A GENERAL UTILITY SYSTEM FOR THE IBM TYPE 650

The Mathematical Analysis Section
Missile Systems Division
Lockheed Aircraft Corporation

THE MATERIAL CONTAINED HEREIN SHOULD ALLOW EFFECTIVE AND EFFICIENT USAGE OF THE TYPE 650 WITHOUT DUPLICATION OF DEVELOPMENT OR MISDIRECTION OF PRINCIPLES. THIS COLLECTION OF ROUTINES AND METHODS REPRESENTS AN OVERALL PHILOSOPHY OF OPERATION WHICH HAS HAD GOOD SUCCESS IN ACTUAL OPERATION IN AN ENGINEERING AND SCIENTIFIC APPLICATION. THESE ROUTINES HAVE BEEN USED IN MUCH THEIR PRESENT FORM ON 650S NUMBER 10 AND 37 AND WILL BE USED ON A THIRD MACHINE DELIVERED AT THE END OF JULY 1955.

ALL OF THESE ROUTINES ARE OF THE TYPE COMMONLY KNOWN AS UTILITY . THIS MEANS THAT THEY ARE APPLICABLE TO MOST PHASES OF ENGINEERING OR SCIENTIFIC COMPUTING. MANY ARE EQUALLY SUITABLE FOR BUSINESS APPLICATIONS. THE STANDARD CARD FORM[1] AND CONTROL PANELS DESCRIBED ARE VITAL TO INTEGRATED OPERATION OF THIS SYSTEM. INITIAL ADOPTION OF THIS SYSTEM FOR LATER MODIFICATION SHOULD PROVE TO BE A GREAT HELP TO NEW INSTALLATIONS.

THE DEVELOPMENT OF THE FLOATING DECIMAL ABSTRACTION WAS DONE JOINTLY BY THE MATHEMATICAL ANALYSIS DEPARTMENTS OF BOTH THE GEORGIA DIVISION AND THE MISSILE SYSTEMS DIVISION OF LOCKHEED. THE ARITHMETIC PORTION IS DUE TO GEORGIA AND THE SUBROUTINE PORTION TO MSD. LATER DEVELOPMENTS WERE MADE AT MSD IN PACKAGING THE SYSTEM AND PUTTING TRACING UNDER CONTROL OF THE CONSOLE. THEREFORE FACS AT GEORGIA AND FLAIR AT MSD ARE SOMEWHAT DIFFERENT IN OPERATION. FOR THIS REASON THE ENTIRE SYSTEM IS PRESENTED HERE AS MSD USES IT - DESPITE POSSIBLE DUPLICATION IN CERTAIN RESPECTS OF THE WORK OF THE GEORGIA PEOPLE.

IT MAY BE NOTICED THAT THE MAJORITY OF THESE ROUTINES ARE NOT WHAT ARE COMMONLY TERMED ELEGANT. EXCESSIVE POLISHING WOULD NOT GAIN US VERY MUCH IN MACHINE SPEED AND WOULD CERTAINLY LOSE EFFORT THAT HAD BETTER BE PUT TO DOING USEFUL COMPUTING WORK. THESE ROUTINES WORK AND THEY WORK SUCCESSFULLY. THE MOST IMPORTANT THING IS THAT THEY ARE AVAILABLE TO ANYONE FOR IMMEDIATE USE. CREDITS FOR THE VARIOUS ITEMS ARE AS FOLLOWS

ARITHMETIC FLAIR-FACS INCLUDING TRACE	GEORGIA MATH ANALYSIS DEPT.
FLAIR COMPILATION AND EDITING	ED DODGE
FLAIR SUB-ROUTINE SQUARE ROOT	ROBERT BEMER
FLAIR SUB-ROUTINE LOG-ANTILOG	IRENE BROWN AND JACK ANTCHAGNO
FLAIR SUB-ROUTINE SINE-COSINE	ALBERT PODVIN
FLAIR SUB-ROUTINE ARCTANGENT	CHARLES WIMBERLEY
MACHINE LANGUAGE TRACE USABLE WITH FLAIR	RAY CIANCI
REGIONAL ASSEMBLY ROUTINE	RAY CIANCI
PUNCH DRUM FROM α TO β	DON JACKSON
PUNCH β EIGHTHS OF THE DRUM	DON JACKSON
TYPE 407 UTILITY PANEL	RICHARD MIDDLETON
TYPE 533 UTILITY PANEL	RICHARD MIDDLETON
FIVE-FIELD LOAD ROUTINE AND CARD FORM	ROBERT BEMER
FLAIR TO FIXED DECIMAL ROUTINE	ROBERT BEMER AND ELAINE GATTEN

1. Other companies may temporarily order the card form from IBM in San Jose, California, if they so desire.

FIVE-FIELD LOAD ROUTINE

THIS TYPE 650 LOADING ROUTINE IS DESIGNED TO LOAD FIVE WORDS PER CARD IN RANDOM ADDRESSES. THE FORMAT IS THAT LABELED NUMBER 1 ON THE STANDARD 650 CARD FORM. A FIVE-WORD CARD WAS CHOSEN ARBITRARILY TO EFFECT THE MOST EFFICIENT LOADING WITH A MINIMUM OF RESTRICTIONS. THIS ROUTINE IS BELIEVED TO BE THE SIMPLEST IN OPERATION AND CAN LOAD THE ENTIRE MEMORY IN 2 MINUTES.

A LOAD-IDENTIFICATION CARD CONTAINING THE SIX INSTRUCTIONS OF THE LOADING ROUTINE MUST PREFACE ANY ROUTINE. 8000 IS SET TO 70 1901 XXXX. DEPRESS THE COMPUTOR RESET AND PROGRAM START BUTTONS. PLACE THE ROUTINE IN THE READ HOPPER OF THE TYPE 533 AND DEPRESS THE READ START BUTTON. THE LOAD-IDENTIFICATION CARD IS READ UNDER THE CONTROL OF 8000 AND THE NEXT INSTRUCTION WILL BE TAKEN FROM 1901. THIS INSTRUCTION IS ONE OF THOSE READ IN FROM THE LOAD-HUB CARD AND CALLS FOR THE READING OF THE FIRST FIVE-FIELD LOADING CARD. THE NEXT INSTRUCTION IS TAKEN FROM 1902 AND RANDOM LOADING PROCEEDS BY SUCCESSIVE LOAD AND STORE DISTRIBUTOR COMMANDS. THE CYCLICAL PATTERN OF LOADING IS EVIDENT BY TRACING THE INSTRUCTIONS. THE O AND I PARTS OF THE STORE DISTRIBUTOR COMMANDS ARE EMITTED ON THE TYPE 533 PANEL. THE DIAGRAM OF THE TYPE 533 UTILITY PANEL SHOWS THIS WIRING IN THE C READ POSITION.

THE ONLY RESTRICTION OF THIS SYSTEM IS THAT THE LAST INSTRUCTION LOADED IN MEMORY IS THE FIRST TO BE OBEYED IN THE ROUTINE. THIS IS ACCOMPLISHED BY A 12 PUNCH IN THE UNITS POSITION OF THE A PART OF ANY OF THE FIVE FIELDS. THIS PUNCH TRANSFERS A CO-SELECTOR WHICH REPLACES THE I PART OF THE STORE DISTRIBUTOR COMMAND BY THE D PART. THUS THE LAST INSTRUCTION IS LOADED INTO ITS ADDRESS AND THE LOAD ROUTINE IS DISRUPTED SO THAT THIS INSTRUCTION IS THE NEXT TO BE OBEYED. THIS AUTOMATICALLY STARTS THE PROGRAM UPON COMPLETION OF LOADING. TO RESTART THE PROGRAM ONCE IT HAS BEEN LOADED IT IS NECESSARY TO USE ONLY THE LOAD-IDENTIFICATION CARD AND THE CARD CONTAINING THAT FIRST INSTRUCTION TO BE OBEYED.

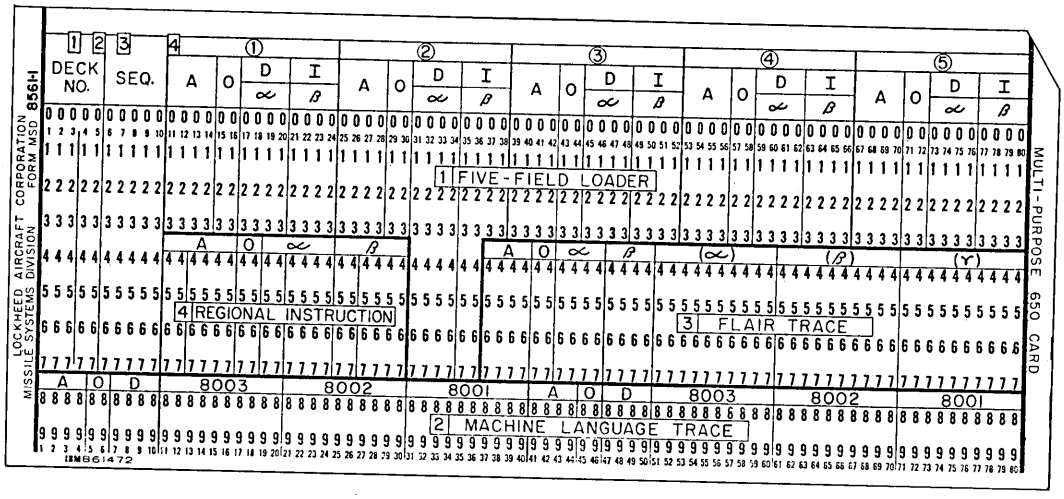
LOAD-IDENTIFICATION CARD		12-PUNCH IN COLUMN 1	
WORD 1	70 1951 1902+	WORD 5	69 1958 1957+
WORD 2	69 1952 1951+	WORD 6	69 1960 1959+
WORD 3	69 1954 1953+	WORD 7	10 8001 1965+
WORD 4	69 1956 1955+	WORD 8	35 0001 1966+

NOTE —— WORDS 1 THRU 8 ENTER ADDRESSES 1901 TO 1908 RESPECTIVELY. WORDS 7 AND 8 IN STORAGES 1907 AND 1908 ARE USED IN FLAIR. THEY MUST BE ON THE LOAD-IDENTIFICATION CARD TO PRESERVE THEM IN CASE THE LOAD-IDENTIFICATION CARD IS USED AFTER FLAIR IS ALREADY ON THE DRUM.

A O D AND I ARE READ FROM EACH FIELD OF THE FIVE-FIELD LOAD CARD SO THAT STORAGES 1951 THRU 1960 ARE FILLED AS FOLLOWS

A	O	D	I	A	O	D	I	A	O	D	I
1951	24	A_1	1903	1955	24	A_3	1905	1959	24	A_5	1901
1952	O_1	D_1	I_1	1956	O_3	D_3	I_3	1960	O_5	D_5	I_5
1953	24	A_2	1904	1957	24	A_4	1906				
1954	O_2	D_2	I_2	1958	O_4	D_4	I_4				

SINCE THE I PART OF 8000 IS NOT USED IN THIS ROUTINE THESE FOUR POSITIONS MAY BE USED AS EFFECTIVE SENSE SWITCHES BY SETTING THEM AT 8 OR 9 AND INTERROGATING 8000 DURING THE ROUTINE. 8000 MAY ALSO BE SET EITHER + OR - AND INTERROGATED FOR DECISION. DO NOT ALTER THE SETTING OF 8000 SWITCHES WITHOUT FIRST DEPRESSING THE PROGRAM STOP BUTTON.



DECK 033.01 PUNCH β EIGHTHS OF THE DRUM

THIS ROUTINE PUNCHES β EIGHTHS OF THE DRUM IN SUCH A FASHION THAT THE LIST IS REPRESENTATIVE OF DRUM LAYOUT. β MAY VARY FROM 1 TO 8. PUNCHING STARTS WITH THE CONTENTS OF α.

1. SET 8000 TO 70 1901 XXXX
2. PUT LOAD-IDENTIFICATION CARD IN FRONT AND LOAD DECK 033.01
3. BEFORE DEPRESSING END-OF-FILE CHANGE CONSOLE TO 00 α β
4. DEPRESS END-OF-FILE BUTTON

A	O	D	I
0997	01	8000	8000
0914	16	8001	0915
0917	24	0978	0918
0920	24	0980	0921
0924	22	0981	0919
0929	24	0986	0930
0938	35	0008	0939
0941	16	0994	0942
0944	65	0996	0945
0990	69	0000	0917
0994	00	0000	0001
0932	16	0993	0933
0936	60	8002	0937

A	O	D	I
0912	69	8003	0913
0915	15	0990	0916
0918	22	0977	0919
0921	22	0979	0919
0926	24	0984	0927
0930	22	0985	0931
0939	44	0946	0940
0942	45	0943	0997
0945	15	0995	0916
0992	00	0050	0003
0996	00	0200	0000
0933	20	0995	0934
0911Y	65	8000	0912

A	O	D	I
0913	23	0991	0914
0916	10	0992	8002
0919	15	8003	8002
0923	24	0982	0924
0927	22	0983	0919
0937	10	8001	0938
0940	65	0991	0941
0943	20	0991	0944
0946	65	0995	0916
0993	00	0199	0012
0931	71	0977	0932
0934	30	0004	0936

PUNCHING IS IN THE FIVE-FIELD LOADER FORM FROM THE C PUNCH OF THE TYPE 533 UTILITY PANEL.

DECK 033.02 PUNCH DRUM FROM α TO β

OPERATION INSTRUCTIONS FOR THIS ROUTINE ARE THE SAME AS FOR DECK 033.01. PUNCHING IS ALSO ON THE FIVE-FIELD LOADER FORM BUT SEQUENTIAL ON EACH CARD.

A	O	D	I
1911	69	1946	1912
1912	35	0004	1913
1913	22	1910	1914
1914	35	0002	1943
1943	60	8003	1915
1915	35	0004	1916
1916	15	1947	1917
1917	10	1948	8003
1918	24	1928	1919
1919	21	1927	1945

A	O	D	I
1920	24	1930	1921
1921	21	1929	1945
1922	24	1932	1923
1923	21	1931	1945
1924	24	1934	1925
1925	21	1933	1945
1926	24	1936	1944
1944	21	1935	1937
1937	71	1927	1938
1938	11	1910	1939

A	O	D	I
1939	46	1940	1941
1940	10	8001	1942
1942	10	1949	8003
1941	01	0000	0000
1945	10	8002	8003
1946	69	0000	0000
1947	00	0001	0002
1948	69	0000	1918
1949	00	0000	9992
1900Y	67	8000	1911

DECK 033.05 - MACHINE LANGUAGE TRACING ROUTINE

ALL MACHINE LANGUAGE COMMANDS ARE ANALYZED IN OPERATIONAL ORDER. THE LOCATION ADDRESS - OPERATION CODE - DATA ADDRESS AND THE THEORETICAL CONTENTS OF 8003-8002 AND 8001 ARE PUNCHED. TWO SUCH INSTRUCTIONS ARE PUNCHED PER CARD. LISTING OF THESE CARDS ENABLES STEP-WISE FOLLOWING OF THE RESULTS OF AN ACTUAL PROGRAM. THE CARD FORMAT IS THAT LABELED NUMBER 2 ON THE STANDARD 650 CARD FORM.

THE TRACING ROUTINE MAY BE STORED IN ANY TWO ADJACENT DRUM BANDS. THE ATTACHED CODING IS LOCATED FROM 1200 TO 1299. THE ROUTINE MAY BE EITHER PLACED ON THE DRUM PREVIOUSLY OR ACCOMPANY THE PROGRAM TO BE TRACED. IN EITHER CASE A TRACING CONTROL CARD MUST BE INSERTED IN THE PROGRAM DECK BEYOND THE LOADING OF THAT INSTRUCTION WITH WHICH TRACING BEGINS. IF THE TRACING CONTROL CARD IS LOADED SEPARATELY A_1 CANNOT BE 800X NOR CAN THE ORIGINAL INSTRUCTION IN A_1 CONTAIN 800X. TRACING MAY START AT ANY PLACE ALONG THE PROGRAM. THE PROGRAM CONTINUES AT MACHINE SPEED WITHOUT TRACING AFTER THE LAST ADDRESS TRACED IS REACHED. SYMBOLS FOR THIS ROUTINE ARE

- A_1 - ADDRESS OF FIRST INSTRUCTION TO BE TRACED.
- I_1 - THE INSTRUCTION AT ADDRESS A_1.
- α_1 - I_1 IS SENT TO ADDRESS α_1. USUALLY $\alpha_1 = A_1$ HOWEVER IF $\alpha_1 \neq A_1$ TRACING WILL BEGIN WHENEVER THE ADDRESS A_1 IS AGAIN INSTRUCTED. THIS FEATURE FACILITATES LOOP TRACING.
- A_n - ADDRESS OF LAST INSTRUCTION TO BE TRACED.

THE TRACING CONTROL CARD IS A FIVE-FIELD LOADER. IT SHOULD CONTAIN THE FOLLOWING THREE WORDS FOR USING ONLY MACHINE LANGUAGE TRACE.

A	O	D	I
1298	←	I_1	→

A	O	D	I
1299	65	α_1	A_n

A	O	D	I
A_1	24	1284	1265

IT SHOULD CONTAIN THE FOLLOWING TWO WORDS WHEN TRACING IS TO BEGIN IN FLAIR AND CONTINUE ALTERNATELY IN MACHINE LANGUAGE AND FLAIR.

A	O	D	I
1290	69	8000	1243

A	O	D	I
1677	16	1834	1239

IF TRACING IS TO BEGIN WITH MACHINE LANGUAGE AND ALTERNATE WITH FLAIR ALL FIVE OF THESE WORDS MUST BE ON THE TRACING CONTROL CARD WITH $A_n = 1735$. COMPOSITE TRACING OF BOTH MACHINE LANGUAGE AND FLAIR COMMANDS IS UNDER THE CONTROL OF THE HUNDREDS POSITION OF 8000D. WHEN 8000 READS 70 1901 XXXX TRACING WILL BE OPERATIVE IN MACHINE LANGUAGE UNTIL THE PROGRAM GOES TO FLAIR. TRACING WILL NOT RESUME UPON RETURN TO MACHINE LANGUAGE. WHEN 8000 READS 70 1801 XXXX TRACING WILL CONTINUE THRU BOTH M. L. AND FLAIR.

A	O	D	I
1200	69	1249	1201
1201	23	1285	1202
1202	60	1282	1242
1203	19	1283	1204
1204	46	1207	1205
1205	60	1282	1206
1206	15	1283	1211
1207	60	1283	1208
1208	19	1262	1209
1209	15	1282	1210
1210	14	1262	1211
1211	21	1278	1212
1212	20	1279	1213

A	O	D	I
1229	22	1233	1218
1230	60	1282	1231
1231	15	1283	1232
1232	69	1284	1233
1233	65	0000	1234
1234	24	1249	1235
1235	65	1233	1236
1236	30	0004	1287
1237	69	1221	1238
1238	24	1218	1240
1239	20	1249	1248
1240	69	1249	1241
1241	24	1285	1202

A	O	D	I
1259	00	1227	1215
1260	71	1277	1237
1261	65	1254	8002
1262	99	9999	9999-
1265	20	1283	1266
1266	21	1282	1267
1267	65	1299	1268
1268	69	1258	1269
1269	23	1258	1270
1270	69	1273	1271
1271	22	1273	1272
1272	69	1298	1273
1273	24	0000	1274

MACHINE LANGUAGE TRACING ROUTINE -- CONTINUED

A	O	D	I	A	O	D	I	A	O	D	I
1213	69	1284	1214	1242	45	1203	1205	1274	24	1249	1275
1214	24	1280	1285	1243	97	1244	1245	1275	30	0004	1276
1215	24	1284	1216	1244	45	1293	1291	1276	20	1277	1287
1216	20	1283	1217	1245	65	1247	1246	1286	88	8080	0000
1217	21	1282	1225	1246	20	1218	1293	1287	69	1249	1288
1218	71	1277	1219	1247	00	0000	1237	1288	23	1281	1289
1219	69	1220	1222	1248	24	1283	1236	1289	16	1258	1290
1220	69	1221	1222	1250	39	9000	0000	1290	45	1293	1291
1221	71	1277	1219	1251	49	9000	0000	1291	65	1260	1292
1222	24	1218	1223	1252	89	9000	0000	1292	20	1218	1293
1223	69	1281	1224	1253	99	9000	0000	1293	65	1261	1294
1224	24	1277	1230	1254	65	1259	1200	1294	69	1249	1295
1225	65	1249	1226	1255	65	1259	1296	1295	84	1254	8002
1226	35	0004	1228	1256	65	1259	1200	1296	69	1249	1297
1227	65	1249	1228	1257	65	1259	1296	1297	22	1285	1201
1228	69	1233	1229	1258	00	0065	1735				

DECK 033.06 - REGIONAL ASSEMBLY ROUTINE

REGIONAL CODING IS DESIRABLE FOR ABSTRACT SYSTEMS. INDEXED REGIONAL ADDRESSES ARE ASSIGNED WHICH CAN BE CONVENIENTLY CONVERTED TO MACHINE ADDRESSES. LONG PROGRAMS MAY BE BROKEN INTO SECTIONS WHICH MAY BE CODED CONCURRENTLY AND SEQUENTIALLY AS IF STARTING AT ADDRESS 0000. EACH SECTION IS ASSIGNED TO TRUE DRUM ADDRESSES WITH THE ASSEMBLY ROUTINE WHEN THE PROGRAMMING IS COMPLETED. C2 0352 IS AN EXAMPLE OF A REGIONALLY CODED ADDRESS. C2 IS THE ADDRESS INDEX AND 0352 IS THE ADDRESS WITHIN THE C2 REGION. ALPHA-NUMERIC INDICES FROM A0-A9 TO H0-H9 ARE ALLOWABLE.

ONE REGIONAL INSTRUCTION IS PUNCHED PER CARD. THE FORMAT IS NUMBER 4 OF THE STANDARD 650 CARD FORM. THE LOCATIONS OF REGIONAL INSTRUCTIONS AND THE REGIONS THEMSELVES DO NOT HAVE TO BE SEQUENTIALLY ORDERED. A DUMMY INSTRUCTION WITH THE INDEX ADDRESS I0 MUST FOLLOW THE LAST INSTRUCTION OF THE LAST REGION TO BE ASSEMBLED.

RELOCATION OF ANY INDEXED ADDRESS TO THE TRUE DRUM ADDRESS IS ACCOMPLISHED BY SPECIFYING THE INCREMENT BY WHICH THE ADDRESS PART IS TO BE ADJUSTED AND THE LAST INDEXED INSTRUCTION TO BE SO ADJUSTED. THE ASSEMBLY ROUTINE WILL PUNCH THE DESIRED ASSEMBLED PROGRAM FROM THE C POSITION OF THE TYPE 533 UTILITY PANEL ONTO THE STANDARD FIVE-FIELD LOAD CARD.

INSERT ADDITIONAL REGIONAL INSTRUCTIONS INTO A COMPLETED REGION BY ADDRESSING AS MANY AS ARE NEEDED WITH THE SAME ADDRESS AS THE INSTRUCTION THEY FOLLOW. PLACE THEM IN THE PROGRAM DECK IN THIS ORDER. CONTROL CARD INFORMATION MUST BE ADJUSTED ACCORDINGLY. DELETION IS COMPARABLE TO INSERTION EXCEPT THAT THE UNDESIRED INSTRUCTION CARDS ARE REMOVED. THESE ALTERATIONS AND EACH REGIONAL INDEX USED MUST BE REPRESENTED WITH CONTROL INFORMATION. CONTROL WORDS ARE LOADED ON FIVE-FIELD LOADERS IN SEQUENTIAL ADDRESSES STARTING WITH 1000. AN EXAMPLE OF AN ASSEMBLY CONTROL CARD IS

A	O	D	I	A	O	D	I	A	O	D	I	
1000	B2	0315	0100	1001	B5	0106	0500	1002	D3	0021	0620	ETC.

O IS THE ALPHA-NUMERIC ADDRESS INDEX OF THE REGION
D IS THE LAST REGIONALLY INDEXED ADDRESS OF THAT REGION
I IS THE INCREMENT TO BE ADDED TO ALL ADDRESSES IN THAT REGION

REGIONAL ASSEMBLY ROUTINE -- CONTINUED

CARDS ARE PLACED IN THE TYPE 533 IN THE FOLLOWING ORDER

1. LOAD-IDENTIFICATION CARD
2. DECK 033.06 - REGIONAL ASSEMBLY ROUTINE
3. ASSEMBLY CONTROL CARDS AS NEEDED
4. STARTER CARD - 0500Y 65 0807 0501 IN FIELD 1.
5. REGIONALLY-CODED PROGRAM - ONE INSTRUCTION PER CARD

A	O	D	I
0500	65	0807	0501
0501	35	0001	0502
0502	20	0817	0503
0503	20	0818	0504
0504	21	0819	0505
0505	65	0803	0506
0506	20	0559	0508
0508	70	0401	0509
0509	65	0401	0510
0510	35	0002	0511
0511	21	0816	0512
0512	30	0001	0513
0513	11	0807	0514
0514	46	0515	0615
0515	65	0817	0516
0516	16	0816	0517
0517	45	0580	0518
0518	65	0818	0519
0519	16	0401	0520
0520	45	0521	0525
0521	46	0522	0641
0522	24	0818	0523
0523	65	0802	0524
0524	21	0819	0528
0525	65	0819	0526
0526	15	0806	0527
0527	20	0819	0528
0528	65	0808	0529
0529	69	0401	0530
0530	84	1000	8002
0531	69	8003	0532
0532	23	0811	0533
0533	65	0809	0534
0534	69	0402	0530
0600	20	0782	0603
0536	69	8003	0537
0537	23	0812	0538
0538	65	0810	0539
0539	69	0403	0530
0810	65	1000	0541
0541	69	8003	0542
0542	23	0813	0543
0543	65	0812	0544
0544	35	0004	0545
0545	15	0402	0546
0546	69	8003	0547
0547	22	0821	0548
0548	65	0403	0549
0549	30	0004	0550
0550	15	0813	0551
0551	69	8003	0552
0552	23	0822	0553
0553	65	0811	0554
0554	35	0004	0555
0555	15	0401	0556
0556	15	0819	0557
0557	69	8003	0558
0558	22	0820	0559
0559	24	0777	0560
0560	65	0559	0561
0561	15	0806	0562
0562	69	0570	0563
0563	22	0570	0564
0564	65	0405	0565
0565	46	0566	0568
0566	66	0821	0567
0567	16	0822	0642
0568	65	0821	0569
0569	15	0822	0642
0570	20	0778	0571
0571	65	0570	0572
0572	16	0804	0573
0573	45	0574	0577
0574	15	0805	0575
0575	69	0559	0576
0576	22	0559	0508
0577	71	0777	0578
0578	65	0803	0579
0579	20	0559	0508
0580	24	0817	0581
0581	69	0401	0582
0582	24	0818	0583
0583	65	0559	0584
0584	21	0819	0585
0585	16	0803	0586
0586	45	0587	0528
0587	16	0802	0588
0588	45	0589	0593
0589	16	0802	0590
0590	45	0591	0597
0591	16	0802	0592
0592	45	0605	0601
0593	65	0801	0594
0594	10	0800	0595
0595	21	0779	0596
0596	20	0780	0599
0597	65	0801	0598
0598	10	0800	0599
0599	21	0781	0600
0601	65	0801	0602
0602	10	0800	0603
0603	21	0783	0604
0604	20	0784	0607
0605	65	0801	0606
0606	10	0800	0607
0607	21	0785	0608
0608	20	0786	0609
0609	71	0777	0610
0610	65	0803	0611
0611	20	0559	0528
0615	65	0559	0616
0616	16	0803	0617
0617	45	0618	0641
0618	16	0802	0619
0619	45	0620	0624
0620	16	0802	0621
0621	45	0622	0628
0622	16	0802	0623
0623	45	0636	0632
0624	65	0801	0625
0625	10	0800	0626
0626	21	0779	0627
0627	20	0780	0630
0628	65	0801	0629
0629	10	0800	0630
0630	21	0781	0631
0631	20	0782	0634
0632	65	0801	0633
0633	10	0800	0634
0634	21	0783	0635
0635	20	0784	0638
0636	65	0801	0637
0637	10	0800	0638
0638	21	0785	0639
0639	20	0786	0640
0640	71	0777	0641
0641	01	0000	0500
0642	15	0404	0570
0800	00	1960	0000
0801	99	9999	9999
0802	00	0002	0000
0803	24	0777	0560
0804	20	0786	0571
0805	20	0787	0571
0806	00	0001	0000
0807	00	0000	0009
0808	65	1000	0531
0809	65	1000	0536

DECK 033.18 FLAIR TO FIXED DECIMAL ROUTINE

THIS ROUTINE TAKES A DECK OF LOAD HUB CARDS CONTAINING EIGHT FLAIR NUMBERS OF THE FORM PP .XXXXXXXX AND CONVERTS THEM TO NINE-DIGIT FIXED DECIMAL NUMBERS. THE POSITIONS OF THE DECIMALS ARE DETERMINED BY A LOAD HUB CONTROL CARD WHICH ALSO CONTAINS THE DECK NUMBER.

THE FIRST FIELD AAAAA 000 5B
THE SECOND THROUGH EIGHTH FIELDS 0000 0000 5B
WHERE
AAAAA IS THE DECK NUMBER
B IS THE NUMBER OF WHOLE NUMBERS IN A NINE-DIGIT FIELD

THE DECK IS PLACED INTO THE TYPE 533 IN THE FOLLOWING ORDER.
1. LOAD-IDENTIFICATION CARD
2. DECK 033.18
3. LOAD HUB CONTROL CARD
4. LOAD HUB DETAIL CARDS

THE DECK NUMBER IS SPLIT OFF FROM THE FIRST FIELD AND STORED IN 0077

A	O	D	I	A	O	D	I	A	O	D	I
0039	70	0042	0042	0017	11	8003	0025	0095	21	0001	0015
0042	60	0001	0011	0025	24	0077	0089				
0011	30	0002	0017	0089	35	0002	0095				

FIELDS ONE THROUGH EIGHT ON THE DETAIL CARDS ARE CONVERTED TO FIXED DECIMAL AS SPECIFIED AND STORED IN 0078 THROUGH 0085 RESPECTIVELY.

A	O	D	I	A	O	D	I	A	O	D	I
0015	70	0064	0064	0062	20	0067	0070	0021	16	0024	0030
0064	65	0067	0071	0070	16	0073	8002	0030	20	0033	0036
0071	15	0074	0029	0073	00	0050	0050	0036	65	0040	0009
0067	65	0050	0063	0013	18	0072	0027	0088	65	0091	0096
0061	65	0050	0063	0027	35	0004	0037	0096	16	0033	0038
0074	00	0001	0000	0037	46	0073	0041	0038	45	0064	0050
0029	20	0047	8002	0044	31	0001	0033	0050	69	0061	0014
0063	35	0002	0069	0041	15	0044	0049	0014	24	0067	0020
0069	21	0072	0075	0049	20	0009	0012	0020	71	0077	0015—PCH
0075	20	0040	0094	0012	65	0067	0021	0091	20	0085	0088
0094	65	0047	0062	0024	44	9972	9975				

PUNCHING FOR THIS ROUTINE IS NOT ON THE TYPE 533 UTILITY PANEL

TYPE 407 UTILITY PANEL

THIS PANEL WILL LIST THE FOUR TYPES OF CARDS WHOSE FORMATS ARE ON THE STANDARD 650 CARD FORM. PRINTING OF THE SELECTED FORM AND APPROPRIATE HEADING IS AUTOMATIC WITH THE 12 PUNCH IN COLUMN 3 5 7 OR 11. ALWAYS TAKE A FINAL TOTAL BEFORE PRINTING. PREFACE LIST DECKS BY A BLANK CARD. THIS AUTOMATICALLY CAUSES A SKIP TO THE NEXT PAGE AND HEADS BEFORE PRINTING. PRINTING IS BASICALLY 50-10. THIS IS CONVENIENT FOR PRINTING DRUM PUNCH-OUT IN DRUM FORMAT. THE FIVE-FIELD LOADERS LIST WITH α AND β IN THE HEADING IF ALTERATION SWITCH 1 IS NORMAL. THE HEADING CONTAINS THE NORMAL D AND I IF THIS SWITCH IS TRANSFERRED.

THE LOCKHEED 407S FOR MATHEMATICAL WORK HAVE SPECIAL TYPE WHEELS AS FOLLOWS

4-8	α	3-8	+	0-1	$\int$
0-4-8	β	0-3-8	ω	12	γ
11-4-8	Σ	11-3-8	ρ		
12-4-8	Δ	12-3-8	.		

WIRING FOR THIS PANEL IS SHOWN ON A 407 BOARD DIAGRAM WHERE CONVENIENT. OTHER WIRING IS LISTED BELOW BY TERMINALS ACCORDING TO THE DIAGRAM INDEX.

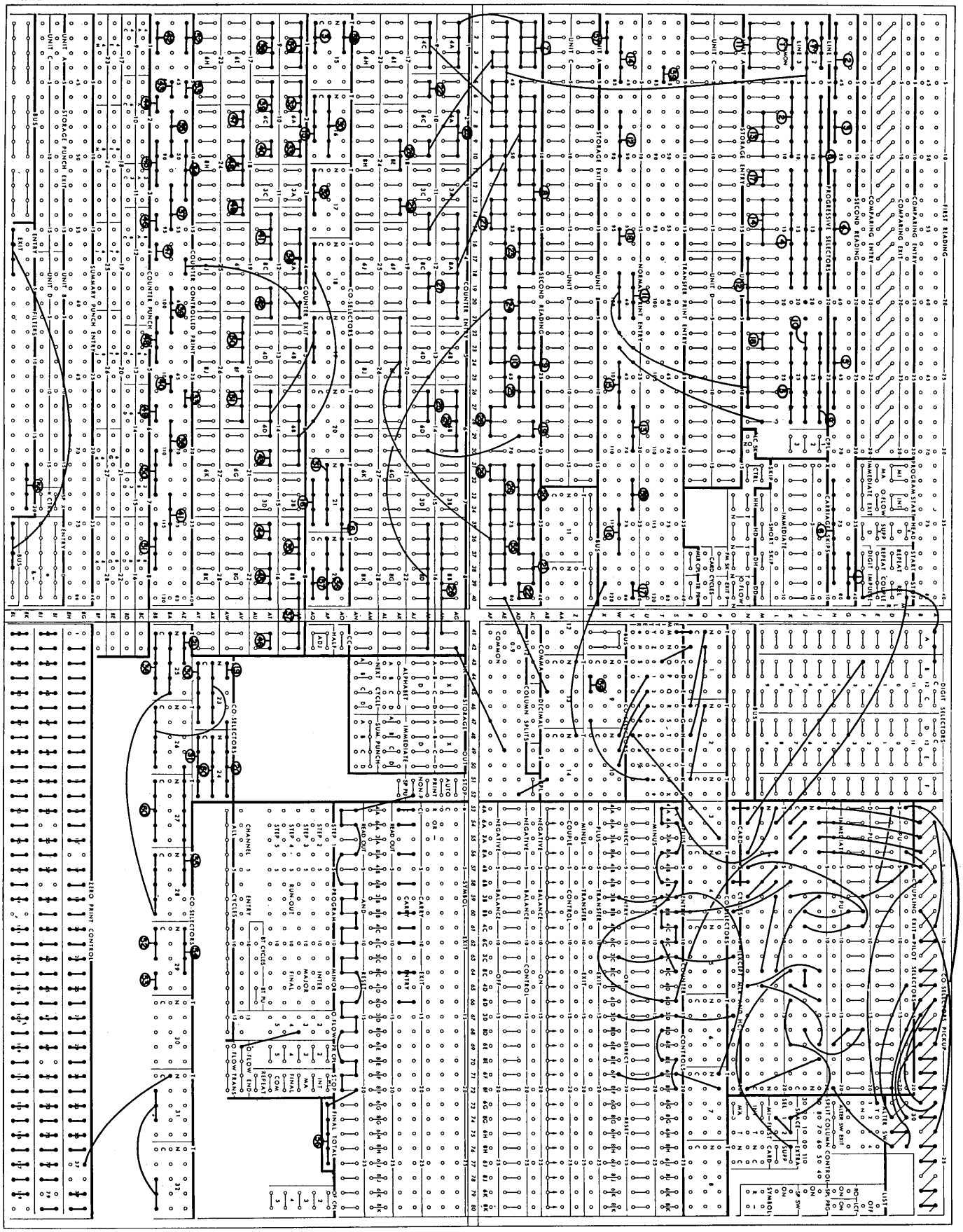
A59- I30	Q54- R58	Z49- X25	AD13-AG05	AO06-AF28	AQ36- W39
A63-AC52	R37- G64	Z50- X18	AD41- O41	AO10- A31	AQ37- W40
A67- C55	R43- R61	Z51- X04	AD42- O45	AO11-AZ19	AQ79- R39
A78- J30	R44- R62	Z52-BG78	AD43- O49	AO14-AZ24	AT18-BA40
D57- C10	R66-AD48	AA33-AK08	AD44- N41	AO15-AZ28	AZ46-AE28
E33- N64	R67- V17	AA34-AK12	AE45-AG06	AO16-AZ29	AZ47-AE29
E34- J55	R68-AZ76	AA35-AK28	AE46-AG31	AO18-AZ32	AZ65-AR14
F41-AG32	R69-AZ77	AA36- I20	AE47-AI29	AO21-AZ38	AZ66-BI54
G65-AP79	R71-AW66	AA37- J20	AE48-AI31	AO24-BA01	AZ67-BI70
G73-AW68	R72-AW67	AA38-AO04	AE50-AI08	AO25- L04	AZ68-BL60
I58- S68	S20- P56	AA39- K20	AE51-AI17	AO26-AD47	AZ69-BI38
K30- B75	S26- P58	AA40-AO08	AE52-AI21	AO27-AD49	AZ71-BI39
K53-AQ67	S28- R47	AA41-AO39	AF01-AI07	AO28- M28	AZ72- V23
K57- E11	S33- P59	AA42-AW45	AF25-AK07	AO29-AD51	AZ73- M15
L72- X27	S49- P62	AA43-AZ44	AF41- A03	AO30-AD46	AZ74-BA47
M05- V24	T02- P57	AA44-AZ48	AF42- A05	AO37- A29	AZ75- X06
M06- V25	T06- Y50	AA45-AZ59	AF43- A07	AO41-AJ32	AZ78-AC15
N42-BK18	T20- Y43	AA46- I05	AF44- A11	AP04-AQ30	AZ79-AC29
N43- E56	T21- Y46	AA52-BI39	AF45-AD14	AP12-AZ21	AZ80-AH09
O42-BK15	T22- Y49	AB33-AF26	AF46-AD24	AP13-AZ22	BA69-BI79
O43- E53	T37- R49	AB34-AF30	AF47-AD28	AP15-AZ30	BA70-BI58
O46-BK16	T38- Y48	AB35-AF40	AF48-AD30	AP19-AZ35	BB66-BJ54
O47- C38	Z33-AB50	AB36-AE20	AF49-AD38	AP20-AZ36	BB67-BJ70
O48- E54	Z34-AB49	AB37-AF20	AF50-AF02	AP23-BA02	BB69-BJ79
O50-BK17	Z35-AB48	AB38- H10	AF51-AF12	AP24-BA03	BB70-BJ58
O51- E55	Z36- I21	AB39- H20	AF52-AF16	AP67- L31	BB71-BH77
P66- W06	Z37- J21	AB40- H30	AF59- K68	AQ04- V35	BB75- L70
P67- Z47	Z38-AQ05	AB41- H40	AF63- K61	AQ10- W31	BB76- G19
P68- L10	Z39- K21	AB42- G30	AF67- H66	AQ15-AR26	BB77- G25
P69- L11	Z40-AO09	AB43- G40	AF71- K60	AQ25-AD45	BI39-BH56
Q48- R54	Z41-AO40	AB44-AE30	AI12- F42	AQ26- L13	BL31- X71
Q49- R55	Z42-AW46	AB46-AC05	AJ35- N70	AQ27- L23	BL32- X67
Q51- R56	Z43-AZ45	AB47- G11	AJ35- K70	AQ28-AD50	BL33- X63
Q52- R59	Z44-AZ49	AB52-BH78	AK16- H41	AQ29-BA55	BL34- X59
Q53- R57	Z45-AZ60	AC51- H70	AO05- V36	AQ31- W52	BL40- E57

IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION

ACCOUNTING MACHINE, TYPE 407, CONTROL PANEL DIAGRAM

Form 22-8275-5
Printed in U.S.A.



REPORT R. V. MIDDLETON DIAGRAM NO. 650 UTILITY PANEL DATE

TYPE 407 UTILITY PANEL -- CONTINUED

S19- P51- P46
S24- P48- P54
S34- P53- X46
T36- P49- W52
Q47- P52- X45
S44- P47- P61

U43- Y51- Y52
V49- R52- Q61
V50- R53- Q62
AP11-AO12-AZ20
AP14-AO13-AZ23
AP16-AO17-AZ31

AP17-AO19-AZ33
AP18-AO20-AZ34
AP21-AO22-AZ39
AP22-AO23-AZ40
BA66-BI35-BA67
BB68-BI36-AZ70

T03- T19- T35- W47
S18- S39- U01- U22- X43- P41
S23- T25- U06- U27- X44- P42

W43- W44- W45- W46- W51
S27- T08- T29- U10- U31- P43
S32- T13- T34- U15- U36- P44

TYPE 533 UTILITY PANEL

THIS PANEL WILL READ

12 IN COL 1	LOAD HUB CARDS
A READ	OPEN FOR TEMPORARY WIRING
B READ	REGIONAL INSTRUCTION CARDS
C READ	FIVE-FIELD LOADER CARDS

THIS PANEL WILL PUNCH

A PUNCH	OPEN FOR TEMPORARY WIRING	
B PUNCH	MACHINE LANGUAGE TRACE	10TH WORD IS 88808 00000
	FLAIR TRACE	88808 08000
	LOAD HUB CARDS FROM PUNCH WORDS 1 TO 8	88808 88000
C PUNCH	FIVE-FIELD LOADER CARDS	

WIRING FOR THIS PANEL IS SHOWN ON A 533 BOARD DIAGRAM WHERE CONVENIENT. OTHER WIRING IS LISTED BELOW BY TERMINALS ACCORDING TO THE DIAGRAM INDEX.

Z33- R10	Z39-AA10	W59-AL45	AK44- L42	S28- R41	S23- X35
Z34- L21	Z40- A33	W60- Q50	AK45- M41	AA21-AC15	D22- X40
Z35- X14	Z21-AC10	W61-AL46	AK46-AD60	AN14- L09	
Z36- Y08	H42- W42	AM44- Q45	AP59- D43	AL44- W55	
Z37- Z02	K42- V42	AM45- Q49	AP61- R30	Y33- L06	
Z38- Z16	AM43- X47	AM46- Q51	AQ61- S38	X21- V05	

Y35- U05-AE07 Y37-AB10-AG07 Y39-AB20-AI07 T42-AB60- N41
Y36-AB05-AF07 Y38-AB15-AH07 S41-AP60-AR61 V41- W41-AR55-AR60

AC03-AC08-AC13-AC18-AD21
W21-AE01-AF01-AG01-AH01-AJ01
AN13- K07- K08- K09- L07- L08
V31- K18- K19- K20- K21- L20
V30- L14- L15- L16- K10- L10

W31- Y34- L17- L18- L19
W30- Y04-AC04-AC09-AC14-AC19
V21- V02-AC02-AC07-AC12-AC17-AC20
Y21-AE02-AF02-AG02-AH02-AJ02-AC05

CORRECT TYPE 533 PANEL SO WORD 5 OF B READ HAS A WORD LENGTH OF 2.

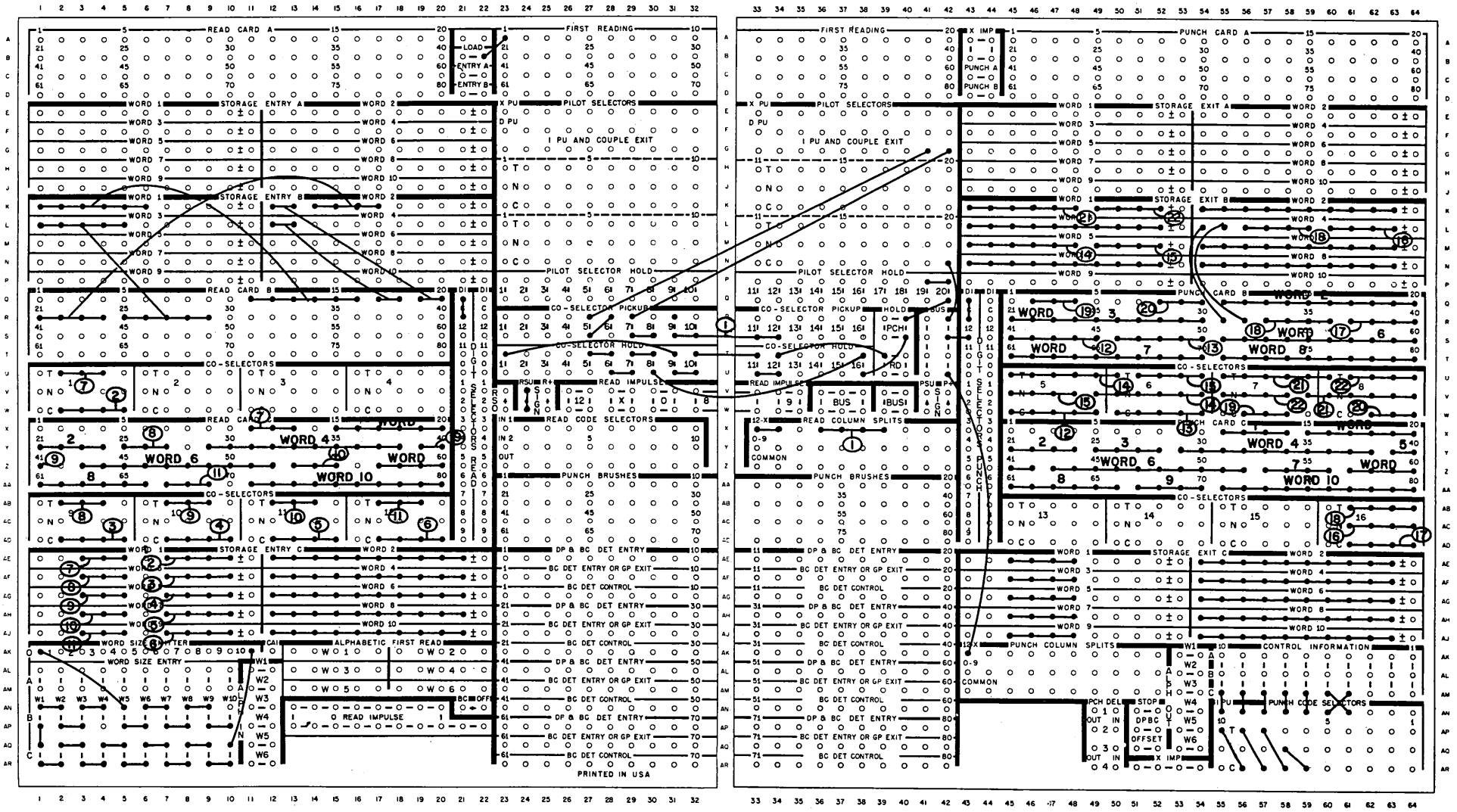
IBM
TRADE MARK

INTERNATIONAL BUSINESS MACHINES CORPORATION

READ-PUNCH UNIT, TYPE 533 CONTROL PANEL

(USED WITH TYPE 650 MAGNETIC DRUM DATA-PROCESSING MACHINE)

Form No. 22-6207-1
Printed in U.S.A.



FLAIR - FLOATING ABSTRACT INTERPRETATIVE ROUTINE

ONLY A BRIEF SUMMARY OF THIS SYSTEM IS GIVEN HERE. IT IS INTENDED TO SHOW DEVIATIONS FROM THE ORIGINAL SYSTEM AS PUBLISHED ELSEWHERE. A LISTING OF THE INSTRUCTIONS AND CONSTANTS IS FURNISHED TOGETHER WITH ENOUGH DESCRIPTIVE MATERIAL TO OPERATE THE SYSTEM WITHOUT GOING INTO SPECIFIC DETAIL. DETAILED BREAKDOWNS OF THE INDIVIDUAL ROUTINES ARE AVAILABLE IN THIS SAME FORMAT FOR THOSE INTERESTED OR HAVING A NEED TO ALTER. ADDRESS A REQUEST TO THE MATHEMATICAL ANALYSIS SECTION - MISSILE SYSTEMS DIVISION LOCKHEED AIRCRAFT CORPORATION - 7701 WOODLEY AVENUE - VAN NUYS CALIFORNIA.

FLAIR IS A PSEUDO-THREE-ADDRESS FLOATING POINT COMPUTING SYSTEM FOR USE ON THE TYPE 650. NUMBERS ARE OF THE FORM

PP .XXXXXXXX WHERE PP IS 50 + THE ASSOCIATED POWER OF 10

ARITHMETIC COMMANDS ARE OF THE FORM

OP α β WHERE α AND β ARE FOUR DIGIT ADDRESSES

LOGICAL AND SUB-ROUTINE COMMANDS ARE OF THE FORM

Oγ α β WHERE α AND β ARE FOUR DIGIT ADDRESSES

THE γ IN THE ARITHMETIC COMMANDS REPRESENTS THE UNITS DIGIT OF THE 10 RESULT STORAGES 0000 TO 0009. THESE ADDRESSES ARE A PART OF FLAIR AND MAY BE USED ONLY FOR THIS TEMPORARY PURPOSE. THE BLOCK TRANSFER COMMAND 8γ FREES THEM FOR FURTHER USE.

THE FLAIR SYSTEM IS UNDER THE CONTROL OF THE WORD IN 1615. THE D PART OF THIS WORD IS THE ADDRESS OF THE FLAIR COMMAND TO BE OBEYED. COMMANDS ARE OBEYED IN SEQUENTIAL ORDER EXCEPT AFTER TRANSFER COMMANDS. ENTER FLAIR BY RESET ADDING A WORD 17 J 1735 TO 8003 AND OBEYING 8003. J IS THE ADDRESS OF THE FIRST FLAIR COMMAND TO BE OBEYED.

THE ENTIRE SYSTEM OCCUPIES THE ADDRESSES FROM 1300 TO 1999. THE ARITHMETIC PORTION PLUS SQUARE ROOT AND ABSOLUTE VALUE OCCUPY THE ADDRESSES FROM 1600 TO 1999 AND MAY BE USED IN THIS ABBREVIATED FORM. IF LESS THAN THE FULL COMPLEMENT OF SUBROUTINES IS NEEDED - USE ARITHMETIC FLAIR PLUS GROUPS OF STORAGES AS INDICATED.

LOG	1500 - 1599
ANTILOG	1450 - 1599
SINE AND COSINE	1350 - 1449
ARCTANGENT	1300 - 1499

TRACING IS UNDER THE CONTROL OF THE CONSOLE. SETTING THE HUNDREDS SWITCH OF 8000D TO AN 8 CAUSES TRACING. A 9 IN THIS POSITION CAUSES THE TRACING TO BE IGNORED AND FLAIR WILL RUN NORMALLY. THE MACHINE WILL STOP IF A DIGIT OTHER THAN AN 8 OR 9 IS INADVERTENTLY SET IN THIS SWITCH. IF THE PROGRAM IS IN FLAIR IT MAY BE RESTARTED BY

1. DEPRESSING PROGRAM RESET BUTTON
2. SETTING THE SWITCH PROPERLY
3. TRANSFER TO 1735 FOR NEXT COMMAND

FLAIR OPERATION SUMMARY - LOGICAL COMMANDS

00 - 06	NO OPERATION. THE NEXT COMMAND OBEYED IS IN β
01	MACHINE STOP. IF PROGRAM START BUTTON IS DEPRESSED THE NEXT COMMAND OBEYED IS IN β
02	NO OPERATION. NEXT SEQUENTIAL COMMAND IS OBEYED.
03	CONDITIONAL TRANSFER ON THE SIGN OF THE CONTENTS OF α THE NEXT COMMAND OBEYED IS IN β IF THE SIGN IS - THE NEXT COMMAND OBEYED IS SEQUENTIAL IF THE SIGN IS +
04	CONDITIONAL TRANSFER ON RELATIVE ZERO - SEE DETAILED ITEM.
05	UNCONDITIONAL TRANSFER OUT OF FLAIR. THE NEXT COMMAND OBEYED IS THE MACHINE LANGUAGE COMMAND IN α . IF THE RETURN TO FLAIR IS AT 1612 THE NEXT FLAIR COMMAND IS SEQUENTIAL TO THE 05 COMMAND. IF THE RETURN IS AT 1792 IT IS FOUND IN β OF THE 05 COMMAND.
07 TO 09	NO OPERATION. MACHINE STOP - THEN SEQUENTIAL COMMAND.

FLAIR OPERATION SUMMARY - ARITHMETIC COMMANDS

1γ	$(\alpha) \cdot (\beta) + (\gamma) \longrightarrow \gamma$	
2γ	$(\alpha) \cdot (\gamma) + (\beta) \longrightarrow \gamma$	
3γ	$(\alpha) + (\beta) \longrightarrow \gamma$	
4γ	$(\alpha) - (\beta) \longrightarrow \gamma$	
5γ	$(\alpha) \cdot (\beta) \longrightarrow \gamma$	
6γ	$-(\alpha) \cdot (\beta) \longrightarrow \gamma$	
7γ	$(\alpha) \div (\beta) \longrightarrow \gamma$	
8γ	$(\alpha+K) \longrightarrow (\beta+K)$	K MAY VARY FROM 0 TO γ

FLAIR OPERATION SUMMARY - SUBROUTINE COMMANDS

90	$\sqrt{(\alpha)} \longrightarrow \beta$	
91	$\text{SIN}\ (\alpha) \longrightarrow \beta$	ARGUMENT IN RADIANS
92	$\text{COS}\ (\alpha) \longrightarrow \beta$	ARGUMENT IN RADIANS
93	$\text{ARCTAN}\ (\alpha) \longrightarrow \beta$	
94	$\text{LOG}\ (\alpha) \longrightarrow \beta$	
95	$\text{ANTILOG}\ (\alpha) \longrightarrow \beta$	
96	$\lvert(\alpha)\rvert \longrightarrow \beta$	
97 TO 99	NO OPERATION. NEXT SEQUENTIAL COMMAND IS OBEYED.	

MACHINE STOPS

9000	SQUARE ROOT OF A NEGATIVE NUMBER
9001	SINE OR COSINE OF AN ANGLE GREATER THAN 100 RADIANS
9004	LOG OF ZERO OR A NEGATIVE NUMBER
9005	POWER OF 10 INDEX OUT OF RANGE

A	O	D	I	A	O	D	I	A	O	D	I
1300	66	1416	1374	1350	00	8334	4000	1400	46	1403	1362
1301	46	1304	1401	1351	46	1365	1358	1401	66	1861	1843
1302	20	1867	1322	1352	22	1805	1408	1402	20	1861	1414
1303	30	0000	1328	1353	60	1836	1391	1403	66	8002	1362
1304	15	1357	1361	1354	00	0000	0007	1404	10	1407	1412
1305	10	1308	1316	1355	61	8003	1363	1405	65	1836	1368
1306	22	1909	1312	1356	46	1410	1411	1406	19	1409	1380
1307	65	1867	1475	1357	00	0000	0003	1407	16	6666	8080-
1308	99	9999	3329	1358	65	1417	1843	1408	66	1861	1415
1309	19	1313	1341	1359	46	1365	1401	1409	40	0000	0000-
1310	60	8003	1486	1360	61	1890	1377	1410	11	1744	1974
1311	11	1890	1419	1361	46	1366	1339	1411	10	1744	1974
1312	61	1876	1909	1362	16	1416	1422	1412	60	8003	1372
1313	00	4054	0580-	1363	19	1875	1404	1413	16	1416	1371
1314	64	1876	1320	1364	24	1867	1420	1414	67	8002	1423
1315	35	0002	1321	1365	15	8001	1373	1415	35	0002	1421
1316	60	8003	1333	1366	15	1369	1323	1416	15	7079	6327
1317	10	1324	1484	1367	10	1325	1334	1417	51	1000	0000
1318	10	1326	1336	1368	45	1446	1843	1418	10	8001	1376
1319	10	1476	1386	1369	00	0000	0001	1419	60	8003	1377
1320	20	1876	1331	1370	46	1835	9001	1420	21	1875	1378
1321	20	1876	1329	1371	14	1424	1434	1421	65	8002	1379
1322	61	1375	1314	1372	19	1875	1426	1422	67	8002	1381
1323	20	1835	1338	1373	35	0004	1385	1423	35	0002	1429
1324	33	3298	5605-	1374	20	1890	1307	1424	62	8318	5307
1325	19	9465	3599	1375	09	9999	9999	1425	35	0001	1382
1326	13	9085	3351-	1376	60	8003	1384	1426	60	8003	1433
1327	10	1330	1335	1377	36	0000	1390	1427	67	8003	1388
1328	21	1836	1340	1378	10	8003	1435	1428	67	8003	1443
1329	68	8003	1337	1379	35	0002	1805	1429	60	8003	1432
1330	05	5909	8861-	1380	10	1383	1387	1430	24	1835	1439
1331	46	1485	1300	1381	24	1836	1389	1431	24	1835	1438
1332	67	1835	1339	1382	60	8003	1440	1432	11	1437	1370
1333	19	1836	1349	1383	30	0000	0000	1433	19	1867	1418
1334	60	8003	1342	1384	19	8001	1436	1434	67	8003	1392
1335	60	8003	1345	1385	69	1899	1352	1435	31	0004	1447
1336	60	8003	1343	1386	60	8003	1494	1436	24	1890	1397
1337	21	1890	1393	1387	60	8003	1398	1437	00	0000	0053
1338	15	1396	1302	1388	16	1354	1359	1438	69	1441	1445
1339	35	0004	1399	1389	16	1444	1449	1439	69	1442	1445
1340	60	8003	1347	1390	20	1893	1448	1440	19	8001	1364
1341	10	1348	1310	1391	19	1394	1425	1441	31	0000	1371
1342	19	1899	1317	1392	16	1395	1400	1442	31	0000	1413
1343	19	1899	1367	1393	15	1346	1301	1443	16	1396	1351
1344	21	1899	1452	1394	33	3333	3333	1444	00	0300	0000
1345	19	1899	1319	1395	31	4159	2654	1445	24	1899	1402
1346	00	0000	0047	1396	00	0000	0008	1446	60	8002	1377
1347	19	8001	1344	1397	60	8003	1406	1447	11	1350	1355
1348	02	1861	2288	1398	19	1890	1419	1448	65	8003	1356
1349	30	0001	1311	1399	69	1303	1306	1449	46	1405	1353

A	O	D	I	A	O	D	I	A	O	D	I
1450	00	7300	0000	1500	07	9432	8234	1550	52	4900	0000
1451	46	1554	1459	1501	08	1283	0516	1551	60	8003	1558
1452	60	8003	1309	1502	08	3176	3771	1552	64	8001	1496
1453	10	1856	1948	1503	08	5113	8038	1553	10	1456	1470
1454	19	1836	1474	1504	08	7096	3589	1554	16	1463	1467
1455	60	8003	1873	1505	08	9125	0938	1555	20	1861	1564
1456	11	5129	2770	1506	09	1201	0839	1556	84	1500	1577
1457	16	1714	1469	1507	09	3325	4300	1557	46	1561	1525
1458	35	0001	1465	1508	09	5499	2586	1558	19	1861	1563
1459	15	1462	1467	1509	09	7723	7220	1559	67	8003	1457
1460	10	1464	1471	1510	10	0000	0000	1560	10	1936	1591
1461	10	1466	1472	1511	12	5892	5410	1561	15	1567	1523
1462	19	1510	1488	1512	15	8489	3190	1562	60	8003	1570
1463	19	1510	1498	1513	19	9526	2310	1563	21	1867	1521
1464	06	6273	1000	1514	25	1188	6430	1564	30	0001	1571
1465	16	8002	1524	1515	31	6227	7660	1565	69	1568	1522
1466	02	5439	0000	1516	39	8107	1700	1566	64	8002	1555
1467	20	1873	1526	1517	50	1187	2330	1567	09	3900	0000
1468	65	8003	1477	1518	63	0957	3440	1568	64	0000	1560
1469	35	0004	1529	1519	79	4328	2340	1569	65	8003	1576
1470	60	8003	1528	1520	99	9999	9990	1570	19	1573	1551
1471	60	8003	1479	1521	60	1875	1575	1571	60	8002	1579
1472	60	8003	1480	1522	22	1875	8001	1572	60	8002	1581
1473	19	8001	1495	1523	46	1534	1527	1573	02	8952	9655
1474	60	8003	1482	1524	30	0005	1487	1574	60	8002	1533
1475	46	1360	1332	1525	66	1835	1542	1575	30	0001	1531
1476	09	6420	0441	1526	67	8003	1481	1576	46	1584	1590
1477	10	1586	1592	1527	66	1835	1540	1577	69	1530	1583
1478	10	1936	1492	1528	19	1836	1478	1578	11	1744	1548
1479	19	1836	1553	1529	46	1483	1532	1579	15	1582	1588
1480	19	1836	1460	1530	64	0000	1572	1580	35	0002	1587
1481	20	1836	1490	1531	10	1836	1541	1581	30	0001	1537
1482	19	1836	1461	1532	69	1535	1489	1582	30	0000	0000
1483	69	1536	1489	1533	44	1538	1843	1583	22	1836	1543
1484	60	8003	1990	1534	16	8002	1491	1584	11	1593	1974
1485	65	1416	1374	1535	35	0000	1491	1585	11	1893	1589
1486	19	1899	1327	1536	31	0000	1491	1586	01	0000	0000
1487	10	8001	1545	1537	84	1500	1565	1587	21	1893	1596
1488	65	8003	1496	1538	36	0000	1598	1588	19	1861	1562
1489	22	1893	1546	1539	67	8002	1547	1589	30	0002	1595
1490	60	1493	1497	1540	35	0002	1549	1590	10	1593	1974
1491	10	1744	1499	1541	11	1594	1599	1591	11	8002	1597
1492	60	8003	1473	1542	46	1544	9005	1592	16	8002	1552
1493	00	1750	0000	1543	30	0001	8001	1593	00	0000	0052
1494	19	1899	1318	1544	16	8002	1843	1594	70	6171	1728
1495	35	0001	1455	1545	30	0001	1451	1595	16	1867	1574
1496	35	0001	1453	1546	65	1805	1893	1596	61	8002	1556
1497	15	1450	1454	1547	16	1550	1557	1597	15	1510	1566
1498	35	0001	1468	1548	65	8002	1458	1598	20	1893	1569
1499	21	1856	1578	1549	20	1805	1559	1599	30	0005	1585

A	O	D	I	A	O	D	I	A	O	D	I
1600	61	8001	1608	1650	65	0000	1659	1700	69	1753	1707
1601	36	0000	1622	1651	15	1708	1664	1701	69	1704	1707
1602	60	8002	1761	1652	65	0000	1665	1702	35	0003	1812
1603	11	8003	1611	1653	15	1656	1662	1703	35	0001	1810
1604	60	8003	1761	1654	35	0003	1663	1704	65	0000	1621
1605	44	1609	1610	1655	30	0004	1732	1705	46	1738	1710
1606	20	1861	1867	1656	65	0000	1689	1706	20	1867	1870
1607	11	1861	1616	1657	11	1861	1628	1707	35	0003	1716
1608	10	1861	1666	1658	10	1861	1627	1708	65	0000	1667
1609	10	1613	8003	1659	35	0002	1715	1709	46	1762	1763
1610	60	8001	8001	1660	35	0002	1668	1710	65	1869	1873
1611	24	1615	1618	1661	35	0002	1669	1711	18	1714	1719
1612	60	1615	8001	1662	22	1867	1720	1712	69	1865	1768
1613	30	0002	1672	1663	22	1867	1672	1713	69	1766	1770
1614	66	0000	1923	1664	22	1867	1670	1714	00	0000	0050
1615	17	0000	1735	1665	35	0002	1671	1715	20	1869	1722
1616	11	1619	1623	1666	10	1619	1623	1716	22	1870	1626
1617	35	0004	1732	1667	35	0002	1724	1717	60	1890	1796
1618	35	0001	1625	1668	15	1721	1682	1718	10	1836	1631
1619	00	0000	0010	1669	15	1723	1682	1719	17	1878	1833
1620	11	8003	1728	1670	16	8001	1827	1720	16	8001	1877
1621	35	0002	1777	1671	20	1875	1779	1721	65	0000	1725
1622	21	1876	1632	1672	69	1780	1783	1722	67	8003	1782
1623	15	1876	1631	1673	69	1615	1787	1723	65	0000	1667
1624	71	1877	1824	1674	00	0000	1612	1724	21	1878	1685
1625	44	1629	1630	1675	69	1778	1781	1725	35	0002	1731
1626	69	1729	1783	1676	11	8003	1786	1726	16	1879	1734
1627	46	1634	1631	1677	16	1834	8002	1727	64	1881	1602
1628	46	1631	1634	1678	00	0000	1792	1728	30	0002	1635
1629	10	1633	8003	1679	00	0000	1643	1729	65	0000	1641
1630	35	0003	1839	1680	00	0000	1643	1730	65	0000	1689
1631	30	0002	1637	1681	00	0000	1643	1731	21	1836	1739
1632	69	1687	1640	1682	69	1636	1740	1732	69	1636	1790
1633	11	8003	1694	1683	35	0004	1644	1733	35	0004	1693
1634	60	1687	1843	1684	68	8003	1691	1734	46	1737	1742
1635	22	1897	1617	1685	20	1890	1897	1735	69	8000	1891
1636	20	0000	1612	1686	16	1692	1755	1736	65	1885	1855
1637	44	1643	1843	1687	00	0000	0000	1737	60	1890	1795
1638	01	0000	1612	1688	18	1642	1798	1738	65	1893	1718
1639	22	1895	1648	1689	35	0002	1745	1739	20	1893	1748
1640	23	1893	1746	1690	15	1893	1647	1740	22	1843	8002
1641	35	0002	1747	1691	17	1744	1799	1741	35	0004	1801
1642	00	0000	0050	1692	00	0008	0000	1742	65	1805	1760
1643	69	1615	1638	1693	22	1897	1752	1743	45	1792	1612
1644	22	1897	1750	1694	22	1897	1655	1744	00	0000	0051
1645	46	1848	1849	1695	30	0001	1651	1745	20	1899	1754
1646	10	1649	1603	1696	30	0001	1653	1746	46	1749	1600
1647	44	1601	1602	1697	69	1650	1654	1747	21	1853	1706
1648	30	0002	1605	1698	69	1751	1654	1748	67	8003	1606
1649	00	0001	0000	1699	69	1652	1707	1749	60	8001	1607

FLAIR (Con't.)

A	O	D	I	A	O	D	I	A	O	D	I
1750	65	8003	1660	1800	10	1756	1967	1850	69	1892	1854
1751	66	0000	1659	1801	20	1805	1758	1851	20	1805	1709
1752	65	8003	1661	1802	15	1805	1809	1852	22	1856	1859
1753	66	0000	1665	1803	10	1856	1811	1853	00	0000	0000
1754	67	8003	1711	1804	22	1837	1806	1854	22	1892	1736
1755	46	1710	1759	1805	00	0000	0000	1855	10	1880	1646
1756	00	0000	0025	1806	30	0008	1850	1856	00	0000	0000
1757	20	1861	1764	1807	20	1861	1814	1857	20	1861	1717
1758	46	1712	1713	1808	11	8003	1816	1858	44	1612	1832
1759	60	1867	1821	1809	46	1612	1813	1859	30	0004	1872
1760	30	0004	1773	1810	10	1614	1620	1860			
1761	45	1864	1843	1811	16	8002	1819	1861	00	0000	0000
1762	69	1865	1868	1812	69	1815	1818	1862	24	1884	1837
1763	69	1766	1820	1813	65	8001	1871	1863	69	1885	1817
1764	60	1867	1772	1814	60	1867	1771	1864	36	0000	1838
1765	65	8003	1873	1815	24	0000	1769	1865	30	0000	1690
1766	35	0000	1690	1816	35	0003	1874	1866			
1767				1817	24	1881	1624	1867	00	0000	0000
1768	22	1873	1776	1818	22	1881	1784	1868	22	1873	1785
1769	11	1873	1828	1819	24	1873	1826	1869	00	0000	0000
1770	22	1873	1726	1820	22	1873	1686	1870	00	0000	0000
1771	30	0001	1727	1821	10	1774	8003	1871	30	0004	1831
1772	19	1875	1604	1822	46	1612	1792	1872	15	8001	1830
1773	17	1836	1857	1823	20	1885	1841	1873	00	0000	0000
1774	00	0000	0184	1824	21	1880	1823	1874	69	1837	1804
1775	24	1882	1846	1825	24	1883	1863	1875	00	0000	0000
1776	15	1829	1933	1826	15	1881	8003	1876	00	0000	0000
1777	20	1881	1684	1827	69	1730	1683	1877	69	1780	1733
1778	65	0000	1789	1828	46	1832	1858	1878	00	0000	0000
1779	67	8003	1688	1829	00	0007	0000	1879	00	0008	0000
1780	65	0000	1725	1830	22	1835	1888	1880	00	0000	0000
1781	22	1835	8001	1831	17	1836	1743	1881	00	0000	0000
1782	18	1836	1791	1832	10	1835	1840	1882	00	0000	0000
1783	30	0004	1694	1833	18	1836	1741	1883	00	0000	0000
1784	30	0004	1845	1834	32	0000	0000	1884	00	0000	0000
1785	15	1788	1705	1835	00	0000	0000	1885	00	0000	0000
1786	22	1890	1794	1836	00	0000	0000	1886	88	8080	8000
1787	01	0000	1792	1837	69	0000	1825	1887			
1788	00	0007	0000	1838	15	8003	1645	1888	65	8001	1896
1789	46	1792	1612	1839	22	1895	1648	1889			
1790	22	1843	1897	1840	15	1793	8003	1890	00	0000	0000
1791	35	0004	1851	1841	69	1844	1847	1891	97	1892	1646
1792	60	1895	8001	1842				1892	69	0000	1862
1793	00	0001	0000	1843	00	0000	0000	1893	00	0000	0000
1794	65	8001	1802	1844	69	0000	1775	1894			
1795	19	1899	1765	1845	69	1898	1852	1895	00	0000	0000
1796	19	1899	1604	1846	35	0001	1808	1896	16	1649	1803
1797				1847	22	1853	8001	1897	00	0000	0000
1798	17	1853	1757	1848	11	8002	1657	1898	69	0000	8002
1799	17	1853	1807	1849	11	8002	1658	1899	00	0000	0000

FLAIR (Con't.)

A	O	D	I	A	O	D	I
1900	15	1856	1922	1950	24	1856	1968
1901				1951			
1902				1952			
1903				1953			
1904				1954			
1905				1955			
1906				1956			
1907	10	8001	1965	1957			
1908	35	0001	1966	1958			
1909				1959			
1910				1960			
1911	90	1999	9999	1961	15	1964	1969
1912	90	2999	9999	1962	11	8001	1920
1913	90	4999	9999	1963	69	8002	1971
1914	90	9999	9999	1964	90	0000	0000
1915	91	9999	9999	1965	10	8001	1973
1916	93	9999	9999	1966	44	1978	1970
1917	95	9999	9999	1967	16	8002	1976
1918	97	9999	9999	1968	65	8003	1934
1919	99	9999	9999	1969	16	8002	1996
1920	15	8001	1983	1970	30	0001	1978
1921	16	8002	1935	1971	30	0006	1985
1922	15	1744	1949	1972	35	0003	1992
1923	45	1977	1843	1973	10	8001	1981
1924	69	1427	1430	1974	11	1893	1948
1925	69	1428	1431	1975	15	1979	8002
1926	20	1861	1315	1976	19	8001	1986
1927	46	1580	9004	1977	46	1980	9000
1928	20	1835	1539	1978	66	8002	1989
1929	67	8002	1843	1979	60	0026	1998
1930	00	0000	1612	1980	35	0002	1987
1931	00	0000	1612	1981	30	0001	1988
1932	00	0000	1612	1982			
1933	46	1738	1737	1983	35	0004	1993
1934	10	1899	1921	1984	65	8003	1991
1935	30	0001	1946	1985	64	8001	1972
1936	10	0000	0000	1986	10	8001	1994
1937	00	0040	0610	1987	11	1744	1999
1938	00	0030	0830	1988	21	1893	1997
1939	00	0025	0980	1989	30	0001	1995
1940	00	0020	1210	1990	19	1899	1305
1941	00	0013	1890	1991	10	1899	1963
1942	00	0010	2420	1992	15	8001	1800
1943	00	0007	3530	1993	19	1899	1984
1944	00	0006	4150	1994	16	8002	1950
1945	00	0005	5000	1995	20	1899	1961
1946	64	8001	1900	1996	84	1900	1975
1947	15	1936	1974	1997	11	8001	1908
1948	30	0002	1843	1998	22	1805	1962
1949	44	1947	1974	1999	10	8003	1907