SECTION III

SPRINGS

General

This section on spring combinations deals with:

Armature Travels
Core Plate
Contact Arrangements
Actuating Cards
Contact Forces
Contact Sequences
Spring Combination Numbers
Balancing Springs
Buffer Springs
Terminals
Terminal Numbering

The AF, AG, AJ, and AL relays are designed to provide single-wire contacts in 12 positions with provision for a make twin-wire contact and a break twin-wire contact in each or any of the 12 positions. The AK and AM relays have single-wire contacts in ten positions with provision for a make twin-wire contact and a break twin-wire contact in each or any of the ten positions. The twin wires farthest from the core form make-contacts, and those nearest the core form break-contacts. The twin wires are held in alignment with the single wires by grooves molded in the single-wire comb near the front end. Twin wires are provided only as required by the spring combination.

The twin wires are actuated by means of a moving card that is held against the armature by the tension of a flat balancing spring.

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The single wires, molded in the middle block, are at all times stationary, being molded into fixed blocks at the front and rear end. A full complement of pretensioned single wires is always supplied. This facilitates terminal numbering and provides sufficient tension to hold the fixed block against the core plate, and prevents false closures or openings of contacts during relay operation or removal of the contact cover cap. Contact metal is provided only where make or break combinations are furnished.

The twin wires that form the make-contacts are tensioned against the outer edge of the moving card and toward the single mating contacts and the core. This tension tends to close the make-contacts and to move the armature towards the core. The balancing spring, however, which is also tensioned against the moving card at the outer edge, but away from the single contacts and the core, provides the armature back tension and a force to counteract the tension of the twin wires. Thus, the make-contacts and armature are held in the unoperated position. As the relay operates, the armature pulls the moving card in the direction of the core, thereby permitting the twin-wire contacts to make contact with the single mating contacts. After the contacts make, the tension of the twin wire is transferred from the moving card, or armature, to the mating contact.

In the unoperated position, the break-contacts are tensioned, by the formation of the twin wires, against the single mating contacts. The twin wires are held away from the moving card. As the relay operates, the card moves forward and lifts the twin wires off the single wires. Slightly after this pickup point, the back tension of the break-contacts is transferred to the moving card, thereby increasing the load on the armature.

The AF, AG, AJ, and AL relays are designed to permit operating contacts in three stages, ie, preliminary-, early-, and late-contact operation. The point in the armature stroke at which contacts are actuated is controlled by the cutting of the moving card. Using the card designed for 12 makes or 12 breaks as a base, the surfaces of the card in positions used for early and preliminary make-contacts are recessed 0.013 inch and 0.026 inch, respectively. The surfaces of the card in positions used for early and preliminary break-contacts are extended 0.013 inch and 0.026 inch, respectively. (See Fig. III-1.)

An AJ relay has been designed to provide single-wire contacts in 24 positions with 24 make-or 24 break-twin-wire contacts provided in each of the 24 positions. These positions are arranged in two vertical rows of 12 positions each. The contacts farthest from the core are positions 1 to 12 and those nearest the core are positions 13 to 24. The positions in each row are numbered from bottom to top.

The construction and actuation of the single and twin wires are the same as for the 12-position relays; however, in assembling these relays, a new clamping plate, core plate, and actuating card are required.

The AK and AM relays contact action is like that of the AF relay except that only two stages of contact operation, early and late, are used.

Armature Travels - Core Plate (See Fig. I-9)

The stop-disc height and the core-plate dimensions primarily determine the armature travel. In general, single-stage (non-sequence contact) relays have short travel (0.026 inch ±0.005 inch), 2-stage (sequence contact) relays have intermediate travel (0.044 inch ±0.005 inch), and 3-stage

(preliminary contact) relays have long travel (0.060 inch ±0.005 inch). Some marginal or sensitive relays may have a combination of stop disc and core plate that provides a travel differing from the standard travel. Armature travels will not be shown in the Circuit Requirements Table.

A lip, formed as a part of the core plate, which is rigidly attached to the core, serves as a backstop for the armature.

Contact Arrangements

By proper selection of the actuating card and single- and twin-wire blocks, the more common contact arrangements shown below may be obtained.

- M - Make
- B - Break
- EM - Early Make
- EB - Early Break
- BM - Break-Make (nonsequence transfer)
- EBM - Early Break-Make (sequence transfer)
- EMB - Early Make-Break (continuity)
- PM - Preliminary Make
- PB - Preliminary Break
- PMEB - Preliminary Make - Early Break (preliminary continuity with respect to late contacts)
- PBEM - Preliminary Break - Early Make (preliminary transfer with respect to late contacts)

If all possible combinations of the above were made available, an excessive number of twin-wire blocks and cards would be necessary. To keep the cost of these relays to a minimum, the number of twin-wire blocks and actuating cards is restricted to that which will provide the greatest number of combinations normally used in service. For the same reason, relays are frequently recommended with more contacts than required for a particular application.

Actuating Cards

Actuating cards for the 12-position relays have been designed to operate various contact arrangements in positions 1 to 12 as shown in Table III-1a. Additional cards may be necessary for special spring combinations that may be requested in the future. These cards are removable and may be replaced without dismounting the relay. The actuating cards for the 10-position AK and AM relays are also shown in Table III-1b.

The actuating cards for the 24-spring relays are designed to provide only 24 make-contacts, or 24 break-contacts.

Contact Forces

The twin wires that form make- and break-contacts are pretensioned to provide nominal 12.5-gram contact force for each

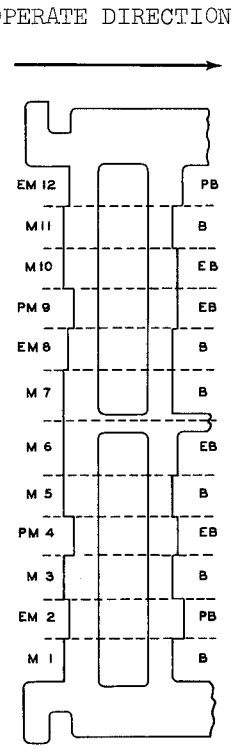

Fig. III-1 - Card Profile

contact pair. For special cases, the twin wires may be pretensioned to provide nominal 8-gram contact force (light contact force) or nominal 18-grams contact force (heavy contact force).

Contact Sequences

Where the EBM or PBEM contacts are used, the break-contacts will always open before their associated make-contacts close. Where the EMB or PMEB contacts are used, the make-contacts will close before their associated break-contacts open.

Where circuit races are involved between contacts in different positions, it can be assumed that ordinarily all preliminary contacts function before the early contacts, and all early contacts function before all late contacts. These sequences are guaranteed by the M specification or readjust gauging requirements, but not by the test gauging requirements, or after a few milli-inches of adverse contact wear. The probability of the nonsequential contact action is low, and when it does occur, the false closure or open time will be small. For critical circuits, where the sequence must be maintained to insure satisfactory performance, it is recommended that a special note be added to the Circuit Requirements Table. Consult the relay requirements group on these critical conditions, only when different spring positions are involved.

TABLE III-1a

CARDS
AF, AG, AJ, AND AL RELAYS

Contact Arrangements
Contact Position Number

Travel	1	2	3	4	5	6	7	8	9	10	11	12
Short	M	M	M	M	M	M	M	M	M	M	M	M
P-19A130	B	B	B	B	B	B	B	B	B	B	B	B
Intermediate	M	M	M	M	M	M	M	M	M	M	M	M
P-19A131	B	EB	B	EB	B	EB	B	EB	B	EB	B	EB
Intermediate	M	M	M	M	M	EM	M	M	M	M	M	EM
P-19A132	B	EB	B	EB	B	B	B	EB	B	EB	B	B
Long	M	EM	M	PM	M	M	M	EM	PM	M	M	EM
P-19A133	B	PB	B	EB	B	EB	B	B	EB	EB	B	PB
Intermediate	M	M	M	M	M	M	M	M	M	M	M	M
P-19A134	EB	EB	EB	EB	EB	EB	EB	EB	EB	EB	EB	EB
Intermediate	M	M	M	M	EM	EM	M	EM	M	M	M	M
P-19A135	EB	EB	EB	EB	B	B	EB	B	EB	EB	EB	EB
Intermediate	EM	M	EM	M	M	M	M	M	EM	M	EM	M
P-19A136	B	EB	B	EB	B	EB	B	EB	B	EB	B	EB
Intermediate	EM	M	EM	M	EM	M	EM	M	EM	M	EM	M
P-19A137	B	EB	B	EB	B	EB	B	EB	B	EB	B	EB

TABLE III-1b

CARDS
AK AND AM RELAYS

	1	2	3	4	5	8	9	10	11	12
Short	M	M	M	M	M					
P-10B701	B	B	B	B	B					
Short						M	M	M	M	M
P-10B702						B	B	B	B	B
Intermediate	M	M	M	EM	EM					
P-10B699	EB	EB	EB	B	B					
Intermediate						EM	EM	M	M	M
P-10B700						B	B	EB	EB	EB
Intermediate	M	M	EM	EM	EM					
P-10B703	EB	EB	B	B	B					
Intermediate						EM	EM	EM	M	M
P-10B704						B	B	B	EB	EB
Intermediate	M	M	M	M	M					
P-10B705	EB	EB	EB	EB	EB					
Intermediate						M	M	M	M	M
P-10B706						EB	EB	EB	EB	EB

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Spring Combination Numbers

AF, AG, AJ, and AL Relays

Spring combination numbers from 1 to 199 are assigned to single-stage (short travel) relays; 200 to 399 to 2-stage (intermediate travel) relays; and 400 to 499 to 3-stage (long travel) relays. Spring combination No. 500 has been assigned to 24 make-contacts, and No. 501 to 24 break-contacts.

The spring combination numbers that have been assigned to date are given in Tables III-2, III-3, and III-4, which also indicate the positions in which the various contact arrangements are located.

On relays with six or fewer positions used, the springs should be located in the even-numbered positions if it can be done without a new actuating card. This permits the shop to speed up production by arranging the contact welders to skip the odd-numbered positions.

Where a relay is to be furnished with a buffer spring, the spring combination number will be followed by a letter "B".

AK and AM Relays

Spring combination numbers from 1 to 199 are assigned to single-stage (short travel) relays and 200 to 399, to 2-stage (intermediate travel) relays. Since the twin-wire combs for the top and bottom parts of the AK and AM relays are molded as one unit, the spring combination number assigned to a relay includes the springs in both the top and bottom relay units.

The spring combination numbers that have been assigned to date are given in Tables III-5 and III-6, which also indicate the positions in which the various contact arrangements are located. Positions 1 to 5 are the bottom relay unit and 8 to 12 the top relay unit.

Balance Springs

The balance spring used in any particular relay will depend upon the number of make-contacts on the relay, its armature travel, and whether the relay is required to meet marginal conditions. The proper selection of balance springs is described in Section IX.

Buffer Spring (See Fig. I-16)

A removable U-shaped buffer spring is available; it may be attached to the AF, AG, AJ, and AL relays to provide an additional load on the armature to the operated position in order to obtain a high percentage release requirement, or to meet a specified maximum releasing time.

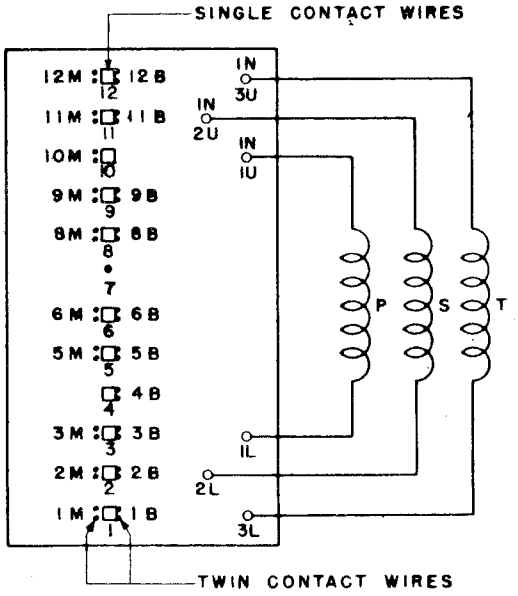
The pretensioned buffer spring is positioned between the spoolhead and outer legs of the core with a lip resting against the center leg of the core between the core plate and card. An adjustable tang, adjacent to the lip, controls the point at which the card engages the buffer spring as the relay operates. The tension of the spring is controlled by changing the offset in the spring.

Terminals and Terminal Numbering

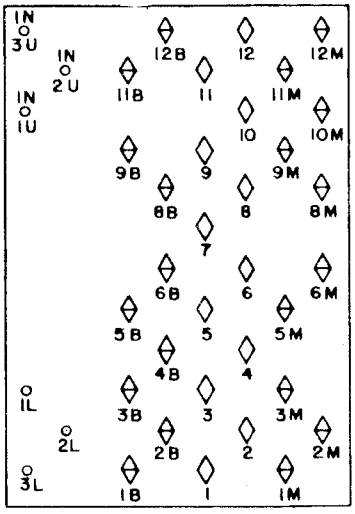
For test purposes, the winding terminals are extended to the front of the relay. The terminals for wiring are shaped to permit the use of solderless wrapped connections. The numbering for winding and contact terminals is shown in Fig. III-2 for the AF, AG, AJ, and AL relays and in Fig. III-3 for the AK and AM relays.

Spring Combinations

In the circuit schematics, the wire spring relays are numbered by spring positions and not individual spring numbers. As an example, an EBM in position 3 would be shown simply as 3 in the detached contact schematics and as EBM 3 in the attached contact schematics. Fig. III-4 shows the way the springs are shown on the attached contact schematics. When referring to a particular contact, as for purposes of insulating a contact of an EBM combination, the M or B designation should be used. Insulate 3B would thus mean insulate the break-contact in position 3.



WINDING AND CONTACT SPRING ARRANGEMENT AS VIEWED FROM THE FRONT (CONTACT SIDE) 12-POSITION AF, AG, AJ, AND AL RELAYS.



WINDING AND TERMINAL ARRANGEMENT AS VIEWED FROM THE REAR (TERMINAL SIDE) 12-POSITION AF, AG, AJ, AND AL RELAYS.

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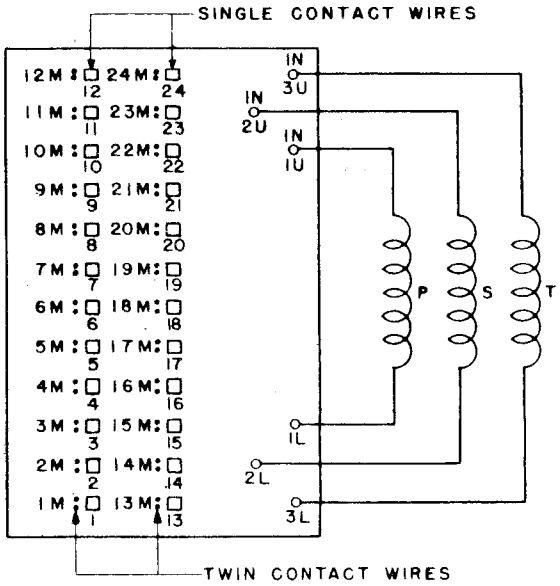
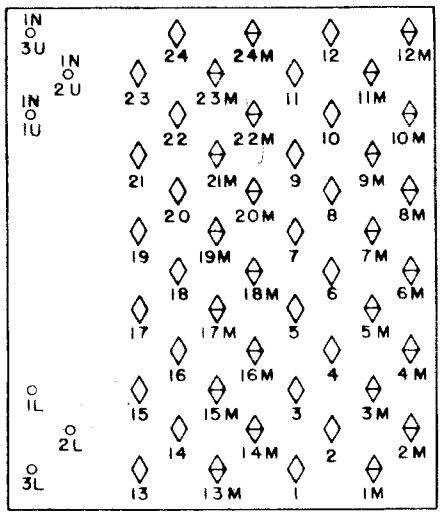
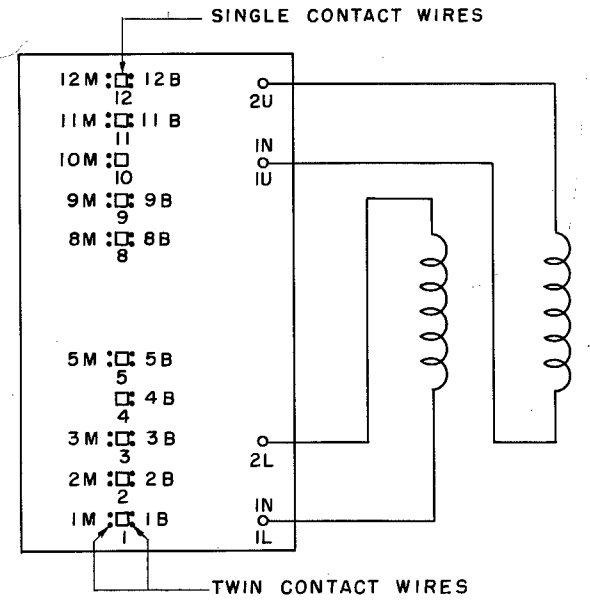


WINDING AND CONTACT SPRING ARRANGEMENT AS VIEWED FROM THE FRONT (CONTACT SIDE) 24-POSITION AJ RELAYS. THE 24-MAKE TYPE IS SHOWN; THE 24-BREAK TYPE IS NUMBERED IN THE SAME PATTERN.

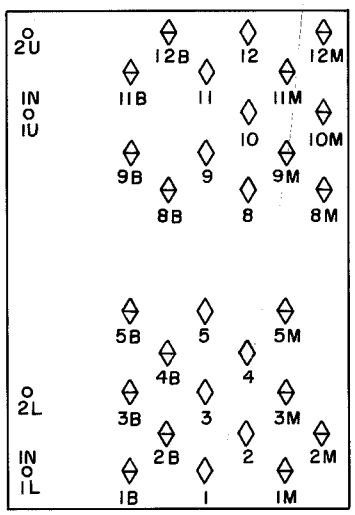


WINDING AND TERMINAL ARRANGEMENT AS VIEWED FROM THE REAR (TERMINAL SIDE) 24-POSITION AJ RELAYS. THE 24-MAKE TYPE IS SHOWN; THE 24-BREAK TYPE IS NUMBERED IN THE SAME PATTERN.

Fig. III-2 - AF, AG, AJ, and AL Relays - Terminal Arrangements



WINDING AND CONTACT SPRING ARRANGEMENT AS VIEWED FROM THE FRONT (CONTACT SIDE)



WINDING AND TERMINAL ARRANGEMENT AS VIEWED FROM THE REAR (TERMINAL SIDE)

Fig. III-3 - AK and AM Relays - Terminal Arrangements

Notes

1. Symbol illustrated is for AF28 relay.

2. If relay contacts are all of same arrangement (all makes, etc), omit the abbreviation (M, etc) from the symbol and add a note adjacent to the core as follows:

   All contacts are M (etc).

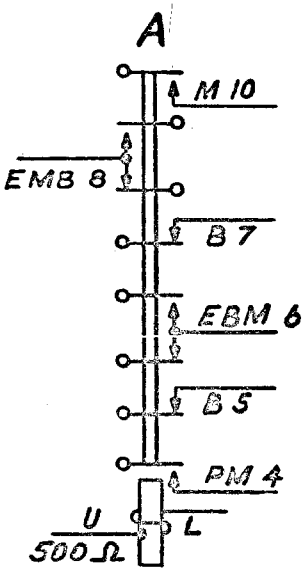


Fig. III-4 - Symbol for Use on Attached-Contact Type Schematic

TABLE III-2

SPRING COMBINATIONS
AF, AG, AJ, AND AL RELAYS

Comb. No.	Spring Combinations			Positions											
	M	B	BM	1	2	3	4	5	6	7	8	9	10	11	12
1	1	-	-	-	-	-	-	-	M	-	-	-	-	-	-
2	2	-	-	-	-	-	-	-	M	-	M	-	-	-	-
3	4	-	-	-	-	-	M	-	M	-	M	-	M	-	-
4	5	-	-	-	M	-	M	-	M	-	M	-	M	-	-
5	6	-	-	-	M	-	M	-	M	-	M	-	M	-	M
6	10	-	-	M	M	M	M	-	M	-	M	M	M	M	M
7	11	-	-	M	M	M	M	M	M	-	M	M	M	M	M
8	12	-	-	M	M	M	M	M	M	M	M	M	M	M	M
9	1	1	-	-	-	-	-	-	M	B	-	-	-	-	-
10	1	2	-	-	-	-	-	B	M	B	-	-	-	-	-
11	5	1	-	-	M	-	M	-	M	B	M	-	M	-	-
12	6	1	-	-	M	-	M	-	M	B	M	-	M	-	M
13	6	2	-	-	M	-	M	B	M	B	M	-	M	-	M
14	9	1	-	M	M	M	M	-	M	B	M	-	M	M	M
15	10	1	-	M	M	M	M	-	M	B	M	M	M	M	M
16	10	2	-	M	M	M	M	B	M	B	M	M	M	M	M
17	1	-	1	-	-	-	-	-	BM	-	M	-	-	-	-
18	2	-	2	-	-	-	M	-	BM	-	BM	-	M	-	-
19	3	-	4	M	M	-	BM	-	BM	-	BM	-	BM	-	M
20	7	-	2	M	M	M	M	-	BM	-	BM	-	M	M	M
21	9	-	3	M	M	M	BM	M	BM	M	BM	M	M	M	M
22	-	-	2	-	-	-	-	-	BM	-	BM	-	-	-	-
23	-	5	-	-	-	B	-	B	-	B	-	B	-	B	-
24	1	4	4	-	M	B	BM	B	BM	B	BM	B	BM	-	-
25	2	2	4	-	M	-	BM	B	BM	B	BM	-	BM	-	M
26	7	1	4	M	M	M	BM	M	BM	B	BM	M	BM	M	M
27	4	1	2	-	M	-	M	-	BM	B	BM	-	M	-	M
28	2	6	4	B	M	B	BM	B	BM	B	BM	B	BM	B	M
29	7	2	1	M	M	-	M	B	BM	B	M	-	M	M	M
30	5	2	1	-	M	-	M	B	BM	B	M	-	M	-	M
31	3	1	6	M	BM	M	BM	-	BM	B	BM	-	BM	M	BM
32	2	1	2	-	-	-	M	-	BM	B	BM	-	M	-	-
33	4	4	-	-	-	B	M	B	M	B	M	B	M	-	-
34	6	-	6	M	BM	M	BM	M	BM	M	BM	M	BM	M	BM
35	8	4	-	M	M	B	M	B	M	B	M	B	M	M	M
36	5	3	-	-	M	-	M	B	M	B	M	B	M	-	-
37	2	1	-	-	-	-	-	-	M	B	M	-	-	-	-
38	3	1	-	-	-	-	M	-	M	B	M	-	-	-	-
39	3	2	-	-	-	-	M	B	M	B	M	-	-	-	-
40	5	7	-	B	M	B	M	B	M	B	M	B	M	B	B
41	2	2	-	-	-	-	-	B	M	B	M	-	-	-	-
42	4	6	2	B	M	B	M	B	BM	B	BM	B	M	B	M
43	2	4	-	-	-	B	-	B	M	B	M	B	-	-	-
44	2	1	1	-	-	-	M	-	BM	B	M	-	-	-	-
45	3	3	-	-	-	-	M	B	M	B	M	B	-	-	-
46	3	-	-	-	-	-	M	-	M	-	M	-	-	-	-
47	-	1	-	-	-	-	-	-	-	B	-	-	-	-	-
48	8	1	-	M	M	-	M	-	M	B	M	-	M	M	M
49	4	-	4	M	M	-	BM	-	BM	-	BM	-	BM	M	M
50	-	-	3	-	-	-	BM	-	BM	-	BM	-	-	-	-

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TABLE III-2 (Cont)

SPRING COMBINATIONS
AF, AG, AJ, AND AL RELAYS

Comb. No.	Spring Combinations			Positions											
	M	B	BM	1	2	3	4	5	6	7	8	9	10	11	12
51	7	3	1	M	M	-	M	B	BM	B	M	B	M	M	M
52	1	1	-	-	-	-	-	-	M	-	-	-	B	-	-
53	-	1	-	-	-	-	-	-	B	-	-	-	-	-	-
54	2	1	2	-	B	-	M	-	BM	-	BM	-	M	-	-
55	2	1	1	-	-	-	M	-	BM	-	M	-	B	-	-
56	2	3	1	-	B	-	M	-	BM	-	M	-	B	-	B
57	3	1	6	BM	M	BM	M	BM	B	BM	-	BM	M	BM	-
58	1	2	1	-	BM	-	-	-	-	-	B	-	M	-	B
59	-	6	6	B	BM	B	BM	B	BM	B	BM	B	BM	B	BM
60	-	-	7	BM	-	BM	-	BM	BM	BM	-	BM	-	BM	-
61	10	-	2	M	M	M	M	M	BM	M	BM	M	M	M	M
62	5	-	4	M	M	M	BM	-	BM	-	BM	-	BM	M	M
63	8	-	4	M	M	M	BM	M	BM	M	BM	M	BM	M	M
64	-	-	12	BM	BM	BM	BM	BM	BM	BM	BM	BM	BM	BM	BM
65	5	-	1	-	M	-	M	-	BM	-	M	-	M	-	M
66	7	1	-	M	M	-	M	-	M	B	M	-	M	-	M
67	4	2	-	-	M	-	M	-	B	-	B	-	M	-	M
68	6	3	-	-	M	-	M	B	M	B	M	B	M	-	M
69	-	1	3	-	-	-	BM	-	BM	-	BM	-	B	-	-
70	-	-	8	BM	BM	-	BM	-	BM	-	BM	-	BM	BM	BM
71	4	1	-	-	M	-	M	-	B	-	M	-	M	-	-
72	4	2	1	-	M	-	M	B	BM	B	M	-	M	-	-
73	6	1	1	M	M	-	M	-	BM	B	M	-	M	-	M
74	1	-	2	-	-	-	M	-	BM	-	BM	-	-	-	-
75	2	1	-	M	M	-	-	-	-	-	-	-	-	-	B
76	3	2	2	-	M	-	M	B	BM	B	BM	-	M	-	-
77	4	-	8	BM	BM	M	BM	M	BM	M	BM	M	BM	BM	BM

TABLE III-3

SPRING COMBINATIONS
AF, AG, AJ, AND AL RELAYS

Comb. No.	Spring Combinations						Positions											
	M	B	BM	EBM	EMB	Others	1	2	3	4	5	6	7	8	9	10	11	12
200	2	2	-	2	1	-	-	M	-	EBM	B	EMB	B	EBM	-	M	-	-
201	-	-	-	2	-	-	-	-	-	-	-	EBM	-	EBM	-	-	-	-
202	1	1	-	1	1	-	-	-	-	M	-	EMB	B	EBM	-	-	-	-
203	-	-	-	4	-	-	-	-	-	EBM	-	EBM	-	EBM	-	EBM	-	-
204	4	1	-	3	-	-	M	M	-	EBM	-	EBM	B	EBM	-	M	-	M
205	2	-	-	4	2	-	M	EBM	-	EBM	-	EMB	-	EBM	-	EBM	M	EMB
206	5	-	-	2	1	1EM	M	M	M	EBM	-	EMB	-	EBM	-	M	M	EM
207	-	-	-	2	1	-	-	-	-	EBM	-	EMB	-	EBM	-	-	-	-
208	-	-	-	4	2	-	-	EBM	-	EBM	-	EMB	-	EBM	-	EBM	-	EMB
209	-	-	-	1	-	-	-	-	-	-	-	EBM	-	-	-	-	-	-
210	4	-	-	2	-	-	-	M	-	M	-	EBM	-	EBM	-	M	-	M
211	-	-	-	1	1	-	-	-	-	-	-	EMB	-	EBM	-	-	-	-
212	3	1	-	3	1	1EM	M	M	-	EBM	-	EMB	B	EBM	-	EBM	M	EM
213	2	3	-	2	1	1EM	-	M	-	EBM	B	EMB	B	EBM	B	M	-	EM
214	3	1	-	1	1	1EM	-	M	-	M	-	EMB	B	EBM	-	M	-	EM
215	4	2	-	1	1	1EM	M	M	-	M	B	EMB	B	EBM	-	M	-	EM
216	2	-	-	-	1	-	-	-	-	M	-	EMB	-	M	-	-	-	-
217	-	-	-	6	-	-	-	EBM	-	EBM	-	EBM	-	EBM	-	EBM	-	EBM
218	2	1	-	2	-	-	-	-	-	M	-	EBM	B	EBM	-	M	-	-
219	6	-	4	-	2	-	M	M	BM	M	BM	EMB	BM	M	BM	M	M	EMB
220	-	-	-	12	-	-	EBM	EBM	EBM	EBM	EBM	EBM	EBM	EBM	EBM	EBM	EBM	EBM
221	3	-	-	1	1	1EM	-	M	-	M	-	EMB	-	EBM	-	M	-	EM
222	4	1	-	1	1	1EM	M	M	-	M	-	EMB	B	EBM	-	M	-	EM
223	6	1	-	1	1	1EM	M	M	M	M	-	EMB	B	EBM	-	M	M	EM
224	3	1	-	4	2	-	M	EBM	M	EBM	-	EMB	B	EBM	-	EBM	M	EMB
225	2	-	-	1	1	-	-	-	-	M	-	EMB	-	EBM	-	M	-	-
226	2	-	3	4	2	-	BM	EBM	BM	EBM	M	EMB	-	EBM	M	EBM	BM	EMB
227	5	1	-	6	-	-	M	EBM	M	EBM	M	EBM	B	EBM	M	EBM	M	EBM
228	3	4	-	1	1	-	-	M	B	M	B	EMB	B	EBM	B	M	-	-
229	2	3	-	-	1	-	-	-	-	M	B	EMB	B	M	B	-	-	-
230	4	3	-	4	-	-	M	M	-	EBM	B	EBM	B	EBM	B	EBM	M	M
231	6	2	-	4	-	-	M	M	M	EBM	B	EBM	B	EBM	M	EBM	M	M
232	4	-	-	-	1	-	-	M	-	M	-	EMB	-	M	-	M	-	-
233	2	2	-	2	-	-	-	-	-	M	B	EBM	B	EBM	-	M	-	-
234	-	-	-	8	2	-	EBM	EBM	EBM	EBM	-	EMB	-	EMB	EBM	EBM	EBM	EBM
235	8	-	-	2	1	1EM	M	M	M	EBM	M	EMB	M	EBM	M	M	M	EM
236	4	3	1	1	-	1EM	M	M	-	M	BM	B	B	EBM	B	M	-	EM
237	2	-	-	2	-	-	-	-	-	M	-	EBM	-	EBM	-	M	-	-
238	-	-	2	1	4	-	EMB	-	EMB	-	BM	EBM	BM	-	EMB	-	EMB	-
239	1	1	-	4	2	-	M	EBM	-	EBM	-	EMB	B	EBM	-	EBM	-	EMB
240	-	-	-	1	2	1EM&1EB	-	-	-	EB	EM	EMB	-	EMB	-	EBM	-	-
241	7	-	-	4	-	-	M	M	M	EBM	M	EBM	-	EBM	M	EBM	M	M
242	2	2	-	1	-	-	-	-	-	M	B	EBM	B	M	-	-	-	-
243	4	1	-	2	1	1EM	M	M	-	EBM	-	EMB	B	EBM	-	M	M	EM
244	7	2	-	1	1	1EM	M	M	M	M	B	EMB	B	EBM	M	M	M	EM
245	1	4	-	3	1	-	-	M	B	EBM	B	EMB	B	EBM	B	EBM	-	-
246	1	2	-	2	-	-	-	-	-	M	B	EBM	B	EBM	-	-	-	-
247	6	1	-	3	-	-	M	M	M	EBM	-	EBM	B	EBM	-	M	M	M
248	4	2	-	-	1	1EM	-	M	-	M	B	EMB	B	M	-	M	-	EM
249	-	-	-	9	3	-	EBM	EBM	EBM	EBM	EMB	EMB	EBM	EBM	EBM	EBM	EBM	EBM
250	2	5	-	3	1	1EM	M	M	B	EBM	B	EMB	B	EBM	B	EBM	B	EM

EMB

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TABLE III-3 (Cont)

SPRING COMBINATIONS
AF, AG, AJ, AND AL RELAYS

Comb. No.	Spring Combinations						Positions											
	M	B	BM	EBM	EMB	Others	1	2	3	4	5	6	7	8	9	10	11	12
251	-	2	-	1	1	-	-	-	-	-	B	EMB	B	EBM	-	-	-	-
252	4	-	-	4	2	-	M	EBM	M	EBM	-	EMB	-	EBM	M	EBM	M	EMB
253	1	-	-	2	1	-	-	-	-	EBM	-	EMB	-	EBM	-	M	-	-
254	-	-	-	6	2	-	EBM	EBM	-	EBM	-	EMB	-	EMB	-	EBM	EBM	EBM
255	7	2	-	-	-	2EM	M	M	M	M	B	EM	B	M	-	M	M	EM
256	1	4	-	2	1	-	-	-	B	EBM	B	EMB	B	EBM	B	M	-	-
257	5	-	-	4	1	1EM	M	EBM	M	EBM	M	EMB	-	EBM	M	EBM	M	EM
258	1	-	-	-	2	-	-	-	-	M	-	EMB	-	EMB	-	-	-	-
259	-	-	-	8	1	2EM	EBM	EBM	EBM	EBM	EM	EMB	-	EM	EBM	EBM	EBM	EBM
260	1	1	-	-	2	2EB	-	-	-	M	B	EMB	EB	EMB	EB	-	-	-
261	7	2	-	2	-	-	M	M	M	M	B	EBM	B	EBM	-	M	M	M
262	5	-	-	3	2	-	M	EBM	M	EBM	-	EMB	-	EMB	M	EBM	M	M
263	4	1	-	4	-	-	M	M	-	EBM	-	EBM	B	EBM	-	EBM	M	M
264	2	3	-	2	-	-	-	-	-	M	B	EBM	B	EBM	B	M	-	-
265	-	5	-	4	1	1EM	-	EBM	B	EBM	B	EMB	B	EBM	B	EBM	B	EM
266	6	3	-	-	-	2EM	M	M	-	M	B	EM	B	M	B	M	M	EM
267	1	-	-	3	-	-	-	-	-	EBM	-	EBM	-	EBM	-	M	-	-
268	7	-	-	3	-	-	M	M	M	EBM	-	EBM	-	EBM	M	M	M	M
269	3	-	-	-	2	1EM	-	M	-	-	EM	EMB	-	EMB	-	M	-	M
270	7	1	-	2	1	1EM	M	M	M	EBM	M	EMB	B	EBM	M	M	M	EM
271	2	1	-	4	2	-	M	EBM	-	EBM	-	EMB	B	EBM	-	EBM	M	EMB
272	-	1	-	3	1	-	-	-	-	EBM	-	EMB	-	EBM	-	EBM	-	B
273	-	4	-	4	-	-	-	-	B	EBM	B	EBM	B	EBM	B	EBM	-	-
274	2	1	-	2	-	-	-	EBM	-	M	-	B	-	EBM	-	M	-	-
275	1	-	-	6	1	2EB	EBM	EBM	EB	EBM	-	EMB	M	-	EB	EBM	EBM	EBM
276	1	2	-	3	2	-	B	EBM	B	M	-	EMB	-	EBM	-	EBM	-	EMB
277	3	5	1	1	1	1EM	BM	M	B	M	B	EMB	B	EBM	B	M	B	EM
278	2	2	-	6	1	1EB	EBM	EBM	EBM	M	EMB	B	M	B	EBM	EBM	EBM	EB
279	3	3	-	-	2	-	-	-	-	M	B	EMB	B	M	B	M	-	EMB
280	3	2	-	3	-	-	-	M	-	EBM	B	EBM	B	EBM	-	M	-	M
281	5	-	4	-	-	1EM	M	M	BM	M	BM	-	BM	-	BM	M	M	EM
282	3	-	-	-	2	-	-	M	-	M	-	EMB	-	EMB	-	M	-	-
283	6	-	3	3	-	-	M	M	M	EBM	BM	EBM	BM	EBM	BM	M	M	M
284	2	2	-	1	-	-	-	M	-	EBM	-	B	-	B	-	M	-	-
285	7	3	-	2	-	-	M	M	M	M	B	EBM	B	EBM	B	M	M	M
286	2	2	-	2	-	-	-	M	-	EBM	-	B	-	B	-	EBM	-	M
287	2	-	-	-	2	1EM	-	M	-	-	EM	EMB	-	EMB	-	M	-	-
288	3	-	-	1	1	-	-	M	-	M	-	EMB	-	EBM	-	M	-	-
289	7	-	-	-	-	3EM	M	M	M	-	EM	EM	M	EM	-	M	M	M
290	-	-	-	1	2	2EB	-	-	-	EBM	-	EMB	-	EB	-	EB	-	EMB
291	1	2	1	3	1	-	BM	EBM	B	-	-	EMB	-	EBM	-	EBM	M	B
292	1	2	-	1	1	-	-	-	-	M	B	EMB	B	EBM	-	-	-	-
293	1	4	-	2	-	-	-	-	B	M	B	EBM	B	EBM	B	-	-	-
294	3	-	-	2	-	-	-	M	-	M	-	EBM	-	EBM	-	M	-	-
295	4	2	-	-	1	-	-	M	-	M	B	EMB	B	M	-	M	-	-
296	3	3	-	-	1	-	-	-	-	M	B	EMB	B	M	B	M	-	-
297	1	-	-	1	2	1EB	-	-	-	EBM	-	EMB	EB	EMB	-	M	-	-
298	8	-	-	4	-	-	M	M	M	EBM	M	EBM	M	EBM	M	EBM	M	M
299	-	-	2	6	4	-	EMB	EBM	EMB	EBM	BM	EBM	BM	EBM	EMB	EBM	EMB	EBM
300	2	-	-	3	-	-	-	M	-	EBM	-	EBM	-	EBM	-	M	-	-

TABLE III-3 (Cont)

SPRING COMBINATIONS
AF, AG, AJ, AND AL RELAYS

Comb. No.	Spring Combinations						Positions											
	M	B	BM	EBM	EMB	Others	1	2	3	4	5	6	7	8	9	10	11	12
301	5	-	-	4	-	-	-	M	M	EBM	M	EBM	M	EBM	M	EBM	-	-
302	-	-	3	-	-	1EM	-	-	-	-	BM	-	BM	-	BM	-	-	EM
303	2	-	-	1	2	-	-	M	-	EBM	-	EMB	-	EMB	-	M	-	-
304	5	4	1	-	-	2EM	M	M	B	M	B	EM	B	M	B	M	BM	EM
305	3	3	-	2	1	1EM	M	M	-	EBM	B	EMB	B	EBM	B	M	-	EM
306	3	4	-	3	1	1EM	M	M	B	EBM	B	EMB	B	EBM	B	EBM	M	EM
307	3	-	-	5	-	-	M	EBM	-	EBM	-	EBM	-	EBM	-	EBM	M	M
308	4	3	2	-	-	1EM	M	M	BM	M	B	-	B	-	BM	M	B	EM
309	3	3	1	2	-	1EM	M	M	-	EBM	BM	B	B	EBM	B	M	-	EM
310	3	5	-	-	-	1EM,1EB	-	M	B	M	B	B	B	EB	B	M	-	EM
311	1	1	-	5	1	1EB	EBM	EBM	EB	M	-	EMB	-	B	-	EBM	EBM	EBM
312	2	1	-	2	1	1EM	-	M	-	EBM	-	EMB	B	EBM	-	M	-	EM
313	4	1	-	2	2	3EB	M	M	EB	EBM	B	EMB	EB	EMB	EB	EBM	M	M
314	2	-	3	5	-	-	BM	EBM	BM	M	-	EBM	-	EBM	M	EBM	BM	EBM
315	-	3	-	1	-	-	-	-	-	-	B	EBM	B	-	B	-	-	-
316	4	-	-	4	2	1EB	M	EBM	M	EBM	-	EMB	EB	EMB	M	EBM	M	EBM
317	3	5	-	2	-	-	B	M	B	M	B	EBM	B	EBM	B	M	-	-
318	-	-	2	2	4	-	EMB	-	EMB	-	BM	EBM	BM	EBM	EMB	-	EMB	-
319	5	-	-	1	1	-	M	M	-	M	-	EMB	-	EBM	-	M	M	-
320	3	3	1	3	-	2EM	M	EBM	M	EBM	B	EM	B	EBM	B	M	BM	EM
321	6	3	-	2	-	-	M	M	B	M	B	EBM	B	EBM	-	M	M	M
322	2	4	-	-	2	1EB	EMB	M	B	-	B	EB	B	-	B	-	EMB	M
AJ101—323	4	-	-	3	1	-	M	EBM	-	M	-	EMB	M	-	-	EBM	M	EBM
324	-	-	-	4	1	-	-	EBM	-	EBM	-	EMB	-	EBM	-	EBM	-	-
325	2	-	-	2	-	1EM	-	EBM	-	M	-	EM	-	M	-	EBM	-	-
326	3	-	3	6	-	-	BM	EBM	BM	EBM	M	EBM	M	EBM	M	EBM	BM	EBM
327	5	-	-	-	1	1EM	M	M	-	M	-	EMB	-	M	-	M	-	EM
328	4	-	-	4	1	-	-	EBM	M	EBM	M	EMB	M	EBM	M	EBM	-	-
329	6	2	-	-	1	-	M	M	-	M	B	EMB	B	M	-	M	M	-
330	7	-	-	3	1	1EM	M	M	M	EBM	M	EM	M	EBM	M	EBM	M	EMB
331	5	-	-	2	-	2EB	M	M	M	-	EB	EBM	EB	EBM	-	M	-	M
332	5	1	-	2	2	2EB	M	M	EBM	EBM	B	EMB	EB	EMB	EB	M	M	M
333	6	-	-	-	-	6EM	EM	M	EM	M	EM	M	EM	M	EM	M	EM	M
334	6	2	-	2	1	-	M	M	M	EBM	EMB	B	EBM	B	M	M	M	-
335	1	-	-	4	-	-	-	M	-	EBM	-	EBM	-	EBM	-	EBM	-	-
336	-	-	-	6	6	-	EMB	EBM	EMB	EBM	EMB	EBM	EMB	EBM	EMB	EBM	EMB	EBM
337	2	1	-	2	2	-	-	EBM	-	M	B	EMB	-	EBM	-	M	-	EMB
338	6	1	2	2	-	-	M	M	M	EBM	BM	-	B	EBM	BM	M	M	M
339	3	1	1	-	1	-	M	M	BM	-	B	-	-	-	-	M	-	EMB
340	-	-	-	-	-	6EM,6EB	EM	EB	EM	EB	EM	EB	EM	EB	EM	EB	EM	EB
341	-	-	-	-	-	6EM	EM	-	EM	-	EM	-	EM	-	EM	-	EM	-
342	-	-	-	-	-	6EB	EB	-	EB	-	EB	-	EB	-	EB	-	EB	-
343	6	-	-	6	-	-	M	EBM	M	EBM	M	EBM	M	EBM	M	EBM	M	EBM

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TABLE III-4

SPRING COMBINATIONS
AF, AG, AJ, AND AL RELAYS

Comb. No.	Spring Combinations								Positions											
	M	B	BM	EBM	EMB	PM	PB	Others	1	2	3	4	5	6	7	8	9	10	11	12
400	1	2	-	1	1	1	-	-	-	-	-	PM	B	EBM	B	EMB	-	M	-	-
401	1	-	-	2	-	2	-	-	-	-	M	PM	-	EBM	-	-	PM	EBM	-	-
402	-	-	-	2	-	1	-	-	-	-	-	PM	-	EBM	-	-	-	EBM	-	-
403	-	2	-	2	1	1	-	2EM	-	EM	-	PM	B	EBM	B	EMB	-	EBM	-	EM
405	-	-	-	1	-	-	-	1PBEM	-	PBEM	-	-	-	-	-	-	-	EBM	-	-
406	-	3	-	2	1	1	-	2EM	-	EM	B	PM	B	EBM	B	EMB	-	EBM	-	EM
407	-	2	1	1	1	-	-	1PBEM 1EM	B	EM	B	-	BM	EBM	-	EMB	-	-	-	PBEM
408	-	-	3	2	1	-	-	2PMEB 1EM	-	EM	BM	PMEB	BM	EBM	BM	EMB	PMEB	EBM	-	-
409	1	3	-	1	1	1	-	-	-	-	B	PM	B	EBM	B	EMB	-	M	-	-
410	3	1	-	1	1	-	1	1PBEM	M	PBEM	-	-	B	EBM	-	EMB	-	M	M	PB
411	-	3	2	2	-	1	-	2EM	BM	EM	B	PM	B	EBM	B	EM	-	EBM	BM	-
412	-	-	-	-	1	-	-	2PBEM	-	PBEM	-	-	-	-	-	EMB	-	-	-	PBEM
413	4	2	1	-	1	-	1EM	2PMEB 1PBEM	M	PBEM	M	PMEB	B	M	B	EMB	PMEB	M	BM	EM
414	-	-	5	2	1	-	-	2PBEM 2PMEB	BM	PBEM	BM	PMEB	BM	EBM	BM	EMB	PMEB	EBM	BM	PBEM
415	-	-	2	2	1	-	-	2PBEM	BM	PBEM	BM	-	-	EBM	-	EMB	-	EBM	-	PBEM
416	2	2	-	2	1	1	-	1EM	M	EM	-	PM	B	EBM	B	EMB	-	EBM	M	-
417	5	-	-	1	-	1	2	1EB	M	PB	M	-	M	EBM	M	-	PM	EB	M	PB
418	1	-	2	2	-	1	-	3EM	M	EM	BM	PM	-	EBM	-	EM	-	EBM	BM	EM
419	2	2	-	2	1	-	-	1PBEM 1PMEB	M	PBEM	-	PMEB	B	EBM	B	EMB	-	EBM	M	-
420	1	5	-	1	-	1	-	3EM	B	EM	B	PM	B	EBM	B	EM	-	M	B	EM
421	1	3	-	1	1	1	-	1EM	-	EM	B	PM	B	EBM	B	EMB	-	M	-	-
422	1	5	-	1	-	1	-	1PMEB 3EM	B	EM	B	PM	B	EBM	B	EM	PMEB	M	B	EM
423	5	-	-	1	-	1	2	1EM,1EB	M	PB	M	-	M	EBM	M	EM	PM	EB	M	PB
424	1	2	1	2	1	-	-	1PBEM 1PMEB	M	PBEM	-	PMEB	B	EBM	B	EMB	-	EBM	BM	-
425	2	1	-	2	1	-	-	1EMPB	M	-	B	-	M	EBM	-	EMB	-	EBM	-	EMPB

500	24	Make in 24 positions
501	- 24	Break in 24 positions

AJ200

TABLE III-5
AK AND AM RELAYS

Comb. No.	Contact Arrangement			Positions										
	M	B	BM	1	2	3	4	5	8	9	10	11	12
1	10	-	-	M	M	M	M	M	M	M	M	M	M
2	-	-	10	BM	BM	BM	BM	BM	BM	BM	BM	BM	BM
3	-	-	4	BM	BM	-	-	-	-	-	-	BM	BM
4	2	6	-	M	B	B	B	-	-	B	B	B	M
5	2	2	1	-	M	-	B	-	BM	-	B	-	M
6	2	2	1	M	BM	B	-	-	-	-	-	B	M
7	5	-	5	BM	BM	BM	BM	M	M	M	M	M	BM
8	4	-	-	-	M	-	M	-	M	-	M	-	-
9	3	1	3	BM	BM	BM	M	-	-	-	M	M	B
10	4	3	3	M	BM	B	BM	M	M	B	BM	B	M
11	6	-	-	M	M	M	M	-	-	-	M	M	-
12	4	-	4	BM	BM	-	M	M	M	M	-	BM	BM
13	-	2	4	BM	BM	B	-	-	-	-	B	BM	BM
14	2	1	5	M	M	B	-	-	BM	BM	BM	BM	BM
15	3	4	3	M	BM	M	BM	B	B	B	M	BM	B
16	-	2	8	BM	BM	BM	B	B	BM	BM	BM	BM	BM
17	4	5	-	M	M	B	B	B	B	B	-	M	M
18	3	-	1	-	M	-	M	-	M	-	BM	-	-
19	6	4	-	M	M	M	B	B	B	B	M	M	M
20	5	2	1	-	B	M	M	M	M	M	BM	B	-

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TABLE III-6
AK AND AM RELAYS

Comb. No.	Contact Arrangement							Positions									
	M	B	BM	EBM	EMB	EM	EB	1	2	3	4	5	8	9	10	11	12
201	2	3	-	3	1	-	-	M	EBM	-	B	B	EMB	B	M	EBM	EBM
202	2	-	-	4	4	-	-	M	EBM	EBM	EMB	EMB	EMB	EMB	EBM	EBM	M
203	-	-	-	6	-	4	-	EBM	EBM	EBM	EM	EM	EM	EM	EBM	EBM	EBM
204	3	1	-	3	1	2	-	M	EBM	EBM	B	EM	EM	EMB	EBM	M	M
205	2	-	-	-	-	2	-	-	M	-	EM	-	EM	-	M	-	-
206	2	2	-	-	2	-	-	M	-	-	EMB	B	B	EMB	-	-	M
207	4	-	-	-	-	4	2	M	M	EB	EM	EM	EM	EM	EB	M	M
208	-	2	-	6	-	-	-	EBM	EBM	EBM	-	-	B	B	EBM	EBM	EBM
209	3	2	-	1	2	-	2	EBM	EB	EB	EMB	EMB	B	B	M	M	M
210	4	-	-	-	4	2	-	M	M	EMB	EM	EMB	EMB	EM	EMB	M	M
211	6	-	-	-	4	-	-	M	M	M	EMB	EMB	EMB	EMB	M	M	M
212	4	-	-	2	2	2	-	M	M	EBM	EM	EMB	EMB	EM	EBM	M	M
213	3	1	-	1	-	1	-	EBM	-	-	B	EM	-	-	M	M	M
214	-	-	-	6	-	-	-	EBM	EBM	EBM	-	-	-	-	EBM	EBM	EBM
215	6	-	-	-	2	2	-	M	M	M	EM	EMB	EMB	EM	M	M	M
216	-	-	-	6	4	-	-	EBM	EBM	EBM	EMB	EMB	EMB	EMB	EBM	EBM	EBM
217	4	-	-	2	-	-	-	M	EBM	EBM	-	-	-	-	M	M	M
218	4	1	-	-	2	-	1	EB	M	-	B	EMB	EMB	-	M	M	M
219	4	-	-	2	2	2	-	EBM	EBM	M	EM	EMB	EMB	EM	M	M	M
220	2	-	-	3	2	-	1	M	EBM	EBM	EMB	-	-	EMB	EBM	EB	M
221	1	-	-	3	4	-	-	M	EBM	-	EMB	EMB	EMB	EMB	-	EBM	EBM
222	-	-	-	10	-	-	-	EBM	EBM	EBM	EBM	EBM	EBM	EBM	EBM	EBM	EBM
223	4	-	-	2	2	-	-	M	M	EBM	-	EMB	EMB	-	EBM	M	M

AK305
AK4