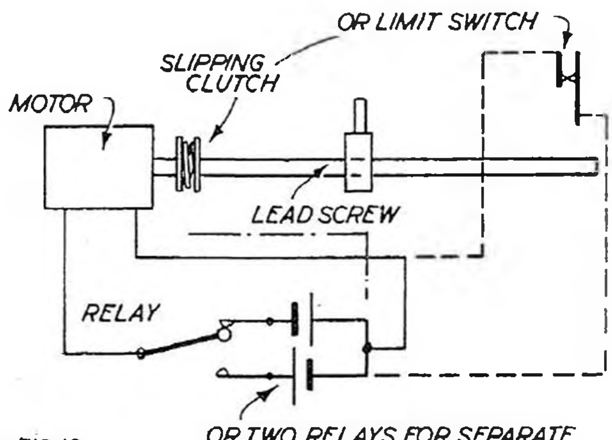


FIG. 12

become particularly complicated and/or grossly unreliable. It is not a practical proposition, for example, to arrange for a motor to drive, say, a rudder continuously from left to right and back again as long as it is switched on and aim to "select" the required rudder setting by switching the signal (and thus the motor) off to stop when the required position has been reached.

Reliable truly proportional control settings can, of course, be produced at the expense of considerable complication of the receiver (and transmitter) end. Numerous simpler solutions have appeared from time to time, all of which have had their limitations.

A typical simple system (Howard Boys type) is shown in simplified form in Fig. 10 for use with a single-channel receiver and variable pulse modulated transmitter signal. The motor drives, via suitable reduction (*e.g.*, friction drive to the edge of the disc) a disc which is constrained against movement in the "drive" direction by a light spring. With no signal (all "space") the spring takes over and pulls the disc round to a limit stop in one direction (corresponding to full control movement in one direction, taken up by suitable linkage). With constant signal on (all "mark") the motor drives the disc against the spring action over to a limit stop on the other side—where, incidentally, it must remain stalled and drawing high current in order to hold on this control position.

For any given mark-space signal ratio the spring and motor reach an equilibrium position. More "space" than "mark" gives an equilibrium over to the spring stop side, and *vice versa*. Thus with an infinitely variable mark-space ratio signal it should theoretically be possible to set the control in any position, predetermined by the transmitter mark-space operating control position. Chief limitations are: there is no definite or automatic neutral, this depending on a 50-50 mark-space ratio setting and therefore difficult to arrive at exactly in practice; the equilibrium position is dependent on motor battery voltage and will vary with it (hence the transmitter control cannot be graduated); and the motor is drawing current all the time. In positions approaching "maximum" motor-stop side, the current drain may be quite high. Except at the extreme positions on either side the motor is tending to oscillate about a "balance" point (virtually it is being switched on and off with variable "on" and "off" periods) and due to the nature of the applied voltage will not draw a very high current over some two-thirds or more of the full movement because of the effective impedance of its coils.

A somewhat similar scheme suitable for two-channel signalling with a self-neutralising action is sketched in Fig. 10. Here the motor is used simply

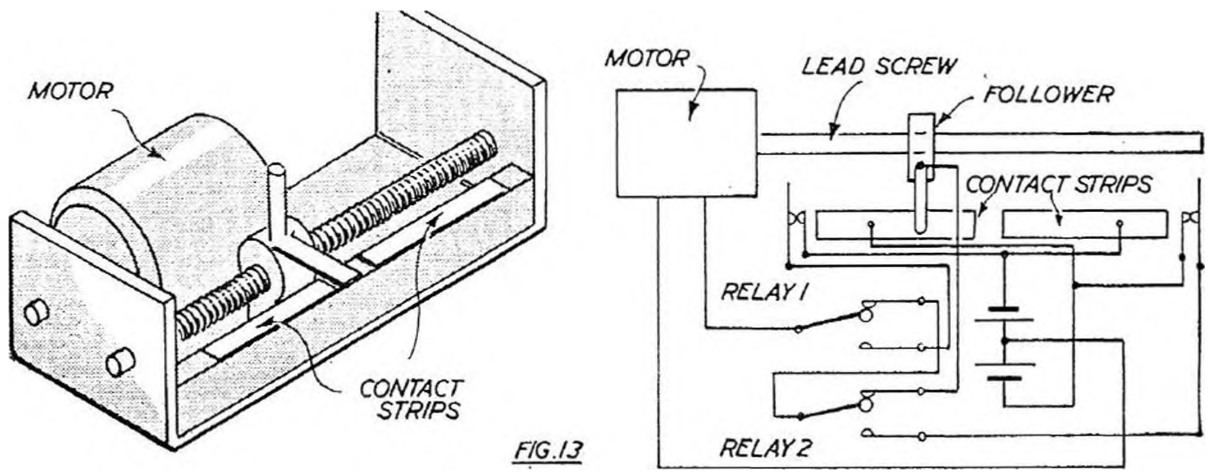
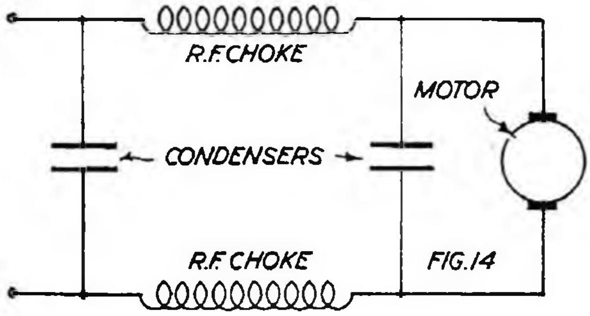


FIG. 13



as a moving coil unit, driving to a limit on one side or the other, when switched into circuit. Held in either extreme position the motor is, of course, stalled and so to reduce the current drain under this condition an additional resistance can be switched into circuit by the limit stop. Self neutralising is provided, immediately the motor is switched off, by rubber bands or light springs.

Such a system is, at best, a rather indifferent compromise, but it does appear to work quite well in practice. Like all other motor types it would be best worked through a reduction gear to the driving disc. To eliminate two of the rubbing contacts involved it would be more logical to wire the motor leads directly to the armature windings (*i.e.*, to the commutator direct) and so dispense with contact through the brushes. These could be a source of trouble in view of the heavy currents passed.

The other form of motor servo which has found more favour in this country (and particularly in the model boat field) utilises a lead screw mechanism for the power take-off. A typical system is shown in Fig. 11 where it will be appreciated that a two-channel receiver is required with two separate motor batteries. One signal closes the first set of relay contacts to apply the first battery to the motor and so drive the follower on the lead screw as long as the signal is held on. On reaching the limit of its travel, either the motor is left to continue to run but slip through a slipping clutch connection or limit switches brought into action to shut the motor off, *i.e.*, break the motor circuit. The second signal switches the relay over to connect the second battery of opposite polarity to the motor, thus making it run in the opposite direction so that the follower travels back along the length of the lead screw to its limit (mechanical disconnection through a slipping clutch, or electrical disconnection through a limit switch). One has, therefore, selectively, two extreme control positions and theoretically (involving keying off at the appropriate point) proportional settings, but with no definite neutral setting.

At the expense of further complicating the wiring and introducing more wiping contacts the system can be made self-centring as detailed in Fig. 12. The latter is a feasible proposition for model aircraft work, whereas the former is not. Both, however, are rather more suitable for models moving relatively slowly in two dimensions only.

With any motor-type actuator where radio interference is marked the completely suppressed circuit of Fig. 14 could be utilised. The R.F.C. chokes should each consist of wire of approximately one-quarter wavelength in length (*i.e.*, approximately 9 ft. at 27 M/c), wire diameter being selected according to the current to be carried and the additional resistance which can be accepted in the circuit. Chokes should be wound as a single layer of close turns on a suitable former. Former size can be determined from the formula:

$$\text{length of wire (in ft.) to wind into a close coil} = F(C+d) \text{ per inch of close coil;}$$

where F is a factor (*see* Table I)
C is the diameter of the core or former
d is the diameter of the wire.

Thus for 27 megacycle suppression

$$\text{length of choke (inches)} = \frac{9}{F(C+d)}$$

The two chokes could be wound together on a single former, or in some cases a single choke in one lead would be sufficient. The condenser values are best determined by experiment, starting with a value of .1 mfd.

TABLE I

WIRE GAUGE s.w.g.	18	20	22	24	26	28	32	36	38
F	5.455	7.273	9,353	11.91	14.57	17.69	24.24	34.45	43.64
RESISTANCE* ohms per yard	.01327	.0236	.0390	.0632	.0944	.1340	.262	.529	.849

* Copper wire

TABLE II. ELECTRIC MOTOR DATA (Sizes Suitable for Actuator Use)

MOTOR	Design Voltage	Weight (oz.)	Brushes (Type)	Test Volts†	Stall Torque (oz.-in.)	TEST DATA* Stall Current amps.	Max. Efficiency R.P.M.	Max. Efficiency Current (amps.)	Max. Efficiency Torque (oz.-in.)	Max. B.H.P. R.P.M.	Max. B.H.P. Current (amps.)	Max. B.H.P. Torque (oz.-in.)
ELECTROTOR	3.0—6.0	3/4	Metal	4.0	Highly Variable	0.6—1.7	4.000	0.58	.06	3,500	0.6	.07
EVER READY	3.0—6.0	1 1/4	Metal	6.0	0.35—0.75	1.4—1.6	5,500	0.4	.15	5,000	0.5	.20
MIGHTY MIDGET	3.0—6.0	1 5/8	Metal	5.6	0.3	.8	7,000	.04	.08	5,000	0.5	.15
FROG TORNADO	3.0—4.5	1 1/4	Metal	4.0	0.25	.9	5,500	0.4	.08	4,500	0.5	.12
TAPLIN 11.76:1 Gear Drive	4.0—6.0	1 3/4	Carbon	6.0	3.5—4.5	1.0—1.4	550	.03	1.2	375	0.6	2.6
FROG REVMASTER	4.5—8.0	3 1/4 Standard 2 3/4 Aluminium Frame	Carbon	6.0	0.8—1.3	1.0	4,500	0.3	.2	3,000	0.6	.6

*Extracted from "MODEL MAKER" Test Reports
†Approximate values for other voltages may be obtained by factoring

FACT OR FANCY?

The fastest climbing model is the one with the steepest angle of climb. A fallacy. The maximum *rate* of climb with any powered aircraft (in still air) is at the flying speed consistent with minimum power for level flight. This gives the greatest *excess* of power available for climb, and the actual climb angle may be relatively shallow. However, on models trimming problems intervene, particularly where there is plenty of power available. But a truly vertical climb will not give the maximum height which *could* be obtained from a given model. In fact, it is possible for a model to assume a vertical climb attitude and hardly gain any altitude at all, merely being supported by the thrust of the propeller, rather than using wing lift for the same job and so making more of the thrust available for climb.

PLASTICS & ADHESIVES

PROBABLY the best general definition of the so-called "plastics" is that they are synthesised or man-made materials. The term "plastics" itself is misleading and confusing—rather like classing every liquid as "water" irrespective of the vast differences in appearance and properties of liquids. The variety possible with the "plastics" is far greater than this simple analogy illustrates for, essentially, their molecules can be "tailored" to give almost any form or characteristic to the resulting material and the possible variations on any single type of molecule are themselves almost endless. Thus even plastics with the same family *name* may differ enormously in some of their properties.

Whilst many of the early plastic materials were substitutes for natural materials (the first plastic of all, celluloid, was produced as a substitute for ivory), essentially modern plastics are materials in their own right. To get the best out of them they must be used where their particular properties show up to best advantage. In such cases they can do jobs for which no other material is satisfactory (except perhaps another plastic), or will do the same job better and cheaper than a natural material. Nylon, for example, which started life as a substitute for silk is now regarded as a superior material to the natural product for many applications (*e.g.*, parachutes). And to illustrate how one plastic material may appear in different forms, solid nylon is also widely accepted for solid mouldings, bearings, etc. Plastics, in other words, tend to be ubiquitous by nature. One could not imagine silk fibres being moulded, without additions, into plastic propellers.

Equally so, all plastic materials will have some limitations and the secret of getting the best out of plastics is knowing which of the many varieties has the least limitations for a certain job. Or, knowing by its limitations that it is not suited for a particular application, instead of finding out later the hard way.

All plastic materials are divided into two main categories—thermoplastic materials and thermoset materials. Thermoplastic materials are those which soften on heating and set on cooling, this process being reversible. In other words a solid moulding produced in a thermoplastic material can be softened again by heating, which is a distinct limitation in many applications but can also be an advantage. Nylon, for instance, is a thermoplastic material and so a moulded nylon propeller can be softened by gentle heating and the blades twisted to increase (or decrease) the pitch angle, if required, setting hard at the new pitch on cooling again. Other common "moulding" plastics like acetate and polystyrene are also thermoplastic materials.

The thermoset plastics undergo an irreversible chemical change on heating and so cannot be re-softened or re-moulded. The heat may be applied direct when moulding or forming, or produced by the chemical action of a catalyst or "hardener". The former is generally applicable to the "solid" resins used for producing mouldings or laminates and the latter to the types of resins now widely used as adhesives or bonding agents.

Whilst on the face of it the thermoset plastic may appear the better "engineering" material, nearly all are extremely brittle and quite unsuitable for stressing. To improve their mechanical properties fillers have to be added, such as woodflour, cellulose fibres, asbestos, etc. Much stronger mouldings can be produced by impregnating layers of paper or fabric with the resins and cutting the whole as one composite moulding—the basis of the strong laminated plastics produced in sheet, rod, bar and tube form (*e.g.*, Tufnol, Paxolin, etc.).

An alternative reinforcement is glass fibre, in cloth or mat form, impregnated with a thermo-setting resin and cured by the addition of a chemical hardener, producing the now well-known "fibreglass" or glass plastic material which has the specific advantage over the other laminates that it is easy to mould to almost any shape over simple forms and is air-hardening without the application of heat and pressure. Hence it is also suitable for amateur use, whereas the laminated plastics can only be fabricated by machining from standard stock sizes.

For aeromodelling use, plastic materials can be classified under three headings—those available in the form of finished mouldings; those available as "stock" materials for working to size; and materials for amateur moulding. The latter two to a certain extent overlap. There is also a fourth category to be considered—liquid forms of plastics used for dopes and finishes, cements, solvents and adhesives.

In this country until comparatively recently a majority of finished solid mouldings were produced in acetate plastic which is a cheap and easy to mould material, can incorporate almost any colour required and have varying properties according to the type of plasticiser used. The addition of camphor, for example, gives a hard surface to the moulding, or dibutyl tartrate promotes toughness.

There is no "ideal" plasticiser for acetate and so acetate mouldings may vary a lot in properties, according to individual manufacturer's preferences. In general, however, such mouldings tend to be rather brittle, strength is low, and the thermoplastic properties readily apparent. Thin "unbalanced" sections, for example, tend readily to warp out of shape or droop. But where such failings are not a major disadvantage, then acetate plastic is about the cheapest of the available moulding powders in this country.

The present trend, however, is away from acetate for aeromodelling mouldings—nylon for high strength mouldings like propellers and polystyrene for "precision" mouldings (*e.g.*, scale models). Polystyrene, as originally used, was far more brittle than acetate and a moulding would shatter readily on impact, leaving jagged edges. The introduction of high-impact polystyrene has overcome this defect so that polystyrene is now becoming the world standard for this type of production and is now replacing acetate for propeller mouldings.

To modellers used to acetate plastics which could be bonded with standard cellulose cement and finished with cellulose dopes, polystyrene presents new problems. It can be bonded only with special cements (polystyrene cement) which tend to be far more "stringy" than standard cellulose cements and therefore need a little practice in use to get good, clean joint lines. The surface is attacked, and spoilt, if painted with most cellulose finishes, so demanding the use of oil-bound finishes for colouring. Depending on the variety of polystyrene used for a particular moulding, some cellulose finishes can be used satisfactorily and where surplus material is available (*e.g.*, the "tree" carrying the detail parts in a scale model kit) a particular finish can be tried out on this first as a check. If in any doubt, it is better to stick to the slower drying oil finishes to be on the safe side. For matt colour finishes, standard emulsion paints are highly satisfactory.

As a useful check, a polystyrene moulding can always be identified from an acetate one by striking it with a solid object or knocking it against the side of a table. A polystyrene moulding will give a sharp, brittle-sounding ring whereas an acetate moulding will sound quite dead by comparison.

Nylon mouldings are currently met with mainly for high-strength plastic propellers, normally in AF grade which is produced only in natural colour—a slightly translucent creamy white. Apart from their greater toughness they are therefore readily identified by colour, acetate or polystyrene mouldings nearly always being coloured—black, green and red being favourite for model propellers, with acetate still the favourite material in this country and polystyrene in America and Germany. No broken propeller mouldings are suitable for repair by bonding or "welding" (*e.g.*, with heat), although all three types are "re-mouldable" with heat, and acetate and polystyrene are cementable.

A limited number of propeller mouldings are also produced in elastomer-type plastics, that is flexible or rubber-like plastics, commonly of vinyl base. Although the form-holding properties of such materials are poor in the sections required, they are capable of absorbing impact by flexing and therefore do not break. Pitch angles, however, are subject to change on ageing, or even during flight and so they are not generally reliable where consistent performance is required. In some circumstances, however, they are most attractive on account of their "unbreakable" nature and the elimination of cuts to the fingers if a hand is accidentally put into the propeller disc.

Almost all the thin, transparent sheet on the model aircraft market used for "glazing" cabins and producing moulded transparencies is cellulose acetate, although still traditionally called celluloid. Celluloid is cellulose *nitrate* and is inflammable, whereas cellulose acetate is not. Both materials stick well with standard cellulose cements although acetone mixed with celluloid chippings is generally regarded as a superior cement for celluloid (only). Acetate is the preferred material for transparencies since it remains clear, whereas celluloid gradually darkens with age. Celluloid, however, is more waterproof than acetate sheet and more dimensionally stable, which still makes it a first choice material for drawing curves and squares.

Both materials may be moulded into canopies, etc., but acetate is preferred both on account of its non-flam properties and the greater clarity of the material. The modern trend in the production of commercial mouldings from thin sheet (*e.g.*, canopies and hollow mouldings) is to use the vacuum-forming process which literally sucks the heated sheet (raised to its softening temperature) into a shaped mould and thus eliminates any tool and "draw" marks associated with the employment of male and female moulds. The main secret of sheet moulding is to raise the material to its softening point before attempting to force it to flow.

On some commercial mouldings, clear polystyrene is used (formed by injection moulding), the "optical" properties of which are generally superior to acetate (moulded from sheet). The best material of all for clear glass-like transparencies is the acrylic group of plastics, typified by "Perspex" in this country and "Plexiglass" in the United States. Available minimum sheet thicknesses are, however, rather thicker than that required for aeromodelling applications. Special cements are required for adhesive bonding. The acrylic plastics are also available in the form of moulding powders for compression or injection moulding and some proprietary items of this type may be met with. A check on this material is to file away a bit of the surplus moulding and see if a sickly-sweet smell is present. Chrloroform is a solvent and quite a good cement if rubbed in until the joint surfaces become tacky, but dries very rapidly and is prone to blush.

Of the stronger plastic materials, limited use only is made of the phenolic laminates. Tufnol tubing has been found excellent for hubs for rubber model propellers and is worked like metal by sawing, drilling and filing. Bonded joints can be made using one of the cold-setting synthetic resin adhesives although pin jointing is recommended for anchoring the blades in the hub. Broken blades can then readily be removed and replaced.

Laminated plastic sheet is little used in aeromodelling except for the specialised duty of radio receiver chassis and (occasionally) mounting plates for actuators. Cellulose cements will not bond to such materials and, in fact, an adhesive of the nature of *Araldite* is required for high-strength joints. Except where electrical insulation and rigidity is of primary importance, plywood is a stronger and generally better aeromodelling material.

Apart from canopies and similar transparent mouldings, plastic materials have little application as yet as structural materials on flying models, largely on account of the weight penalty. Only in the case of control line models, where weight is of less importance, have any real attempts been made to produce moulded plastic assemblies for wings or fuselages, etc.

Acetate, moulded from sheet, and polystyrene, moulded by the injection process, are two plastics which could yield thin shell mouldings, suitable for fuselages and wings with suitable structural reinforcement. The latter has the advantage of being some 20 per cent. lighter than acetate, but still nearly ten times as dense as balsa. Hence the walls would have to be one-tenth the thickness of comparable hollow-log balsa construction to compare in weight, which is not a proposition.

So far, in fact, where moulded-type fuselages have been produced at a satisfactory weight they have been of the sheet balsa type, reinforced with a paper backing and moulded wet under heat and pressure—difficult a job and one which requires a fairly critical material selection.

The most promising results with regard to producing an all-plastic moulded flying model are comparatively recent and have involved the use of air-expanded or "foamed" polystyrene, by which process a rigid material may be produced with a density figure far lower than even that of balsa. In appearance something like elderberry pith, foamed plastics are integral structures with quite good strength in generous sections and capable of being hard surfaced or coated to give a smooth, durable outer surface. In addition, of course, they can be bonded using the appropriate type of adhesive. From the production point of view one attractive feature is that the complication and expense of an injection moulded machine is not required. However, their possible application in the aeromodelling field is yet undeveloped, although there are a number of German "toy" aeroplanes currently being produced in foamed plastics.

The only material which has made any definite inroads into amateur construction is glass plastic, particularly for the production of shaped parts of secondary structures, like cowlings. If the weight can be spared, glass plastic will do the job more simply than beating out a similar shape from thin metal, and with sheet metal strength compared with carved balsa. Indeed, whole fuselages and wings have been moulded in glass plastic although the resulting weight must border on the prohibitive.

Another particular application often recommended for glass plastic (the term "Fibreglass" is strictly only applicable to a proprietary brand of glass fibre productions) is for reinforcing and "binding" vulnerable parts of a model, such as the front end of the fuselage on a radio model. For such purposes it is excellent, giving greater strength than plywood covering at not greatly increased weight. It is not commonly realised, however, that for local binding, *e.g.*, strengthening a front former joint to the fuselage, ordinary bandage strip impregnated with the same polyester resin as used with glass fibre is equally effective, lighter and somewhat smoother in surface when set. Also many other types of resins may be used with glass fibre cloths or mats, or cotton or linen strips, etc., for particular purposes. Polyester resins just happen to be about the most suitable for general use with glass fibre reinforcement, particularly as it readily "wets" and thus sticks to the glass. Cellulose cement would not be as satisfactory. On the other hand a cement-soaked bandage strip used for binding is essentially the same type of reinforced plastic structure, although in this case thermoplastic.

A majority of modern adhesives are, in any case, plastic materials under the general heading. Balsa cements are either cellulose acetate or nitrate, usually together with added synthetic resins, plasticiser, solvent and inhibitor. The main purpose of the latter is to produce an air-tight seal on the inside of the tube and thus give a good shelf life. Standard lead tubes are relatively porous which means that solvents tend to evaporate out, even before the nozzle is pierced. Some manufacturers use tin-coated lead tubes for a better initial seal with or without added inhibitors to the cement itself. Acetate cements are generally weaker and are not waterproof, but are more heatproof than slower drying, stronger nitrate cements. Rapid drying cements have added ether and set very quickly, at some expense in strength, with a marked tendency to blushing in damp atmospheres.

Cellulose cements are undoubtedly the best adhesives for general jointing work in dry balsa. Nitrate cements combined with synthetic resins are equally good for hardwoods and mixed assemblies, *e.g.*, jointing ply to balsa. They are also satisfactory for jointing acetate or nitrate (celluloid) sheet, with some exceptions. If these materials are contemplated for making lead-acid accumulator cases, for example, celluloid would be preferred to acetate (because it is more waterproof) and would have to be jointed with acetone or acetone-celluloid "syrup". Bonding with ordinary cement would lead to early failure of the joints. Cellulose cements are excellent for bonding card and most natural fibres, *e.g.*, linen tape, cotton, silk strips (used as reinforcing binding or hinges), but dissolve some artificial fibres like rayon, etc. They are not suitable for bonding plastics outside the "cellulose" family—*e.g.*, Perpex, P.V.C., polystyrene, etc. Nor are they suitable if the joint surfaces are very damp.

For bonding wet woods, *e.g.*, in making laminated balsa windings for formers, wing tips, etc., synthetic resin adhesives give excellent results, with the only disadvantage of being much slower drying than balsa cement. A wide variety of these are formulated from urea-formaldehyde resin which is a "standard" in the present-day woodworking industry and consists of powders which are made up into a liquid for use by the addition of a certain proportion of water. In this state they have a storage life of several months, if necessary.

Immediately before use a hardener is added to an (estimated) amount of resin required, when the pot life of the resulting mix may vary from ten minutes up to an hour, but seldom more. Unlike the cellulose cements which set by drying out, the synthetic resins set by irreversible chemical action and are therefore more stable and stronger. Most types are also completely waterproof and thus vastly superior to cellulose cements in this respect, particularly on hardwoods. Ply-balsa joints made with cellulose cements will separate under the action of water, but will remain intact even under prolonged immersion with U-F resin bonding. Wastage, however, tends to be higher because any unused resin-hardener mixture quickly becomes useless. It is also less convenient to use than the handy "tubed" balsa cement. But its distinct advantages in jointing hardwoods could be more generally exploited in aeromodelling.

An earlier type of synthetic powder glue requiring only to be mixed with water for use is casein, again giving a high-strength joint with hardwoods (and balsa) and, of course, being suitable for use on wet surfaces. It is not, however, completely waterproof, nor is the joint strength comparable with that of a good thermosetting resin mixture.

Polyvinyl adhesives are a relative newcomer to the field, generally compounded on polyvinyl acetate and put out in the form of a thick white paste similar in appearance to the dextrin pastes much favoured for sticking tissue on to airframes. It is, however, quite a strong glue although the joint is somewhat flexible and not waterproof. P.V.A. adhesive will joint non-porous surfaces quite well, provided a high joint strength is not required, *e.g.*, will stick paper to metal, stick to thermoplastic materials, etc. A useful workshop application is sticking sanding discs to metal face plates.

For "impossible" gluing jobs, where joint strength is not critical, rubber based adhesives are often satisfactory. These are formulated on both natural rubber solutions and cements (the latter often with added synthetic resins), and natural or synthetic latex. The latter are invariably white in colour, usually with a slight but distinctive sour smell (ammonia is added to natural latex as a preservative immediately after collection). A wide variety of rubber-based adhesives are suitable for sticking metal foils to wood, card, etc., although the joint is somewhat flexible and can be separated fairly readily by peeling. Rubber solutions are the best type of adhesive for attaching metallised paper or foil coverings to models.

An increasing number of adhesives are becoming available which will give truly strong metal-to-metal joints, or metal-to-wood joints. Of these the epoxy resin types currently available in this country are suitable for amateur use since they are produced in both air-setting and heat-curing forms (the latter requiring baking at a predetermined temperature for a given period). Both epoxy and polyester resins will bond tenaciously to shiny surfaces which are mechanically clean, but the strongest joints are realised only with the heat-curing epoxy resin type. Glued metal-to-metal joints in aluminium are then comparable in strength with riveted or bolted assemblies, if properly made. As an extreme example it is possible to glue a pair of dural motor mounts directly to a plywood firewall and produce a satisfactory fixing capable of withstanding the strain of a vibrating motor, although this technique would not be recommended as a standard "production" method.

Having mentioned rubber, a few brief notes on synthetic rubbers are included, although these materials are not generally classified as "plastics".

They are, nevertheless, man-made materials. The first synthetic rubber to appear on any scale was German and designated "W" for soft and "H" for hard grades, respectively, followed by the Russian SKA (based on petroleum) and SKB (based on alcohol). Then neoprene (first called Duprene) appeared in America in 1931 as the first of the synthetic rubbers which did truly resemble natural rubber in chemical composition. Neoprene, in general, is comparable with natural rubber as regards most mechanical properties, but is more weather resistant, withstands a higher temperature and is not affected by oils or greases. It is no good for rubber motors, but excellent for fuel tubing on account of the latter property. It is currently available in a variety of grades, designated by letters, of which GN is the general purpose grade; W and WRT are similar, but with somewhat superior properties; grade Q has even better resistance to oils; and type KNR is widely used in the formulation of paints.

Buna rubber which appeared in Germany in the mid 1930's was of two types, S and N (the former incorporating styrene). Due to a shortage of neoprene just before the war, America imported Buna N (known as Perbunan in U.S.A.) and during the war produced the equivalent of Buna S as a general purpose synthetic rubber GF-S (government rubber, styrene type) which largely replaced natural rubber during the wartime shortage. We mention this in some detail to show the prominence of America in the synthetic rubber field and also to show how styrene entered into both government-sponsored industries. Hence styrene was produced in both countries in quantity, and cheaply, so that polystyrene mouldings, mentioned earlier on, were a "natural" in those countries for post-war development.

Almost the only application in aeromodelling for synthetic rubbers is, however, for fuel tubing, neoprene (wartime GR-M) being about the best of the readily-available materials, but now superseded in performance by the modern polysulphide rubbers which retain better flexibility. Butyl rubbers (wartime GR-1) are not so resistant to fuels. Silicone rubbers are more heat-resistant than any other type, but lack mechanical strength. This type is favoured for O-ring seals as used on the contra-piston of some diesels, although butyl rubbers are tougher. The oil seal on the front ball race of the Frog 2.49 is of butyl rubber.

Finally, as a further group of aeromodelling plastics we have dopes and finishes. To generalise, model aircraft dopes are invariably cellulose based, graded as clear dopes with tautening action and coloured dopes with itt e or no tautening action. Finishes, as opposed to dopes, may be ce lulose, natural or synthetic varnishes, clear or coloured, with or without special properties. Fuel proofers, for instance, are specially formulated finishes (usually based on synthetic resins) resistant to softening and attack by model fuels, particularly methanol and nitro fuel "dopes". Even castor oil has a softening action on most cellulose films.

Most clear dopes possess tautening properties, the stronger tautening dopes invariably being of cellulose nitrate "cut" to the required strength. Acetate dopes are not widely favoured for model work although they have less tendency to darken on ageing (*e.g.*, with an initial clear film), are rather more prone to blushing and less waterproof. Their main use on full size aircraft is for interior finishing since they are fireproof.

Other types of dopes which have been exploited from time to time, particularly in America, are (cellulose) butyrate or acetate butyrate which give a film similar to acetate dopes but with enhanced durability and improved moisture resistance; cellulose acetate proprionate and methyl cellulose and ethyl cellulose. Butyrate dopes are currently favoured in the United States as being more waterproof than nitrate or acetate dopes, but have certain other limitations.

Coloured dopes, in this country at least, are nearly all formulated on cellulose nitrate suitably pigmented, with added resins for gloss (these being omitted in matt dopes, of course). They may retain slight tautening properties, but probably are more correctly classified as "finishes" and technically should be regarded as such. In other words, any tautening required should be completed before colour doping, usually by water spraying in the case of tissue covering plus a base coat or two of clear tautening dope. Translucent dopes are essentially clear dopes or finishes (*i.e.*, tautening or non-tautening) with colour added in the form of dyes rather than pigments. Hence they give a translucent colour rather than a solid colour, with an appreciable saving in weight.

Banana oil as a finishing medium is no longer a descriptive term. Originally it was taken to mean a cellulose acetate finish, *i.e.*, virtually a cellulose semi-gloss varnish coating with no tautening properties. Today such a variety of cellulose varnishes have been put out under this name, both acetate and nitrate, ranging from thin, clear liquids to dark, treacle-like substances that as a specification it has ceased to have any real meaning. Some dope manufacturers do, in fact, deny that "banana oil" ever existed as any definite formulation and so because there is a (limited) demand for it simply put out their own ideas on a cellulose varnish under that name. Oil-bound varnishes are also used under such names as "paper varnish", "high gloss", etc. the main thing to remember is that any oil-bound finish will be softened immediately on contact with stray fuel on a power model. For the same reason aluminium finishes with an oil-bound base are unsuitable for finishing power models, particularly as the majority of fuel-proofers will not cover the surface without attacking the finish.

WEIGHTS OF TYPICAL PLASTIC MATERIALS
(For comparison, Average Values for Balsa are: S.G. 114, Lb./cu. in. .005)

PLASTIC	FORM	SPECIFIC GRAVITY	WEIGHT lb/cu. in
Bakelite	Thermoset Mouldings	1.34—1 /	.049—.051
Catalin	Cast Synthetic Resin	1.30	.047
Cellulose Acetate	Mouldings	1.30 (av.)	.047 (2v.)
	Sheet	—	.00075 oz. per sq. ft. per .001" Thickness
Acetate-Butyrate		1.20—1.22	
Cellulose Nitrate	Mouldings or Sheet	1.35—1.60	.050—.057
Ethyl Cellulose	—	1.14	.041
Nylon A.F.	Mouldings	1.14	.041
Paxolin	Sheet	1.39	.050
Perspex	—	1.19	.043
	Sheet 3/32		2.32 oz. per sq. ft.
	1/8		3.1 oz. per sq. ft.
	5/32		3.86 oz. per sq. ft.
	3/16		4.64 oz. per sq. ft.
Polystyrene	Mouldings	1.05—1.14	.038—.041
Polyvinyl Acetate	—	2.05	.074
Polyvinyl Chloride	—	1.20—1.60	.043—.057
Tufnol	Tube, Sheet	1.39—1.38	.049—.050

The author about to step into the cockpit of the diminutive metallic green Druine Turbulent which he demonstrated throughout England in June, 1956. It was flown from Croydon to Paris non-stop for an operating cost of 15/-!

GO A STAGE FURTHER!

Aeromodellers will not find building an ultra-light aircraft so very different from a power model

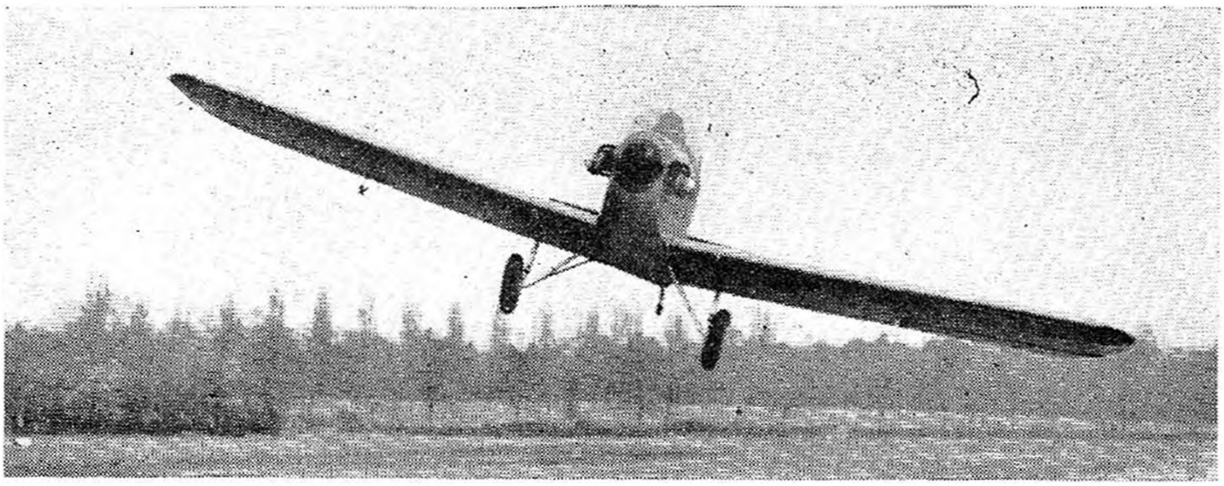
By H. BEST-DEVEREUX

ONE OF THE main reasons for the success of ultra light aircraft in France since the war is the wide background of model aircraft building. The model movement is widely established and is closely connected to the existing flying clubs, nearly all of whom have an active model section which is officially supported. There can be no doubt that a young boy or girl having acquired a background of aviation knowledge from model building progresses naturally and simply to ultra light aircraft construction. In turn, the ultra light movement benefits, for nearly all flying clubs in France construct an aircraft of their own and it is obvious that the model builder member of the club can barely resist trying his hand in an even bigger and better model.

There are now many types of ultra light aircraft available, and naturally each type has its protagonists. The single seater enthusiast is probably the purest of ultra light aircraft purists in that he has usually built his aircraft alone, and his greatest joy in life is to fly in the satisfaction that he is airborne cheaply by his own unaided efforts.

Flying a single seater such as the Druine Turbulent portrayed on the front cover is an experience which is unequalled in any other class of aircraft. Perhaps the single seater constructor's feeling can be expressed in the quotation from a book by Henri Mignet, the great French amateur of 25 years ago:

"This fuselage which I am making by sticking together small pieces of wood which I prepare, plane down and nail . . . what will be its destiny? What clouds, what valleys will it fly over? Towards what countries will I be drawn, seated on its cushion, tied to its seat with a belt? It possesses, latent in it, a whole programme, a whole life of adventure."



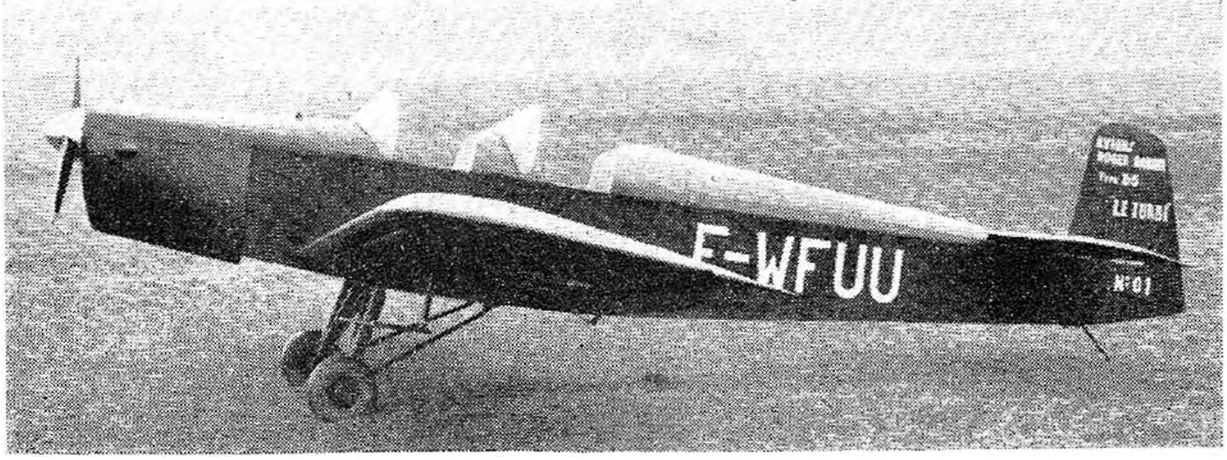
Head on view of the Turbulent being demonstrated at Elstree Aerodrome by the author. A series of low level turns were made to show how the Turbulent can provide a most enlightening display within the confines of any small airfield.

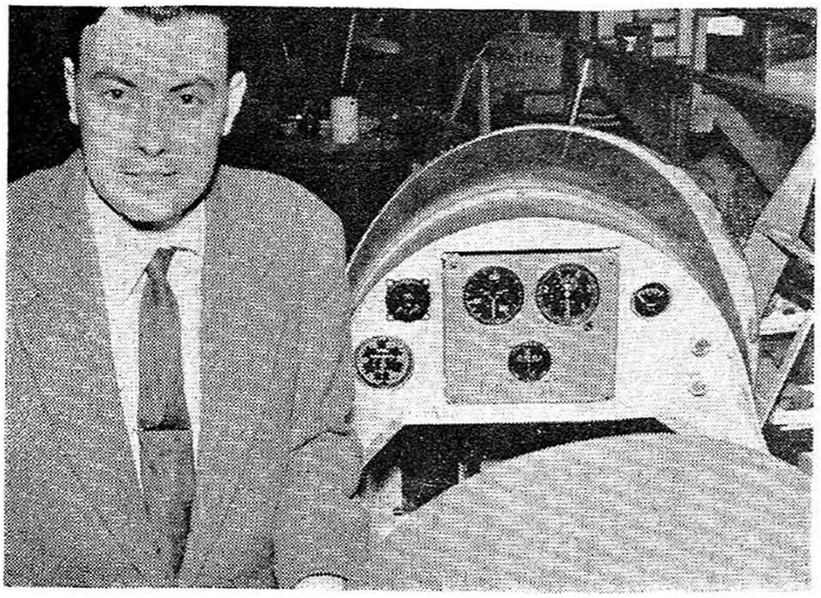
In the United Kingdom, due to many official restrictions, the pre-war enthusiasm for ultra light aircraft such as the Chilton, Luton Buzzard, Drone, Luton Minor and others, was not maintained except by a few keen spirits. Their activities have resulted in the Popular Flying Association being entrusted by the Ministry of Transport and Civil Aviation with the responsibility of recommending Permits to Fly for ultra light aircraft. The P.F.A. was quick off the mark and immediately carried out a wide programme of investigation into available designs, and the first to obtain their approval was the Druine Turbulent, which, during June, 1956, toured British Flying Clubs to show surprised club members what performance could be obtained on 28 b.h.p. by an amateur-built aircraft. This aircraft finished its tour by flying from Croydon to Paris non-stop for fifteen shillings!

For the amateur who prefers a simple two seater the Druine Turbi was chosen, and an investigation into this type showed the claims of its designer that it was specially designed for amateurs and could be built like a large model, to be well founded. The first of the British examples is being built by a group of young students of Hatfield Technical College who found their knowledge of model making standing them in good stead.

To the model maker used to large models an ultra light aircraft should present few difficulties. The construction of a slab side for a model fuselage is virtually the same as making a wing rib for a Turbi and conversely a fuselage

Le Turbi is the bigger brother of the Turbulent, and this is the prototype aircraft. The letter "W" in the French registration signifies that it is flying on preliminary registration, this letter being changed for "P" at a later stage when fully approved.





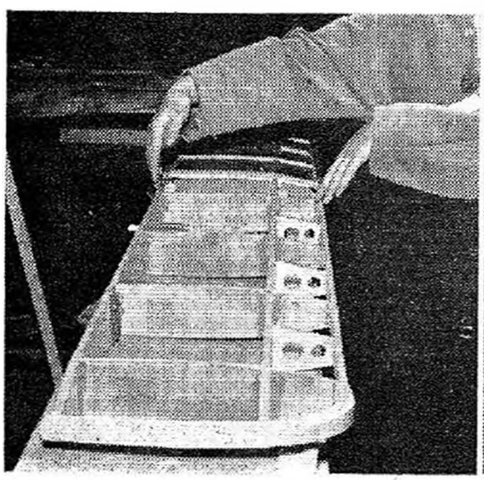
M. Roger Druine beside the cockpit of a Turbulent being built in a Parisian workshop by youthful enthusiasts. It so happens that this is the same aircraft eventually displayed in England.

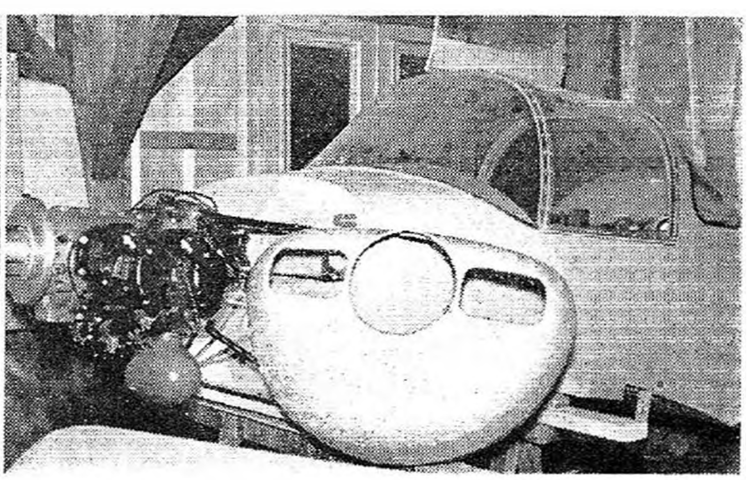
side for a slab sided design like the Turbulent is only like making an outside wing rib.

The Turbi designer constructed his prototype at a cost for jigs not exceeding ten pounds, and this significant figure should do much to alleviate fears often expressed that the ultra light aircraft needs expensive building facilities.

The technique involved in the construction of an amateur built aircraft is mainly one already well developed in the model maker, firstly a scrupulous attention to the details drawn in the plans, and secondly a precise approach to setting up structures. Several of the same tricks are involved and similarly the same pitfalls. Normally, the fuselage is constructed by laying out the side full scale on a flat surface, preferably wooden. On this surface the longerons and vertical members are located by small blocks attached to the full scale layout, the majority of the blocks being accurately placed to prevent the outside edges exceeding the dimensions on the plan. With the members laid in position, all nodes or joints are checked to ensure that they are level, after which the ply skin, already spliced up into one long length, is glued to the structure. Pressure for this operation is provided by use of tacking strips which are laths about $\frac{3}{16}$ in. or $\frac{1}{4}$ in. thick pinned through the ply to provide a temporary means of pressure until the glue sets, after which they are removed, together with the pins.

Here it should be mentioned that there are certain principles which apply to all stages of ultra light aircraft construction. One is that a mass of glue cannot be used to make a bad joint good, and no matter how much the temptation, a poor joint should not be packed with glue. Contrary to normal woodwork practice timber joints are rarely made by notching tenons or similar methods.





Angle joints are usually plain butts and longerons, rib booms, and stringers are continuous so that the load transference qualities are maintained. From the point of view of strength, it is interesting to note that the ends of diagonal members in ribs are usually cut off square without any detriment to their strength. Plywood joints are made by feather edge splices, as often as possible glued up off the job, but arranged so that the splice rests along a structural member.

Having made one side of the fuselage the opposite side is easily made by locating the members by use of a few headless pins on to the existing side. This method saves making a new layout, ensures that one does not construct two right or left sides and also ensures complete accuracy in matching the two sides.

Following the trimming of the fuselage sides by removing all surplus plywood down to the longerons, they are stood inverted on a flat surface accurately marked out with a centre line. Bulkheads are then fitted to the centre section and the sides drawn together at the stern post after which the bottom skin is attached. At this stage an accurate check is made to ensure that no movement has taken place followed by the forward part of the fuselage being fitted with the nose bulkhead, and the bottom skinning completed.

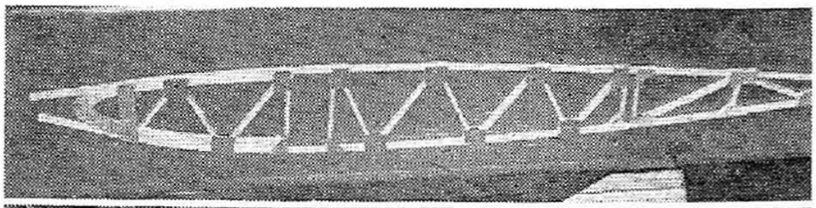
With the fuselage box turned right way up a short time is usually spent removing slight discrepancies in alignment, and then the top decking is fitted.

Metal fittings, made from simple mild steel sheet transfer the main structural loads and it is therefore essential that these are accurately made and carefully attached avoiding double or elongated holes in either the fittings or the woodwork. Normally the holes are drilled undersize and opened when correct alignment is assured.

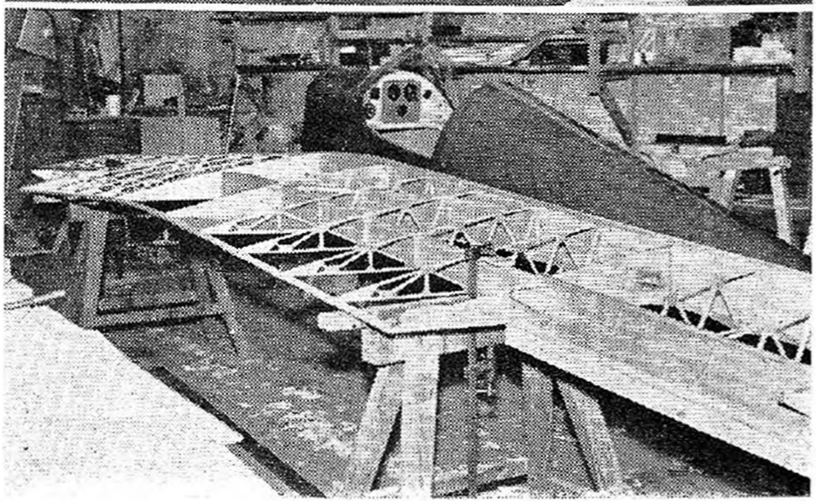
Nearly all ultra light designs of the present decade have a box section main spar with laminated booms. Undoubtedly this item is the biggest constructional job to be undertaken, but this fact alone should not cause the amateur constructor to be unduly alarmed. Each boom is made separately, usually from three laminations of carefully machined timber with about $\frac{1}{16}$ in. of spare "meat" left on the widest dimension, this spare being cleaned off when

Opposite, left: Tailplane chord of the Turbulent is a mere 12 inches and construction well within the capacity of any aeromodeller.

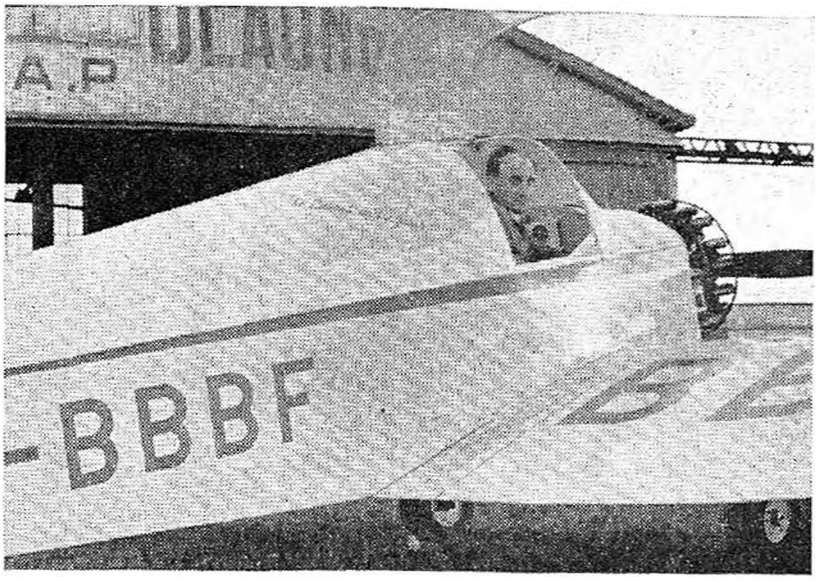
The Druine Condor being built, showing the Continental flat-six engine and hand beaten cowling which have just been fitted to this two-seater.



Right, top: A Turbulent wing rib, actually inverted, with spacers and contours only about $\frac{3}{8}$ in. square!



At right: The Turbulent wing is built upside down over a pair of trestles, and ribs slide over spars before being tacked and glued in place. Small span allows construction in a relatively confined space.



M. Delemontez, co-designer with M. Joly, in the cockpit of the prototype two-seater Jodel D.11, a popular French home-built aircraft.

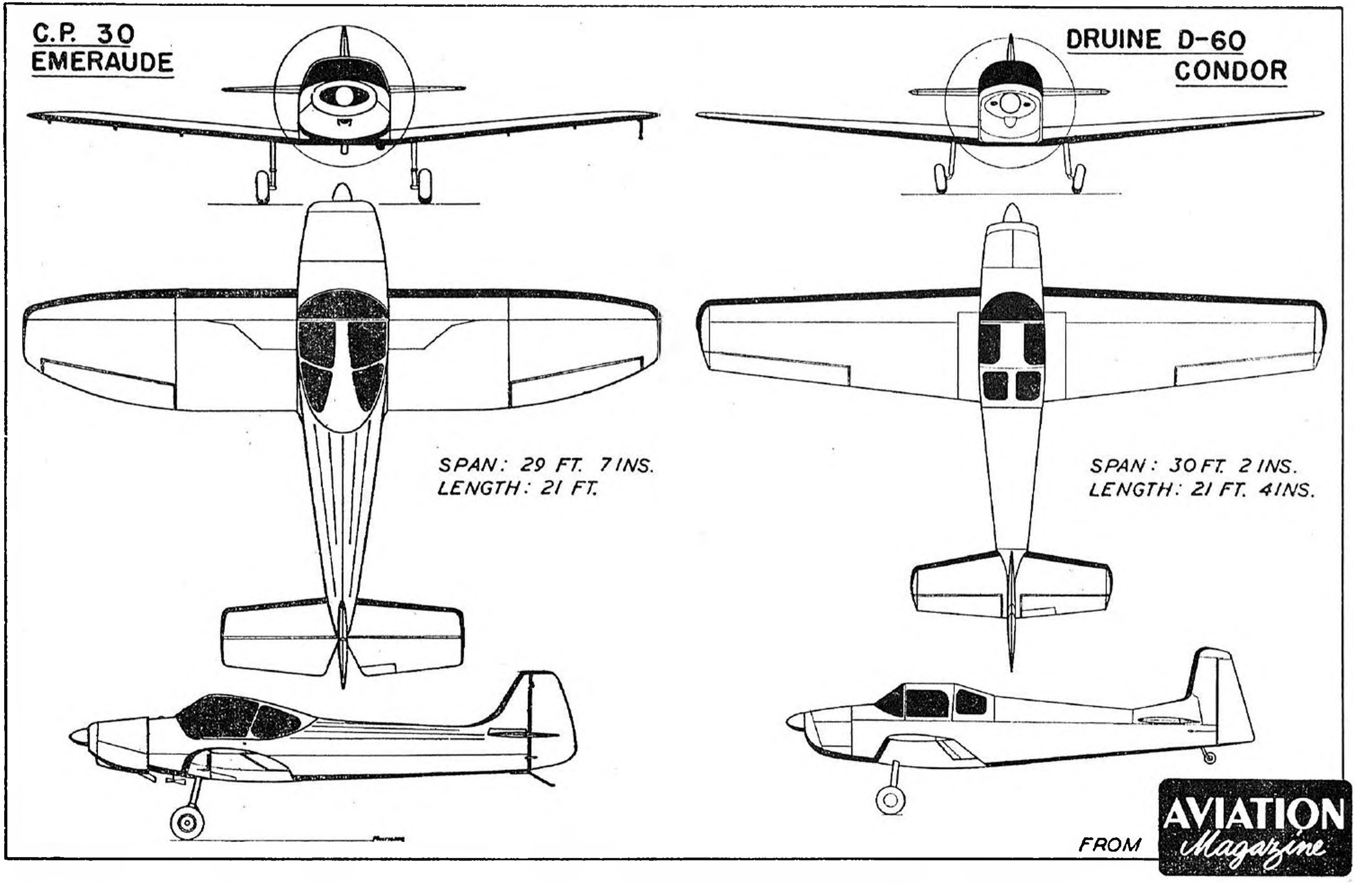
Typical home-constructed Jodel 9 Bebe at Rheims, colouring being pale blue with plum registration.

the boom is removed from the jig. Such a jig consists of two stout pieces of square section timber bolted or cramped to a flat surface and set with an accurate vertical face to which the external face of the boom is offered. These pieces of timber are set at the appropriate angle so that the plan view on the jig working face denotes the dihedral angle of the outer face of the particular boom being glued.

Provided the jig is simple and solid and sufficient cramps are available with long blocks to spread the load, the glueing operation is one of patience. Working out from the centre with two pairs of hands and using the blocks and cramps already laid nearby at the ready, an apparently formidable task is made simple. The completion of the spar after trimming the booms and inspecting is a straightforward imitation of the method used in the fuselage side construction.

Wing ribs, as mentioned previously, are virtually slab sides for a model aircraft fuselage, and made in a simple jig on a flat plank of wood. With the ribs threaded on to the main spar and auxiliary spar the wing is accurately set up on trestles so that there is no twisting of the spar and the trailing edges are properly aligned. Leading edge ply covering is preformed by soaking and attached using tacking strips.

The empennage components are simple pieces using similar principles to the larger parts of the aircraft and for an amateur constructor who feels that he should make haste slowly these are the components on which to make a start. These small parts are also a good start for fabric covering which on such small


C.P. 30
EMERAUDE
DRUINE D-60
CONDOR
SPAN: 29 FT. 7 INS.
LENGTH: 21 FT.
SPAN: 30 FT. 2 INS.
LENGTH: 21 FT. 4 INS.
FROM
AVIATION
Magazine

aircraft is a fairly simple task if cleanliness and tidiness are observed.

With the advent of facilities for amateur construction the time now seems ripe for a resurg nce in British light aviation. Designs exist to suit all tastes; for the single seat enthusiast the Turbulent and its Volkswagen car engine makes a winning combination, while for the simple two seater point of view there is the Turbi which, if desired, can be fitted with a hood. For the more skilled amateur the Piel C.P.30 "Emeraude" has been accepted by the P.F.A. and the first examples are already started. Soon it is to be hoped that British designs of equal merit will be produced. Already British-produced kits of parts are being made available and wide interest is being shown by educational authorities in the possibilities of ultra light aircraft construction as a starting point for the new generation of aeronautical technologists.

Since the announcement that translated French plans are available, the Popular Flying Association has received numerous requests for information, particularly from overseas and many sets of plans have been sold. A number of amateur built aircraft are now on the stocks, and it seems that very soon we shall see new shapes in the English skies together with the opportunity for the enthusiast to at last fly cheaply.

For example, it is possible for a Druine Turbulent to be built for an estimated outlay of £350. The cost of maintenance is negligible and fuel cost under the group ownership scheme is approximately five shillings per flying hnor. With a conservative engine, overhaul period of 800 flying hours it is obvious that flying is now within the reach of all for the cost of running a large motor cycle. At the other end of the scale an "Emeraude" costing about £600 to build provides a two seater sporting aircraft with a speed of 100 m.p.h. on 65 b.h.p.

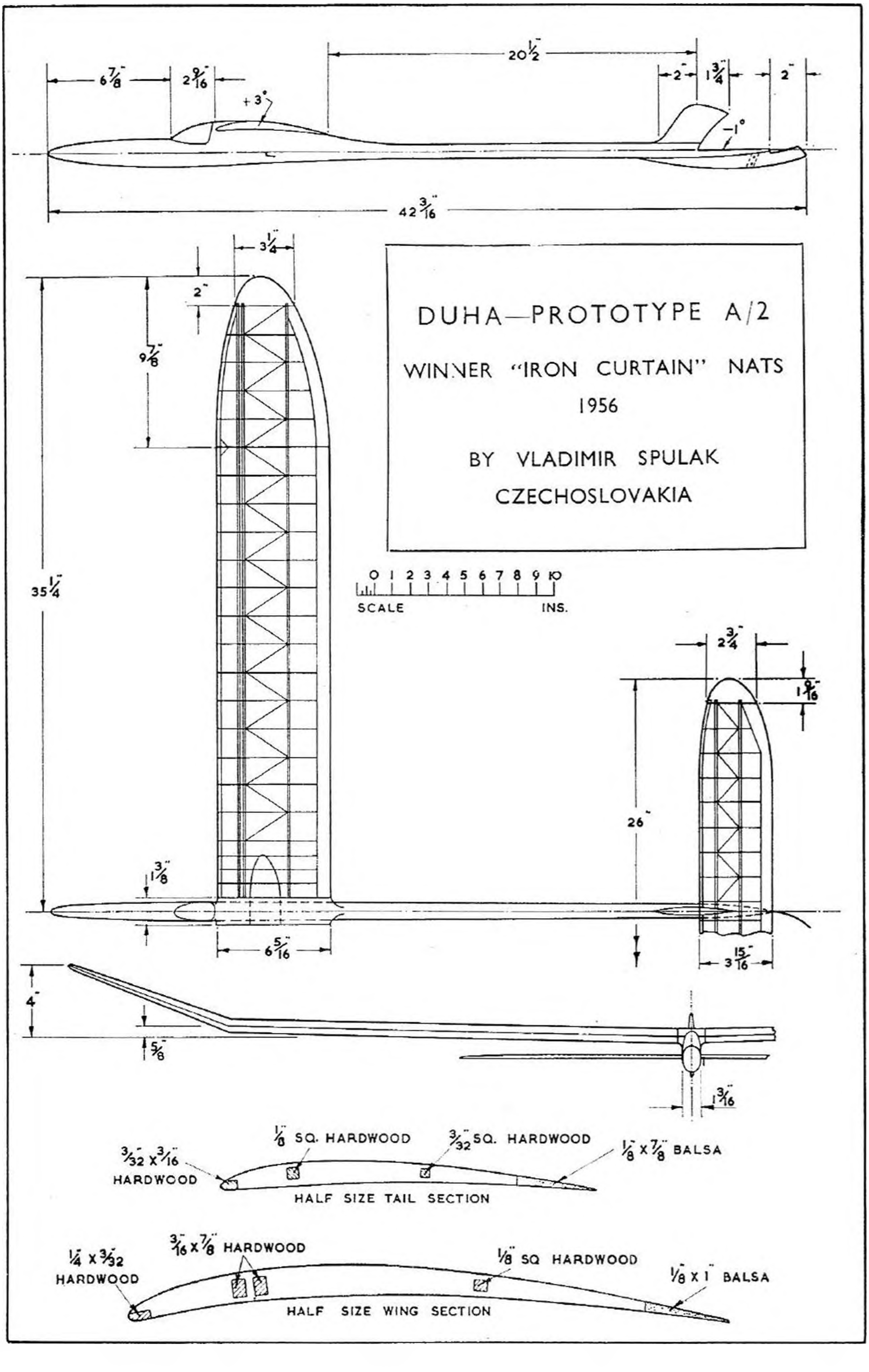
The intermediate Turbi fitted with a Coventry Victor engine should cost about £450 to build and provides cheap flying for two at less than 3 gallons of fuel per hour.

Under the new regulations there is less "red tape" and the amateur constructor is encouraged to carry out his own maintenance. The Permit to Fly lasts for one year and is renewed on a satisfactory report on the condition of the aircraft by a licensed aircraft engineer. Thus expensive C. of A. overhauls are avoided and the amateur who maintains his craft in tip top condition has little or no expense to face when his Permit is renewed.

FACT OR FANCY?

Additional power can be tapped off an engine without loss of performance. Power for "pressurisation" can be tapped off either the crankcase of the cylinder head of an engine (the latter usually applicable only in the case of glow motors) without any appreciable loss of engine crankshaft power. In both cases the tapped pressure will be positive. If the crankcase is tapped and connected to a circuit which can bleed, then this circuit will have to be closed for starting, otherwise there would be no suction produced in the crankcase to draw in fuel.

A change of props. may affect the trim of a power model. This is true if the propellers are sufficiently different geometrically to alter the running speed of the motor. Then both the torque and thrust produced are altered. This can happen with nominally identical propellers, particularly with the plastic variety where blade angles are prone to distort and change after removing from the moulds.



DUHA—PROTOTYPE A/2
WINNER "IRON CURTAIN" NATS
1956
BY VLADIMIR SPULAK
CZECHOSLOVAKIA
SCALE INS.
0 1 2 3 4 5 6 7 8 9 10
20½"
6⅞"
2 9/16"
+3°
2"
1¾"
2"
−1°
42 3/16"
3¼"
2"
9⅞"
35¼"
1⅜"
6 5/16"
2¾"
1 9/16"
26"
3 15/16"
4"
⅝"
1 3/16"
3/32" x 3/16" HARDWOOD
⅛" SQ. HARDWOOD
3/32" SQ. HARDWOOD
⅛" x ⅞" BALSA
HALF SIZE TAIL SECTION
¼ x 3/32 HARDWOOD
3/16 x ⅞ HARDWOOD
⅛" SQ HARDWOOD
⅛ x 1" BALSA
HALF SIZE WING SECTION

TRY HYDRAULICS!

IN FULL SIZE aircraft, hydraulics are widely used for transmitting power. Power transmission by fluid pressure is a flexible, simple method which certainly bears investigation as to its possible applications to operating model aircraft controls. The only workable systems of this type known at present employ air pressure and are largely based on the vacuum-type system originated by the German Stegmaier some four years ago.

The basic advantages of a pneumatic system are that it dispenses with electro-mechanical actuators or servos and their attendant batteries, although still requiring electro-magnetic switching, can provide a limitless number of operations all the time the engine is running, and the mechanical power which can be extracted in terms of force can amount to several pounds "push" or "pull", if necessary. Nor is such a system necessarily susceptible to leakages, in fact a continuous bleed system may well be an advantage. In any case, with the system continually being exhausted (or charged) whilst the motor is running, accidental small leaks can be accommodated without failure. Properly made it should be a very reliable system. It does, however, present certain difficulties over the construction of the necessary selector valves and "pressure capsules" or pneumatic servos.

A pneumatic system can be worked either with *positive* pressure or suction pressure (the so-called vacuum system, although the actual reduction in pressure is relatively small). Stegmaier's system, and most of those who have followed to date, are of the latter type.

A schematic arrangement of the Stegmaier system is shown in Fig. 1. The reduction in pressure is provided by means of a small vacuum pump driven off an extension of the engine crankshaft. This is connected via a check valve to a reservoir or reserve tank, thence feeding to a selector valve. Each end of the selector valve feeds to opposite sides of a diaphragm unit so that, in effect, the diaphragm can be sucked one way or the other. This mechanical movement is carried to the control surface via a rigid rod anchored to the centre of the

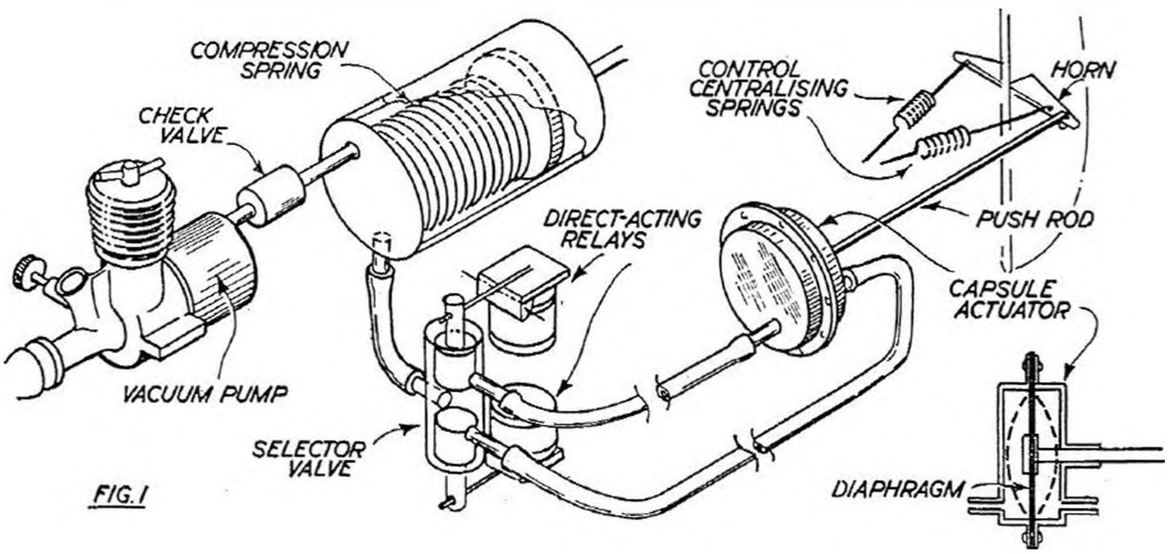


FIG. 1

diaphragm. Depending on the pressure in the system and the area of the diaphragm, the actual force transmitted by the push-pull rod can be adjusted, as necessary.

In the Stegmaier system, control of the selector valve is by means of relay-type switches operating direct on the valve. Any number of such selector valves can be coupled up with pairs of relay-type controls, each feeding a different (mechanical) control system, if required. The only requirement is that separate control signals must be available for each relay-switch pair, such as available in a multi-reed receiver. A single control system could, of course, equally well work off a single channel receiver the relay-switches then being controlled by the normal receiver relay.

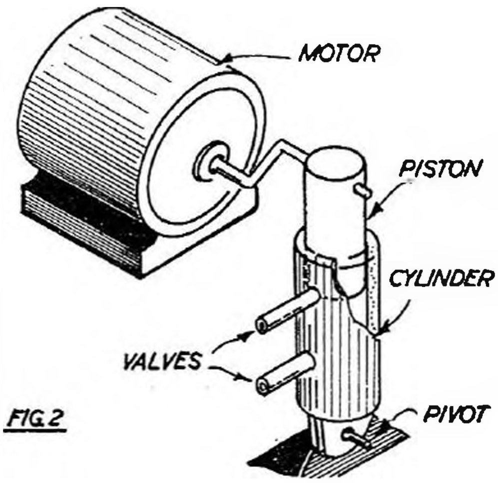


FIG 2

The reservoir is necessary to supply a reserve of vacuum pressure for the system to draw on when the engine has stopped, e.g., on the glide or for ground testing. The size of this reservoir is therefore largely governed by the "engine off" requirements—how many separate control systems may have to be used during this period and for how many times.

An alternative method of providing the vacuum pressure, which has been tried in Switzerland, is to separate the pumping system entirely from the engine and drive the pump by a separate electric motor. Thus this system can operate throughout the flight, dispensing with the need of an air reservoir, although this may still be employed as a safety measure to guard against excessive demand on the system being more than the pump can cope with—*e.g.*, a large number of operations at short intervals. Brief details of a type of pump produced for this purpose by Degen, Shenker and Fischer, are summarised in Fig. 2.

The basic pneumatic system will, of course, work equally well with positive pressure—reversing the action of the spring in the reservoir of Fig. 1 and also reversing the control sequence. This method of working is, in fact, very attractive, for it may be possible to extract the necessary working pressure for the system directly from the engine and so dispense entirely with any separate pump.

An engine is, after all, working as a pump throughout each revolution with alternate negative and positive pressure cycles in the crankcase and varying positive pressure in the head. Both regions can be "tapped" for a source of pressure and this can normally be done without any appreciable loss of power in engine output.

Only a *positive* pressure can be extracted from an engine in this way. Experimental work on "tapping" the crankcase on a number of typical production 2.5 c.c. diesels have shown that a very steady positive pressure of the order of 8 ounces per sq. in. can be obtained without apparent loss of r.p.m. or any alteration in running characteristics (although, of course, it is necessary to close the crankcase "bleed" for starting, otherwise the engine will not suck in fuel). No one-way valve is necessary to maintain a steady pressure and about the only practical disadvantage is a general migration of surplus fuel from the crankcase along the pressure line. Working against a positive pressure build-up in a reservoir this flow would, of course, be held in check, but would probably

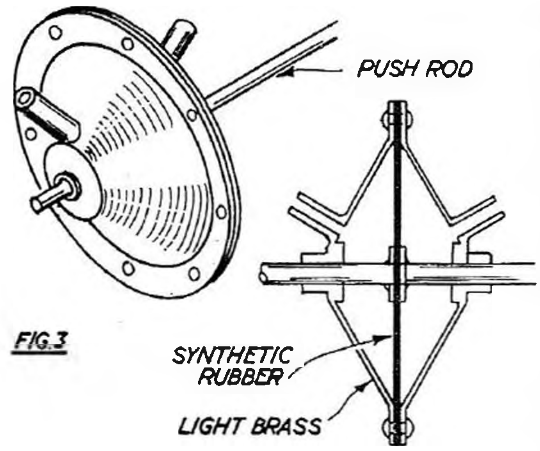


FIG. 3

tend to flow through the system on the opening of a selector valve. Hence, in effect, the system might operate partly flooded with fuel unless provision is made to stop off fluid flow, if this proves a practical proposition. Otherwise one would have to design for the possibility of fuel bleeding through the system.

American reports have mentioned tapping off positive pressure from the head of glow motors and although no working data are available, it would appear that pressures of a similar order could be obtained. Probably, too, results would be better than trying to tap the crankcase of such types.

Maximum pressure obtainable in the system is, of course, strictly limited with these methods. However, the actuating force generated by the diaphragm unit will be equivalent to the product of the available pressure and the diaphragm area. Thus assuming no losses and an available pressure of 8 ounces per sq. in., a 2 sq. in. diaphragm would produce a "push-pull" force of one pound, and pro rata for other sizes. Since 2 sq. in. represents a circle of only 1.6 in. diameter, it can be seen that the size of pressure capsule necessary to yield "push-pull" forces of a substantial order is quite moderate and readily accommodated within the fuselage of even a small radio model. Being lightweight units, too, the pressure capsules can be located in the extreme rear end of a fuselage, if necessary, without aggravating balance problems. The unit sketched in Fig. 3, for example, need not weigh more than ¼ ounce complete with push-pull rod.

As a basis for further experimentation the table gives theoretical forces available for different diaphragm diameters over a range of working pressures, assuming no losses. Since a certain amount of loss will be inevitable through bleeding on a simply constructed capsule unit working figures will be reduced somewhat, but an 80 per cent. efficiency at least should readily be achieved. The lower the pressure differential the lower the anticipated losses.

WORKING FORCE (Ounces)

Diaphragm Diameter (ins.)	WORKING PRESSURE (ounces per sq. in.)						
	4	6	8	10	12	14	16
½	.78	1.18	1.56	1.96	2.36	2.74	3.12
¾	1.54	2.31	3.08	3.85	4.62	5.38	6.16
1	3.14	4.71	6.28	7.85	9.42	11.0	12.56
1⅛	3.98	5.96	7.95	9.94	11.92	13.91	15.90
1¼	4.9	7.35	9.8	12.27	14.7	17.3	19.6
1⅜	5.94	8.92	11.88	14.85	17.82	20.8	23.8
1½	7.06	10.6	14.12	17.67	21.2	24.7	28.2
1¾	9.6	14.4	19.2	24.05	28.8	33.6	38.4
2	12.6	18.9	25.2	31.42	37.7	44.0	50.3
2¼	15.9	23.9	31.8	39.76	47.7	55.6	63.6
2½	19.7	29.5	39.3	49.09	58.9	68.7	78.6
2¾	23.75	35.7	47.5	59.40	71.3	83.2	95.0
3	29.0	42.4	58.0	70.69	84.8	99.0	116.0

Gaza Vass of Hungary with his "Smoothie" type stunt design that took first place at the 1956 Soviet International meeting held in Budapest. Motor is a 5 c.c. French Micron.

WHERE DO WE GO FROM HERE?

In which HARRY HUNDLEBY *discusses the future of Stunt Control Line Flying*

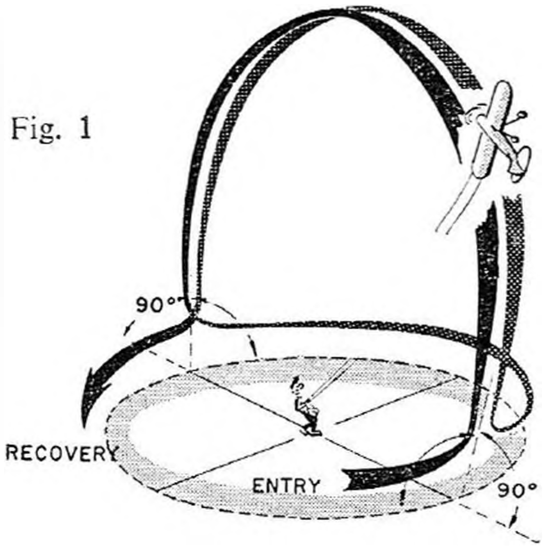
WAY BACK IN 1940 "Ole man Walker", that fabulous character of American modelling, filed a patent for a U-control device which to all intents and purposes started control line flying as we know it today.

Boosted by wartime conditions, this new phase of modelling grew at an astonishing rate, and although attacked by diehard free flight fans with cries of "bricks on strings" and prophecies that it was a five-minute wonder, it has not only survived the test of time but blossomed forth into new channels in recent years.

It is an unfortunate fact that stunt flying, the original basis of the control line theme, is losing out to the more popular sports of Combat and Team Racing. Not only the number of entries in aerobatic contests have fallen, but also the standard of flying of the *average* enthusiast, and it is obvious that if the S.M.A.E. want control line stunt flying to survive they must take new and more drastic steps to promote interest.

The author has judged the "Gold Trophy", which is, incidentally, the *only* national aerobatic contest of the year, more times than he cares to remember. He has also judged a number of control line aerobatic contests at American Service meetings in Europe, flown to the A.M.A. Stunt Schedule. There is no shadow of doubt that the A.M.A. schedule, although similar in broad outline to its S.M.A.E. counterpart, has a number of desirable features worthy of consideration by we Britishers.

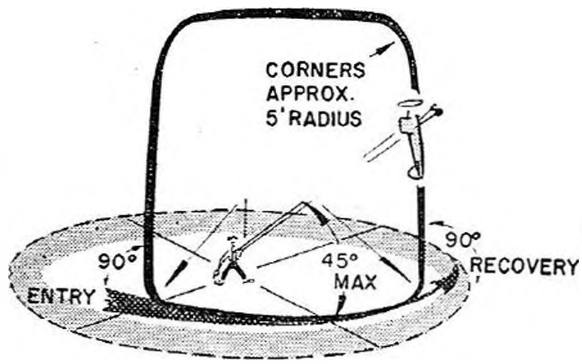
Fig. 1



Pete Russell with his "334G" which won the 1956 "Gold Trophy" event at the British Nationals. Model is semi-scale in appearance, uses elevator control only, and flies fast with an E.D. 2.46.

The inclusion of *Reverse Wing Overs* for instance, which follow the normal Wing Over as we know it. In this manoeuvre the model starts from normal level flight, makes a vertical climb and dive, passing directly over the flier's head, cutting the ground circle in half, and recovers in an inverted position at normal level flight. The model continues for half a lap inverted, to the starting point, then makes a vertical climb and dive over the centre of the circle from inverted flight and recovers in normal level flight. See Fig. 1.

After *Inside* and *Outside Loops* are completed the A.M.A. schedule takes in two single manoeuvres which, although simple in pattern are nevertheless a test of skill to perform with precision and in a form recognisable to the judges. The first is an *Inside Square Cornered Loop*, which at one time was included in the S.M.A.E. schedule, but dropped in recent years as it was considered impossible to judge. In the A.M.A. pattern, a correct square loop is judged when the model starts from normal flight, makes a vertical climb, levels off inverted with the lines at 45 degrees or less with the ground, flies inverted approximately the same distance as the climb, makes a vertical dive, and recovers into normal level flight. All corners must be smooth, precise, and of approximately 5-ft. radius. See Fig. 2. This manoeuvre is definitely not impossible to judge, but needs a skilled flier to perform same in a recognisable fashion.



The same can be said of the next manoeuvre, the *Triangular Loop*. Again the model starts from normal level flight, turns 120 degrees, proceeds in an upwards and backwards direction to an altitude of 45 degrees elevation, turns 120 degrees and flies downwards to make another 120-degree turn and recovers in normal flight altitude. All corners must be smooth, precise, and

Fig. 3

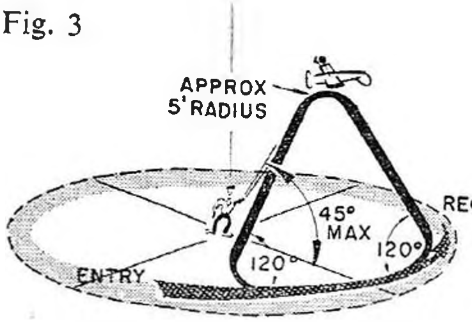
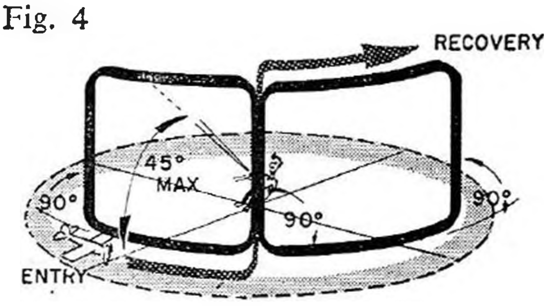


Fig. 4



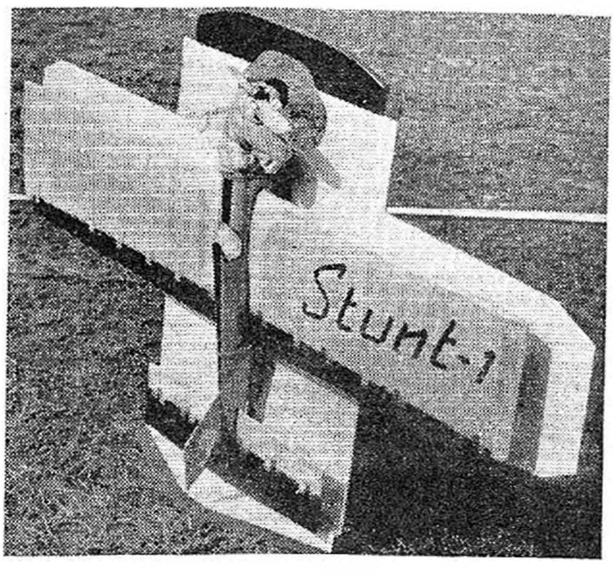
of approximately 5 feet radius. Fig. 3.

After the normal horizontal, vertical and overhead eights, the A.M.A. pattern embellishes the "eight family" with a *Square Cornered Horizontal Eight*, which is similar to the normal horizontal eight except that the corners are squared off, see Fig. 4. There is also an optional digression from the normal landing in the form of a *Spot Landing* which can be included at the discretion of the Contest Director.

Also worthwhile is the A.M.A. system of awarding *Flight Pattern* points up to a maximum of 25 (see the last line in the score sheet. Fig. 5). These points are awarded to every contestant who completes the entire stunt schedule in its correct sequence, and within the stipulated time limit. Omitting any manoeuvre or completing a manoeuvre out of its proper sequence results in loss of flight pattern points, likewise if the model crashes or the engine fails.

From the judge's viewpoint, the A.M.A. scoring system is first-class, and the system of marking, even for a relatively inexperienced judge, almost foolproof. A typical marking sheet is shown in Fig. 5, where it will be noticed that all the judge has to do is to tick in the appropriate column against each manoeuvre. It is, of course, essential that the judge knows what to look for in every stunt. To know the shape, the method of entry, the angle of lines, to watch for circle wandering and the many other vital factors that make or mar the

At the 1956 Criterium of Europe Roggl of Austria, *on right*, flew a "Bluepants". Also seen was this novel Dutch system for transporting two stunt models, which utilised a plywood silhouette with a model lashed either side.



Only A.M.A. sanctioned meeting in Europe in 1956 was the USAAFE contest at Wiesbaden, Germany, where stunt flying to the A.M.A. pattern was flown. The entry being examined here by Contest Director Hank Brewer on left, and Captain Laughton on right, was built by Glenn Howard from a Veco kit. It is, of course, Bob Palmer's latest model, the "Thunderbird", and this particular example is a very fine piece of aeromodelling construction and finish.

Below, Watson of Lewisham with Fox 35-powered stunt model flown at the 1956 Gold Trophy.

perfect pattern. It is essential that each manoeuvre is marked immediately it is made, hence the author's appreciation of the A.M.A. marking system, which avoids the impossible task of marking actual points down during the flight.

Many stunt fliers do not realise the difficult task that *accurate* judging entails and how much easier they can make things by a little intelligent co-operation and forethought. It is absolutely essential to fly at least one level lap between each manoeuvre, two if you have a fast model, and please remember to signal by raising your free hand before commencing the next item in the pattern. After all, if your method of flying is such that it rushes or confuses the judge, you are not likely to come out of the circle with bonus marks!

For heaven's sake learn the stunt pattern by heart before you enter the circle, otherwise you can never hope to reach the top. A famous American Stunt flier, when asked how one can become a consistent winner, said that he saw the pattern as a piece of chain, each link representing a different set of manoeuvres, with each set smoothly joining the others. If you have a rusty link in the chain, don't break it just to practise the manoeuvres that need attention. Practice the full pattern each and every time, which will not only improve your poor manoeuvres, but the good ones as well.

Equally important is your aeroplane, which must be built to perfection if you want those appearance points. Be sure that all control linkages are completely free, that your lines are the right length and in good condition, and that your surfaces are rigged correctly. Positive or

PRECISION ACROBATIC SCORE SHEET

Name .... Contestant or AMA No. ....

Design ...3..... (1-8) Workmanship ...3.... (1-8) Detail ...2.... (1-8) Total ....8...............

	POOR	FAIR	GOOD	EXCELLENT	SCORE
Appearance					8
Take-off (within 1 min.)	5	5	5	5	5
Take-off	1	2	3 ✓	5	3
Level Flight	1	2	3 ✓	5	3
Climb	1	3	~~6~~ —	~~10~~	8
Dive	1	3	6 +	10	7
Wing-over	3	5	7 —	10	6
Reverse Wing-over	3	10	~~15~~ —	~~20~~	17
Inside Loops	5	~~10~~ —	~~15~~	20	12
Inverted Flight	5	10	15 —	20	14
Outside Loops	5	10	15 +	20	16
Inside Square Loop	5	10	15 —	20	14
Triangular Loop	5	~~10~~ —	~~15~~	20	12
Horizontal Eights	10	20	30 +	40	32
Vertical Eights	10	20	30 ✓	40	30
Overhead Eights	10	20	30 —	40	28
Square Eight	10	20	30 ✓	40	30
Landing	1	7	14	20 —	18
Spot Landing					
Flight Pattern	25	25	25	25	25
TOTAL					288

Fig. 5.—Score sheet system is simple—take-off within one minute points, if earned, are indicated by ringing around figure "5". Manoeuvres rated as poor, fair, good or excellent are merely ticked in the appropriate column. Slightly less than fair is marked by a minus sign or slightly better than fair by a plus sign. If the judge feels the manoeuvre was half way between fair and good for instance, he connects the two marks with a line.

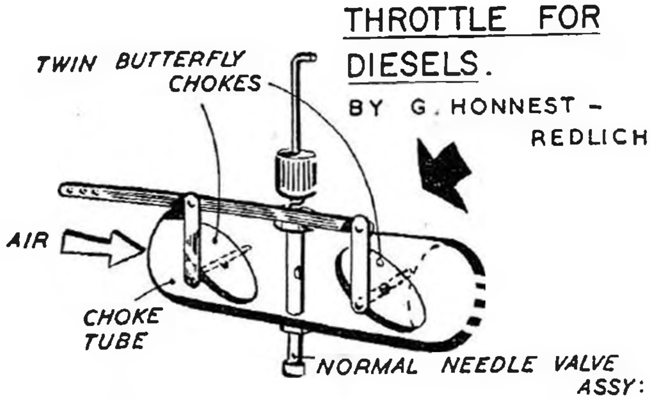


Fig. 6a

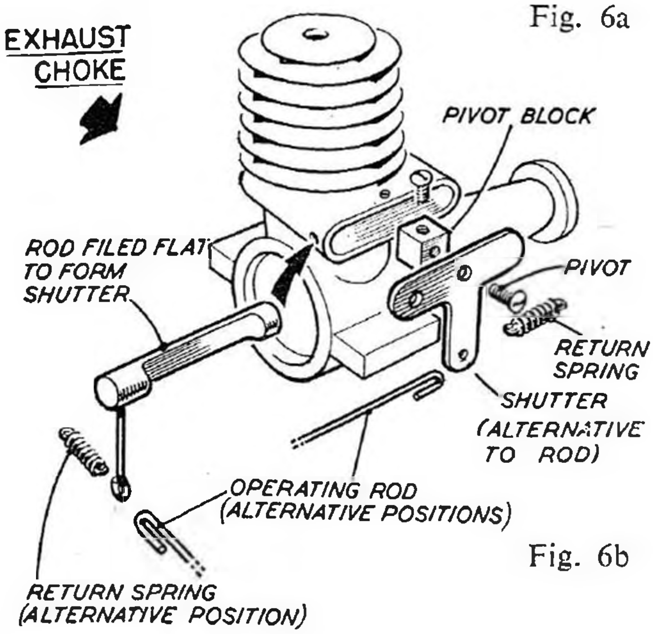


Fig. 6b

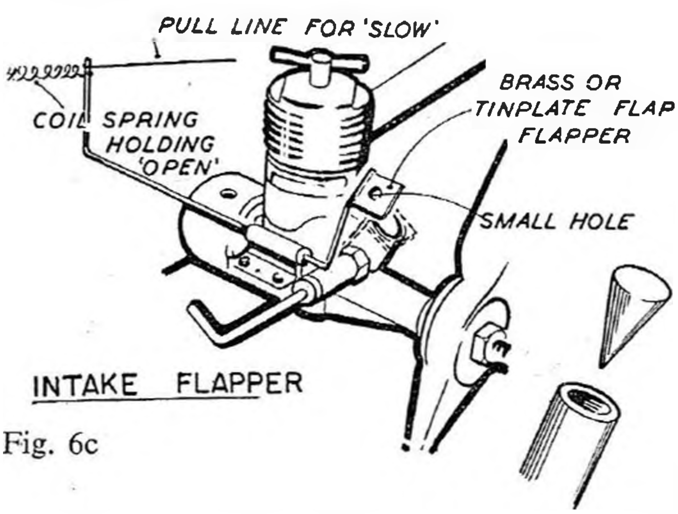


Fig. 6c

negative incidence on the flying surfaces can cause trouble, see that they are built accurately at 0 degrees. Make certain your tank is big enough and the motor absolutely 100 per cent. upright or inverted.

Returning to the question of stunt schedules, the S.M.A.E. would do well to carefully consider the A.M.A. pattern which is more advanced and more entertaining to the man on the end of the handle. For the advanced flier, the S.M.A.E. stunt schedule is now definitely boring and we can safely say that the decrease in flying standard amongst the top boys, so noticeable at the 1956 Nationals, was due to the fact that they have lost interest in the present schedule.

The lack of entries might be traced to another source, which may well be that the flier of average standard passes up the "Gold Trophy", as he feels that he does not stand a chance against the experts.

To a certain extent this is true, and the obvious answer is to run two national stunt contests, one for the experts using an advanced pattern, the other for the average stunt flier using a simple straightforward pattern, rather on the lines of the present schedule. This latter event would be open only to people who had not placed within the top twelve in the "Gold Trophy", or on some similar basis.

As an alternative scheme, both for expert and beginner, we might consider an entirely different approach to stunt flying, which is a complete departure from the long established stunt patterns.

Last year in *Flying Models*, an enthusiast rejoicing in the name of "Swede" Johnson suggested, like the author, that control line flying could do with a shot in the arm. In an article entitled "Fun Day", he put forward a number of obstacle type manoeuvres on the basis they would provide an entertaining yet different day's flying for the club boys.

The author sincerely believes that a series of such tests could well be introduced into an official advanced stunt schedule, which would then be sufficiently different to attract the interest and test the skill of our foremost stunt experts.

Before describing some of these tests, there is one additional control that could be introduced as a further test of the operator's manipulative skill, and that is engine control. By means of a choke tube, a clapper valve of the Jim Walker type, or a twin needle valve set-up operated by a third line, one could perform slow speed manoeuvres. It would also be possible to arrange an engine cut-off by means of the same line.

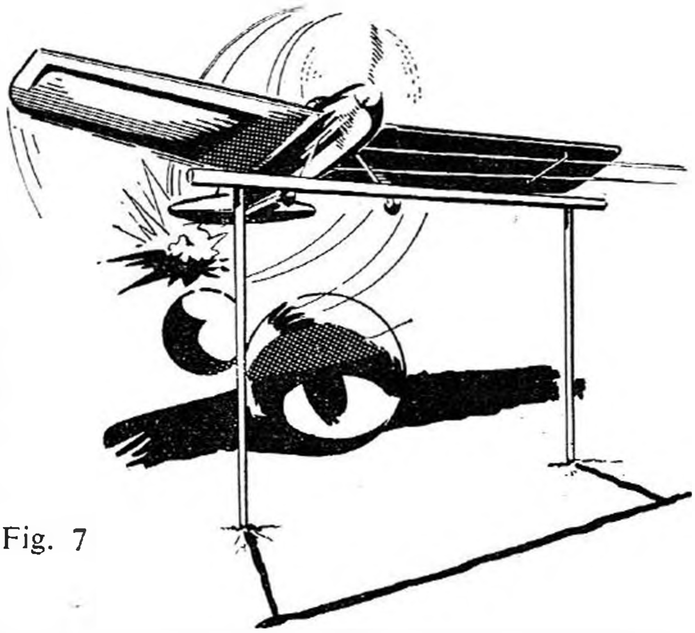


Fig. 7

There are various schemes for obtaining two speed engine control with diesel motors. Fig. 6A shows George Honnest Redlich's twin butterfly throttle set up developed for radio control purposes which will, of course, operate quite happily off a third line with the addition of a spring to hold the throttle in the *half speed position.* This is preferable to operating the other way round, as by means of a trigger on the control handle, one merely holds against the spring tension when flying under full throttle, releasing the trigger for half speed when spot landing, etc. Fig. 6B shows two versions of the Jim Walker scheme which is only suitable for diesels with exhaust stacks such as the E.D. 2.46 and the Amco 3.5. In one version the T-piece is pivoted on a metal block screwed to the stack and blanks off the exhaust port by varying degrees according to the amount of movement given. A hole is drilled through the T-piece to prevent complete blocking of port. The other version utilises a rod which pivots through the port longitudinally, and which has a flat filed on one side so that it opens and closes the port according to the amount of movement. Both schemes, it will be noted, have return springs working on a similar principle to 6A.

In 6C we have a simple clapper valve which can be modified quite simply for motors with rear induction. A hole is drilled in the clapper to prevent complete choking and, as an alternative, one can use a cone shape clapper which fits into the intake. By these various methods

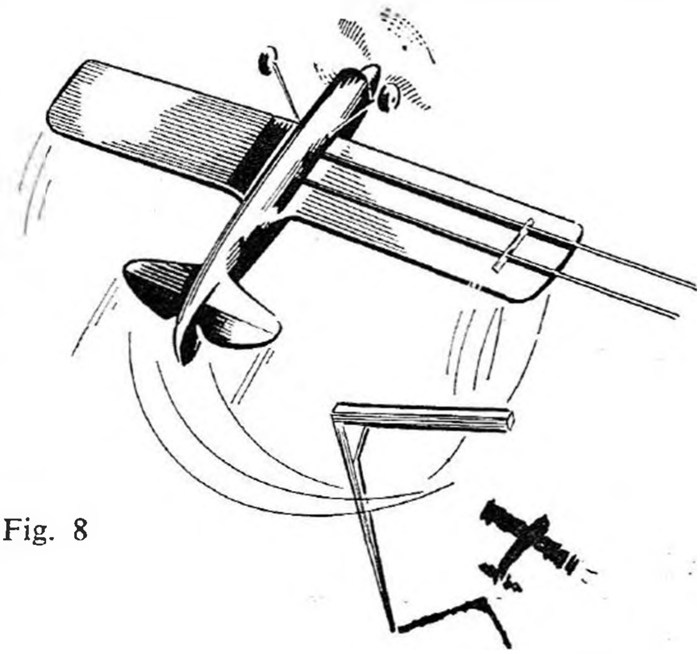


Fig. 8

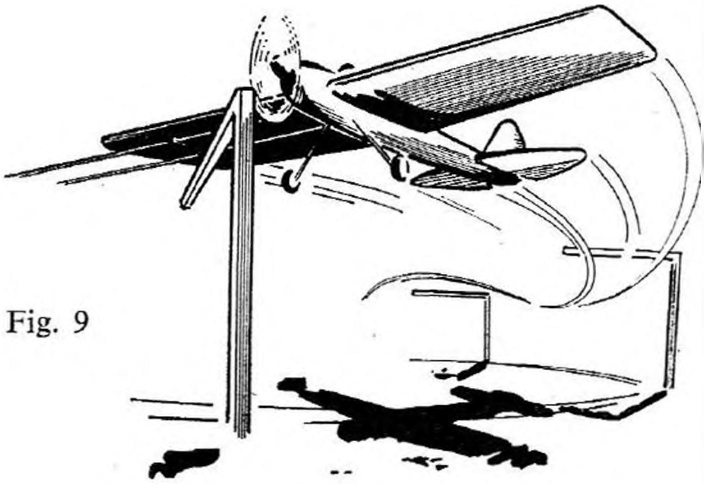


Fig. 9

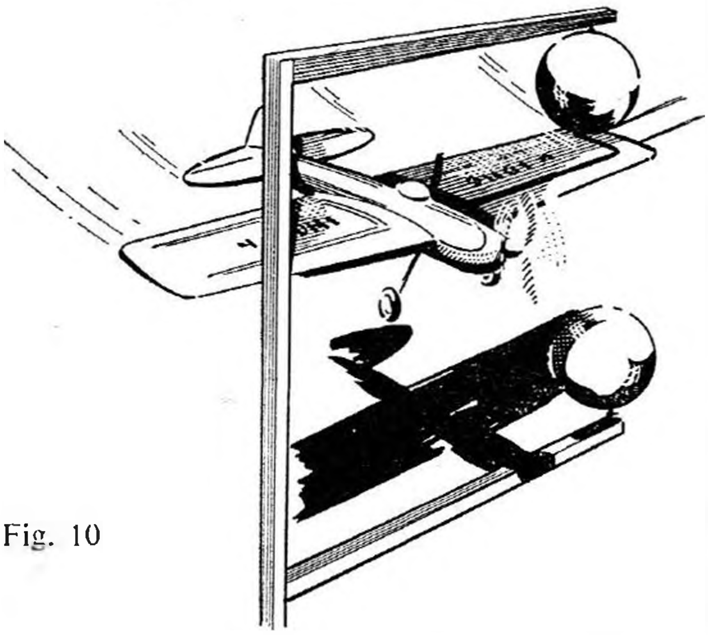


Fig. 10

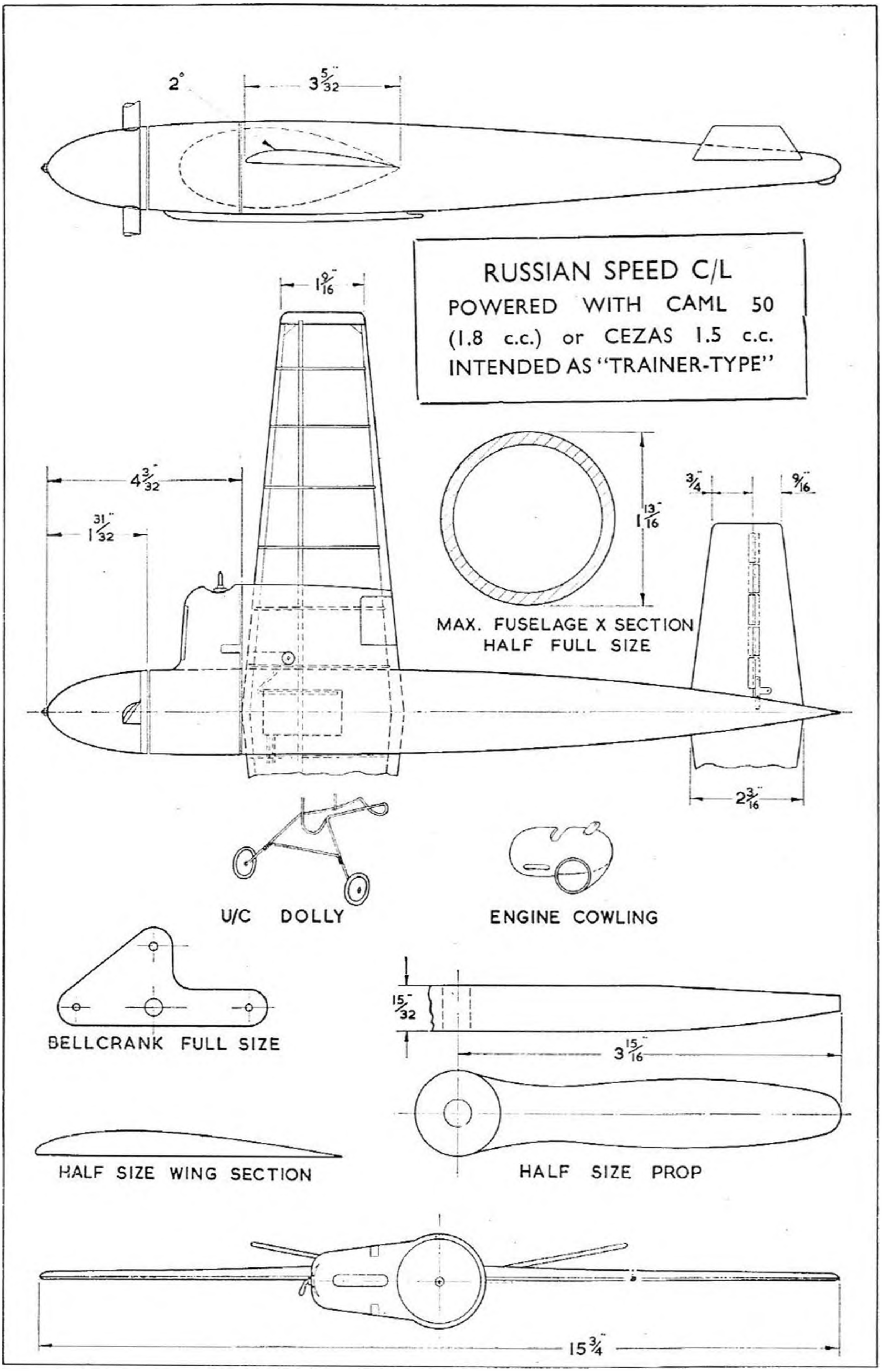
we could introduce that wonderfull decider the *Spot Landing*, which so far has avoided a tie between the experts in Radio Control. A landing mat marked off in a grid, both in front and beyond the actual marker, operated in conjunction with a points system, would provide a real test of engine operation coupled with an accurate assessment of the model's glide characteristics on the part of the operator. A further test would be the control line equivalent of a radio control *Touch and go*, where again skilful operation of the engine two-speed control would be used to perform a wheel touchdown over a given section of the flight circle.

In Fig. 7 a light balsa barrier some three feet high, made of strip is used as an obstacle. A row of balloons with the nearest placed on the ground approximately ten feet from the barrier is arranged. The rest of the balloons are each a foot further away, arranged so that they step up to a height of two feet. The idea is to break the balloons in order, starting with the one furthest from the hurdle. Breaking the hurdle or missing a balloon voids the attempt, and once the stunt is started, the flier must break a balloon on each pass. Fig. 8 shows another strip balsa "gallows" positioned at the downwind side of the stunt circle, which serves as a test of accurate positioning as well as correct shape, when performing the normal *Loops* and *Inverted Loops*. This embellishment will certainly cure those people who tend to drift their successive loops around the flight circle!

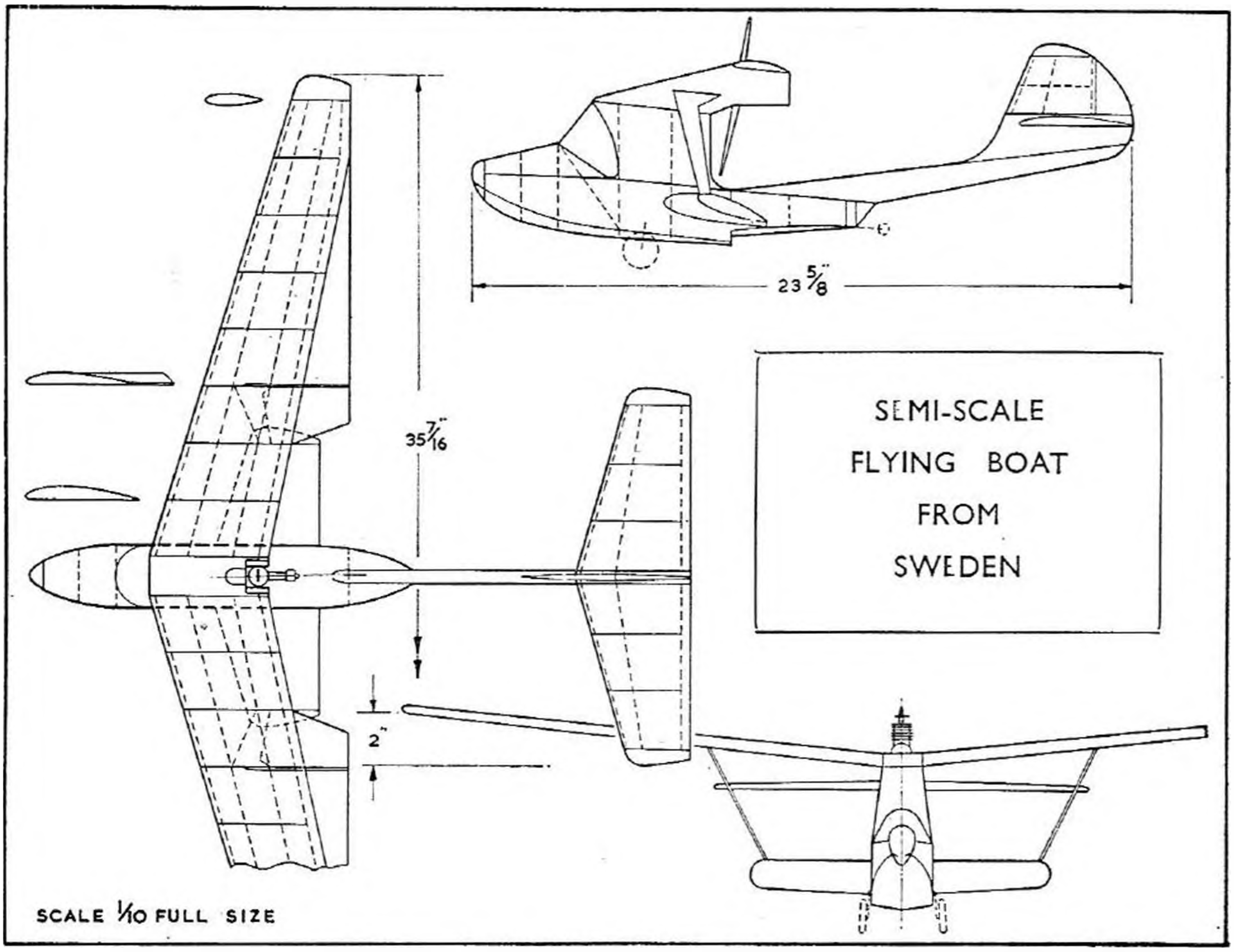
Things start to get a little more difficult in Fig. 9, where three open ended hurdles four feet high are used for an "under over" or "over under" manoeuvre according to taste. If you want to be really different, try this one inverted!

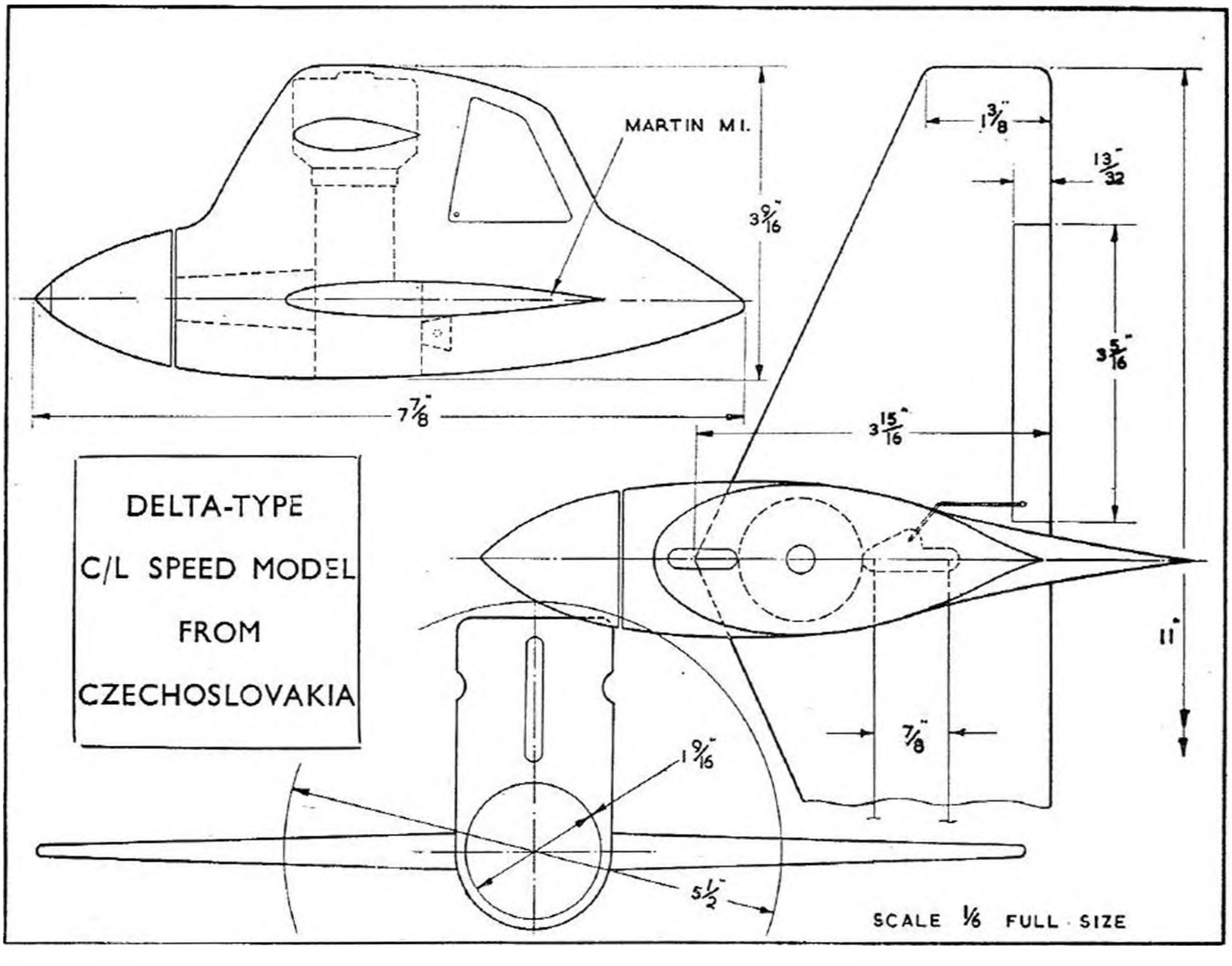
Another theme is the double gallows arrangement (Boy! We sure get hung up!) in Fig. 10. The distance between the two balloons is the overall height of the model plus 6 in. remembering to make allowance for prop clearance.

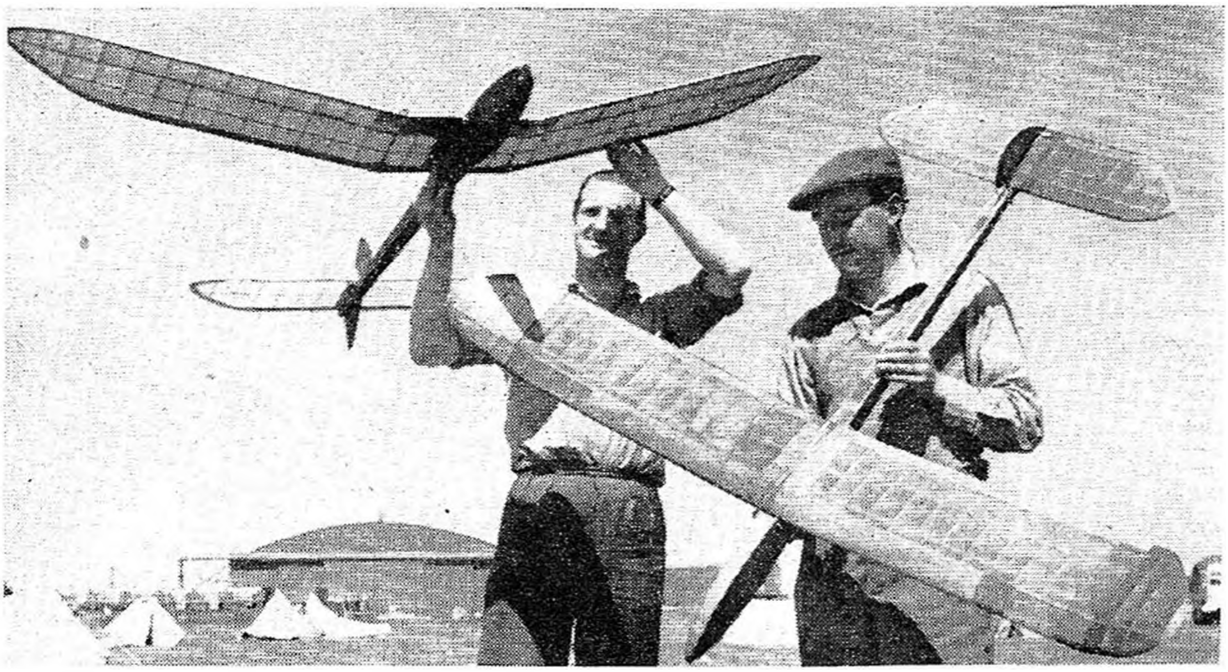
These are but a few of endless obstacle themes that can be thought up which could brighten the present mundane stunt schedule. With most of our top notch stunt fliers already deserting in the direction of the Team Race and Combat circles, something has to be done if stunt flying is to survive.



2°
3 5/32
1 9/16
RUSSIAN SPEED C/L
POWERED WITH CAML 50
(1.8 c.c.) or CEZAS 1.5 c.c.
INTENDED AS "TRAINER-TYPE"
4 3/32
1 31/32
1 13/16
3/4
9/16
MAX. FUSELAGE X SECTION
HALF FULL SIZE
2 3/16
U/C DOLLY
ENGINE COWLING
BELLCRANK FULL SIZE
15/32
3 15/16
HALF SIZE WING SECTION
HALF SIZE PROP
15 3/4


23 5/8"
35 7/16"
2"
SEMI-SCALE
FLYING BOAT
FROM
SWEDEN
SCALE 1/10 FULL SIZE


MARTIN M1.
3 9/16"
7 7/8"
1 3/8"
13/32"
3 5/16"
3 15/16"
11"
7/8"
1 9/16"
5 1/2"
DELTA-TYPE
C/L SPEED MODEL
FROM
CZECHOSLOVAKIA
SCALE 1/6 FULL SIZE



Author Jim Waldron and Henley clubmate Dave Painter, with their very successful Pelican Gliders at the British Nationals, 1955. Dave placed first and Jim third in this event out of 123 entrants. Note the difference in upper fin position and dihedral of these models.

IMPROVING THE CONTEST GLIDER

By J. G. WALDRON

GLIDERS ARE the one type of contest model in which the "luck element" of thermal conditions plays a major part towards the attainment of success. This does not, however, detract from the fact that *consistent* successes must come from an aerodynamically sound model combined with a sound flying technique, and for this reason, well-known names still recur at the top of the glider contest lists.

It is the writer's intention here to summarise the more basic requirements of competition glider flying, both from the point of model design and also flying technique.

Performance and Flying Stability

It is impossible to attain consistent high performance if flying stability is lacking, and equally impossible to use the performance available if the model has poor towline stability.

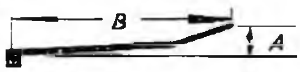
Aerofoils

Aerofoil selection has an important bearing on stability considerations; for maximum performance it is desirable to obtain the highest lift coefficient commensurate with a reasonable coefficient of drag, and this is only obtained near the stall. This operating condition is obtained by correct location of the C.G. and rigging of the tailplane, and in the normal way would continue indefinitely were it not for the attenuated conditions which the model must often fly in.

Most aerofoils can give good accounts of themselves in calm evening conditions, but in rough weather (even with modified tailplane rigging) many perform very indifferently.

Highly chambered sections (above 6%) are very prone to instability in rough weather, partly due to their large centre of pressure travel and also

FIG. 1. DIHEDRAL RATIO FOR TYPICAL MODELS

Model	Type of Dihedral	Tip Dihedral b/a	Notes
SERAPH		1 in 5.9	Published Dec., '53 A.M.
NEBULA		1 in 8.95	Published July, '54 A.M.
AURIKEL		1 in 8.6	By Hans Hansen
M.P. 12		1 in 6.5	By M. Hacklinger
SPINNE		1 in 5	By R. Lindner
TOOTHPICK		1 in 4.8	By O. Czepa
A1 WINNER		1 in 6	By A. Ortnover June, '55 A.M.
PELICAN		1 in 5.85	Published March, '56 A.M.
1950 A 2 WINNER		1 in 4.75	By S. Bernfest
BG.44		1 in 6.2	Published Jan., '53 A.M.
ALTAIR		1 in 6.0	Published Sept., '55 A.M.

due to the tendency at model speeds for airflow to partially break away without completely stalling the section, this readily occurring in the momentary "lull" after meeting a gust.

It has been found that retrimming a model suffering from this trouble gives no better performance in these conditions than that obtainable from a model a lower cambered section (say 4%) which has not had its rigging changed.

It is possible to alleviate this trouble, however, by use of turbulators as described later, but it is still necessary to make some adjustment to the tailplane.

A conclusion that can therefore be immediately formed is that if we intend using a highly cambered section for all-weather flying, we must provide a high degree of static longitudinal stability (as described later), and if wishing to "play safe" and avoid risk of inconsistency induced by aerofoil characteristics, then use a lower cambered section such as N.A.C.A. 4409 or SI. 53009.

Wing Chord

Chord length has a very definite bearing on both attainable performance and also any tendency towards the upper surface airflow breakaway mentioned earlier.

In order to reduce induced drag to a minimum, a high Aspect Ratio is desirable with ratios of 10-12/1 and above, but this means an inefficiently low wing chord on any models below A2 size, and the reduction in drag is offset by loss of aerofoil efficiency.

Much thought has gone into improving efficiency at low chord sizes and flying speeds over the past few years, and to this end turbulence induced in the surrounding boundary layer of air has been found most effective.

Four methods of doing this have been, or are in current use:—

1. Sharp leading edges, such as in Isacson aerofoils.
2. Turbulence Spar on the upper leading edge, as used by Ellila.
3. Turbulence Thread or wire in front of the leading edge, as used by Hacklinger.
4. Perforated wing leading edges, as developed by the British M.A.R.P.

Roy Yeabsley and the prototype of his Nebula design demonstrating the experimental wing flap used to ascertain correct angle of droop and also the inevitable Yeabsley eliptical wing tips

It is not generally appreciated that the efficiency of a wing section is also dependent on the wing loading of the model. At a certain value of CHORD FLYING SPEED, an aerofoil's efficiency drops off sharply, and in order to improve matters it is necessary to increase either of these values. Increasing wing loading by adding weight has the effect of increasing flying speed, so in effect the model is being given an increase in penetration, which ensures improved airflow.

A typical case is the writer's A.P.S. PELICAN design, which has a 9 in. wing chord. With the same 4 oz./sq. ft. wing loading, one of these models was experimentally flown with a higher Aspect Ratio Wing of 7.5 in. chord using the same section. Despite the reduction in induced drag, this model was found to be no better and if anything less consistent than with the 9 in. chord.

Some readers may also have flown their A2 models as lightweights, only to be mystified by little or no apparent increase in performance.

Generally speaking, it has been found that 6.5 in. is the lower limit for aerofoils of 6% chambered and above used on A2 models without use of turbulators. For small models or lightweight designs, it is definitely good practice to keep wing chord as large as possible, and wing aspect ratios can be safely dropped to figures of 7-8/1; use of lower chambered aerofoils also makes for efficiency on these types.

Wing Tips

Losses occur at the tips due to high-pressure air on the underside of the wing spilling over into the low pressure region above it, this resulting in the formation of drag vortices.

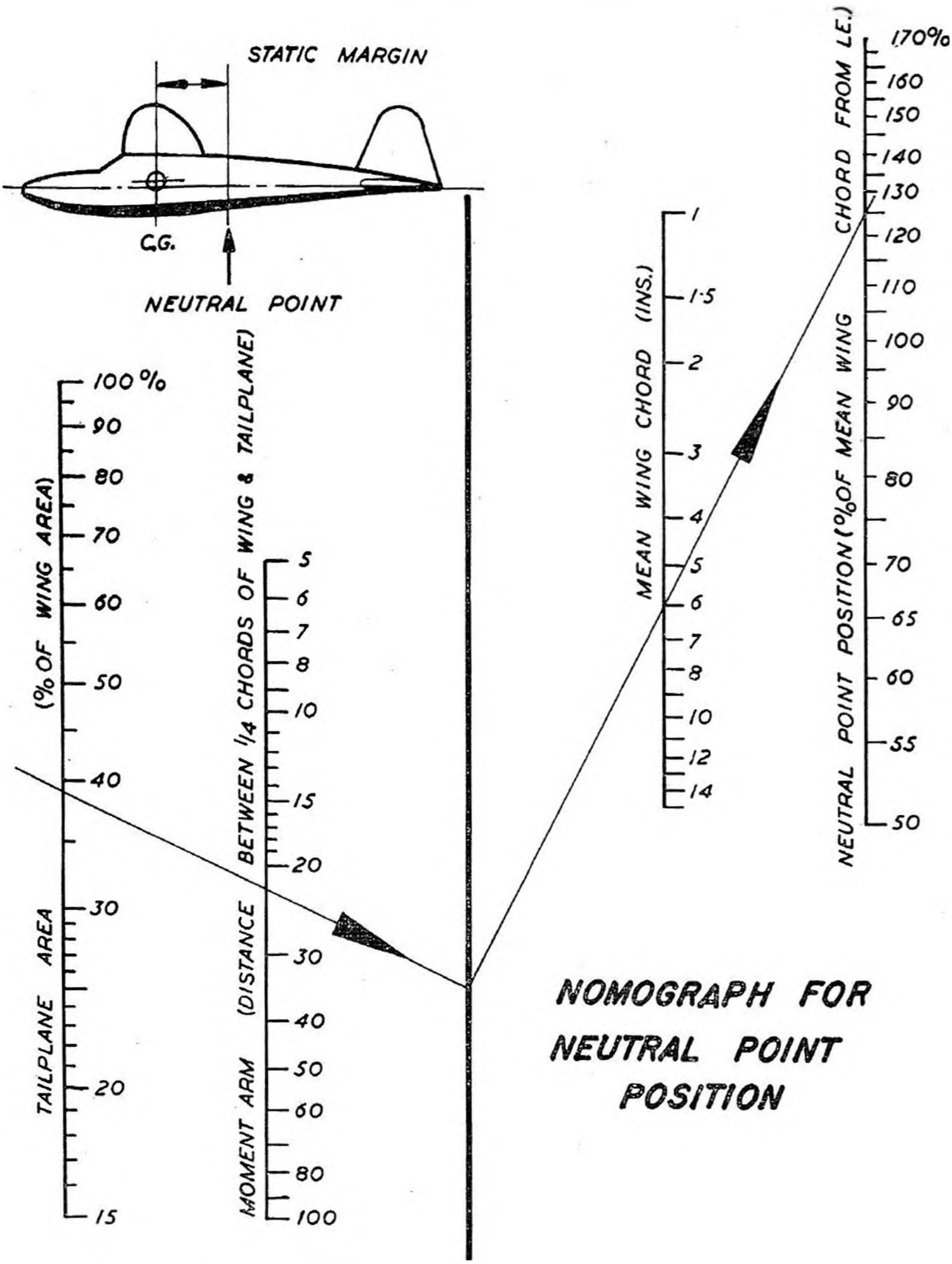
These vortices can be reduced or eliminated by the use of "endplate" tip fins. However, if excessive in size, these fins can induce instability in gusty conditions due to becoming stalled in side winds.

Square tips cause considerable drag, although aerofoil efficiency is good right up to the end of the wing; if it is intended to use these, reduction of tip chord as in GUNIC's BG.44 is a good compromise.

Elliptic types as used by Hacklinger and Yeabsley are probably the most efficient for all conditions; the writer's experience appears to confirm this.

Dihedral

The only function of dihedral is maintenance of lateral stability, a table of values for typical well-known models being given in Fig. 1. Excessive dihedral does not greatly affect performance, but requires a large Tail Fin in order to



NOMOGRAPH FOR NEUTRAL POINT POSITION

prevent inefficient wallowing on the glide known as "Dutch Rolling", also a large Tail Fin is bad for tow-line stability; the rule for fin area is thus "enough for glide stability and no more".

Longitudinal Stability

Neutral Point

On any aircraft, there is a point between the wing and tailplane quarter-chords which is termed the "Neutral Point", and can be described as the point at which the resultant lift of the wing and tailplane due to any change of flying attitude takes effect.

For longiitudinal stability to be present this point must always lie aft of the C.G., the lift then having a stabilising effect during any change of flying attitude, and the distance between these two points is known as the Static Margin. Should the C.G. lie on or aft of the neutral point, it will be impossible to stabilise the model by rigging the wing or tailplane at any angle relative to one another, and conversely increasing the Static Margin by enlarging the tailplane or its moment arm improved the longitudinal stability.

FIG. 3. TYPICAL MODEL NEUTRAL POINT POSITIONS

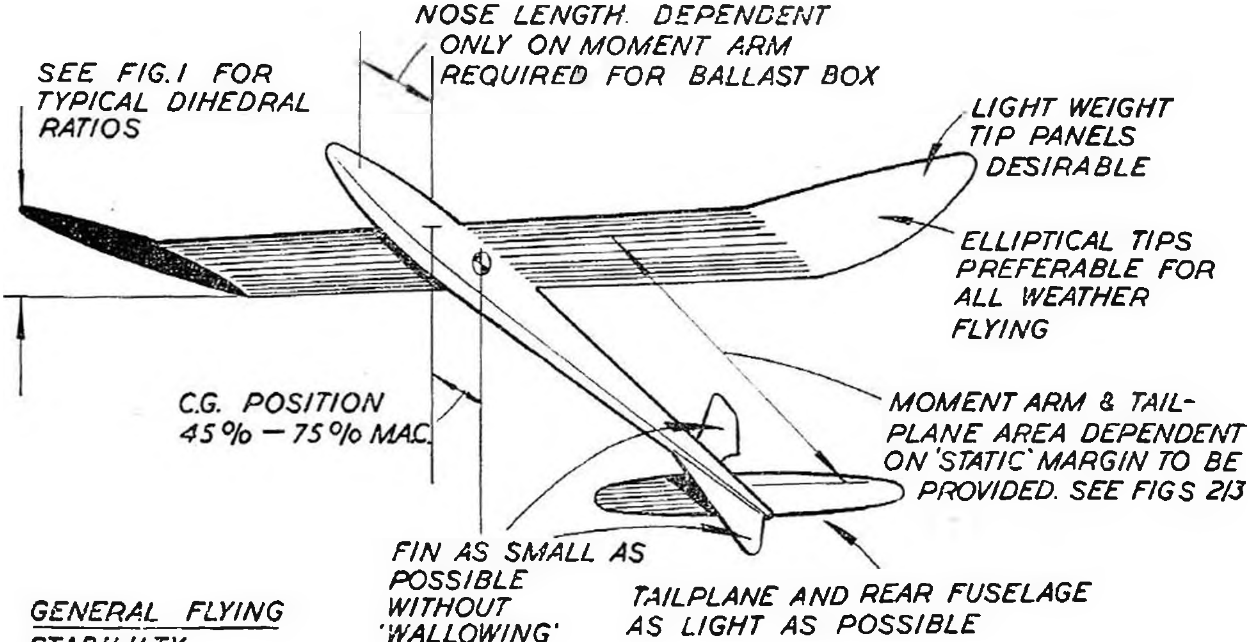
Model	Neutral Point Position % M.A.C. from L.E.	Static Margin % M.A.C.	Notes
SERAPH	90%	30%	
NEBULA	90%	40%	
AURIKEL	83%	33%	
SPINNE	88%	32%	By R. Lindner
BG.44	75%	25%	
PELICAN	95%	45%	
M.P.12	80%	18%	C.G. at 62% for rough weather
M.P.12	80%	5%	C.G. at 75% for calm weather

A graph for Neutral Point position is given in Fig. 2 and a selection of positions for typical models in Fig. 3.

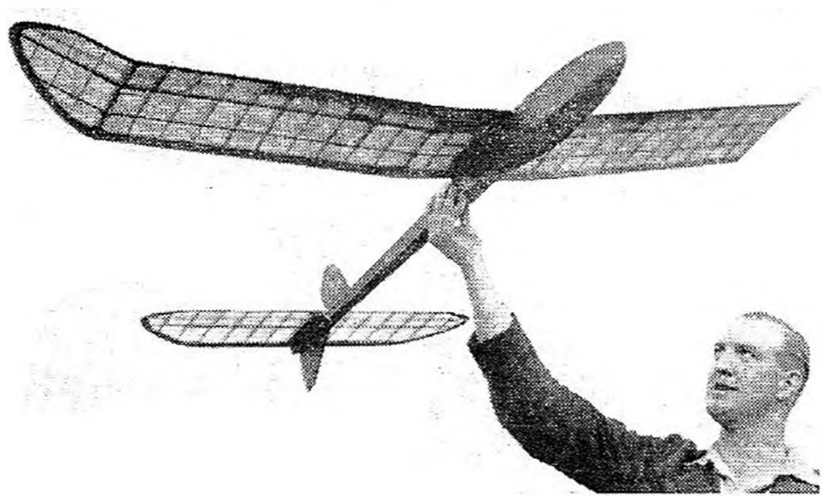
Dynamic Effects

Another important factor affecting longitudinal stability is the amount of weight distributed fore and aft of the C.G. Excessive weight at the rear of a fuselage requires extra nose ballast weight in order to maintain a reasonable C.G. position, and these give rise to excessive moments of inertia about the C.G. during any change of direction in pitch.

From this it follows that a model with a long heavy fuselage and a small static margin would have considerable difficulty in returning to level flight from any fore and aft oscillation. An improvement would naturally be effected by increasing the tailplane area or moment arm, but it is clear that keeping the



GENERAL FLYING STABILILTY CONSIDERATIONS



Author and his Pelican. Revised polyhedral compares with photo on page 121. The Pelican has a tremendous list of contest successes in open events.

extremes of a fuselage light and concentrating weight round the C.G. is advantageous. These same rules also apply to distribution of weight in the wings, for if the outer panels are excessively heavy (even though balanced) lateral stability will suffer considerably and side-slip recovery be affected.

Towline Stability

This subject has been dealt with more fully in the writer's article in the July, 1955, "AEROMODELLER", and need only be briefly summarised here.

Fig. 4 shows the basic requirements, which in order of merit are as follows:—

1. Correct hook position.
2. Correctly functioning auto-rudder.
3. No flying surface or fuselage warps.
4. Balanced wings.

Position of Hook relative to the C.G. is very important; if too far aft the model is impossible to tow, while if in a forward position, weaving from side to side will result; the correct position lies between these extremes and can be obtained by moving either Hook or C.G.

Forward Keel Area is useful in making the model less sensitive to hook position and it should be remembered that increasing tail fin area will not cure an unstable model; it is also interesting to note that use of forward side area is now becoming common on slope soaring gliders.

Fuselage

Configuration of the fuselage is far from critical on gliders, the only function of it being to hold the wing, tailplane and fin at a given distance and setting relative to one another, also provide stowage for ballast and location for the tow hook and auto-rudder system.

Distance between wing and tailplane can be decided from the considerations in Figs. 2 and 3 and nose length is dependent on the moment arm required for the ballast box.

Model glider C.G. positions are rarely forward of 45% M.A.C. these days, and usually not farther aft than 75%; nose length is thus very much dependnet on the weight of the rear fuselage and tailplane.

As the fuselage contributes only a small proportion of drag to the total for the model, it is better not to lavish a highly glossy finish on it if the result will only be extra weight added over its length; far better indeed to concentrate on the finishing and accuracy of the wings.

From the strength requirement point of view, one factor which must be borne in mind, is the shock bending load imparted to the fuselage at the

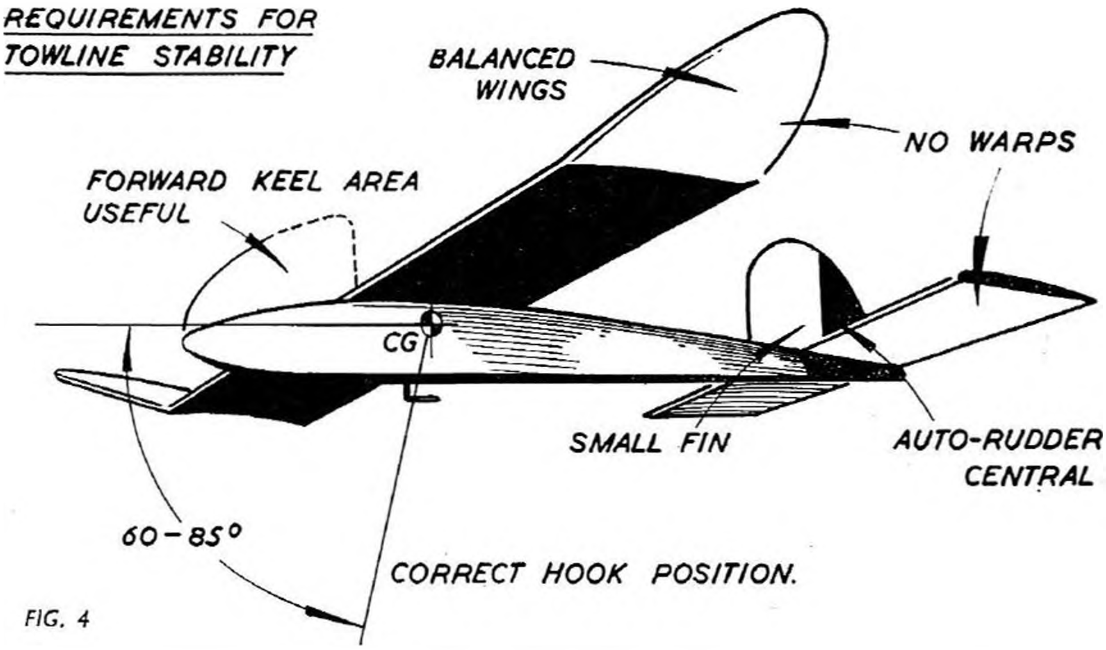


FIG. 4

termination of a fast D/T descent. This can often crack or break a thin fuselage, especially immediately forward of the tailplane; the remedy is obvious.

Contest Flying

Generally speaking, this means the application of a compromise of the points already mentioned.

Towline reliability is essential, and fast towing checks when trimming in calm conditions are necessary in order to simulate windy weather and show the presence of any warps or unbalance.

Prevention of warps is very important, and undoubtedly the best method of doing this is to keep the flying surfaces strapped on suitably shaped boards when not in use, this eliminating the complication of anti-warp construction techniques.

When flying, in order to make maximum use of any thermals present, a reasonably tight glide circle is necessary, this conflicting with the wide circuit required for maximum performance in calm conditions.

Short fuselage models are undoubtedly most suitable for rough weather flying, experience showing that "Toothpick" type designs, although good in calm conditions are not suitable for flying in rough "thermal" weather.

Trimming for maximum performance in calm weather means obtaining the maximum power factor $\frac{(Cl\ 1.5)}{Cd}$ as mentioned earlier this occurring near the stall. For rough weather flying, in order to maintain flying speed above the stall, it will be essential to increase the Lift/Drag Ratio, maximum value for this occurs at a lower angle of incidence than for the maximum power factor and is the *flattest* angle at which the model can glide.

To achieve this, extra positive tailplane incidence is necessary and it is much better to adopt this course of action than use an even tighter turn when flying in rough weather.

Possible Future Developments

There is still much practical development which can be done on gliders, particularly on aerofoils.

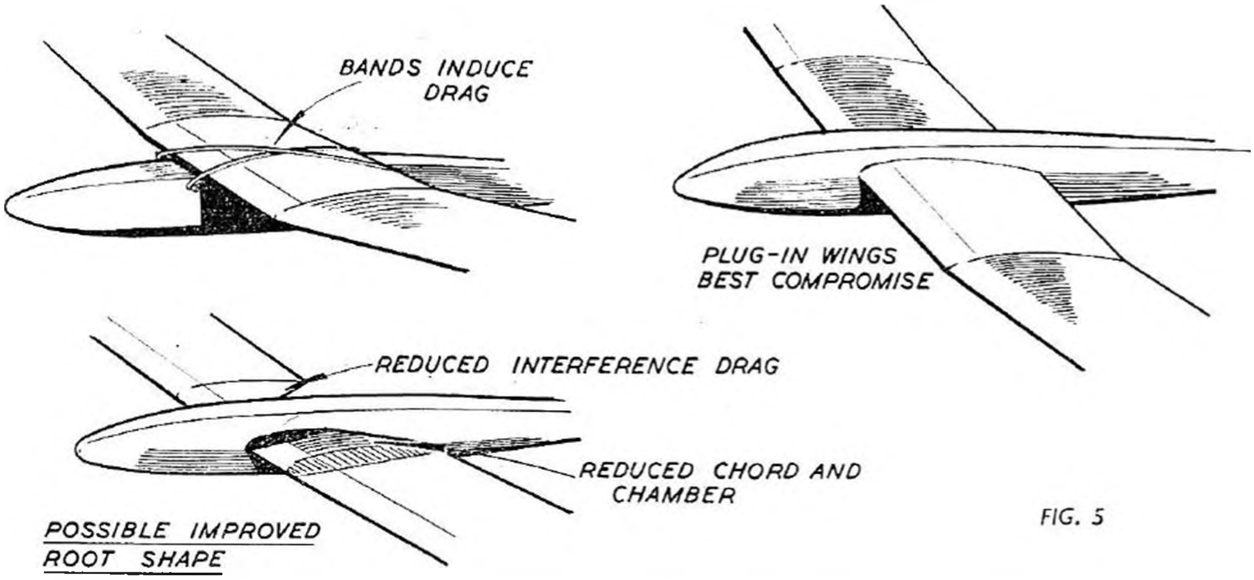
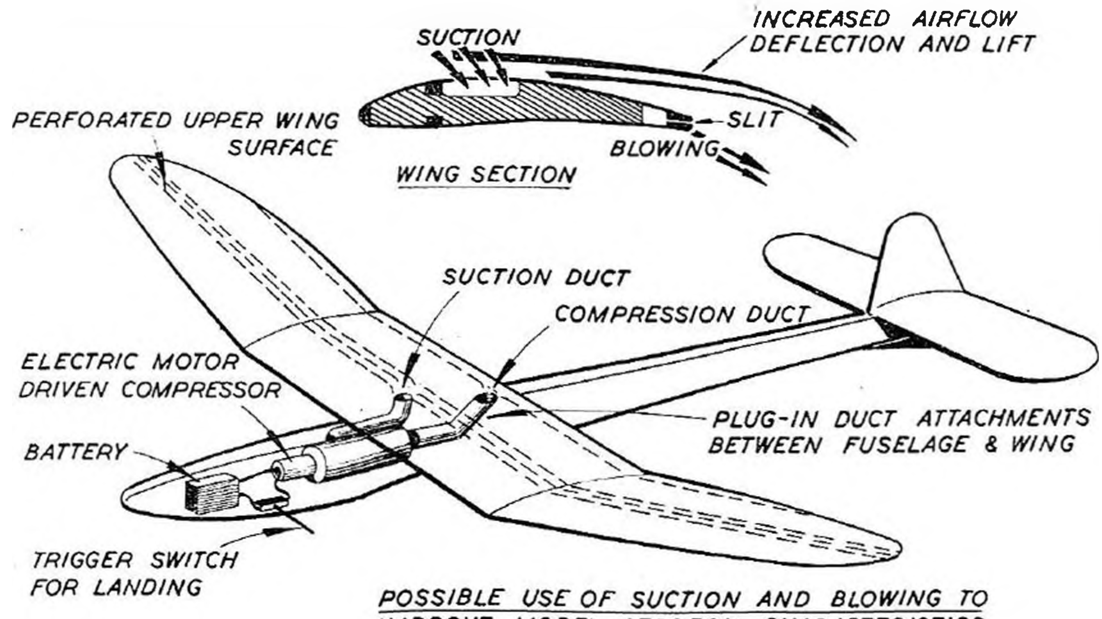


FIG. 5

The amount of lift obtainable from wing sections gliding at model speeds is reaching its upper limit, but reduction of drag while still obtaining this lift presents possibilities.

One source of drag is the Wing/Fuselage function, especially on models with wings attached to the fuselage by means of rubber bands. Due to the viscosity of air at low speeds, breakaway of airflow readily occurs at this point, wing fillets give doubtful improvement, while plug-in wings offer the best compromise. One possible line of research here could be the reduction of wing chord and thickness at the centre-section, as shown in Fig. 5; this in effect "waisting" the wing. As the wing bending and torsion loads are greatest at this point, however, careful structural design would obviously be necessary.

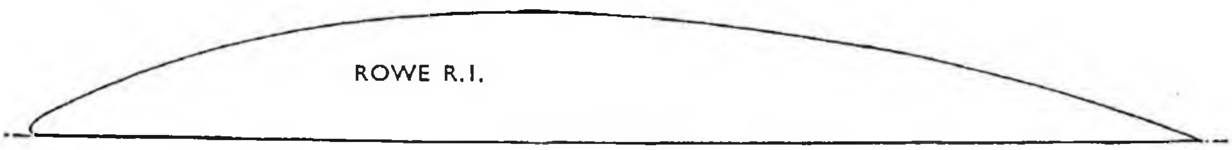
Application of a current "full-size" line of research might prove profitable for the experimentally minded, namely control of airflow over the wing by sucking air from the upper surface and blowing it out and down from the trailing edge. This would have the effect of increasing the deflection of air over the top of the wing and enabling higher coefficients of lift to be obtained without stalling it, this in turn lowering the sinking speed. (Fig 6)



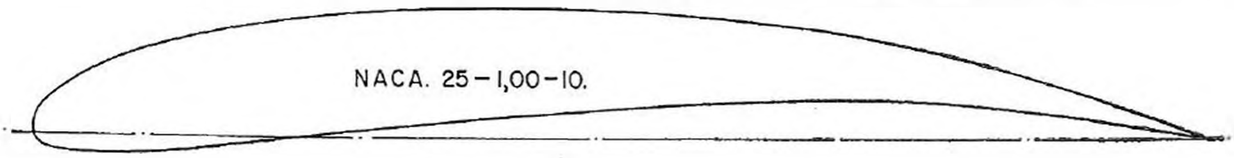
POSSIBLE USE OF SUCTION AND BLOWING TO IMPROVE MODEL AEROFOIL CHARACTERISTICS

FIG. 6

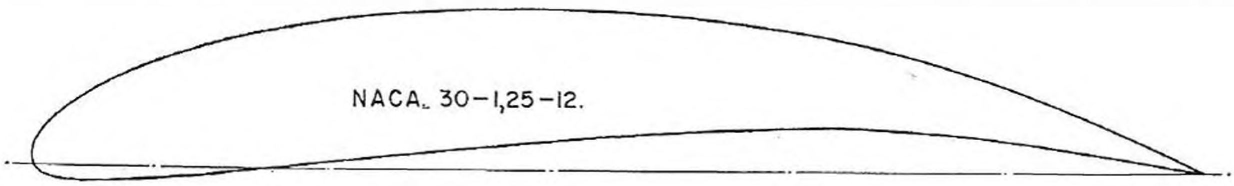
AEROFOIL SECTIONS



Station	0	1.25	2.5	5	7.5	10	15	20	25	30	40	50	60	70	80	90	95	100
Upper	.55	1.90	2.55	3.80	4.90	5.90	7.45	8.70	9.75	10.5	11.15	10.95	10.0	8.45	6.40	3.55	1.85	.20
Lower	.55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

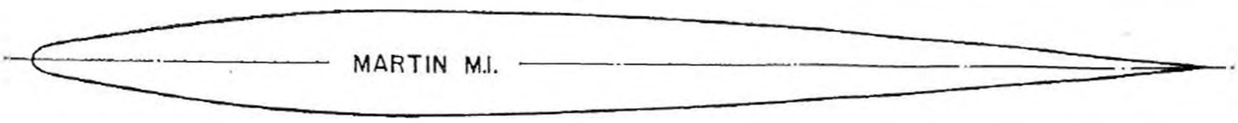


Station	0	.5	1	2.5	5	7.5	10	15	20	25	30	40	50	60	70	80	90	95	100
Upper	1.60	2.35	2.90	4.10	5.55	6.70	7.55	8.85	9.75	10.40	10.75	11.00	10.85	10.05	8.70	6.55	3.50	1.75	0
Lower	0	–.70	–1.0	–1.35	–1.55	–1.5	–1.35	–.80	–.20	.30	.80	1.75	2.55	3.05	3.20	2.80	1.50	.75	0

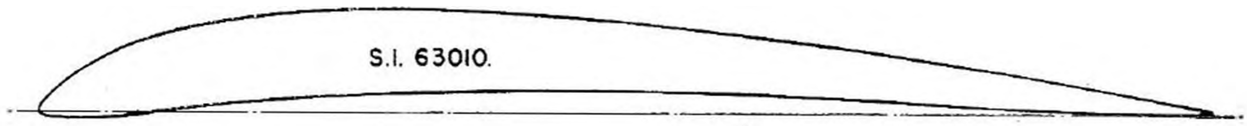


Station	0	.5	1	2.5	5	7.5	10	15	20	25	30	40	50	60	70	80	90	95	100
Upper	1.8	2.6	3.6	4.65	6.35	7.75	8.85	10.55	11.70	12.65	13.25	13.8	13.6	12.75	11.05	8.45	4.55	2.35	0
Lower	0	–.5	–.75	–1.1	–1.25	–1.15	–.95	–.45	.05	.55	1.10	2.15	3.0	3.55	3.70	3.15	1.70	.85	0

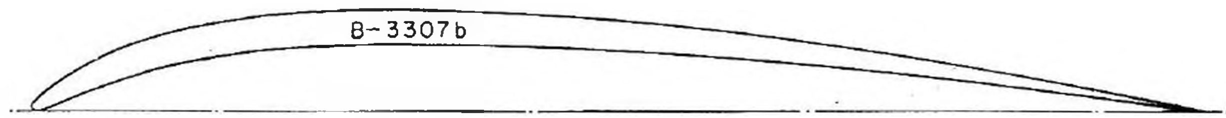
Station	0	1.25	2.5	5	7.5	10	15	20	25	30	40	50	60	70	80	90	95	100
Upper	0	1.25	1.88	2.79	3.53	4.15	5.15	5.90	6.42	6.76	6.90	6.55	5.85	4.85	3.56	1.96	1.05	0
Lower	0	–.64	–.79	–.82	–.73	–.60	–.25	.12	.46	.74	1.1	1.24	1.27	1.26	.91	.49	.24	0



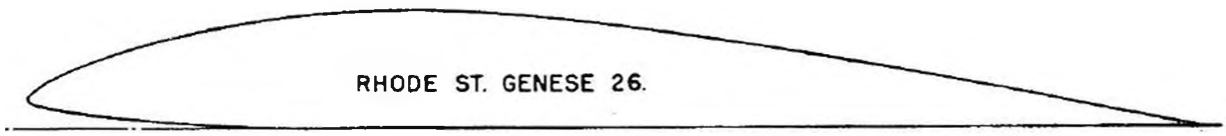
Station	0	1.25	2.5	5	7.5	10	15	20	30	40	50	60	70	80	90	95	100
Upper	0	1.20	1.50	1.90	2.3	2.7	3.32	3.80	4.4	4.20	4	3.4	2.7	2.0	1.1	.60	0
Lower	0	–1.2	–1.5	–1.90	–2.3	–2.7	–3.32	–3.8	–4.4	–4.2	–4	–3.4	–2.7	–2	–1.1	–.60	0



Station	0	2.5	5	10	20	30	40	50	60	70	80	90	100
Upper	0	3.0	4.6	6.7	8.3	8.7	8.4	7.8	6.6	5.3	3.8	2.0	.3
Lower	0	–.5	–.4	0	1.2	1.6	1.8	1.8	1.5	1.2	.6	.1	0

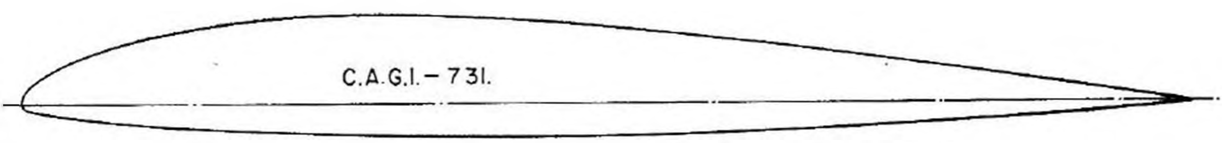


Station	0	1.25	2.5	5	7.5	10	15	20	25	30	40	50	60	70	80	90	100
Upper	.40	1.72	2.65	4.15	5.34	6.24	7.55	8.23	8.55	8.63	8.40	7.73	6.67	5.27	3.73	2.0	.12
Lower	.40	.25	.70	1.72	2.68	3.48	4.67	5.28	5.60	5.73	5.65	5.27	4.57	3.59	2.52	1.33	0

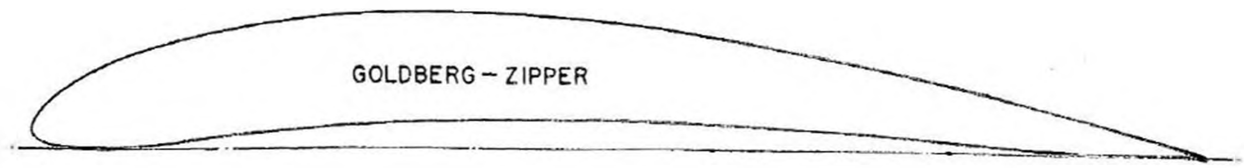


Station	0	1.25	2.5	5	7.5	10	15	20	30	40	50	60	70	80	90	95	100
Upper	2.5	3.75	4.5	5.5	6.38	6.8	8.15	9.1	10.0	9.8	8.8	7.3	5.5	3.9	2.1	1.0	0
Lower	2.5	2.05	1.75	1.3	.88	.8	.39	.2	0	0	0	0	0	0	0	0	0

Station	0	5	10	20	30	40	50	60	70	80	90	100
Upper	1.11	5.83	8.0	9.97	10.4	9.91	8.88	7.5	5.9	4.2	2.32	.33
Lower	1.11	.05	.5	1.87	2.7	3.05	2.98	2.67	2.22	1.62	.89	0

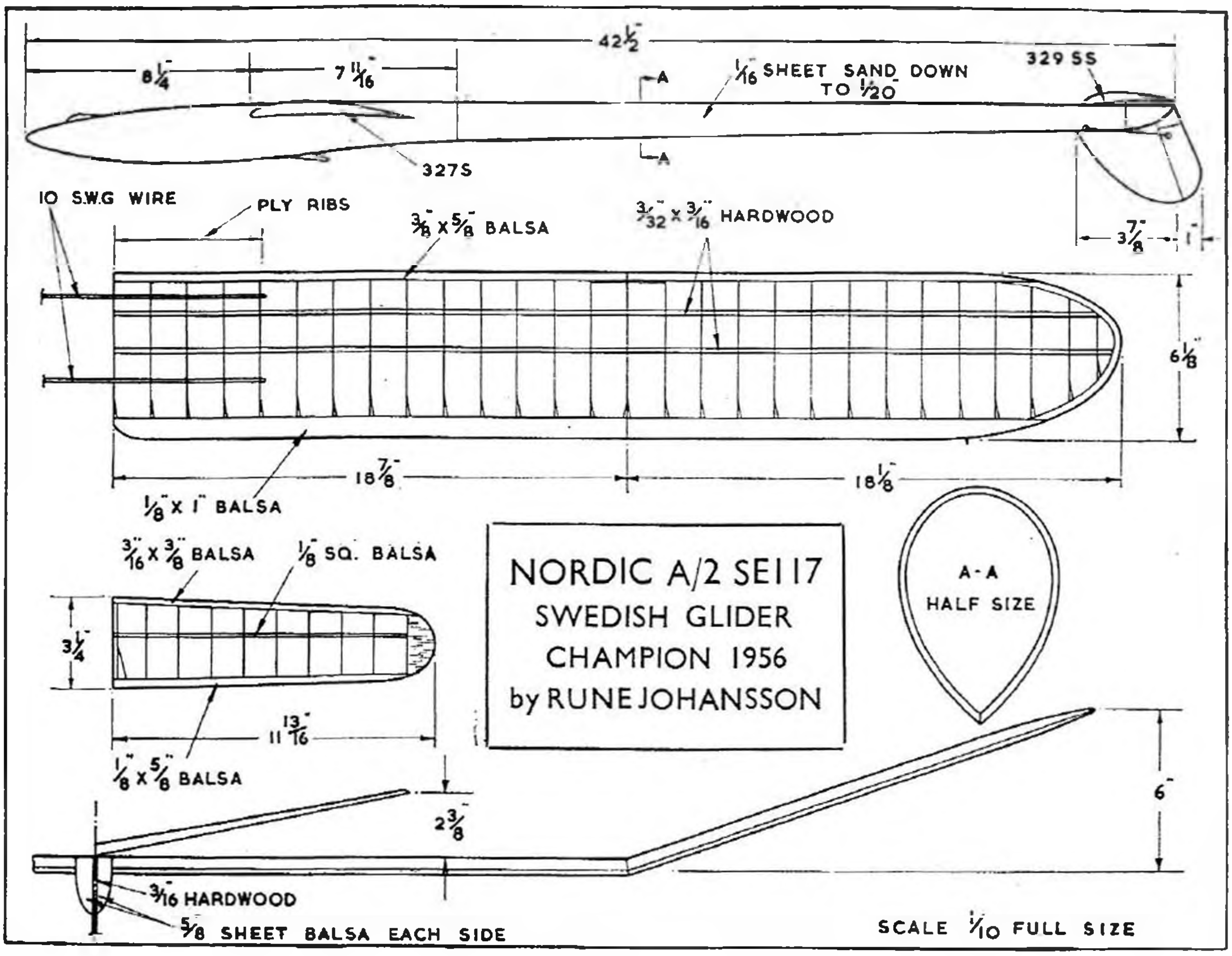


Station	0	2.5	5	10	20	30	40	50	60	70	80	90	100
Upper	0	2.74	3.94	5.48	7.0	7.45	7.29	6.52	5.52	4.28	2.9	1.45	0
Lower	0	–.86	–1.26	–1.77	–2.33	–2.61	–2.63	–2.51	–2.29	–1.93	–1.48	– .91	0

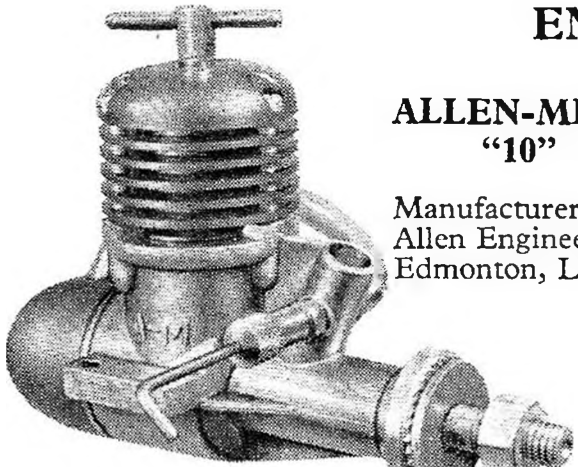


Station	0	1.25	2.5	5	10	20	30	40	50	60	70	80	90	100
Upper	1.5	3.8	4.9	6.5	8.4	10.6	11.4	11.35	10.6	9.1	7.3	5.3	3.05	0
Lower	1.5	.3	0	0	.06	1.5	2.12	2.28	2.3	1.9	1.45	.76	.03	0

Station	0	1.25	2.5	5	7.5	10	15	20	25	30	40	50	60	70	80	90	95	100
Upper	.5	1.8	2.6	4.0	4.9	5.9	7.3	8.4	9.3	9.7	9.8	9.2	7.7	6.2	4.2	2.1	1.0	0
Lower	.5	–.4	–.6	–1.1	–1.5	–1.9	–2.5	–3.2	–3.7	–4.2	–4.8	–5.0	–4.8	–4.2	–3.2	–1.9	–1.0	0



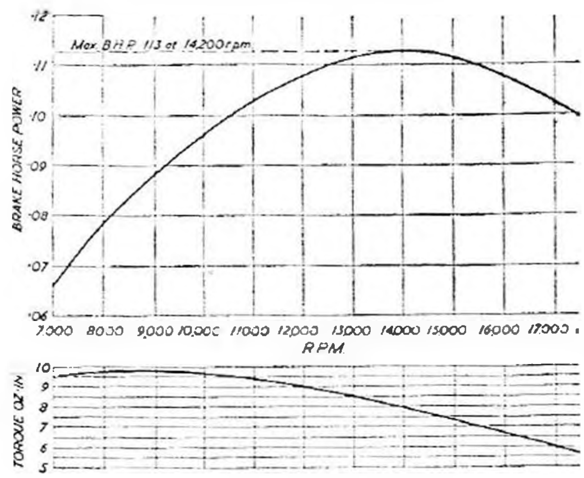
ENGINE ANALYSIS



ALLEN-MERCURY "10" 1 c.c.

Manufacturers: Allen Engineering, Edmonton, London, N.9.

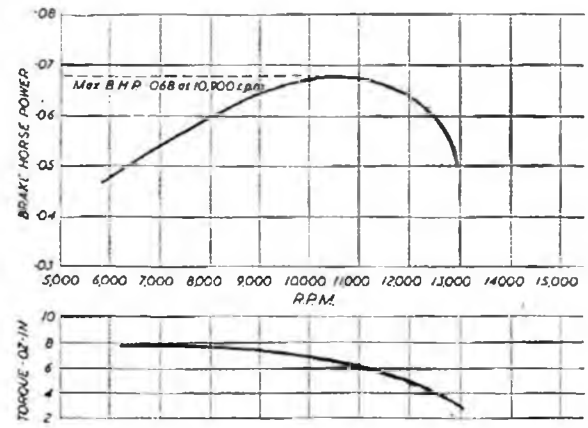
Retail price: 58s. 6d. including P.T.
Bore: .426 in.
Stroke: .430 in.
Bore/Stroke ratio: .99.
Displacement: 1.00 c.c. (.0614 cu. in.).
Bare weight: 3 ounces (including tank).
Max. B.H.P.: .113 at 14,200 r.p.m.
Max. torque: 9.8 oz.-in. at 9,000 r.p.m.
Power/Weight ratio: .38 B.H.P. per oz.
Power rating: .113 B.H.P. per c.c.



PROPELLER	R.P.M.
dia. = pitch	
8×5 (Stant)	8,800
8×4 (Stant)	10,000
7×6 (Stant)	10,300
7×4 (Stant)	11,800
6×6 (Stant)	11,700
6×4 (Stant)	13,900
6×3 (Trucut)	14,600
6×4 (Frog nylon)	17,000

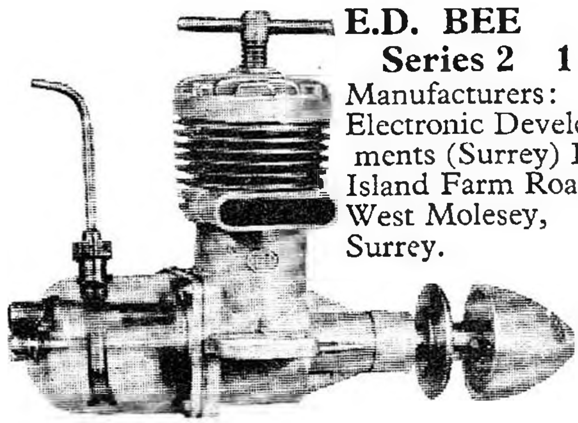
Fuel: Mercury RD.

Cylinder, Piston, Contra-piston: Meehanite.
Connecting rod: Turned from forged Dural bar.
Crankcase: Pressure die casting in LAC 112A light alloy.
Main bearing: Plain.
Crankshaft: S-14 case-hardened steel.
Cylinder jacket & Tank: Dural, anodised green.
Spraybar assembly: Dural.



E.D. BEE Series 2 1 c.c.

Manufacturers: Electronic Developments (Surrey) Ltd., Island Farm Road, West Molesey, Surrey.



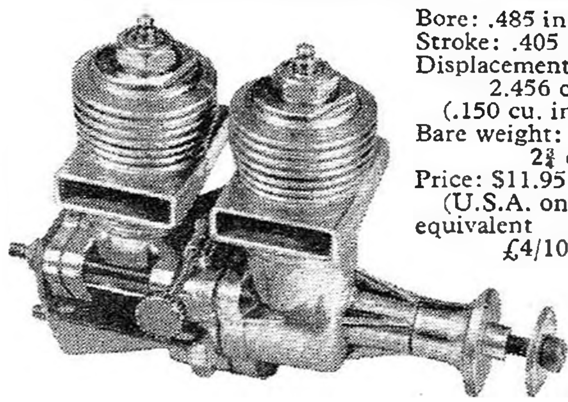
Retail Price: £2/15/0.
Displacement: .99 c.c. (.0605 cu. in.).
Bore: .438 in.
Stroke: .40 in.
Bore/Stroke ratio: 1.095.
Bare weight: 3 oz.
Max. B.H.P.: .068 at 10,900 r.p.m.
Max. torque: 8 oz.-in. at 7,000 r.p.m.
Power rating: .07 B.H.P. per c.c.
Power/Weight ratio: .021 B.H.P. per oz.

Crankcase: Pressure die-cast light allloy.
Cylinder: Case-hardened steel.
Piston: Cast iron.
Crankshaft: Ground and hardened steel.
Con. rod: Case-hardened steel.
Figures approx. common to E-D, Mercury No. 8 and Allbon fuels.

PROPELLER	R.P.M.
dia. pitch	
8×4 (Stant)	7,900
7×4 (Stant)	9,500
6×4 (Stant)	10,750
6×4 (E-D plastic)	11,800
6×3 (constant g.m.p.)	12,200
7×5	9,600

K & B ALLYN "SKY FURY" 2.45 c.c.

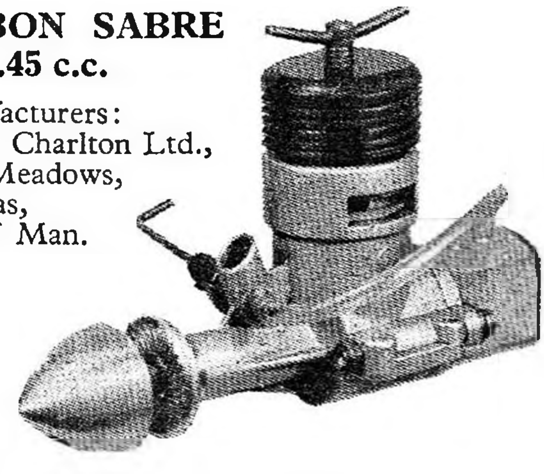
Manufacturers: K & B Allyn Co., 5732 Duarte St., Los Angeles 58, U.S.A.



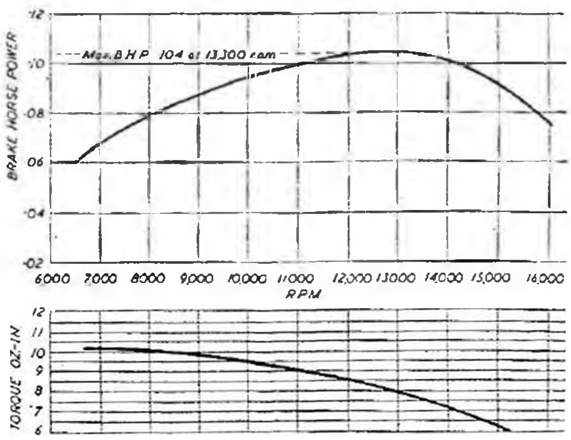
Bore: .485 in.
Stroke: .405 in.
Displacement: 2.456 c.c. (.150 cu. in.).
Bare weight: 2¾ oz.
Price: $11.95 (U.S.A. only) equivalent £4/10/0

ALLBON SABRE 1.45 c.c.

Manufacturers:
Davies Charlton Ltd.,
Hills Meadows,
Douglas,
Isle of Man.



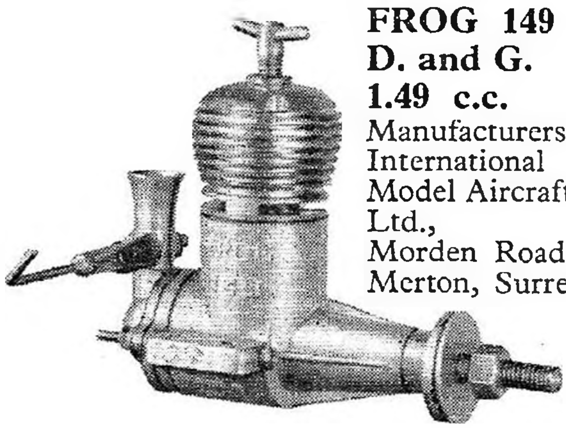
Retail Price: 67/5 (including P.T.).
Displacement: 1.457 c.c. (.089 cu. in.)
Bore: .519 in.
Stroke: .420 in.
Bore/Stroke ratio: 1.24:1.
Bare weight (with tank): 3¼ oz.
Max. B.H.P.: .104 at 13,300 r.p.m.
Max. torque: 10.3 oz.-in. at 7,000 r.p.m.
Power/Weight ratio: .032 B.H.P. per oz.
Power rating: .0715 B.H.P. per c.c.



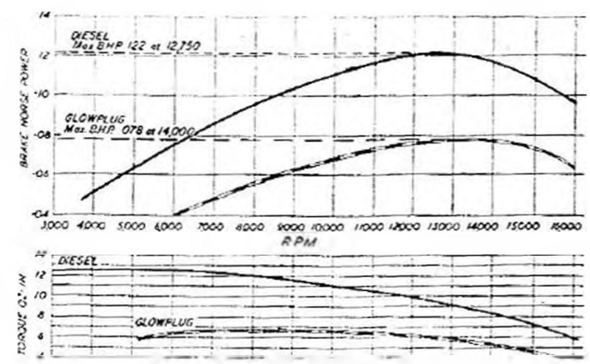
Cylinder: Mild steel.
Contra-piston: Steel.
Piston: Cast iron.
Connecting rod: Drop forged light alloy.
Crankcase casting: Pressure die casting in light alloy.
Crankshaft: Steel.
Bearing: Plain.
Cylinder jacket: Light alloy, anodised red.
Spraybar assembly: Brass.
Tank: Transparent plastic, integrally mounted.
Spinner nut: Light alloy, anodised red.

PROPELLER	R.P.M.	
dia. pitch	Allbon diesel fuel	Mercury No. 8
8×8 (Stant)	6,400	—
8×4 (Stant)	9,000	8,800
6×6 (Stant)	11,200	—
6×4 (Stant)	13,300	12,950
8×5 (Stant)	7,800	7,800
7×4 (Stant)	—	11,600
8×3 (constant g.m.p.)	10,200	—
7×3 (constant g.m.p.)	13,400	—
6×4 (Frog nylon)	15,000	—

FROG 149 D. and G. 1.49 c.c.



Manufacturers:
International Model Aircraft Ltd.,
Morden Road,
Merton, Surrey.



Retail Price: 54/9.

Diesel Specification

Displacement: 1.49 c.c. (.091 cu. in.).
Bore: .50 in.
Stroke: .460 in.
Bore-Stroke ratio: 1.09.
Bare weight: 3¼ oz.
Max. torque: 12.5 oz.-in. at 3,000-6,000 r.p.m.
Max. B.H.P.: .122 at 12.750.
Power/Weight ratio: .0375 B.H.P. per oz.
Power rating: .082 B.H.P. per c.c.

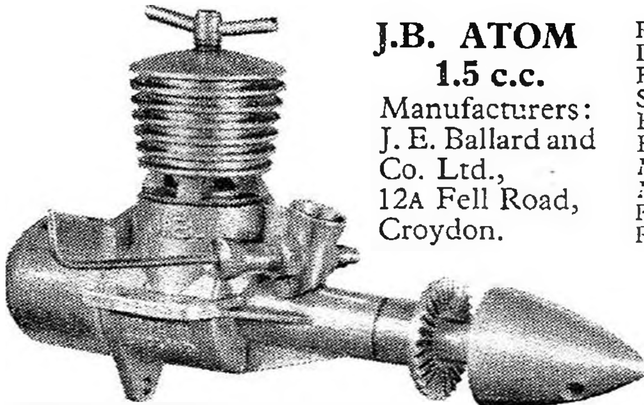
Glow Specification

Bare weight: 3.3 oz.
Max. torque: 6.8 oz.-in. at 7,000-9,000 r.p.m.
Max. B.H.P.: .078 at 14,000 r.p.m.
Power/Weight ratio: .023 B.H.P. per oz.
Power rating: .0525 B.H.P. per c.c.

Cylinder: Phoenix case-hardening mild steel.
Piston and Contra-piston: Brico centrifugal cast iron.
Crankshaft: Phoenix case-hardened mild steel (stress relieved).
Bearing: Vandervell steel backed sintered bronze sleeve.
Crankcase: LAC 112A light alloy die casting.
Cylinder jacket: Dural anodised red.
Con. rod: Dural forging.

PROPELLER	R.P.M.	R.P.M.
Nylon Propellers dia. pitch	*Glow*	*Diesel*
8×6	6,400	8,000
8×5	7,000	9,000
7×5	8,400	—
6×4	15,000	16,200
5½×4	16,200	—
6×6 (approx.)	12,800	—
Wooden Propellers		
7×4 (Stant)	10,400	11,500
6×4 (Stant)	12,600	13,900
6×3 (Stant)	12,800	14,500
6×3 (Trucut)	13,000	14,500
9×6 (Stant)	5,300	—

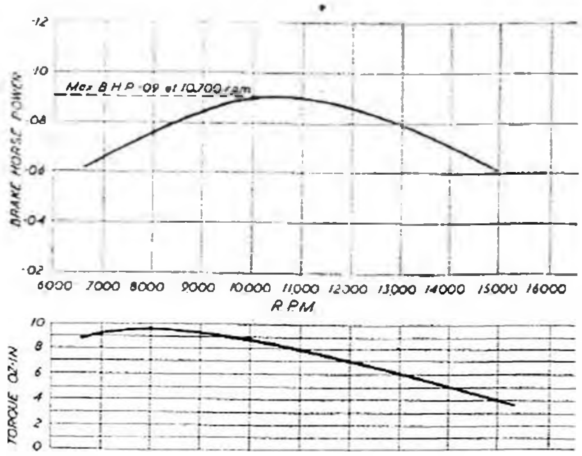
Glow:
Fuel: Frog "Redglow" plus 10 per cent. nitromethane.
Diesel:
Fuel: Frog "Powamix".



J.B. ATOM
1.5 c.c.

Manufacturers:
J. E. Ballard and Co. Ltd.,
12A Fell Road,
Croydon.

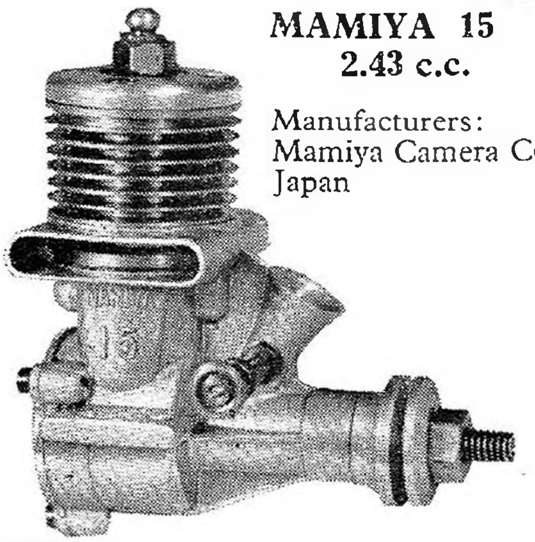
Retail price 58/- (including P.T.).
Displacement: 1.472 c.c. (.09 cu. in.).
Bore: .5365 in.
Stroke: .397 in.
Bore/Stroke ratio: 1.35.
Bare weight: 3¼ oz. (including 1 oz. tank).
Max. B.H.P.: .09 at 10,700 r.p.m.
Max. toque: 9.7 oz.-in. at 8,000 r.p.m.
Power/weight ratio: .029 B.H.P. per oz.
Power rating: .06 B.H.P. per c.c.



Cylinder: Hardened steel.
Piston: Hardened cast iron.
Contra-piston: Hardened steel.
Connecting rod: Hardened steel.
Crankshaft: Hardened steel.
Crankcase casting: Light alloy.
Spraybar assembly: Brass, 4 B.A.
Cylinder jacket: Dural.

PROPELLER	R.P.M.
dia. pitch	
8 × 8 (Stant)	5,200
8 × 8 T R(Stant)	7,100
8 × 5 Frog nylon	8,600
8 × 4 (Stant)	9,000
7 × 4 (Stant)	9,500
6 × 4 (Stant)	12,200
6 × 5 (Stant)	11,400
6 × 4 Frog nylon	14,000
9 × 4 (Stant)	6,800

Fuel: J-B "Atomic".



MAMIYA 15
2.43 c.c.

Manufacturers:
Mamiya Camera Co.,
Japan

Bore: .578 in.
Stroke: .566 in.
Displacement: 2.435 c.c. (.149 cu. in.).
Weight: 3¾ oz.
Max. B.H.P.: .16 at 12,850 r.p.m.
Max torque: 15.2 oz.-in. at 8,500 r.p.m.
Power/Weight ratio: .043 B.H.P. per oz.
Power rating: .066 B.H.P. per c.c.
Price: Not available in U.K. (equivalent £2/).

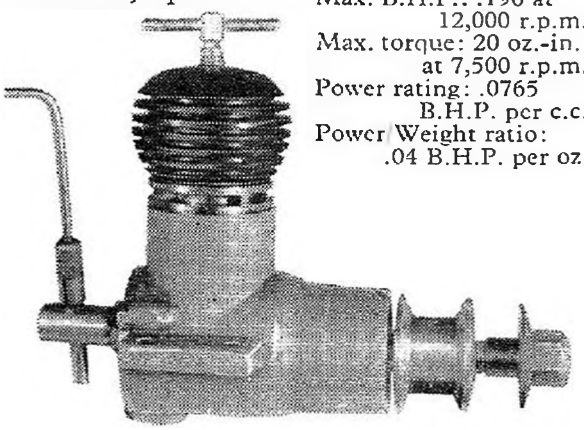
Fuel:
25% castor.
75% methanol.
Plus 25% nitromethane.

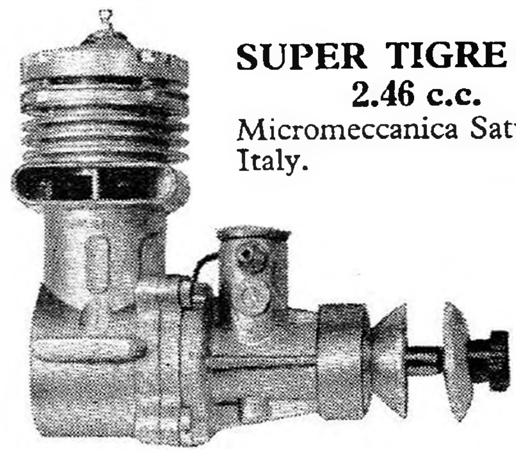
PROPELLER	R.P.M.
9 × 6 (Stant)	8,000
9 × 4 (Truflo)	9,100
8 × 4 (Stant)	11,600
6 × 4 (Stant)	15,500
7 × 4 (Stant)	13,600

BYRA
2.5 c.c.

Manufacturers:
F. Battlo,
Barcelona, Spain.

Displacement: 2.564 c.c. (.1564 cu. in.).
Bore: .598 in.
Stroke: .557 in.
Bore/Stroke ratio: 1.075.
Bare weight: 5 oz.
Max. B.H.P.: .196 at 12,000 r.p.m.
Max. torque: 20 oz.-in. at 7,500 r.p.m.
Power rating: .0765 B.H.P. per c.c.
Power/Weight ratio: .04 B.H.P. per oz.

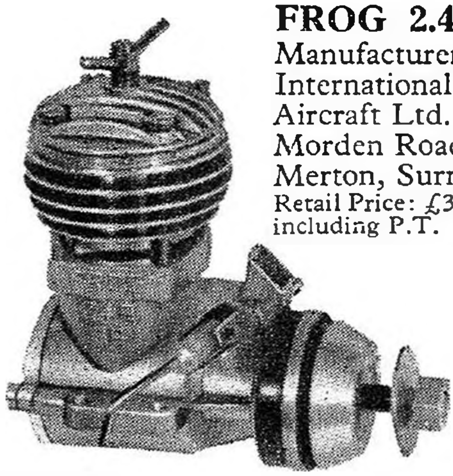




SUPER TIGRE G.20
2.46 c.c.

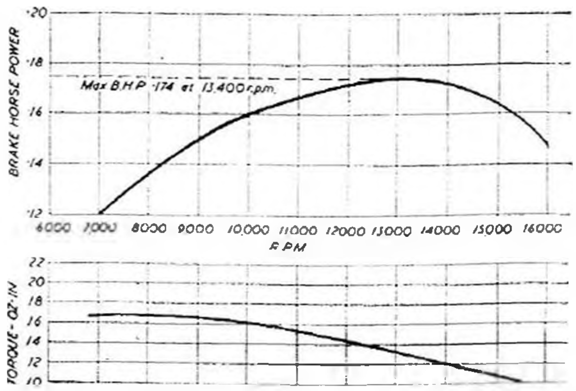
Micromeccanica Saturno,
Italy.

Bore: .591 in. (measured) (15 mm. quoted).
Stroke: .549 in. (measured) (14 mm. quoted).
Displacement: 2.468 c.c. (.1506 cu. in.).
Bare weight: 4¼ oz.
Max. B.H.P.: .174 at 13,400 r.p.m.
Power rating: .071 B.H.P. per c.c.
Power/Weight ratio: .041 B.H.P. per oz.
Availability in England: Through private negotiation only. Price *circa* £4/10/0.



FROG 2.49 BB

Manufacturers:
International Model Aircraft Ltd.,
Morden Road,
Merton, Surrey.
Retail Price: £3/19/3 including P.T.

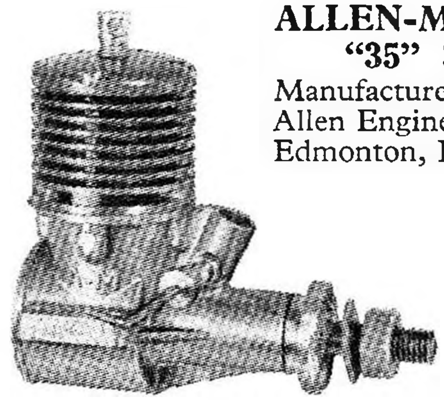


Bore: .581 in.
Stroke: .574 in.
Displacement: 2.494 c.c. (.152 cu. in.).
Bore/Stroke ratio: 1.01.
Bare weight: 5.7 oz.
Max. B.H.P.: .206 at 13,700.
Max. torque: 20.8 oz.-in. at 7,000 r.p.m.
Power rating: .083 B.H.P. per c.c.
Power/Weight ratio: .036 B.H.P. per oz

Cylinder liner: Heat treated fine grain, mild steel ground internally and externally, wet honed bore.
Piston and Contra-piston: Cast iron (ground and lapped).
Gudgeon pin: Silver Steel.
Connecting rod: RR.56 light alloy forging.
Crankcase unit and Cylinder head: LAC 112A light alloy, die cast.
Crankshaft: 3 per cent. nickel steel. (Heat treated and ground.)

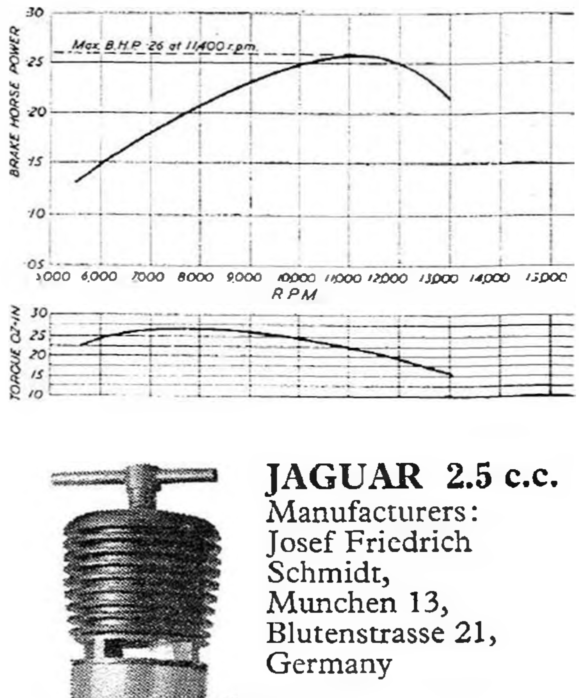
PROPELLER	R.P.M.
dia. pitch	
11 × 5 (Stant)	6,500
9 × 8 (Stant)	7,750
9 × 4 (Stant)	9,800
8 × 5 (Stant)	11,200
8 × 4 (Stant)	12,600
7 × 6 (Stant)	13,300
7 × 5 (Stant)	14,400
6 × 4 (Stant)	17,000

Fuel: Mercury No. 8.
Fuel: Frog "Powamix".



ALLEN-MERCURY "35" 3.4 c.c.

Manufacturers:
Allen Engineering,
Edmonton, London, N.9.



Retail price: 69/6.
Displacement: 3.44 c.c. (.210 cu. in.).
Bore: .890 in.
Stroke: .562 in.
Bore/Stroke ratio: 1.59.
Bare weight: 4 7/16 oz.
Max. B.H.P.: .26 at 11,400 r.p.m.
Max. torque: 27 oz.-in. at 8,000 r.p.m.
Power rating: .076 B.H.P. per c.c.
Power/weight ratio: .058 B.H.P. per oz.

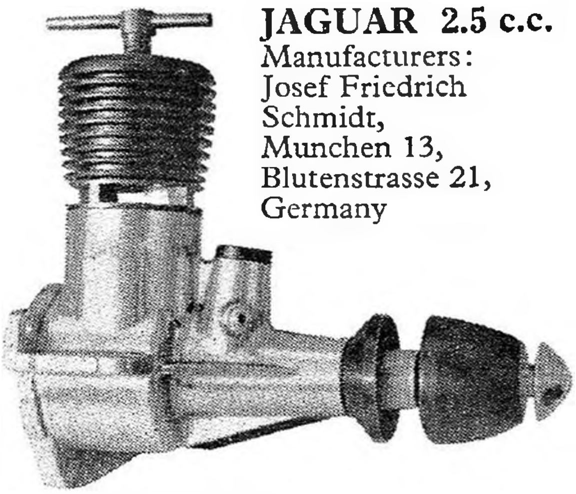
Crankcase: Light alloy (L.M2) diecasting.
Cylinder: Meehanite.
Cylinder jacket: Duralumin.
Piston: Meehanite.
Contra-piston: Meehanite.
Connecting rod: Duralumin.
Crankshaft: Case hardened steel (S.14).
Crankshaft bearing: Meehanite bush.

PROPELLER	R.P.M.
dia. pitch	
9 × 4 (Stant)	11,200
9 × 6 (Stant)	10,500
11 × 6 (Trucut)	6,100
10 × 6 (Trucut)	9,000
11 × 5 (Stant)	7,800
8 × 6 (Trucut)	11,500

Fuel used:
Mercury No. 8 for running-in.
Mercury RD for test.
NOTE.—After running-in, RD fuel showed a consistent 300-400 r.p.m. increase for similar propellers.

JAGUAR 2.5 c.c.

Manufacturers:
Josef Friedrich Schmidt,
Munchen 13,
Blutenstrasse 21,
Germany



Displacement: 2.48 c.c. (.151 cu. in.).
Stroke: .59 (15 mm.).
Bore: .55 (14 mm.).
Bore/Stroke ratio: 1.07.
Bare weight: 3¾ oz.
Max. B.H.P.: .188 at 12,750 r.p.m.
Power rating: 076 B.H.P. per c.c.
Power/Weight ratio: .052 B.H.P. per oz.

List of British National Model Aircraft Records

As at 31st August, 1956

Rubber Driven

Monoplane	Boxall, F. H.	(Brighton)	15/ 5/1949	35 : 00
Biplane	Young, J. O.	(Harrow)	9/ 6/1940	31 : 05
Wakefield	Boxall, F. H.	(Brighton)	15/ 5/1949	35 : 00
Canard	Harrison, G. H.	(Hull Pegasus)	23/ 3/1952	6 : 12
Scale	Marcus, N. G.	(Croydon)	18/ 8/1946	5 : 22
Tailless...	Woolls, G. A. T.	(Bristol & West)	25/ 9/1955	4 : 56
Helicopter	Tangney, J. F.	(Croydon & U.S.A.)	2/ 7/1950	2 : 44
Rotor plane	Crow, S. R.	(Blackheath)	23/ 3/1936	0 : 40
Floatplane	Parham, R. T.	(Worcester)	27/ 7/1947	8 : 55
Ornithopter	White, J. S.	(Barking)	20/ 6/1954	1 : 55
Flying Boat	Parker, R. A.	(Kentish Nomads)	24/ 8/1952	1 : 05

Sailplane

Tow Launch	Allsop, J.	(St. Albans)	11/ 4/1954	90 : 30
Hand Launch	Campbell-Kelly, G.	(Sutton Coldfield)	29/ 7/1951	24 : 30
Tailless, T. L.... ...	Lucas, A. R.	(Port Talbot)	21/ 8/1950	22 : 34
Tailless (H.L.) ...	Wilde, H. F.	(Chester)	4/ 9/1949	3 : 17
A/2 (T.L.)	Allsop, J.	(St. Albans)	11/ 4/1954	90 : 30
A/2 (H.L.)	Campbell-Kelly, G.	(Sutton Coldfield)	29/ 7/1951	24 : 30
Radio Control (H.L.)	Bailey, D.	(Burton-on-Trent)	17/ 7/1956	14 : 15*

Power Driven

Class A...	Springham, H. E.	(Saffron Waldon)	12/ 6/1949	25 : 01
Class B...	Dallaway, W. E.	(Birmingham)	17/ 4/1949	20 : 28
Class C...	Gaster, M.	(C/Member)	15/ 7/1951	10 : 44
Tailless...	Fisher, O. F. W.	(I.R.C.M.S.)	21/ 3/1954	4 : 12
Scale	Tinker, W. T.	(Ewell)	1/ 1/1950	1 : 37
Floatplane	Lucas, I. C.	(Brighton)	11/10/1953	4 : 58
Flying Boat	Gregory, N.	(Harrow)	18/10/1947	2 : 09
Radio Control ...	O'Heffernan, H. L.	(Salcombe)	7/10/1954	151 : 20
Class I Speed	Bassett, D. M. J.	(Sidcup)	21/ 5/1956	83.7 m.p.h.*
Class II Speed ...	Gibbs, R.	(East London)	18/12/1955	129.3 m.p.h.
Class III Speed ...	Hall, J. F.	(Chingford)	20/ 9/1953	114.7 m.p.h.
Class IV Speed ...	Gibbs, R.	(East London)	25/ 9/1955	146.2 m.p.h.
Class V Speed ...	Wright, P.	(St. Albans)	24/ 5/1953	124.3 m.p.h.
Class VI Speed ...	Gibbs, R.	(East London)	15/ 7/1956	159.7 m.p.h.
Class VII Jet	Stovold, R. V.	(Guildford)	25/ 9/1949	133.33 m.p.h.

Lightweight—Rubber Driven

Monoplane	Wiggins, E. E.	(Leamington)	11/ 7/1954	40 : 13
Biplane	O'Donnell, J.	(Whitefield)	18/ 5/1952	6 : 46
Canard	Lake, R. T.	(Surbiton)	7/ 4/1952	7 : 32
Scale	Woolls, G. A. T.	(Bristol & West)	26/ 6/1955	1 : 22
Floatplane	Taylor, P. T.	(Croydon)	24/ 8/1952	5 : 15
Flying Boat	Rainer, M.	(North Kent)	28/ 6/1947	1 : 09

Lightweight—Sailplane

Tow Launch	Green, D.	(Oakington)	11/ 4/1954	36 : 02
Hand Launch	Redfern, S.	(Chester)	11/ 7/1954	11 : 15
Tailless (T.L.) ...	Couling, N. F.	(Sevenoaks)	3/ 6/1951	22 : 22
Tailless (H.L.) ...	Wilde, H. F.	(Chester)	11/ 7/1954	9 : 51
Canard (T.L.) ...	Caple, G.	(R.A.F. M.A.A.)	7/ 9/1952	22 : 11

Lightweight—Power Driven

Class A...	Archer, W.	(Cheadle)	2/ 7/1950	31 : 05
Class C...	Ward, R. A.	(Croydon)	25/ 6/1950	5 : 33
Tailless...	Fisher, O. F. W.	(I.R.C.M.S.)	27/ 7/1954	3 : 02
Floatplane	Mussell, A.	(Brighton)	11/10/1953	2 : 53

INDOOR

Stick (H.L.)	Read, P.	(Birmingham)	10/10/1954	23 : 58
Stick (R.O.G.) ...	Monks, R.	(Birmingham)	12/ 9/1954	20 : 30
Fuselage (H.L.) ...	Parham, R. T.	(Worcester)	12/ 9/1954	13 : 16
Fuselage (R.O.G.) ...	Parham, R. T.	(Worcester)	12/ 9/1954	12 : 10
Tailless (H.L.) ...	Monks, R.	(Birmingham)	12/ 9/1954	4 : 13
Tailless (R.O.G.) ...	Poole, D.	(Birmingham)	29/ 6/1956	3 : 31*
Ornithopter ...	Parham, R. T.	(Worcester)	9/ 1/1954	1 : 10
Helicopter	Monks, R.	(Birmingham)	19/11/1954	5 : 01
Rotorplane	Poole, D.	(Birmingham)	8/ 5/1955	1 : 26
R.T.P. Class A ...	Muxlow, E. C.	(Sheffield)	10/12/1948	6 : 05
R.T.P. Class B ...	Parham, R. T.	(Worcester)	20/ 3/1948	4 : 26
R.T.P. Speed ...	Jolley, T. A.	(Warrington)	19/ 2/1950	42.83 m.p.h.

(* Ratification pending.)

List of World and International Model Aircraft Records

As at 31st August, 1956

No.						
		ABSOLUTE WORLD RECORDS				
	Duration	Bethwaite, F.	New Zealand	2/ 4/1956	7 hr. 37 min.
	Distance	Boricevitch, E.	U.S.S.R.	14/ 8/1952	378,756 km.
	Height	Lioubouchkine, G.	U.S.S.R.	13/ 8/1947	4,152 m.
	Speed	Ivannikov, I.	U.S.S.R.	8/ 8/1955	275 km/h.
		Class F-1-A RUBBER DRIVEN				
1	*Duration*	Kiraly, M.	Hungary	20/ 8/1950	1 hr. 27 min. 17sec.
2	*Distance*	Benedek, G.	Hungary	20/ 8/1947	50,269 km.
3	*Height*	Poich, R.	Hungary	31/ 8/1948	1,442 m.
4	*Speed*	Davidov, V.	U.S.S.R.	11/ 7/1940	107.080 km/h.
		Class F-1-B POWER DRIVEN				
5	*Duration*	Koulakovsky, I.	U.S.S.R.	6/ 8/1952	6 hr. 1 min.
6	*Distance*	Boricevitch, E.	U.S.S.R.	14/ 8/1952	378,756 km.
7	*Height*	Lioubouchkine, G.	U.S.S.R.	13/ 8/1947	4,152 m.
8	*Speed*	Stiles, E.	U.S.A.	20/ 7/1949	129.768 km/h.
		Class F-2-A HELICOPTERS—RUBBER DRIVEN				
9	*Duration*	Evergary, M.	Hungary	13/ 6/1950	7 min. 43 sec.
10	*Distance*	Roser, N.	Hungary	9/ 4/1950	238 m.
11	*Height*	*No record established.*			
12	*Speed*	*No record established.*			
		Class F-2-B HELICOPTERS—POWER DRIVEN				
13	*Duration*	Tichtchenko, M.	U.S.S.R.	12/ 4/1954	2 min. 49 sec.
14	*Distance*	*No record established.*			
15	*Height*	*No record established.*			
16	*Speed*	*No record established.*			
		Class F-3 GLIDERS				
17	*Duration*	Toth, I.	Hungary	24/ 5/1954	4 hr. 34 min. 11sec.
18	*Distance*	Szomolanyi, F.	Hungary	23/ 7/1951	139.8 km.
19	*Height*	Benedek, G.	Hungary	23/ 5/1948	2,364 m.
		Class F-1-B RADIO CONTROL—POWER				
20	*Duration*	Velitchkovski, P.	U.S.S.R.	6/ 7/1955	3 hr. 6 min. 38sec.
21	*Distance*	*No record established.*			
22	*Height*	Gobeaux, J.-P.	Belgium	15/ 8/1955	1,142 m.
23	*Speed*	Stegmaier, K. H.	Germany	21/ 3/1954	58 km/h.
		Class F-3 RADIO CONTROL—GLIDERS				
24	*Duration*	Bethwaite, F.	New Zealand	2/ 4/1956	7 hr. 37 min.
25	*Distance*	*No record established.*			
26	*Height*	*No record established.*			

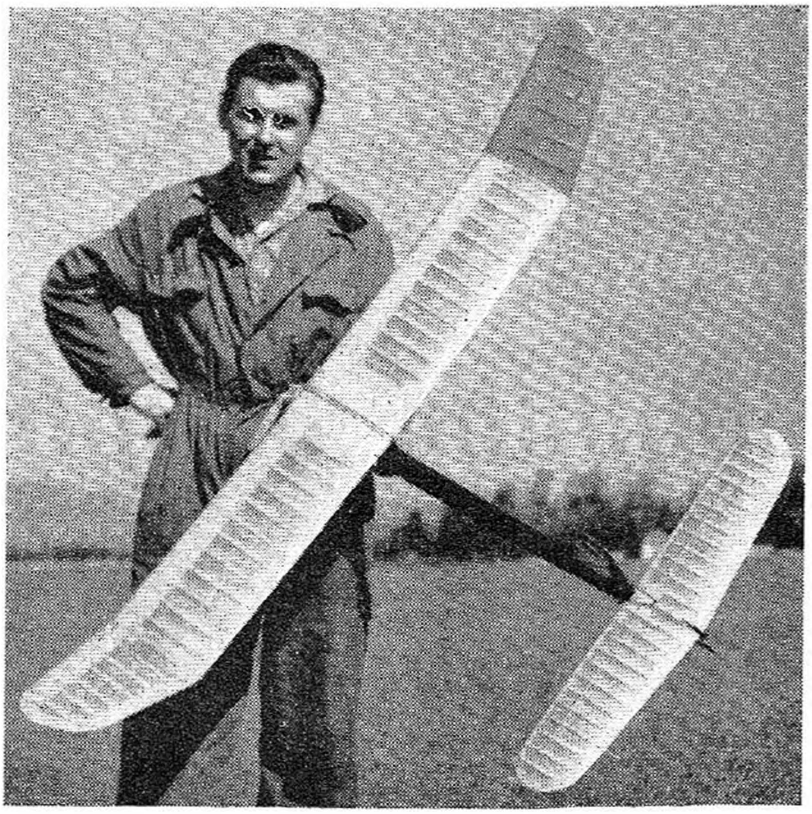
CONTROL LINE SPEED

27 *Category I* (0-2.5 c.c.)
Gibbs, R.
Great Britain
18/12/1955
208 km/h.

28 *Category II* (2.5-5 c.c.)
Gibbs, R.
Great Britain
25/ 9/1955
235 km/h.

29 *Category III* (5-10 c.c.
Berke, I.
Hungary
8/ 8/1954
255 km/h.

30 *Category Jet*
Ivannikov, I.
U.S.S.R.
8/ 8/1955
275 km/h.



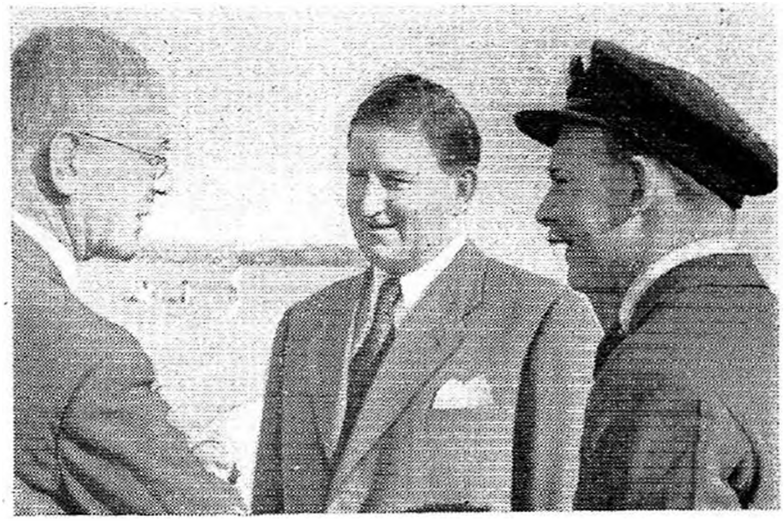
Rudolf Czerny of Czechoslovakia with his R.C.56 winner of the Iron Curtain Nationals this year and featured on page 82 of the ANNUAL.

NATIONAL MODEL AIRCRAFT GOVERNING BODIES

In most instances the full-size national aero club is directly responsible for the conduct of model aeronautics, but in some cases, as for example the S.M.A.E., a specialist group has been delegated to handle affairs on behalf of the parent body. To avoid delays in correspondence any letters dealing with model aeronautics should always be very clearly marked as such.

GREAT BRITAIN	The Society of Model Aeronautical Engineers, Londonderry House, Park Lane, London, W.1.
AUSTRALIA	The Model Aeronautical Association of Australia, Sec.: Robert A. Ross, 195 Elizabeth Street, Sydney, New South Wales.
AUSTRIA	Osterreichischer Aero Club, Vienna 1, Dominikanerbastei 24.
ARGENTINE	Aero Club Argentino (Section Aeromodelismo), Rodriguez Pena 240, Buenos Aires
BELGIUM	Federation de la Petite Aviation Belge, 67 Av. Victor Emmanuel III, Uccle-Bruxelles.
BRAZIL	Aero-Clube de Brasil, 31, Rua Alvaro Alvim, Rio de Janiero.
CANADA	Model Aeronautics Association of Canada, 1555, Church Street, Windsor, Ontario.
CHILE	Club Aero de Chile, Santa Lucia 256, Santiago.
CUBA	Club de Aviacion de Cuba, Edificio Larrea, Havana.
CZECHOSLOVAKIA	Aeroklub Republiky Ceskoslovensko, Smecky 22, Prague 11.
DENMARK	Det Kongelige Aeronautiske Selskab, Norre Farrimagsgade 3 K, Copenhagen.
EGYPT	Royal Aero-Club d'Egypte, 26 Rue Sherif Pacha, Cairo.
FINLAND	Suomen Ilmailulitto, Mannerheimintie 16, Helsinki.
FRANCE	Federation Nationale Aeronautique (Modeles Reduits), 7, Avenue Raymond Poincare, Paris XVI
	Aero-Club de France (Modeles Reduits), 6, Rue Galilee, Paris.
	(*Communications should always be addressed in duplicate to both these bodies as they jointly share responsibility for certain aspects of aeromodelling.*)
GERMANY	Deutscher Aeroclub, e.v. Kommissions-sekretar der MFK, (16) Frankfurt am Main, Taunusanlage 20, Germany.
HOLLAND	Koninklijke Nederlandsche Vereeniging voor Luchvaart, Anna Paulownaplein 3, The Hague.
HUNGARY	Magyar Repulo Szovetseg, V. Sztalin-ter 14, Budapest.
ICELAND	Flugmalafelag Islands, P.O. Box 234, Reykjavik.
INDIA	All India Aeromodellers Association, 8 Lee Road, Calcutta, 20.
IRELAND	Model Aeronautics Council of Ireland, 9, Lower Abbey Street, Dublin.
ISRAEL	Aero Club of Israel, 9 Montefiore Street, P.O.B. 1311, Tel Aviv.
ITALY	Federazione Aeromodellistica Nationale Italiana (F.A.N.I.), Via Cesare Beccaria 35, Rome.
JAPAN	Nippon Koku Kyokai, Kikokan (Aviation) Building 1-3 Tamura-Cho, Minato-Ku, Tokyo.
JUGOSLAVIA	Aero-Club Jugoslavije, Uzon, Mirkova IV/I, Belgrade.
LUXEMBOURG	Aero-Club du Grande-Duche de Luxembourg, 5 Avenue Monteray, Luxembourg.
MONACO	Monaco Air-Club, 8 Rue Grimaldi, Monaco.
NEW ZEALAND	New Zealand Model Aeronautical Association, c/o Mr. A. R. Rowe, 29 Compton Crescent, Taita, Lower Hult, N.Z.
NORWAY	Norske Aero Club, Ovre Vollgae 7, Oslo.
PERU	Aero Club del Peru, Lima.
POLAND	Aeroklub Rzeczypospolitej Polskie, Ul. Hoza 39, Warsaw.
PORTUGAL	Aero Club de Portugal, Avenida da Liberdade 226, Lisbon.
RUMANIA	Aeroclubul Republico al Romaniei, Lascar Catargi 54, Bucharest.
SOUTH AFRICA	South African Model Aeronautic Association, P.O. Box 2312, Johannesburg.
SPAIN	Real Aero-Club de Espana (Subeseccion de Aeromodismo), Carrera de Jan Jeronimo 19, Madrid.
SWEDEN	Kungl. Svenska Aeroklubben, Malmskillnadsgatan 27, Stockholm.
SWITZERLAND	Aero Club de Suisse (Modeles Reduits), Hirschengraben 22, Zurich.
SYRIA AND LEBANON	Aero Club de Syrie et du Libon, Beyrouth.
TURKEY	Turk Hava Kurumu (T.H.K.), Enstitu Caddesi, 1, Ankara.
UNITED STATES OF AMERICA	Academy of Model Aeronautics, 1025 Connecticut Avenue, Washington 6, D.C.
U.S.S.R.	Aero Club Central de l'U.S.S.R., V. P. Tchkalov, Moscou-Touchino.
URUGUAY	Aero-Club de Uruguay, Paysandu 896, Montevideo.

Last minute change of venue from R.A.F. Waterbeach to R.A.F. Hemswell for this year's Nationals if anything increased attendance. Usual grand R.A.F. co-operation was manifested, and here we see S.M.A.E. Chairman, Alex Houlberg with Wing Commander Russell-Bell, who presented the prizes, and liaison officer F/O Goodnough, who did Trojan work for competitors



CONTEST RESULTS

RESULTS of S.M.A.E. Contests for balance of 1955 Season, together with principal Galas, are included in this report to complere records. Those 1956 events which have been decided before going to press are also included, and will be completed in next year's "AEROMODELLER ANNUAL"

August 21st, 1955—SOUTH MIDLAND AREA RALLY RESULTS

Held at Cranfield

	Team Race "A"		
	Thompson	Foresters	9 : 45
	Team Race "B"		
	Marsh, K.	W. Essex	9 : 45
	Combat		
	Grimmett	W. Bromwich	4 cuts
	Chuck Glider		
	Monks, R.	Birmingham	2 : 12
	Rubber		
1	Revell, H. W.	Northampton	12 : 00
2	Jones, A. E.	Birmingham	11 : 26
3	Monks, R.	Birmingham	11 : 05
	Glider		
1	Barr, A.	Coventry	12 : 00
2	Adamson, R.	Derby	10 : 18
3	Morley, D.	Creswell	9 : 57
	Power		
1	Bickerstaffe, J.	Rugby	11 : 11
2	Mack, B.	C/Member	11 : 10
3	Draper, R. C.	Coventry	11 : 10
	R/Control		
1	Ardron, E.	Ely	111 pts.
2	Boys, H.	Northampton	57 pts.
3	Redlich, G. H.	Bushey Park	52 pts

August 21st, 1955—"AEROMODELLER" RADIO CONTROL TROPHY

	Radio Control	(11 *entries*)	*Centralised*
1	Hemsley, O. E.	Bushey Park	265 points
2	Ardron, E.	Ely	220 ,,
3	McDonald, A.	West Essex	205 ,,
4	Fox, J.	Hatfield	177 ,,
5	Honnest-Redlich, G.	Bushey Park	140 ,,
6	Blunt, R.	C/Member	118 ,,

September 16th/17th—PAA SCOTTISH FESTIVAL OF MODEL AVIATION

Held at Heathfield

	International PAA-Load (2.5 *c.c.*)		
1	Parsons, R.	Prestwick	1.40
	America Class PAA-Load (1 *c.c.*)		
1	Muller, P.	London	3.37
	Rubber PAA-Load		
1	O'Donnell, J.	Salford	2.36
	Jetex Radio		
1	Armstrong, R.	Belfast	19.1
	Class A Combat		
1	Jones, R.	Maybole	
	Class B Combat		
1	Dunn, I.	Perth	
	Class B Team Race		
1	Barclay, A.	Perth	
	F.A.I. Team Race		
1	Howard, J.	Nottingham	
	Power		
1	Collinson, A. R.	Bradford	11.08
2	Gaster, M.	London	10.43
3	Ford, G.	Newcastle	9.32
	Glider		
1	Gilroy, I.	Galston	10.03
2	Hinds, S.	Wallasey	8.26
3	Nicholson, P.	Wallasey	8.20
	Rubber		
1	O'Donnell, H.	Salford	12.00
2	Bennett, E.	Croydon	10.16
3	Hope,	Belfast	10.13
	Radio Control		
1	Breeze, V.		176 points
	Scale		
1	Barr, R.	Irvine	123 points
	Best Placed Junior		
	Bryan, C.	Wallasey	

September 18th, 1955—UNITED KINGDOM CHALLENGE MATCH

		Centralised
1	England	13 points
2	Scotland	9 ,,
3	Ireland	5 ,,

October 2nd, 1955—GUTTERIDGE TROPHY

	Wakefield Eliminator	(121 *entries*)	*Area Centralised*
1	Girling, C.	Ashton	15:00 – 3:05
2	Lipscombe, D.	R.A.F.	14 : 50
3	Revell, H.	Northampton	14 : 46

4	Monks, R. C.	Birmingham	14 : 45
5	King, A.	C/Member	14 : 42
	Baldwin, R.	Wigan	14 : 42
	Evans, G.	Cheadle	14 : 42

"MODEL ENGINEER" CUP
Team Glider (36 *Clubs*) *Area Centralised*

1	Croydon & D.M.A.S.	38 : 57
2	Whitefield M.A.C.	36 : 04
3	De Havilland (Hatfield)	33 : 19
4	Cheadle M.A.C.	32 : 23
5	Surbiton M.F.C.	30 : 21
6	Loughboro' College M.A.C.	30 : 16

October 16th, 1955—HALIFAX TROPHY
Power Eliminator *Area Centralised*
(118 *entries*)

1	Lloyd, K.	Thomeside	15 : 00+2 : 25
2	Petty, C.	Walsall	15 : 00+2 : 05
3	Jays, V.	C/Member	14 : 25
4	Bedale, R.	Walsall	13 : 23
5	Posner, D.	N.W. Middlesex	13 : 01
6	Hartley, J.	Wolves	12 : 58

K.& M.A.A. CUP
A/2 Eliminator *Area Centralised*
(254 *entries*)

1	Marshall, J.	Hayes	15 : 00
2	Yeabsley, R.	Croydon	14 : 51
3	Crossley, P.	Blackheath	14 : 10
4	Manville, J.	Bournemouth	13 :.53
5	Thwaites, R.	Portsmouth	13 : 09
6	Young, F.	C/Member	12 : 56

March 25th, 1956—GAMAGE CUP
Unrestricted Rubber *Decentralised*
(74 *entries*)

1	Miller, C. P.	Bradford	11 : 05
2	Cartwright, J. K.	Hull Pegasus	10 : 53
3	Chambers, T.	Stockton	10 : 20
	Wilkie, J.	Wigan	10 : 20
5	Burwood, R	Blackheath	10 : 10
6	Barnacle, E.	Leamington	9 : 40

March 25th, 1956—PILCHER CUP
Unrestricted Glider *Decentralised*
(148 *entries*)

1	Roberts, G.	Five Towns	10 : 50
2	Painter, D.	Henley	10 : 25
3	Harris, J.	Loughboro' College	9 : 57
4	Goodall, R.	Surbiton	9 : 36
5	Willis, N.	Anglia	9 : 33
6	Kay, J.	Loughboro' College	8 : 54

April 8th, 1956—S.M.A.E. GLIDER CUP
A/2 Eliminators *Area Centralised*
(189 *entries*)

1	Robson, R.	Hayes	13 : 26
2	Manville, J.	Bournemouth	13 : 21
3	Goodhew, R.	Men of Kent	12 : 49
4	Boxall, F.	Brighton	12 : 31
5	O'Donnell, J.	Whitefield	12 : 21
6	Byrd, G.	Loughboro' College	12 : 09

FARROW SHIELD
Area Centralised
(17 *Clubs*)

1	Croydon & D.M.A.S.	35 : 14
2	Leeds M.F.C.	29 : 13
3	Birmingham M.A.C.	28 : 52
4	West Middlesex M.F.C.	25 : 43
5	Blackheath M.F.C.	21 : 05
6	Whitefield M.A.C.	20 : 15

WOMEN'S CHALLENGE CUP
Area Centralised
(7 *entries*)

1	Moulton, Mrs. B.	West Herts	7 : 42
2	Filtness, Mrs. M.	Chester	7 : 10
3	Arnold, Mrs. F.	Bournemouth	6 : 31
4	Buskell, Mrs. M.	Surbiton	4 : 53
5	Pepper, Miss M.	Southampton	4 : 22
6	Cox, Miss G.	Thameside	3 : 41

JETEX CHALLENGE CUP
Area Centralised
(18 *entries*)

1	Dowsett, I.	W. Middlesex	28.02	ratio
2	Done, J.	Wallasey	25.40	,,
3	Pratt, K.	Ashton	23.00	,,
4	O'Donnell, J.	Whitefield	20.17	,,
5	Lipscombe, D.	R.A.F.	16.00	,,
6	Balding, A.	Cleethorpes	15.12	,,

April 15th, 1956—"AEROMODELLER" R/C TROPHY
Radio Control (17 *entries*) *Centralised*

1	Fox, J.	Hatfield	579	points
2	Parkinson, G.	C/Member	457.5	,,
3	Boys, H.	Northampton	438	,,
4	Fisher, D.	C/Member	393	,,
5	Cooke, R.	West Essex	379.5	,,
6	Higham, R.	C/Member	360	,,

April 22nd, 1956—ASTRAL TROPHY
Power Eliminator *Area Centralised*
(147 *entries*)

1	Averill, R.	Birmingham	15 : 00+4 : 00
2	Jays, V.	C/Member	15 : 00+2 : 55
3	Bickerstaffe, J.	Rugby	14 : 28
	Jackson, D. W.	Ashton	14 : 28
5	Upson, G.	Northwick Park	14 : 15
	Pass, F.	Cheadle	13 : 59

WESTON CUP
Wakefield Eliminator *Area Centralised*
(100 *entries*)

1	Read, P.	Birmingham	15 : 00+12 : 32
2	Moore, L.	Leamington	15 : 00+ 6 : 36
3	Yale, A.	Bournemouth	15 : 00+ 6 : 35
4	Trahearne, R.	Birmingham	15 : 00
5	Baldwin, R.	Wigan	14 : 54
6	Palmer, J.	Croydon	14 : 46

May 4th, 1956—HAMLEY TROPHY
Power (62 *entries*) *Decentralised*

1	Wisher, A.	Brixton	11 : 58
2	Firth, R.	York	10 : 09
3	West, J.	Southern Cross	9 : 26
4	Mussell, A.	Brighton	8 : 55
5	Trainor, J.	Whitefield	8 : 43
6	Moss, G.	Luton	8 : 41

May 20th/21st, 1956—BRITISH NATIONALS
Held at R.A.F. Hemswell

THURSTON CUP
Glider (148 *entries*) *Centralised*

1	Boxall, F.	Brighton	12 : 00+6 : 34
2	Cartwright, E.	North Lincs.	12 : 00+2 : 11
3	Greygoose, R.	Anglia	11 : 45
4	Cameron, G.	Leeds	11 : 04
5	Leeson, K.	Derby	10 : 49
6	Moore, L. E.	Leamington	10 : 42

S.M.A.E. RADIO CONTROL TROPHY
Radio (11 *entries*) *Centralisea*

1	Nixon, J.	C/Member	306	points
2	Donohue, R.	Kersal	296	,,
3	Budding, H.	York	266	,,
4	Airey, H.	C/Member	248	,,
5	Boys, H.	Northampton	216½	,,
6	Parkinson, G.	C/Member	193	,,

SHORT CUP
Payload (10 *entries*) *Centralised*

1	Ward, R. A.	Croydon	5 : 34
2	Faulkner, B.	Cheadle	5 : 32
3	Mussell, A.	Brighton	4 : 35
4	Glynn, K.	Brixton	3 : 38
5	Vandam, G.	Walsall	3 : 31
6	Monks, R. C.	Birmingham	3 : 03

"GOLD" TROPHY
C/L Stunt (21 *entries*) *Centralised*

1	Russell, P.	Worksop	310	points
2	Steward, L.	West Essex	303	,,

3 Lloyd, E.	R.A.F.	283	,,
4 Winch, J.	Worksop	275	,,
5 Eiffiander, J.	Macclesfield	266	,,
6 Dickenson, D.	Huddersfield	239	,,

DAVIES "A" TROPHY

Team Racing		*Centralised*
1 Howard, J.	Foresters	
2 Harris, B.	Prestwick	
3 Harding, J.	Sidcup	
4 Pratt, D.	Sidcup	

DAVIES "B" TROPHY

Team Racing		*Centralised*
1 Martin, W.	Chingford	
2 Tuthill, R.	Enfield	
3 Barclay, A.	Perth	
4 Lawton, P.	Heath	

SIR JOHN SHELLEY CUP

Power	(86 *entries*)	*Centralised*
1 Smith, T. W.	English Electric	12 : 00+6 : 39
2 Ford, G.	Novocastria	12 : 00
3 Sedgebeer, A.	Sharston	11 : 19
Hartley, J.	Wolves	11 : 19
5 West, J.	Southern Cross	11 : 02
6 Stenning, D.	C/Member	10 : 51

"MODEL AIRCRAFT" TROPHY

Rubber	(56 *entries*)	*Centralised*
1 Cartwright, J.	Hull Pegasus	12 : 00+6 : 54
2 Marshall, S.	Boston	12 : 00+6 : 51
3 Alexander, A.	Cowley	12 : 00+1 : 45
4 Pollard, R.	Tynemouth	11 : 50
5 North, R. J.	Croydon	11 : 37
6 Monks, R. C.	Birmingham	11 : 28

LADY SHELLEY CUP

Tailless	(10 *entries*)	*Centralised*
1 Marshall, J.	Hayes	6 : 09
2 Hedgeman, P.	Hayes	4 : 33
3 Hinds, S.	Wallasey	4 : 27
4 Headley, J.	English Electric	4 : 11
5 Finn, P.	St. Albans	3 : 52
6 Crawshaw, I.	St. Albans	3 : 34

SUPER SCALE TROPHY

Scale	(7 *entries*)	*Centralised*
1 Wilson, G.	Maybole	80 points
2 Bridgewood, J.	Doncaster	79 ,,

3 Fearnley, E.	North Lincs	70	,,
4 Ferguson, J.	Glasgow	63	,,
5 Archbold, J.	Leicester	44	,,
6 Ball, P. H.	Leicester	34	,,

TAPLIN TROPHY

Radio Control	(12 *entries*)	*Centralised*
1 Nixon, J.	C/Member	368 points
2 Parkinson, G.	C/Member	288 ,,
3 Fisher, D.	C/Member	257 ,,
4 Boys, H.	Northampton	202 ,,
5 Askew, R.	Kersal	165 ,,
6 Airey, W.	C/Member	145 ,,

CLASS I SPEED

C/L Speed	(6 *entries*)	*Centralised*
1 Gibbs, R.	East London	127.5 m.p.h.
2 Wright, P.	St. Albans	100.8 ,,
3 Edmonds, D.	High Wycombe	100.3 ,,
4 Drewell, P.	Lewisham	92.2 ,,
5 Lawton, S.	Macclesfield	76.5 ,,
6 Wynch, J.	Worksop	76 ,,

CLASS II SPEED

C/L Speed	(3 *entries*)	*Centralised*
1 Gibbs, R.	East London	147.1 k.p.h.
2 Wright, P.	St. Albans	123 ,,
3 Watson, J.	Lewisham	115.2 ,,

CLASS III SPEED

C/L Speed	(2 *entries*)	*Centralised*
1 King, R.	West Essex	145.3 m.p.h.
2 Yeldham, G.	Belfairs	139.8 ,,

BOWDEN TROPHY

Precision	(2 *entries*)	*Centralised*
1 Ball, P. H.	Leicester	860 points
2 Ward, P.	Darlington	740 ,,

June 9th/10th, 1956—INTERNATIONAL TEAM TRIALS
Held at R.A.F. Spitalgate

A/2 Glider	(59 *entries*)	*Centralised*
1 Roberts, G.	Five Towns	14 : 33
2 Boxall, F.	Brighton	13 : 16
3 Willis, N.	Anglia	12 : 28
4 Amor, R.	C/Member	12 : 20
5 Wimder, W.	De Havilland	12 : 16
6 Burwood, R.	Blackheath	12 : 10

South Midland Area Rally scene at Cranfield, one of the most popular area rallies for all within possible—and sometimes even impossible—range, combining a good prize list with an unequalled flying field.

Wakefield	(29 *entries*)	*Centralised*
1 Lefever, G.	C/Member	14 : 24
2 O'Donnell, J.	Whitefield	14 : 03
3 O'Donnell, H.	Whitefield	13 : 49
4 Revell, H.	Northampton	13 : 27
5 Baldwin, R.	Wigan	12 : 47
6 Budding, H.	York	12 : 26

Power	(38 *entries*)	*Centralised*
1 Upson, G.	Northwick Park	15 : 00
2 Draper, R.	Coventry	13 : 45
3 Lanfranchi, S.	Bradford	12 : 23
Gaster, M.	C/Member	12 : 23
5 Posner, D.	N.W. Middlesex	11 : 58
6 Buskell, P.	Surbiton	11 : 49

June 24th, 1956—KEIL TROPHY

Power	(54 *entries*)	*Decentralised*
1 Stenning, D. W.	C/Member	12 : 00 + 4 : 11
2 Draper, R.	Coventry	11 : 58
3 Moss, G.	Luton	11 : 20
4 Lanfranchi, S.	Bradford	11 : 16
5 Barr, A.	Coventry	11 : 09
6 Bickerstaffe, J.	Rugby	10 : 50

FROG JUNIOR TROPHY

Unrestricted Rubber/Glider	(20 *entries*)	*Decentralised*
1 Greaves, D.	Leamington	9 : 45
2 Cordes, A.	Novocastria	9 : 13
3 Watson, M.	Whitefield	9 : 11
4 Manville, P.	Bournemouth	9 : 00
5 Rushton, G.	Bolton	8 : 05
6 MacConnall, M.	Sharston	7 : 39

July 8th—NORTHERN HEIGHTS GALA
Held at R.A.F. Halton

THE QUEEN ELIZABETH CUP (*Wakefield*)
1 Rowe, B. St. Albans 789 points

FLIGHT CUP (*Open Glider*)
1 Winder, W. G. D. H. Hatfield 8 : 00

FAIREY CUP (*Open Rubber*)
1 Crossley, P. J. Blackheath 8 : 00

DE HAVILLAND TROPHY (*Open Power*)
1 Jayes, V. C/Member 6 : 11

THURSTON HELICOPTER TROPHY
1 Ingram, C. M. Southampton

R.A.F. FLYING REVIEW CUP (*R/C Spot Landing*)
1 Fisher, D. J. C/Member 21 feet

KEIL COMBAT CUP
1 Smith, M. High Wycombe

"AEROMODELLER" CHALLENGE CUP—Gala Champion
1 Lennox, R. Birmingham

July 8th—STOCKPORT EXPRESS RALLY
Held at Woodford Aerodrome

Glider		
1 Neild, W. S.	Cheadle	5.22
Power		
1 O'Donnell	Whitefield	6.00
Rubber		
1 Evans, G.	Cheadle	6.00
Jetex		
1 Roberts, R.	Bolton	18.5
Flying Scale		
1 Barton, G.	Doncaster	76 points
Class "A" Team Race		
1 Thompson, B.	Foresters	

June 24th—WEST HANTS RALLY
Held at R.A.F. Andover

Rubber		
1 Elliott	Man of Kent	8 : 58
Radio Control (Glider)		
1 Copland, R.	Northern Heights	
Class "A" Team Race		
1 Studer, R.	Northern Heights	
Class "B" Team Race		
1 Muscutt, M.	West Essex	
Glider		
1 Manville, P.	Bournemouth	7 : 00
Power		
1 Mussell, A.	Brighton	8 : 15
Class "B" Team Race		
1 Lawton, P.	Heath Aeromodellers	
Combat		
1 Fletcher, N.	Monkseath and W. Brom.	
Ladies' Event		
1 Mrs. Smith	English Electric	

June 17th—CLYWD HILLS SLOPE SOARING RALLY

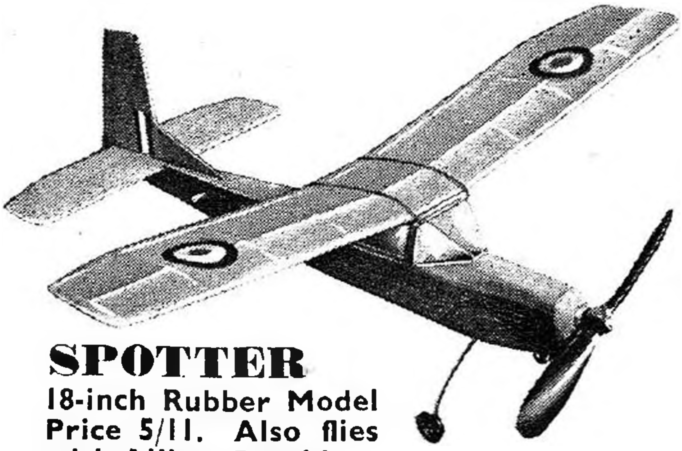
Open	
1 Chadwick, J.	Ashton
Nordic	
1 Mrs. R. Sutton	Wallasey
Tailless	
1 Wilde, H. F.	Chester
Junior	
1 Wilde, K.	Chester
R/C	
1 Bailey, D.	Burton-on-Trent

July 15th—ENFIELD CONTROL LINE RALLY

Class "A" Team Race		
1 Edmonds, R.	High Wycombe	8 : 38.0
Class "B" Team Race		
1 McCoun, S.	West Essex	9 : 15.4
Combat		
1 Templeman, J.	Sidcup	+18 points
Handicap Speed		
1 Gibbs, R.	East London	10 c.c. (159.8 m.p.h.)

FACT OR FANCY ?

Reds and yellows are the best colours for visibility. There just are no foolproof rules on this subject. So much depends on the conditions. On bright days against a blue sky, the darker the colours the better they show up. With white or light colours, the model appears translucent and soon disappears from sight in the sky. But near the ground, light colours may show up better against a background of trees. On a dull day against a cloud background, most models will look black at a distance. What we have found best, is to use colours which show up well *on the ground*—i.e., to contrast with grass, etc., and make the model stand out from a distance. Here red and yellow may not be as effec- _ve as black and white since the latter two do not occur so widely in nature.



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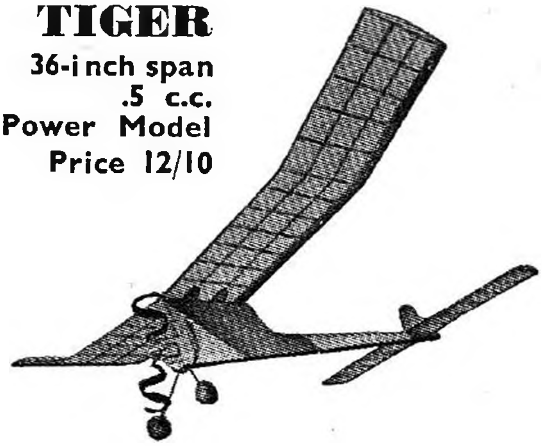

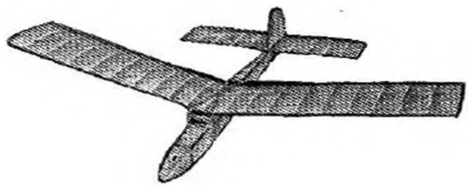

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Price 6/7 *inc. cement*

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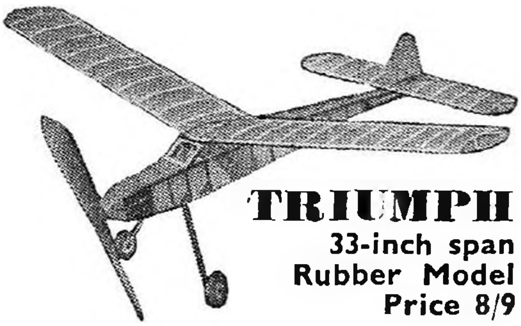

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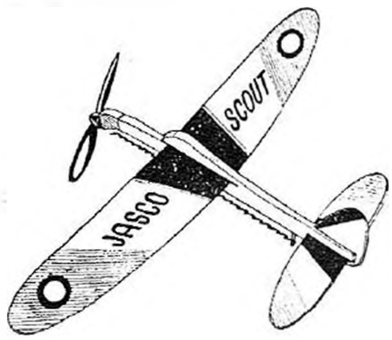
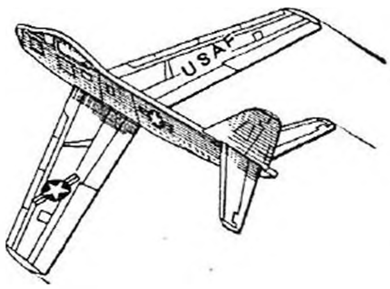
Rubber Model
Price 8/9

TROJAN
18-inch C/Line
stunt model for .5 to 1.5 c.c. motors
Price 10/3

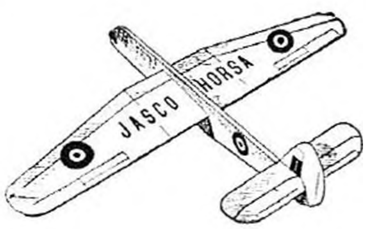
SCOUT Price 4/3



SABRE Price 2/11
cement included



HORSA Price 2/11



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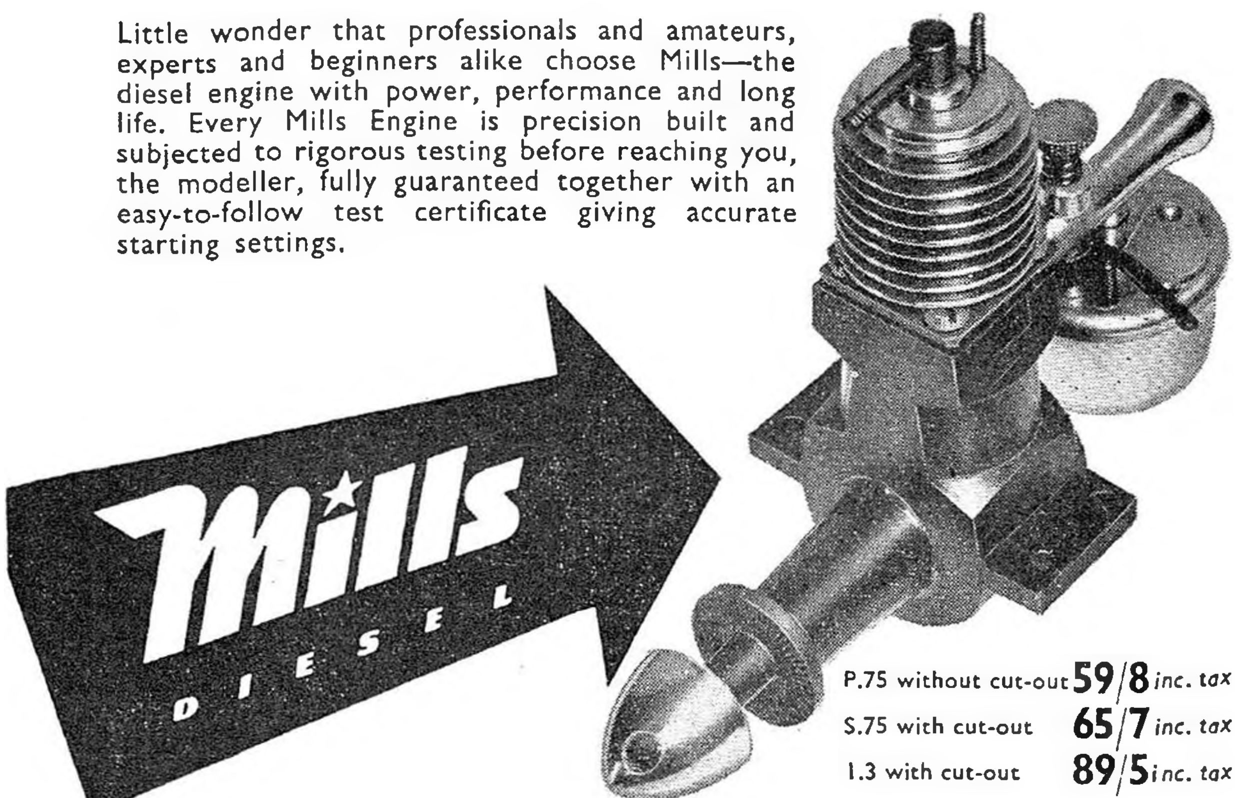

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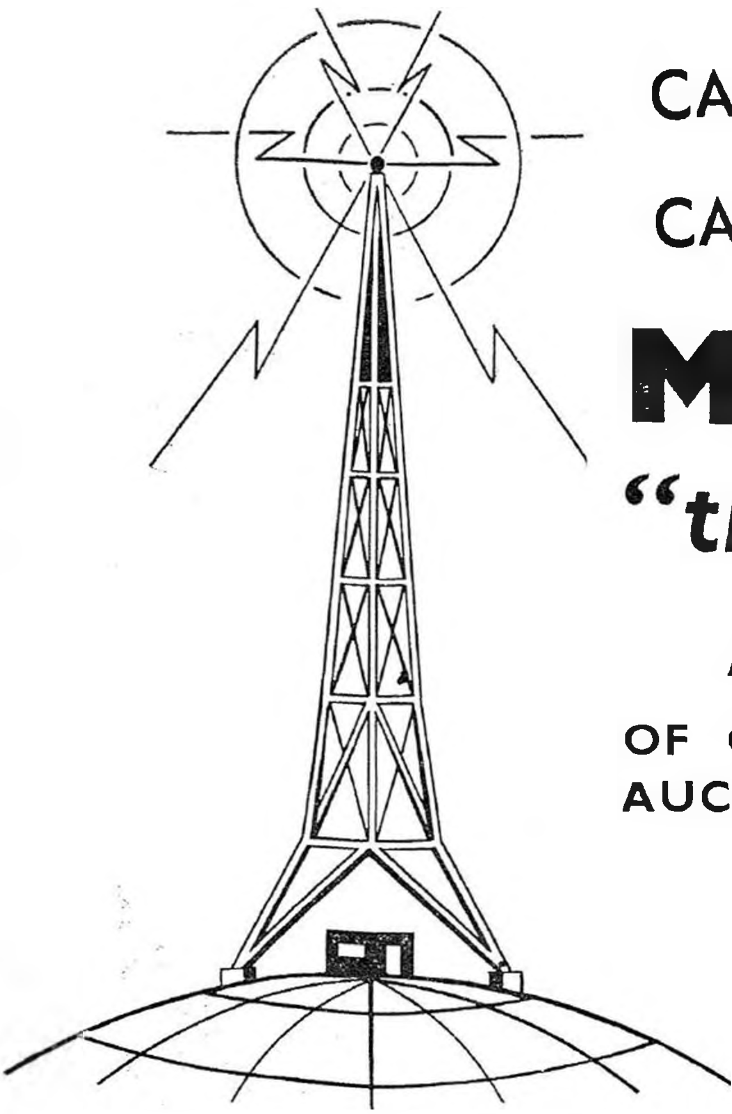

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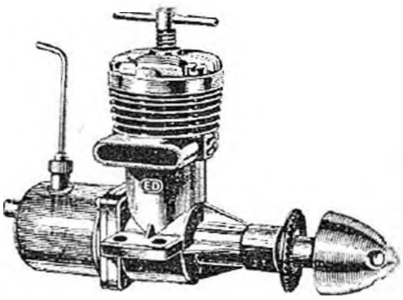

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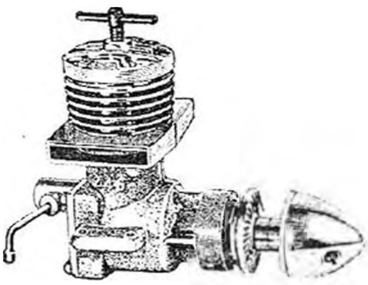

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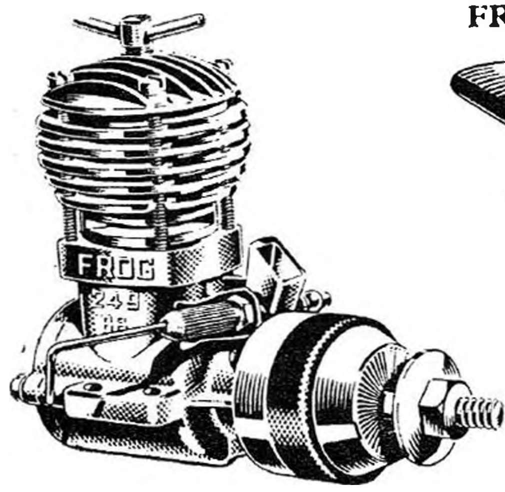

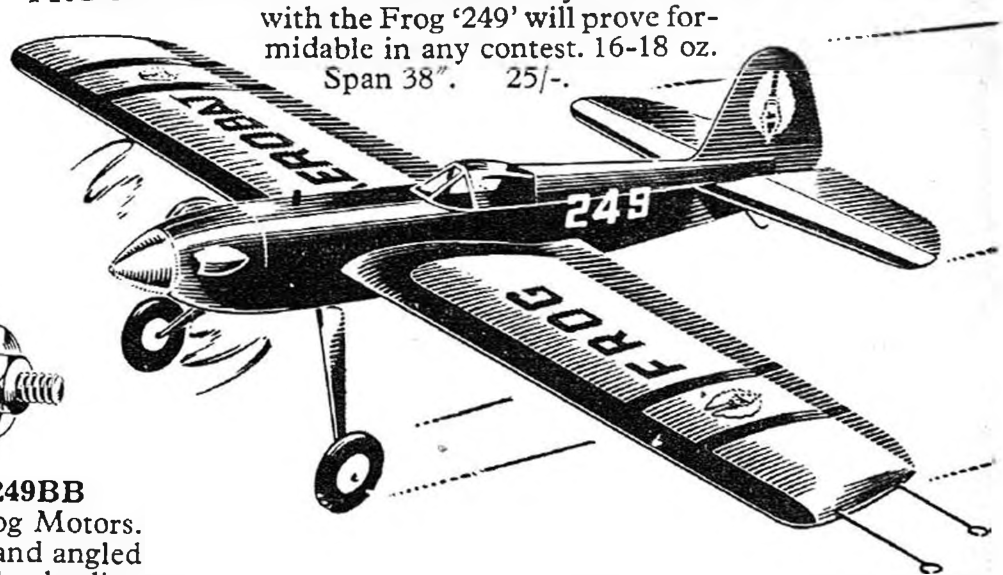

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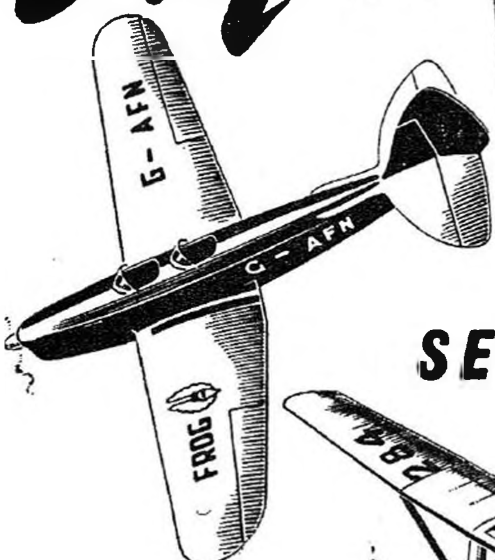

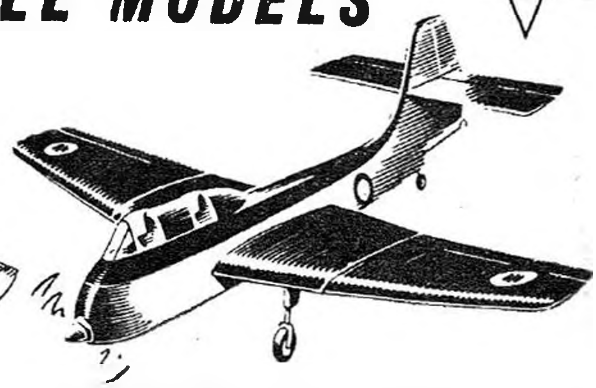

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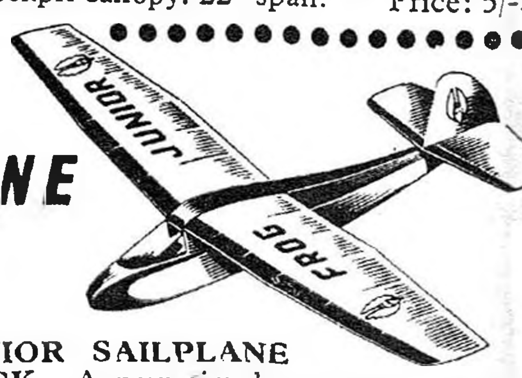

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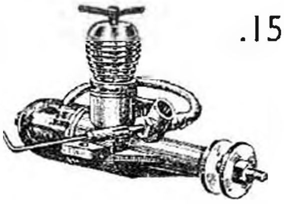

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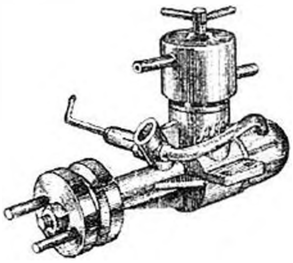

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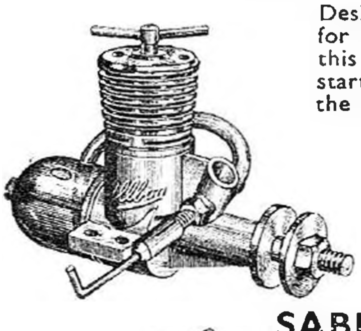

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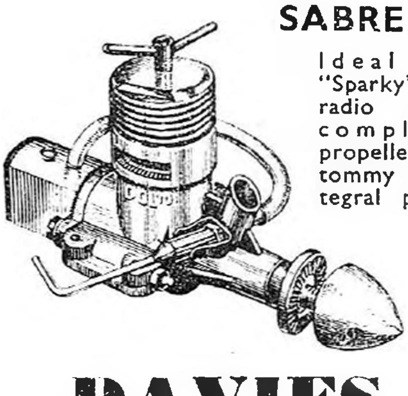

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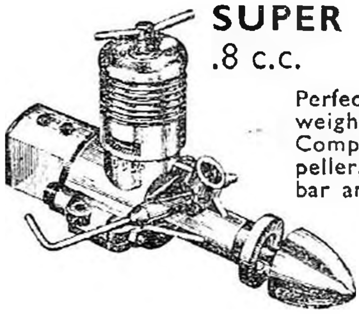

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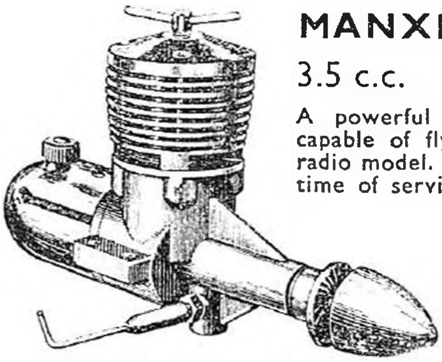

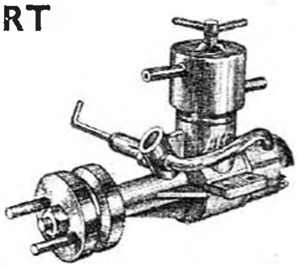

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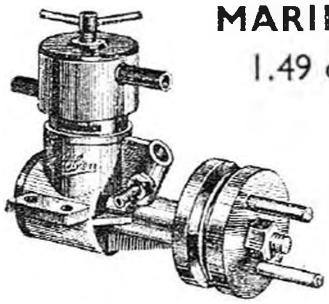

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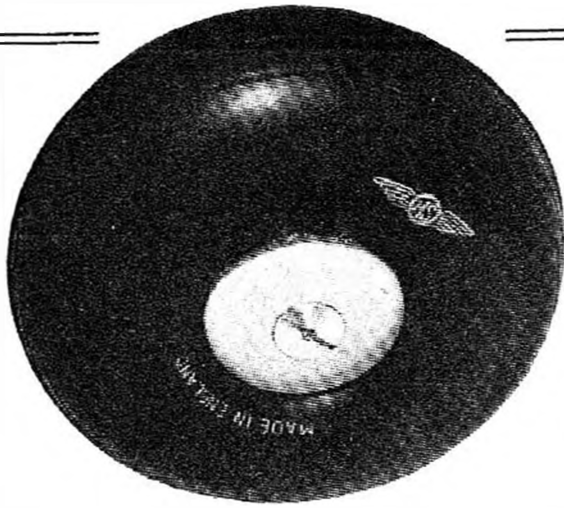

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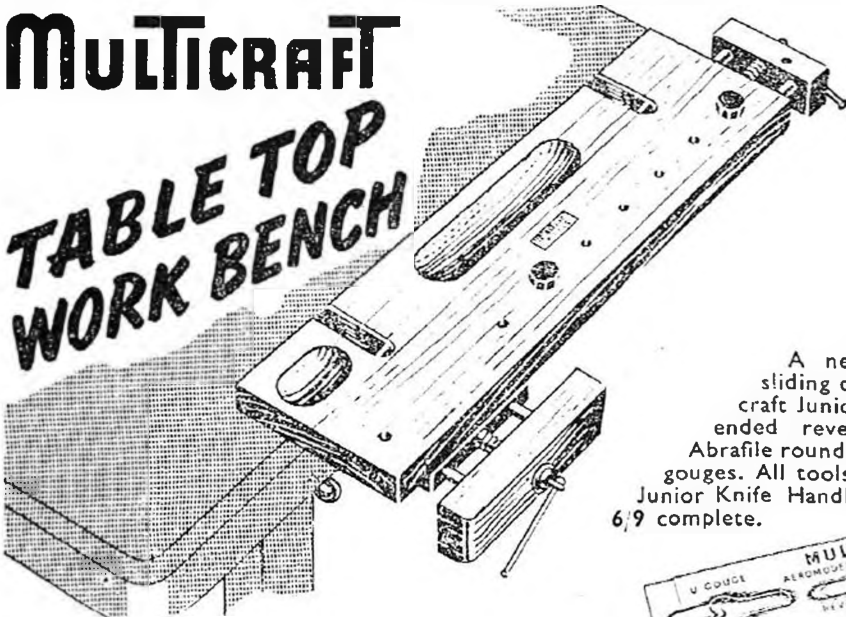

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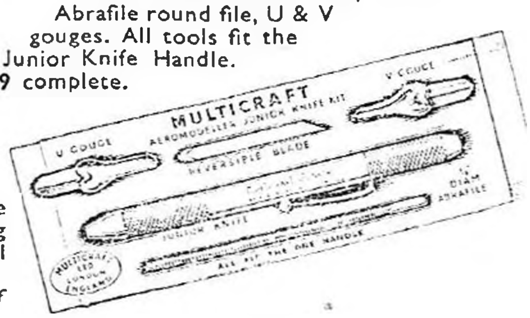

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